

THE IRON ORE INDUSTRY OF THE UNITED STATES.*

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IRON ores have been mined or are known to exist in every State or Territory of the United States, with possibly three exceptions. In some States which in years past maintained an iron producing industry upon local ores, as Maine, New Hampshire, Vermont, Rhode Island, Delaware, South Carolina, California, Utah and Washington, the iron ore deposits are not now wrought, or if any small quantities of ore are obtained they are smelted in other States or used as a flux in silver smelting. In other States—Florida, Louisiana, Mississippi, Arkansas, Wyoming, New Mexico and Montana—either known iron ore resources await utilization or but small quantities of ore are produced. In still others, as New Jersey, New York, Pennsylvania, Maryland, West Virginia and Ohio, many local ores have been displaced by richer or more desirable ones obtained from other States or from foreign countries; although in several, particularly New York, New Jersey and Pennsylvania, large quantities of excellent ores are still mined. Other States, as Michigan, Wisconsin and Minnesota, mine large amounts of iron ore, only a small portion of which is used within their boundaries.

The iron ore mines of the Lake Superior region, located in the northern portions of the States of Michigan, Wisconsin and Minnesota, contribute a large proportion of the ore smelted in the United States. The percentages of the total ore output of the country which came from this region were: 51 in 1889, 56 in 1890, 53 in 1891, 59 in 1892 and 57 in 1893. While the Lake Superior region is to be credited with more than one-half of the total iron ore tonnage of the country, the quality of mineral taken from its mines is also above the average of domestic ores mined, thus adding to the commercial importance of this region. It is estimated that the iron ores extracted in this region during the period 1889 to 1893 made from 55 to 63 per cent. of the pig iron produced in the country in that period, provided all the ore mined from this district was smelted in the year it was produced, no account of stocks of ore on hand being taken into consideration. The mines on the upper peninsula of Michigan have produced the largest amount of iron ore, but in late years Minnesota has been advancing rapidly, and may compete with Michigan for pre-eminence. Wisconsin, although contributing heavily, is far behind Michigan and Minnesota in output. The bulk of the ores coming from the Lake Superior region are of the red hematite variety, but a part of the ore from a number of mines is hydrated, and ranked as brown hematite. However, but few of the active mines can be considered as producing the latter class of ore only. Several important mines supply magnetite in quantity, which is found in juxtaposition with red hematite.

The distance between the mines of the Lake Superior region and the majority of blast furnaces using their product demands that only the richer ores be shipped; consequently, deposits furnishing high grade ores which could supply in addition liberal amounts of leaner red and brown hematites, and apparently extensive veins of magnetite of inferior grade, are unwrought, or, if they were worked, are not now exploited except for the better ores. The mines in the Lake Superior region are located from 1,200 to 1,800 ft. above Lake Superior (or from 1,800 to 2,400 ft. above sea level), and are from 15 to 100 miles from the lake. Some of the prominent mines which have been exploited in late years are wrought "open cut," and the first development of the iron ores of the region was by open work. Most of the mines, however, are wrought underground, the various levels extending in some instances from 1,000 and even 1,500 ft. below the surface. In no other part of the country—and probably nowhere in the world—is iron ore mining carried on in a more thorough manner than in the Lake Superior district. The hoisting and pumping machinery and the compressor plants are generally of the most approved design. Power drills and high explosives are utilized to break the mineral economically. Electricity is introduced for lighting and for traction underground, and air compressed by water power machinery is conveyed miles to work hoists, pumps, drills, etc. In mining methods this district is well advanced; mine timbering and shaft sinking have received careful attention, and the steam shovel is employed to dig ore in the open cuts, or to load it on cars from stock piles. The ore, after being mined, is placed on stock piles or conveyed by railroad cars from fifteen to one hundred miles to various ports on Lakes Superior and Michigan, and there dumped into pockets in imposing shipping docks from which vessels are quickly and cheaply loaded. These vessels carry the ore to various points on Lakes Michigan and Erie, where expensive machinery lifts the ore from the vessels and conveys it on to stock piles or to cars which transport it to points of consumption even more distant. A comparatively small portion, yet by no means an insignificant amount, of this ore is smelted near where it is mined, or reaches the blast furnaces, using it by direct rail transportation. The shipping appliances have been a most important feature in permitting the ore from the Lake Superior region to reach distant points of consumption. Millions of dollars have been expended on shipping docks, and millions more on receiving docks and railroad terminals. Other millions still have been devoted to building and equipping magnificent steam vessels of large capacity. Among these the novel structures known as "whalebacks" were built to facilitate cheap transportation on the great lakes system. The importance of the Lake Superior region is best illustrated in the statement that since ore shipments were commenced in 1849 to the close of 1893 a total of over 81,500,000 tons of iron ore have been taken from the mines, the greatest annual output being in 1892, when 9,564,388 long tons were mined. Of this great total there have been won from the mines of the State of Michigan, since 1849, 69,500,000 tons; from Minnesota, since 1884, 7,000,000 tons; and from Wisconsin, since 1880, about 5,000,000 long tons.

Next to the Lake Superior district the most important contributor to the iron ore output of the United States is the region embracing Central Tennessee, Northern Alabama, and Northwestern Georgia, where red and brown hematites are mined in quantity, Alabama fur-

nishing the greatest quantity, followed in order by Tennessee and Georgia. The red hematite ores are known as the Clinton fossil ores, and locally have designations of Red Mountain, dye stone, mountain, and river ores. They are inferior to the Lake Superior ores in iron contents, and are generally higher in phosphorus. Some of the deposits near the outcrops have been wrought open cut, but most of the mining is underground. For a considerable distance from the surface two varieties of ore, known as hard and soft ore, are mined, but as the workings gain in depth the hard ore predominates. The percentage of silica and lime also varies greatly. The brown hematites are excellent, and compare favorably with others of the same class found elsewhere, making satisfactory foundry iron. The deposits are of unusual size, and are largely wrought by open cut, steam shovels being used to dig the ore, which is carried to washers to be prepared for use or shipment. The district has an advantage in the relative position of the ores and the coal seams. The red hematite especially lies convenient to coal deposits, which supply fuel for smelting the ores, while the Lake Superior region is hundreds of miles from any available coalfield. The brown hematites are generally more distant from coal, but many of the deposits are close to large timbered areas from which charcoal is made for blast furnaces, and a number of them are within convenient distances of good coal deposits. Prior to the civil war small charcoal furnaces were located in this district, local brown hematite deposits supplying ores which were of good character and easily smelted. It was not until after the war that the red hematite or Clinton fossil deposits were exploited, and then development was rapid, owing to the cheapness with which they could be mined and their close proximity to coking coal, particularly in the neighborhood of Birmingham, where the veins of red hematite reach their greatest width. This Clinton fossil ore, unlike the ore of the Lake Superior district, is not rich in iron, yielding on an average from 42 to 47 per cent. The Southern brown hematites, if properly washed, yield from 45 to 50 per cent. of iron, being often used as mixtures with red ores. The cheapness with which both ore and coal can be mined has combined to build up a large industry in late years, most of the iron produced being of foundry grade, but too high in phosphorus to be used in the Bessemer steel process. Some carbonates and a limited quantity of magnetite are used in this district. The production of iron ore in the Alabama-Tennessee region in 1893 was 2,301,421 long tons.

While producing one-half the total pig iron made in the United States, and rich in all four of the different varieties of iron ore, Pennsylvania did not furnish in 1893 more than about one-tenth of the total ore required for the State's blast furnaces in that year. The iron ores, though abundant, seldom contain as much iron as is demanded by the present advanced blast furnace management, and the State therefore draws largely on the Lake Superior region, New York, New Jersey, and various foreign countries. The State may really be divided into two, if not more, districts. West of the Alleghenies the Lake Superior iron ores are relied on entirely, only a small amount of native carbonate ores being mined and smelted. In the eastern district native red and brown hematites, as well as magnetites, are mined, and iron ore brought in from New York, New Jersey, the Lake Superior region, Cuba and other foreign countries is also used. In this district are situated the Cornwall Ore Hills, which are really three hills of iron ore, composed almost entirely of magnetite, of Bessemer grade, but rather low in iron contents, averaging from 40 to 48 per cent. This deposit has furnished iron ore for over 150 years, the amount taken from it in this time being estimated as over 12,500,000 tons to the close of the year 1893. Of this amount one-half has been taken out within the past decade. In 1893 the Cornwall Ore Hills produced more ore than any other single mining operation in the United States, the output, 439,705 long tons, being small when compared with the maximum—769,020 long tons in 1889. The brown hematites are found extending in a general northeast and southwest direction along the eastern side of the Blue Ridge and Bald Eagle Mountains and their spurs, while on the western side of the Blue Ridge occur the red hematite deposits, the magnetite mines being principally along the South Mountains. In 1893 the production of Pennsylvanian ores reached a total of 697,985 long tons.

New York State also produces the four different characters of iron ore, the bulk of the product being magnetite from the Lake Champlain district, in the northeastern portion of the State. A small amount of the same variety is obtained in the southeastern section, the latter also furnishing all of the brown hematite and carbonate ores, while the red hematite is mined in the northern central section. Approximately from one-half to two-thirds of New York's output of iron ore is smelted in the blast furnaces located in various portions of the State; the balance of the richer magnetites, red hematites and carbonate ores are sent to Pennsylvania. A small amount of foreign iron ore and limited quantities of Lake Superior and Massachusetts ores are also brought into New York. The Lake Champlain district is the most prominent producing region, and up to the close of the year 1893 had, since its first exploitation in 1804, produced about 18,000,000 tons of iron ore. The State of New York produced 534,122 tons of iron ore in 1893. The greater portion of the magnetite obtained in the State of New York is rich in iron, some of it being of Bessemer grade, while ore from neighboring openings is high in phosphorus. It is in New York that up to the present time the largest amount of concentrated iron ore has been produced.

The general line of magnetite deposits starting in northern New York extends to southeastern Pennsylvania, passing through the northwestern portion of New Jersey in a general northeast and southwest direction. With the exception of a small amount of ore which is a mixture of magnetite and brown and red hematite, the former predominating, all of the output of New Jersey is of the magnetite variety, the bulk of which is used by local blast furnaces or is sent to Pennsylvania for smelting into pig iron. While the iron ore mines of New Jersey have been active for over a century, and much of the ore is of excellent quality, the deposits are becoming deeper and more costly to operate on narrow veins, and some of them are practically exhausted. It is therefore probable that unless the leaner ores are utilized, or radical

changes are introduced, New Jersey's iron ore mines will not contribute in the future as large an amount annually to the supply of the country as they have furnished in past years. New Jersey has several concentrating plants for enriching the lean ores, one of which is the largest in the country, but the quantity produced has not been sufficient to influence the position of the State, owing to the fact that the work has been largely experimental. The output of iron ore in New Jersey was, in 1893, 356,150 long tons.

Virginia practically consumes all of the iron ore which it produces, but little ore being either brought into or sent out of the State. Three classes of ore are produced, but the majority is of the brown hematite variety, in which the State takes first position; in addition to which small amounts of red hematite and a mixture of red hematite and magnetite are mined. The producing mines are generally situated in the southwestern portion of the State, extending in a general northeast and southwest direction along the Blue Ridge. In 1893, 616,965 long tons of iron ore were produced in Virginia.

Ohio and Kentucky furnish carbonate ores and their derivatives, all of which are consumed in local blast furnaces, most of the iron mining operations being found in the coal measures of the eastern and southeastern portions of the State. Although Ohio ranks next to Pennsylvania as a producer of pig iron, the domestic mines contributed but about 3 per cent. of the total iron ore smelted in the State, the balance coming from the Lake Superior region. The position of Ohio as an iron ore producer, owing to the comparatively poor character of the ores, has gradually declined. In 1893 only 68,141 long tons of iron ore were produced.

Missouri, like Ohio, has declined as an iron ore producer, due mainly to the practical exhaustion of Pilot Knob, one of the principal deposits. The two largest producers in Missouri have been Iron Mountain and Pilot Knob, but the output of the former has been greatly restricted in late years, while the latter mines but little ore. The total production of Iron Mountain has been about 3,500,000 tons, and Pilot Knob about 1,500,000 tons. With the exception of a small amount of brown hematite ore obtained in the southern central portion of the State, the iron ores produced are all of the red hematite variety, and are found in the eastern section of the State. The ore is generally of good quality, the red hematite yielding 50 to 65 per cent. of iron, averaging about 57 per cent. In 1893 the output of iron ore was 77,863 long tons.

Of the remaining States, Massachusetts and Connecticut produce excellent brown hematite, the Salisbury region in the western portion of these States furnishing 40,752 long tons in 1893. Maryland obtains from the vicinity of Baltimore a small amount of nodular carbonate ore, which is used in nearby charcoal blast furnaces, and also mines a limited quantity of brown hematite ore in the western, or rather northwestern portion of the State. The principal source of the ore supplied to the large blast furnaces of the Maryland Steel Company at Sparrow Point, near Baltimore, has been Cuba. West Virginia mined a small amount of brown hematite ore in the extreme northeastern section of the State, but, as in the western portion of Pennsylvania, the bulk of the iron ore for West Virginia blast furnaces comes from the Lake Superior region. North Carolina produces a small amount, generally from 10,000 to 25,000 tons, of magnetite ore (some of which is sorted by magnetic concentrators), the greater portion being smelted in the one active furnace at Cranberry, close to a large deposit of lean ore. A new furnace has been built, but is not yet in operation. Kentucky in 1893 won 36,714 long tons, principally brown hematite, with some carbonate and red hematite ore, nearly all of which was used in the blast furnaces of the State with ores from Missouri and Lake Superior. Texas blast furnaces are supplied by local deposits, all of the brown hematite variety, and yielding 40 to 48 per cent. of iron, producing 22,620 long tons in 1893; but in addition, in that year 3,000 tons of magnetite were obtained, though not shipped, in the Llano district, in the western section of the State. In the Western States the bulk of the iron ore produced in 1893 was brown hematite and magnetite, and with the exception of the amounts used in the blast furnaces of the Colorado Iron and Fuel Company, at Pueblo, Colo., and of the Oregon Iron and Steel Company, near Portland, Oreg., this ore was all employed as a flux in silver smelting.

In mining silver ore, principally in Colorado, a large amount of argentiferous iron ore is obtained, which does not contain enough of the precious metal to make it valuable on that account, and it is sold to the smelters as a flux in refining gold and silver ores. There is a number of large undeveloped deposits in New Mexico, Wyoming, Utah, Montana, California, Washington and other States, which will, no doubt, become active when local demand for such ores arises. There exist at various points on the Atlantic and Pacific seaboard deposits of magnetic iron sands, or rather layers of finely comminuted magnetite, which have, by the action of the waves, become partially separated from the siliceous materials forming beach sand. These deposits have been exploited to a limited extent by picking the magnetite from the mass by means of magnetic separators, but as there is usually a considerable percentage of titanium in the ore sand, and as the material must be made into briquettes for transportation and convenient use, but little of this ore has been employed in iron production. Some of these sands have been taken from the shores of Long Island Sound and Narragansett Bay, but at present the little now produced there is used by painters, and for other purposes than the production of iron. On the Pacific Coast deposits of this sand are wrought in Northern California and Oregon for the purpose of extracting the gold found therein, the iron ore being considered as tailings.

The California Fruit Transportation Company has perfected arrangements with the Southern Pacific Company and its connections by which it expects to ship considerable green fruit to England this summer. The shipment of green fruit in refrigeration to the markets of Europe last season was largely experimental. The Southern Pacific, Union Pacific, and Chicago and Northwestern lines will carry the train through to Chicago from Sacramento in 120 hours, and equally fast time will be made between Chicago and New York. It is expected to land the fruit in England in twelve days from the time it leaves Sacramento.

* Extracted from the sixteenth annual report of the director of the United States Geological Survey.—From the Colliery Guardian.