from ore, and Pennsylvania from pig and scrap iron ; Michigan is the leading producer of charcoal pig iron, and now makes no other kind ; only live States make Bessemer steel ; and two States, Penn­sylvania and New Jersey, produce nearly all the crucible steel.

The census year 1880 was one of exceptional prosperity for the iron and steel industries of the country. The production of pig iron and of Bessemer steel ingots and rails since 1880 is shown in the following table (IX.), from the statistics collected by the American Iron and Steel Association :—

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | I 1881. | 1882. | 1883. | 1884. | 1885. | 1886. |
| Pig iron | 4,144,253 | 4,623,323 | 4,595,510 | 4,097,868 | 4,044,526 | 5,683,329 |
| Bessemer steel ingots.. | 1,374,217 | 1,514,687 | 1,477,345 | 1,375.317 | 1,519,426 | 2,269,190 |
| Bessemer steel rails....] | 1,187,769 | 1,284,066 | l,148,709 | 996,465 | 959,470 | 1,562,409 |

The total number of completed Bessemer steel works at the close of 1886 was 33, with 69 converters. Pennsylvania in that year made 59 per cent. of the ingots produced, Illinois 21, and other States 20. In the following table (X.) the amount of steel of all kinds produced is given (in tons) for the years stated :—

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Bessemer Steel Ingots. | Open-Hearth Steel Ingots. | Crucible Steel Ingots. | All other Steel. | Total. |
| 1870 | 37,500 | 1,339 | 31,2 | 50 | 70,089 |
| 1875 | 335,283 | 8,080 | 35,179 | 11,256 | 389,799 |
| 1880 | 1,074,261 | 100,850 | 64,664 | 7,558 | 1,247,334 |
| 1885 | 1,519,430 | 133,375 | 57,599 | 1,514 | 1,711,919 |
| 1886 | 2,269,190 | 218,973 | 71,972 | 2,366 | 2,562,502 |

By far the largest production of iron ore in the United States is from the rocks which lie below the Lower Silurian—the Azoic series of Foster and Whitney and the Archæan of Dana. In this formation the ore occurs in immense quantity—in what may without exaggeration be called mountain masses, which in many cases exhibit all the evidences of an eruptive origin, as in the case of the Iron Mountain of Missouri, or in some of the localities in the Marquette and Menominee regions of Lake Superior. At the first- mentioned locality the ore is intimately associated with an undoubted eruptive rock, with which it is intermingled in such a manner as to show that the two—ore and rock—must have had one and the same origin. A similar condition of things is revealed on Lake Superior, where the ore occurs in repeated interlaminations between sheets of unquestionably eruptive material. The ores thus occurring are hæmatite or specular ore and magnetite, with some hydrated oxide, or limonite, the result of the action of water on the previously formed hæmatite. They are in general extraordinarily free from deleterious ingredients, especially phosphorus and sulphur, although usually containing a small amount of silica. The purity of these ores is a strong indication of their origin differing from that of ordinary sedimentary deposits. Many of the analyses of Lake Superior ore show the presence of only a few hundredths of one per cent. of phosphorus. The most important district in which these ores occur is the south shore of Lake Superior, and the most im­portant port of shipment is Marquette, a considerable amount being also shipped from Escanaba on Lake Michigan. From 1856 to 1886 the total shipments of iron ore from the region amounted to 31,030,160 tons. A district known as the Vermilion Lake iron district, in which the ore has similar characters, and where the quantity is believed to be very large, has been recently opened in Minnesota, on the north shore of Lake Superior. The Iron Mountain region, a little less than a hundred miles south of Saint Louis, although small, is of considerable importance. A very large portion of the Lake Superior ores goes to the Appalachian coal-field to be smelted ; and this was formerly the case with the Iron Moun­tain ore, but the latter is now used in nearer localities. There is a very important and apparently inexhaustible deposit in Lebanon county, Pennsylvania ; the ore is chiefly magnetite, and its mode of occurrence in close connexion with an eruptive rock is to the present writer strong, if not absolutely convincing, evidence of its igneous origin. There are important deposits of iron ore, on the eastern border of New York, especially in the Adirondacks, and along the Hudson River. The geological position in which a por­tion of these ores occurs is certainly the same as that of the ores of Lake Superior—namely, the Azoic. That is the character of the Adirondack ores, which have long been and still are extensively worked. The localities are chiefly in Clinton, Essex, and Franklin counties. In the last-named county are the very extensive Chateau­gay mines. The ores of this region are chiefly magnetite, but they often contain too much phosphorus to be used in the manufacture of steel. There are important occurrences of magnetic ore near New York city and also near the Hudson river, in Orange, Rock­land, Putnam, and Columbia counties. Some of these ores are adapted to the manufacture of Bessemer steel. The mode of occur­rence of the ores in southern New York and northern New Jersey is peculiar ; they are not so distinctly eruptive as are the ores of Missouri and Lake Superior. One authority regards the New Jersey ores as unquestionably of sedimentary origin. This New Jersey

district is not in a flourishing condition at present, since the ores, as a rule, are not adapted to the manufacture of Bessemer steel. Similar ores occur at many points, and often in large quantity, in the Azoic or crystalline belt of the Appalachian system, in the States lying farther south than New Jersey. In Mitchell county, North Carolina, is a deposit known as the Cranberry Bank, of which the quality is excellent, and the quantity is believed to be very great. Up to the present time, however, but little of this ore has been shipped. Next to the Azoic ores in importance, but decidedly in­ferior in quality, arc those of the Clinton group, a member of the Upper Silurian series. The ore occurring in this geological position is known by various names, the most common ones being fossil or dyestone ore. It is a red hæmatite, not crystalline like the specular variety of the peroxide, but usually in a more or less granular or concretionary form, that of flattened grains resembling flax seed being a common mode of occurrence, whence the name “flax-seed ore. ” This deposit occurs at many points along the outcrop of the Clinton group all the way around from Wisconsin, through Canada and New York, into Pennsylvania, and down the eastern slope of the Appalachian range to Georgia, and is said to be the most extensive deposit of iron ore in the world yet discovered. The fossil ore, though large in quantity, contains too much phosphorus to be used for making steel in the ordinary method; but, being in places favourably situated with regard to fuel, and yielding as it does a satisfactory quality of cast iron, it is quite extensively mined at various points. Next to the Clinton ore in importance comes the brown hæmatite ore (limonite), which occurs in numerous localities, but of which the most extensive deposits are those occurring in the Lower Silurian limestones of the Appalachian system, and especially along the line of the Great Valley. Some of the ores are of excellent quality, notably those of Litchfield county, Connecticut, in the so-called Salisbury district. The iron made in charcoal furnaces in this region is considered as being of the highest value for articles in which strength and toughness are essential. Carbonate of iron, in the form of spathic iron, is of rare occurrence. The argillaceous carbonates (clay ironstone) are also of comparatively little import­ance, although used to some extent, especially as mixed with other ores, in western Pennsylvania and Ohio. The coal-fields west of the Appalachians are very poorly supplied with iron ores. Black­band ore is also of somewhat rare and limited occurrence in the United States.

In spite of the abundance of iron ore in the United States and the existence of a heavy protective duty (75 cents per ton), a large quantity of ore is imported from abroad—chiefly from Spain, Elba, Algiers, and Cuba (1,039,433 tons valued at $1,912,437 in 1886). Almost all this was used in Pennsylvania, and chiefly in the manufacture of Bessemer pig iron and spiegeleisen. Up to 1884, at least, no pig iron suitable for the manufacture of Bessemer steel by any process now in use in the United States had ever been made south of the Potomac or south of Wheeling. Neither has iron suitable for crucible steel been made in the United States which can compete with that of Sweden.

The annexed table (XI.), published by Mr Swank, shows the pro­duction of iron ore in tons in the leading ore-producing districts for the years 1884, 1885, and 1886 :—

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1884. | 1885. | 1886. |
| Lake Superior (Michigan and Wisconsin) | 2,455,924 | 2,231,064 | 3,258,174 |
| Vermilion Lake (Minnesota) | 62,124 | 225,484 | 304,396 |
| Missouri | 233,225 | 169,162 | 379,776 |
| Cornwall (Pennsylvania) | 412,320 | 508,864 | 688,054 |
| New Jersey | 393,710 | 330,000 | 500,501 |
| Chateaugay (Lake Champlain, New York)... | 214,394 | 143,278 | 214,800 |
| Crown Point (New York) ) |  |  | ( 60,084 |
| Port Henry (New York) | 290,500 | 235,799 | 298,868 |
| Other Lake Champlain mines (New York) ) |  |  | 15,000 |
| Hudson River Ore and Iron Company (New York) | 90,000 | 55,000 | 75,000 |
| Tilly Foster (New York) | 35,964 | 18,910 | 17,728 |
| Forest of Dean (New York) | 20,370 | 18,274 | 18,000 |
| Salisbury region (Connecticut) | 25,000 | 32,000 | 36,000 |
| Cranberry (North Carolina) | 3,998 | 17,839 | 24,106 |
| Tennessee Coal, Iron, and Railroad Com­pany's Inman mines (Tennessee). | 70,757 | 94,319 | 81,650 |
| Total | 4,308,286 | 4,079,993 | 5,972,137 |

*Gold and Silver.—*The washing of the high or Tertiary gravels by the hydraulic process and the working of mines in the solid rock did not, on the whole, compensate for the diminished yield of the ordinary placer and river diggings, so that the produce of gold in California continued to fall off, and by 1860 had decreased to about half what it had been ten years before. Discoveries in other Cordilleran Territories, notably in Montana and Idaho, made up, however, in part for the deficiency of California, so that in 1860 the total amount of gold produced in the United States was estimated at not less than $45,000,000. In the latter part of the decade 1850-59 the Territories adjacent to California on the east, north, and south were overrun by thousands of miners from the Sierra Nevada gold-fields, and within a few years an extraordinary num­ber of discoveries were made, some of which proved to be of great