THE FIRST CENTURY OF THE REPUBLIC.

[Eighth Paper.]

THE DEVELOPMENT OF OUR MINERAL RESOURCES.

TO write the story of the development of the mineral resources of the United States during the last century would demand a volume. The whole history of the new States and Territories beyond the valley of the Mississippi is little else than that of the opening and the working of their rich mines of gold and silver since 1849. But this region was not a part of the national territory at the time when our survey commences. While the Spaniards, greedy for that wealth which proved their ruin, planted their colonies from Mexico to Chili along the western portion of the continent, rich in precious metals, our English ancestors fixed their homes in a portion which, though not destitute of mineral resources, offered no tempting prizes to the miners of that early day. The records of our colonial period have little to tell beyond the working of some iron ores along the sea-board, and attempts on a small scale to mine ores of copper and of lead. The first half century of our national existence does not add much to this record, and the history of the marvelous developments in the working of the coal, petroleum, iron, and copper in our Eastern regions, and in the mining of gold and silver in the West, belongs to the present generation.

It will be found convenient in our inquiry to follow, with a few exceptions, the geographical division just indicated, and to point out for each of these regions separately the general results already obtained in the development of its mineral wealth, considering in the first place the territory which stretches from the eastern base of the Rocky Mountains to the Atlantic. It is in this division of our territory that are found the great stores of coal and iron, besides vast supplies of petroleum, salt, copper, and other minerals of less importance. Geologically described, this eastern half of the United Sates is essentially a great basin of paleozoic strata nearly encircled with azoic crystalline rocks, and has been aptly described as a great bowl filled with mineral treasure, the outer rim of which is formed by the mountains of Northern New York, the hills of New England, the Highlands of the Hudson, and their southward continuation in the Blue Ridge nearly to the Gulf of Mexico. Thence, passing to the eastern base of the Rocky Mountains, it extends northward, and by the Great Lakes around the northern rim of the bowl to the point of departure. Within the area thus inclosed lies the vast Appalachian coal-field, with its dependent areas of anthracite and semi-bituminous coal, the lesser coal-fields of Michigan and Illinois, and the still more western one to which the coals of Iowa, Missouri, and Arkansas belong. It includes, moreover, formations containing petroleum, salt, and lead, besides much iron, though not less abundant stores of the latter metal are found in the surrounding crystalline rocks.

The coal deposits of the great paleozoic basin furnish the mainspring of our principal mechanical and commercial enterprises, the great source of motive power, and the chief means of reducing and manufacturing our iron. If to this we add that the value of the coal now mined in the United States is equal to that of all the iron, gold, and silver produced in the country, we have said enough to justify us in assigning it the first place in a survey of our mineral resources. The forest growth supplied the demands for fuel of the early English colonists, to whom the treasures of the great basin were little known, and the first attempts at mining mineral fuel were in the coal basin of Richmond, Virginia, one of several small areas which lie over its eastern rim, or between the Blue Ridge and the sea. The coal of Richmond occurs in what are known to geologists as mesozoic rocks, and belongs to a later age than the bituminous coal of Pennsylvania, which, however, it resembles in quality. It was probably first mined as early as 1750, and after the war of the Revolution was exported to Philadelphia, New York, and Boston, until within the last thirty years. Other coals have since replaced it in these markets, and it is now mined chiefly for local use.

The anthracite of Eastern Pennsylvania was first discovered, it is said, in 1770. In 1775, just a century since, a boat-load was taken down to the armory at Carlisle, and in 1791 the great open quarry of this fuel near Mauch Chunk was made known. From its unlikeness to the Virginia coal, and the difficulty of igniting it, the Pennsylvania anthracite encountered much opposition. Tradition tells us that a boat-load taken to Philadelphia in 1803 was broken up and used to mend the roads. But it slowly found its way into use; and from a pamphlet published in 1815 we learn that the coal from the Lehigh had been several years on trial in Philadelphia, where it had been compared with the Virginia bituminous coal, and, from the testimony of iron-workers, distillers, and others, was to be preferred to it for durability and economy. Oliver Evans had, moreover, at this time tried the anthracite with success under the

boilers of his steam-engine, and also insisted upon its advantages for domestic purposes. Notwithstanding these results, the new fuel found its way very slowly into use, and in 1822 the total production of the anthracite mines was estimated at 3720 tons, against 48,000 tons of the coal from Richmond, Virginia, then its only rival. Fifty years later, or in 1872, the official returns give for the exportation of coal from the anthracite region not less than 19,000,000 tons, besides about 2,500,000 tons for local consumption, while that of the Virginia coal-field for the same year is estimated at 62,000 tons. The late Professor Silliman, who visited the anthracite region in 1825, and published his report of it in the following year, was the first to appreciate the real value and importance of this deposit of fossil fuel, which he then spoke of as a great national trust.

The small detached basins of the anthracite region have together an area of only 472 miles; but the immense aggregate thickness of the seams of coal, varying in different parts from fifty to one hundred feet, and estimated at an average of seventy feet for the whole, makes this wonderful region of greater value than Western coal-fields whose extent is measured by many thousands of square miles. Mr. P. W. Shaeffer, who has calculated the cubic content of these anthracite beds, estimates it to have been at the time when mining was commenced equal to 26,361,070,000 tons, from which one-half may be deducted for waste in mining and breaking for market, and for losses from faults and irregularities in the beds, giving of merchantable coal 13,180,538,000 tons. If from this we subtract the amount produced by the mines from 1820 to 1870, estimated at 206,666,325 tons, we had still in store at the latter date a supply of 25,000,000 tons a year, or more than the present rate of consumption, for 525 years. The large waste in mining this precious fuel is due in part to the difficulty in working seams of unusual thickness, often in highly inclined positions. Moreover, the loss in breaking and dressing for the market, which demands the anthracite in regularly assorted sizes, is very great, and the waste from these two causes amounts to about one-third the entire contents of the veins, while in Great Britain the average loss in mining and marketing ordinary coals is not over one-fifth. The great value of our American anthracite is due in part to its peculiar qualities, its hardness, density, purity, and smokelessness, which render it pre-eminently fit for domestic purposes and for iron smelting; but in part also to its geographical position. Its proximity to the Atlantic sea-board, which is almost destitute of coal, to our great cities and wealthy and populous districts, and, moreover, to some of the most important deposits of iron ore in the country, has already led to an immense development of mining in the anthracite region. The New England States, Eastern New York, New Jersey, and Eastern Pennsylvania look to it for their chief supplies of fuel; great systems of railways and canals have been called into existence by it; and a vast iron-producing industry has grown up, dependent upon the anthracite fields, which now furnish nearly one-half of all the coal mined in the United States. It results from the course of trade that large quantities of anthracite find their way westward by railways, canal-boats, and lake steamers, freights in that direction being very low at certain seasons of the year. Thus there were brought to Buffalo in 1873 about three-quarters of a million of tons of anthracite, the greater part by railway, of which Chicago received over half a million, or nearly one-third of its entire coal supply. Smaller quantities of anthracite find their way down the Ohio River to Cincinnati and beyond.

The chief coal supply of the regions to the west of the meridian of Washington comes, however, from the great Appalachian basin, which, underlying much of the western half of Pennsylvania and of the eastern third of Ohio, West Virginia, and a part of Eastern Kentucky, stretches through Eastern Tennessee as far as Alabama, embracing an area of coal-bearing rocks estimated at nearly 58,000 square miles. Along the eastern border of this vast field of bituminous coal there are in Pennsylvania and in Maryland several small areas which furnish a semi-bituminous coal, intermediate in composition, as in position, between it and the anthracite of the East, and now very largely mined. The best known of these outlying basins are the Blossburg, on the north, and the Cumberland, in Maryland, on the south; but there are between these other similar areas of considerable importance, such as the Broad Top, Johnstown, Towanda, and Ralston, the production of the whole being about 5,000,000 tons of coal annually, of which nearly one-half comes from the Cumberland and about one-fifth from the Blossburg. This latter was first opened by a railway in 1840, while an outlet from the Cumberland field to the sea-board was established by the Baltimore and Ohio Railroad in 1842, thus bringing for the first time the bituminous coal of the interior to tide-water, and displacing in Eastern markets the coal of Virginia. These semi-bituminous coals, very rich in carbon, and yet possessing the property of coking in the fire, are much esteemed for iron-working and for generating steam, for which they are largely used on our railways and ocean steamers, besides which great quantities are converted into coke for iron smelting. These valu-

able coals, like the anthracite, are confined to small areas, and will be exhausted in a few years, or at most a few generations. The Cumberland basin, at its present rate of working, will not last thirty years, and the time is not far distant when both the anthracite and the semi-bituminous coals of Pennsylvania will become augmented in price from their rarity. Its geographical position has led us to mine and consume first the most valuable portion of our coal, which, under different circumstances, it would have been wise to have replaced in part by other and more abundant varieties.

In this connection it should be mentioned that on the southeastern border of the Appalachian coal-field, in Montgomery County, Virginia, are found small deposits of semi-bituminous and anthracite coals, both of good quality, which were mined to a considerable extent during the late civil war. Another area of anthracite demands our notice, which, like the coal of Richmond, Virginia, is outside of the great basin. It is situated in Rhode Island and Massachusetts, where it occupies an area estimated at not less than 500 square miles, and includes, in various parts already explored, beds of anthracite from ten to twenty feet in thickness. This coal-field was discovered in 1760, and attempts at working it were made as early as 1808. The geological peculiarities of the region, the somewhat broken condition of the coal, and, above all, the competition of the anthracite of Pennsylvania have retarded its development, so that the total production was estimated in 1872 at 14,000 tons, the production of a single mine at Portsmouth, Rhode Island, where this coal is employed for copper smelting. There is no doubt that this important field of anthracite will one day be found of great value to New England.

The supplies of true bituminous coal which are found in the great Appalachian field are practically inexhaustible, and the mining of it is rapidly assuming proportions second only to those of the regions along its eastern border, which it is destined before long to surpass in its production. The bituminous coals may be divided into three classes, close-burning or coking coals, free-burning splint or block coals, and cannel. Of these the former are the most abundant, and for the greater number of purposes are used in their raw state. Unlike the anthracite, however, they are not fitted for iron smelting and for many other metallurgical operations unless previously converted into coke, for the production of which they are not all equally fitted. While some are too sulphurous, others contain too much ash, are too poor in fixed carbon, or yield a coke deficient in weight and in solidity. In view of all these circumstances, the value of a superior coking coal is very great, and a striking example of this appears in the Pittsburg seam, as it is called, of Western Pennsylvania. This remarkable coal seam, to the south of the city whose name it bears, attains near Connelsville an unusual thickness, and yields a coke of unsurpassed quality, which is not only the foundation of the iron-smelting industry of the western part of the State, but finds its way in large quantities to Cleveland, Chicago, Cincinnati, and St. Louis, and even as far as Utah, where it is used to smelt the silver-lead ores of that region.

Pittsburg is at present the great centre of the Western coal trade, and in addition to the large amount consumed in its own manufactures, distributes coal in various directions by railway and river, sending vast quantities down the Ohio to supply the cities on its banks, and even the Lower Mississippi. The amount of coal received at Pittsburg in 1872, in great part by the Monongahela, was over 115,000,000 bushels, which, at twenty-eight bushels to the ton, is considerably over 4,000,000 tons, and the annual increase for three years up to that time was at the rate of thirty-five per cent. To this we must add the amount of coke received, which doubled annually for the same three years, and equaled in 1872 nearly 44,000,000 bushels, the product from coking about 2,600,000 tons of coal. The total estimated production of bituminous coal for Pennsylvania in 1872 (including about 3,000,000 tons of semi-bituminous) was 10,442,000 tons, and if to this we add the 21,500,000 tons of anthracite, we shall find that this State alone furnished in that year more than two-thirds of all the coal mined in the United States. The figures from official sources fail to give the full amount of coal used for local consumption, but the entire production of the United States for 1873 Macfarlane estimates at not less than 50,000,000 tons. The check which all our industries, and especially the working of coal and iron, sustained throughout the year 1874 has produced a temporary falling off in production, so that the figures for 1872 and 1873 are really a fairer index of our progress than those of a later date.

Next in importance to that of Pennsylvania is the coal production of Ohio, which was estimated in 1872 at 4,400,000 tons. Owing to the want of proper railway communications the coal deposits of this State have as yet been but little worked. It is in Ohio that the free-burning splint or block coal (which appears to a limited extent in the Chenango Valley, on the western frontier of Pennsylvania) finds its greatest development. This coal, which is extensively mined in the adjacent parts of Ohio, chiefly in the valley of the Mahoning, is prized not only on account of its freedom from ash and sulphur, but from the fact that it can be di-

rectly used in the blast-furnace for smelting iron ores without previous coking, and it has given rise to an important iron industry in its vicinity. The supply in Northern Ohio is, however, limited, and it is rapidly becoming exhausted. A much more abundant deposit of a similar coal, under very favorable conditions for mining, has lately been made known farther southward in the State, in the Hocking Valley, where it is, moreover, accompanied by large beds of coking coal. The coal of Ohio is destined from its geographical position to become of great importance: lying on the northwest border of the Appalachian field, as the anthracite and semi-bituminous coals of Pennsylvania do upon its northeast border, it has to the north and west of it a vast wealthy and populous region, with growing industries, and demanding large and increasing supplies of coal.

The extension southward of the Appalachian coal-field through West Virginia and parts of Kentucky, Tennessee, and Alabama is known to abound in valuable beds of bituminous coal, which have lately attracted considerable attention. Since the opening of the Chesapeake and Ohio Railroad the coals from the valley of the Kanawha are finding their way, to some extent, to the seaboard and into Eastern markets, but with this exception the vast coal deposits of this great Southern region are as yet mined only to supply the limited local demands.

Among the important uses of bituminous coal is the manufacture of illuminating gas, for which purpose immense quantities of coal are distilled. The annual consumption for this purpose in the cities of New York and Brooklyn is estimated at about 400,000 tons. Those coals which yield large quantities of pure gas of high illuminating power are greatly prized. The Eastern cities are in part furnished with gas coal from Cape Breton, but the greater part of the coals for this purpose is got from Western Pennsylvania. Excellent gas coals are, however, obtained in Ohio and in West Virginia.

The State of Michigan includes a coal basin with an area of not less than 6700 square miles, but the beds of coal which it contains are few, thin, and of inferior quality. For this reason, and from the fact that the State is cheaply supplied with superior coals from Pennsylvania and Ohio, the coal of Michigan is worked only to a small extent for local consumption, the estimated production for 1872 being but 30,000 tons. The Illinois coal basin, which underlies the greater part of that State, and extends into the western parts of Indiana and Kentucky, has an area of not less than 47,000 square miles. Along its eastern and western borders in Clay County, Indiana, and near St. Louis, are found deposits of an excellent block coal like that of Ohio, adapted for iron smelting, but with this exception the coals of this great basin are generally sulphurous and inferior in quality, and command in the market of Chicago a price much below those of Pennsylvania and Ohio. Chicago received in 1873 over 1,600,000 tons of coal, of which about two-fifths only were from the adjacent coal-field, the remainder being brought from the two States just named. The first working of coal in Illinois dates from 1810, and the production of the State for 1872 was equal to 3,000,000 tons, while Indiana furnished 800,000, and that portion of the coal-field which lies in Western Kentucky 300,000 tons.

The coals of the great field west of the Mississippi, which extends through Iowa, Missouri, Kansas, and Arkansas, are mostly of inferior quality and in thin beds, but are of great local importance in these sparsely wooded regions. In the State of Arkansas, moreover, there are found beds of a superior semi-bituminous coal, approaching to anthracite in its character. Further westward, in the Rocky Mountains and thence to the Pacific coast, from the confines of Mexico to Canada, are extensive deposits of tertiary coals or lignites, which, though inferior in quality to the coals of the Appalachian basin, are, in the absence of better fuel, employed for generating steam and for domestic purposes. They are, however, very variable in quality, and some beds have of late been found which are fit for the manufacture of illuminating gas, and are even capable of yielding a coke suitable for metallurgical processes. These coals are mined in Utah, Colorado, and Wyoming, and again on the Pacific coast in California, Oregon, and Washington Territory. Of the coal supply of San Francisco in 1873, which equaled 441,000 tons, about sixty per cent. came from these deposits along the western coast, the remainder being from Australia, England, and the Eastern States.

The petroleum industry of the United States was in its beginning closely connected with coal, since it was the production of oils from bituminous coals which led the way to the utilization of the native mineral oils. It had long been known that tar and oily matters could be extracted from coal and from shales impregnated with coaly matter by subjecting them to a high temperature, these substances, although not existing ready-formed in the coals, being generated by the decomposing action of heat. A product thus obtained was known to apothecaries more than a century ago by the name of British oil; and in 1834 experiments on a large scale were made in France by Selligue to manufacture illuminating oils by the distillation of shales, and with partial success. In 1846 similar results were obtained by Gesner in New Brunswick; and in 1850 Atwood, of Boston, prepared a lubri-

cating oil from coal-tar. At the same time Young, of Glasgow, was experimenting, and in 1850 introduced into the market, under the name of paraffine oil, a product from cannel-coal. The first works for this manufacture in the United States were established on Long Island in 1854, under Young's patents for manufacturing oils from the Boghead coal brought from Scotland, or from American coals. From this point the industry spread rapidly, and in 1855 and 1856 works for the distillation of oils from coals were erected in Kentucky, Ohio, and Pennsylvania, as well as along the Atlantic sea-board, where the principal material employed was the mineral from Scotland just named. In January, 1860, there were in the United States not less than forty factories, the total daily production of which was about five hundred barrels, chiefly of burning oil. This was sold in the market with the trade name of kerosene, or simply as coal oil; and lamps suitable for burning it having been devised, it became widely used. But this industry of the distillation of coal was destined to have a very short duration, for the oil wells of Pennsylvania, opened in 1859, furnished in 1860 not less than 500,000 barrels of petroleum—a production far exceeding that of the coal distilleries. It was soon found that from this mineral oil products could be extracted in all respects similar to those from coal, and the result was that from this time the manufacture of coal oil was abandoned, and the works which had been erected for this purpose were changed to petroleum refineries.

The early history of petroleum is curious. Known and employed for burning from remote antiquity in the Old World, no process for its purification had been devised, and it was therefore at best but an indifferent and cheaper substitute for animal and vegetable oils. The first attempts to refine it for commercial purposes are believed to have been made by Young, of Glasgow, in 1847, on petroleum got from Derbyshire, in England, from which he prepared a lubricating oil, and it was the exhaustion of this supply which led him to improve the methods for the extraction of oils from coal.

Meanwhile, in the United States, the existence of sources of mineral oil had been known to the Indians of New York and Pennsylvania, who prized it as a medicine, for which purpose it became familiar to the early European colonists under the name of Seneca-oil. It appears to have been an object of research to the aborigines ages ago, since in the oil regions of Western Pennsylvania are found pits or wells apparently dug for the purpose of collecting the oil, carefully timbered, and affording from the growth of the forest upon the site evidences of an antiquity of from 500 to 1000 years. As early as 1819, in boring for brine on the Muskingum River, in Ohio, from a depth of 400 feet were obtained large quantities of mineral oil, which was a source of great annoyance to the salt-makers. At this time attempts were made to use the oil for illumination, but, from the want of proper lamps, it was not found to be adapted to the purpose. In 1854 the successful manufacture of oils from coal caused attention to be drawn to the possibility of utilizing these native oils, and the Pennsylvania Oil Company was formed for the purpose of manufacturing the petroleum found at Oil Creek, in Venango County, Pennsylvania. The chemical investigation of the material was committed to Professor B. Silliman, Jun., and his report to the company, which appeared in April, 1855, has been the point of departure for the immense industry of petroleum which has grown up within the last twenty years. In this report was described the conversion of the crude petroleum by fractional distillation into products differing in density and in volatility, the manufacture from it of a burning oil of great illuminating power, of an oil capable of supporting a low temperature and fitted for lubrication, and also of paraffine. He farther showed the importance of distillation in a current of highly heated steam, and noticed the breaking up of heavier into lighter oils by continued heat —processes which have since assumed a great importance in the manufacture of petroleum.

Notwithstanding these remarkable results, little was effected for some years; the supply of petroleum was limited to that which could be gathered from the surface of the water in the locality, and from its cost it could not compete with the product of the distillation of coal. At length an attempt was made to repeat the early experiment of the Muskingum salt-works, and a well was bored by Drake, the superintendent of the Pennsylvania Oil Company, from which, at a depth of seventy-two feet, a supply of oil amounting to ten barrels or 400 gallons a day was obtained, which was sold for fifty-five cents a gallon. This was in August, 1859, and the successful trial was soon followed by many others not less so. The history of the wild excitement and speculation which followed this discovery, and the great accession of wealth to the region, is familiar to all. Wells were soon sunk which yielded from 100 to as much as 2000 barrels of oil daily, often without the labor of pumping. Of one well it is recorded that it afforded 450,000 barrels of oil in a little over two years, while another is said to have given not less than 500,000 barrels in a twelvemonth. Petroleum was soon discovered not only over a wide district in Pennsylvania, but in Eastern Ohio and in parts of West Virginia and Kentucky, and even in Indiana, as well as in Western Can-

ada. In 1860 the production rose to 500,000 barrels of forty gallons each, and for the decade ending with 1870 it amounted to not less than 35,273,000 barrels of crude oil. Of this by far the greater part came from Pennsylvania, for of the 6,500,000 barrels produced in 1870, not less than 5,569,000 were from that State, the production of about 3000 wells, which is an average of only about five barrels daily for each well.

The wells in Venango County, where this industry began, were generally from 600 to 800 feet in depth, but with the partial exhaustion of these the scene of operations has been removed to more southern districts, where the oil supplies are found at greater depths; and the wells in Butler County, now the great seat of production, are from 1200 to 1500 feet deep. The crude oil is carried from the wells to the points of refining or of shipment through iron pipes. Some of these lines are fifteen and twenty miles in length, and one is in process of construction from Butler County to Pittsburg, a distance of about forty miles. It has even been proposed to convey the oil by a series of conduits and reservoirs across the mountains to Philadelphia.

The processes for refining the crude petroleum and preparing from it various commercial products have been perfected by much chemical skill. The loss in refining amounts to about ten per cent., and the average product of illuminating oil from the crude petroleum of Pennsylvania is about sixty-five per cent. The other products are dense lubricating oils, light naphthas, and paraffine or mineral wax, of which a barrel of crude oil yields about five pounds.

The abundance of the Pennsylvania petroleum and the skillful manner in which it is refined have led to a general exportation of these products to every part of the civilized world. Already in 1861 we find the shipments of petroleum from the United States to foreign ports equal to nearly 28,000 barrels of forty gallons each, and for the ten years ending with 1870 the exportation was 14,465,000 barrels. By far the greater part of this was shipped in the refined state, and its average price for the term of ten years was estimated at twenty-five cents a gallon, thus representing an aggregate value of over $144,000,000. The increase in the amount exported has been regular and constant. That for the calendar year 1870 was 3,495,800 barrels; for 1872, 3,754,060; for 1873, 5,937,041; and for 1874, 5,878,578 barrels, of which about nine-tenths is refined oil.

This large increase in the exports of the last two years shows the very considerable augmentation in production which has followed late discoveries of new and productive oil districts in Pennsylvania. These have been attended by a great reduction in price. From fifty-five cents the gallon, at which the first crude oil from the wells was sold, it soon fell to twenty cents, and to sixty or seventy cents for the refined oil. In 1872 its price in New York had fallen below twenty-four cents, in 1873 to below nineteen, and in 1874 to a small fraction over thirteen cents, the crude oil in New York having fallen in the same three years from about thirteen to less than six cents the gallon. Of crude oil forty-three and a half gallons are counted to a barrel, yet its price in Western Pennsylvania in 1874 was from sixty to seventy-five cents a barrel at the wells, and from eighty cents to a dollar at the delivery pipes. Even at the present reduced prices the annual value of the petroleum product of the country is very great. The export for 1874, chiefly of refined oil, at the mean price of 13.09 cents the gallon, equals $30,825,268. The present annual consumption of the United States is estimated at 1,500,000 barrels of refined petroleum, which, added to the export for 1874, gives a total of 7,378,000 barrels of refined oil. The estimated production of crude oil for 1874 is not less than 10,687,930 barrels, or 29,282 daily. Already in 1870, when the production was considerably less than at present, it was said that the petroleum wells of the United States yielded in a week an amount of oil greater than the entire annual production of the whale-fisheries of New England at the time of their greatest prosperity. American petroleum has now almost entirely replaced the products of these fisheries, and furnished to the whole world a cheap and admirable means of illumination. Petroleum abounds in many parts of the Old World, but attempts to compete with the product of Pennsylvania have not been successful. The same remark will apply to the petroleum found in Santa Barbara County, California, which is refined there to a limited extent for domestic use, and yields, besides a good burning oil, one peculiarly fitted for lubricating purposes.

We now proceed to notice the history of the iron industry of the United States, which is as yet confined to the region east of the Rocky Mountains, and must be considered in connection with the coal upon which it is to a great extent dependent. The great supplies of iron ores to the east of the Appalachian coal-field are, first, from the beds, chiefly of the magnetic species, but occasionally of red hematite, which abound in the Adirondack region of New York, extending northward into Canada (which furnishes a considerable quantity of ore to the American market); while southward, in the mountain belt from the Highlands of the Hudson to South Carolina, are great deposits of similar ores, extensively mined in New York, New Jersey, and Pennsylvania. Within the eastern rim of the basin and parallel with

it is, in the second place, a belt of iron ores, chiefly brown hematite, which is traced from Vermont along the western border of New England, and assumes a great development in parts of Pennsylvania, Virginia, Tennessee, and Alabama. Further westward, within the great basin, are found the red fossiliferous ores, which lie near the summit of the Silurian series, and are traced from Wisconsin eastward through Ontario and Central New York, and thence southward, parallel with the Alleghanies and in proximity to the coal, through Pennsylvania, as far as Alabama. Besides these are to be considered the great deposits of iron ores belonging to the coal measures, including those of the lower carboniferous. These ores, which are carbonates and limonites, occasionally with red hematite, abound in Western Pennsylvania, Ohio, and West Virginia. They are wanting or rare in the middle and western coal-fields of the great basin; but between these, in Missouri and Arkansas, there rise from the thinly spread out paleozoic strata mountains of crystalline rocks, which include immense deposits of red hematite and magnetic ores of great value. Farther northward these crystalline rocks, with their metallic treasures, are concealed beneath newer strata, but they re-appear, charged with great quantities of these same species of iron ore, in the northern peninsula of Michigan, whence, sweeping eastward through Canada, the chain of crystalline rocks bearing these ores is continued to the Adirondack region of New York.

In the colonial period, and even during the first years of the republic, the smelting of iron ores was confined to the eastern rim of the great basin, and indeed the first furnaces erected were for the reduction of the limonite ores which occur in small deposits along the Atlantic border and outside of the limits above defined. We find an attempt to make iron at Jamestown, in Virginia, as early as 1619, and a little later a furnace was erected at Lynn, Massachusetts. As early as 1717 pig-iron was exported from the colonies to England, and the increase of the iron industry excited the jealousy of the British iron manufacturers, so that in 1750 an act of Parliament forbade the erection of rolling or slitting mills in the colonies. Before the time of the Revolution we find numerous blast-furnaces from Virginia as far as Western Massachusetts smelting the limonites, and in New Jersey and Pennsylvania the magnetic ores of these regions.

A considerable portion of the iron of this early time was, however, made in bloomary furnaces, by means of which malleable iron is obtained directly from the ore, a method of no little interest in the history of our manufacture. A similar process belongs to the infancy of the metallurgic art, and is still practiced among barbarous nations, where the mode of making pig-iron in the blast-furnace is unknown. A modification of this direct method survives in the Catalan forge of Western Europe, and in the last century another form was known in Germany, where it is now forgotten. The German bloomary furnace found its way to America, and was employed in New Jersey and Pennsylvania at least as early as 1725. This furnace had the great advantage that its construction required but little skill and little outlay. A small water-fall for the blast and the hammer, a rude hearth with a chimney, and a supply of charcoal and ore, enabled the iron-worker to obtain, as occasion required, a few hundred pounds of iron in a day's time in a condition fitted for the use of the blacksmith, after which his primitive forge remained idle until there was a farther demand. To this day such furnaces are found in the mountains of North Carolina, and furnish the bar-iron required for the wants of the rural population.

An interesting episode in the history of the American iron manufacture is afforded by the attempts of the early explorers to utilize the black iron sand which is found at many points along our sea-board, from the Gulf of St. Lawrence to the Capes of the Chesapeake, and early in the last century, under the name of the Virginia sand iron, was the subject of unsuccessful attempts to treat it for the extraction of iron. At length the Rev. Jared Elliot, of Killingworth, Connecticut, grandson of John Elliot, the apostle of the Indians, after many experiments on the iron sand, which is found in considerable quantities on the south coast of that State, succeeded by the aid of the German bloomary in resolving the problem, and made blooms of malleable iron of fifty pounds weight, for which discovery he was in 1761 awarded a medal by the Society of Arts, of London. He informs us that his son had, moreover, been able to convert this iron into steel of superior quality, and would have established a manufactory of it but for the act of Parliament passed at that time prohibiting the production of steel in the colonies. It is curious to see this forgotten discovery brought up again in our day, and applied to these sands on the southern shore of Long Island, and more successfully at Moisie, in the Lower St. Lawrence. Still more worthy of note is it that this primitive bloomary furnace, discarded in Europe, has been improved by American ingenuity, enlarged, fitted with a hot blast, water *tuyères*, and other modern appliances, so that in the hands of skilled workmen in Northern New York it affords for certain ores an economical mode of making a superior malleable iron, of which about 50,000 tons are thus produced yearly. A large part

of this product is consumed at Pittsburg for the manufacture of cutlery steel of excellent quality.

The first half century of the republic saw but little progress in the manufacture of iron, and the total amount produced in 1810 is estimated at only 54,000 tons, which is not equal to the present annual yield of four or five of our modern blast-furnaces. During this period charcoal was the only fuel employed, and the first great step in our iron manufacture was the use of anthracite. Attempts were made to employ a mixture of this fuel with charcoal at Mauch Chunk, Pennsylvania, in 1820, and at Kingston, Massachusetts, with the anthracite of Rhode Island, in 1827, but the way to the solution of the problem was finally prepared by the introduction of the hot blast in 1831, and in 1833 a patent was granted in the United States for the smelting of iron with anthracite by the aid of a blast of heated air. The first successful attempt to use anthracite alone in this country seems to have been in 1838, near Mauch Chunk, with a furnace twenty-one and a half feet high, producing two tons of iron daily. From this the industry spread, and in 1840 there were six furnaces employing this fuel, and making each from thirty to fifty tons weekly of pig-iron. To-day our anthracite furnaces are many of them sixty and even eighty feet in height, producing from 250 to 300 tons of iron in a week. Of 680 furnaces in the United States in 1873, 226 consumed anthracite, and produced nearly one-half of all the pig-iron made.

From its purity, hardness, and power of resisting the weight of the charge, this fuel is unrivaled for the purpose of iron smelting. This coal supplies the furnaces of Eastern Pennsylvania and New Jersey, and to a great extent those of Eastern New York and of Maryland; but as we approach the central region of Pennsylvania its use is gradually replaced by that of charcoal and of coke from the semi-bituminous coals, while further westward the coke of the true bituminous coals, of which that of Connelsville is the type, is the principal fuel, until we reach the western border of the great Appalachian field, where, in Ohio, are found the free-burning splint or block coals, which can be used in the smelting furnace in the raw state either alone or with an admixture of coke. The ores of the coal measures of Southern Ohio, known as the Hanging Rock district, have hitherto been smelted with charcoal, which is now being replaced by the block coal of the region. Similar coals on the eastern and western borders of the Illinois coal-field are also used for iron smelting.

The relations of the ore to the fuel are of great importance to the development of the iron industry. Thus of the ores of Lake Superior a small portion only is smelted with charcoal in the region, and by far the greater part is brought southward by the lakes—some to Chicago to be smelted with the coal of Indiana, and much more to Cleveland, where it is met by the block coal of Ohio, and in still larger quantities is carried southward to the mines of this coal, chiefly in the Chenango and Mahoning valleys, or as far as Pittsburg, to be smelted with the coke of that region. In like manner the rich ores of Missouri find their way to the block coals of Indiana, to Southeastern Ohio, and even to Pittsburg, filling the returning vessels which have gone down the Ohio River laden with coal. In the East the iron furnaces consuming anthracite are not directly in the coal region, but scattered through the eastern part of Pennsylvania, and the adjacent portions of Maryland, New Jersey, and New York, sometimes, moreover, at points more or less remote from the ore beds which supply them. In the valley of the Hudson the anthracite comes half-way to meet the rich ores of Lake Champlain, and even on the shores of this lake may be seen large blast-furnaces smelting the ores of the vicinity with the help of the anthracite brought as back freight by the vessels carrying the supplies of ore southward. The ores from the crystalline rocks, on account of their greater richness, can support the cost of a longer freight than the poorer ores found within the paleozoic basin, and they have, moreover, the advantage in many cases of yielding a purer iron. The early manufacturers of Bessemer steel in this country were under the necessity of bringing their supplies of pig-iron from Cumberland, in England, and ores have even been brought from Spain and Algeria to be smelted with anthracite for the manufacture of Bessemer pig metal. Recently, however, it has been found that by careful selection the crystalline ores from our Eastern regions may be made to yield a pig-iron suitable for this purpose, while the region beyond the Alleghanies gets its supply of Bessemer metal from the ores of Lake Superior or of Missouri.

The history of the growth of the iron manufacture in the United States within the last fifty years exhibits a remarkable progress. From a production of 54,000 tons in 1810, it had become 165,000 tons in 1830, 347,000 tons in 1840, and 600,000 tons in 1850, as near as can be estimated. In 1860, it had reached 919,870; in 1870, 1,865,000; and in 1872, 2,880,070 tons; while the diminished production of 1873, 2,695,434 tons, shows already the effect of the depression under which the iron interest of the country still suffers. Of the production of 1873, very nearly one-half was made in Pennsylvania, and not less than 1,249,673 tons with anthracite, while the total amount of charcoal-

made pig-iron was only 524,127 tons, to which is to be added 50,000 tons of malleable iron made by the direct process in bloomaries. The importation of foreign iron and steel for 1872 was 795,655 tons; for 1873, 371,164 tons; and for 1874, less than 200,000 tons. From the figures for 1872 and 1873 we may conclude that the consumption in the United States was then equal to about 3,500,000 tons of iron yearly.

The great demand for iron in this country for the purposes of railway construction, together with the high prices in Great Britain in 1872 and 1873, led to a large increase in the number of blast-furnaces. In the two years just named eighty-three furnaces, some of them among the largest in the country, were finished and put into blast, and the whole number in operation in the autumn of 1873 was estimated at 636, having a capacity of producing not less than 4,371,277 tons of pig-iron, while a later estimate from the same source, the American Iron and Steel Association, gives in July, 1874, a capacity of 4,500,000 tons, or about 1,000,000 more than the greatest consumption yet reached. Even at the previous rate of increase, many years must elapse before the country can consume such an amount of iron, and with the general prostration of business, and especially of the iron trade, in 1874, we are not surprised to find that a very large proportion of these furnaces is now out of blast, and that the selling price of pig-iron at the beginning of 1875 is below that at which it can be made at some of the furnaces. For the future the iron manufacturers of our country must strive for progress not only in the selection of ores and fuels, but in improvements in the construction and the management of furnaces, in all of which directions great economies remain to be effected, as the results obtained in late years by the skill and high science of British iron-masters abundantly show. In this way we may hope before long to rival not only in quality but in cheapness the iron products of other countries. With the boundless resources of coal and iron which our country affords, it is only a question of how soon we can successfully contend with Great Britain in foreign markets. The entire iron production of the world was in 1856 about 7,000,000 tons, and in 1874 it was estimated at 15,000,000 tons, of which, at both of these periods, about one-half was furnished by Great Britain. It is supposed by Mr. A. S. Hewitt that at the end of the century the demand will amount to not less than 25,000,000 tons. The present immense production is already taxing heavily the resources of England, which obtains a large proportion of its purer ores from foreign countries, and a period will soon be reached when she can no longer meet the world's increasing demand, for the supply of which no other country offers advantages comparable with the United States. The day is therefore not far distant when, in the words of Mr. Hewitt, all rivalry between the two nations in iron production must pass away.

So long as the business of iron smelting was prosperous, and the profits were, as has been the case for the past few years in most parts of the country, very large, considerations of economy in the production of iron were too much neglected, but for the future all this must be changed. It is probable that before long we shall see some of the old furnaces and furnace sites abandoned, and a transfer of capital and skilled labor from many of the present centres of production to points where iron can be made at lower rates. Questions of freight of the raw materials will be closely considered, and new fields will be sought where the associations of ores of iron with coal suitable for smelting them will enable pig-iron to be produced more cheaply than where both the ore and the fuel are brought from afar. In districts like Fayette County and the Johnstown and Broad Top coal-fields in Pennsylvania, and along the western outcrop of the great Appalachian coal-field in Eastern Ohio, where the characteristic iron ores of the coal measures are more abundant than farther eastward, and are accompanied with coals suitable for their reduction, these conditions for the cheap production of iron exist. While the ores thus found in proximity to the coal are adapted for the production of all the ordinary qualities of iron, the increasing export of coal from this western border to the regions northward and westward permits the bringing back at low rates of freight of the rich ores of Missouri and Michigan, which are adapted to the making of Bessemer steel. The southward extension of this great coal-field into West Virginia, Eastern Kentucky and Tennessee, and Northern Alabama also offers great facilities for the cheap manufacture of iron from native ores, which will at no distant day be utilized.

The copper mines of the United States next claim our attention. Throughout the crystalline rocks which form the eastern border of the paleozoic basin ores of this metal are pretty abundantly distributed, and are now mined and treated for the extraction of the copper in Vermont, Pennsylvania, North Carolina, and Eastern Tennessee, besides which ores from other localities along this belt, and from various regions to the westward of the great basin, are brought to Baltimore and to the vicinity of Boston for reduction. The total production from all these sources, which has never been greater than at present, is, however, estimated at less than 2500 tons—an amount inconsiderable when compared with the production of the mines of Lake Superior. In these, unlike the mines just mentioned, and, in-

deed, unlike most others in the world, the copper, instead of being in the condition of an ore—that is to say, mineralized and disguised by combination with sulphur or with oxygen and other bodies, from which it must be separated by long and costly chemical processes—is found in the state of pure metal, and needs only to be mechanically separated from the accompanying rocky matters previous to melting into ingot copper. The history of the copper region on the south shore of Lake Superior is famous in the annals of American mining. The metal, which in many cases is found in masses of all sizes up to many tons in weight, was known and used by the aboriginal races, and the traces of their rude mining operations are still met with. The first modern attempts at extracting this native copper, in 1771, were unsuccessful, and it was not until 1843 that the attention of mining adventurers was again turned toward this region. Numerous mines were opened, and a period of reckless speculation followed, which ended, in 1847, in the failure and abandonment of nearly all the enterprises which had been begun. They were, however, soon resumed under wiser management, and have been followed up with remarkable success. At first the operations were chiefly directed to the extraction of the great masses of native copper which were found distributed in an irregular manner in veins or fissures in the rocks, and yielded in some cases large profits; but with the exhaustion of these a more abundant and regular source of supply has been found in layers of a soft earthy material, known as ash beds, containing metallic copper finely disseminated, or in beds of a conglomerate of which pure copper forms the cementing material. The successful working of these two kinds of deposits has been arrived at only by well-directed skill in management, and by mechanical appliances which diminish the costs of mining, crushing, and washing the rock, and reduce to a minimum the inevitable loss of copper in the waste material. No mining industry illustrates more strikingly than this the importance of such economies. A rock which may be made to yield one part in a hundred of metallic copper can, under favorable conditions, be treated with profit, and the residue in such a case may still contain one-half as much more copper, which is lost. A mine in this region a few years since yielded annually, from the treatment of 1,200,000 tons of rock, 800 tons of metallic copper, being at the rate of two-thirds of one per cent., and this amount, at the price of copper then prevailing, was just sufficient to pay all the costs of extraction. The residues showed by assay the presence, in a finely divided state, of as much more copper, and it is evident that a greater perfection in the process of extraction, by which one-half of the copper thus lost could have been saved, would have yielded 400 tons additional, which, inasmuch as the costs of mining, crushing, and washing were already paid by the first 800 tons, would have been clear profit. One of the best-known mines in the region, which has been worked with continued success since its opening, in 1849, produced, in 1872, 1138 tons of fine copper, to obtain which over 100,000 tons of rock were mined, and over 60,000 tons of this selected for stamping and washing, so that the copper yielded was only 1.12 per cent., yet the profits of the year's working were $200,000. It would be foreign to our plan to describe modes of treatment, but statements of results like this serve to show what may be obtained by the application of skill and science to mining industry. At the Calumet and Hecla mine, the most remarkable one of the Lake Superior region, from 700 to 800 tons of rock are now treated daily, and yield about four per cent. of metallic copper, which, when converted into ingots, costs about thirteen cents the pound —a price far below that at which it can be extracted from the less rich deposits of the region or from the ores of the metal by the ordinary process of smelting. This mine produced of ingot copper, in 1872, 9717 tons, and in 1874, 9918 tons, of 2000 pounds. The crude copper from these mines, as delivered to the refiners, who melt it into ingots, yields on an average about eighty per cent. of metal—a fact to be borne in mind in consulting the statements of production, which are generally given for the unrefined product. The amount of copper yielded by the Lake Superior region from its opening, in 1845, to 1858 is estimated at 18,000 tons. From about 4100 tons in the latter year the production has shown a progressive increase, with some slight fluctuations, to the present time. It equaled, for 1873, 18,514 tons, and for 1874 not less than 22,235 tons, making an aggregate for the past thirty years of 217,134 tons, which at eighty per cent. equals 173,704 tons of ingot copper. The total yield of ingot copper for the lake region in 1874 is estimated by Caswell at 17,327 tons, to which he adds for the production from the ores of the metal 2375 tons, making a total production for the United States of 19,702 tons of copper. This exceeds considerably the domestic consumption, and accordingly we find that there were exported in 1874 not less than 4500 tons of copper. The supply of native copper from the mines of the lake region will probably continue to increase, and in years to come the working of the great deposits of copper ores which abound both in the Eastern and Western portions of our country will add largely to the production, so that henceforth the United States is destined to furnish considerable quantities of copper to foreign markets. The price

of this metal is subject to remarkable fluctuations. Thus from fifty-five cents the pound in 1864 it gradually fell to nineteen in 1870, rising again to forty-five cents in 1872, and, falling once more to nineteen in the summer of 1874, rose to twenty-four cents at the close of the year.

It yet remains to speak of our mines of gold and silver. Although gold is distributed in greater or less quantity throughout the mountain ranges which form the eastern rim of the great basin, its presence was not made known till 1799, when it was discovered in the soil in Cabarrus County, North Carolina. For the next twenty-five years small quantities of gold were gathered by washing from the earth at various points from the Potomac to Alabama; but it was not until 1825 that the precious metal was found in veins of quartz both in North Carolina and Virginia. The whole amount of gold got from this Southern region up to 1827 is estimated at only $110,000; but with the opening of the gold-bearing veins a rapid increase in production took place, and in 1837 branch mints were established by the government in North Carolina and in Georgia, where they existed up to the time of the late civil war; before which, however, the gold production of the region had greatly fallen off, these mines having been deserted for the richer ones of the western coast. The whole amount of gold from this region for three-quarters of a century up to 1873 is estimated at about $20,000,000; but for the last year mentioned it amounted only to $160,000, the chief part of which was from North Carolina.

The great supply of precious metals has come from the western half of our territory. The vast region from the eastern base of the Rocky Mountains to the Pacific presents geographical features very different from those of the great Eastern paleozoic basin. Its numerous nearly parallel mountain ranges, to which the collective name of the Cordilleras has been appropriately applied, are rich in mineral treasures, which, as pointed out by Blake and by King, may be described as arranged in parallel zones, coinciding with the mountain belts. Along the Pacific coast range are deposits of quicksilver, tin, and chrome, while the belt of the Sierra Nevada and the Cascades carries a range of copper mines near its base, and a line of gold-bearing veins and gold alluvions on its western flank. Along the eastern slope of the Sierra lies a zone of silver mines stretching into Mexico, and including the great Comstock lode of Nevada, while silver ores abound in the subordinate ranges between the Sierra and the Wahsatch. The silver-lead ores of New Mexico, Utah, and Western Montana, and the still more eastern gold deposits of New Mexico, Colorado, Wyoming, and Montana, follow the same general law of distribution. We can, within our present limits, do little more than note some of the principal points in the history of the opening of these mining regions, and give some figures which serve to show the vast mineral wealth of the Cordilleras.

The gold of California was noticed by early Spanish explorers, and was again discovered on the Colorado River, just a century since, in 1775, but attracted no attention till its rediscovery early in 1848, when the existence of very rich gold alluvions was made known. A rapid immigration to the region at once followed, and it was reported in August of that year that the daily production of gold was from $30,000 to $50,000. It was not until 1851 that the gold-bearing veins were discovered, and the larger part of the gold of California has been got from the placers, as the alluvions are called. It is from the partial exhaustion of these that the production has of late years considerably diminished. In 1848 it was estimated at $10,000,000, and reached its maximum of $65,000,000 in 1853. In 1870 it had fallen to $25,000,000, and reached $19,000,000 in 1873, but rose again in 1874 to $20,300,000. The total yield, since the opening of the mines in 1848, amounts to more than $1,000,000,000. The working of the gold-bearing veins and of the deeper alluvions or placers has of late been systematized and greatly improved, and from the abundance and richness of these, and the persistence of the veins in depth, this region may be expected to produce great amounts of gold for generations to come.

From California explorations were soon carried both northward and eastward, and in addition to the gold of Oregon, Idaho and Washington Territories, the vast silver deposits of Nevada were made known. It was in 1859 that silver ore was first discovered on what has since been known as the Comstock lode—a vein which, viewed in the light of recent developments, is one of the most remarkable known in the history of mining. This lode, of great breadth, has been traced for a length of over five miles, and worked for more than four miles, in some places to a depth of 1500 feet. The ore has not been rich, seldom yielding over fifty dollars to the ton, and often less than one-half that amount, yet such has been its abundance that the production of the vein from its first working, in 1860, up to 1868 was $81,500,000, and up to the close of 1874 it had yielded a total amount of about $180,000,000, with very large profits to the miners. The bullion extracted from these ores contains an amount of gold equal to about one-third of the entire value. Other silver-producing districts, second only in importance to that of Virginia City, which is the site of the Comstock lode, have since been discovered in Nevada, and the value of the bullion

from the State in 1872 amounted to not less than $25,000,000, of which $13,500,000 were from this lode. For the calendar year 1873 it equaled $31,666,000, of which $21,756,000 were from Virginia City; and the returns for the first half of 1874 show a still increasing production. During the latter months of the year remarkable discoveries have been announced in the Comstock lode, which appear to surpass all previous developments in that region. An enormous mass of ore, in great part below a depth of 1500 feet, has been exposed, far richer than any thing hitherto found in the lode, and said to yield an average of many hundred dollars to the ton. Some of the recently published estimates of the value of this discovery are probably exaggerated, but there seems little doubt that the amount of treasure now revealed will exceed the whole production of the lode up to the present time.

The existence of silver-bearing lead ores in Utah was known as early as 1863, but the first attempt to develop them was made in 1870, when a few thousand tons of ore were shipped from the Emma mine eastward over the Union Pacific Railroad. In 1872, however, the production of this region had reached a value of $3,250,000; in 1873, of $3,750,000; and in 1874, very nearly $6,000,000. The ores are in great abundance, but are often not rich enough to support the cost of transportation, while, on the other hand, the great rarity of fuel renders their treatment on the spot very costly. The average value of the ores exported, chiefly to the eastern and western sea-boards, in 1873 was $115 a ton, besides which a large quantity was reduced in the region, yielding what is called base bullion, that is, lead carrying silver and some gold, and valued at from $200 to $250, the lead being there estimated at about $50 the ton. In some establishments in Utah the precious metals are extracted from the lead before shipment. The fuel is in part charcoal and in part coke sent from Pennsylvania to Utah. The lead furnished to the United States markets from the silver-lead ores of Utah and Nevada in 1874 is estimated at 26,000 tons, while the lead production of Missouri was 15,000, and that of Iowa, Illinois, and Wisconsin only 5500 tons.

The silver production of the United States was altogether insignificant until 1861, when the Comstock lode gave $2,000,000 of silver, since which time there has been a steady increase to $36,500,000 in 1873, giving a total production of $189,000,000. It is probable that for some years to come the supply of silver from the mines of the Cordilleras will be much greater than in the past. Already within the last four years the immense production of silver in this country has considerably reduced its price in the markets of the world, and the effect of recent discoveries can not fail to be a still farther depreciation of its value.

The history of the mining of our gold and silver would be imperfect without a notice of the quicksilver of California, as it is by its aid that nearly the whole of these precious metals, with the exception of the silver of the lead ores, is extracted. Quicksilver ore was discovered in California as early as 1849, and the mines opened soon after have not only continued to supply the wants of the immense gold and silver industry of the West, but since 1852 have furnished large quantities for exportation to Mexico, South America, China, and Australia. This amounted in 1865 to 44,000 flasks of seventy-six and a half pounds each, or 3,366,000 pounds of quicksilver. The increased demand for this metal for the treatment of our silver ores, and the diminished production of the mines, have since reduced considerably the exportation. In no other region of the globe, however, is the ore of quicksilver so widely distributed as in California, and there is reason to believe that from the opening and working of new deposits the production will soon be much increased—a result which will be stimulated by the present high price of quicksilver and its scarcity in foreign markets.

We have noticed the falling off in the yield of gold from California which began in 1853. It was not until 1860 that supplies of this metal from other districts appeared, rising from $1,000,000 in that year to $28,000,000 in 1866, since which time there has been a gradual falling off from these also, so that while for 1873 the gold of California equaled $19,000,000, that from other sources in the Western United States was $17,000,000, making a production of $36,000,000, that of the entire world being estimated at $100,000,000. Dr. R. W. Raymond, to whom we are indebted for these figures, gives the entire gold product of the country from 1847 to 1873 inclusive at $1,240,750,000; and if to that we add his calculation of the silver produced up to that date, equal to $189,000,000, we shall have $1,429,750,000. Adding to this the figures for 1874, which exceed a little those of 1873, we have a grand total of over $1,500,000,000 of gold and silver as the production of the territory between the eastern base of the Rocky Mountains and the Pacific since the opening of the mines of California in 1847.

There are many mineral resources in the United States besides those already mentioned which might justly claim a place in a sketch like the present. Among them are the ores of chrome, zinc, lead, and nickel, now extensively mined; the extensive salt deposits in New York, Michigan, Pennsylvania, Ohio, Virginia, and West Virginia, which now supply to a great extent the markets of the country; the mineral phosphates of

the vicinity of Charleston, South Carolina, which are not only manufactured into fertilizers for domestic consumption, but largely exported to Great Britain; and the granites, marbles, sandstones, roofing slates, and other materials of construction, which are now the objects of large and profitable industries. We have, however, selected, in preference to any of these, coal, petroleum, iron, copper, silver, and gold, which, from their great pecuniary value and their direct connection with material progress, have been among the most important elements in our national growth and prosperity.

T. STERRY HUNT.

BOSTON, MASSACHUSETTS.

PAUL EVELETH'S PORTRAIT.

THE crowd in the Piazza del Popolo waited in breathless expectation. Opposite, in the light of the clear April evening, the Pincian Hill rose greenly, with its palm-trees plainly defined. But there was something more: an odd structure, a skeleton—the ghost, we might say, of many architectural fancies—rose up weird and white, with the background of green gloom. The Italian soldiers were walking about with apparent nonchalance but real vigilance, for there was always danger of a republican outbreak when the people were assembled *en masse;* and what more fitting time than the birthday of Rome for a grand *émeute?*

Yes, that was the cause of the gathering; a very problematic event—at least the share which the twins had in it, and the date more problematic still—but it was enough to bring the fête-loving people together, and better than the old days, when the captives were butchered to make a Roman holiday. Seats had been arranged and hired out, and those who were comfortably settled in them looked out complacently on their poorer neighbors in the piazza, who were jostled about by the crowd and military.

Whenever there was an unusual commotion a portly lady in one of the seats would cry out: "There's a scrimmage. Wotever are they hup to now? I'm sure I 'eard a shot. Oh, Cathie, just fancy a revolution!"

Then a very gentle voice would answer: "Oh no, mamma; there's not a bit of danger. Paul is certain of that."

And then a manly growl succeeded, with something re-assuring and a little impatient.

Niel Stanley, an American artist, who had come to Rome to try and discover the art of selling pictures, began to grow curious about his neighbors after a while, and cast a backward glance in search of the voice. He had lived among Italians for years, and associated largely with long-haired, spectacled German artists, so that the sound of pure refined English was a treat to him.

All the party were staring at the architectural skeletons on the Pincian Hill, and he had a chance to examine them. The young girl had one of those pure English faces of bloom and child-like freshness, and sunny golden hair, which one notices especially in Rome, among the dark-eyed beauties of that country. She was very young, but there was more firmness and decision in her face than in that of her portly mother, and her eyes, clear, limpid, and blue, were full of eloquent feeling. The face suited the voice, Niel decided, as he viewed with the eye of an artist this fresh face, like an English violet, and noted the long half-uncurled locks of sunshiny hair which lay in such beautiful contrast over her black velvet dress. Her hat was of black velvet also. A long black ostrich plume floated back among the golden curls. The lady mamma, a comfortable-looking woman of forty-five, the lines of her face lost somewhat indefinitely in folds of fat, had been handsome too in her way, and was stylishly dressed, but something about her seemed to indicate a lack of refinement. Perhaps Niel decided this because he had heard her voice and language, perhaps because she had an overblown and flushed appearance, or because she was such a contrast to the young girl at her side. But these contrasts are constantly met in life, so that one wonders how this mother can have such a daughter, or how this daughter can have such a mother, continually.

Niel found himself wondering. And then he remembered Paul. What was Paul like?

Paul was like a hundred other Englishmen, only somewhat dark, and not so well-fed-looking. He had an absent expression, as if he hardly saw the arrangements for the fire-works or the beautiful girl at his side. Then Niel noticed that his coat had a very clerical cut, that his tie was white, and that he must be either a theological student or a clergyman. "And very High-Church at that," decided Niel, as a blaze of light called his wandering eyes off to the display on the hill. Suddenly, as if touched by an enchanter's wand, the buildings whose skeletons had stood out in such bold relief blazed into colored light. Wonderful, mysterious, beautiful, all the pride of Italy was there arrayed. The Campidoglio in white light, the Cathedral of Milan with starry pinnacles all aflame with crimson and emerald gems, the grand St. Peter's in living characters of flame, Pisa's tower, and many other structures, shone resplendent against the dark green background of the Pincian Hill, while across the whole, and seeming to fence off the whole from the surging mass of people, was a heavy festooned garland of green leaves and immense roses in burning light. Then the fountains themselves in the Piazza del Popolo sent up torrents of fire instead of water. Wonderful indeed were