engineer of long experience in that region, has made a statement that the anthracite fields originally contained about 25,000,000,000 tons of coal. Mr Ashburner, the assistant in charge of the State survey of the anthracite coal district, has stated that, up to 1st January 1883, the total production of that district had amounted to 509,333,695 tons. He also estimates that two-thirds of the coal actually attacked had been lost in the mining. Making allowance for increased consumption and other considerations, it would appear that 200 years must be taken as the maximum time during which the anthracite fields will hold out, while it is prob­able that they will be practically exhausted considerably earlier. As regards the quantity of available coal in any portion of the bituminous coal-fields of the country, the only estimate we have is that of Prof. Lesley, who (February 1886) estimates the amount of available coal in the Pittsburgh seam at 5,000,000,000 tons, but confesses that any exact calculation is impossible. If the consumption remains at the figure at which it stood in 1884 (11,000,000 tons), this quantity will last about 450 years.

*Petroleum.@@1*—The oil-producing districts of present or past im­portance are nearly all in Pennsylvania ; but there are small pro­ductive areas in the adjacent portions of New York. (1) The Allegany district, including the Richburg and several small outly­ing pools in Allegany county, New York, has a productive area of 31 square miles, and up to January 1885 produced 15,000,000 barrels. (2) The Bradford district, embracing the oil-pools in central and northern M'Kean county, Pa., and southern Cattaraugus county, N.Y., has a productive area of 133 square miles, 121 of which are included in the Bradford field proper. The geological position of the oil-bearing strata is indicated by the fact that the uppermost oil-sand is, at Bradford, 1775 feet below the bottom of the lower member of the millstone grit, or Pottsville conglomerate, which in western Pennsylvania is one of the most persistent and best-recognized geological horizons, and is there known as the Olean conglomerate. This district had up to January 1885 pro­duced 109,000,000 barrels of oil. (3) The Warren district lies in eastern Warren and north-eastern Forest counties, Pa. ; it has an area of 35 square miles, and up to January 1885 had produced 12,000,000 barrels. The oils from different subdivisions of this district vary considerably in colour and gravity, although gener­ally spoken of as “amber oils.” They come from “sands” (sand rocks) of varying geological horizons, from 1100 to 1850 feet below the Olean conglomerate. (4) The Venango district—the scene of all the earlier oil developments—has an area of 65 square miles, and includes forty distinct and well-recognized oil-pools, the largest of which lies between Oil City on the south and Pleasantville on the north, and covers an area of 28 square miles. The production of this district up to January 1885 had been about 55,000,000 barrels. The oil of the Venango district comes from three principal sand beds, of which the uppermost one lies about 450 feet below the base of the Olean conglomerate. They are all contained within an interval of 350 feet. The oils are generally green, but frequently black, and sometimes amber. The pebbles of the sand rocks are water-worn, sometimes as large as hazel-nuts, loosely cemented together and bedded in fine sand ; but the sands are not so regular or homogeneous as in the Bradford and Allegany fields ; conse­quently, the risk of obtaining unproductive holes and variable wells has always been greater in the Venango than in the Bradford and Allegany districts. (5) The Butler district includes the oil­pools in Butler and Clarion counties and in south-eastern Venango county. The area is 84 square miles, and up to January 1885 the production had been about 69,000,000 barrels. The oil here comes from the same group of sand rocks as in the Venango district. (6) The Beaver district includes the two principal oil-pools known as Slippery Rock and Smith’s Ferry, having an area of about 16 square miles, with a production of 1,000,000 barrels up to January 1885. In both the oil-pools of the Beaver district heavy oil is obtained from the representative of the Pottsville conglomerate, and amber oil from the Berea grit, a member of the Sub-Carbonifer­ous series. The geological position of all the other oil-fields is con­sidered by the geologists of the Pennsylvania Survey as Devonian. The total area of the productive oil areas is given by Messrs Carll and Ashburner at 369 square miles, and the general boundaries of the oil-regions of Pennsylvania are now regarded as established. That production is declining is shown by the following figures. In July 1883 the number of producing wells was 17,100, and the average daily product per well was 3∙8 barrels ; in 1884 the corre­sponding figures were 21,844 and 3∙0, and in 1885 they were 22,524 and 2∙5. Since July 1882, when the maximum average daily pro­duction for any one month was realized (105,102 barrels), there has been an irregular but steady decline. In 1884 the shipments of petroleum were more than 1,000,000 barrels in excess of the pro­duction. At the end of August 1884 the stock of oil on hand had reached its maximum, 39,084,561 barrels ; in September 1885 it had declined to 35,343,771 barrels. The price of petroleum had

not, up to July 1885, been influenced by this condition of things, crude oil being at that time worth 92½ cents a barrel, 13¼ cents less than the average price for 1884. The extraordinary fluctuations in the price of petroleum during 1880 to 1886 are shown by the following figures :—in 1880 it ranged from 124⅜ to 70 ⅝ cents per barrel for crude oil ; in 1881 from 100½ to 72 ; in 1882 from 135 to 49¼ ; in 1883 from 125 to 84¾ ; in 1884 from 115¾ to 51 ; in 1885 from 111⅝ to 68 ; in 1886 from 92¼ to 59¾. These figures, however, have but little reference to changed conditions of production. The fluctuations are simply the result of a colossal system of gambling, the magnitude of which may be inferred from the statement that the “clearances” on the “consolidated stock and petroleum ex­change” for 1886 amounted to about 2,275,000,000 barrels. The daily average exports of petroleum for that year are given at about 44,300 barrels. The tendency to lower prices in 1886 was due in part to the remarkable yield of the oil-wells at Baku, on the Caspian Sea, and in part to discoveries, supposed to be of importance, in Ohio.

*Natural Gas.—*The use of natural gas for illumination, and even for metallurgical purposes, has lately become a matter of importance. The existence of outflows or springs of gas in the region west of the Alleghany range has been long known, and the gas obtained from wells or bore-holes was used for illumination in Fredonia, N.Y., as early as 1821. One well after another was bored for this purpose at that place, until, in 1880, the supply had reached the amount of 110,000 cubic feet per month. The following figures, reported by T. P. Roberts, show the estimated value of the coal displaced by natural gas in the region where this source of heat and light was in use for the years mentioned :—

1. Pittsburgh region, $75,000; elsewhere, $140,000; total, $215,000
2. „ 200,000; „ 275,000; „ 475,000
3. „ 1,100,000; „ 360,000; „ 1,460,000

Gas seems to be a general concomitant of the oil all through the petroleum region, but for a long time the outflow of gas from the oil-wells was looked upon as a nuisance. According to Mr Ash­burner,@@2 the amount of gas at present flowing from the explored sands of Pennsylvania is probably two or three times greater than is required to meet all present demands. The same authority gives an account of the development of the natural gas resources of Ohio. Their amount is not yet ascertained with any degree of certainty, but it seems likely to be large. All the gas comes from the Palæozoic strata, from the Upper Coal-measures down to the Trenton lime­stone,—the most prolific gas-bearing rocks being the Berea grit in the Sub-Carboniferous and the Trenton limestone of Lower Silurian age. Natural gas has been obtained in numerous localities in New York, but nowhere in considerable quantity except in the vicinity of the Allegany oil-district, in the county of that name. Portions of West Virginia, especially the Kanawha valley, give promise of being regions of large production.

*Iron and Steel.—*The following table (VII. ) will convey an idea of the condition of the iron industry at the date of the last census, and of the progress made during the ten preceding years :—

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | No. of Establish­ments. | Amount of Capital invested. | Value of Products. | Weight of Products in Tons. |
| 1870 | 808 | $121,772,074 | $207,208,696 | 3,245,720 |
| 1880 | 1005 | 230,971,884 | 296,557,685 | 6,486,730 |
| Increase per cent | 24∙38 | 89∙68 | 43∙12 | 98∙76 |

The “ weight of products,” as given above, includes the products of all the various processes or operations ; hence there is evidently a certain amount of duplication (rolled iron, for instance, being mainly produced from pig). The following table (VIII.) gives the production in each branch of the steel and iron industries :—

|  |  |  |
| --- | --- | --- |
|  | 1870. | 1880. |
| Pig iron and castings from furnace .. | 1,832,876 tons. | 3,375,901 tons. |
| All products of iron rolling mills .... | 1,287,347 „ | 2,101,114 „ |
| Bessemer steel finished products .... | 17,324 „ | 794,550 „ |
| Open-hearth steel finished products.. | 0 ,, | 83,163 „ |
| Crucible steel finished products .... | 25,061 „ | 62,784 „ |
| Blister and other steel | 2,040 „ | 4,424 „ |
| Products of forges and bloomeries .. | 98,935 „ | 64,784 „ |

The distribution of the iron industry is extremely irregular. West of the Mississippi, with the exception of the angle between that river and the Missouri adjacent to St Louis, the amount of iron made is very small. The percentage of total production in 1880 was distributed as follows :—Pennsylvania, 50 ; Ohio, 13 ; New York, 8 ; Illinois, 6 ; New Jersey, 3 ; Wisconsin, W. Virginia, Michigan, and Massachusetts, each nearly 2 ; Missouri, Kentucky, and Maryland, between 1∙5 and 2 ; Indiana and Tennessee, about 1 ; all the other States and Territories, an aggregate of about 4 per cent. New England now makes but little pig iron, and the South scarcely any rolled iron ; the West has largely embarked in the manufacture of steel by the Bessemer process, while New York has not a single Bessemer establishment ; New York manufactures chiefly

@@@1 The substance of the following paragraph is mainly derived from a paper read by Mr C. A. Ashburner, of the Pennsylvania Geological Survey, at a meet­ing of the American Institute of Mining Engineers in September 1885.

@@@2 Paper read before the American Institute of Mining Engineers, Oct. 1886.