The Great Western Ironworks at Brady's Bend, Armstrong County, Erected about 1840
[From a lithograph in the possession of the Carnegie Library of Pittsburgh]
THE RISE OF IRON MANUFACTURE IN WESTERN PENNSYLVANIA

ARTHUR CECIL BINING

The origin of the great iron and steel industry that now centers in western Pennsylvania can be traced to the period when the Monongahela country was a part of the frontier; for it was not long after the vanguard of pioneers had pushed into this region that iron manufacture began. Before the outbreak of the American Revolution relatively few settlers ventured west of the mountains. This was partly due to Great Britain’s policy of attempting to restrict settlement to the fringe of territory along the Atlantic coast. Migration was also retarded because of the large tracts of unoccupied lands that still remained just east of the mountains. During the struggle with England and even earlier, stories of green valleys, clear streams, and abundant game, told by explorers and traders, lured a few of the sturdy sons of Pennsylvania and Virginia to the Alleghenies, even as far as the beautiful Ohio River. Here some of them settled, building stockades as a means of protection against the untamed Indian and clearing green woodlands in order to plant fields of golden grain. After independence had been wrested from

1 Copyright, 1933, by Arthur Cecil Bining. Dr. Bining is an instructor in history in the University of Pennsylvania. His monograph on British Regulation of the Colonial Iron Industry has recently been published by the University of Pennsylvania Press and he has in preparation a work on “Pennsylvania Iron Manufacture in the Eighteenth Century.” Ed.
the mother country, emigrants in increasing numbers sought the newly-opened West, and the Monongahela region became one of the great highways over which thousands and thousands of stalwart pioneers passed on their arduous and difficult trek westward—pioneers who looked forward to making homes for themselves in the fertile wilderness, staking their strength, courage, and ambitions against isolation, privation, and hardship.

Many factors played a part in bringing settlers to the western country after 1783. The removal of British restrictions, the five years of dismal business depression following the treaty of peace, the failure of crops in Virginia, the encouragement given by crafty land speculators, the land hunger of veterans of Washington's armies, the passage of the Northwest Ordinance, Anthony Wayne's brilliant victory over the Indians at Fallen Timbers, and important changes in the land laws, all encouraged eager home-seekers and discontented citizens from the East to migrate westward. Before the close of the eighteenth century thousands had traveled over the mountains to the Monongahela River and from there on boat and raft to the Ohio River. Many, on reaching western Pennsylvania, went no farther but took up land adjacent to the waterways of the region, while others traveled on in their search for economic security.

Even on the quiet frontier, far away from the rankling cries of civilization, iron was required for many uses. Horses had to be shod and wagon tires often needed repairs; nails, hinges, and bolts were essential for buildings; and strong axes were necessary for clearing the dense forests. Among the earliest pioneers were a few blacksmiths, who took with them on their journey westward small quantities of hammered bar iron from eastern forges, which they shaped to meet frontier needs. From the earliest days of settlement bar iron was sent to the frontier. As might be expected, however, there was always a scarcity of iron in all forms, and hastily built cabins and houses were often put together with wooden pins and pegs. Many stories have been told of the burning of deserted structures for the purpose of procuring the iron nails they contained. Even the temporarily abandoned Fort McIntosh was almost entirely destroyed by westward migrators, who drew its nails and secured from it other material to aid them in building homes.*

Because of the great need for iron in the new country, it was not long before enterprising men seized the opportunity to engage in iron manufacture, and ironworks of different kinds arose amidst the shadows of deep green forest glades, where Indians still lingered. The flames from the stacks of blast furnaces, forced upward by the rhythmic blast, which at night cast a glare on the sky like a brilliant display of northern lights, the scintillating sparks scattered in the forges by giant hammers striking the red-hot iron bars, the ringing sound of the anvils of many blacksmith shops where iron was shaped into needed articles, and the splashing of water over large water wheels, which furnished the only power for these early manufacturing plants, soon gave many parts of the agricultural frontier a glowing tinge of industrial activity.

It was natural that the Fayette County region should take the lead in establishing iron manufacture in western Pennsylvania because it was along the populous line of travel westward and possessed all the natural advantages necessary for the production and manufacture of iron. Rich ores were found outcropping on the surface of the earth in many places, vast primeval forests furnished the material for the charcoal fuel needed in furnace and forge, beds of limestone laid down in past ages were available for fluxing the ores, and water power was abundant. A list of the first works built in this section of the frontier clearly illustrates the rapidity with which iron manufacture took hold. Among the pioneer ironworks established during the last decade of the eighteenth century in this region were the Alliance (Jacob’s Creek) Iron Works, Fairfield Furnace and Forge, Hayden’s Bloomery, Laurel Furnace, Little Falls Bloomery, Mary Ann (later Fairview) Furnace, Mount Vernon Furnace and Forge, Pears’ Bloomery and Slitting Mill, Pine Grove Forge, Redstone Furnace, Springhill Furnace and Sylvan (Oliphant’s) Forge, Union Furnace and Forge, and Youghiogheny (Lamb’s) Forge. In three other sections of western Pennsylvania ironworks were built before 1800: the ill-fated Greene Furnace in Greene County, Westmoreland Furnace

1 Fayette County Archives, Road Docket 1, p. 51, 67, 68, 72, 89, 93, 98, 99, 101, 103, 120, 121, 143, 145, 158, 170, 174, 182, 201; Deed Book A, p. 392; Deed Book B, p. 39, 319; Deed Book C 2, p. 758-760, 896-898; Deed Book C 3, p. 1076-1079, 1202; Township Property Rolls, 1796-1800.
and Forge in the thickly wooded Ligonier Valley, and the short-lived furnace of George Anshutz at Shadyside, Pittsburgh. Thus before the dawn of the nineteenth century—a century that was to bring so many industrial changes—iron manufacture had been well planted and had taken root in western Pennsylvania.

Most of the ironworks of this early period were organized on plantations, as were those in the Juniata Valley, in southeastern Pennsylvania, and in other parts of the United States. The home of the ironmaster, the chinked, daubed, and whitewashed cabins of the workers, the store where all the necessities and the few luxuries of the period could be obtained, the woodlands, the farmlands, the ironworks, the gristmill, the sawmill, and the blacksmith shop made up an almost self-sufficing community. This form of industrial organization—a combination of agriculture and industry—continued in many places throughout the period, especially in the production of pig iron, castings, and bar iron. A few such communities could be found at the close of the nineteenth century but, as a result of the vicissitudes of iron production, the many changes in technological processes, and the development of large-scale production and consolidation after the Civil War, most of them had disappeared, and today all are merely memories of an almost forgotten age.

The opening years of the nineteenth century were fraught with dangers, perplexities, and difficulties for the industrial pioneers of western Pennsylvania. It was difficult to entice skilled workers from the more settled East, and therefore there was a continual shortage of skilled labor. Capital was always scarce and adequate banking facilities did not exist. The ironmasters, many of whom lacked experience, were beset with metallurgical problems in an age of experimentation, when chemical analyses of iron were unknown in this country and metallography was undreamed of. Many problems connected with transportation arose, which required complete solving if profits were to be made. Although a few tragic financial failures occurred, the industry as a whole expanded, and

4 Greene County Archives, Deed Book 1, p. 748-750; Deed Book 2, p. 70; Westmoreland County Archives, Deed Book 2, p. 55; Deed Book 3, p. 54, 170; Deed Book 4, p. 175; Deed Book 5, p. 53.

by 1810 there were eighteen blast furnaces in western Pennsylvania, eleven of which were in Fayette County. In the section of the state west of the mountains there were also eleven refinery forges, five plating forges or tilt hammers, four foundries, three slitting mills, one steel furnace, one bloomery, thirty-two naileries and five hundred and thirty-five blacksmith shops.\(^6\)

While the production of pig iron and bar iron made great headway in western Pennsylvania during the first generation of settlement, Pittsburgh, the key to the West, produced none, chiefly because the carbonate ores of the vicinity were embedded too deeply in the earth to be available. But Pittsburgh, because of her favored position at the junction of the three rivers, the Monongahela, the Allegheny, and the Ohio, became the shipping point, not only for merchandise and produce, but also for some of the iron and iron manufactures of this part of the country, which, from the earliest days of production, found a market down the Ohio and the Mississippi even as far as New Orleans.\(^7\) The "commercial emporium," as many travelers and visitors called Pittsburgh, was also slowly becoming a manufacturing center, not only on account of its geographical position, but also because of easily accessible quantities of coal secured from many mines in the immediate vicinity.\(^8\)

Pittsburgh passed her first milestone along the highway of manufactures when Joseph McClurg in 1805 established the first air furnace or foundry, the forerunner of the modern cupola.\(^9\) Others followed. The importance of such foundries where castings of all kinds were made from pig iron should not be minimized. Although at first only hollow wares such as pots, pans, kettles, stoves, grates, andirons, plow iron, and mill iron were cast, with the advent of the machine age, such works soon became important in casting the various parts of machinery. A second milestone was passed when Mahlon Rogers established a factory for the manufacture of steam engines in 1808; for in the years that followed steam was substituted for water power in the developing factories and even in grist


\(^7\) François A. Michaux, *Travels to the West of the Allegheny Mountains*, 158 (Reuben G. Thwaites, ed., *Early Western Travels*, vol. 3—Cleveland, 1904).

\(^8\) David Thomas, *Travels through the Western Country in the Summer of 1816*, 53 (Auburn, N. Y., 1819).

\(^9\) *Commonwealth* (Pittsburgh), February 12, June 11, 1806.
mills. With the increasing use of steam power this branch of iron manufacture expanded rapidly and became exceedingly important. Within a few years plants were built that furnished steam engines designed on the plans of Oliver Evans and Robert Fulton, as well as those of the English company of Boulton and Watt. The manufacture of nails also goes back to the early days of Pittsburgh's history. Before the end of the eighteenth century cut and forged nails were made. The opening of Christopher Cowan's slitting mill in 1812, where slit iron for making nails was produced in large quantities, gave an impetus to the manufacture of those much-needed articles. Under the same roof and operated by the much-admired seventy-horse-power steam engine was a tilt hammer or plating mill where sheet iron was hammered out into many different sizes and gauges. Within the limits of the borough at the same time were many smitheries where bar iron was fashioned into articles of various kinds by artisans who took great pride in their workmanship. Out of these humble beginnings the future "Steel City" arose.

During the years when the foundations of industry were being firmly laid in western Pennsylvania there was little competition from the East or from foreign countries. The mountain barrier and the high cost of transportation prevented much rivalry in this respect, although foreign manufactures could be obtained west of the mountains from the earliest days of settlement. The foreign articles available were needed during this early period and competition was not felt. The Napoleonic wars temporarily eliminated much English competition in the American market, although iron wares, sheet iron, and especially nails were exported from England to the United States until the period of the embargo, and even

11 Cramer, Navigator, 60 (eighth edition, Pittsburgh, 1814).
12 Pittsburgh Gazette, February 2, May 11, 1799; Cramer, Navigator, 58 (eighth edition).
14 Michaux, Travels, 203; Fortescue Cuming, Sketches of a Tour to the Western Country, 229 (Reuben G. Thwaites, ed., Early Western Travels, vol. 4—Cleveland, 1904); Cramer, Navigator, 72 (seventh edition).
during the embargo such materials were smuggled in by way of Canada. The War of 1812 had the effect of excluding British goods, and during the period of the war much capital that had been obtained in commercial pursuits was invested in American manufactures of many kinds, and iron manufacture in western Pennsylvania and in other parts of the country flourished.

The Treaty of Ghent brought the War of 1812 to a close, but peace ushered in a crisis; for it left Great Britain free to reconquer her former markets and to stifle the industries that had made great progress from the beginning of the century. The only salvation to most industrialists was a continuance of the double duties imposed during the emergency of war on imported articles. For the first time the ironmasters and manufacturers of western Pennsylvania displayed a vital interest in questions relating to the tariff. All sections of the country united in supporting the tariff measure of 1816, which was intended to protect industry. The law, however, proved to be a disappointment to the ironmasters as well as to many other interests. The new tariff imposed a duty of one dollar and fifty cents a hundredweight on rolled bar iron, which was not yet produced in this country. This section of the law had the two-fold purpose of protecting American hammered bar iron against English rolled bar iron and of encouraging a native rolling-mill industry. The duty imposed on hammered bar iron was only forty-five cents a hundredweight despite strong protests from forgemasters who desired greater protection against Russian and Swedish hammered bars. Although at this time there was little competition between American and foreign pig iron, relatively high duties were placed on foreign importations of that commodity.

Ironmasters and iron manufacturers all over Pennsylvania, especially in Pittsburgh, were dissatisfied with the tariff of 1816 and petitioned Congress for additional protection, while a committee of the state Senate reported that “in all parts of the country our manufactures are rapidly declining and sinking under a foreign combination and forced importation, and the unwillingness of the government to protect and uphold

15 Pittsburgh Mercury, October 21, 1815; Niles' Weekly Register, 12:130 (April 26, 1817).
16 United States, Statutes at Large, 3:310–314.
Through the efforts of the Pennsylvania delegation under the leadership of John Sergeant of Philadelphia an act was passed that increased the duties on hammered bar iron, pig iron, castings, and iron manufactures of various kinds. The western section was little affected by foreign competition in regard to pig iron and bar iron, but foreign iron wares and manufactured articles now flooded all parts of the country.

While the nation was struggling with the problem of the influx of foreign manufactures the financial crisis of 1818–21 descended like an unrestrained flood, the direct result of a faulty banking structure and an inflated currency. Western Pennsylvania suffered greatly. Mills and factories were closed or worked on a part-time basis only. Manufactures in Pittsburgh fell off from a total of $2,617,833 in 1815 to about $832,000 in 1819. Since large quantities of foreign merchandise and manufactures continued to reach the West over the mountains from the Atlantic seaports and by way of the rivers from New Orleans, many believed that their troubles were caused, not by the difficulties attending the depression, but by the inadequacy of the tariff.

The financial crisis greatly aided the protectionist movement in western Pennsylvania. It even brought into line the apathetic farmers, for they had come to realize that their interests were bound up with the prosperity of industry, and they went so far as to petition Congress for more adequate protection to domestic industry. From this time on many protectionists from western Pennsylvania were sent to Congress. During the height of the panic Henry Baldwin of Pittsburgh led the Pennsylvania delegation in the fight for higher duties. He insisted on further protection on the “national principle, that we ought to feed, clothe, and be able to defend ourselves.” All maneuvers for an increase in tariff duties at this time failed, and the eternal question was shelved for the time being.


19 *Pittsburgh Gazette*, February 8, 15, 1820.

The tariff act of 1824 made a few changes in the iron schedule in the direction of increases, and by the time it went into effect the long-awaited prosperity began to return, especially in the vicinity of Pittsburgh. The old mills and factories were busy again and many new ones were being built throughout the country. An era of prosperity and plenty was gathering momentum, which was to end once again in stark disaster after a long period of speculation and inflation had run its course. Meanwhile industry flourished. The tariff act of 1828 was the result of the agitation of the woolen interests for additional protection and the efforts of Jacksonian politicians to further the interest of their candidate. Jackson’s men had not intended the obnoxious tariff to pass but had expected to use its defeat to great advantage in the coming election in scoring their enemies for the loss of a protective measure and thus to insure the aid of industrialists in carrying the Indian fighter and hero of the belated battle of New Orleans to victory. To the surprise of all, the bill that the erratic Virginian, John Randolph, stated “referred to manufactures of no sort or kind, except to the manufacture of a President of the United States,” obtained a sufficient number of votes and was spread on the statute books amid a storm of opposition, especially in the South. Under this “Tariff of Abominations” the duties on many types of iron and iron manufactures were increased, and the protectionists celebrated an outstanding victory.

During the period of prosperity that followed recovery after the dark days of the panic of 1819 many new ironworks were built. By 1830 as many as thirty-four new furnaces were constructed in western Pennsylvania, and the amount of iron rolled in Pittsburgh increased greatly. This period marked the beginning of the iron industry in the Allegheny and Shenango valleys, where furnaces were established to compete with the works of the Juniata Valley in furnishing Pittsburgh with iron. With the development of steamboat transportation and the demand for steam engines and machinery of all kinds the western metropolis, which by this time had earned its title of the “Birmingham of America,” required increasing quantities of iron for its manufactures, and works from several

---

22 Statutes at Large, 4: 270–275.
23 Congressional Debates, 22 Congress, 1 session, 473.
regions, even the new works of Tennessee, now filled that demand. Expansion was so rapid during these years in all parts of the country, especially in the pig iron and bar iron trade, that it brought about domestic competition and much lower prices, although prosperity continued.

The dark clouds of South Carolina's threat to nullify the tariff of 1828 because the law was hostile to the interests of that state and other southern states broke in full fury in 1832. The dropping of the "abominations" and the slight reductions in the tariff law passed in this year did not satisfy the southerners. The tariff issue, which was fraught with peril for the Union, was clearly drawn and was of supreme importance to the iron interests at a time when the prices of iron were declining and importations of foreign iron were increasing. Such imports, however, did not hurt the iron manufacturers of western Pennsylvania except in small manufactures such as hinges, locks, and nails. While the warfare was at its height in 1833, Henry Clay, master of the art of compromise, laid before the struggling groups a bill to reduce the tariff to the level fixed in 1816, the proposed reduction to be made in easy stages over a period of ten years. The staunch southerner, Calhoun, had helped to work out the bill. Congress at the same time passed the force act giving the president powers that might be needed in enforcing the tariff laws in South Carolina. But the planters of that state accepted Clay's compromise tariff, satisfied their honor by nullifying Jackson's force bill, and claimed complete victory. On the other hand, Jackson boasted that the victory was his and pointed with pride to his achievement in keeping South Carolina within the Union and in having that state accept the new tariff law. Protected industries, he stated, would have plenty of time to adjust themselves to changed conditions. The protectionists believed that too high a price had been paid for domestic peace; one editor declared that the American system had been abandoned and that the country was on the verge of ruin. Other protectionists believed that new laws granting protection to industry would be adopted before 1842, when, under the act of 1833, no rates could be above twenty per cent ad valorem.
The iron industry did readjust itself to the changed conditions brought about by the new tariff, and agitation was stilled in Pennsylvania until the midst of the financial crisis of 1837-42. During the period of great activity, economic development, and increasing inflation preceding the economic catastrophe, there was general prosperity, and fair prices prevailed. The increasing importations of foreign iron, especially for the railroads, were to a great extent overlooked in the expanding market for iron. The tariff issue for the time being passed out of national politics, and President Jackson and the bank issue took the center of the stage.

Few new processes had been introduced into American iron manufacture down to this time. Cold-blast charcoal iron similar to that made by the early Puritans in Massachusetts was the only kind of pig iron produced, and the only improvement made at the blast furnaces was the introduction of blowing cylinders or "tubs," an English invention, which from the latter part of the eighteenth century gradually displaced the old bellows in providing the blast. Bloomeries, little improved from their medieval European models, where iron was made directly from the ores, still flourished. Refinery forges, where pig iron was heated to a semi-molten mass and beaten under ponderous hammers, produced bar iron needed for innumerable purposes. Slitting mills, which produced slit iron needed for making nails; plating mills, where sheet iron was hammered out under tilt hammers; and small steel furnaces for making blister steel were still the ironworks of the period.

The first revolutionary change in iron manufacture in the United States was the adoption of the English invention of Henry Cort of puddling furnace and rolling mill. The process, which had been rapidly adopted by English ironmasters following its invention in 1784, substituted the reverberatory puddling furnace for the hearth of the forge and grooved rolls for the forge hammer. The new method made possible greater lengths and different shapes of bars and more varied and more regular thicknesses of plates. English legislation prohibiting the exportation of machinery and plans as well as the emigration of skilled artisans was chiefly responsible for the delay in introducing the new method into this country.27 In 1817, however, the first mill for rolling iron in the

United States was put into operation in Fayette County by Welsh workmen at the Plumsock plant of Isaac Meason. This progressive ironmaster died soon after the mill went into operation, and under the control of others it operated only intermittently in the years that followed. The introduction of rolling mills in Pittsburgh began with the establishment of the plant connected with the Pittsburgh Steam Engine Company in 1819. By 1826 there were seven rolling mills in the city and before the Civil War the number had increased to twenty-five.28 While a few rolling mills were built in other parts of western Pennsylvania, there was a centripetal tendency at work drawing this important branch of iron manufacture to the Pittsburgh area. Up to this time iron had been sent to Pittsburgh chiefly in the form of bars, but the new rolling mills provided a market for pig iron and blooms.

Until the decade of the thirties all pig iron made in the United States had been made with charcoal as fuel. As anthracite coal was introduced into manufacturing in the eastern part of the state from the early years of the nineteenth century, many attempts were made to use it in the smelting of iron in order to reduce the cost of iron production. All early attempts failed, but the growing scarcity of wood in eastern Pennsylvania and the resultant higher cost of charcoal, together with the increasing importations of British iron,29 made it imperative that a cheaper way be found to produce pig iron if the United States was to be relieved from dependency upon Great Britain and other foreign countries for large amounts of iron, especially for railroad purposes. Because of these conditions the Franklin Institute of Philadelphia in 1832 offered gold medals to the persons who should make the largest quantity of iron in the country with anthracite and with bituminous fuel, providing that in each case at least twenty tons be produced. Four years later the legislature of Pennsylvania passed a law authorizing the governor of the state to form joint-stock corporations for the purpose of smelting iron with mineral fuel.30

28 Pittsburgh Gazette, May 26, 1818; March 5, 1819; Zadok Cramer, Pittsburgh Magazine Almanack, 62 (Pittsburgh, 1819); Samuel Jones, Pittsburgh in the Year 1826, 50–53 (Pittsburgh, 1826); Hunt's Merchants' Magazine, 39:756 (December, 1858).
29 Hunt's Merchants' Magazine, 23:448 (October, 1850).
30 Franklin Institute, Philadelphia, Address of the Committee on Premiums, 1 (1832); Pennsylvania, Laws, 1835–36, p. 799.
signed to use anthracite as fuel were put into blast. Success was obtained by the substitution of the hot blast for the cold blast, a Scotch invention of the previous decade. By 1846 forty-three blast furnaces using anthracite as fuel were producing about one-third of the pig iron made in Pennsylvania and within a decade this number had more than doubled. 31

The success of eastern ironmasters in smelting iron with anthracite, a much cheaper fuel than charcoal, gave an impetus to the experiments being made to use bituminous coal in blast furnaces in the western part of the state; for the fear of competition loomed up before the western ironmasters like a gaunt specter. Many early attempts had been made to use bituminous coal in the form of coke in blast-furnace production, but all early efforts failed to produce a good quality of pig iron. The failures were due, not to difficulties in producing good coke, but to an inability to use coke successfully in the blast furnace. 32 As early as 1813 a newly-arrived English coke-maker offered his services to the ironmasters of western Pennsylvania. Other British coke-makers migrated to this country and the process of converting coal into coke became known. When the Plumsock Rolling Mill, the first rolling mill in the United States, went into operation in 1817 coke was the fuel used, and as this branch of the iron industry developed the use of coke increased. In 1819 experiments were made in the production of pig iron with coke at Bear Creek Furnace in Armstrong County, but without much success. 33 The gold medal offered by the Franklin Institute in 1832 as an incentive to the production of pig iron with bituminous coal remained unclaimed for several years. The law of 1836 permitting the organization of joint-stock companies for smelting iron with mineral fuel was meant especially to encourage the use of coke in the smelting of iron. Many attempts to smelt iron with coke followed.

The Oliphants of western Pennsylvania were partly successful in making pig iron with coke, but they abandoned their experiments because


33 *Pittsburgh Mercury*, April 1, 1813; *Pittsburgh Gazette*, May 26, 1818; James M. Swank, *Introduction to a History of Ironmaking and Coal Mining in Pennsylvania*, 68 (Philadelphia, 1878).
such iron did not respond under the forge hammer like the more workable charcoal iron. The first furnace to use coke successfully in this country was Lonaconing Furnace in western Maryland, which was built to use that fuel in 1837 and within two years was producing seventy tons of pig iron a week. Experiments were also made with some degree of success at Karthaus and Farrandsville, Pennsylvania, but by the middle of the century only the four blast furnaces at Brady’s Bend used coke regularly in Pennsylvania, and even they produced but little iron during the depression of 1849–51. By 1856, however, there were twenty-one furnaces in Pennsylvania and three in Maryland using coke. It was at last definitely proved that coke could be used satisfactorily and profitably in blast-furnace production and from this time on its use was gradually extended, although it was not until many years after the Civil War that more pig iron was produced with coke than with anthracite coal.\(^\text{34}\)

At the time that experiments were being made with coke, attempts were made to use raw bituminous coal in blast furnaces. The weakness of the blast was the chief factor in producing failure when the fuel was first used. This difficulty was finally remedied and in 1846 the first successful furnace using such raw fuel was put into blast at the Mahoning Iron Works of Wilkeson, Wilkes, and Company, in Ohio. The use of raw bituminous coal in smelting iron soon spread to other furnaces in the Mahoning Valley and to the contiguous Shenango Valley in western Pennsylvania. In 1850 there were eleven furnaces in these regions using raw coal. Six years later there were six in western Pennsylvania and thirteen in Ohio.\(^\text{35}\) While this fuel, either alone or mixed with coke, was used in blast furnaces in several states, it was chiefly confined to the furnaces of the Mahoning and Shenango valleys. Its use gradually declined, however, and like anthracite it was entirely displaced by coke.

During the decade of the thirties Fayette County lost its position of leadership in the production of pig iron and bar iron in western Pennsyl-


vania; for when the zenith of protectionism before the Civil War had been reached and the demand for iron for the new rolling mills of Pittsburgh had increased, many furnaces were built in the Allegheny and Shenango valleys. The presence of vast forests, suitable water power, and local ores, together with the proximity of the Pittsburgh market, thus created an iron industry in Armstrong, Butler, Clarion, Mercer, Lawrence, and Venango counties. By 1850 there were 150 furnaces in western Pennsylvania, and these furnished Pittsburgh with one hundred thousand tons of pig metal annually. The furnaces in the upper Allegheny Valley did not remain long; they arose and disappeared like ephemeral visions in a dream. In the fifties and sixties, because of the leanness of their ores, most of them failed to meet the competition of the furnaces in the Shenango Valley, which had direct water and rail connections with the Lake Superior region, where rich ores were obtained. The Shenango furnaces were also using as fuel bituminous coal and coke, which were cheaper than the charcoal fuel used in the upper Allegheny Valley. Iron production was given up in this region, especially in Clarion and Venango counties, and the furnaces became moss-covered ruins while the attention of this part of the country was turned to dreams of untold wealth in its resources of oil. By the time of the Civil War the pig iron industry of western Pennsylvania was largely concentrated in Mercer and Lawrence counties in the Shenango Valley, but important works could be found in Armstrong, Cambria, and Fayette counties. This period also marked the beginning of the successful production of pig iron in Allegheny County. No pig iron had been produced in this county from the failure of George Anshutz' furnace during frontier days until Clinton Furnace was established in Pittsburgh in 1859 by Graff, Bennett and Company. Other furnaces using coke as fuel were built, and Allegheny County became another important center for the production of pig iron.

Throughout the period the chief stimulus to the erection of blast furnaces in western Pennsylvania was the industrial development of Pittsburgh, where most of the iron produced in the region and some from

16 Hazard's Register, 2:239; 4:128; 8:59 (October 25, 1828; August 22, 1829; July 23, 1831); Hunt's Merchants' Magazine, 22:688 (June, 1850).

other districts was used in manufactures. The rolling mills, foundries, machine shops, blister steel furnaces, and engine shops of Pittsburgh re-
quired much metal. The disastrous fire of 1845 interfered little with the expansion of manufactures; phoenix-like, a greater manufacturing city arose from the smoldering ruins. By the middle of the century more than fifty steamboats were built in the city annually and before the Civil War steam engines to the value of one million dollars annually were manu-
factured. The famous Eagle Steel Works produced cast steel of all vari-
eties, including bar, shear, and sheet, and used Swedish iron for its best products. Attempts made to produce rails for railroads were not success-
ful, but along all other lines iron manufactures flourished. 38

Most of the iron used in the early development of American railroads was imported from England. The federal law of 1832 provided a draw-
back on all duties paid on iron used by railroads, and from 1831 to 1841 almost five million dollars paid in duties were refunded on imported rail-
road iron. 39 The first rails and rolled axles for railroads made in this country were produced in 1837 at the Tredegar Iron Works of Virginia, destined to become the most famous works in the South before the Civil War. 40 The Great Western Iron Company, later called the Brady's Bend Iron Works, situated about forty miles from Pittsburgh, rolled rails in 1842 and four years later filled an order for twelve thousand tons of rails for the Grand Central Railway in Michigan. The works at Brady's Bend consisted at first of four blast furnaces, built to use coke as fuel and intended to provide pig iron for the Pittsburgh market. The manufac-
turers of Pittsburgh refused at this time to use coke pig iron, and there-
fore an extensive rolling mill was built in connection with the plant to work up the product of the furnaces. 41 In the fifties a similar plant of furnaces and rolling mills went into operation at Johnstown under the name of the Cambria Iron Works. 42 Before the Civil War these two rail mills

38 Hunt's Merchants' Magazine, 23: 470; 34: 388; 36: 634 (October, 1850; March, 1856; May, 1857); Pittsburgh Gazette, August 15, 1853.
39 Statutes at Large, 4: 604; 27 Congress, 2 session, House Executive Documents, no. 265, p. 4 (serial 405). See also 26 Congress, 1 session, House Executive Documents, no. 18, p. 1-6 (serial 364). The law of 1832 was in force until 1843. See Statutes at Large, 5: 548-567.
40 Hunt's Merchants' Magazine, 16: 530 (May, 1847).
41 Hunt's Merchants' Magazine, 16: 212 (February, 1847); Pittsburgh Gazette, November 17, 19, 1846.
42 James M. Swank, Cambria County Pioneers, 68 (Philadelphia, 1910).
in western Pennsylvania turned out about one-seventh of the 150,000 tons of rails produced in the entire country.\textsuperscript{43} By this time the American mills were producing about one-half of the railroad iron used in the country; the other half was imported chiefly from England.

Although the iron industry of western Pennsylvania as a whole expanded in a phenomenal way from the beginning of the century, there were periods of depression and financial disturbances that brought suffering and ruin to many. The panic of 1819 and the perilous times of 1837-42 have been mentioned. The most widespread and disastrous of the periods of difficulty for ironmasters and iron manufacturers before the Civil War occurred in the years 1849-51. For a number of years there had been an overproduction of iron and iron products, prices were falling, and the low Walker Tariff of 1846 did not protect industry to any extent from foreign importations. The decline in demand for railroad iron in England following the bursting of the many-colored bubble of railroad speculation in the forties and the disturbances on the continent about the middle of the century, which closed the European markets to England, brought about an enormous overproduction in Great Britain, and forced prices down below the cost of production. British pig iron, bar iron, and iron manufactures flooded American markets, with the result that many of the blast furnaces in the country were out of blast and almost all the American rolling mills and forges were stilled.\textsuperscript{44} Large amounts of Scotch pig iron were imported, some being sent to Pittsburgh by way of New Orleans and the western rivers.\textsuperscript{45} The depression, felt on both sides of the Atlantic, was fundamentally due to overproduction and the resulting low prices.

Western Pennsylvania felt the mid-century depression keenly. It was estimated that four-fifths of the ironworks in Allegheny County failed during the months preceding President Taylor's visit to Pittsburgh in

\textsuperscript{43} Hunt's Merchants' Magazine, 38:637 (May, 1858).
\textsuperscript{44} 30 Congress, 2 session, House Executive Documents, no. 33 (serial 540); Pittsburgh Gazette, May 2, 1849; Ironmasters' Convention, Philadelphia, 1849, Documents, 57.
\textsuperscript{45} Pittsburgh Gazette, February 1, March 17, 1848; May 2, November 22, 1849; October 5, 1852; Hunt's Merchants' Magazine, 22: 457; 29: 383 (April, 1850; September, 1853).

The discovery of the Blackband ores early in the century together with the invention of the hot blast by Neilson in 1829 and the development of railroad building stimulated the Scotch pig iron industry. In 1825 Scotland produced 30,000 tons of pig iron. In 1849 she produced more than 692,000 tons, of which 94,000 tons were exported to the United States.
The president was convinced that foreign imports were responsible for the ruin and that the duties imposed under the Walker Tariff of 1846 were "utterly inadequate to the protection of many interests." A large number of ironmasters failed in Pennsylvania during this difficult period, and when the depression reached its lowest depth almost all the furnaces in Armstrong and Clarion counties were shut down. During the depressed condition of industry conventions of iron manufacturers and ironmasters were held in Pittsburgh and Philadelphia. Both conventions asked the federal government for protection in the form of high duties against the influx of foreign iron. The cries of the iron interests were not heeded by Congress; they were lost amidst the more vociferous shouts and fierce clashes of groups and sections struggling over questions dealing with the disposition of territories acquired from Mexico, which were settled for the time being by the Compromise of 1850.

The recovery after the depression of the mid-century was remarkably rapid. Many tried to account for it by the flow of gold from California, which had a direct tendency to raise prices. The European horizon also brightened and British iron once again found a market on the continent, with the result that prices moved upward. Whatever factors brought about renewed activity, an era of industrial and agricultural prosperity set in. Pig iron, bar iron, and iron manufactures soared in price in spite of the fact that the cost of production had decreased during the previous decade. Large profits brought many new plants into operation, and rolling mills and other works in Pittsburgh and elsewhere operated day and night. Blast furnaces using the new coal and coke fuel were built larger and larger, and most of the charcoal furnaces were put in blast again. By the autumn of 1854 increased output and continued foreign importations brought about a drop in prices, but, with the exception of a

46 Philadelphia Public Ledger, August 23, 1849.
47 Pittsburgh American, August 20, 1849, quoted in the Pittsburgh Post, August 21, 1849.
49 Pittsburgh Gazette, November 22, 23, 24, 1849; Iron Manufacturers' Convention, Pittsburgh, 1849, Proceedings (Pittsburgh, 1849); Ironmasters' Convention, Philadelphia, 1849, Documents.
50 Pittsburgh Post, November 11, 1852.
51 Hunt's Merchants' Magazine, 30:438 (April, 1854); Pittsburgh Gazette, June 10, 1854.
short time during the panic of 1857, which was fatal to a few ironmasters, prosperity continued to the Civil War, when a new era of even greater prosperity dawned.

One of the greatest problems that confronted ironmasters and iron manufacturers as well as other interests throughout the period prior to the Civil War was the scarcity of capital; for in the new country capital was needed for a multitude of purposes including transportation facilities, agriculture, banking, and business, as well as for the extension of industry. During frontier days, when the first ironworks were established, the problem of securing money to build plants and to carry on operations was indeed a serious one. It was natural that most of the capital during the early period should come from the East; for the early industrialists came from Philadelphia, the Juniata Valley, Boston, and parts of Virginia and New Jersey. Much of this capital, however, had been made in mercantile and commercial pursuits. Capital also accumulated on the frontier; for, as poor as most of the pioneers were, they brought with them their meager savings, and this money was put into circulation. As Pittsburgh became the key to the West, emigrants bought necessary supplies there before traveling farther westward. A part of the capital accumulated in this way was invested in ironworks.

Since business in the ante bellum period was largely organized on an individual or a partnership basis, it was relatively difficult to accumulate large amounts of capital. There were, however, a number of joint-stock companies as early as the second decade of the nineteenth century, although there was no general law for incorporation in Pennsylvania until 1849. Such works as Mason, Miltenberger and Company's Rolling Mill, Franklin Iron Works, Clarion Furnace, Oil Creek Furnace, Venango Furnace, and Tionesta Bloomery were owned by joint-stock companies. Under the act of 1836 corporations were formed for producing iron with mineral coal as fuel. The general law of incorporation was passed in 1849, and even before the Civil War several corporations were formed under its provisions. Thus during this early period much money was brought together by means of joint-stock organizations, although the corporate form of organization did not come into general use until after the Civil War.

As the West was settled and western markets developed, the profits from iron manufacture grew larger and were drawn upon to build up the industry. In many cases it became customary to apply all the net profits in expanding the business. Capital, however, could not keep pace with the expansion desired, nor did banking facilities grow rapidly enough. There were, therefore, many complaints throughout the period because of the lack of capital and many bitter condemnations against the eastern part of the state for not furnishing more financial aid to the West.

Especially during the early days ironmasters, because of poor banking facilities, had great difficulty in obtaining liquid capital to continue operations. Producers of pig iron and castings, in particular, were continually handicapped by such a condition. The necessary stock for each blast, including ore and fuel, amounted to a large sum of money, and, until the iron was sold and paid for, which usually took many months, the ironmaster had to support his dependents, repair his blast furnace, and secure the raw materials for the next blast. An example of such difficulties can be seen in the pathetic appeal of John Hayden of Fayette County to his countrymen in 1801. Because of the lack of ready money he issued notes for one year in denominations of from one to ten dollars, which he promised to redeem in iron at the end of the year or in cash at the expiration of the year after thirty days notice. He asked the public to accept his currency at the same rate as gold and silver in return for what he had done in providing the western pioneers with iron. "I have spent," he declared, "upwards of a thousand nights at hard labour, when others were taking their ease in bed, beating off ice, from the wheels and keeping business going on;—my furnace blows almost without ceasing, metal can be had at all times, at reasonable terms." He hoped to secure a sufficient amount of cash in this way to buy stock and provisions for his plantation for the ensuing year. Conditions were against this courageous ironmaster, and he met defeat.

One of the causes for the financial distresses of the industrialists during the entire period was the difficulty of securing cash for their products.

53 Manufactures in the United States, 2: 249 ff.
54 Pittsburgh Gazette, June 30, 1818; April 9, 1846; November 7, 1849; March 8, 1850; Commonwealth (Pittsburgh), April 3, 1816; Thurston, Pittsburgh as It Is, 109, 196; Hunt's Merchants' Magazine, 30: 438 (April, 1854).
55 Pittsburgh Gazette, January 30, 1801; Tree of Liberty (Pittsburgh), March 7, 1801.
Most of their iron and iron manufactures were sold on credit. The terms of credit varied from four to twelve months, although it was usually six months. There was also much barter, not only because of the scarcity of a medium of exchange, but also because many ironmasters preferred to take, for a part of their iron at least, such provisions, produce, and supplies as they could use to stock their stores, rather than accept the depreciated and confused currency of the time. Such barter was resorted to from pioneer days until the Civil War and even later.

The many changes that took place in transportation had a great effect on the development of the iron industry in western Pennsylvania. Indian trails became the early roads, and narrow roads grew into turnpikes over which stage coaches traveled, as well as innumerable wagons carrying merchandise, produce, and iron. During the early days most of the iron needed for Pittsburgh's industries was sent from the Juniata Valley and the Fayette County region by road and waterway, chiefly in the form of bar iron and castings at first, and later, after Pittsburgh had established rolling mills, as pig iron and blooms. New sources of supplies developed as furnaces appeared in the Shenango and Allegheny valleys, although most of the latter were short-lived. Rivers and canals came to be of first importance to these industrial enterprises, as they were to those of districts farther away, such as the Hanging Rock region in Ohio and parts of western Tennessee, which sent iron to Pittsburgh. Before the close of the period the furnaces of western Pennsylvania were receiving ores from Lake Superior, Missouri, and Lake Champlain chiefly by means of the waterways. In shipping the finished products, also, the waterways were all-important before the Civil War, although the railroads were developing in the western part of the state.

The market for Pittsburgh's manufactures and for the products of western Pennsylvania increased with the rapid development of the West, although competition developed in the new western states and territories.

56 Manufactures in the United States, 2: 240 ff.
57 Allegheny Furnace letterbooks, in the possession of the Blair County Historical Society at Altoona; Pittsburgh Gazette, November 30, 1793; January 30, 1801; Pittsburgh Daily Advocate and Advertiser, October 1, 1839; Manufactures in the United States, 2: 248 ff.
58 Pittsburgh Mercury, September 9, 1813; Pittsburgh Gazette, September 28, 1814; June 12, 1818; James Hall, Letters from the West: Containing Sketches of Scenery, Manners, and Customs, 35 (London, 1828).
As the regions in the Northwest and near the Great Lakes were settled, additional markets were secured. The canals and later the railroads aided in the opening up of these regions, which did much for the industrial development of western Pennsylvania, although at the same time better communication brought about competition between the East and the West. Few iron products were exported from the Pittsburgh district to foreign countries before the Civil War. The chief exports of iron manufactures, consisting of steam engines, machinery, and sugar mills, were sent to parts of Central and South America. The principal market for the manufactures, merchandise, and produce of western Pennsylvania throughout the period was the ever-expanding West.

The rise of iron manufacture in western Pennsylvania was rapid and remarkable. From the small beginnings at the time the region constituted a part of the frontier until the Civil War, when this section of the country was fairly well settled, industry grew. During those years when the Pittsburgh district furnished many of the materials needed in the developing West, the foundations of a great industrial structure were laid. The early industrialists overcame many difficulties, including financial and technological problems as well as those connected with transportation. The Civil War ushered in a new era in which many changes in industrial organization, in the development of new markets, and in the policy of protection by the federal government took place. The utilization of Lake Superior ores with their regular qualities, the advances made in transportation, the increasing use of coke in blast furnaces, as well as the adoption and improvement of new processes in all branches of industry, have played a part in making the Pittsburgh district a great pulsating industrial center and one of the greatest iron-producing and iron-manufacturing regions in the world.