CONNELLSVILLE COAL & COKE REGION
Connellsville Vicinity
Fayette
Pennsylvania

HAER No. PA-283

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HISTORIC AMERICAN ENGINEERING RECORD

CONNELLSVILLE COAL & COKE REGION

HAER No. PA-283

Location:	Connellsville Vic., Fayette County & Latrobe Vic., Westmoreland County, Pennsylvania
Significance:	Considered among the world's richest mineral deposits, the Pittsburgh seam of coal underlying portions of Fayette and Westmoreland Counties in southwestern Pennsylvania produced metallurgical coke of exceptional quality. Covering nearly 147 square miles, the seam's thickness, nearness to the surface, friable structure, and chemical attributes made Connellsville coke the ideal fuel for late nineteenth and early twentieth century iron furnaces. Combined with the adjacent Klondike fields, the region contained the world's largest complex of beehive coking ovens.
Historian:	Frederic L. Quivik

Project Information:
In February, 1987, the Historic American Engineering Record (HAER) and the Historic American Buildings Survey (HABS) began a multi-year historical and architectural documentation project in southwestern Pennsylvania. Carried out in conjunction with America's Industrial Heritage Project (AIHP), HAER undertook comprehensive inventories of Fayette and Westmoreland Counties to identify the region's surviving historic engineering works and industrial resources. (Sarah Heald, ed., Fayette County, Pennsylvania: An Inventory of Historic Engineering and Industrial Sites. Washington, DC: U.S. Department of the Interior, 1990; Edward K. Muller and Ronald G. Carlisle, Westmoreland County, Pennsylvania: An Inventory of Historic Engineering and Industrial Sites. Washington, DC: U.S. Department of the Interior, 1994.) Archives for HAER/AIHP projects are located at the Indiana University of Pennsylvania.

HISTORY

Pittsburgh Coal and Connellsville Coke

Under most of western Pennsylvania are the bituminous coal seams comprising the northeastern segment of the Appalachian coal region. Through the roughly 2,800 vertical feet of coal measures (the coal seams and the intervening rock strata of sandstone, shale, clay, and limestone) are 42 distinct coal beds.[1] The most important to the economic and cultural development of the region is the Pittsburgh seam. Limited in Pennsylvania to the southwestern quarter of the state, the seam crops at Pittsburgh and thereby derives its name. The Pittsburgh coal extends from the southwestern corner of Pennsylvania into Maryland, Ohio, and West Virginia. Because of its thickness, nearness to surface, structure, and chemical attributes, including low contents of ash, phosphorous, and sulfur, the Pittsburgh seam has attracted miners and mine developers across its entire area. The coal in a particular segment of the seam was of such a quality that it spawned a boom in coke manufacture unique in the history of American industry; the area that lies over that segment is known as the Connellsville coke region.[2]

The Pittsburgh seam lay in waves with axes running southwest to northeast. Two anticlines, the Chestnut Ridge and the Fayette, eroded long ago, but the synclines between them survive. The two synclines are known as the Uniontown and the Latrobe. They are separated by a secondary or cross anticline which runs roughly perpendicular to the Chestnut Ridge and Fayette anticlines.

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[1] John N. Hoffman, "Pennsylvania's Bituminous Coal Industry: An Industry Review," Pennsylvania History: Quarterly Journal of the Pennsylvania Historical Association 45 (October 1978): 351-352.

[2]The Pittsburgh seam has yielded so much mineral wealth that at the end of the 1930s, more value had been extracted from it than from any other single mineral deposit in the world. Howard N. Eavenson, The Pittsburgh Coal Bed--Its Early History and Development (New York: The American Institute of Mining and Metallurgical Engineers, 1938), 1. This paper was also printed in the Transactions of the American Institute of Mining and Metallurgical Engineers 130 (1938). Eavenson goes on to say that, "While this distinction may in a few years pass to the gold reef of the Witwatersrand, it is possible that eventually, owing to the tremendous reserves still remaining, the ultimate yield of the Pittsburgh bed will be greater than that of any other known single deposit."

Between the ends of both synclines, the coal dips as much as 500 feet. Along the sides and ends of the synclines, erosion has taken the Pittsburgh coal away so that a map of the two surviving beds looks like two elongated islands nearly on axis with each other.[3] The total Connellsville coke region (the Uniontown syncline and the southwestern end of the Latrobe syncline) is 42 miles long, and an average of 3.5 miles wide, covering 147 square miles.[4]

The Pittsburgh seam has a very consistent thickness, allowing mine developers to confidently predict that they could produce at least 10,000 tons of coal and perhaps as much as 13,500 tons of coal per acre in the Connellsville region. Owners of tracts of coal land could then determine a suitable size for the coke plant, knowing that 100 beehive ovens consumed about nine acres of Pittsburgh coal per year. In 1922, 98% of all the coal ever mined in Fayette County and 96% of that mined in Westmoreland County had been from the Pittsburgh bed, and virtually all of it was charged into coke ovens.[5]

Another attribute of the Pittsburgh coal which was attractive to coke producers was the clean quality of the seam. Of the its two divisions, the lower is almost pure coal. Generally seven or eight feet thick in the Connellsville region, the lower division has one or two slate partings, depending on the area, but these partings usually have a sum thickness of no more than an inch. Such a small percentage of impurity meant that coal from the

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[3] This discussion is derived from John Aubrey Enman, "The Relationship of Coal Mining and Coke Making to the Distribution of Population Agglomerations in the Connellsville (Pennsylvania) Beehive Coke Region," (PhD diss., University of Pittsburgh, 1962), 18-48. In terms understandable to the lay reader, Enman provides an excellent, well-illustrated, and much more detailed description of the interrelationship between the geology and the topography of the Connellsville region.

[4] Ibid.; H.C. Frick Coke Co., Connellsville Coke (Pittsburgh: Duquesne Printing and Publishing Co., 1893), n.p.

[5] Enman, 48-52; John F. Reese, "Coal Reserves in Fayette County, Pa., Contained in Seven Beds," Coal Age 22 (2 November 1922): 718; and "Coal Reserves in Westmoreland County, Pa.," Coal Age 21 (11 May 1922): 778; "Tons of Coking Coal to Acre," The Weekly Courier 1914 Special Number, 26. The amount recovered per acre depended, of course, on how much of the seam was left in the roof in general and how much was left in the pillars during the last stage of extraction.

lower division was considered clean enough to charge directly into the ovens without washing.[6]

Coke makers also liked Pittsburgh coal because of its structure. In the Connellsville region, coal is soft and friable, meaning it breaks easily. In the process of mining, loading, shipping, and unloading Connellsville coal, it became pulverized and therefore unfit for efficient combustion in most domestic or industrial uses. This characteristic, however, made it ideal for charging coke ovens, because it did not have to be crushed first as harder coals did. An added benefit of its friability was that the Pittsburgh coal in the Connellsville region was easier to mine, especially in the days when the miner's main tool was the pick.[7]

Finally, the chemical composition of Connellsville coal made it superior for coking. Good coking coal for any process in which combustion of the coal itself must provide the heat for coking, such as the beehive process, should be low in ash, phosphorous, and sulfur to yield a metallurgical fuel with few deleterious impurities and it should be high in volatile material so that a minimum of carbon is consumed during coking. Such aspects of chemical composition could be relatively easily measured, yet early analysts, such as John Fulton, mining engineer of the Cambria Iron Company in Johnstown, recognized that coals which otherwise seemed to be comparable chemically yielded coke of different quality. The only sure determination of whether a particular coal made good coke was to empirically try it.[8] If the resulting coke was "silvery, with metallic ring, cellular, capable of bearing a heavy burden, and as free as possible from impurities," then it was deemed to be good coke.[9] In this regard

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[6] Enman, 53-57; sections through the Pittsburgh seam showing the various strata and their dimensions at each of the early mines in the Connellsville coke region are provided in Franklin Platt, Special Report on the Coke Manufacture of the Youghiogheny River Valley in Fayette and Westmoreland Counties, Second Geological Survey of Pennsylvania, 1875 (Harrisburg: Board of Commissioners for the Second Geological Survey, 1876), 40-60.

[7] Enman, 57-60.

[8] John Fulton, "On Methods of Coking Coal for Furnace Use: Its Efficiency and Economy, as Compared with Anthracite Coal in the Metallurgy of Iron," in Platt, Coke Manufacture, 118-121.

[9] Platt, Coke Manufacture, 62. This visual means of identifying good coke existed prior to the rise of the Connellsville coke region as the nation's leading producer of

Connellsville coke had no equal. Indeed, Connellsville coal was so valuable for the coke it could produce in beehive ovens that, rather than burning their own Connellsville coal in boilers, operators were said to have shipped other coal into the region to produce steam to drive their equipment.[10]

But the widespread acceptance of beehive coking technology emerged after the depletion of standing wood reserves. England had already experienced a charcoal shortage (charcoal was the primary fuel source for furnaces through the mid-ninteenth century), much more dire than that faced by American iron makers. English innovators experimented with the methods they used for making charcoal to see if such techniques could be used to carbonize coal and make a fuel suitable for smelting iron ore. Although several patents were granted in the 16th and 17th centuries for various means of using coal and coke for iron smelting, none of the techniques proved satisfactory until 1709-1711, when Abraham Darby succeeded at Coalbrookdale in combining the proper coal with the proper coking technique to make a fuel suitable for smelting iron. Darby's discovery is considered a major catalyst in the industrial revolution.[11]

Coke for fueling blast furnaces was slow to gain rapid acceptance in western Pennsylvania, where bituminous coal is prevalent, for a combination of reasons. Although iron manufacturers had tried coke for firing their blast furnaces, they had not found the proper technique to produce a coke which would yield iron of as high a quality as that made in charcoal-fired blast furnaces. In

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standard furnace coke. For example, when the Cambria Iron Company was incorporated in 1853, it was for the purpose of smelting iron in blast furnaces designed for the use of coke produced from locally-mined coal. The new company boasted that "The coke is of superior quality, sound, heavy, and of a silvery appearance, well calculated for smelting iron." P. Shoenberger, President, "The Cambria Iron Company," Cambria Iron Company of Johnstown, PA (New York: George F. Nesbitt & Company, Printers, 1853), 17.

[10] The Engineering and Mining Journal 69 (28 April 1900): 491.

[11] Descriptions of the early experiments in coking coal and in finding a suitable replacement for charcoal are many. See, for example, R. Wigginton, Coal Carbonisation (London: Balilliere, Tindall and Cox, 1929), 1-5; and on Darby see Arthur Raistrick, Dynasty of Iron Founders: The Darbys and Coalbrookdale (London: Longmans, Green and Co., 1953), 36-39.

the first half of the 19th century, the western Pennsylvania market for iron was mainly for pig iron needed by blacksmiths, who required a high-quality material serviceable in a variety of unspecified applications, whereas the eastern market possessed a variety of niches with which iron of various qualities could be matched. Iron purchasers in western Pennsylvania were not willing to pay as much for pig iron made with coke, so there was not much of a stimulus for either coke manufacture, or iron made with coke.[12]

Pittsburgh itself, which would later become the scene of a great iron smelting industry, was not home to any successful blast furnaces until the second half of the 19th century. Previously, the city's importance in the iron trade was as a fabricating center. Rolling mills and foundries arose early in the century, acquiring their iron from areas as far away as the anthracite region and as nearby as surrounding counties. The mills and foundries used a variety of fuels, including coke. By 1850 there were perhaps 80 coke ovens in or very near Pittsburgh supplying fuel to local fabricators. These ovens were supplied with coal mined where it outcropped at Pittsburgh. While the coke served as forge or foundry fuel, there were still no blast furnaces within the city to use it, and had there been, furnacemen would likely have found it unsatisfactory. The first successful blast furnace in Pittsburgh, that of Graff, Bennett & Company, was built in 1859 to supply their Clinton rolling mill. The furnace smelted ore from Lake Superior mines and, more important to the development of the coke industry, was the first to use Connellsville coke and to recognize that it was a superior blast furnace fuel.[13]

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[12] The adoption of fuels to replace charcoal in the American iron industry is well described in Peter Temin, Iron and Steel in Nineteenth-Century America: An Economic Inquiry (Cambridge, MA: The MIT Press, 1964), especially the chapter "A Question of Fuel," 51-80. Temin does not place as much emphasis in explaining the retarded market for coke-fired iron on the willingness of western purchasers to pay more for high-quality charcoal-fired iron as does Louis C. Hunter in "The Influence of the Market upon Technique in the Iron Industry of Western Pennsylvania Up to 1860," Journal of Economic and Business History 1 (February 1929): 241-281.

[13] Pittsburgh: Its Industry & Commerce, Embracing Statistics of the Coal, Iron, Glass, Steel, Copper Petroleum, and other Manufacturing Interest of Pittsburgh (Pittsburgh: Barr & Myers, 1870), 18, 22-32.

Market conditions conducive to coke-fired pig iron arrived in the 1850s, when railroad connections between Philadelphia and Pittsburgh made iron smelted with anthracite available to western markets, stimulating the western furnace owners to redouble their efforts to produce an acceptable coke. In general, coke needed to be low in sulfur to make a high-quality iron, and, to support proper combustion, it needed to have the size and strength to resist crushing under the weight of ore and limestone in the blast furnace. Heretofore, low-sulfur coals had not yielded coke with the desired structural qualities and coals yielding the desired structural qualities were high in sulfur. The discovery in the Connellsville region of low-sulfur coal which yielded a coke with the desired structural qualities made it possible to produce higher-quality iron at a cost still well below that of pig iron made with charcoal.[14] The importance of Connellsville coke to both the iron and the coke industries was noted by Joseph Weeks in his 1880 U.S. Census report on the coke industry: "It was not, however, until the development of the Connellsville region, Pennsylvania, that the use of coke as a blast-furnace fuel or the manufacture of coke itself in the country assumed any importance."[15]

The iron industry and the demand for coke grew rapidly together with the nation's expanding railroad network after the Civil War.[16] The volume of iron made with each of the three fuels, charcoal, anthracite, and coke, increased from 1860 to 1880. From 1880 to 1900, the volume of iron made with charcoal declined, that made with anthracite or a mix of anthracite and coke remained fairly steady, and the volume of iron made in furnaces fired with coke continued to show dramatic increases almost every year. Coke produced in the Connellsville region comprised more than half of the fuel firing the latter category

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[14] Temin, Iron and Steel, 74-80;

[15] Joseph D. Weeks, Report on the Manufacture of Coke (Washington, DC: Government Printing Office, 1885), 26.

[16] Blacksmiths insisted upon qualities which iron from charcoal blast furnaces possessed but that from coke blast furnaces did not. Iron from coke blast furnaces was, however, well suited for the production of rails. Louis C. Hunter, "Influence of the Market upon Technique in the Iron Industry in Western Pennsylvania up to 1890," Journal of Economic and Business History 1 (February 1929): 241-281.

of furnaces and it became the standard against which all other coke for furnace fuel in the U.S. was measured.[17]

The availability of an excellent fuel helped to make Pittsburgh the center of the nation's iron and steel industry in the late nineteenth century. Although improved transportation made it feasible to ship ore longer distances, coke could not be so readily shipped because it is bulkier and deteriorates over time. Pittsburgh's proximity to the Connellsville coke region gave the region advantages over other industrial centers to which ore could be shipped but which lacked comparable fuel. Growth in markets and exploitation of new deposits of raw materials opened new centers of iron and steel production as well, such as Birmingham, Alabama, and Pueblo, Colorado, both situated near iron and coking coal deposits. Nevertheless, Pennsylvania retained the leading position in iron and steel manufacture, with an ever increasing proportion in the western part of the state, especially Pittsburgh.[18]

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[17] "The Relation of Coking Districts to the Production of Pig Iron," American Manufacturer and Iron World 38 (4 June 1886): 10; William T. Hogan, Economic History of the Iron and Steel Industry in the United States, vol. 1 (Lexington, MA: Lexington Books, D.C. Heath and Company, 1971), 25, 205.

[18] Temin, Iron and Steel, 194-199. In the twenty years between 1870 and 1890, annual pig iron production in the United States grew from about 2.5 million long tons to over 9 million tons, surpassing that of Great Britain, which had been the world's leading producer, in 1890. Pennsylvania produced just over half of the nation's pig iron in 1890. The same period saw an even more dramatic increase in steel production, which went from less than 200,000 long tons in 1870 to over 4 million long tons in 1890. The U.S. had surpassed England in the production in all types of steel except open-hearth steel by the mid-1880s. Pennsylvanian led the nation not only in the production of iron and steel, but in iron and steel products as well. Most of the iron and steel being produced in the U.S. was used at rolling mills where it was made into rails for the nation's rapidly expanding railroad network and into structural steel for bridges and buildings. Pennsylvania produced a little less than half of the nation's two million short tons of rolled iron and steel in 1873, but by 1890, when the U.S. rolling mills turned out 6.7 million short tons of rolled iron and steel, Pennsylvania produced 59% (almost 4 million tons) of it. James M. Swank, "Twenty years of Progress in the Manufacture of Iron and Steel in the United States," in U.S. Geological Survey, Mineral Resources of the United States, 1891 (Washington, DC: GPO, 1893), 52-61.

In addition to changes in production technologies and sources of raw material and fuel, America's iron and steel industry went through significant structural change as the 19th century drew to a close. In 1860, 286 businesses operated about 400 blast furnaces. By 1880 there were 490 establishments operating 681 furnaces. But production during this period grew even more dramatically, from 919,770 tons to 4,295,414 tons, suggesting that the new furnaces had much greater capacities than the old. Furthermore, some of the firms manufacturing iron and steel had payrolls of more than a thousand persons, leading the United States Census to refer to them as "monster establishments." Such giants included the Cambria Iron Company of Johnstown, Pennsylvania, and Carnegie Steel Company and Jones & Laughlin of Pittsburgh.[19] In 1880, there were nine steel companies with capacities in excess of 100,000 tons of steel per year, but there were almost 500 other firms in the industry, some with capacities as small as 3,000 tons. The Edgar Thompson Steel Works was the largest in the U.S. with a capacity of 450,000 tons. Over the next decade, the large firms acquired some of the smaller ones and drove many others out of business, especially those based on local ore pits and dependent on local markets. By 1892, corporate consolidation yielded two giants with over a million tons of annual capacity: Carnegie Steel and Illinois Steel. Changes in state and federal laws further influenced the course of consolidation so that in the two years between 1898 and 1900 eleven large mergers absorbed almost 200 previously independent firms. By the end of the century holding companies controlled vast amounts of the steel-making capacity in the nation, with most of the holding companies falling into groups headed by one

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[19] Hogan, Economic History of Iron and Steel, 25, 91-109. Carnegie, which would play an important role in the growth of the Connellsville coke region, had its origins in the Iron City Forge, a partnership formed by Henry Phipps and Anton and Andrew Kloman in 1861. Three years later, Andrew Carnegie and others organized the Cyclops Iron Company a few blocks away from the Iron City Forge. Originally formed to compete with Iron City, Cyclops instead merged with it a year later to form Union Iron Mill Company, with Kloman, Phipps, and Carnegie among the shareholders. In 1870, Carnegie, his brother Thomas, and colleagues built a blast furnace to supply iron for their mills, which were producing rails and other iron products needed by the railroads. Three years later, the men built what would soon be known as the Edgar Thompson Works to produce Bessemer steel. In 1881, the Carnegies reorganized their various iron and steel holdings into Carnegie Brothers and Company. Berlie Charles Forbes, Men Who Are Making America (New York: B.C. Forbes Publishing Co., 1919), 42.

of three men: Andrew Carnegie, J. P. Morgan, or W.H. Moore.[20] It was in this climate that the Connellsville coke region grew to the pre-eminence it held during the third of a century between 1880 and the First World War.

Coke Manufacture

Coke used in the earliest smelting efforts was produced from heaps of coal placed on the ground and covered with wetted soil, straw, leaves, and breeze (pulverized coke) to limit the supply of air, much like crude charcoal kilns. Flues within the mass of coal were built of wood to channel combustion gasses away. Being easier to ignite, the wood flues were also used to start the coal burning. Increasing demand stimulated a search for improved coking techniques. John Wilkinson devised a chimney of loose bricks in 1768 which, when placed at the center of a heap, facilitated the escape of gasses and allowed tenders to control the draft. The practice of quenching (cooling the heap of coked coal with water) began about 1815 at Staffordshire, when it was found to increase the yield of coke and reduce the time needed to make it. The idea of making coke in a permanent brick oven was actually borrowed from a 17th-century German process for distilling wood to derive wood tar. Early brick beehive ovens (so named because of their shape and appearance) were relatively tall and narrow and conveyed the combustion gasses to a condenser from which tar could be collected. By the middle of the 18th century, these ovens had been adapted for use in making coke, but without the condensers, because coal tar was considered inferior to wood tar. Because batteries of these ovens were built in rows, many early examples were square in plan, rather than circular as became more common. In 1781, the Earl of Dundonald received the first patent for making coke in a beehive oven, with the patent also covering his process for recovering tars, pitch, and oils, but not gas.[21]

Beehive ovens are generally between ten and twelve feet square or in diameter. The side walls of each oven are two to three feet high, and the domed top extends several more feet above the walls. There is usually an opening called a trunnel at the center of the dome through which combustion gasses can escape.

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[20] Hogan, Economic History of Iron and Steel, 235-239.

[21] Ibid., 25-34; John Armstrong, Carbonisation Technology and Engineering (London: Charles Griffin and Company, Limited, 1929), 177-184; Frederick H. Wagner, Coal and Coke (New York: McGraw-Hill Book Company, Inc., 1916), 295; R. Wigginton, Coal Carbonization (London: Failliere, Tindall and Cox, 1929), 32-33.

An oven is charged by pouring a bed of coal about two feet thick (five to seven tons) through the trunnel and onto the floor, where it is leveled. Heat stored in the brick of the oven, especially the dome, heats the bed of coal and begins to evolve volatile materials out of the top layer of coal. The volatiles combust in the space between the coal and the dome, which radiates heat back down onto the coal, driving the coking process, i.e. the giving off of volatiles, deeper into the bed. Air to support the combustion process is admitted and regulated through a door at the side of the oven. Combustion gasses and unburned volatiles escape through the trunnel and into the atmosphere. By limiting the amount of air admitted, the coke itself is kept from burning. Depending on how much coal is in the oven, an entire charge will coke in between 48 and 72 hours, at the end of which the coke is quenched and drawn from the oven through the door. If the proper amount of water is not used in quenching, and too much time is not taken between drawing the coke and adding the new charge, the oven will retain enough heat to begin the coking process anew. If an oven has been dormant for a while, the first new charge must be fired with more easily combustible fuel, such as wood, or with coal burned with an ample supply of air. A freshly fired oven yields a coke of inferior quality.[22]

As coal is heated during the coking process, it begins to soften and fuse into a pasty, plastic mass at about 400 degrees C (752 degrees F). As the temperature rises, gas and condensable vapors given off by the coal form bubbles within the plastic mass. Continued heating drives the bubbles out of the mass around 500 degrees C (932 degrees F) and it begins to solidify into a cellular structure, with the partitions of the cells defined by the paths along which the bubbles escape. The solid coke continues to give off volatiles until about 600 degrees (1,112 degrees F). Beyond that temperature, complex hydrocarbons in the coke begin to break down and give off hydrogen. The solid mass begins to shrink, pulling away from the oven walls and developing shrinkage cracks along the lines followed by the escaping volatiles. As the coke is drawn from the oven, it breaks along these shrinkage cracks, yielding large pieces. Coke is comprised almost entirely of carbon, with any ash or phosphorous present in the coal remaining in the coke. Some of the sulfur present in the coal departs with the volatiles and some remains with the

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[22] The basic process of coking in beehive ovens is described in many sources. See, for example, Wilson and Wells, Coal, Coke, and Coal Chemicals, 138-140; Wigginton, Coal Carbonisation, 33-34.

coke.[23] Good metallurgical coke is low in sulfur content and is therefore superior to bituminous coal as a fuel for smelting iron.

Rise of Connellsville

By about 1810, there was extensive use of bituminous coal in western Pennsylvanian homes, as well as for brick-making and blacksmithing. Soon thereafter, its use grew markedly with the introduction of steam power. The first use of coke in the United States is said to have been at the brewery of George Shiras in Pittsburgh about 1796. The high cost of charcoal induced many iron masters to attempt to replace that fuel in blast furnaces with coal or coke, but most attempts were unsuccessful because, as already noted, impurities imparted by the fuel to the iron during smelting caused the iron to possess qualities not accepted by the iron market of the early 19th century. Successful use of coke in the iron industry was limited to forges and foundries. Various authors attribute the first attempts to use coke in the western Pennsylvania iron industry to different individuals. The Allegheny Furnace in Blair County reportedly tried coke in its furnace in 1811. A blast furnace on Bear Creek in Armstrong County was built in 1819 to use coke, but after a short trial, it was converted to charcoal.[24]

Pittsburgh's iron industry adopted coke as a fuel for its forges and foundries, principally because any impurities left in the fuel after the coking process did not harm the quality of the charcoal-smelted iron at these stages of iron manufacture. Visitors to Pittsburgh in the 1830s and 1840s often commented on the striking appearance of coke ovens lining the Monongahela River, indicating that the technology of coking was quite established in western Pennsylvania well before the rise of the Connellsville coke region. The first iron works in southwestern Pennsylvania recorded to have fired its forge with coke was Plumsock Iron Works in 1817. Owned by Isaac Meason, it was also the first rolling mill west of the Alleghenies. He employed three men to mine coal, coke it, and haul the coke to his forge,

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[23] Wilson and Wells, Coal, Coke, and Coal Chemicals, 81, 188-192.

[24] Eavenson, American Coal Industry, 171-184; "History of Coking in the United States," American Manufacturer and Iron World 39 (November 1886): 13; Walkinshaw, Annals, Vol. III, 205; Hunter, "Iron Industry in Pennsylvania," 258-259.

where coke was the sole fuel. Within a couple of years, however, he had returned to using charcoal.[25]

Meason made his coke in ricks on the ground. Reports conflict as to the first coking oven built in the Connellsville region. One report suggests that one of Meason's employees named Nichols, experienced with beehive ovens in England, talked Meason into letting him build an experimental oven at Plumsock in 1831. Because he fired the oven with Redstone coal, the coke was unacceptable and the experiment dropped. Another report credits Lester LeRoy Norton with the first coking oven in the region in 1833. Norton operated a small textile mill in Connellsville. He added a small foundry to his plant in 1831. Shortly afterward, Nichols came to work for Norton and convinced him to build a single 12-foot-square oven at his foundry. This oven was more successful, first supplying coke in 1833 to Norton's foundry as well as to Meason's works. Although these ovens produced some coke for sale, their owners did not enjoy long-term success. Nevertheless, towards the end of the first half of the 19th century several rolling mills and forges in Fayette County had shifted to the use of coke.[26]

Meanwhile, with the rising expense of charcoal for firing blast furnaces and the success of eastern iron manufacturers in adapting their furnaces to the use of anthracite, western Pennsylvania iron producers continued to try to find a way to use their coal to smelt high-quality iron. The Pennsylvania Legislature passed a bill in 1836 aimed at encouraging a coke industry to support the iron industry, but success in the state was elusive. In 1837, F.H. Oliphant gained renown for sending to Philadelphia's Franklin Institute specimens of iron produced with coke at his Fairchance Furnace. He was trying to attract eastern capital to his business. Although Oliphant produced almost 100 tons of pig iron using coke, he soon returned to charcoal. That same year, the Mary Ann Furnace in Huntington County was able to produce iron for about a month using coke made from Broad Top coal. The first successful use of coke for firing a blast furnace, as measured by its continuous use over a relatively long period of time, took place at Lonaconing Furnace, operated by George's Creek Coal Company near Frostburg, Maryland, beginning

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[25] Hunter, "Iron Industry in Pennsylvania," 258, 260-261; Eavenson, American Coal Industry, 179.

[26] Eavenson, American Coal Industry, 179, 380-381; J.C. McClenathan, et al., Centennial History of the Borough Connellsville, Pennsylvania, 1806-1906 (Connellsville: Centennial Historical Committee, 1906), 263-269.

in 1837. Two years later, the furnace was producing 70 tons of foundry iron per week using coke as its fuel. The Great Western Iron Works at Brady's Bend on the Allegheny River began to use coke extensively for producing iron as early as 1840, but it was not Connellsville coke. The use of coke was soon suspended at Brady's Bend because its high-sulfur content yielded iron which was brittle when hot, a quality considered unacceptable by forges. In 1849 there were no furnaces using coke in Pennsylvania, as iron men had still not succeeded in combining the right coal, a sound coking technique, and a blast furnace configuration, with a market that would accept their product.[27]

The demand for rails by the expanding railroad network created a new market for iron in the 1850s, and that, in turn, created a new outlet for the product of coke fueled blast furnaces. The Great Western Iron Works, for example, erected a rolling mill to produce rails, returned to using coke in its furnaces, and began exclusively producing for the railroad industry. The completion of the Pennsylvania Railroad through Johnstown in 1850 stimulated a similar shift on the part of George King and Peter Shoenberger, owners of several charcoal-fired blast furnaces in Cambria County. By combining their own coal and iron-ore lands with capital from New York and Boston, they formed the Cambia Iron Company, converted their smelting operations to be fueled with locally-produced coke, and erected rolling mills for the manufacture of rails. The Cambria Iron Company had the largest iron works west of the Alleghenies, representing the importance of the new market for rails and suggesting the approaching prominence of coke as a furnace fuel. By 1856, there were 21 furnaces in Pennsylvania and three in Maryland using coke. They produced a total of 44,481 tons of pig iron that year, representing 5.5% of the nation's total. None of those blast

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[27] "History of Coking in the United States," 13; Walkinshaw, Annals, Vol. III, 136, 205; Joseph D. Weeks, Report on the Manufacture of Coke, report by the Census Office, Department of the Interior (Washington, DC: Government Printing Office, 1885), 22-27; Bining, Pennsylvania's Iron and Steel Industry (Gettysburg: The Pennsylvania Historical Association, 1954), 12; George Dallas Albert, ed., History of the County of Westmoreland, Pennsylvania, with Biographical Sketches of Many of the Pioneers and Prominent Men (Philadelphia: L.H. Everts & Co., 1882), 403-404; W.G. Irwin, "Development of the Connellsville Coke Region," Engineering and Mining Journal 69 (24 March 1900): 350.

furnaces were in the Connellsville region, nor were any using Connellsville coke.[28]

Connellsville coke producers began to find some success in the 1840s, but the market for their coke was outside of western Pennsylvania. Iron works in Pittsburgh and other centers relied on local coal for their foundry and forge coke, but blast furnace operators did not, because the suitability of Connellsville coke for that purpose had not yet been discovered. In 1841, Provance McCormick, James Campbell, and John Taylor built two 10-foot-diameter ovens at Sedgwick along Hickman Run near its mouth on the Youghiogheny, made coke through the winter, and in the spring of 1842 loaded it on boats which they floated downstream to Cincinnati. They had such trouble finding a buyer, that when the eventual buyer, the foundryman Miles Greenwood, liked the fuel he had acquired and asked them to make more, they declined. Instead, they sold the ovens to Mordecai, James, and Sample Cochran, who in 1843 also shipped their product to Greenwood at Cincinnati. Over the next several years, the Cochrans continued to manufacture coke, and a few other ovens were built in the Connellsville area by entrepreneurs, such as Stewart Strickler, who intermittently found markets for their product to the west. By 1855, there were reportedly 26 ovens in the Connellsville area near the Youghiogheny. At that time, there were also about 80 coke ovens in Pittsburgh, but they were not producing furnace fuel but rather were supplying forges and foundries.[29]

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[28] Hunter, "Iron Industry in Pennsylvania," 276-277; J.P. Lesley, The Iron Manufacturer's Guide to the Furnaces, Forges and Rolling Milles of the United States (New York: John Wiley, Publisher, 1859), 759-760; "Cambria Iron Company," historical sketch accompanying the index to the records of the Cambria Iron Company in the Bethlehem Steel Corporation Records, Acc. No. 1699, Hagley Library and Museum.

[29] The numerous accounts of the beginnings of coke production in the Connellsville region all vary slightly concerning such details as who built how many ovens when. Virtually all accounts agree, however, that the Cochrans were the first to export coke from the region. The author of this narrative relies on several accounts, selecting the most plausible version when accounts differ. The author's main intent is to provide an overview, rather than a precise chronology, of how the coke industry arose in the region. Sources include: Joseph D. Weeks, Report on the Manufacture of Coke (Washington, DC: Government Printing Office, 1885), 23-27; Irwin, "Development of the Connellsville Coke Region," 350; H.C. Frick Coke Company, Connellsville Coke (no pub.: printed for distribution at the

The change in the market for Connellsville coke came with the construction of the Pittsburgh and Connellsville Railroad in 1855 and the development of Graff, Bennett & Company's Clinton Furnace in Pittsburgh in 1859. Although not intent on tapping the coke trade, the railroad generally improved transportation facilities out of the Connellsville region, opening the way for increased coke production. Philo Norton purchased his father's coal tract in the mid-1850s, built and operated four beehive ovens, but produced several times as much coke in ricks on the ground. He shipped all his coke by rail. By this time, Strickler had expanded his Sterling works near Jimtown to 80 ovens and was shipping foundry coke by rail to the foundry of Graff, Bennett & Company. Demand for expansion of the coke market arrived when, after coke made from coal in the Pittsburgh seam near Pittsburgh failed at the Clinton Furnace, someone suggested to the owners that they try Connellsville coke. An order was placed with Cochran and Keister's Fayette coke works at Sedgwick on Hickman Run, which had just been enlarged to about 30 or 40 ovens. Firing the Clinton Furnace with this coke in 1860 proved successful, opening a market for Connellsville furnace coke.[30]

Through a process of trial and error, coke operators had found what they believed to be the most practical designs, materials, and methods of operation for beehive ovens, and these became standard practice. Thus it was only happenstance that such beehive technology was finally matched with the Connellsville basin's Pittsburgh coal, which is naturally low in sulfur, to

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Chicago World's Fair, 1893), on file at the Uniontown Public Library, Uniontown, PA, and at the Library of Congress, Washington, DC; "The Coking Industry," Coal and Timber 1 (June 1905): 8; A.W. Belden, Metallurgical Coke, Technical Paper 50 of the Bureau of Mines, U.S. Department of the Interior, (Washington, DC: Government Printing Office, 1913), 5-7; "The Connellsville and Lower Connellsville Regions," The Weekly Courier, May 1914 (Special Historical and Statistical Number, hereinafter referenced as The Courier, 1914 Special), 8; McClenathan, Centennial History of Connellsville, 269-275; Pittsburgh: Its Industry & Commerce, 18.

[30] "The Connellsville and Lower Connellsville Coke Regions," 8; "Railroads in the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 48; H.C. Frick Coke Company, Connellsville Coke, n.p.; McClenathan, Centennial History of Connellsville, 276-278.

produce a coke with superior metallurgical qualities.[31] The Fayette and Sterling works were the first of any significant size in the region to produce furnace coke commercially. Soon thereafter, the Connellsville Gas Coal Company built the 40-oven Wheeler plant just outside Connellsville; Meskinnin, Faber & Bailey built several ovens on the Davidson farm; Cochran and Keister built the 40-oven Jackson works on Hickman's Run in 1864; and Watt, Taylor and Company built 40 ovens near Dunbar in 1869. In 1870, there were between 550 and 790 ovens in the Connellsville region (sources vary) producing about fifteen million bushels of coke annually. About 560 men worked in the coke region's mines and coking works. By that time, there were seven blast furnaces in Pittsburgh, and they consumed about a third of the coke the Connellsville ovens exported. Most of the rest of the exported coke was sent to markets west of Pittsburgh. Forges and foundries in Pittsburgh had not yet entered the market for Connellsville coke, being satisfied with the five million bushels being produced annually by approximately 300 ovens in or near Pittsburgh.[32]

Early plants were clustered near the center of the Connellsville region because their developers knew the coal there produced coke with the very hard structure preferred by furnacemen. Coke made from coal mined in other areas of the Pittsburgh seam contained more sulphur and/or yielded a softer coke which could not bear the weight of ore and limestone in a blast furnace. Indeed, furnacemen and early coke operators understood the technological capabilities of different coals. Hence the concentration of early coking operations near the town of Connellsville.[33]

Despite the drop in the price for Connellsville coke in the mid-1870s, it had already gained renown for its quality. The Second Geological Survey of Pennsylvania in 1875 referred to it as "the

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[31] R.M. Atwater, "The Effect of Coke Oven Construction on Coke," Proceedings of Engineers Society of Western Pennsylvania 12 (1896): 74.

[32] "The Connellsville and Lower Connellsville Coke Regions," The Courier, 1914 Special, 8; H.C. Frick Coke Company, Connellsville Coke, n.p.; McClenathan, Centennial History of Connellsville, 278-280; Pittsburgh: Its Industry & Commerce, 18; John Fulton, "Coal Mining in the Connellsville Coke Region," Engineering and Mining Journal 38 (13 September 1884): 170.

[33] Atwater, "The Effect of Coke Oven Construction on Coke," 74.

famous Connellsville coke,"[34] and its author expressed astonishment at the sudden growth of the coke industry in the region:

> Perhaps the most surprising feature of this enormous business is its sudden and recent growth; nearly all of these ovens having been built within the last ten years. Before 1865, the trade was small, the market chiefly local to the Pittsburg [sic] region, the reputation of the coke much less wide spread, and the number of coke ovens growing slowly. Since that time the increase of the business has been amazing. Other coking districts have enlarged their capacities also; much coke, and of good quality too, now coming from the line of the Pennsylvania railroad from Blairsville to Pittsburg; but the growth of their trade has been slow compared to that of the Connellsville region.[35]

The author cited tests purporting to show that "for strength and efficiency, the only coke which closely approaches the Connellsville coke, is that made at Bennington station, on the Allegheny mountain."[36] Although Pittsburgh was a significant market for the Connellsville region's product, much of the coke was being shipped to other western Pennsylvania locations, such as the local Dunbar furnace and Johnstown, and as far as Chicago, Milwaukee, St. Louis, Salt Lake City, and even California. Moreover, not all the coal mined was used for coking. F.H. Frost & Son operated twelve ovens, but also shipped between ten and fifteen cars of lump coal daily to Connellsville for use by the Pittsburgh and Connellsville Railroad. Some of the operators, such as Sherrick, Merkle & Co. and Morgan & Co. also served as marketers, buying coke from other Fayette County producers and then selling and shipping it to customers elsewhere.[37]

Despite Frick's move to acquire existing properties, the market expanded so rapidly after 1879 that there was ample opportunity

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[34] Franklin Pratt, Special Report on the Coke Manufacture of the Youghiogheny River Valley in Fayette and Westmoreland Counties with Geological Notes of the Coal and Iron Ore Beds, Second Geological Survey of Pennsylvania, 1875 (Harrisburg: Board of Commissioners for the Second Geological Survey, 1876), 40.

[35] Ibid., 61.

[36] Ibid., 61-62.

[37] Ibid., 40-60.

for new operators. The market was continuously growing that there was said to have not been a single insolvency nor forced liquidation of a coke business in Fayette County from the Panic of 1873 to the early 20th century.[38] In 1880 there were 6,237 ovens in the region with 1,242 more under construction, and additional ovens followed in subsequent years. This boom period gave rise to many coking companies, some of which were small operators operating a single plant with only a few ovens, while others owned several works and hundreds of ovens. The most important of Frick's competitors was the Cleveland entrepreneur, W.J. Rainey, who acquired coal lands at Fort Hill near Vanderbilt in 1879 and the following year built 153 ovens.[39]

Hundreds of people often worked at plants of the size developed in the Connellsville region. At the Leisenring No. 1 plant, which also had 500 ovens, Connellsville Coke and Iron employed 422 in 1888. During that year, the company produced about 348,000 tons of coal at Leisenring No. 1, of which it shipped only 1,500 tons, the rest going straight into its ovens. Leisenring No. 1 produced about 247,000 tons of coke that year. In addition to the humans employed at the works, the company derived power from 11 boilers and 27 horses and mules. Working inside the mine were 252 men, of whom 1 was the foreman, 180 were miners, 28 were drivers, 23 were classified "all company men" (men employed by the company to undertake the numerous tasks in a mine which did not fit the job descriptions of miners or drivers), 5 were miners' boys, and 15 were doorboys or helpers. Another 170 worked outside the mine, including a foreman, 6 blacksmiths and carpenters, 6 engineers and firemen, 132 cokers and yardmen, another 19 all company men, and 6 office personnel, including the superintendent, bookkeepers, and clerks.[40]

By comparison, the H.C. Frick Coke Company employed 981 at its Standard Shaft No. 2, the largest coke producer in the Connellsville region in 1888. At this works, Frick produced 436,000 tons of coal, all of which went to the 885 ovens, where Frick produced 382,000 tons of coke. To aid the workers, Frick

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[38] L.W. Fogg, "The Connellsville Coke Supply," The Iron Age 79 (28 March 1907): 972.

[39] "The Connellsville and Lower Connellsville Coke Regions," 9; H.C. Frick Coke Company, Connellsville Coke, n.p. McClenathan, Centennial History of Connellsville, 281; "Obituary" of W.J. Rainey, The Engineering and Mining Journal 69 (31 March 1900): 386.

[40] Davis, "Fifth Bituminous District," 347-350.

employed 15 boilers and 63 horses and mules. Working inside the mine were 551 men, of whom 2 were foremen or mine bosses, 448 were miners, 35 were all company men, 45 were drivers or runners, 5 were miners' boys, and 16 were doorboys or helpers. Outside the mine were another 430 employees, including 5 foremen, 14 blacksmiths and carpenters, 14 engineers and firemen, 340 cokers and yardmen, 35 all company men, and 5 persons in the office (the superintendent, bookkeepers, and clerks). By the end of the 19th century, Frick had added 23 ovens to the Standard Shaft No. 2 works for a total of 908. Said to be the largest coking plant in the world at the time, Standard shipped 125 carloads of coke daily when in full production.[41]

Toward the other extreme in size of operation was the W.J. Rainey Company's Paul works, where 70 people were employed. The mine at Paul produced 43,000 tons of coal, all of which went to the ovens. The 83 ovens produced 29,000 tons of coke. To assist the workers, Rainey only employed one boiler and six horses. The 44 workers inside the mine were divided as follows: 38 miners, 5 drivers, and 1 doorboy or helper. The 26 outside workers included: 2 blacksmiths and carpenters, 2 engineers and firemen, 20 cokers and yardmen, 1 superintendent for the entire operation, and one bookkeeper/clerk.[42]

In 1888, The Engineering and Mining Journal conducted a study to determine what were the various costs in making a ton of coke in the Connellsville region. Costs at the three works surveyed ranged from $1.00 per ton to $1.20 per ton. About 85% of those costs were for labor. In each case the cost of coal, direct from the mine, comprised a little more than half the cost of coke. About 40% of the cost of coal was the actual cost of mining at the working face, the rest including charges for haulage, hoisting, supervision, maintenance, and office costs. The cost of manufacturing coke ranged from 37 cents to 42 cents per ton, with the largest portion, about 18 cents or close to half of that cost, going to coke drawers' wages. Charging the ovens and leveling the ovens each cost about 2-1/2 cents per ton, and loading the coke onto cars cost between 3 and 5 cents per ton. The remainder of the costs for coking went to supervision, maintenance, and office costs. The study noted that these costs exceeded the current price of coke, which was about $1.00 per

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[41] William Jenkins, "Second Bituminous District," in Reports of the Inspectors of Mines of the Anthracite and Bituminous Coal Regions of Pennsylvania for the Year 1888, 276-281; Keighley, "The Connellsville Coke Region," 31-32.

[42] Davis, "Fifth Bituminous District," 348-353.

ton. The study also noted that its figures did not include the credits that would appear on a balance sheet for the profits made from sales at the company store and from the rent of houses. Concluding that the operators in the region were currently barely breaking even, if that, the study said the price would have to rise above about $1.25 per ton to make a profit.[43]

If the growth in the Connellsville coke industry had been amazing during the ten years leading up to 1876, it continued to be so through the end of the century. At the close of 1880, there were 7,211 ovens in the region with another 731 under construction. Operators in the region mined over 3 million tons of coal and produced 2.2 million tons of coke that year. By comparison in 1880, there were in the United States 186 establishments operating about 13,500 ovens, using about 5.2 million tons of coal, and producing about 3.3 tons of coke. Coking businesses were spread through 13 states and territories, with Pennsylvania leading the list with 124 establishments. Pennsylvania as a whole produced 2.8 million tons of coke. The Connellsville region, therefore, produced 79% percent of Pennsylvania's coke and 67% of the national total.[44]

During the next twenty years, as the iron and steel industry grew, so did the demand for coke. Part of this increased demand even came from the anthracite-burning iron industry, because during the 1875 coal strike in the anthracite region, eastern furnaces had kept operating using coke shipped by rail from the bituminous region. After the strike was settled, eastern furnaces continued to mix coke with anthracite because, even though anthracite was cheaper than coke in that region, furnacemen had found coke to be a superior fuel because of its size. By the end of 1898, there were almost 19,000 ovens in the Connellsville coke region and annual production stood at over 12

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[43] "Cost of Coal Mining and Coke Making in the Connellsville District, PA," The Engineering and Mining Journal 46 (13 October 1888): 300. A more detailed accounting of production costs was carried in "The Cost of Making Connellsville Coke," The Engineering and Mining Journal 38 (11 October 1884): 252, based on court proceedings. It does not, however, put the costs in terms of tons of coke produced.

[44] Joseph D. Weeks, "The Manufacture of Coke," in U.S. Geological Survey, Mineral Resources of the United States, 1883 and 1884 (Washington, DC: Government Printing Office, 1885): 147, 149; Pennsylvania Department of Internal Affairs, Bureau of Statistics, Pennsylvania's Mineral Heritage (Harrisburg: Department of Internal Affairs, 1944), 28.

million tons of coal mined and over 8 million tons of coke produced. Growth continued, with over 20,000 ovens in the region in 1900 producing over 10 million tons of coke. The remarkable growth in coke production in the Connellsville region kept it far ahead of all others both in Pennsylvania and the United States. For the last twenty years of the century, the Connellsville region produced about 75% of the coke made in Pennsylvania, reaching a peak of 87.6% in 1895, and until 1900 the state was responsible for over half the nation's output. That year, for the first time, Pennsylvania's share dropped below half to 49.5%. Because of its high quality and the high demand for its use at furnaces throughout America's northern steel belt, Connellsville coke sold for a higher price than other coke except for that produced in remote regions where transportation kept costs high. Because of the high price Connellsville coke fetched, it accounted for over half the coke production in the United States, measured by value, even in 1900. The coking quality of the Connellsville coal was so highly prized that of the 114 mines operating in the greater Connellsville region in 1900, only four of them did not send their coal straight to the ovens.[45]

To insure themselves of a supply of Connellsville coke, a number of the nation's largest iron and steel producers established companies to operate works in the Connellsville region. Coal in the original Connellsville coke region, however, was rapidly being depleted and several old plants had been closed and demolished by the end of the century. The first such plant to be demolished was the Fountain works, which closed in 1881 after Frick bought the coal lands to supply the nearby Valley works. Next to be demolished, in about 1890, were the old independent Cora ovens. In 1895, the Charlotte Furnace Company of Scottdale demolished its Charlotte ovens, which had been out of service since 1888. Not only was coal being exhausted in the old Connellsville region; there was virtually no coal lands available for new operators in the field, Frick and others having acquired all the acreage. This compelled coke specialists to test nearby fields in the hope of finding coal which could produced a product of equal value to that produced in the old Connellsville region. Such tests late in the 1890s showed that the Pittsburgh seam just

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[45] Temin, Iron and Steel, 201-203; Keighley, "The Connellsville Coking Region: A History of Its Development and an Account of Its Wonderful Production at the Present Time," Mines and Minerals 20 (February 1900): 320; "Connellsville Coke Output in 1903," Iron Trade Review 37 (24 January 1904): 66; Eavenson, "The Connellsville Region," 27; "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 10.

west of the Uniontown syncline, in what was known as the Klondike (and eventually as the Lower Connellsville) region, produced good metallurgical coke. The Klondike coke region opened in 1899.[46]

Early operators in the Klondike region included the American Coke Company, associated with the American Steel and Wire Company and which developed the Gates (a mine only, situated on the Monongahela River for downstream shipment of coal, not coke, by barge), Edenborn, Lambert, and Palmer works, and the Eureka Fuel Company (soon thereafter the South West Connellsville Coke Company), associated with the Illinois Steel Company and which operated the Footedale, Lechrone, and the Buffington works. These companies, the Washington Coal and Coke Company, and the W.J. Rainey Company were the first operators to develop works to utilize coal from the Lower Connellsville region. Changes in steel-making technology helped to create the market for coke from the Lower Connellsville region. Coal mined there produced a more dense coke than did that mined in the original Connellsville region. Earlier blast furnaces could not burn such dense coke. As furnaces grew in size, however, they were provided with higher-pressure blast. Thus, the dense coke from the Lower Connellsville region became desirable to support the greater weight in the larger furnaces and the stronger blast made it possible to burn such coke.[47]

Henry Clay Frick

In 1871, Henry Clay Frick joined with other local promoters in the Scottdale area to invest in the 10-mile Broad Ford and Mt. Pleasant Railroad, which provided transportation to the coal lands north of Jacob's Creek. That same year, Frick and his cousin A.O. Tintsman joined Joseph Rist to form a partnership called Frick & Co., bought 300 acres of coal land near Broad Ford, and built 50 ovens, known as the Frick works. Expanding

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[46] The Weekly Courier 17 (8 November 1895): 3; H.C. Frick Coke Company, "Historical Data: H.C. Frick Coke Company's Plants," 3, 7.

[47] "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 10; "H.C. Frick Coke Company," US Steel News Coal Number (December 1936): 22; J.A. Coll, "Coke Ovens of the United States Steel Corporation," The Engineering and Mining Journal 71 (27 April 1901): 526; J. Percy Hart, Hart's History and Directory of the Three Town: Brownsville, Bridgeport, West Brownsville (Cadwallader, PA: J. Percy Hart, 1904), 43-46; Keighley, "Why Do Some Coals Coke," Mines and Minerals 28 (October 1907): 112.

its operations in 1872, Frick & Co. added 50 ovens to the Frick works and built the 100-oven Henry Clay works near Broad Ford on the Youghiogheny. Others followed suit that year, with Robert Hogsett building the 100-oven Mt. Braddock works, the Cochrans building the 100-oven Jimtown works, and the lawyers Willson, Boyle, and Playford developing the 50-oven Valley works. This was the beginning of a boom, leading to a total of 3,673 ovens in the region by 1873. A nationwide recession that year, called the "Panic of 1873," slowed the iron industry, and created an oversupply of coke which drove the price of coke down to about one dollar per ton. Believing there was a future in coke, Frick and his backers bought many coal and coke properties at bargain prices. Renewed vigor in the iron industry soon brought back the demand for coke, and in 1879 the price jumped to five dollars per ton. This episode formed the basis of Frick's dominance in the Connellsville coke region.[48]

Although opportunities in the Connellsville coke industry experienced almost constant growth during the last quarter of the 19th century, the H.C. Frick Coke Company was able to retain dominance, due largely to the business sense of Henry Clay Frick. Born in 1849 at Overton, Frick grew up in relatively privileged circumstances. His father was a farmer, but more importantly his maternal grandfather, Abraham Overholt, was a prominent landowner, miller, and distiller. This latter endeavor proved quite lucrative for the Overholt family, which produced the nationally-marketed Old Overholt whiskey. Henry Clay Frick attended local primary schools and spent brief periods at the Classical and Scientific Institute at Mt. Pleasant and Otterbien University in Westerville, Ohio. During those years of schooling, the young Frick worked on his father's farm, his uncle's store, and for a time as a clerk and bookkeeper in his grandfather's business. During the latter employment, he had ample opportunity to observe Overholt's new West Overton coke works developing nearby. Joseph Rist, a nearby farmer, encouraged Frick, then 21, to buy some coal land and start making coke.[49]

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[48] "The Connellsville and Lower Connellsville Coke Regions," 8-9; H.C. Frick Coke Company, Connellsville Coke, n.p.

[49] There are several accounts of Frick's early life. A brief summary is in Allen Johnson and Dumas Malone, Dictionary of American Biography, Vol VII (New York: Charles Scribner's Sons, 1931), 29-31. The most extensive biography is George Harvey, Henry Clay Frick: The Man (New York: Charles Scribner's Sons, 1928). There are several romanticized biographical sketches of Frick in collections of American titans of industry during the

As already noted, shortly after Frick began his coking business, the Panic of 1873 struck, furnaces in Pittsburgh shut down, and the bottom fell out of the coke market. Rist and Tintsman wanted out of the coke business, but Frick chose to weather the storm, purchasing his partners' shares in Frick and Company. He was also able to buy some other works at bargain basement prices. Believing that the damage done to ovens if they were allowed to cool down and later reheated was greater than the loss he would incur by selling coke below cost, he kept his plants operating and worked tirelessly travelling to Pittsburgh to personally market his product to the few furnaces still producing. One of the ways he paid for the labor to operate his works was to pay wages in Frick & Co. script, closely resembling U.S. currency and redeemable at his new company store. Frick charged competitive prices for goods in his store. When U.S. currency became scarce as a result of the panic, Frick & Co. script became the currency of the Broadford community.[50]

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late-19th and early-20th centuries, including James Burnley, Millionaires & Kings of Enterprise (Philadelphia: L.P. Lippincott Co., 1901), 400-406; Herbert N. Casson, The Romance of Steel: The Story of a Thousand Millionaires (New York: A.S. Barnes & Company, 1907), 104-144; and, the most analytical of the three, Berlie Charles Forbes, Men Who Are Making America (New York: B.C. Forbes Publishing Co., 1919), 131-143. There are also anecdotal local treatments of Frick's early career, such as John W. Oliver, "Henry Clay Frick, Pioneer-Patriot and Philanthropist, 1849-1919," The Western Pennsylvania Historical Magazine 32 (September-December 1949): 67-78; and C.S. Wardley, "The Early Development of the H.C. Frick Coke Company," The Western Pennsylvania Historical Magazine 32 (September-December 1949): 79-86. Kenneth Warren is working on a book (forthcoming from the University of Pittsburgh Press) on Frick's career, examining his personality in the context of the rise of Pittsburgh's steel industry and America's corporate/industrial revolution. Warren presents a summary assessment of Frick's career in "The Business Career of Henry Clay Frick," Pittsburgh History (Spring 1990): 3-15.

[50] George Dallas Albert, ed., History of the County of Westmoreland, Pennsylvania, with Biographical Sketches of Many of the Pioneers and Prominent Men (Philadelphia: L.H. Everts & Co., 1882), 547-549; Harvey, Henry Clay Frick, 52-57; Enman, "Coal Company Store Prices Questioned: A Case Study of the Union Supply Company, 1905-1905," Pennsylvania History: Quarterly of the Pennsylvania Historical Association 41 (January 1974): 56.

Frick was able to keep his lenders from foreclosing by always making his interest payments, and then applying for extensions on repayment of the principal. He aided his financial situation in 1874 greatly by securing options from his fellow investors in the Mt. Pleasant and Broad Ford Railroad and then selling the line to the B&O, reaping a $50,000 profit which he promptly invested in additional coal lands. Then, while others were withdrawing from financial activity, Frick took out a mortgage on his property to purchase freight cars so that he could insure shipment of the coke he was producing. He also brought an investor, E.M. Ferguson, a Pittsburgh capitalist, into his business, now renamed H.C. Frick and Company. During this period, Frick was the only Connellsville operator who continued to produce coke on a regular basis.[51]

When the nation pulled out of its economic crisis in 1879 and iron production returned to earlier levels, there was a sudden demand for coke. The price of coke jumped from under a dollar to $5.00 per ton. By 1882, Frick had greatly expanded the number of works he owned or operated. During and shortly after the economic crisis, he had acquired the following properties: the Morgan works, begun by Morgan and Company (Tintsman and Morgan) in 1869, acquired by Frick in 1877; Valley works, begun by Wilson, Boyle & Playford in 1869, acquired by Frick in 1877; White works, begun by Charles Armstrong in 1873, taken over by A.A. Hutchinson & Bro., and then acquired by Frick in 1877; Foundry works, begun by Strickler and Lane in 1870, acquired by Frick in 1879; Tip Top works, begun by Charles Armstrong in 1878, taken over by Frick in 1879; Eagle works, begun by Sherrick, Markle & Co. in 1870, acquired by Frick in 1880; and the Summit works, begun by James Cochran in 1874, taken over by Hurst, Moore & Co., and then acquired by Frick in 1880. In addition, between 1878 and 1881 he leased and operated the Fountain works and the Anchor works (also known as the Home works), begun by J.W. Blake in 1872 and 1877, respectively.[52] As already noted, in 1880

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[51] Forbes, Men Who Are Making America, 135; H.C. Frick Coke Company, Connellsville Coke, n.p.; James Howard Bridge, The Inside History of the Carnegie Steel Company: A Romance of Millions (New York: Arno Press, 1972 reprint of 1903 edition), 172; Harvey, Henry Clay Frick, 52-57.

[52] H.C. Frick Coke Company, "Historical Data: H.C. Frick Coke Company's Plants," xerographic copy of types tables compiled in approximately 1923, on file at the Office of Resource Management, US Diversified Group, USX Corporation, Uniontown. Some sources also suggest that Frick developed the Mt. Braddock works in the early 1870s, and then sold them in 1881 to A.O.

there were 6,237 ovens in the region with 1,242 more under construction. Of the total, Frick owned or controlled more than 1,000 ovens and was by far the largest operator in the Connellsville region.[53]

In the process of marketing his coke, Frick had become well acquainted with Thomas Carnegie who was always looking for fuel for his furnaces (by the 1880s, his brother Andrew moved to New York, from where he kept a hand in his iron interests). In 1882, Frick and the Carnegies negotiated a deal whereby a new corporate entity, the H.C. Frick Coke Company, would take over the properties and operations of the old H.C. Frick and Company. The new company, headquartered at Broadford, issued 40,000 shares of stock valued at $50 each for a capitalization of $2 million. The old Frick Company received 33,500 shares in compensation for the property brought into the new firm. Other shares were issued as follows:

Andrew Carnegie	1,000
Thomas M. Carnegie	500
Henry Phipps, Jr. (a Carnegie associate)	500
H.C. Frick	680
E.M. Ferguson	660
Walton Ferguson (brother of E.M. Ferguson)	660
Carnegie Brothers and Co.	2,500

All of the individual shareholders except Andrew Carnegie were named as directors and Frick was the president. Frick and the Ferguson brothers each owned a third of the old company, so the new distribution of stock left Frick owning just under 30% of the H.C. Frick Coke Company. Within a year, in order to capitalize new acquisitions of coal lands and coke works, the Fergusons sold their shares and Frick sold most of his to the Carnegies, leaving

Tintsman, who later sold them to W.J. Rainey. The Frick records which USX retains do not show Frick ever owning Mt. Braddock. Other sources also suggest that Frick developed the Jimtown works in the early 1870s, but USX records say the works were begun by Mordecai Cochran in 1860, taken over by James W., Alex C., and Lutellas Cochran in 1865, by Brown and Cochran in 1868, and acquired by J.M. Schoonmaker Coke Co. in 1880. H.C. Frick Coke Co. did not acquire the Jimtown works until 1889.

[53] H.C. Frick Coke Company, Connellsville Coke, n.p.

Frick with little control of stock but still in the position of president and in complete control of the operations.[54]

At the time of the merger with the Carnegie interests, Frick and Company owned the Frick, Henry Clay, Morgan, Foundry, White, Eagle, Summit, Valley, and Tip Top works. The Monastery works at Latrobe, owned by Carnegie Brothers and Company, joined the H.C. Frick Coke Company's stable of plants.[55] Yet the Frick Coke Company could not meet demand for its product. Frick saw that the market for coke would continue to expand and that coal and coke properties would continue to gain value, so he advocated buying existing operations while prices were still relatively low to insure that the company could meet future demand. Casting his eye about the region, he targeted those properties which he believed had been well built, such as the works of Hutchinson and Company and the Connellsville Gas Coal Company: "They were not built to sell; are good in every respect--good coal--good improvements and, what is of no small importance, well located."[56] Thus continued a pattern in which the H.C. Frick Coke Company acquired rather than developed coking works. From the time of its incorporation until its absorption into the U.S. Steel Corporation in 1903, the H.C. Frick Coke Company built only two plants, the Adelaide works, across the Youghiogheny from Broadford in 1888, and Standard No. 2, built to replace the works destroyed by fire at Standard No. 1.[57]

This method of expansion was effective. The H.C. Frick Coke Company acquired operating facilities and so was able immediately upon purchase to begin producing revenue, and the company eliminated competitors. By 1886, there were over 10,000 ovens in the Connellsville region, and Frick controlled 3,453 of them.

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[54] Articles of Incorporation for the H.C. Frick Coke Company, filed 12 March 1882, Charter Book 14, Corporations Bureau, Secretary of the Commonwealth of Pennsylvania, Harrisburg, 280-281; Harvey, Henry Clay Frick, 76-82.

[55] U.S. Steel Public Relations Department, "The Frick District: The First 100 Years," script for slide show marking the centennial of the H.C Frick Coke Company, 1982, on file at the office of US Diversified Group, USX Corporation, Uniontown, 7.

[56] Frick to Andrew Carnegie, 13 August 1883, letter quoted in its entirely in Harvey, Henry Clay Frick, 79-80.

[57] Wardley, "The Early Development of the H.C. Frick Coke Company," 82-83; H.C. Frick Coke Company, "Historical Data: H.C. Frick Coke Company's Plants."

Newly acquired or leased plants included: the American works, 72 ovens acquired from Samuel Warden; the Davidson works, 296 ovens acquired from the Pittsburgh and Connellsville Gas Coal Company; Morewood works, 470 ovens from the Morewood Coke Company; Standard works, 573 ovens from A.A. Hutchinson & Bro.; Tarr's works, 66 ovens from D.R Dillinger & Bro.; Trotter works, 464 ovens from the Consolidated Connellsville Coke Company; and the Leith works, 284 ovens from the Chicago and Connellsville Coke Company. (Henry Clay Frick was actually one of the nine shareholders of the latter company, incorporated in 1886. The other shareholders were Walter Ferguson and Charles H. Spencer, both of Pittsburgh, and six men from Chicago, who probably represented furnace companies in that city desiring access to Connellsville coke.) To pay for this expansion, the Carnegies increased the capitalization of the H.C. Frick Coke Company to $3 million in 1883 and to $5 million in 1889.[58]

While the number of coke ovens in the Connellsville region grew, there was not necessarily a steady growth in demand for coke. The coke trade was definitely subservient to the iron and steel industry, in which production levels and consequent demand for coke fluxuated with changes in the construction, railroad, and other markets. In 1884 in an effort to stabilize prices, Frick organized the Coke Syndicate consisting of the four largest operators in the region: the H.C. Frick Coke Company with 2,784 ovens; the McClure Coke Company, 1,146 ovens; James Schoonmaker, 780 ovens; and the Connellsville Coke & Iron Company, 764 ovens. The Coke Syndicate marketed its own coke as well as that produced by the Connellsville Coke Producers Association comprised of 18 of the smaller operators who had a aggregate of 1,421 ovens. Three operators (W.J. Rainey, James Cochran, and J.W. Moore) of medium size and totalling 908 ovens chose not to join either group. The Syndicate and the Association reached agreements concerning prices they would accept, levels of production, and the rate at which new ovens would be built. They succeeded in stabilizing prices until 1887 when labor unrest in the region disrupted the organizations. Prior to its breakup, the Syndicate had monitored the market and gave orders to member firms concerning how many ovens could be operated. For example during

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[58] Joseph D. Weeks, "Directory of the Coke Works of the United States," American Manufacturer and Iron World, Coke Supplement (November 1886): 21; H.C. Frick Coke Company, "Historical Data: H.C. Frick Coke Company's Plants;" H.C. Frick Coke Company, Connellsville Coke, n.p; Articles of Incorporation for the Chicago & Connellsville Coke Company, 10 September 1886, Charter Book 23, Bureau of Corporations, Secretary of the Commonwealth of Pennsylvania, Harrisburg, 110.

the summer of 1885, when several furnaces in Pittsburgh and elsewhere were out of blast and others had an extra supply of coke in storage, members of the Syndicate and the Association shut down as many as 50% of their ovens during August. Rainey and the others went it alone, sometimes having no orders for their coke and at other times being able to operate at full capacity. During the fall, as furnaces in Ohio and the Chicago area went into blast again, the Syndicate and the Association began rekindling idle ovens, and by the end of the year nearly all ovens were operating again, leading to a scarcity of labor.[59]

Following the demise of the Syndicate, Frick acquired many of the coke producers in the Connellsville region. For example, in July 1889 the H.C. Frick Coke Company acquired all of the properties of the Connellsville Coke and Iron Company, which had been a member of the Syndicate and was owned by the Leisenrings of Philadelphia. The Leisenrings' 1,500 ovens gave Frick a total of about 7,000, at which point the company was said to be the largest coke operator in the world. By the end of August, Frick had also acquired J.W. Moore's 579 ovens and J.M Schoonmaker's 1,336, leaving the McClure Coke Company as the only member of the old Syndicate still operating outside the Frick orbit. With rumors abounding of more Frick acquisitions, McClure moved to strengthen its position by buying Robert Hogsett's Lemont works of 134 ovens in October 1889. McClure's independence did not last long, however, for in 1895 the Frick Company bought the McClure Coke Company, adding 2,500 more ovens to its holdings.[60]

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[59] "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 6; "Coal Trade Notes," The Engineering and Mining Journal 40 (4 July 1885): 8-9; (18 July 1885): 45; (1 August 1885): 80; (8 August 1885): 96-97; (12 September 1885): 186; (10 October 1885): 202; (24 October 1885): 294; (7 November 1885): 325; (21 November 1885): 357; (28 November 1885): 374; and (19 December 1885): 421.

[60] "Connellsville Coke and Iron Company," The Engineering and Mining Journal 48 (13 July 1889): 37; "Connellsville Coke," The Engineering and Mining Journal 48 (27 July 1889): 82; "Connellsville Coke," The Engineering and Mining Journal 48 (31 August 1889): 189, 191; "Connellsville Coke," The Engineering and Mining Journal 48 (14 September 1889): 234; "Connellsville Coke," The Engineering and Mining Journal 48 (21 September 1889): 256; "McClure Coke Company," The Engineering and Mining Journal 48 (5 October 1889): 301; "H.C. Frick Coke Company," The Engineering and Mining Journal 48 (28 December 1889): 574; H.C. Frick Coke Company, "Historical Data," 1-7; "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special

As the century closed, the H.C. Frick Coke Company controlled over 10,000 ovens, but its control of the coke region was even more extensive. Whereas early Frick acquisitions had been absorbed outright into the Frick Company, by the late 1890s, subsidiaries like the McClure Coke Company and the River Coke Company still existed as corporate entities, but they were owned by the Frick Company and governed by directors who were in the Frick Company/Carnegie Steel circle, such as Thomas Lynch and Charles Schwab.[61]

Frick's association with the Carnegies also brought him into the iron and steel business. Recognizing how effectively Frick managed his Connellsville coking operations, which employed 10,000 men, Carnegie invited Frick to acquire shares in Carnegie Brothers and Company in 1889, making him chairman of the board with the assignment of reorganizing the 20,000-employee business. Frick succeeded in doing so, bringing order to a disharmonious management staff, putting young men such as Charles Schwab in positions of responsibility, reorganizing the operations to make them run more systematically, and building the Union Railroad system in the Pittsburgh area which connected and integrated the various Carnegie works. Frick's organization of Carnegie's operations was considered a model for corporate departments functionally arranged under a centralized structure. He also orchestrated Carnegie acquisitions of leading Pittsburgh competitors, such as the Duquesne Steel Company. Perhaps his most significant contribution to the assembly of the Carnegie steel empire was in convincing Andrew Carnegie in the 1890s to buy iron ore reserves on the Mesabi Range in northern Minnesota, something the iron baron had been reluctant to do. This move insured Carnegie of control of the supply of that essential raw material. Before the century ended, Frick also effected the purchase of a small fleet of ships to carry ore across the Great Lakes and developed the Pittsburgh, Bessemer & Lake Erie Railroad to transport ore. It is important to note that each of these other operations, like the H.C. Frick Coke Company's operations,

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Number, 7.

[61] Articles of Incorporation for the H.C. Frick Coke Company merging the several companies, 31 March 1903, Charter Book 68, Bureau of Corporations, Secretary of the Commonwealth of Pennsylvania, Harrisburg, 529-534; Deed transferring title of the George E. Hogg Tract, Luzerne Twp., Fayette County, from Andrew B. Ledwith to River Coal Company, 27 May 1901, Deed Book Vol. 192, Office of Clerk and Recorder, Fayette County Courthouse, Uniontown, 132; "H.C. Frick Coke Co. Absorbs Coke Companies," <u>The Iron Trade Review</u> 36 (9 April 1903): 35.

remained separately managed, connected through negotiated contracts, rather than being brought wholly under the centralized control of the Carnegie Company.[62]

The relationship between Frick and Carnegie, however, was not without contention. Early signs of disagreement arose in 1883 when Frick had recommended acquiring more coking properties while Carnegie took a more conservative position. Differences between the men came to a head in 1887 during labor unrest in the Connellsville region. Frick was resisting the unions' demands, believing they could not sustain a strike. Carnegie, however, was more worried that a strike would interrupt the supply of coke to his furnaces, so from New York he overruled Frick and met the unions' demands. Saying that this response would encourage repeated actions by the unions, Frick resigned in anger. Frick's prediction proved correct. Carnegie altered his views and in 1888 asked Frick to resume his duties as president of H.C. Frick Coke Company. Frick took a stern position regarding union demands in the Connellsville region. The recognition of this attitude, coupled with an appreciation of Frick's overall managerial capabilities, that induced Carnegie to ask Frick to take over the operations of Carnegie Steel. Frick's resolute resistance to union demands reached its climax, then, during the Homestead lockout in 1892, one of the nation's bloodiest labor/management confrontations and a benchmark in American labor history. Frick refused to yield at all to the unions and, with the help of Pinkertons and the military, succeeded in breaking the unions at Homestead.[63]

Frick and Carnegie were at odds again in 1899, when Frick believed that Carnegie was paying the H.C. Frick Coke Company too little for coke. To resolve the impasse Carnegie tried to buy

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[62] Johnson and Malone, Dictionary of American Biography, 30; Harvey, Henry Clay Frick, 93; Forbes, Men Who Are Making America, 138; Alfred D. Chandler, Jr., Strategy and Structure: Chapters in the History of the Industrial Enterprise (Cambridge: The M.I.T. Press, 1962), 285; Chandler, "The Beginnings of 'Big Business' in American Industry," reprinted from Business History Review 33 (Spring 1959): 1-31 in The Essential Alfred Chandler: Essays Toward a Historical Theory of Big Business, Thomas K. McGraw, ed. (Boston: Harvard Business School Press, 1988), 63.

[63] Harvey, Henry Clay Frick, 80-92; Forbes, Men Who Are Making America, 139. The most recent treatment of the social, political, and corporate context of the Homestead lockout is Paul Krause, The Battle for Homestead, 1880-1892: Politics, Culture, and Steel (Pittsburgh: University of Pittsburgh Press, 1992).

Frick out, but at terms Frick would not accept. Frick sued Carnegie and won a settlement much more lucrative than Carnegie's offer. During the ten years Frick headed Carnegie Steel, output of its plants grew from 536,838 tons of steel in 1889 to 2,663,412 in 1899. The H.C. Frick Coke Company had not expanded at quite the same rate as Carnegie, in part because Frick had the capacity to produce about twice the coke Carnegie's furnaces required (the H.C. Frick Coke Company supplied other steel companies as well) and in part because much of what would have been Frick Company profits were plowed instead into improvements in steel plants. Nevertheless, the Frick Company had also grown to be a giant industrial concern by the end of the century, owning 11,000 ovens, 2,500 railroad cars, and 3,500 dwellings. After severing his relationship with Carnegie, Frick was not out of the steel business for long, jointly investing with his friend Andrew Mellon in the Union Steel Company in 1900. In 1901, J.P. Morgan brought Frick into negotiations which led to the 1902 formation of United States Steel. The last two decades of Frick's life were active in other spheres of business. He joined Mellon in banking interests, served on the boards of several railroads, helped plan a copper mining venture in Peru, and chaired a committee investigating the Equitable Life Assurance Society. He also remained active in U.S. Steel, serving on the board until his death. When he died in 1919, Henry Clay Frick was considered among the very elite of the nation's businessmen.[64]

The 1890s saw the concentration of the nation's iron and steel industry into fewer hands, who sought to vertically integrate the industry. Distinct corporate entities were responsible for mining raw materials, making raw steel, rolling structural shapes, or fabricating finished products, each supplying each other with raw and partially finished materials. The largest of these holding companies orbited around one of three men, as did each of the three largest steel producers. Andrew Carnegie's Carnegie Steel Company was the nation's largest, followed by the Federal Steel Company of the J.P. Morgan group. W.H. Moore's

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[64] Forbes, Men Who Are Making America, 142-143; Johnson and Malone, Dictionary of American Biography, 30-31; Bridge, History of the Carnegie Steel Company, 297-298; Warren, "Henry Clay Frick," 8-13; "Seventeenth Annual Report of the United States Steel Corporation for the Fiscal Year Ended December 31, 1918," and "Eighteenth Annual Report of the United States Steel Corporation for the Fiscal Year Ended December 31, 1919," (U.S. Steel Bound Annual Reports, 1901-1966, Box 1, Shelf 6, Section 4012, Room 14, United States Steel Corporation Archives, Annondale, PA).

National Steel Company was third. The Morgan and Moore groups included a number of producers of finished products, such as National Tube, American Steel and Wire, American Bridge Company, American Tinplate, American Sheet Steel, and American Steel Hoop. Carnegie Steel, however, dominated the production of raw steel and structural shapes, supplying fabricators of finished products. When some of these lesser corporations moved to develop their own supplies of raw steel, Carnegie retaliated in 1900 with plans to build its own tube, wire, and other finished-product mills. Carnegie even threatened to develop its own interstate railroad network. These moves by the nation's largest steel producer forced discussions which eventually led to the formation of U.S. Steel.[65]

Buying Carnegie out was the only option competitors saw to the price war which would ensue if Carnegie followed through on its threats. Members of the Moore and Morgan circles turned to J.P. Morgan as the only individual with the financial capability of buying Carnegie's assets. After a series of negotiations, the U.S. Steel Corporation was formed with to acquire the assets of the three groups, paying $492 million to the Carnegie Steel Company. U.S. Steel became the first billion dollar corporation, capitalized at $1.4 billion. Despite its giant scale, U.S. Steel was not in a position to attain complete control the steel industry, as there were still a good number of other large and healthy steel makers to contend with, including the likes of Bethlehem Steel, Cambria Steel, Lackawanna Steel, Jones & Laughlin, Colorado Fuel and Iron, and Republic Iron and Steel. Moreover, observers recognized that the purpose of forming U.S. Steel was not to drive up prices, but as the New York Times put it, "to eliminate Mr. Carnegie from the trade. His competitors are tired of dancing to the music of his bagpipes and could make no plans for their own protection until his vast capital and masterful intelligence were devoted to philanthropy rather than to business."[66]

Because the H.C. Frick Coke Company was owned by Carnegie Steel, it became a part of U.S. Steel. Henry Clay Frick was himself no longer directly involved in the Frick Company, but he was a

[65] Hogan, Economic History of Iron and Steel, Vol. 2, 463-468.

[66] "Domestic Competition in Steel and Iron," editorial, New York Times, 28 February 1901, quoted in Hogan, Economic History of Iron and Steel, 473. See also Alfred D. Chandler, Strategy and Structure: Chapters in the History of the Industrial Enterprise (Cambridge: The M.I.T. Press, 1962), 34-35.

member of U.S. Steel's board of directors, in which capacity he served as a senior advisor to Morgan and, for example, played a key role in U.S. Steel's acquisition of the Tennessee Iron, Coal, and Railroad Company of Birmingham, Alabama. Thomas Lynch, who had been superintendent of the early H.C. Frick Coke Company and become president after Henry Clay Frick left, remained as president, as well being made president of the other U.S. Steel coal and coke companies, such as McClure (formerly owned by Frick), United Coal and Coke (formerly owned by National Tube and American Steel Hoop), South West Connellsville Coke Company (formerly owned by Illinois Steel/Federal Steel), American Coke (formerly owned by American Steel & Wire), and Continental Coke (formerly owned by National Steel). In 1903, all of those companies ceased to exist as their assets were merged with Frick's. This action paralleled consolidation of other steel companies which had been brought together by the formation of U.S. Steel. The further consolidation of U.S. Steel into a single operating company did not occur, however, until the 1930s. Prior to that time, each of the major subsidiaries, such as the H.C. Frick Coke Company, operated as single-function entities in mining, coking, transportation, smelting and basic metal production, or fabrication.[67]

One major impact of the U.S. Steel merger was that the H.C. Frick Coke Company ceased selling coke on the open market, supplying only U.S. Steel plants. With the 1903 merger, the Frick Company owned 16,770 ovens in the Connellsville and Lower Connellsville regions with a daily production capacity of about 36,000 tons of coke. In total, U.S. Steel owned about 30,000 ovens, both beehive and by-product, throughout the nation.[68] Yet U.S. Steel's demand for coke was so great that even with the addition of all the Connellsville plants brought in by the merger of the other subsidiary companies, the Frick Company could not satisfy that demand. The situation was exacerbated by the fact that some

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[67] Hogan, Economic History of Iron and Steel, 490; Articles of Incorporation for the H.C. Frick Coke Company merging the several companies, 31 March 1903; "H.C. Frick Coke Co. Absorbs Coke Companies," 35; "The United States Steel Corporation," The Iron and Steel Magazine 7 (May 1904): 495-498; Warren, "Henry Clay Frick," 12; Alfred D. Chandler, Jr., The Visible Hand: The Managerial Revolution in American Business (Cambridge: Harvard University Press, 1977), 361.

[68] "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 7; "The H.C. Frick Coke Company," US Steel News, 22; J.A. Coll, "Coke Ovens Owned by the United States Steel Corporation," 71 (27 April 1901): 526.

of the old coking plants were located by depleted coal mines. The first decade of the 20th century signalled significant changes in operations at the Frick companies.

To meet the new demand for its product and to replace ovens being retired from service, the H.C. Frick Coke Company embarked on a large-scale program to build new coking works during the first decade of the 20th century. This marked a significant change in activity for the Frick Company, because, as already noted, it generally did not build coking plants but rather added to its roster of plants through acquisition. Other than the construction of the Frick, Henry Clay, and Adelaide works and the rebuilding of the Standard works early in its history, the Frick Company had not engaged in new construction. The new century, then, also signalled a new phase of activity for the H.C. Frick Coke Company: the design and construction of new coking plants.

In 1904, the company began to appropriate large sums of money for enlarging existing plants and developing new ones, beginning with the addition of 122 ovens to the Mutual works (98 new ovens had already been built there in 1902). Later that year, the Frick Company let contracts for the construction of three new works: Yorkrun with 500 ovens and Shoaf and Bitner with 200 each (the original construction at Shoaf actually was 300 ovens). In 1906, the company added 100 ovens to Bitner, 144 ovens to Shoaf, 170 to Wynn, 60 to Lambert, and 26 ovens to Buffington, and developed four new works: Ronco (350 ovens), Dearth (250 ovens), Collier (400 ovens), and Phillips (400 ovens). The Ralph and Palmer works were developed in 1907 with 500 ovens each.[69] Such projects required large sums of capital to build not only the ovens but to acquire necessary land, sink mine shafts, construct water works, build mine buildings and workers' housing, and

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[69] H.C. Frick Coke Company, Appropriation No. 4 dated 7 January 1904, Appropr. No. 43 dated 20 June 1904, Appropr. No. 89 dated 1 February 1906, H.C. Frick Coke Co. Appropriations Vol. I, Appropr. No. 113 dated 14 November 1906, Appropr. Nos. 152 and 153 dated 30 September, Records of the Frick Coal Division, Box 8, Shelf 3, Section 72, Room 17, United States Steel Corporation Archives, Annondale, PA.

purchase and install necessary equipment. For example, all facets of the construction of Yorkrun cost the following:[70]

Real estate	29,905.83
Engineering	31,963.01
General Expenses	5,020.41
Mine Construction	35,429.06
Equipment	150,976.27
Water Works	10,401.29
Maintenance	5,231.58
Coke Ovens	270,093.65
Tenements	102,707.13
Temporary Structures	4,337.73
Insurance	399.32
Mine Buildings	156,322.29
TOTAL EXPENSE	802,787.57

Obviously, the manpower needed to undertake such a large program of construction exceeded that in the employ of the Frick Company. It is also likely that, because Frick had not built any plants for over a decade, the company did not possess the engineering expertise to design the new facilities. H.C. Frick Coke Company records which survive at the U.S. Steel corporate archives are limited to the appropriations for expenditures, beginning with late 1903 and running almost continuously through 1949. The appropriations also provide detailed accounting of the actual expenditures made for each project, including to whom and for what they were made. Unfortunately, of all the appropriations in the collection, the one for which those detailed records are missing is that for the first new construction of coke works undertaken by Frick: the construction of Yorkrun, Shoaf, and Bitner in 1904. All subsequent appropriations show engineering expenses as an in-house cost. Yet evidence suggests that Frick contracted for engineering services in this inaugural construction effort. An 1927 in-house memo referring to the lost records mentions "original plans as prepared by the W.C. Wilkins Co."[71] Other evidence also suggests that Frick contracted with the W.G. Wilkins Company, civil and mining engineers of Pittsburgh. A 1907 Wilkins publication shows views of various coal mines and coking plants the company engineered, including

[70] H.C. Frick Coke Company, Appropriation No. 43 dated 20 June 1904.

[71] Memo from W.V.W. dated 5-11-27 in H.C. Frick Coke Company, Appropriation No. 43 dated 20 June 1904,.

Bitner, Shoaf, and Yorkrun. At the back of the booklet is a table of some of the company's projects, and Bitner, Shoaf, and Yorkrun are listed, with the H.C. Frick Company as the client.[72]

A Pittsburgh native, William Glyde Wilkins was born in 1854. After graduating in civil engineering from Rennsalaer Polytechnic Institute, he worked for railroads, government surveys, and a Pittsburgh consulting engineer before forming his own firm of Wilkins and Davidson in 1890. By 1900, it was simply the W.G. Wilkins Company. One of Wilkins' principal employees was the civil engineer W.M. Judd, who authored a number of articles and papers describing the design and construction of coke ovens, workers' housing, and mining towns. Prior to his employment at the Wilkins Company, Judd had worked with Selwyn Taylor, another Pittsburgh mining engineer, with whom he helped to design the Eureka Fuel Company's Buffington, Footedale, and Lechrone works in the Lower Connellsville coke region. He then served for a brief time as the Eureka Fuel Company's resident engineer.[73]

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[72] The W.G. Wilkins Company, <u>Views of Bituminous Collieries and Coke Plants: Designed by and Built under the Superintendence of The W.G. Wilkins Company</u> (Pittsburgh: The W.G. Wilkins Company, 1907).

[73] "William G. Wilkins Dies at his Home," source unknown, obituary clipping on file at the Historical Society of Western Pennsylvania, Pittsburgh; J.P. Brennen, "The New Coke Plant of the Eureka Fuel Company in the Klondike Region, Pennsylvania, A Complete Modern Plant," <u>Mines and Minerals</u> 21 (April 1901): 388.

The illustrations in one of Judd's articles on coke ovens are identical to those in the International Library of Technology's textbook on bituminous coal mines and coke works, suggesting the Wilkins Company contributed to the preparation of the textbook. The article and text describe the standard ovens built in the Connellsville region at the turn of the century. The drawings are virtually identical to the Frick Company's standard oven designs of a few years later. The illustration in the ILT text of a coal tipple and headframe is obviously drawn from a photograph in the Wilkins Company booklet of the tipple and headframe at the Oliver and Snyder Steel Company's Plant No. 3, engineered by Wilkins. The entries in the textbook are not attributed to any author, but the evidence suggests that Judd and others from the Wilkins Company authored the text. Wilkins, <u>Views of Collieries and Coke Plants</u>; ITL, "Coking in the Beehive Oven;" Judd, "Coke-Oven Construction;" Judd, "Beehive Coke Oven Practice;" Judd, "Miners' Houses and Mining Towns," <u>Proceedings of the Coal Mining Institute of America</u>, Vol. 8 (Greensburg:

After hiring the Wilkins Company to design Bitner, Shoaf, and Yorkrun, Frick derived its own standardized designs from the Wilkins work and Frick's engineers developed their own in-house expertise in the design and construction of coking plants. Subsequent appropriations for construction of coke works show expenditures for company engineering services only.[74]

Although the Frick Company retained masons and other workers necessary for much of the rebuilding required to maintain its beehive ovens,[75] it had to hire contractors to undertake the extensive construction effort required by its expansion program, which required manpower levels well beyond those employed at mines and coking works. For example, a local newspaper reported that Uniontown contractor Patrick Reagan would employ about 300 men for many months building the 200 ovens at Bitner in 1904.[76] Other oven contractors working on the various Frick projects included Dore Brothers, P.F. McCann, H.F. Stark, W.H. Wilkey (Uniontown), Owen Murphy, and Reagan, Lynch and Company (a partnership probably succeeding Partick Reagan). Masonry units, including common red brick, oven liners and crown brick, and complex shapes for the arches and jambs, were procured from area manufacturers such as Harbison-Walker Refractory Company and Joseph Soisson Fire Brick Company. Stone for the front and wharf walls came from on-site or was acquired from other operations, even competitors such as W.J. Rainey. Outfits like D.M. Fair and

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Chas. M. Henry & Co., 1910), 109-133; H.C. Frick Coke Co. Engineering Department, "Standard Bee-Hive Coke Ovens," n.d., on file at the office of the U.S. Diversified Group, Uniontown.

[74] H.C. Frick Coke Company, Appropriations No. 4, 43, 89, 113, 152, and 153. H.L. Auchmuty's two-part "The Leith Mine," The Colliery Engineer 17 (August 1896): 1-7 and (September 1896): 41-46, names the H.C. Frick Coke Company's late chief engineer Joseph H. Paddock and members of the company's engineering staff as designers of the improvements at Leith, but all the detail descriptions in the article are of the mine and its surface structures. Mention of the 306 ovens at the works comes only in the introductory paragraphs and at the end of the article, with no clear statement as to whether the ovens were re-built at the same time the Frick Company made extensive improvements to the mine or remained from the operations of the Chicago & Connellsville Coke Company, which built the ovens in 1880.

[75] H.C. Frick Coke Company, Appropriation No. 579 dated 25 March 1913, Vol. 7.

[76] Daily News Standard (Uniontown), 4 August 1904, 1.

Son and the Nicola Building Company erected workers' housing, company stores, and mine buildings, as did material suppliers such as Eggers and Graham Lumber Company and the Broadway Planing Mill of Scottdale. John I. Dick was a prominent contractor for installing water systems at coke plants. Dravo Contracting Company, Heyl, Patterson & Company, F.J. Foye, and the S.J. Harry Company were among those who sank mine shafts on contract.[77]

Ovens, Pullers, and Waste Heat Utilization

At the end of the 1890s and in the early 20th century, significant changes took place in beehive oven construction. The diameter of ovens had already increased from about 8 feet to 12 feet and more. Accompanying the growth in size was an increase in the weight of the charge, in wear on the liners, and in the temperatures the ovens reached. Moreover, as the Lower Connellsville region opened to coking in 1899, a higher volatile coal was being burned, further increasing temperatures. Whereas a relatively low-grade fire brick had sufficed in the earlier days, the larger ovens increased the standards brick had to meet. Oven builders had also been less exacting in selecting material for loam mortar and the fill around the ovens. New ovens built using the old materials deteriorated quickly, and fusible material in the brick, mortar, or fill would flow out of the crowns and down the liners. Soon such ovens required rebuilding. One response to the changing circumstance was that brick manufacturers and oven builders were more careful in selecting higher-quality refractory material for their fire bricks, mortar, and fill. Also important was the advent of silica brick for use in the crowns of the ovens. Against the protests of local brick manufacturers, Orran W. Kennedy, at the time (1893) Frick's assistant general manager in Scottdale, tried silica bricks, made at Layton, Pennsylvania, in some oven crowns at the Valley works, and they proved satisfactory.[78] Silica brick, already widely

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[77] H.C. Frick Coke Company, Appropriations No. 89, 113, 152, 153, 458, 519, 646; Coal and Timber 1 (April 1905): 21 and (May 1905): 24; A.F. Allard, "The Phillips Plant of the H.C. Frick Coke Company--Arrangement, Coke Ovens--Shaft Construction--Power Plant Utilization Coke Oven Heat," Mines and Minerals 28 (March 1908): 388-391.

[78] Kennedy to Fulton, letter dated 16 March 1904 reprinted in John Fulton, Coke: A Treatise on the Manufacture of Coke and Other Prepared Fuels and the Saving of By-Products (Scranton, PA: International Textbook Company, 1905), 191-192; H.C. Frick Lynch, "Evolution of Connellsville Coke," Coal 6 (3 October 1907): 22. These two articles describe the Frick Company's early experiments

used for metallurgical purposes, were made of crushed silica rock mixed with either lime (preferred) or clay binder. They were capable of sustaining rapid temperature changes, such as occur when the coke is quenched, without cracking. Silica brick were not used for oven liners, however, because they could not resist the wear inherent in charging, leveling, and drawing as well as good fire brick. Furthermore, they could not store as much heat as did clay brick for starting the coking of a subsequent charge.[79]

Faced with varying conditions among its many plants in the Connellsville and Lower Connellsville regions the Frick Company's chief engineer, J.R. Campbell, began late in the first decade of the 20th century using instruments to measure the heat obtaining at several locations within ovens of different sizes and under various conditions. Using thermo-couples and the relatively new techniques of pyronometry, he was able to determine what the actual temperatures were at various stages of the coking process and to develop theory upon which to base the proper selection of materials for various applications in oven construction. For example, he found that the maximum temperature at the trunnel in the old-style ovens charged with Connellsville coal would be 2,200 to 2,400 degrees F., while the new, larger ovens charged with high-volatile coal from the Lower Connellsville region would reach temperatures of 2,400 to 2,600 degrees F. Because of the increased draft induced by flues installed to recover waste heat (see below), larger ovens so equipped could reach temperatures as high as 2,900 degrees F. These findings revealed why the low-

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with silica brick. Joseph Soisson claimed to introduced silica brick into coke-oven practice ten years earlier, but his claim is dubious, because he did not acquire the Layton silica brick plant until 1894. The Weekly Courier, 1914 Special Number, 58; McClenethan, Centennial History of Connellsville, 503.

[79] "Silica Coke-Oven Brick: Their Action on Heating and Cooling--Comparison of their Wearing and Heat Resisting Qualities with those of Clay Brick," Mines and Minerals 25 (June 1905): 536-537; A.F. Greaves-Walker, "Fire Brick Problems of Metallurgy," The Iron Trade Review 39 (23 August 1906): 17-21; J.M. McKinley, "Coke-Oven Materials: The Behavior of Coke-Oven Brick Made of Different Materials and in Varying Proportions--Effect of Physical Conditions," Mines and Minerals 27 (February 1907): 313-314; J.R. Campbell, "Refractories Used in the Construction of Coke Ovens--The Maximum Amounts of Impurities Allowable for Satisfactory Service," Mines and Minerals 28 (May 1908): 457-459; H.C. Frick Coke Company, Appropriation No. 579 dated 25 March 1913, Vol. 7.

grade refractory bricks had yielded years of satisfactory service in the old ovens but were failing under the harsher conditions in the Lower Connellsville region. If a bank of ovens were to be equipped with waste heat flues, only the highest quality refractories would do.[80]

Kennedy's early willingness to experiment with silica brick and Campbell's scientific investigations of how bricks perform in ovens are indicative of the kinds of tests the H.C. Frick Coke Company conducted of new technologies as they came along. For example, shortly after Frick bought Lemont Nos. 1 and 2 from the McClure Coke Company in 1895, mine workings had grown so extensive that it became difficult to deliver adequate steam pressure to distant pumps and haulage engines. To compensate, the company installed a central compressor plant and converted its pumps and haulage engines to compressed air, a relatively new technology for the Connellsville coke region. Although there are exceptions, which will be discussed, the Frick Company was generally considered to be a leader in progressive technologies in the coke region.[81]

The most widely heralded technological change in the Connellsville region came in the form of mechanisms aimed at addressing a significant bottle-neck in the manufacture of coke in beehive ovens. After the turn of the 20th century, the Frick Company was at the center of the introduction of this new mechanization. The Connellsville coke region had been slow to mechanize in the 19th century. The trade journal Coal observed in 1906: "Coke making is perhaps the only colossal industry wherein machinery has entered little within a period that will always be remarkable for the invention and introduction of labor-saving devices."[82]

In the early 1900s, most mines in the Connellsville region still produced hand-mined coal hauled by animal-power. At the coke ovens, many larries were still drawn to the ovens by mule, and at

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[80] J.R. Campbell, "Pyronometry of Beehive Coke Ovens," Mines and Minerals 30 (October 1909): 141-144.

[81] "The Connellsville Coke Region," Report of the Bureau of Mines of the Department of Internal Affairs of Pennsylvania, 1898 (Harrisburg: Wm. Stanley Ray, State Printer, 1899), xxv.

[82] "Machinery in Coke Making," Coal 4 (18 October 1906): 20. This short notice asserted that labor shortages had induced experimentation with coke-drawing machines and that, if the shortages continued, machine mining might be introduced as well.

all the works, except the Semet-Solvay by-product plant at Dunbar, coke was hand-drawn from the ovens and loaded onto cars by fork or with wheelbarrows. As already noted, the most expensive aspect of coke-making was hand-drawing the coke from the ovens. Operators had accepted this fact in the 19th century, but as the number of ovens in the region expanded, labor often grew scarce, especially for drawing the ovens in the hot summer months, when coke-drawers could find no respite from the heat of the ovens other than not showing up for work. Coke operators in the region were not unaware of the possibility of mechanizing coke drawing. As early as 1883, The Keystone Courier (predecessor to The Weekly Courier in Connellsville) had reported on the Thomas patent oven, noting that its machine for drawing and loading coke, along with other mechanized attributes of the oven, were said to reduce operating costs by 50%. Yet Connellsville operators were content with the labor-intensive method of hand drawing because it produced nice large pieces of the coke which were in great demand by furnacemen.[83]

The Connellsville region was not without its own innovators who began to look for means of mechanizing the process of drawing coke from ovens. In 1890, for example, W.H. Dinsmore, a blacksmith at the Connellsville Machine and Car Company, patented a device for drawing coke by means of a pulley and a rod fitted with a scraping head. He also claimed it would reduce the wear on the oven floor normally brought about by hand-drawing.[84] Operators in the region did not adopt his device.

Such lack of interest was not the case elsewhere in the coke industry. The earliest patented mechanisms for drawing coke, dating back to 1867, were intended for use in gas retorts. Being rectangular in plan, such ovens were conducive to mechanical drawing (or pushing) of the coke by means of linear motion. Beehive ovens, being circular in plan on the other hand, required

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[83] "An Aid in Coke Drawing," The Engineering and Mining Journal 50 (12 July 1890): 51-52; W.L. Affelder, "Progress in Coke Drawing Machinery," Proceedings of Coal Mining Institute of America, Vol. 6 (Greensburg, PA: C.M. Henry & Co., 1908), 162. A notice in "Connellsville Letter," Coal 2 (2 September 1905): 13, described W.J. Rainey ovens at Vanderbilt whioh often sat idle during the summer months because of the difficulty of finding drawers willing to subject themselves to the heat at the center of the plant. The early report of the Thomas patent oven is The Keystone Courier 4 (23 February 1883): 1.

[84] Monroe, Coke, Appendix B, Digest of Patents Relating to Coke, Subclass 5: Coke Ovens--Chargers and Dischargers, 553.

more complex motion for drawing. Consequently, one early strategy for mechanically drawing coke included alteration of the oven to a rectangular shape. In 1875, J. King McLanahan invented a rectangular coke oven equipped with a machine for pushing coke out the opposite end of the oven. He apparently patented neither the oven nor the pusher, and there is no record of his oven ever having been used. In 1881, Richard Thomas of Carbondale, Illinois, patented a rectangular oven, which was later built and operated in Alabama. Although some observers thought he derived his oven design from the Belgian oven, an early by-product oven, Thomas and others who used it stressed that his design more closely resembled the Welsh oven, in that limited combustion of coal within the oven provided the heat needed for coking, whereas in the Belgian oven combustion gasses passing through flues outside the oven supplied the heat. Once coking was complete in the Thomas oven, a rod was passed over the bed of coke and attached to a "drag" pre-situated at the rear of the oven. A steam-powered dinky pulled the rod and the drag from the oven drawing the coke out as well. The coke was not quenched until after it was drawn. The earliest-known large-scale installation of Thomas ovens was built in 1888 at the Sloss Iron & Steel Company's coke works at Coalburg, Alabama. Sloss' manager at the works, J.T. Hill, claimed that the product was the equal of standard beehive coke and his cost comparison showed significant savings in labor costs. As already noted, Connellsville operators knew of the Thomas oven as early as 1883. Perhaps Connellsville operators did not approve of a system in which coke was quenched outside the oven. It yielded coke lacking the silvery appearance furnacemen preferred. This was John Fulton's principle criticism.[85]

While McLanahan and Thomas attempted to design rectangular ovens which embodied both the advantages of the beehive process of coking (heat generated by combustion within the oven) and of a shape more conducive to mechanized drawing, other inventors applied their energies to devising a means of drawing coke from standard beehive ovens. In 1874, a man named Joseph H. Connelly patented a device consisting of tongs mounted on a carriage, apparently for drawing coke from beehive ovens. Like many

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[85] J.T. Hill, "The Thomas Patent Coke Oven," Proceedings of the Alabama Industrial And Scientific Society for 1891 (Tuskaloosa: Alabama Industrial and Scientific Society, 1892), 86-90; Monroe, Coke, Appendix B, 552; The Keystone Courier 4 (23 February 1883): 1; The Weekly Courier 10 (4 July 1889): 3; John Fulton, Coke: A Treatise on the Manufacture of Coke and the Saving of By-Products (Scranton, PA: The Colliery Engineer Company, 1895), 121-127.

inventions after his, it was not adopted in the field. In 1891, Thomas Smith patented a machine for drawing coke which served as the basis for the first widely-used mechanism. According to the summary description, his invention:

> provide[d] first, means for forcing a plate through the door of the oven and under the coke and for then withdrawing the said plate, bringing with it the coke which is to be extracted; second, enable[d] the said plate to be directed to all parts of the oven in succession, so as to withdraw the whole of the coke; third provide[d] guides for the bar carrying the said plate and for allowing it to be moved horizontally in any direction, and fourth, provide[d] means for propelling the entire machine along rails in either direction.[86]

Smith worked at the Thorncliffe Iron Works near Sheffield, England. Four years or so after he received his patent, his machine was installed at a plant near Latrobe. The Latrobe Coal and Coke Company built 30 ovens equipped with the Newton-Chambers system for recovering by-products from beehive ovens. Abandoning the Newton-Chambers system, the Latrobe Coal and Coke Company widened the doors on the ovens to better accommodate the Smith coke-drawing machine. The machine drove a wedge-shaped plate under the coke and then withdrew the plate, bringing coke with it. The machine deposited coke on a conveyor belt running along the base of the oven doors. The conveyor moved coke to railroad cars waiting at the end of the block of ovens. Although the success of the Smith machine at Latrobe, located at the northern end of the Connellsville coke region, would seem to have predicted a wider market for its use, the machine was not immediately accepted.[87] Smith's principle of driving a wedge or shovel under the coke did inspire several other experimenters and it eventually became the basis for the most successful line of innovation for coke-drawing machines. After a period of

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[86] Monroe, <u>Coke</u>, Appendix B, Digest of Patents Relating to Coke, Subclass 5: Coke Ovens--Chargers and Dischargers, 551-556. The earliest patent in the digest for a device for drawing coke from a gas retort is no. 61,144 granted to Sealy James Best and James John Holden. Connelly's patent is no. 149,836 and Dinsmore's is no. 428,466. Smith's patent is no. 446,936.

[87] John Fulton, <u>Coke: A Treatise on the Manufacture of Coke and Other Prepared Fuels and the Saving of By-Products</u> (Scranton, PA: International Textbook Company, 1905), 187-188; "Machine for Drawing Coke from "Bee-Hive Ovens," <u>Coal</u> 4 (25 October 1906): 20.

refinement, the Covington Machine Company of Covington, Virginia, successfully marketed a derivative machine based on the Smith patent, rights to which the Covington Company had purchased. A variation on the Smith design was developed by company president John S. Ham. The company installed three mechanical coke drawers at the works of the Low Moor Iron Company at Kay Moor, West Virginia, in 1901 and four at the works of the Central Iron and Coal Company at Tuscaloosa, Alabama. These were all steam-power machines.[88] A company catalog later described the Covington machine as follows:

> The Covington Coke Machine consists of two principal parts--an extractor for drawing the coke out of the ovens, and a conveyor for screening and loading it into cars....A steel ram-bar, carried in a swinging carriage so as to reach either side of the oven, is supported on this frame, and provided at the end with a chilled cast-iron, wedge-shaped shovel, which is thin at the front and high at the back. This ram-bar has teeth on the side, and is driven forward or back by a steel pinion mounted on a vertical shaft....The length of the ram and the power employed are sufficient to force the ram in under the coke to the back of the oven. By reversing the motion of the gearing, the shovel is withdrawn from the oven with its load of coke. In other words, the ram acts like a wedge, raising and parting the coke so as to cause it to fall in the manner stated....While it is possible to reach any part of the oven by the arrangement above described, there will always remain in the oven a small quantity of coke which it is expedient to remove by hand....The coke, when drawn, falls on a conveyor, which, as stated

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[88] Affelder, "Progress in Coke Drawing Machinery," 163; Walter W. MacFarren, "Coke Drawing Machines and Other Machinery for Use at the Ovens in the Manufacture of Coke, I," <u>The Iron Trade Review</u> 41 (19 December 1907): 996; "Labor Saving Devices of Connellsville Coking Practice," <u>The Weekly Courier</u> 1914 Special Number, 24; E.C. Ricks, "Coke Drawing Machines for Beehive Ovens: The Covington Machine," <u>Coal & Coke Industrial Review</u> (supplement to the Uniontown <u>Daily News Standard</u> 21 October 1913), 21. Other machines based on the Smith patent included the Heyl & Patterson machine, which was nearly identical to the Covington, and the Marmac, which mounted a ram with a Smith shovel on a carriage which allowed the ram to rotate about an imaginary center located at the oven door opening. This feature was supposed to make it easier to reach all areas of the oven. See MacFarren, "Coke Drawing Machines, I" 998-1002.

> above, is carried on a separate truck and operated by a separate motor....The machine, as made today, has an extension on the conveyor which runs along in front of the ovens, so that while the machine is drawing oven No. 2 the small amount of coke remaining in oven No. 1 may be pulled directly onto the conveyor....While the foregoing description mentions electric power only, we are prepared to furnish steam-driven machines also, steam being furnished by a small boiler carried on the machine. The steam-driven machine, however, requires an extra man to look after the boiler, and we recommend, when possible, that electricity be used.[89]

Before the Covington machine was ready for a larger market, however, another inventor from the Connellsville region patented a device that competed for the attention of local operators. John A. Hebb was a coke drawer at the Frick Company's Redstone works at Brownfield in the 1890s. In 1894, it occurred to him that he could devise a machine to replicate what he was doing by hand. Building wood models, he refined his idea until 1899, when he was able to patent it. In 1900, he gave a machine its first trial, drawing 20 ovens at the Hero Iron & Coke Company's works at Smock. After noting problems, Hebb rebuilt his machine and gave a larger version a trial at Frick's Redstone works in 1901. The increased size led to new problems, so Hebb revised his machine again, testing it next at the Oliver works of the Oliver & Snyder Steel Company in 1902. This trial was fairly successful, drawing an oven through the conventional 32-inch-wide door in 28 minutes. After officials of the Frick Company observed the trial at Oliver, they agreed to modify several ovens to wider, 40-inch doors at the Continental No. 1 works, where superintendent Enoch Abraham was unsuccessfully trying to develop a coke-drawing machine himself. At a test run in 1903, Hebb's machine was able to draw three ovens in 38 minutes through the 40-inch doors. Hebb's machine received its most extensive test at the Jones & Laughlin Steel Company's 1,500-oven beehive works in Pittsburgh in 1908, and the Frick Company continued to experiment with it as late as 1909, when it installed a Hebb machine at the Dearth works.[90]

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[89] Covington catalog quoted in Affelder, "Progress in Coke Drawing Machinery," 164-165.

[90] Affelder, "Progress in Coke Drawing Machinery," 168; "The Hebb Coke-Drawing Machine: A Device Recently Built for Mechanically Removing the Coke from Beehive or Other Coke Ovens," Mines and Minerals 24 (February 1904): 304; "Labor Saving Devices," The Weekly Courier, 1914 Special Number, 24; Affelder,

The experiments with coke-drawing machines attracted the attention of several individuals from outside the coke region who were working on similar ideas and who hoped that the Frick Company might be induced to test their prototypes. For example, a Mr. Eklund of the American Steel and Wire Company (another subsidiary of U.S. Steel) of Worcester, Massachusetts, observed the Hebb experiments in the Connellsville region and then, with the assistance of F.H. Daniels, American Steel and Wire's chief engineer, designed what they believed to be an improvement on the Hebb machine. Daniels sent plans and specifications of the machine to the Frick Company headquarters, soliciting the company's interest in building a prototype and testing it. The new machine had many more moveable parts in the drawing mechanism, allowing the rake beam to be raised and lowered and the rake head to be opened and closed by air cylinders.

Meanwhile, I.C. Kelly, the master mechanic at Frick's Everson Shops, was also working on a new approach mechanical coke drawing. He proposed that the ram of his machine be driven under a portion of the coke, after which air cylinders would cause a clamp to grasp a load to be withdrawn from the oven. By this time, Thomas Lynch was quite interested in finding a mechanical means of addressing the most severe bottleneck in the production beehive coke: hand drawing. He asked Frick general superintendent Clingerman and mechanical engineer G.E. Huttelmaier to closely scrutinize the two sets of plans and specifications with and eye toward testing them at Continental No. 1. Correspondence among the three Frick officials indicates that they were not only concerned with the initial cost of the machines but especially were concerned with anticipated maintenance costs and the costs of installing power at plants to operate the machines. Continental No. 1 was one of the few Frick coke works with the necessary power. Lynch was also hesitant in proceeding with experiments because, even though hand-drawing was a bottleneck, it was nevertheless extremely inexpensive and it would be very difficult to justify the expense of mechanical drawing of coke on direct economic grounds. Huttelmaier and

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"Jones & Laughlin's Coke Plant: A Description of an Installation of 1,500 Coke Ovens in the Closely Built Part of the City of Pittsburgh," <u>Mines and Minerals</u> 29 (December 1909): 198; H.C. Frick Coke Company, Appropriation No. 203 dated 7 January 1909. Hebb's first patent was no. 621,663. In 1903, he was granted six additional patents for coke drawer machines and coke conveyors, and in 1904 yet another patent for a drawing machine.

Clingerman estimated that the Kelly machine would cost about $4,500 to fabricate and the Daniels machine about $12,000.[91]

Meanwhile, the Covington Machine Company began to seek a market for its mechanical coke drawer in the Connellsville region. President John Ham had also read about Hebb's experiments and traveled to the Connellsville region to witness them. While there, he received permission from the Frick Company to install an experimental Covington machine at Continental No. 1. The first Covington coke-drawing machine was installed at Continental No. 1 in October 1904. Using electric motors rather than a steam engine for motive power brought about a particular problem for a mechanism to be used in a coke yard: coke dust is an excellent conductor and could ground the motors so they wouldn't function. Protective shrouds were placed over the motors to keep dust out. The model Frick first tried did not include the conveyor and merely pulled the coke from the oven, dropping it onto the yard beneath the oven door, necessitating hand labor to load it into cars. At the time, the average cost of drawing coke by hand in the Connellsville region was 92 cents per oven and Frick plants were averaging less than 81 cents. Frick engineers calculated that, counting all expenses including labor, electricity, and depreciation, operating the Covington machine would cost about 50 cents per oven.[92]

Frick engineers recommended to the Covington Company that further savings could be effected by attaching an automatic loader to the coke drawer. Alterations were made and in April 1905 a crowd of coke operators gathered at Continental No. 1 to witness a machine drawing coke and loading cars. The following September at

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[91] Description of Improvements in [Daniels] Coke Drawing Machine, Description of Kelly Pneumatic Coke Drawer, D.H. Coble to W.H. Clingerman dated 8 June 1904, and 29 June 1904, Thomas Lynch to Clingerman dated 15 July 1904 and 1 September 1904, Clingerman to Lynch dated 9 February 1906 (including attached proposed appropriation), all in Correspondence, Prints, Descriptions, and Reports on the I.C. Kelly and American Steel & Wire Co. Coke Drawing Machines, 1904-1906, H.C. Frick Coke Company Records, Miscellaneous Agreements.

[92] Ricks, "The Covington Machine," 21; "The Covington Coke Drawer," Mines and Minerals 25 (July 1905): 604-605; M.R. Clarke, "Covington Coke Extractor," article from General Electric Review reprinted in Coal 7 (30 April 1908): 25; Thomas Lynch to W.H. Clingerman dated 1 September 1904, letter in Correspondence, Prints, etc. on the Kelly and American S & W Co. Machines; H.C. Frick Coke Company, Appropriation No. 71 dated 7 September 1905.

Continental No. 1, the Frick Company installed two experimental Covington coke-drawing machines with coke conveyors, said to be "the first successful machine in the world to take coke from a common beehive oven and deposit it in a car."[93] Experience with the conveyor yielded the finding that attaching a "trap" to the upper end of the conveyor reduced the breakage of coke as it fell into the car. The trap would accumulate coke until a certain mass was collected, at which time the trap would automatically drop the coke in a bunch into the car. The machine could pull coke from 40 to 50 ovens in a 10-hour day. Its major initial drawback was the excessive wear it caused to the door jambs, but superintendent Enoch Abraham soon designed an iron jamb block to replace the masonry units usually used.[94]

Despite the apparent success of the Covington machine, Frick officials were not completely satisfied with its performance, perhaps because it broke the coke into smaller pieces than did hand drawing. By this time, Lynch was convinced that coke drawing had to be mechanized, but he was also willing to authorize the expenditures necessary to build test models of the more expensive Kelly and Daniels machines. In the fall of 1906, the Frick Company installed two more machines, still termed "experimental," at Continental No. 1. One was a Covington machine equipped with a coke conveyor and probably fitted with a Kelly clamp for extracting coke. The other machine, was that designed by Eklund and Daniels. The prototype, fabricated by the Alliance Machine Company, was more closely related to the Hebb machine in that the coke drawing arm entered the oven over rather than under the coke. The Alliance machine proved overly complex and unreliable, drawing only about three ovens during its brief trial. By the end of the year, the company decided to begin installing Covington machines at several of its other plants, ordering a total of twelve for use at Baggaley, Fairchance, Hecla No. 1, Leisenring No. 1 and No. 3, Lemont No. 2, Oliphant, and Standard, spending $108,000 to do so (about $5,000 for each machine and approximately $10,000 at each plant to install tracks, trolley wires, and make necessary modifications to the

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[93] Discussion of the gathering of operators at Continental No. 1 is in H.G. Lawrence, "Uniontown Letter," Coal and Timber 1 (May 1905): 24; The Weekly Courier 26 (14 April 1905):2, (21 April 1905): 2. Quote is from E.H. Abraham, "Coke-Drawing Machines," Mines and Minerals 27 (June 1907): 507.

[94] E.H. Abraham, "Coke-Drawing Machines," Mines and Minerals 27 (June 1907): 507; M.R. Clarke, "Covington Coke Extractor," article from General Electric Review reprinted in Coal 7 (30 April 1908): 24.

ovens). Covington soon modified the wedge at the front of the ram to consist of two hinged plates which lay nearly flat while the ram was driven under the coke and then raised up, much like a barbed hook, as the coke was withdrawn. This reduced the fracturing of the coke, a major concern of those who were leery that furnacemen would not accept machine-drawn coke. Observers in the region, as well as Frick officials, were impressed by the speed with which the machine drew coke from ovens. Furthermore, experience quickly demonstrated that customers would accept machine-drawn coke.[95]

A significant benefit of the machine's speed was that a new charge of coal could be added as soon as fifteen minutes after the previous charge had been quenched, as compared to several hours after quenching for hand-drawn ovens, meaning that an oven would cool less and the new charge would begin coking more quickly. Also, the quenchers would only have to cool the coke the minimum necessary to extinguish the coking process. When coke pullers quenched the coke, they often cooled it excessively to make it easier to face the oven's heat while drawing. An overly cool oven led to black ends on the coke of the subsequent charge, caused by insufficient heat for the coking process reach the bottom of the bed in the allotted time. Use of a coke-drawing machine also allowed a deeper bed of coal to be charged into ovens. Hand drawers found it difficult to pull a deep bed of coke. On the other hand, some coke experts believed that a

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[95] Thomas Lynch to W.H. Clingerman dated 28 May 1906, G.E. Huttelmaier to J.P.K. Miller dated 25 June 1906, and J.P.K. Miller to Clingerman dated 27 July 1906, all in J.P.K. Miller's Report & G.E. Huttelmaier's Report on Kelly & American S.W. Co. Coke Drawing Machine, June 1906, H.C. Frick Coke Company Records, Miscellaneous Agreements; Appropriations no. 103 dated 31 July 1906 and no. 111 dated 14 November 1906; discussion following George T. Wickes, "Mechanical Coke Drawers," Proceedings of the Coal Mining Institute of America, Vol. 3 (Pittsburgh: The Coal Mining Institute of America, 1906), 252-254; Affelder, "Progress in Coke Drawing Machinery," 166-167; MacFarren, "Coke Drawing Machines, I," 998; MacFarren, "Coke Drawing Machines and Other Machinery for Use at the Ovens in the Manufacture of Coke," Proceedings of the Engineers Society of Western Pennsylvania 23 (November 1907): 465; discussion following Judd, "Coke-Oven Construction," Proceedings of the Engineers Society of Western Pennsylvania 22 (October 1906): 354-355.

deeper bed could minimize the loss of fixed carbon during the coking process.[96]

While advocates for the machine claimed cost-savings, W.A. Affelder, a Frick official, suggested that any savings in labor cost were offset by costs of electricity, maintenance and depreciation of equipment, and coke lost by the mechanization of the process. Nevertheless, he, too, advocated the machine for its labor-saving attributes in an era of labor shortages. Without the machine, it generally took about 20 workers to level, quench, and draw 40 ovens. The Covington machine allowed six men to handle the same number of ovens. And in the words of another advocate, "It is easier to get men to run the machine than to get men to stand the heat and hard labor of drawing ovens by [the] hand method," and the "Machine does not play out in hot weather."[97] In 1907, while the Frick Company was building new plants especially designed to accommodate coke-drawing machines, the company also made the decision to convert many of its existing ovens to mechanical coke drawing, citing as the primary reason the labor shortages brought about by booming coke demand in the midst of competing economic activities which attracted laborers to other jobs. The Covington coke-drawing machine proved so satisfactory that operators in the Connellsville region were said to have installed 150 of them by 1908 (a claim which appears doubtful, because Frick orders for the machine did not exceed 70 until 1913). Other machines used in the region included the Hebb apparatus and a device developed by D.B Stauft, driven by compressed air, which also replicated a human coke-drawer.[98]

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[96] "Machine for Drawing Coke from Bee-Hive Ovens," Coal 4 (25 October 1906): 21.

[97] Affelder, "Transition in Coke Making: A Description of Some New Forms of Ovens and Machines for Quenching and Drawing Coke and Leveling Coal in Ovens," Mines and Minerals 28 (May 1908): 484; Affelder, "Progress in Coke Drawing Machinery," 166. Quotes are from "The Covington Coke Drawer: An Electric or Steam-Operated Machine for Drawing Coke from Beehive Ovens and Loading It on Cars," Mines and Minerals 25 (July 1905): 605.

[98] Engineering and Mining Journal 83 (30 March 1907): 639; "Labor Saving Devices," The Weekly Courier, 1914 Special Number, 24; "Laborers Are Scarce," Coal 4 (12 July 1906): 31; Affelder, "Transition in Coke Making," 484; Ricks, "The Covington Machine," 21. Affelder makes the claim for 150 of the Covington machines in the Connellsville region by 1908. Ricks lists the orders made by the Frick Company through 1913.

The realization that machines offered relief from the labor shortage in the coke region stimulated numerous other attempts at devising a successful coke-drawing machine. One was the Marmac machine, jointly invented by Warren MacFarren, a Pittsburgh mechanical engineer, and R.L. Martin, Jr., of the Bessemer Coke Company. The Marmac had a ram for extracting coke similar to that of the Covington machine, but it differed in the way it pivoted so that the ram could reach all areas within an oven. The carriage supporting the ram and its drive mechanism rotated about an imaginary center located in the middle of the oven door. The operator could thus insert the ram into all areas of the oven without having to move the truck supporting the machine back and forth along its tracks. The Marmac machine was given an extensive test at the Bessemer Company's Griffin works. Another machine was devised by former Frick engineer Edward O'Toole, who at that time was general superintendent of U.S. Steel's United States Coal & Coke Company in the Pocahontas region of West Virginia. His scheme, proposed to Thomas Lynch in 1907, went beyond merely providing a machine for drawing large pieces of coke from the oven by offering a means for mechanically cleaning the oven as well. There is no record of his machines ever having been built and tested by the Frick Company.[99]

The Covington Machine Company quickly recognized that adoption of its coke-drawing machine could also have a significant impact on the design and construction of new plants. Because the machine conveyed coke directly into rail cars, there was no longer a need for the elevation difference between the yard and the yard tracks. Eliminating the masonry yard walls and the fill behind them constituted a considerable capital savings. The Covington Machine Company promoted this change from the tradition beehive coke layout by successfully inducing the Frick Company to try the new scheme at the battery of 170 additional ovens being built at its Wynn plant. The experiment at Wynn proved successful and a coke plant layout without wharf walls became standard new construction practice for the Frick Company. The company's Phillips plant, built in 1907, consisted of three blocks of 114 ovens each and a bank of 58 ovens. The plant, with seven Covington machines, one for each row of 57 or 58 ovens, was designed without the yard walls. The Collier, Dearth, and Ronco

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[99] MacFarren, "Coke Drawing Machines," Proceedings of the Engineers Society of Western Pennsylvania 23 (November 1907): 474; The Weekly Courier 29 (12 February 1908): 1; E. O'Toole to W.H. Clingerman dated 19 June 1907 and accompanying detailed description, Description and Letters Relative to O'Toole's Coke Drawing Machine and Oven Cleaner, June 1907, H.C. Frick Coke Company, Miscellaneous Agreements.

plants, built under the same appropriation and with coke-drawing machines as original equipment, were similarly designed, as were the Thompson No. 1 and 2 plants being built by the newly formed Thompson-Connellsville Coke Company.[100] As the following table shows, the total cost for ovens at these four plants was essentially the same as that for Bitner, Shoaf, and Yorkrun, suggesting savings in the elimination of wharf walls were offset by added costs for tracks and other features necessary for the operation of the coke-drawing machines.

COST OF OVEN CONSTRUCTION[101]

Appropriation No. 89			**Appropriation No. 113**		
Plant	Total Cost	Cost/Oven	Plant	Total Cost	Cost/Oven
Bitner	$102,013.53	510.07	Collier	$224,653.97	$561.63
Shoaf	146,856.31	489.52	Dearth	132,703.35	530.82
Yorkrun	270,093.65	540.19	Phillips	219,889.35	549.72
			Ronco	207,476.76	592.79

If anything, the ovens at Collier, Dearth, Phillips, and Ronco cost a bit more than those at Bitner, Shoaf, and Yorkrun. Clearly the main motivating factor in the Frick Company's

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[100] Affelder, "Progress in Coke Drawing Machinery," 166; Affelder, "Transition in Coke Making," 485; "A Machine for Drawing and Loading Coke," Coal 4 (9 August 1906): 25 and (18 October 1906): 20; Ricks, "The Covington Machine Company," 21; H.C. Frick Coke Company, Appropriation nos. 89, 113, and 116. The latter calls for additional expenditures needed to complete no. 89, under which the new ovens at Wynn were built. The additional expenditure was for the installation of a transfer table at the end of the new ovens opposite the coal bins. The transfer table would allow coke-drawing machines to be moved from one set of tracks to another, adding flexibility to the operations.

[101] H.C. Frick Coke Company, Appropriation nos. 89 and 113. There is less detail in the cost summaries for the former appropriation than the latter, so it is impossible to be certain than specific items were charged to the same categories in each. The general cost categories, however, do suggest that costs of oven construction in the two appropriations are directly comparable. Costs for oven construction include fixed appliances, such as tracks, trolley lines, and water lines, but do not include machines or equipment, such as larries or coke-drawing machines.

selection of the Covington coke-drawing machine was the cost and availability of labor. Once having made the decision to use the machines, the company eliminated unnecessary wharf walls, even though that step did not make beehive ovens built for machine drawing less expensive than those built in the conventional configuration.

The Covington machine was the most successful of the coke-drawing mechanisms introduced into the Connellsville region, at least as measured by the numbers put in use and the longevity of their use. They were still being used in the third quarter of the 20th century as the last of the Connellsville coke plants ceased operations. Thus, the machines outlived the company that had made them. The company was founded in 1892 and at the turn of the century was said to be the largest machine shop between Newport News, Virginia, and Huntington, West Virginia. Covington had acquired the rights to Thomas Smith's patent, and once the coke-drawing machine had proven practical, orders arrived from the Kanawha, New River, and Pocahontas coke regions as well as the Connellsville region, where it also opened a Uniontown sales office and supply shop in 1906. In 1907, the company employed 250 workers and was seeking more machinists and molders to help fill orders for the coke-drawing machine. By 1913, the company reported that it had sold more than a million dollars worth of coke-drawing machines and that it had on hand a further one hundred thousand dollars worth of orders. With the decline in the beehive coke industry, the Covington Machine Company went out of business during the Great Depression of the 1930s, selling out to the Ricks Manufacturing and Supply Company of Uniontown, which manufactured new versions of the coke-drawing machine during World War II, when numerous coke plants in the Connellsville region were rehabilitated, selling its business and the rights to manufacture the Covington coke-drawing machine to E.C. Ricks of Uniontown.[102]

Innovators also put their creative minds to the other hand-operated tasks at coke ovens: quenching and leveling. At about the same time as the Covington coke-drawing machine came into wide use, W.L. Affelder of the Frick Company and W.W. MacFarren each developed a mechanized quenching machine and MacFarren

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[102] Allegheny County, Virginia: Its Resources and Industries (Covington, VA: The Chamber of Commerce of Covington, 1907), 22-24; Horton P. Beirne, ed., Historical Sketches by Gay Arritt (Covington, VA: The Allegheny Historical Society, 1982), 36-37; Ricks, "The Covington Machine," 21; The Weekly Courier 27(13 July 1906): 2; Fredric L. Quivik, personal interview with Max Noble, 29 August 1992.

developed a mechanized leveler as well which could be mounted on a coke-drawing machine. The expense of such machines, however, could apparently not be offset by labor savings or other benefits. The Frick Company experimented at the Continental No. 1 plant in 1910 with another leveling machine, designed by Ham and Abraham and built by the Covington Machine Company. The machine ran along the larry tracks, transporting a vertical shaft equipped with pantographic arms at its lower end which, when lowered through the trunnel head, used rotary motion to spread the pile of coal. Because the machine operated from the larry tracks, the oven door could be re-bricked prior to charging, effecting a further savings in heat. The machine could level about 200 ovens per day and was apparently adopted at some Frick plants.[103]

While hand-leveling remained standard practice for many conventional beehive ovens, a less complicated quenching device than MacFarren's was successfully introduced and widely adopted. Developed by D.B. Stauft, general superintendent of the Taylor Coal and Coke Company, the device consisted of two arms of perforated 3/4-inch pipe which rotated around the end of a 1-inch pipe placed at the center of the oven. Water spraying out of the perforations caused the arms to rotate, evenly wetting the coke. The device allowed one man to quench three ovens at a time, and to do so more evenly while spraying less water on the hot bricks of the crown. By the end of the 1910s, the Stauft coke watering apparatus was in wide use at Frick and other coke works in the Connellsville region.[104]

Coke-drawing machines and other mechanisms used at the coke ovens addressed one of the bottlenecks in the Connellsville region, but another problem existed in the mines. During the period of high production in 1906, labor shortages inhibited output at many of

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[103] W.H. Clingerman to W.L. Affelder dated 12 November 1909 and attached copy of allowed claims, file on Affelder Machine, H.C. Frick Coke Company, Miscellaneous Agreements; Walter W. MacFarren, "Coke Drawing Machines, II," Iron Trade Review 41 (26 December 1907): 1036-1037; "Beehive-Oven Leveling Machine," Mines and Minerals 30 (May 1910): 594; "Improved Coke Oven Practice," Mines and Minerals 32 (July 1912): 720-721; "Labor Saving Devices," The Weekly Courier, 1914 Special Number, 24; H.C. Frick Coke Company, Appropriation No. 256 dated 18 November 1909.

[104] Affelder, "Transition in Coke Making," 485; "An Apparatus for Watering Coke Ovens," The Iron Trade Review 41 (1 August 1907): 187-188; "Labor Saving Devices," The Weekly Courier, 1914 Special Number, 24.

the region's plants. According to The Weekly Courier, the shortage of skilled miners was actually often chronic than the shortage of coke drawers, as many mines could not produce enough coal to charge the ovens as they were being drawn. A Courier editorial predicted that success with experimental coke-drawing machines would be followed closely by the introduction of machine mining into the region. Indeed, in August 1906 the Frick Company sent its mechanical engineer, G.E. Huttelmaier, to Chicago to inspect a machine developed by E.C. Morgan, which both cut coal and loaded it into pit cars. Early in 1907, the company began testing the machine in the Leckrone mine. The Phillips mine was one of the Frick Company's first to be more fully equipped with mining machines to supplement traditional pick methods. The company spent over $10,000 for mining machines in its original expenditures for opening the Phillips mine, but spent only about $600 for a machine at Collier and nothing for machines at Dearth or Ronco (Ronco already had an operating mine, which Frick had acquired from the Sharon Coke Company, and it may have been equipped with machines).[105] Following The Courier's prediction, the H.C. Frick Coke Company in about 1910 began installing electric or compressed-air mining machines in its mines, after first sending some of its superintendents and mine inspectors to other mines in the area which had been using such mechanisms for as long as a decade. Returning from his visit to the Greensburg mine, the Frick Company's Clay Lynch reported:

The Mine Foreman here was an old fellow by the name of David Clark, who said that he had worked in many mines in the Connellsville Coke Region, and who, since leaving the Region, has had about 12 years' experience in the Greensburg District. It was his opinion that there was no reason except the prejudice of the foremen and the men, why the Connellsville Region coal could not be worked by machines. Both he and [mine superintendent] Null told the same story in regard to the installation of machines in this mine, about 8 yrs. ago...... There was a great howl and all the old Mine Foremen, Fire Bosses, and other experts claimed that it [machine mining] could not be done, that the coal was not as good, that the roof would not stand the wide places, and that the men could not be obtained to run machines. He says

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105 The Weekly Courier 27 (29 June 1906): 2, (6 July 1906): 3, and 28 (3 August 1906): 2, (19 October 1906): 2, 4 (editorial); H.C. Frick Coke Company Appropriation No. 113; letters among Thomas Lynch, J.P.K. Miller, E.C. Morgan, G.E. Huttelmaier, W.H. Clingerman, and others in "Correspondence, Etc. for Morgan Mining Machine," H.C. Frick Coke Company, Miscellaneous Agreements.

that they now have trouble getting pick work done and that the cutters and loaders are plentiful.[106]

Soon after that report, the Frick Company began placing mining machines in its existing mines. For example, in January 1910 the company authorized $4,800 for the installation of three electric Morgan-Gardner machines in the Shoaf mine, not only to supply coal for the ovens but to ship out of the region as well.[107]

The Frick Company utilized another feature at the Phillips plant which differed from 19th century practice. The company installed flues along the backside of the bank of ovens for conducting waste heat to a nearby boiler house, which in turn provided steam to drive a generator in the adjacent powerhouse. In fact, the bank of ovens was designed as a bank not because of site constraints, as was traditionally the case, but because the flues could be more conveniently placed on the backside of a bank of ovens than in the midst of a block of ovens. The Frick Company had already experimented with extracting heat from flues over the ovens at Continental No. 1 and then installed a more complete waste-heat-utilization apparatus at Yorkrun. A contemporary newspaper account, stating that "Saving the heat is a new feature at Frick, and will be the nearest it has approached the by-product scheme," indicated that Yorkrun, alone among Frick's three 1904-1905 plants, would be equipped with flues to convey waste heat to the powerhouse. Waste heat from 100 ovens supplied

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[106] Quote is from Clay F. Lynch to W.H. Clingerman, letter dated 11 May 1909. Reports from visits to Washington Run mines and Colonial mines are in A. King to W.H. Clingerman, letter dated 1 October 1907, and Clay F. Lynch to W.H. Clingerman, letter dated 31 August 1909. All three letters are in packet dealing with machine mining found in Miscellaneous Agreements, H.C. Frick Coke Company, room 16, section 396, shelf 5, box 13, United States Steel Corporation Archives, Annondale. Lynch concludes his May letter by saying: "I see no reason, after looking over conditions in these mines, why we cannot successfully operate punchers in any of our mines. I would not recommend their use in ribs, but I certainly think that a large proportion of our room coal and perhaps an even larger proportion of our heading coal could be produced by machines, at prices which, including the cost of installation, air, etc., would not exceed the cost of pick work." On the softness of coal in the Connellsville region and the late arrival there of machine methods, see also The Weekly Courier 28 (19 October 1906): 2, 4.

[107] H.C. Frick Coke Company Appropriation No. 270, dated 7 January 1910.

heat to boilers in Yorkrun's powerhouse, where generators produced electricity for the Yorkrun, Shoaf, Fairchance, Smiley, Wynn, and Kyle works as well as the new Collier plant. Unlike the flues at Phillips, those at Yorkrun ran along the tops of the ovens.[108] Utilization of waste heat was not a Frick innovation. Even though 19th-century American coking works did not generally recover other by-products, some did utilize some of the heat produced in coking to generate steam. An early example was Pratt works of the Tennessee Coal, Iron and Railroad Company, built in the 1890s with flues conveying heat to boilers.[109]

In a recent article, Kathleen Ochs has observed that mining engineers at the turn of the 20th century were especially interested in measuring costs as they applied their expertise to improving mining operations.[110] This proclivity has already been demonstrated in the several studies, cited in the previous chapter, the Engineering and Mining Journal completed on coking costs in the Connellsville region. Early in the 20th century, Edward D'Invilliers completed a similar study, comparing costs of producing beehive coke in the Connellsville and the Reynoldsville regions and taking much greater pains to recognize and account for variables which had been ignored in earlier studies. He noted that in previous studies, costs of coal charged to the ovens were often based on the local market value of the coal rather than its actual production cost. Studies also often failed to distinguish between slack coal and run-of-mine coal or whether the cost of coal charged to the ovens included the cost

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[108] Allard, "The Phillips Plant," 388-391; The Weekly Courier, 26 (10 March 1905): 2; I.G. Roby, "Fifth District," Report of the Department of Mines of Pennsylvania: Part II, Bituminous, 1905 (Harrisburg: Harrisburg Publishing Company, 1906), 259; discussion following Warren W. MacFarren, "Coke Drawing Machines," Proceedings of the Engineers Society of Western Pennsylvania 23 (November 1907): 512-513. The Weekly Courier account was mistaken in stating that Shoaf, not Yorkrun, was being equipped with boilers fired by waste heat from the ovens. Shoaf was never equipped with flues for utilizing waste heat.

[109] Fulton, Coke, 1895 edition, 129-132; Erskine Ramsay, "The Generation of Steam from the Waste Heat and Gases of Coke Ovens," Proceedings of the Alabama Industrial and Scientific Society 3 (1893): 40-62.

[110] Kathleen H. Ochs, "The Rise of American Mining Engineers: A Case Study of the Colorado School of Mines," Technology and Culture 33 (April 1992): 295.

of washing. Finally, he complained that coke-production costs were often arbitrarily attributed to an entire districts, even though actual conditions and production costs at mines within those districts varied widely. Incidently, his study showed how exceptionally profitable beehive coking in the Connellsville district was.[111]

Tests conducted by the H.C. Frick Coke Company in the early 20th century show a similar growing sophistication in understanding the importance of accounting for variables. Perhaps stimulated by the conservation movement in the United States, perhaps driven by tests which showed that by-product ovens saved as fixed carbon a higher percentage of the coal charged than did beehive ovens, and perhaps in an effort to better understand costs to improve economies of production, the Frick Company undertook experiments at most of its coke plants in 1902 and 1903 to determine how much coke was lost through breakage as it was piled on the wharf before being loaded into cars. Records show a growing sophistication on the part of Frick managers and engineers in defining problems and devising methods of measuring. For the first tests, conducted in 1902, plant superintendents were simply asked to measure the amount of coke lost in the process.

Responses from the superintendents indicate that they each interpreted their assignment differently and submitted results of experiments that could not be compared with each other. The 1903 tests were intended to be standardized, as superintendents were instructed to measure the coal charged into the ovens and weigh the coke first as it was taken from an oven and then as it was taken off the wharf to be loaded into cars. Each superintendent was to conduct the test at two different ovens making first 48-hour coke and then 72-hour coke. The superintendents returned consistent results of their experiments, which identified another level of variables for which management had not accounted. For example, J. Finch, superintendent of Baggaley, noted that for this experiment he had used coal relatively free of slate, but that coal from other parts of the mine contained more slate and yielded coke with more waste. Clay Lynch, superintendent at Brinkerton, observed that all four ovens tested had been leveled by the same man, who was very conscientious in his work. Ovens leveled by another leveler, who was not so conscientious, would have yielded more waste. Other variables would have included the

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[111] Edward V. D'Invilliers, "Estimated Costs of Mining and Coking and Relative Commercial Returns from Operating in the Connellsville and Walston-Reynoldsville Districts, Pennsylvania," Transactions of the American Institute of Mining Engineers 35 (1905): 44-59.

heat of the ovens when they received the charge. The combination of variables at the different plants led to results that varied by more the 600%.[112]

Water Companies

Beehive ovens required vast quantities of water for quenching the coke; 25,000 to 40,000 gallons were needed daily for every 100 ovens. Obviously, the Frick Company had to control major water resources to supply its thousands of ovens. Henry Clay Frick formed the coke region's first water company for supplying his ovens in the early 1880s. He built a reservoir at the headwaters of Jacob's Creek to supply the town of Mt. Pleasant as well as his works at the north end of the region. Other 19th-century water companies of the Frick Company included the Youghiogheny Water company, which pumped water from the Yough at Broad Ford to reservoirs at the several plants along Morgan Valley, and the Trotter Water Company, which had a pumping station along the Yough just above Connellsville and supplied the Trotter and Leisenring works.[113]

The Trotter Water Company became Frick's, and indeed the region's, largest water system as a result of a major expansion in 1905. When completed, the new system included a reservoir on Porter Hill near Dunbar supplied by the pumping station above Connellsville, with a capacity of ten million gallons per day, and another station on the Monongahela River at Huron, with a daily capacity of six million gallons. A 28-mile, 24-inch pipe extended from the reservoir into the south end of the region, serving such coke works as Lemont, Leith, Oliphant, Wynn, the Continentals, Yorkrun, and Shoaf. The Trotter Water Company also made arrangements to supply Dunbar and Uniontown with the system. Contractors Robert Talbot and O.J. O'Hara of Greensburg built the system, employing as many as 500 men.[114]

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[112] "Coke Waste Tests," H.C. Frick Coke Company, Miscellaneous Agreements, room 16, section 396, shelf 5, box 13, United States Steel Company Archives, Annondale.

[113] McClenathan, Centennial History of Connellsville, 286; "The Connellsville and Lower Connellsville Coke Regions," 11.

[114] Ibid.; The Weekly Courier, 15 September 1905, 3; "Connellsville Letter," Coal 2 (16 September 1905): 14.

Company Housing and Company Stores

As was common practice in the Connellsville coke region, the H.C. Frick Coke Company provided housing for its employees in towns adjacent to its mines and coke works. Provision of housing for industrial workers went back at least to the mid-19th century in western Pennsylvania.[115] The Frick Company followed the typical coke region pattern, in which rows of double dwellings were arranged along several parallel or nearly parallel streets forming a small grid pattern. Each town had at least one larger single-family house for the superintendent. The other common element of the company town was the company store.

Although some U.S. corporations had made an effort to implement model designs, both in terms of layout and individual dwelling design, at some of their company towns in 19th century, no such examples seem to have existed in the Connellsville coke region. As the mines and coke works evolved from small operations, relying for their labor on nearby farms, to more extensive enterprises which had to try to maintain a permanent and stable labor forces in otherwise remote areas, it became necessary to build towns to house those workers and their families. At first such towns consisted of little more than shacks offering minimum shelter. Operators soon learned that they had to offer a higher quality of dwelling to keep workers on the job for any appreciable time. Moreover, mine owners in remote areas learned that a substantial portion of their profits could actually stem from rents charged for housing and the mark-up on goods sold in the store. In fact, such arrangements were so profitable that one trade journal in 1906 suggested that they actually served to retard the acceptance of mining machines in some regions, because mining machines meant fewer workers and fewer workers meant decreased profits from rents derived from company housing and sales at the company store. Some of the paternalism or noblesse oblige prevalent in the 19th century likely also stimulated the mine owners to improve living conditions for their workers. The layout of the towns and the form of the housing followed standard 19th century practice. Until the turn of the century most of

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[115] Peter Shoenberger, "Cambria Iron Company," president's report in Cambria Iron Company of Johnstown, PA (New York: George F. Nesbitt & Co., Printers, 1853), 5. When Shoenberger and his partner, George King, raised eastern capital to convert their charcoal blast furnaces to coke, they also expanded other facets of their physical plant, including the construction of tenements for at least families.

Frick's towns were acquired from previous operators, so Frick towns conformed to the standard patterns.[116]

In 1881, Pennsylvania's legislature passed a law in 1881 to prohibit company stores. The law, however, which was intended to minimize the exploitation of workers, was ruled unconstitutional. Responding to sustained pressure to curtail abuse of workers through company stores, the legislature passed a new law in 1891 requiring that the company store had to be owned by a separate corporation from the mining company. According to the state's Attorney General, many corporations abided by the spirit of the legislation, but others established new corporations formally distinct from the parent company, yet tied to the latter in such a way that companies could nevertheless pressure employees to buy at their company stores. As in former years, employers still deducted purchases made at company stores from employees' paychecks. Such arrangements were implemented through "orders, checks, dividers, coupons, pass-books, and other means" by which stores managed charges to employers. The Attorney General found the language of the 1891 law too vague to prosecute violators. In a further attempt to discourage abusive company store practices, the legislature in 1901 enacted a tax on such orders, checks, dividers, etc.[117]

In the early years of H.C. Frick & Company, company stores at the various mines and coke works were simply known as the store of the Frick Company. Frick paid workers in part by issuing company currency supposedly redeemable only at its company stores, but which, in violation of state law, was used in place of United States currency in the coke region. Presumably in response to the 1881 law, Frick's stores were placed in the hands of an

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[116] "Advantage of Machines," Coal 4 (6 September 1906): 22; W.M Judd, "Miners' Houses and Mining Towns," Proceedings of the Coal Mining Institute of American, Vol. 8 (Pittsburgh: Chas. M. Henry & Co., 1910): 109-111; John S. Garner, The Model Company Town: Urban Design through Private Enterprise in Nineteenth-Century New England (Amherst: The University of Massachusetts Press, 1984), 53-54, 83-110. Discussion of mine owners profiting by the provision of company stores and company housing is in the Coal article. It states that profiteering is great "especially where colored labor is employed."

[117] Report of the Attorney General of Pennsylvania for 1894 (Harrisburg: Clarence M. Busch, State Printer, 1895), xviii; Report of the Attorney General of Pennsylvania for the Two Years Ending December 21, 1902 (Harrisburg: Wm. Stanley Ray, State Printer, 1903), xxii-xxiii, xix.

enterprise called the Union Supply Company. Yet there remained an apparent connection between Union Supply and the Frick Company. For example, in December, 1903 when Frick announced wage cuts during a severe slump in the coke trade, the Union Supply Company simultaneously announced that it would cut prices at its stores. While the Union Supply Company was commonly known as "the mercantile end of the Frick Coke Company," it did remain a legally separate corporation. In response to complaints by two independent shopkeepers, the Pennsylvania Attorney General in 1905 found "that there is no interest in the Union Supply Company held by the H.C. Frick Company or the men who run H.C. Frick." He further found "no evidence that Frick employees are compelled or unlawfully coerced to patronize stores of the Union Supply Company."[118] The looseness of Pennsylvania law is evident in the fact that, the Attorney General's finding notwithstanding, both the H.C. Frick Coke Company and the Union Supply Company were wholly owned by the United States Steel Corporation.[119]

The company stores of the Connellsville region seem to have deviated from the norm found so oppressive in other coal fields. In 1895, a correspondent for the Pittsburgh Times spent three weeks examining living and working conditions in the bituminous coal fields of Pennsylvania and Ohio. He called them generally deplorable, specifying "voracious company stores" as one of the worst features. He found conditions in the Connellsville region, however, to be much better. Concerning the company stores in particular he said: "The company store is regarded with more leniency here than in any place else I recollect. The Frick stores are looked upon as quite equitable in their treatment of

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[118] "Payment of Wages," Annual Report of the Secretary of Internal Affairs of the Commonwealth of Pennsylvania, Part III: Industrial Statistics, Vol. VII, 1878-1879 (Harrisburg: Lane S. Hart, State Printer, 1880), 364-367; "Payment of Wages," Annual Report of the Secretary of Internal Affairs of the Commonwealth of Pennsylvania, Part III: Industrial Statistics, Vol. VIII, 1879-1880 (Harrisburg: Lane S. Hart, State Printer, 1881), 198-201; The Weekly Courier 25 (18 December 1903): 1, 26 (10 March 1905): 2 and (22 September 1905): 1.

[119] Articles of Incorporation for the Union Supply Company, Charter Book 67, p. 15, and Articles of Incorporation for the H.C. Frick Coke Company, Charter Book 68, p. 529, Bureau of Corporations, Secretary of the Commonwealth of Pennsylvania, Harrisburg.

the men."[120] Commenting on the company-store system in the Connellsville coke region (presumably all company stores, not just those of the Union Supply Company), The Weekly Courier said "There the employe may get what he wants, and get it cheaper than anywhere else. Although the unions had brought their opposition to the system from other coal districts into the Connellsville region, it did not become a significant issue in the coke region."[121]

John Enman completed a study in 1974 of prices charged by the Union Supply Company. Comparing prices at the company's Buffington store with those at independent stores in Washington, a comparably remote southwestern Pennsylvania community, and Pittsburgh, a large city, he found that the Buffington store's prices were about the same as those at Washington, but higher than prices in Pittsburgh. Noting that the Union Supply Company was the largest chain store in western Pennsylvania, Enman found that Union set its prices by what the market would bear. Thus, even though the Union Supply Company's bulk purchasing would likely have allowed it to retail at or below the prices charged in Pittsburgh, the company used prices which were competitive in the outlying areas its stores served. In this manner, company stores in larger communities in the Connellsville coke region actually drew customers from among residents who were not Frick employees. The Union Supply Company, Enman concluded, made its profits not by exploiting Frick employees but through the economies of scale possible when owning such a large chain of stores.[122]

If the Union Supply Company did not charge Frick employees excessive prices, there is still the question of whether employees were compelled to shop Union Supply Company stores. In 1906 Max Miller of Scottdale wrote the President of the United States, "to call your attention to the practice in our

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[120] Pittsburgh Times article quoted in The Weekly Courier 16 (30 May 1895): 1.

[121] "Company Store System of the Coke Region," The Weekly Courier, 1914 Special Number, 66.

[122] Enman, "Coal Company Store Prices," 53-62. In its article, "The Company Store System of the Coke System," The Weekly Courier concurred with Enman that company stores sold a prices lower than found in independent stores and that "In the larger towns many persons not connected with the coke business often deal with the company stores in preference to going elsewhere," 66.

neighborhood of the H.C. Frick Co. compelling the men to buy in their stores, compel him to Rent Houses from the Co if they Refuse they are discharged or put to work in the worst Place and will quite on his own account. Thousands of citizens can testify to that Effect."[123] How the thousands of Frick laborers or neighboring residents perceived the way the Frick Company treated its employees probably varied widely and remains largely unknown. One thing seems certain, however: the H.C Frick Coke Company prided itself in the care it took of its employees' welfare.

Safety and Sociology at the H.C. Frick Coke Company

On June 16, 1890, disaster struck the Hill Farm mine operated by the Dunbar Furnace Company. Some water had been released in the mine. A boy was sent to warn men deeper in the mine of possible danger from water flowing their way. Carrying an open flame to light his way, he inadvertently passed some gas escaping from a drill hole. The resulting explosion set the slope afire, killing 31 men.[124] After the Hill Farm fire, Thomas Lynch sent a letter to all Frick mines stating:

> The late disaster at the Hill farm mine should serve as a reminder and a warning to us all, that we are liable to have accidents of the same kind, and we should spare neither time, labor, nor expense to guard against them. We should always keep the fact prominently in our minds that it is the desire of our company, and our duty as well, that we make the safety of the lives of our employes our first and most important business.[125]

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[123] Max Miller to President of the United States, 23 May 1906, file 4139, box 262, RG-122, Records of the Bureau of Corporations, Federal Trade Commission, National Archives, Washington, DC.

[124] F.C. Keighley, "Hill Farm Disaster," report appended to William Duncan, "Fifth Bituminous District," Reports of the Inspectors of Mines of the Anthracite and Bituminous Coal Regions of Pennsylvania for the Year 1890 (Harrisburg: Edwin K. Meyers, State Printer, 1891), 371-379.

[125] William Jenkins, "Mammoth Mines," special report included in his "Second Bituminous District," Reports of the Inspectors of Mines of the Anthracite and Bituminous Regions of Pennsylvania for the Year 1891 (Harrisburg: Edwin K. Meyers, State Printer, 1892), 321. By mid-century, Lynch's letter was attributed to Henry Clay Frick in Douglas A. Fisher, Steel Serves the Nation, 1901-1951: The Fifty Year Story of United States

In November, he sent another letter to his superintendents saying, "The newspapers of last week furnish two warnings of danger from gas in the mines, and I would suggest that you take advantage of them to impress on your men the necessity of care and vigilance in every mine where the lives of men are at stake."[126] Yet early the next year, on January 27, 1891, the worst mine accident to that date in Pennsylvania and still the worst disaster in Connellsville mining history occurred when an explosion in the Mammoth mine killed 134 miners.[127]

In August 1889, Henry Clay Frick had acquired Mammoth from J.W. Moore, who opened the mine and coke works in 1885. Frick transferred the property to the H.C. Frick Coke Company in October 1889. A year later, the Frick Company hired Fred C. Keighley to superintend the Mammoth works. Keighley had just previously been State Mine Inspector for the Fifth Bituminous District, and the Hill Farm fire had occurred under his jurisdiction. As soon as he had heard of the Hill Farm accident, Keighley rushed to the mine to help with rescue efforts, and he conducted subsequent investigations of the accident's cause. Taking over the operations of the Mammoth mine, he and Frick chief engineer J.H. Paddock took steps to insure that ventilation exceeded state requirements, as was common practice at Frick mines. William Jenkins, State Mine Inspector for the Second Bituminous District, had toured Mammoth mine nine days before the accident, reporting that the ventilation system typical of the bituminous region was in place and that the volume of air moving through the various workings of the mine did indeed surpass that required by state law. Early on January 27, William Snaith, fire boss for the Mammoth mine, made his rounds through the workings to verify the mine's safety before men were allowed to enter. Believing the mine to be safe, he certified its safety in writing, according to specified procedures, before re-entering the mine with the miners, dying with them later in the shift. Tragically, a fall of coal had occurred after his inspection tour, releasing gas, called fire-damp, and leading to the explosion. Three-quarters of the men who died were actually smothered by after-damp, combustion gases generated by the fire.[128]

<u>Steel</u> (New York: United States Steel Corporation, 1951): 79.

[126] Jenkins, "Mammoth Mines," 321.

[127] Ibid., 316.

[128] Keighley, "Hill Farm Disaster," 371-379; Jenkins, "Mammoth Mines," 316-320.

In response to the disaster, the Frick Company established a relief committee comprised of two Roman Catholic priests, a Methodist pastor, Peter Wise, who was local Master Workman of the Knights of Labor, and Frick's general superintendent Thomas Lynch. The committee was to care for the immediate needs of widows and orphans of the disaster and to determine how to distribute a $25,000 fund the Frick Company made available for their long-term care.[129] Lynch also drafted a set of rules for the mines intended to eliminate the possibility of another such disaster from the Frick mines. The first rule, meant to characterize the rest of the rules, read "Safety is the First Consideration."[130] In 1899, the Frick Company began a safety campaign with the phrase, "Safety First, Quality Second, Cost Third," which soon became the "Safety First" slogan used throughout American society. The company posted signs throughout its mines and surface works with that slogan printed in five different languages. The Frick Company's workplace safety programs were widely recognized by the close of the century.[131]

In addition to establishing standards for ventilation in its mines which exceeded those set by the State of Pennsylvania, the Frick Company's safety programs placed a major emphasis on educating its workers in the safety rules and on instructing its supervisors to closely monitor the practices of its workers to assure their safety. The company employed its own mine inspectors whose duty it was to travel through the mines to make sure the workers and supervisors were following safe procedures. The company stressed safety at all levels of its hierarchy through a variety of interactions. New employees were trained by

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[129] Report of the Mammoth Mine Commission (Harrisburg: Edwin K. Meyers, State Printer, 1892), 7.

[130] "Safety and Welfare in the Connellsville Coke Region," 16.

[131] The origin in the Frick Company of the slogan "Safety First" seems well established. In addition to Fisher, Steels Serves the Nation, 79; and "Safety and Welfare in the Connellsville Coke Region," 16; see Stephen L. Goodale, "'Safety the First Consideration': Methods Employed by the H.C. Frick Coke Co. for the Prevention of Accidents to Employes," Mines and Minerals 32 (August 1911): 5; "Frick Welfare Brotherhood," Coal Age 9 (8 April 1916): 641. On the Frick Company's reputation at the close of the century, see "The Connellsville Coke Region," Report of the Bureau of Mines of the Department of Internal Affairs of Pennsylvania (Harrisburg: Wm. Stanley Ray, State Printer, 1899), xxvii.

experienced hands. Each mine had a safety committee comprised of individuals from various lines of work to discuss conditions and recommend remediation of unsafe conditions. Mine superintendents met weekly with their subordinates to discuss safety matters, and all superintendents met on a regular basis at the company's main office in Scottdale. At least once, in 1908, the Frick Company sent four officials to Europe to study safety practices. Upon their return, they made a presentation to a meeting of over 500 Frick supervisors and employees to Scottdale.[132]

One of the ideas the Frick delegation brought back from the Europe was the establishment of rescue stations outside the mines from which specially-trained rescuers equipped with breathing apparatus would enter mines in emergencies to bring out trapped or injured miners. Thomas Lynch was so intent on trying to prevent accidents in the mines that his first response to the idea of rescue stations was negative. If there was money to be spent on establishing rescue stations, he thought it would be better spent on even more efforts to prevent accidents. Eventually, however, he was convinced that some accidents cannot be foreseen and that rescue stations would have a value in helping to save victims of such accidents. The Frick Company established its first rescue station at its Leisenring No. 1 mine in 1909. In addition to the breathing apparatus, the station was equipped with a brick building specially designed with a smoke chamber in which rescue crews could train. The Leisenring facility was followed quickly by rescue stations at Buffington

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[132] "Safety and Welfare in the Connellsville Coke Region," 18; Thomas W. Dawson, "Welfare Work--H.C. Frick Coke Co.," Proceedings, Coal Mining Institute of America, Vol. 10 (Wilkes-Barre, PA: R. Baur & Son, 1912), 179, 185-186; W.L. Affelder, discussion following paper by C.B. Franks, "The Rescue Station and General Safety Measures of the H.C. Frick Coke Co.," Proceedings of Coal Mining Institute of America, Vol. 7 (Greensburg, PA: M. Henry & Co., 1909), 156. A detailed discussion of Frick safety practices is provided in a four-part series by University of Pittsburgh Professor of Mining and Metallurgy Stephen L. Goodale, "Safety the First Consideration: Methods Employed by the H.C. Frick Coke Co. for the Prevention of Accidents to Employes," "Appliances for Preventing Accidents: Guards and Automatic Devices to Render Impossible Many of the Common Accidents," "Underground Safety Appliances: Protection of Shaft Bottoms, Haulage Appliances, Electric Wires, Stables, Rope Crossings, Etc," "Safety Through Systematic Timbering: Method of Mining Used by the H.C. Frick Coke Co. That Results in Safety and Economy," Mines and Minerals 32 (August - November 1911): 5-8, 74-77, 155-158, 195-200.

and Trauger. These three stations were to serve Frick mines of the central, southern, and northern areas, respectively, of the Connellsville region.[133]

The extensive supervision that accompanied the Frick Company's safety program also led to the further mechanization of the mines. Frick supervisors and mine inspectors recognized that, with miners using picks, it took a lot of time to visit all the work areas in the mine. An option would be to decrease the number of work areas and to increase the production at each work area. Longwall methods were considered impractical because of the depth of the seam and the expense of installing a structural support system for the roof when leaving wide ribs accomplished the purpose. Thus, a very large percentage of the coal extracted in the Connellsville region came from taking out ribs, which was not susceptible to longwall methods. To use mining machines and concentrate the number of mining machines into as small an area as possible, Frick mining engineers had to develop new methods. Patrick Mullen, a Frick Company mine inspector, devised a method for using shortwall mining machines to extract rib coal and an efficient haulage system for carrying the coal away from the concentrated work places without undue congestion. This led to the wider use of electric and compressed-air haulage locomotives in the Frick mines. Tried first in the Bridgeport mine in 1909, the method then spread to other Frick mines and those of other operators. The Bridgeport mine was a non-gaseous mine, and the company experimented with electric mining machines made by the Jeffrey Manufacturing Company. At other mines, such as Collier, Edenborn, and Continental Nos. 2 and 3 which were gaseous, engineers tried a variety of machines driven by compressed air and steam.[134]

The Frick safety rules also had an effect on the surface works, including coke ovens, largely through the placement of signs on equipment while it was being repaired. For example when a coke-drawing machine was being repaired or cleaned, workers would hang a sign on the controls saying "Do Not Move," lock the trolley wheel, and carry the key with them, all as a precaution against someone else moving the machine while they were inside it. These

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[133] Franks, "Rescue Station of the Frick Company," 143- 167.

[134] W.H. Howarth, "Mining by Concentration Method," Coal Age 9 (15 January 1916): 125; Mullen, "New Methods for Mining Coal by the Frick Company," 714-721; H.C. Frick Coke Company, Appropriations No. 219 dated 19 July 1909, 226 dated 3 August 1909, 227 dated 11 August 1909, 231 dated 26 August 1909, 238 dated 2 October 1909, and 242 dated 1 October 1909.

tactics seem to be of a common-sense nature, but prior to the safety campaign such precautions had been overlooked by supervisors and employees unaccustomed to new dangers associated with machinery. Other measures included placing a fence and brick barriers along waste-heat flues, accompanied by "Danger Keep Off" signs in several languages, to protect workers from falling through the flues. Larry drivers rode on a small platform at one end of the larry. Until the safety campaign, there was not protective railing or canopy for the drivers. Furthermore, they had to drive the larries through dense smoke emanating from the trunnel heads. To send a warning of the larry's approach, the company installed a foot-operated bell.[135]

Frick Company concern with employee welfare went well beyond safety in the workplace. The company also undertook extensive programs to improve living conditions in its towns. Such practices were widespread in the U.S. during the early 20th century as corporations tried to attract and maintain a stable work force while at the same time discouraging union organizing.[136] The Connellsville coke region and the bituminous coal region of western Pennsylvania commanded the attention of sociologists and others concerned with social conditions and how those conditions could be controlled or enhanced. A fundamental feature of those conditions was that, by the turn of the 20th century, a very large proportion of the miners and coke workers in the region were immigrants, especially from southern and eastern Europe. Early in the history of the region's coke industry, workers came from the surrounding farms. As labor needs grew, operators attracted immigrants, but they were largely from northern-European countries such as Germany, Ireland, and Wales. Reportedly, the first Slavs to work in the region were hired at the Morewood Coke Company's plant near Mt. Pleasant in 1879. Two years later, H.C. Frick and Company hired a group of Slavs to work at its White and Eagle works.[137] Prejudice against immigrants from southern and eastern Europe abounded in Pennsylvania, but Slavs were generally held in the lowest regard.

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[135] "Safety and Welfare in the Connellsville Coke Region," 17; Goodale, "Appliances for Preventing Accidents," 75-77.

[136] Gwendolyn Wright's chapter "Welfare Capitalism and the Company Town," in Building the Dream: A Social History of Housing in America (New York: Pantheon Books, 1981), 177-192, provides a good overview of corporations' motivations and techniques for maintaining orderly company towns.

[137] "The Slav Invasion," The Weekly Courier, 1914 Special Number, 13.

An 1884 report on immigrant labor by the Secretary of Internal Affairs stated:

> the evil effects of the importation of Italian and other pauper labor, bad as they are, working gross injustice to our working classes, whose social and moral positions suffer degradation by the contact, sink into comparative insignificance when we come to speak of that worse class--the Hungarians [Serbs, Croats, and other immigrants from Austria-Hungary].[138]

Of the three immigrants groups studied in that report, Italians, Poles, and Hungarians, the author found the conditions in which the latter lived in the U.S. to be particularly disturbing, comparing their abodes to those of animals. The report claimed that Hungarians drew and forked coke for lower wages than other laborers and that groups of Hungarians, including women and children, often contracted for such jobs, which standards of the time held were acceptable only for men. The author found substandard conditions throughout the state, "but it is the coke region where they are seen in the worst phases of life."[139]

Italian workers were said to have first arrived in the region as strike-breakers brought in by the operators during the strike of 1891.[140] Whatever the dates or circumstances of the initial arrivals of these immigrant groups, by the early 20th century, they comprised the largest segments of the working class in Fayette and Westmoreland counties, as shown by the following table, derived from a 1912 survey of the nationalities of miners completed by the Pennsylvania Department of Mines:

Nationality	Fayette Co.	Westmoreland Co.
American	2,453	3,072
Slavonian	3,079	1,852
Italian	1,157	3,207
Polish	967	1,337
Hungarian	1,151	720

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138 "Immigrant Labor," Annual Report of the Secretary of Internal Affairs of the Commonwealth of Pennsylvania, Part III: Industrial Statistics, Vol. XII, 1884 (Harrisburg: Lane S. Hart, State Printer, 1884), 68.

139 Ibid., 71.

140 "The Industrial Wars of the Connellsville Coke Region," 30.

The study identified 35 nationalities working in the mines. Others, such as Russians, Germans, Austrians, Horwats (Croats), and Lithuanians numbered several hundred working in the mines, while such nationalities and Swedes, Greeks, Finns, Belgians, and French had less than a hundred working in the mines.[141] The study showed similar concentrations of ethnic groups in the two counties among employees working outside the mines:

Nationality	Fayette Co.	Westmoreland Co.
American	1,613	1,444
Slavonian	1,139	423
Italian	752	533
Polish	544	248
Hungarian	261	120

In 1912, all of the highest positions at the mines, such as superintendent, foreman, and machinist, were still held by English-speaking individuals, but non-English-speaking workers had begun to work their way into more skilled positions such as motorman, driver, timberman, track layer, and even fire boss, which required a State certificate.[142]

The immigrants working in the mines and coke works of the region came from conditions of poverty in their home countries. This fact, coupled with their cultural practices, led to domestic conduct in the company towns which disturbed company officials, who were used to a higher level a affluence and American cultural traditions stemming from northern European antecedents. Such officials took it as their responsibility to improve the physical conditions in which the immigrants lived and to educate them in the cultural values thought necessary for American citizenship. Such a paternalistic attitude, mixing condescension with genuine concern, was typical of the Progressive Era of the turn-of-the-century United States. But mine officials' motivations did not stem solely from regard for forging better citizens. They were also imbued with a Progressive-Era attitude which saw labor as a capital investment, as part of the machinery of production which needed to be maintained like any piece of hardware. Commenting on modern methods of organizing production in a paper presented

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141 Pennsylvania Department of Mines, "Nationality of Employees Working Inside Bituminous Mines, 1912, cited in W.E. Fohl to Estate of Wm. Thaw, Dec'd., 17 August 1915, folder 44, series IX, Wm. Thaw Papers, Historical Society of Western Pennsylvania, Pittsburgh, 2-3.

142 Fohl to Thaw Estate, 4-6.

to the Coal Mining Institute of America in 1909, S. Rae King, superintendent of the Donahoe Coke Company, said:

> To secure these desired results we are calling to our aid the best forms of construction, material, and the most efficient electrical and mechanical devices, as the day has passed when any old thing is good enough for a coal mining plant. We are constantly searching about for superintendents and foremen of the best ability who can handle and direct these forces, and most important of all to guide and manipulate the movements of the greatest and most complicated piece of mechanism of all our equipment--the foreign laborer.
>
> This human machinery is imported principally from the Latin and Slavonic races where there exists economic distress, the land being held by a privileged class and labor poorly paid. Until our immigrant laws are changed, we can expect to receive the poorest and most ignorant from these corrupt and unprogressive countries, from which, no matter how undesirable it may seem, we must coin our future citizens from whom will arise fathers and mothers of coming generations. The raw material, disrobed of its habits and customs, is good enough--much better than the thin, worn out, blue-blood we purchase for the daughters of some of our millionaires-- but the question is to mould and educate this raw material and their off-springs into desirable Americans.[143]

One of the earliest formal presentations to mining engineers and coke manufacturers in the Connellsville region concerning the importance of the social aspects of the communities they governed was a 1907 paper presented to the Coal Mining Institute of America by C.L. Fay of the Y.M.C.A. in Greensburg.[144] While

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[143] S. Rae King, "The Sociological Side of Coal Mining," Proceedings of Coal Mining Institute of America, Vol. 7 (Greensburg, PA: Chas. M. Henry & Co., 1909): 37-38, reprinted under the same title in Mines and Minerals 30 (October 1909): 145-147.

[144] C.L. Fay, "A Study of Social Conditions," Proceedings of the Coal Mining Institute of America, Vol. 5 (Greensburg, PA: C.M. Henry & Co., 1907): 17-29, and reprinted under the title, "A Brief Study of Social Conditions in the Bituminous Coal Region of Pennsylvania," in The Engineering and Mining Journal 83 (22 July 1907): 1199-1200.

improving living conditions was apparently a general pattern in the Connellsville region, the Frick Company was the undisputed leader in doing so.[145] Describing the Frick Company's employee welfare programs, assistant superintendent W.H. Glasgow recognized that such extensive expenditures were possible because of the vast financial resources of U.S. Steel. Because the Frick Company had such unusual backing for its programs, it made information derived from its efforts available to other operators, saying, in Glasgow's words, "The welfare of the miner and other employees engaged in the mining industry, is the welfare of the industry," and further, "We contend that the employees of the H.C. Frick Coke Co. are the best treated and best satisfied coal and coke workers in the world. I know of nothing more conducive to the highest efficiency and uninterrupted service from working men than fair treatment and pleasing surroundings."[146]

Beginning about 1910, the Frick Company embarked on a program in which it spent over $500,000 improving sanitary conditions through better drainage and the construction of improved privies; demolishing "nondescript outbuildings and replacing them with company-built stables, chicken coops, and pig pens; demolishing sub-standard houses and building new ones to current standards; adding front and back porches to those dwellings without; painting all dwellings "a durable red with white trimmings;" and putting picket fences around every yard. The company went beyond such immediate physical concerns to address a number of more intangible aspects of living conditions. With the help of two men from the Connellsville Courier, the company organized a baseball league consisting of teams representing several towns so that immigrants could learn "to appreciate creditable playing on the part of an opponent." League play expanded to include representatives of other company towns, such as those of W.J. Rainey. The Frick Company offered prizes to encourage gardening and well-kept lawns. At the Gates mine, the company built an

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[145] In describing "Safety and Welfare in the Connellsville Coke Region," The Weekly Courier (1914 Special Number, 16-20) asserted that the Frick Company was the region's leader. In his letter 17 August 1915 to the Thaw Estate describing the condition of properties it leased to other operators, W.E. Fohl said that "The Frick villages at Trauger and Hecla vie with the best in the region."

[146] W.H. Glasgow, "The Welfare of the Miner is the Welfare of the Industry," Proceedings of the Coal Mining Institute of America, Vol. 10 (Wilkes-Barre, PA: H. Baur & Son, 1912): 218-219.

incline to transport workers and their families between low ground, where the works, store, and passenger depot were located, and the high ground, where 85% of the houses were located. In 1911 at Leisenring No. 1, the company built a swimming pool, complete with change houses, and the next year converted an abandoned fraternal lodge building into a community recreation hall equipped for reading, bowling, basketball, dancing, and other amusements. In 1913, the company built additional pools at Redstone, Footedale, and Standard. The Union Supply Company at Phillips went beyond offering necessary foodstuffs by installing an ice cream parlor and soda fountain.[147]

The Frick Company awarded compensation for workers injured on the job and for families of miners killed in accidents. Other employee benefits included a pension plan and an opportunity to purchase stock in U.S. Steel.[148]

H.C. Frick Coke Company Management Structure

When the H.C. Frick Coke Company was first incorporated in 1882, its charter specified that its chief place of business would be at Broadford. An 1888 amendment to the charter shifted the operational headquarters to Scottdale. When the Frick Company became part of U.S. Steel and the McClure Coke Company and the several large steel-company-owned coke companies (United, Continental, American, and South West Connellsville) were merged into the Frick Company in 1903, the new charter again specified that Scottdale would be the principal office. By this time, however, the corporate office was located in Pittsburgh,[149] where

[147] "Safety and Welfare in the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 16-20; Dawson, "Welfare Work--H.C. Frick Coke Co.," 193-202; H.C. Frick Coke Company, Appropriation No. 157 dated 6 November 1907 and No. 577 dated 17 March 1913; "Rational Sociology at Mines," Mines and Minerals 32 (November 1911): 193-194; "Swimming Pools for Mining Towns," Mines and Minerals 32 (December 1911): 276; "Rational Mine Sociology," Mines and Minerals 33 (January 1913): 303-304; "Company Store System of the Coke Region," 66.

[148] Dawson, "Welfare Work--H.C. Frick Coke Co.," 189-192.

[149] Articles of Incorporation for the H.C. Frick Coke Company, 13 March 1882, Charter Book 14, 280-281, Articles of Amendment for the H.C. Frick Coke Company, 2 May 1888, Charter Book 24, 90, Articles of Incorporation for the H.C. Frick Coke Company merging the several companies, 31 March 1903 Charter Book 68, 532, Bureau of Corporations, Secretary of the Commonwealth of

president Thomas Lynch and his immediate staff had offices in the Frick Building. The general superintendent, chief engineer, and the administrative officers who managed day-to-day operations in the coke region had their offices at Scottdale, with the superintendents of the various works reporting directly to them. Little is known of the management structure of the Frick Company before it became a part of U.S. Steel, but evidence from immediately after the formation of the steel company exists. Furthermore, evidence suggests that in the first years after U.S. Steel came into existence there was little change in the management structure of its constituent companies.

In June 1903, two years after the Frick Company became part of U.S. Steel and just months after all of U.S. Steel' Connellsville coke companies were merged together, the Frick Company employed over 16,000 persons at its coke plants as well as about 80 in the Engineering Department at Scottdale, 30 in the Accounting Department, 15 in the Shipping Department, 130 at the Everson car shops, and 10 in divisional and miscellaneous offices. Orran W. Kennedy was the general superintendent at Scottdale and W.H. Clingerman and Edward O'Toole were his assistants. J.P.K. Miller was the chief engineer, William A. Todd headed the shipping department, and chief clerk J.A. Barnhart headed the accounting department. In addition to Lynch, the Pittsburgh office included Phillip Keller, treasurer of the corporation, and C.H. Spencer, general sales agent. Of those working at the coke plants, 15,874 were wage earners and 395 were salaried. At the Everson car shops there were 116 wage earners and 11 salaried persons. All of the employees in the engineering, accounting, shipping, and divisional offices were salaried.[150]

At the coke plants, most wage earners were either miners or coke drawers. The number of salaried people depended on the size of the plant. At small plants such as Monastery (150 ovens) and White (200 ovens), there were only four or five salaried people. Monastery had a total employment of 99. In addition to the superintendent, salaried people at Monastery included a mine boss, yard boss, clerk, and machinist. At White, where 90 people worked, there were a superintendent, mine boss, yard boss, clerk, shipper, and stable boss. Larger plants had many more employees, both hourly and salaried. Yorkrun, with 500 ovens and 443

Pennsylvania, Harrisburg.

[150] "Statement of Earnings" dated 30 June 1903, Miscellaneous Agreements, H.C. Frick Coke Company, room 16, section 396, shelf 5, box 13, United States Steel Corporation Archives, Annondale; Weekly Courier 27 (6 April 1906): 3.

employees, had a mine boss, yard boss, clerk, shipper, janitress, stable boss, machinist, two electrical engineers, and an electrician. Southwest No. 1 had 625 ovens and 612 employees, including three mine bosses, yard boss, assistant yard boss, timekeeper, clerk, watchman, janitor, stable boss, and two machinists. Standard, the largest plant in the Connellsville coke region, had 901 ovens and 925 employees, including a mine boss and two assistant mine bosses, a yard boss, two clerks, a shipper, janitress, five stable bosses, supplyman, machinist, fan engineer, and yard engineer.[151]

W.J. Rainey Company

The son of Scotch-Irish immigrants, W.J. Rainey was born at Martin's Ferry, Belmont County, Ohio, in 1834. After local schooling, he entered business trading agricultural goods. When he gained possession of the coal under his father's farm, he mined and shipped the coal down to Cleveland, forming the basis from which his wealth grew. He also made important contacts with members of the coking industry in Cleveland. From that position, he began working as an agent for Connellsville coke. In 1879 Rainey decided to invest in the Connellsville coke region, purchasing and developing the Fort Hill works near Vanderbilt. In little more than a decade, he had also acquired and developed large works at Grace (Moyer), Paul, Elm Grove, and Mt. Braddock.[152]

As already described, many of the operators in the Connellsville region joined to form marketing pools in the 1880s. The largest operators (Frick, McClure, Schoonmaker, and Connellsville Coke & Iron) created the Coke Syndicate to market their own coke as well as that of smaller producers represented by the Connellsville Coke Producers' Association. By combining their output in this way, the smaller producers could assemble large enough volumes of coke to meet the demands of large contracts offered by iron-furnace companies in Pittsburgh and elsewhere. Three medium-

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[151] "Life of Plants," and "List of Monthly Men Employed in the Region and Salaries of Same," 1 March 1907, both in H.C. Frick Coke Company, Miscellaneous Agreements, room 16, section 396, shelf 5, box 13, United States Steel Corporation Archives, Annondale; H.C. Frick Coke Company, "Historical Data: H.C. Frick Coke Company's Plants."

[152] "Mr. William J. Rainey Dies After an Operation," Cleveland Plain Dealer, 29 March 1900, 3; "Obituary," The Engineering and Mining Journal 69 (31 March 1900): 386; Belmont County History, 1903, 203.

sized coke producers, Rainey, James Cochran, and J.W. Moore did not join either group. On behalf of the operators, the Syndicate also negotiated with Connellsville unions in the 1880s, and it was this facet of the Syndicate's function that brought about its demise in 1887 when Andrew Carnegie demanded that the Frick Company yield to union demands, contradicting the policy of the Syndicate. After the Syndicate fell apart, Frick acquired Moore's properties and those of all the large producers except McClure. The remaining small producers tried to organize a new pool, but because Rainey and Cochran refused to join, the effort failed. Despite occasional rumors that Rainey would sell out to Frick, he steadfastly remained an important independent force in the region. Furthermore, Rainey made certain in his will that his properties would remain independent after his death.[153]

Rainey died in 1900, by which time he owned and operated about 2,200 ovens and employed about 2,000 men in the Connellsville region. In the early 20th century, the Rainey Company, like the Frick Company, also maintained extensive shops in support of its mines and coking works. Under the superintendence of J.A. McCreary, the shops were located at Mt. Braddock and were said to employ about 80 men. Rainey's heirs took control of the W.J. Rainey Company, which had its corporate offices in Cleveland. Actual operations were under the supervision of Thomas Jefferson Mitchell, the brother of Rainey's wife, Eleanore. Mitchell maintained offices in Connellsville. Rainey's eldest son, William T., owner the William T. Rainey Coal Company of Philadelphia, played a major role in managing his father's business until he, too, died in 1904. The following year, Rainey's two surviving sons, Roy and Paul, moved the corporate offices from Cleveland to New York City, where they remained through the period of this study. In 1906, general manager Mitchell moved Rainey's operational offices from Connellsville to Uniontown, which was closer to Rainey's new works in the south end of the Uniontown syncline and in the Lower Connellsville region.[154]

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[153] "The Connellsville and Lower Connellsville Coke Regions," 6-7; The Iron Trade Review 38 (4 May 1905): 57; Office of the Recorder of Wills, Fayette County Courthouse, Uniontown, PA, Book of Wills No. 11, pp. 451-457. Rainey's will stated that the principal of his estate could not be divided until 1925 and that it was to be managed by his heirs to provide them with income until then.

[154] "Rainey Dies," 3; Daily News Standard, 15 August 1904, 1; The Weekly Courier 26 (19 May 1905): 2 and 28 (31 August 1906): 2; John W. Jordan and James Hadden, eds., History of

Mitchell, who like Rainey came from a Scotch-Irish background, was born in Jefferson County, Ohio, in 1845. He graduated from Washington and Jefferson College in Washington, Pennsylvania. After teaching school for four years, he went to the University of Michigan law school, from which he graduated in 1873. Shortly thereafter, he moved to Cleveland to become Rainey's private secretary (Rainey had married Mitchell's sister in 1864). In 1884, Mitchell moved to Fayette County to become general manager of Rainey's works. Mitchell remained general manager of the Rainey operations until sometime after 1913, when he was succeeded by L.L. Willard, who had been his assistant. Mitchell remained in Uniontown into the late 1920s as an independent coal operator, developing mines as far afield as Kentucky.[155]

In its effort to retain its status as the largest independent coke producer in the Connellsville region, the W.J. Rainey Company conducted its affairs in a manner which often seemed secretive to the Connellsville coking community. For example, in 1905 Rainey opened new car shops at Mt. Braddock, where the company could produce daily one new steel-bottomed and wood-sided railroad cars of a design attributed to shop superintendent J.A. McCreary. Employing 100 men, this new plant began with the intent of producing 600 privately-owned cars for the Rainey Company. In support of its new undertaking, the Rainey company also built 30 double houses to house workers. In an article describing the plant, the Weekly Courier commented that, typical of other Rainey projects, the company had not advertized its plans and few outsiders knew the project was underway.[156] Yet, there was one realm of activity in which the Rainey Company operated in a spirit of cooperation with other operators: innovation for beehive coking.

The H.C. Frick Coke Company was willing to try new or innovative

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Fayette and Greene Counties, Pennsylvania, Vol. III (New York: Lewis Historical Publishing Company, 1912), 146.

[155] Nelson's Biographical Dictionary and Historical Reference Book of Fayette County, Pennsylvania (Uniontown, PA: S.B. Nelson, 1900), 998-999; L.L. Willard, "Modern Coke Plants of W.J. Rainey," Coal and Coke Industrial Review, special supplement to the Daily News Standard 21 October 1913, 7; Daily News Standard 23 June 1917, 1; The Weekly Courier 41 (28 February 1918): II, 13; Uniontown City Directory, 1926, listing under Mitchell, 1928, Mitchell not listed.

[156] Connellsville Weekly Courier 26 (6 January 1905): 3, and (3 February 1905): 3.

technologies in its Connellsville coking operations, but it did so within the parameters of conventional beehive coking practices. The W.J. Rainey Company may have been more willing to experiment with approaches that radically altered conventional practice. One of the earliest examples of the Rainey Company being willing to try a new technology was in the electrification of larries. Evidently, at the turn of the century, most coke operators in the Connellsville region did not believe electrified larries would offer any significant savings in either time or money. In early 1900, the Rainey Company installed an electric trolley system for the larries at its Paul works near Vanderbilt, the first attempt of its kind in the Connellsville region.[157] Electrified larries had still not become standard at Frick works by the time Bitner, Shoaf, and Yorkrun were built in 1904 or when Ronco, Dearth, Collier, and Phillips were built in 1906-1907. In 1910, the Frick Company installed an electric larry system at Bitner to replace the old steam locomotive used for hauling the larries at that works.[158]

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[157] "Pennsylvania, Bituminous Coal," The Engineering and Mining Journal 69 (21 April 1900): 480, reports the Rainey company installing electric larries at its Paul works. "Electrically Operated Coke 'Larries,'" Mines and Minerals 21 (August 1900): 46, describes an operator in the Connellsville region, believed to be the Rainey Company, which installed electric motors, controllers, and trolleys on its larries in earlier in 1900 and demonstrated cost savings when compared to using horses to pull the larries. In addition to cost savings in the operations, the experiment pointed out that savings would also accrue from obviating the need to construct a surface along the tops of the ovens which could support the horses.

[158] H.C. Frick Coke Company, Appropriation No. 113 dated 14 November 1906, Vol. 2 shows that, while the Frick Company was installing coke-drawing machines at Ronco, Dearth, Collier, and Phillips, the company was still supplying the works with locomotives to pull the larries. Appropriation No. 281 dated 18 February 1910, Vol. 4 shows that the company estimated the electric larry system, when compared with the steam locomotive then hauling the larries, would save $500 per year in operating expenses. The new system cost $3,750 to install. In addition, the company calculated a credit of $2,600 on the steam locomotive and three old larries, which could be put to use elsewhere. This was not the first installation of electrified larries at a Frick plant (for example, according to Appropriation No. 136 in 1907, the company installed electrified larries at Continental No. 1), but rather the first in which the operating cost savings were discussed in the appropriation.

The most important innovation pioneered by the Rainey Company was the rectangular oven, also known as the Mitchell oven after T.J. Mitchell, general manager of the Rainey Company and the man credited with its development. Reflecting on the development of the Mitchell oven ten years after its first trials, H.V. Schiefer pointed out that, whereas the Covington, Hebb, and similar coke-drawing machines were responses to conditions imposed by the standard beehive oven, Mitchell's work called into question the basic assumptions about oven configuration. Mitchell defined his task as developing an oven configuration conducive to mechanized operation while yielding the same high quality of Connellsville coke as the standard beehive. Working at Rainey's Mt. Braddock works, Mitchell's design retained the principal of top-loading the ovens by means of larries charging coal through centrally-located trunnel heads. He abandoned the circular shape and the single door of the beehive, however, and adopted a principle from by-product coking practice, in which doors at both ends of a rectangular oven allowed a mechanical pusher at one end to drive the coke out the other end. Although some observers called these new ovens modified Belgian ovens because of their obvious visual similarity, William Affelder suggested that such was a misnomer because the Belgian ovens derived their heat for coking from flues surrounding the ovens rather than from combustion taking place within the ovens and because Belgian ovens excluded air from their interiors. Mitchell's ovens required a regulated amount of air to sustain combustion, as did the standard beehives. Affelder recommended the moniker "Mitchell oven."[159]

Mitchell's ideas for the rectangular oven were not wholly original. The Mitchell oven was very similar too and derived from the McLanahan and Thomas ovens, which themselves were modifications of the old Welsh oven. All of these earlier rectangular ovens were depicted in John Fulton's 1905 edition of <u>Coke</u>, which Mitchell had studied while trying to take a more practicable approach to the mechanization of drawing coke. As already noted, Welsh ovens were rectangular, but operators removed the coke by withdrawing a drag, which had to be placed at the rear of the oven prior to charging with coal. The Thomas oven employed a similar system to draw, rather than push, the

coke from within. Mitchell had visited Coalbrook, Alabama, to

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[159] H.V. Schiefer, "Machinery for Mitchell Type of Rectangular Coke Oven," <u>Coal Age</u> 10 (11 November 1916): 796-797; Affelder, "Transition in Coke Making," 486.

observe the Thomas patent ovens built there in the 1880s.[160]

Mitchell's concept, however, differed from Thomas' because it entailed pushing the coke from the ovens, an idea Mitchell may have got from the McLanahan oven. In addition to a system of flues which improved the delivery of air to the combustion chamber above the bed of coal and below the vaulted ceiling of the oven, J. King McLanahan's oven, first designed in 1875, featured a steam-powered ram for pushing the coke from the oven. Coal was charged into the McLanahan oven through four trunnel heads. The coke pusher was also equipped with a device for leveling the coal. Associated with the McLanahan Machine Company of Hollidaysburg, Pennsylvania, McLanahan improved his design during the course of the late 19th century, but, although coking expert John Fulton extolled the potential economies of the McLanahan oven as early as 1895, there is no evidence of its being used in the United States. McLanahan's coke pusher was used at Syracuse, New York, at the ovens of the Solvey Process Company, a by-product producer. The Semet-Solvey by-product ovens at Dunbar also employed a steam ram to discharge coke. The record does not specify whether the ram used at Dunbar was McLanahan's coke pusher or an apparatus very like it. Photographic evidence suggests it was. Whatever the case, the Dunbar system of drawing coke, little more than a mile from Rainey's Mount Braddock works, may have been the installation closest to hand which inspired Mitchell's innovation.[161] He would also likely have been inspired by the arrival of the Covington coke-drawing machine on the Connellsville scene, by continued labor shortages, and by knowledge of the impending more general adoption of by-product coking, which he could predict

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160 John Fulton, Coke, 1895 edition, 124-127, 266-267; Fulton, "The Mitchell Patent Coke Oven," Mines and Minerals 30 (November 1909): 247; J.T. Hill, "The Thomas Patent Coke Oven," Proceedings of the Alabama Industrial and Scientific Society 1 (1891): 86-90; Charles Orr, "Opinion in the Case of Mitchell v. Connellsville Central Coke Company, 14 February 1916," The Federal Reporter, vol. 231 (St. Paul: West Publishing Co., 1916), 134.

161 John Fulton, Coke, 1895 edition, 124-127, 266-267; Fulton, "The Mitchell Patent Coke Oven," Mines and Minerals 30 (November 1909): 247; William L. Affelder, "The Semet-Solvey Coke Plant," Mines and Minerals 20 (February 1900): 297. An excellent photograph of the pusher at the Semet-Solvey ovens at Dunbar may be found in Donald C. Morrison, Dunbar, 1883-1983: The Furnace Town (Dunbar, PA: Centennial Book Committee, 1983), 15.

would provide stiff competition for coke operators in the Connellsville region.

Mitchell built his first experimental rectangular oven at Mt. Braddock in the winter of 1905-1906. It was 30 feet long, 4 feet wide, and had a vaulted, horizontal crown. He initially used two trunnel heads, on the theory that this would allow a lower crown. He found, however, that this made it difficult to regulate air to the oven. Wind easily set up a current of fresh air entering one trunnel and exiting the other. After moving to a single trunnel, tests revealed that coal near the middle of the oven did not coke thoroughly. Upon further investigation, Mitchell realized that the horizontal crown did not allow the volatiles emanating from the middle of the bed of coal to combust, while the combusted gases emanating from the ends of the oven had already yielded their heat by the time they passed over the middle of the bed. He surmised that by building a crown which rose to a high-point at the center of the crown, much like the traditional beehive, the rectangular oven would coke the coal throughout. To perfect his design, Mitchell built a dozen side-by-side experimental ovens at Mt. Braddock in the fall of 1906 to try several configurations. The ovens were all 30 feet long. Ten of them were 4 feet wide, giving them about the same area as the standard beehive. One of the 4-foot ovens had a horizontal crown, so that its performance could be compared with the others having the crown rising to 8 feet 6 inches at the center. The other two ovens were slightly wider, one at 50 inches and one at 54 inches. The ten 4-foot ovens were each 32 inches high to the spring-line of the arched door opening, and the wider ovens were 42 and 40 inches high, respectively. Additionally, each of the ovens was 2 inches narrower at the pusher end than at the discharge end to facilitate the extraction of the coke, but after a few charges Mitchell found that the coke shrank sufficiently upon quenching that the difference in width was unnecessary. The thickness of the walls separating the ovens varied to determine what was sufficient. In an effort to militate against the flattening of the crown, Mitchell eliminated mortar joints, opting instead for dipping each silica crown brick in a silica-and-lime cement mixture before placing it. Although Mitchell had ideas for machines to use in conjunction with his oven, the first experiments were undertaken with jerry-rigged mechanisms. For example, to push the coke out of the ovens, crews attached a block and tackle to a telegraph pole, which served as the ram at the back end of each oven. A locomotive pulled the lead line of the block and tackle to drive the ram through each oven.[162]

In these first trials of the rectangular ovens, the doors were bricked up like standard beehives. Quenching and extracting the coke, cleaning the ovens, and charging fresh coal took place in less than 30 minutes. In such a short time, so much heat was retained in the ovens that it was reported that the new charge ignited before the doors could be bricked and sealed with loam mortar. This identified another problem needing a solution: how to build a re-usable oven door which could withstand the intense heat of a burning oven (this had also been a problem during the earlier beehive era, but one which never found a satisfactory solution). Mitchell did not conduct his experiments in secret. Superintendents representing most of the operators in the Connellsville region visited Mt. Braddock to witness the operation of the new ovens. Although some were skeptical, others believed Mitchell's development would revolutionize the way ovens were built in the region. Some put their minds and the energies of their engineers and mechanics to the task of devising a door which would work on the rectangular ovens. Several doors were introduced. Meanwhile, the Wellman-Seaver-Morgan Company of Cleveland built three separate machines, driven by electricity, for leveling coal, quenching coke in the ovens, and pushing coke out of the ovens. To complete the mechanization of the rectangular ovens, the Scottdale Foundry & Machine Company built a loader, which screened out breeze before loading the coke into cars.[163]

Apparent success with the rectangular ovens induced the Rainey Company to build 38 more in 1907, bringing the total number of ovens at Mt. Braddock to 50. That same year, Jones & Laughlin built 10 experimental rectangular ovens at its northside Pittsburgh plant to see if the new design would work with J & L's flue system used for smoke abatement. The Connellsville Central Coke Company, incorporated in 1902 by Herbert DuPuy, John C. Nef, J.H. Hillman, and J.P. Brennan, built its Herbert works of 250 conventional beehive ovens near New Salem in the Klondike region

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162 Fulton, "The Mitchell Patent Coke Oven," 247; Orr, "Mitchell v. Connellsville Central," 136, The Weekly Courier, 29 (25 June 1908): 2; "An Innovation in Coke Ovens," The Iron Trade Review 39 (22 November 1906): 17-18; Affelder, "Transition in Coke Making," 486.

163 "An Innovation in Coke Ovens," 18; Affelder, "Transition in Coke Making," 486-487; Affelder, "Progress in Coke Drawing Machinery," 170-171

that year. General Manager Nef was among those observing the 1906 experiments at Mt. Braddock. Nef devised some modifications to the Mitchell design, based on which Connellsville Central developed its own version of the rectangular-oven scheme. The company built and operated 100 new ovens at its Herbert works in 1907. Herbert, the region's first large plant consisting of the rectangular design, had ovens were 30 feet long, 5 feet wide, and 30 inches high at the top of the spring line of the door. Connellsville Central built an additional 110 ovens at Herbert in 1909. The plant was equipped with the above-described machines for rectangular ovens. The company devised a means of using compressed air to blow dust and breeze from the ovens before placing the next charge. Connellsville Central also experimented with four-part cast iron doors lined with firebrick. The two bottom segments could be placed before the oven was charged with coal, leaving space at the top of the opening for the leveler to reach inside. Although the doors worked well in conjunction with the mechanical leveler, after four months the linings were seriously cracked and falling out.[164]

Although the Connellsville Central Coke Company fired its rectangular ovens in September 1907, the H.C. Frick Coke Company was evidently not convinced of the efficacy of the new configuration. On September 30, Frick appropriated funds for the 500-oven Ralph, Palmer, and Filbert works, and all were conventional beehive plants. Other companies as well stayed with the proven beehive technology. For example, right next to the Herbert plant, the Taylor Coal & Coke Company completed 250 ovens at its Searights plant in 1907. About two-thirds of the new ovens were designed to be hand-drawn, while the remainder were equipped with iron jamb blocks so that Covington coke-drawing machines could be used. Several smaller operators in the Connellsville region, however, did see the Mitchell ovens as a promising means of cutting production costs. By the end of 1908, several other companies had rectangular ovens either in operation or under construction. The River Coal Company had 100 rectangular ovens in operation at its Bridgeport works near Brownsville, the Tower Hill Connellsville Coke Company had 48 rectangular ovens in operation at its Tower Hill No. 2 works, and E.A. Humphries had 40 in operation at Bradenville east of

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[164] Affelder, "Transition in Coke Making," 487; "Two Hundred New Typed Coke Ovens To Be Erected," Iron Trade Review 40 (9 May 1907): 734; "Complete New Ovens," The Iron Trade Review 41 (24 October 1907): 673; "A Battery of Belgian Type Ovens," The Iron Trade Review 41 (14 November 1907): 785-788; The Weekly Courier 41 (28 February 1918): 20; Orr, "Mitchell v. Connellsville Central Coke Company," 135-136.

Latrobe. Tower Hill Connellsville was building additional rectangular ovens at both its No. 1 and No. 2 works and the W.J. Rainey Company had rectangular ovens under construction at its Royal plant. Although the Frick Company did not build any rectangular ovens, it owned the River Coal Company, which had built the ovens at Bridgeport. At the end of 1908, the Frick Company absorbed the River Coal Company, thereby taking over the Bridgeport plant, with which Frick engineers joined the experimentation in refining techniques for the new ovens. For example, Frick engineers devised a scheme in which the top of a rectangular oven would consist of two vaults (each with its own trunnel), the axes of which were perpendicular to the main axis of the oven. The vaults were supported by the arches of the door openings and by an arch at the middle of the oven. Consequently, a longitudinal section of the oven resembled that of two beehive ovens joined back to back.[165]

As the decade came to a close, experimentation continued on hardware details associated with the rectangular ovens. The original quenching machine built by the Wellman-Seaver-Morgan Company had proved to be too time consuming, being no faster than a man using the conventional hand-quenching technique. Working with Mark Gorton of Brownfield, William Affelder of the Frick Company devised a new quenching machine, which was built by the Herron-Webb Engineering Company of Monongahela, Pennsylvania, and given its trial runs at the Bridgeport works. After a successful trial, the Tower Hill Connellsville Company ordered eight of the machines for its 445 rectangular ovens at Tower Hill Nos. 1 and 2. Numerous individuals also worked at devising a door which would stand up to the rigors of a rectangular oven. Because of the size and number of doors involved (a plant of 100 ovens required 200 doors), some operators were reluctant to invest in unproven hardware and continue to incur the labor cost of bricking up the openings and daubing the brick with loam mortar. One door was developed by Mitchell and James McCreary, superintendent of Rainey's machine shops at Mt. Braddock. The door consisted of a flexible frame held together with rods and

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[165] H.C. Frick Coke Company, "Historical Data," 1; Frick Company, Appropriations No. 152, 153, and 166 dated 30 September 1907; "Searights Plant of Taylor Coal & Coke Co.," <u>The Iron Trade Review</u> 41 (8 August 1907): 237; Affelder, "Transition in Coke Making," 486; Affelder, "Progress in Coke Drawing Machinery," 170; Affelder, "An Automatic Coke Waterer," <u>Mines and Minerals</u> 30 (July 1910): 725; H.C. Frick Coke Company, Office the Chief Engineer, "Rectangular Coke Oven," drawing dated 22 December 1908 on file at the Office of Mineral Resources, U.S. Diversified Group, USX, Uniontown.

covered with tile. It was flexible so that it could expand and contract with temperature change. Another widely used door, developed by Frick superintendent William McMurray of Mt. Pleasant, was lined with a mixture of asbestos and fire-clay invented by J.R. Campbell, Frick's chief engineer.[166]

The apparent success of the rectangular ovens led T.J. Mitchell to seek a patent for his design, but his efforts were fraught with difficulty and in the end failed. He first applied for the patent in the fall of 1906, but so did G.C. Landis, who had been superintendent at Rainey's Mt. Braddock works for many years. Fairfax Bayard, Examiner of Interferences for the U.S. Patent Court, heard testimony concerning who should receive the patent in late 1907 and early 1908, deciding in Mitchell's favor in June 1908. Upon receiving his patent, Mitchell began advertizing his concept in trade journals and also filed a patent-infringement suit against the Connellsville Central Coke Company. After hearing evidence, Judge Charles P. Orr of the U.S. District Court for the Western District of Pennsylvania voided Mitchell's patent, ruling that there was nothing new in his invention. The most important facet of the design Mitchell claimed in his patent was the rise in the crown from the doors to the trunnel. Orr found that, although Mitchell had ignored it, Thomas had specified a rise in the crown of his oven, albeit a much more gradual rise. Moreover, Mitchell derived his inspiration for the need for the rise from conventional beehive construction practice. Orr's opinion stated that Mitchell's design "is a mere aggregation of old elements, which, so far as the record shows, does not produce a new and better result." Orr's opinion is especially interesting in the glimpse it gives of the sharing of technical information which conventionally took place among operators in the Connellsville coke region.[167]

As will be seen, after 1910 few new plants were built in the United States which did not recover by-products. As coal reserves in the Connellsville region declined, there was also less construction of new ovens there. Improvement of apparatus for use with rectangular ovens, however, helped to continue their

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[166] Affelder, "An Automatic Coke Waterer," 725-726; John W. Jordon, Genealogical and Personal History of Fayette and Greene Counties (New York: Lewis Historical Publishing Company, 1912), 146; "Labor Saving Devices of Connellsville Coking Practise," The Weekly Courier, 1914 Special Number, 25.

[167] The Weekly Courier 29 (5 February 1908): 12 and (25 June 1908): 2; The Coal and Coke Operator 8 (15 April 1909): vii; Orr, "Mitchell v. Connellsville Central Coke Company," 131-136.

popularity among the few operators still building ovens. Within the region, new rectangular ovens included the 140 ovens of the Union Connellsville Coke Company's Katherine plant at Simpson, W. Harry Brown's 400-oven Alicia works near Brownsville, and the 310 ovens of the Mt. Pleasant Coke Company's Mt. Pleasant works at Hecla. Even the Taylor Coal & Coke Company built a few rectangular ovens at Searights. Companies outside the region also adopted the rectangular-oven technology: the Pittsburgh-Westmoreland Coal Company built 300 rectangular ovens at Bentleyville, Pennsylvania, the Keystone Coal Company and the Atlantic Crushed Coke Company built rectangular-oven plants near Greensburg, and the Jamison Coal and Coke Company built rectangular ovens near Fairmont, West Virginia. Willingness to try the rectangular oven spread well beyond the neighboring state of West Virginia, as the Wisconsin Steel Company experimented with the technology at its coking plant at Benham, Harlan County, Kentucky. Even as late as 1917-1918, at about the time by-product ovens in the U.S. were to overtake beehive ovens production, the Cascade Coal and Coke Company built 200 rectangular ovens at its Sykesville plant in Clearfield County, Pennsylvania.[168]

Meanwhile, the W.J. Rainey Company continued to be the major independent operator in the Connellsville region, operating more than 2600 ovens in 1915 at its Acme, Allison No. 1 and No. 2, Elm Grove, Fort Hill, Grace, Mt. Braddock, Paul, Rainey, Revere, Royal, and Union works. There were rectangular ovens at the Allison, Royal, Mt. Braddock, and Revere works. In 1918, the Rainey Company operated 2,208 ovens in the Connellsville region, of which 1,778 were rectangular. Responding to the growing importance of by-product coke in the steel industry, the Rainey interests joined with the Alan Wood Iron & Steel Company of Philadelphia for form the Rainey-Wood Coke Company, which built a by-product coking plant at Swedeland, Pennsylvania, to supply the Wood blast furnaces and steel works. In 1920, the Rainey interests incorporated as W.J. Rainey, Inc., and continued to develop coal properties in the Connellsville region, for example, developing the Stewart mine near Hecla in 1921 for export from the region of coal from the Pittsburgh seam. In the depths of the Great Depression, W.J. Rainey, Inc., was one of the few merchant coke companies in the Connellsville region to stay in

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[168] "The Connellsville and Lower Connellsville Coke Regions," 11; Affelder, "An Automatic Coke Waterer," 726; J.R. Foster, "Coking Coal Industry in Harlan County, Kentucky," Coal Age 10 (16 December 1916): 1002; Dever C. Ashmead, "Modern Rectangular Coke-Oven Plant," Coal Age 13 (23 February 1918): 362-367.

business, operating its Allison Nos. 1 and 2 plants (293 and 200 ovens, respectively).[169]

Other Competitors

There were essentially three classes of coke operators in the Connellsville region: the H.C. Frick Coke Company, which was in a class by itself, both before and after its merger into the United States Steel Company; those which operated furnace ovens, owned by iron and steel furnace companies and producing coke specifically for their own use; and independents. With the formation of U.S. Steel, numerous furnace ovens, such as those at Buffington, Lechrone, Footedale, Egenborn, and Lambert, were absorbed into the Frick Company. Yet at the close of 1905, there were still almost 2,000 furnace ovens in the region, including the Semet-Solvey ovens at Dunbar, the Stewart Iron Company's Stewart works, Oliver & Snyder Steel Company's Oliver Nos. 1, 2, and 3, and the ovens of the Cambria Steel Company. Cambria had exhausted the coal under its Wheeler and Morrel works and abandoned more than 500 ovens there, but its Atlas and Mahoning works, totalling 510 ovens, were still operating.[170] The desirability of Connellsville coke, however, continued to entice furnaces to the region, and the number of furnace ovens soon began to grow again. Meanwhile the independents also prospered. Continuing demand for coke on the open market stimulated existing independents to expand and new independents to enter the field. Independence was fine when demand and prices were high, but in times when the trade was dull, many operators sought to band together as a means of regulating production and sustaining prices.

Coke producers in the Connellsville coke region, at the initiation of Henry Clay Frick, formed a syndicate in 1884 to control prices by coordinating production and marketing. The Coke Syndicate consisted of the four largest producers in the region, the H.C. Frick Coke Company, the McClure Coke Company, James M. Schoonmaker, and the Connellsville Coke and Iron

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[169] "Coke Works," listed compiled and published by The Weekly Courier, 1 June 1915; The Weekly Courier 41 (28 February 1918): II, 13 and (27 June 1918): 1, 43 (6 January 1921): 8; The Daily Courier (10 January 1935): 8-9; Alphonse F. Brosky, "Shaft in Connellsville Region Dumps Run-of-Mine Into Bins and Transports it by Larry to Tipple," Coal Age 605 (13 April 1922): 605-607.

[170] "Connellsville Letter," Coal 2 (23 September 1905): 14 and (23 December 1905): 17-18.

Company. Although three medium-sized producers (W.J. Rainey, James Cochran, and J.W. Moore) remained independent of any organization, the small producers in the region also formed the Connellsville Coke Producers Association. To better control the price of coke and levels of production, the Syndicate entered into an agreement with the Association, made up of 18 of the smaller operators in the region. Among the small producers were:

Fairchance Furnace Company	B.F. Keister & Company
J. Newmyer & Son	J.R. Stauffer
Stauffer & Wiley	Bliss & Marshall
Percy Mining Company	Dunbar Furnace Company
Reid Brothers	William Mullin
A.C. Overholt & Company	John M. Cochran
John L. Dillinger	John D. Boyle
Pennsylvania Mining & Manufacturing Company	

By marketing coke for the small producers, the Syndicate could assemble quantities of their coke into lots of sufficient quantity to meet buyers' needs, which a single small producer could not supply. In return for having their coke marketed, the small producers agreed to abide by production levels set by the Syndicate and to build new ovens at a rate stipulated by the Syndicate. The independents, of course, produced coke and built ovens as they pleased, benefiting in the wake of the disciplined course followed by the Syndicate and the Association. At the time of the formation of the Syndicate, the price of coke was under $1.00 per ton. Upon organizing their pool, the Connellsville coke producers agree to set a floor of $1.00 on the price of coke, and in a short time were able to raise the price to $1.25, despite low demand.[171]

With operators receiving greater prices for their coke, miners and coke drawers demanded increased wages, leading to the strike of 1887. The Syndicate and the Association agreed not to yield to union demands. When Andrew Carnegie ordered the Frick Company to accede to the workers' demands, the other members of the producers' pool believed Frick had violated the spirit, if not the actual terms, of the agreement creating the Syndicate, causing the pool to disintegrate. In response to this alleged violation, the other members of the Syndicate determined to withhold payment of $90,000 to the Frick Company for coke marketed. Meanwhile, the other large producers recognized that

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[171] "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 6; Engineering and Mining Journal 38 (29 November 1884): 357.

they would have difficulty maintaining coke prices without Frick in a Connellsville pool. During meetings to create a new organization, Frick made it clear that he and his ovens would not become part of a producers' pool unless the old Syndicate paid him the $90,000 it owed him. When the old group finally paid him, he declared that he would join a new pool only if it was made up of all operators in the region. Negotiations with Rainey and Cochran, however, failed to bring them into the group, and in March 1888 efforts to organize a new region-wide pool ended. Nevertheless, smaller producers did not abandon their efforts to pool their production and marketing activities. John F. Atcheson, who had been secretary of the old Syndicate and who worked as a selling agent for J.W. Moore, worked at enlisting smaller producers, and by the spring of 1889 assembled more than 2,500 ovens. Unfortunately for the small producers, though, the Frick Company's voracious appetite for absorbing other operations disrupted attempts by the small producers to maintain a semblance of market stability. In August 1889, Frick bought out Moore's interests and soon had acquired Connellsville Coke & Iron Company and Schoonmaker's interests.[172]

During the last decade of the 19th century and until the H.C. Frick Coke Company became a part of the U.S. Steel Corporation in 1901, the Frick Company itself often served as the closest thing in the region to a marketing pool. With that company signing contracts with buyers to supply large volumes of coke, it often had to purchase coke from the smaller producers in the region to fulfill those contract. Other interests did, on occasion, join Frick in formal attempts to form a pool of their own. Such was the case in 1896, when the Oliver & Snyder Steel Company, Hostetter-Connellsville Coke Company, Hecla Coke Company, and the Dillinger interests formed a sellers pool. This organization lasted until 1901, when the Frick Company left the open market and began selling its coke exclusively to steel companies owned by U.S. Steel. Small producers no longer enjoyed the benefit of having Frick sell their coke, thereby keeping prices high. The effects of the new situation were soon felt in the Connellsville coke region in 1903 during a severe slump in coke demand. Not having to respond to the open market, Frick was able to maintain wages during the slump. This placed smaller producers in a pinch, with the market driving prices down while the Frick wage scale made it impractical to decrease wages correspondingly. Small operators met at Uniontown in October 1903 to form an organization and to set a minimum price for coke. The following

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[172] "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 6-7; Engineering and Mining Journal 45 (28 January 1888): 79.

month, all coke producers, including Frick and Rainey, met at Pittsburgh, where they formed a committee to devise a means to regulate production and maintain prices.[173]

The committee was remarkable not because it had a representative from the group of small operators who had met earlier at Uniontown, nor because it included several of the normally cooperative large producers, such as Oliver Snyder and the Hecla Coke Company, but because Frick and Rainey were participating. Thomas Lynch, president of the Frick Company, was named president of the committee, signaling his and the company's interest in maintaining stability in the Connellsville coke region and their willingness to work with other producers to do so. Even more remarkable was the participation of the Rainey interests, represented by W.T. Rainey, the late W.J. Rainey's son. Reports from the Pittsburgh meeting indicated that Rainey was prepared to abide by the recommendations of the committee, and the Weekly Courier was quick to point out that this marked the first time ever that the Rainey ovens might become part of a regional pool.[174]

From then until the demise of the Connellsville coke region, producers who were not tied to users continued to be plagued by fluxuations of the open market. The last serious attempt to organize the independent coke producers in the region came in 1909, towards the end of the slump which followed the region's most productive year, 1907. Two Pittsburgh financiers, John W. Boileau and Charles McKnight, joined Uniontown lawyer George D. Howell in concocting a plan to merge all of the coke producers in the region except the Frick Company. At that time, while Frick operated 23,558 ovens in the Connellsville and Lower Connellsville regions, other interests operated 14,649 ovens at 109 works. Of these, merchant producers (those not tied to steel mills) operated 11,490 ovens. On behalf of his group, Boileau purchased options on numerous plants in the region and their sale prices were appraised by reputable engineers. When the package was submitted to New York capitalist who were to underwrite the deal, it suddenly died for reasons never made public. Late in 1909, the coke market improved again and coke producers lost their desire to sell their operations. Merchant producers met

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173 "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 7; The Weekly Courier 25 (23 October 1903): 4, (30 October 1903): 3, (13 November 1903): 2.

174 Connellsville Weekly Courier 25 (13 November 1903): 2, (11 December 1903): 5.

again in 1910 to explore the possibilities of forming a pool, but fears of prosecution under the Sherman Anti-Trust Act negated any further association. The closest entity to a pool after that point came with the formation of the Producers' Coke Company, a brokerage business jointly owned by some of the merchant producers. Dating back to the beginnings of the Connellsville coke industry, individual brokers had occasionally prospered marketing coke for independent producers, but Producers' Coke marked the first brokerage effort undertaken jointly by coke producers. By 1914 it handled about one third of the merchant coke in the region. During World War I, Producers Coke, representing 30 operators and controlling 3.5 million tons of annual production capacity, cooperated closely with the federal Fuel Administration in distributing coke where needed for war-time production.[175]

Development of the Connellsville Region

The number of ovens in the Connellsville coke region grew steadily from its inception until the close of the first decade of the 20th century, after which growth in the Connellsville region slowed in the face of increasing competition from by-product ovens.

Growth of the beehive coking industry was not only evident in the numbers of ovens in the Connellsville coke region or tons of coke the region produced. It was also evident in development of an extensive railroad system, in the evolution of working conditions, and in the industrial infrastructure which grew to support the coking operations. This chapter will provide an overview of each of these facets of the Connellsville coke region and will conclude with a brief summary of sudden ascendence of by-product coking during World War I, which not only led to the closure of many of the coking plants in the region but in alterations to the accompanying facets as well.

The advent of railroad transportation in the Connellsville coke region was a key to the incredible growth in the number of coke ovens and coking businesses in the region during the late 19th century. The first railroad into the area was not, however, attracted by the potential coke-hauling business, but rather by the farms and the small industries, especially iron furnaces, which operated in Fayette County. Prior to the railroads, Fayette County relied on crude roads and the rivers for

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[175] Coal and Coke 16 (15 July 1909): 13; "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 7-8; The Weekly Courier 41 (28 February 1918): 9.

communication with Pittsburgh and the eastern part of the United States. Even before the Revolutionary War, there were military roads across the western part of Pennsylvania. As early as the 1750s, Braddock's Road linked western Maryland with Fort Pitt, passing near the site of Connellsville. Early in the 19th century, a westward extension of that road branched at Summit, southeast of Uniontown. Construction reached Uniontown in 1817 and was complete to Wheeling by 1820. The route from Maryland to Wheeling became known as the National Road. Construction of two other routes, Glade Road through Mount Pleasant and Forbes Road through Ligonier, began in the 1750s, linking Bedford and Pittsburgh by way of Westmoreland County. Small settlements in what would become the Connellsville coke region grew up along each of these roads, including Connellsville (1768) along Braddock's Road, Uniontown (1768) along the National Road, and Mount Pleasant (1774) along the Glade Road. Augmenting the throughways, a network of local roads soon developed, spawning additional communities, such as Pleasant Unity (1798) along a stage route linking the Forbes and National roads.[176]

Fayette County was the early center of iron smelting in western Pennsylvania. In addition to the furnaces, businessmen around Connellsville established other facilities to fabricate iron tools and wares needed by settlers moving west along the early roads to the Ohio Valley. Such goods, in addition to the produce of area farms, made Fayette County an important early supply point for the westward expansion of the United States. By the close of the 18th century, however, improvements to the Forbes Road made it the preferred route west, by-passing Connellsville. This, coupled with the 19th-century growth in Pittsburgh's iron industry, made the city at the confluence of the Monongahela Allegheny rivers, the principle market for Fayette County's iron, both pig and finished products. With transportation by road expensive and unreliable, Connellsville manufacturers preferred to ship their goods by flatboat down the Youghiogheny and Monongahela rivers to Pittsburgh, though river transportation, too, was far from ideal. Rapids just below Connellsville made that town the effective head of Youghiogheny navigation, and even from that point the river was usually too shallow. Producers had to store their goods until a freshet temporarily raised the river enough to allow flatboats to pass. Farther west, the Monongahela had sufficient water for navigation, but rapids made it treacherous until 1844, when the State of Pennsylvania incorporated the Monongahela Navigation Company to construct locks and dams needed to open navigation between Brownsville and

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[176] Enman, "Population Agglomerations in the Connellsville Coke Region," 100-104.

Pittsburgh. By that time, the Baltimore & Ohio Railroad was complete to Cumberland, Maryland. Numerous travellers took the B & O to Cumberland, the National Road to Brownsville, and the Monongahela River to Pittsburgh on their way west.[177]

The Monongahela was too distant to be of much use to Connellsville shippers, so in the 1840s local advocates induced the Pennsylvania Legislature to establish navigation companies to build locks and dams on the Yough. The Connellsville and West Newton Navigation Company, incorporated in 1841, was to make the Yough navigable between those two towns, but it never completed the task. More successful was the Youghiogheny Navigation Company, incorporated in 1843. This enterprise completed locks and dams on the Yough between West Newton and the Mon River in 1850, greatly enhancing Fayette County's transportation prospects. Floods in the mid-1860s destroyed the locks and dams on the lower Yough, but by that time the structure were superceeded by the Pittsburgh and Connellsville Railroad. Indeed, improved navigation on the lower Yough played a significant role in the opening of Fayette County to rail transportation.[178]

As Enman stresses, the Pittsburgh and Connellsville Railroad was not opened in 1855 to haul coke. What little coke was being produced in Fayette County was either supplying local foundries and furnaces or being shipped by boat down to Cincinnati. Farm goods and iron were the main commodities eyed by developers of the railroad. The first section of the new railroad ran between Connellsville and West Newton, essentially serving as a portage around the rapids below Connellsville so that goods could be placed on boats at West Newton for shipment to Pittsburgh. In 1861, the railroad was completed to Pittsburgh, obviating the need for locks and dams on the Yough. A year before, the Fayette County Railroad had extended south, linking Uniontown to the Pittsburgh and Connellsville system.[179]

Throughout the 1860s, the Pittsburgh and Connellsville was the only railroad serving Fayette County. It ran along the

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[177] Ibid., 104-112; Walkinshaw, <u>Annals of Southwestern Pennsylvania</u>, 71-75.

[178] Enman, "Population Agglomeration in the Connellsville Coke Region," 120; Walkinshaw, <u>Annals of Southwestern Pennsylvania</u>, 76-78.

[179] Enman, "Population Aggregation in the Connellsville Coke Region," 120-127.

Youghiogheny to Connellsville and up Dunbar Creek and Gist and Cove Runs to Uniontown. Early coke operators located virtually all of their ovens along these same water courses, but as Enman demonstrates, the locations of rail lines and coke ovens during this decade were not directly related as they would later be. Intent on serving the iron furnaces (because coke was not yet recognized as a lucrative export), the railroad followed the water courses because they offered gradual grades up through otherwise hilly terrain to Connellsville and Uniontown. Coke ovens were located along those water courses for similar reasons, but not because the railroad was there. Most coke operators were not shipping coke out of the region, but rather were carting coke short distances to the Fayette County iron furnaces, so they did not rely on the railroad. The operators sought bottom land along water courses because it provided flat ground for building banks and blocks of ovens, it placed their ovens next to an ample supply of water for quenching coke, and it made cart transportation relatively easy along the same gradual grades that attracted the railroad.[180]

During the 1870s, a much closer and direct relationship developed between railroad location and coke-oven construction. As already noted, Henry Clay Frick and others opened the Broad Ford and Mount Pleasant Railroad (later known as the Mt. Pleasant Branch) in 1871 linking coal lands in Westmoreland County north of Jacobs Creek with the Pittsburgh and Connellsville Railroad at the mouth of Galley Run along the Yough. Six coking plants, including the Standard mine and works, opened along the Mt. Pleasant Branch between 1871 and 1879. The shorter Hickman Run Branch also opened during this period. The Pittsburgh and Connellsville became a part of the Baltimore and Ohio Railroad (B & O) system in 1871 when the latter completed a line between Cumberland and Connellsville. This was a major blow to the Pennsylvania Railroad, which had hoped to block the B & O from entering the state. (The Pennsylvania and B & O were locked not only in battle over service to Pittsburgh but also, with the New York Central, in long-standing battles to develop the most effective routes connecting the Atlantic seaboard with developing territories as far west as Chicago and St. Louis.) To compete directly with the B & O for the coke trade, the Pennsylvania began construction of its Southwest Pennsylvania Branch southward from Greensburg in 1871, reaching Connellsville in 1873 despite B & O efforts to block construction by not granting grade crossings where the competing lines intersected. Several other new works,

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180 Ibid.

including Southwest No. 1, opened during the 1870s along the Southwest Pennsylvania Railroad and its Scottdale Branch.[181]

In the three years after it reached Connellsville, the Southwest Pennsylvania extended southward to Uniontown and in 1880 it reached Fairchance. In this effort, the Pennsylvania encountered less effective opposition from the B & O than it had north of Connellsville. When the Fayette County Railroad had built to Uniontown in 1860, its route ran along the eastern outcrop of the Uniontown syncline. Thus the few coking works which opened in the 1860s along the railroad, such as Dunbar and Wheeler, were just to the west of the right of way. Enjoying a monopoly in the area, the Fayette County Railroad had required that the coke operators build their own spurs between the mainline and their works. When the Southwest Pennsylvania built south to Uniontown, it located its right-of-way almost parallel to and just west of that of the Fayette County Railroad, crossing the several spurs to coking works. Because the B & O did not control these spurs, it could do nothing to halt the Southwest Pennsylvania, which when completed was able to capture much of coke traffic from existing and new works along the eastern edge of the syncline. New works developed along the lines between Connellsville and Uniontown during the 1870s included Mt. Braddock, Lemont No. 1, and Mahoning.[182]

The 1880s further demonstrated the now close link between developments of railroads and coking works. On the one hand, investors opened new works along existing lines as well as new lines built by the Pennsylvania Railroad. On the other hand, the region's burgeoning coke trade attracted a third railroad into the area. In 1882, the Pittsburgh, McKeesport and Youghiogheny Railroad (associated with the Pittsburgh and Lake Erie, a railroad developed by William Vanderbilt of the New York Central system) completed a line up the west side of the Yough to New Haven, across the river from Connellsville. Familiarly know as the "Peemickey," this new competitor presented further plans for lines into nearly all parts of the coke region served by the

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[181] Ibid., 141-148; Walkinshaw, Annals of Southwest Pennsylvania, 93; "Railroads of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 48.

[182] George H. Burgess and Miles C. Kennedy, Centennial History of The Pennsylvania Railroad Company (Philadelphia: The Pennsylvania Railroad Company, 1949), 118; "Railroads of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 50; Enman, "Population Agglomeration in the Connellsville Coke Region," 121, 142, 145-146.

Pennsylvania and the B & O. To stanch competition which could drastically reduce shipping rates, the two older railroads negotiated a pooling agreement with the Peemickey whereby, in exchange for not expanding further into the region, the Peemickey would receive a favorably high percentage of shipments from works served by its line to New Haven.[183]

Through the end of the 19th century, the Peemickey held to its word and did not expand its system, but the Pennsylvania and the B & O did build new lines. Enman's work clearly shows that and as the two railroads opened new portions of the Connellsville coke region to railroad service, coke operators opened new works along those lines.[184] No new railroads entered the region until the Lower Connellsville coke region opened in 1899. The Monongahela Railroad, jointly owned by the Pennsylvania and the Pittsburgh and Lake Erie, developed a line, completed in 1903, up the Mon River from Brownsville to Martin and built branches into the Lower Connellsville coke region (the B & O gained an interest in the Monongahela Railroad in 1927). The Pennsylvania and the B & O also built new branches of their own to serve this newly opened region as well as mines in the southern end of the Uniontown syncline. With the exception of minor modifications to branches and spurs, the construction of new lines in the Lower Connellsville region and the south end of the Uniontown syncline marked the end of new railroad construction in the Connellsville coke region.[185]

There were changes in railroad service to the coke ovens beyond the construction of new lines during the late 19th and early 20th centuries. For example, the nature of the cars used to haul coke evolved. In the early 1880s, the average car, largely built of wood, carried 12 tons of coke. As the 19th century drew to a close, average capacity grew to 20 tons. There were of two principle types of cars: gondolas, with open racks extending

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[183] Walkinshaw, Annals of Southwestern Pennsylvania, 95-96; "Railroads of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 50.

[184] Enman, "Population Agglomeration in the Connellsville Coke Region," 121, 142, 152, 163, 173. Each of these maps represents a distinct time period (to 1869, 1870-1879, 1880-1889, 1890-1899, and 1900-1908), showing new railroad lines built and new coke works opened. Enman's maps graphically demonstrate the relationship between development of railroads and coking plants.

[185] "Railroads of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 52.

above the car bodies, and box cars. The former were used for both local trade and long-distance shipping and the latter were used exclusively for long-distance shipments, for which they were the preferred mode. Men loading cars from the wharf next to the ovens could use wheel barrows to dump the coke directly into the gondolas, but additional hand work was required in loading box cars to move coke to the ends of the cars after it had been dumped in a pile just inside the door. As the box cars filled, additional hand work was required to insert wood slats across the door openings and to place large pieces of coke against the slats to prevent smaller pieces from falling through the spaces between slats. During periods of high demand and production in the 19th century, operators often complained of car shortages, which could cause coke to build up in giant piles on the wharves (if the wharves filled to capacity before cars arrived, operators were forced to bank their ovens and lay off coke workers, something they preferred not to do).[186]

To alleviate possible car shortages, many of the larger operators in the Connellsville coke region made or purchased their own to supplement whatever cars the railroads allocated them. This practice began as early as the late 1880s. By 1889 there were about 4,000 private cars hauling coke out of the region, including 2,400 controlled by the H.C. Frick Coke Company, almost 1,000 controlled by the McClure Coke Company, and 200 owned by W.J. Rainey. By the early 20th century, the Connellsville coke region had its own capacity for manufacturing coke cars. The McClure Coke Company completed shops at Lemont for building and repairing cars in early 1895. In early 1905, the W.J. Rainey Company, with the intention of producing 600 private cars, opened a new car fabricating shop at Mt. Braddock capable of turning out a car a day. New cars in the early 20th century were typically built of steel and had a capacity of about 25 tons and more.[187]

Railroads pro-rated car allocations to coke operators based on production levels. Privately-owned cars were not included in the allocation calculations. Small operators complained to the Interstate Commerce Commission that this practice discriminated against any producer which did not have the capital to acquire and maintain its own fleet of cars. In a 1907 ruling, a federal

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[186] The Weekly Courier 2 (11 March 1881): 1; "Railroads of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 48; International Library of Technology, "Coking in the Beehive Oven," 62-63.

[187] The Weekly Courier 11 (25 October 1889): 2, 16 (8 March 1895): 2, 26 (6 January 1905): 3.

circuit court found in favor of the small operators, ordering railroads to include private cars in the calculations of allocations, thus eliminating any advantage to coke producers in owning their own cars. This ruling did not drastically curtail relationships between railroads and shippers; the Pennsylvania had already circulated a plan to shippers whereby it proposed to acquire their steel cars (the railroad hoped to rid the rails of the old wooden cars). The H.C. Frick Coke Company was the first to rid itself of its private cars. Shortly after 1910, the W.J. Rainey Company followed suit, and by 1914 only a few coke producers still owned their own cars. By this time, steel coke cars had largely replaced the earlier wooden ones. The new cars had an average capacity of 30 tons and some went as high as 40 or 50 tons. Equipped with bottom discharge mechanisms, the cars looked similar to coal hoppers but were used exclusively for hauling coke.[188]

That the new steel cars were specifically designed to haul coke exemplifies the importance ascribed by the railroads to the coke trade. In its 1914 Special Edition, the Connellsville Weekly Courier asserted that the railroads were by that time providing the coke region with excellent service:

> It [coke] moves on a fast schedule and is really preferred traffic. Although not requiring the attention of perishable freight, it is neverless [sic] handled as well. So important is the coke traffic that the railroads place officials in direct charge of it, rather than making it incidental to the freight traffic department.[189]

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[188] "Railroads of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 48; ITL, "Coking in the Beehive Oven," 62-63; "Pitcairn Coal Company vs. The Baltimore and Ohio Railroad Company," Coal and Coke 14 (15 June 1907): 7-13; "Connellsville Letter," Coal 2 (2 December 1905): 14; "To Abolish Private Cars," Coal 4 (20 September 1906): 25. The latter article reported that in 1906 the H.C. Frick Coke Company owned about 25,000 cars, a number which seems doubtful based on U.S. Steel's tally of railroad equipment owned by subsidiary companies in "Fifth Annual Report of the United States Steel Corporation for the Fiscal Year Ended December 31, 1906," (U.S. Steel Bound Annual Reports, 1901-1966, Box 1, Shelf 6, Section 4012, Room 14, United States Steel Corporation Archives, Annondale, PA), 52.

[189] "Railroads of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 48.

Such special attention was certainly merited, given the immense volume of traffic leaving the region. For example, during a period of high production in 1903 when ovens in the Connellsville and Lower Connellsville regions exceeded 300,000 tons of coke per week, railroads hauled more than 10,500 car loads of coke out of the region per week: 4,084 cars to Pittsburgh and river tipples, 4,849 cars to points west of Pittsburgh, and 1,656 cars to points east of Connellsville. The apparent weekly record for cars shipped from the Connellsville and Lower Connellsville regions occurred during a week in mid-October 1906, when 15,811 loaded gondolas left the region (5,082 destined for Pittsburgh, 8,894 for points west of Pittsburgh, and 1,835 for points east of Connellsville) as weekly output at the ovens approached 400,000 tons. Many of the cars by this time were the larger 40- and 50-ton units. As more of the larger cars replaced older rolling stock, the number of cars needed declined. Thus, during a record-setting peak of Connellsville coke production in 1907, the number cars shipped was actually less than it had been earlier.[190]

Such high volumes of traffic often caused delays in the railroads' networks, not only in the coke region but throughout the nation as well. Such bottlenecks also delayed the return of empty cars to the coke region, leading coke operators to complain of cars shortages (frequently referred to as "car famines") when there actually were plenty of cars in the system; the cars simply were not where the operators needed them. Car famines in the coke region, whether caused by actual shortages or by traffic jams outside the region, were often severe enough that operators had to bank their ovens or put them out. In 1906, the Pennsylvania Railroad was handling its own traffic in addition to some cars normally hauled by the B & O because the latter was suffering a shortage of engines on its system. At the Pennsylvania's Youngwood yards and scaling facility at the north end of the coke region, the railroad handled 68 train crews and 120 locomotives daily. Twenty-five crews ran into the coke region each day to distribute and gather cars, 20 crews headed west with loaded trains averaging 40 cars in length, returning at the end of the day with a like number of empties, and 15 crews headed east with trains averaging 30 cars. In addition, the

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[190] Connellsville Weekly Courier 24 (11 September 1903): 2 and 28 (19 October 1906): 2.

Pennsylvania maintained crews and locomotives at Everson and Rainey stations.[191]

The railroads calculated their shipping rates according to three factors: type of coke shipped (furnace or foundry), weight, and destination. Weighing all the cars before they left the Connellsville coke region required a substantial railroad infrastructure, including scales and sidings. The B & O, for example, established scales at Hickman Run in the early 1880s and at Mt. Braddock in the early 1890s. Then in 1903, the railroad decided to locate a central scaling facility at Connellsville, closing the other two. Four sets of tracks extending over a mile from Connellsville to Broad Ford accommodated strings of cars waiting to be weighed. With this facility in place, every coke car leaving the Connellsville region on the B & O would first have to pass through Connellsville, whence it was consigned to its destination. The Pennsylvania, on the other hand, continued to operate several scaling stations, at West Brownsville and at Youngwood, for instance.[192]

Quality of service notwithstanding, Connellsville coke producers often complained that the railroads' rates for shipping coke were too high. In a 1913 ruling, the Interstate Commerce Commission partially vindicated those complaints. Responding to a case filed by the Coke Producers' Association of the Connellsville Region, the ICC ruled that railroads had to reduce rates to many destinations by 12-15%.[193] Exhibits presented in that case demonstrate both the almost singular nature of coke trade for railroads in the Connellsville coke region and the complexity of their operations. An exhibit cites the 1910-1911 annual report for the Monongahela Railroad, in which the following shipments were recorded:

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[191] Connellsville Weekly Courier 28 (28 December 1906): 5; "Connellsville Letter," Coal 2 (23 September 1905): 14 and (2 December 1905): 14.

[192] Connellsville Weekly Courier 24 (23 October 1903): 1; "Exhibits Prepared by J.P. Muller, Accountant, for the Complainant," The Coke Producers Association of the Connellsville Region, Complainant, Against the Baltimore & Ohio Railroad Company et al, Defendants, Docket No. 3854, Interstate Commerce Commission, 1912 (on file at the Library of Congress), 8, 10.

[193] "Coke and Iron Ore Freight Rate Decisions," Iron Age 91 (19 June 1913): 1478.

Material	Tons
Coke	5,260,439
Bituminous Coal	518,572
Stone, Sand, etc.	32,867
Cement, Brick & Lime	2,059
Lumber	2,933
TOTAL	5,816,870[194]

Virtually all of the Monongahela's business was in hauling coke. The P & L E probably shipped similar percentages of coke and other freight but less coal, because mines in the area it served did not export coal. The Pennsylvania and especially the B & O may have shown higher percentages of other freight because of through trains, but percentages for those railroads of freight originating in or destined to the Connellsville coke region would have been very similar to the percentages shown for the Monongahela Railroad.

The ICC exhibit also gives a sense of the day-to-day operations of the railroads within the region. The railroads assigned crews and locomotives to each branch line and specific groups of coke plants. For example, six days per week the Pennsylvania Railroad at Youngwood assigned two locomotives, with an engineer and fireman for each, and a crew, including a conductor, two brakemen, and a flagman, to the Sewickley Branch, which served the United, Calumet, and Mammoth Nos. 1 and 2 works of the H.C. Frick Coke Company, totalling about 1,120 ovens, as well as the 150 ovens of the Claire Coke Company and the 40 ovens of the Magee Coke Company. Each morning, the crew returned empties to the Mammoth, Claire, and Magee yards and hauled loaded cars from those plants and Calumet to the Youngwood scales along the Southwest Pennsylvania line. In the afternoon, the crew delivered empties to Calumet and United and hauled loaded cars from United to the scales. The shift lasted about 11 hours on average. At the Youngwood scales, crews worked two shifts, day and night, weighing and classifying cars assembled from the Sewickley branch and others tributary to Youngwood. Each shift consisted of three engineers, three firemen, a conductor, four (night) or six (day) brakemen, and eight car droppers. Each shift lasted ten hours. Crews weighed and classified an average of 500 cars daily. Trains leaving the region averaged 50 cars in

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194 "Exhibits Prepared by J.P. Muller, Accountant, for the Complainant," 5.

length, meaning approximately 10 trains of coke cars departed the Youngwood scales daily and the same number returned with empties.[195]

Freight railroads were not the only ones serving the Connellsville coke region. Trolley lines of the West Penn Traction & Water Power Company laced through the entire length of the region as well. West Penn was a conglomerate of several smaller electric street railways which had formed in the 1890s. These included the White Electric Traction Company (1890) in McKeesport; the Uniontown Street Railway (1890); the Connellsville, New Haven & Leisenring Street Railway (1891); the Latrobe Street Railway (1891); and the Scottdale, Everson, & Broadford Street Railway (1891). In 1899, promoters from Pittsburgh formed the Mt. Pleasant, Scottdale & Connellsville Street Railway and took over the lines of the Scottdale, Everson & Broadford. A year later they merged with the McKeesport lines, beginning the formation of a regional system, soon acquiring the other lines. Meanwhile, a street railway company started independently in Greensburg in 1901. The conglomerate acquired the Greensburg company in 1907, after which all new lines were extensions built by the West Penn.[196]

The mainline of this system linked Uniontown with Greensburg through Connellsville, Scottdale, and Mt. Pleasant. One major branch left Mt. Pleasant to serve the northern end of the Latrobe syncline as far as Latrobe. Another line reached from the coke region toward Pittsburgh, where passengers could transfer to other interurbans. The line headed west from Greensburg through Jeannette to Irwin, where it branched north to Trafford City, west to McKeesport, and south to Hermine. From McKeesport, a line ran up the Youghiogheny to Scott Haven. In addition to these lines several others snaked through the hollows in the coke region serving otherwise out-of-the-way coal patches. There were actually two routes between Connellsville and Uniontown, one passing through Trotter, Leisenring, Bitner, and Phillips, the other passing through Dunbar, Mt. Braddock, and Youngstown. A branch left Leisenring for Vanderbilt and Dickerson to the north. Two lines out of Uniontown served the south end of the Uniontown syncline and the Lower Connellsville region. The line south of Uniontown went through Leith and Oliphant Furnace to Fairchance. The other line went west out of Uniontown through Revere to

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[195] "Exhibits Prepared by J.P. Muller, Accountant, for the Complainant," 10.

[196] Joseph M. Canfield, ed., West Penn Traction (Chicago: Central Electric Railfans' Association, 1970), 12-13.

Brownsville Junction. There one branch went northwest through Buffington, Filbert, and Allison to Brownsville and the other went southwest to Martin via Lambert, McClellandtown, Leckrone, and Masontown. West Penn provided freight as well as passenger service to the coke region. Beginning with a small single-truck car which made runs twice daily, the company eventually acquired twelve full-sized, double-truck freight cars. Because the West Penn ran on broad-gauge track, it could not interchange with the steam-powered freight railroads serving the region.[197]

West Penn also supplied electricity to the region, communities and coking works alike. Typical mines and coke plants in the Connellsville region were equipped with a powerhouse to generate steam, but many operators found it more economical to purchase electricity from West Penn than to install their own electrical generators. West Penn had numerous small coal-fired, steam-powered generators around the region, but after 1904 its main generating station was located just south of Connellsville along the Youghiogheny River. Headquartered in Connellsville, the West Penn's main shops were also there.[198]

Wages, Working Conditions, Labor Organizations

Approximately sixty percent of the workers at a Connellsville region coke plant were actually employed in and about the mine. The remaining workers operated the ovens. The division of labor in the mines was not unlike that in other bituminous coal mines. Coke-oven operation, on the other hand, led to a distinct division of labor. In early days of coking in the Connellsville region, the physical configuration of the ovens determined a very basic division, with coal chargers working on top of the ovens delivering coal from the bin to the ovens, and coke drawers working on the coke yard, responsible for all of the tasks associated with tending the ovens. A further division of labor is said to have first been implemented at A.A. Hutchinson & Brother's Globe works (renamed the White works after H.C. Frick bought it in 1882) in 1878, when a man was hired specifically as a leveler responsible only for leveling piles of coal after they had been charged into ovens. By the turn of the 20th century, labor at the coke ovens had been further divided to include the following classifications: foreman (coke boss or oven boss),

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[197] Canfield, West Penn Traction, 35, 41-43.

[198] "Electric Power, Light, and Trolley Service," The Weekly Courier, 1914 Special Number, 56; Connellsville Weekly Courier 24 (30 October 1903): 10.

assistant boss (at larger works), drawers (also called pullers), chargers, levelers, daubers, ash boys, and laborers.[199]

In addition to supervising and coordinating the operation of the ovens, the coke boss and his assistants were responsible for monitoring the coking process in each oven, noting by the character of the smoke emanating from the trunnel head when all the coal in a charge had been coked. At this time, boss or his assistant sealed the oven completely, daubing the remaining crack around the arch of the oven door. If the oven could not be drawn soon the boss would partially close the trunnel with a damper, a round cast iron lid which fit over the trunnel. The boss had to exercise care in this move, making sure that the oven had cooled sufficiently to be damped. Placing the damper too soon could overheat the oven, causing undue expansion and damage.[200]

Daubers had the task of bricking up the oven doors. They or the drawers would first loosely brick the opening up to spring line of the arch to prevent coal from spilling out the door as it was charged through the trunnel. Chargers filled the larries at the coal bin. Rather than weighing the coal, they used marks inside the larries to gauge the amount of coal necessary for a charge, one amount for 48-hour coke and a greater amount for 72-hour coke. After an oven was charged, a leveler spread the pile into a level bed, using a twelve-foot-long hoe-like tool. After leveling, daubers filled in the rest of the opening, spreading loam mortar over the outer face of the brick to seal air passages into the oven, leaving only a one-inch gap around the arch. Air passing through the gap sustained the limited combustion necessary for coking in the beehive. When coking in an oven was complete, a drawer pulled the bricks from the oven door and proceeded to quench the coke by inserting a pipe, connected to a water hose, into the oven and spraying water over the coke. This took nearly an hour for each oven. With a tool identical to that used by the leveler, the coke puller than split off pieces of coke from the cooled mass and drew them from the oven. Laborers moved coke from beneath the oven door to the edge of the coke yard using pitch forks. Ash and pieces of coke small enough to fall between the tines of the forks were considered waste. Called coke breeze, this waste material was hauled in wagons by ash boys to dumps at the ends of the yard. Laborers loaded the coke into cars by hand, using forks, and with special coke

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[199] The Weekly Courier, 1914 Special Number, 22; ILT, "Coking in the Beehive Oven," 64.

[200] ILT, "Coking in the Beehive Oven," 51-52, 64.

wheelbarrows. Each job classification at a coke works had its own pay scale, usually based on tasks completed rather than hours worked.[201]

The dangers of mining coal are well-known. Coke workers also faced dangers, especially from working in proximity with heavy moving equipment, such as larries and railroad cars. Moreover, work around the coke ovens was arduous because of the smoke and heat. Thus, coke workers were reluctant to perform added work without additional pay. Such an episode in 1886 led to one of the early strikes in the Connellsville coke region. Beginning in 1885, operators began building larger ovens, requiring a larger charge. Coke drawers were paid per oven, and their pay had not been adjusted to compensate for the larger charge. After operators failed to respond to demands for higher pay, the coke workers organized a short-lived strike in January 1886. Successful, coke workers went back to work when operators agreed to adjust the pay scale.[202]

The 1886 job action was not the first in the Connellsville region. According to the Weekly Courier, the first strike of any note took place in 1881, beginning in the spring at Morrel and spreading to a general strike of miners in the region by June. Peter Wise was the leader of the 1881 strike and he would become one of the region's major labor figures in ensuing years. At an 1886 convention in Scottdale, miners of the Connellsville coke region elected him to head a local union, which made demands of increased wages, abolishing the company stores, and improving working conditions. Coke drawers joined the miners, making demands of their own pertaining to company stores and working conditions at the ovens. Following repeated demands and several strikes, coke operators responded on May 1st with a wage increase, hoping to end the labor struggles. Workers continued to press demands, however, and toward that end the miners formed the Miners' and Laborers' Amalgamated Association on May 30th. After gaining additional wage increases for miners, the organization took up the concerns of the coke drawers. Again the operators conceded, averting a strike. By autumn, some miners, led by Peter Wise, had shifted allegiance to the Knights of Labor, but the more radical among them, wishing to press additional demands, remained with the local organization. Amalgamated wanted operators to weigh coal to insure miners were paid for what they mined, and the organization wanted operators

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[201] ILT, "Coking in the Beehive Oven," 50-64.

[202] "The Industrial Wars of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 28.

to pay workers every two weeks rather than monthly (the Pennsylvania Legislature passed a law in 1886 requiring by-weekly pay). After months of negotiations between operators and both labor organizations, miners struck in May 1887.[203]

Led by Henry Clay Frick, operators in the Connellsville coke region resisted union demands for more than a month until, in a decision already described in chapter V, Andrew Carnegie overruled Frick and met miners' demands for increased wages. This decision temporarily split Frick and Carnegie, but it brought Frick workers back to work. The strike continued against the other operators in the region. Independent operators activated some of their works by hiring Pinkerton agents to protect strike-breakers. When miners and cokers finally went back to work later in 1887, it was at a lower scale than that paid by Frick. This differential provided the basis for a subsequent strike in August 1889, when all the works in the region closed. With demand for coke high, Frick re-signed the 1887 agreement. Other operators, yielding to worker demands, met the Frick scale. The new scale was especially beneficial for coke drawers, who saw their pay increase from 53 cents to 95 cents per oven.[204]

Over the next five years, there were rises and declines in demand for coke, accompanied by fluxuating prices and wage scales. During this time, the region continued to experience labor unrest, marked not only by antagonism between miners and operators but by struggles among different ethnic factions and between radical and conservative factions among the miners as well. Ethnic differences complicating labor unrest can been seen in an example from the 1889 strike. Frick workers were among the main supporters of the strike, while Slavs working for some the independent operators were initially unwilling to go out. Finally, by promising that all workers in the region would remain on strike until all operators signed the new wage scale, organizers succeeded in convincing the Slav workers to strike. When the strike was settled, Slavic workers at the Southwest No. 1 works formed a mob, marched to the nearby Alice mine where they vandalized the works and forced workers to flee for safety. From

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[203] "The Industrial Wars of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 28.

[204] "The Industrial Wars of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 30; Engineering and Mining Journal 44 (9 July 1887): 28; E&MJ 47 (23 February 1889): 191, (13 April 1889): 354, 357; E&MJ 48 (20 July 1889): 59, (10 August 1889): 124; Harvey, Henry Clay Frick, 90-91.

there the angry mob moved to the Bessemer works, where they were intercepted by Robert Watchorn, a Knights of Labor organizer, who was able to convince the rioters to disband. The outbreak brought an angry diatribe in The Weekly Courier against "the Huns." Some time later, the Courier received new information concerning the cause of the violence. As it happened, only Frick and other major operators had agreed to sign the new wage scale, yet the Frick workers had promised no one would go back to work until all operators had signed. When Slavs working for an operator which had not signed heard that Frick workers had gone back to work, they vented their rage by attacking nearby works. The Courier relented in its criticism of the Slavs only slightly, saying that the violence was perhaps not wanton, being weighed against those who "enveighed them [Slavs] into a strike against their will and then basely deserted them." Nevertheless, using condescending language the Courier continued to decry the behavior of the Slavs in that particular event, in their tendency to drunkenness, in the way they lived, and nearly everything else about them.[205]

In the early 1890s, R.D. Kerfoot was one of the radical leaders and Wise was by then associated with the conservatives. Miners on occasion rioted, committing property damage. W.J. Rainey hired Pinkerton agents to guard his plants. Frick and others engaged in lockouts. The government sent the National Guard to police the region during a prolonged strike in 1891, in the course of which several foreign-born miners were killed. By this time, the United Mine Workers (UMW) had been formed to organize coal miners nationally. With the 1891 strike in its thirteenth week, Samuel Gompers unsuccessfully visited the Connellsville region to lure miners away from the Knights of Labor and into the UMW. Meanwhile, operators began importing immigrant workers, especially Italians, into the region as strike breakers, in the face of which coke workers went back to work.[206]

Operators reduced wages in 1893, and in the spring of 1894 the UMW sent organizers into the Connellsville region in another recruiting effort. On April 3rd, the longest strike in the region to date began. Again violence erupted and operators soon locked striking workers out. To maintain production, some operators again imported foreign workers and Rainey brought the first sizeable group of African-Americans into the regions. Many

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[205] The Weekly Courier 11 (16 August 1889): 1 and (23 August 1889): 1, 2 (editorial).

[206] "The Industrial Wars of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 30.

of the locked out workers were Slavs, numbers of whom migrated out of the region in search of other work. By October, the strike was effectively over, with the roles at many works filled by strike-breakers or by strikers who, desperate for work, had drifted back to work. When the UMW tried to call the new workers out on strike they failed, following which the Knights of Labor made an unsuccessful effort to re-organize workers. The operators claimed that their intent in breaking the unions was not to deprive workers of fair wages, but to secure control of the plants for management. Operators were determined that they, not union officials, would decide whether plants would produce coke or close. As a signal to workers that their welfare rested with the operators, not unions, the operators, led by the H.C. Frick Coke Company, voluntarily increased wages by about 15%. From 1894 until 1922, the Connellsville coke region was virtually free of strikes, and labor organizations were unsuccessful in recruiting members there despite significant union activities and periodic strikes elsewhere, even in nearby bituminous coal fields. In 1899 and again in 1904, the Pittsburgh District of the UMW mounted unsuccessful organizing drives in the Connellsville region, the latter effort following a reduction in wages.[207]

Although organized conflict over wages and working conditions was virtually absent from the coke region for nearly 30 years after 1894, there were nevertheless other divisions, particularly along ethnic and racial lines. Distaste for Slavs among native-born Americans and immigrants from northern Europe continued, as did widespread discrimination against African-Americans. That workers from the dominant ethnic and racial groups should be antagonistic to the new arrivals is understandable because many blacks and eastern and southern Europeans were brought into the coke region as strike breakers. But even after members of the new groups because permanent residents, the dominant population felt threatened by them because they remained different. Response to blacks living in and near Dunbar may have been typical. Termed "Roanoke niggers" because many had been recruited from that Virginia city, African-Americans in the coke region had actually been brought in from various points in the south during the 1894 strike. Rainey for example had kept his Moyer plant running during the entire strike by employing blacks and armed guards to protect them. Dunbar Furnace Company and other iron works also brought black workers into the region. According to an investigative article in The Pittsburgh Times,

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207 "The Industrial Wars of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 30; Connellsville Weekly Courier 25 (16 October 1903): 1, (18 December 1903): 3.

some 800 negroes were brought from southern states in August 1894 to work as striker breakers, and by the following year they comprised very obvious new settlements in Dunbar, Mt. Braddock, Vanderbilt, and other communities just south and west of Connellsville. As different people, they formed the basis for wild rumors of immorality and depraved lifestyles, which circulated among whites not only in the coke region but Pittsburgh as well.[208]

To investigate the veracity of these rumors, The Pittsburgh Times sent L.C. MacPherson to Dunbar and its environs late in 1895. In an article entitled "Dunbar Is Not A Sodom," he reported that blacks living in and around Dunbar, while living in somewhat more crowded conditions than neighboring whites employed at the same jobs, exhibited no worse behavior. They kept their houses and their children clean, attended church regularly, worked hard, got along well with fellow white workers at the plants, were good customers at area stores, and on average engaged in no more drunken or violent behavior than did their white neighbors. Interviewing white neighbors as well as such public officials as burgesses, justices of the peace, and constables, MacPherson could find no evidence of the loose morals rumor attributed to blacks. Foreman H.G. Munroe of Dunbar Furnace stated, "The negroes are good and steady workers. People in the North did not think they could do the labor. I want no better men. Whites and blacks work without friction, side by side." Yet Justice of the Peace D.K. Cameron, after generally praising the character of blacks resident in Dunbar, concluded, "It would be better, however, if the negroes were away, for the prejudice is ineradicable."[209]

While ethnic and racial differences may have persisted, organized labor found no such differences between workers and employers in which to plant seeds of new union activities among miners and coke workers as the new century dawned. The Weekly Courier claimed that Connellsville miners and coke workers were not interested in joining unions because they received "liberal wages and fair treatment." It is difficult to compare wages in the Connellsville region with those elsewhere because scales were based on different units. In 1901, for example, Connellsville miners' pay was based on bushels mined and loaded, whereas nearby miners worked under an agreement negotiated between operators and the Pittsburgh District of the UMW in which they were paid by the

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208 The Weekly Courier 16 (11 January 1895): 2 and 17 (22 November 1895): 6; The Pittsburgh Times 13 November 1895, 1.

209 The Pittsburgh Times 13 November 1895, 1, 3.

ton. Difficulty in making comparisons also stems from the consistency of the Pittsburgh seam in the Connellsville region versus the wide variety of seams mined elsewhere. Whereas for Connellsville miners in 1901 there were only three rates--for mining and loading room and rib coal, for mining and loading heading coal, and for mining and loading wet heading coal--there were numerous variables in the Pittsburgh District scale. Variables included location within the mine, method of mining, whether by pick or by any of several types of mining machines, and the nature the coal to be mined, including thickness of the seam, type of clay veins present in the seam, and whether or not the coal was screened or mine-run. Difficulty in making comparisons notwithstanding, the Engineering & Mining Journal concurred with the Weekly Courier's assessment of the Connellsville pay scale. In March 1900, following the most recent wage increase, the journal noted:

> The wages are the highest in the history of coke-making. The miners will receive $1.25 per 100 bu. of coal, which is considerably higher than the wages paid the bituminous coal miners in neighboring districts. This will raise the average wages paid to $2.50 per day.[210]

Coke workers were paid less than miners. Following the 1900 increase, drawers earned $.72 per oven, or $2.16 per day assuming three ovens drawn per day. With the exception of a few decreases during slumps in coke demand, the Frick Company continued to increase wages in the Connellsville coke region. On the eve of World War I, twenty years after Frick set its first scale, aggregate wages were 85% higher than they had been in 1894. During and immediately following the war, wages continued to climb, reaching their highest peak in September 1920, fully 125% higher than they had been in 1914. In the early 1920s, the industrial sector of the economy went into a depression and, as usual, declining iron and steel production brought declining demand for coke. Consequently, wages in the Connellsville region went down 25% (still 185% higher than they had been in 1894). According to Coal Age the Connellsville wages were still the highest of any coke producing region in the world. Such high wages, coupled with the variety of corporate welfare programs for

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[210] Connellsville Weekly Courier 25 (16 October 1903): 4; "The Industrial Wars of the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 30; "Pittsburgh Mining Scale," Coal and Coke 8 (19 April 1901): 7-9; "Industry Notes -- Pennsylvania," Engineering & Mining Journal 69 (3 March 1900): 270.

which the Frick company was renowned, were not enough, however, to permanently exclude unions from the Connellsville coke region.[211]

The first sign of the potential for renewed union activity in the coke region came in 1921. Following the end of hostilities in World War I, there was a serious decline in demand for coke at the nation's blast furnaces, felt especially hard among beehive coke producers because during the war iron and steel companies had invested heavily in the construction of by-product coke ovens. Because by-product ovens represented more substantial capital, furnace companies sought to maintain production at those ovens while allowing beehive ovens to idle. Demand for coke reached a low point in the middle of 1921. By mid-June, not a single Frick oven in the Connellsville coke region was burning, and most other furnace ovens were also idle. More than 2,000 merchant ovens were burning at that time, but independent operators were producing at much below their capacity. To compensate for the decline in coke prices--the average price for Connellsville coke dropped from $8.30 per ton to $4.07 per ton between 1920 and 1921--some independent operators reduced wages, marking the first time since 1894 that independent operators rather than the H.C. Frick Coke Company set pay scales. The W.J. Rainey Company posted an 18% wage reduction on March 9, 1921, and in early April six Rainey plants were temporarily idled by a strike. In August, Rainey again cut wages. This time all Rainey wage earners struck, trying to convince workers at neighboring plants to strike as well. Although this strike was temporarily successful, the generally depressed conditions in the region made the work stoppage difficult to continue and workers returned to their jobs. In 1921, coke production in the Connellsville region was the lowest it had been in 35 years, totaling only 3,572,417 tons.[212]

In 1922, the United Mine Workers staged a nation-wide strike and mounted a significant effort to organize coal-miners' strikes in non-unionized regions in sympathy with the strikes in unionized regions. Much to the surprise of operators in the Connellsville region, the UMW succeeded in organizing sympathy strikes there among miners and coke workers. Beginning with strikes at just a few Frick works, by early April the UMW had nearly closed the

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[211] John L. Gans, "Present Strike an Anomaly in Labor Disputes in the Connellsville Coke Region," Coal Age 21 (25 May 1922): 889.

[212] The Weekly Courier 43 (6 January 1921): 1, (2 June 1921): 1, and 44 (5 January 1922): 1, 8.

Lower Connellsville region, and strikes were beginning to spread into the old Connellsville region itself. As strikes progressed, the UMW promised strike benefits. When payments were not forthcoming, some strikers went back to work, but in general the strike spread and held throughout the region. By the early 1920s, production of by-product coke had surpassed that of beehive coke. Thus iron and steel mills were able to supplant coke cut off by the Connellsville strikes with by-product coke made from coal imported from non-union and non-striking coal fields, especially in the south. Thus, the 1922 strike furthered the decline in the production in the Connellsville region.[213]

Industry Infrastructure in the Connellsville Region

To support such a large but dispersed (both in terms of geography and ownership) industry as the beehive coking industry in the Connellsville region, an infrastructure of support was necessary. Engineers were needed to plan mining operations and design surface structures. To build and operate mines and coking works, operators needed pumps to de-water mines, structural iron and steel for headframes and tipples, common brick for buildings and refractory and silica brick for coke-oven linings, and mine cars for hauling coal from underground and larries for hauling it to the ovens. Such a dispersed industry also needed the ability to communicate critical information between individual units. It might have been possible for a large company such as the H.C. Frick Coke Company or even the W.J. Rainey Company to provide many of its own support functions, but the agglomeration of so many small coke producers created a market for support services which specialty companies could satisfy. Given the infrastructure network which arose in the Connellsville region, it is not surprising that the Frick Company, too, availed itself of many outside consultants, contractors, and suppliers rather than maintaining all of the support services it needed in-house. This section of the chapter will survey some of the industrial infrastructure in the Connellsville region, including not only independent companies, but the facilities the Frick Company maintained itself and Pittsburgh-based companies which served the Connellsville region as well.

Engineers

The firm of Hogg and Porter was one of the first locally-based engineering consultant in the region. Both principals worked for a time with the H.C. Frick Coke Company. James B. Hogg was born

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[213] Coal Age 21 (13 April 1922): 628, (4 May 1922): 751, (11 May 1922: 791; Coal Age 22 (5 October 1922): 547-548.

in Fayette County in 1857. After attending local schools, he attended Lafayette College, where he received a degree in civil engineering in 1881. Beginning his professional career helping to survey the route of the Peemickey Railroad into the Connellsville region, Hogg then moved west to Washington, where he worked for the Northern Pacific Railroad, the City of Seattle, and the Port Townsend Southern Railroad. In 1900, he returned to Pennsylvania to supervise surveying for a railroad Andrew Carnegie planned as a threat to the Pennsylvania Railroad. He next joined the engineering staff of the Frick Company, working first in the Connellsville coke region and in 1902 being transferred to Frick's holdings in West Virginia. Returning soon to southwestern Pennsylvania, Hogg established a private consulting business in Connellsville with branch offices in Uniontown (which he operated with Porter), Scottdale, Brownsville, and Pittsburgh. In addition to work with Porter on mines and coking plants, Hogg was independently interested in municipal improvements such as sanitary engineering. He died in 1912.[214]

George Porter was born in 1875, also in Fayette County. After some local schooling, he attended high school in Pittsburgh for two years and Fayette County's Redstone Academy for a year. Porter then went to Cornell University, where he received a degree in mechanical engineering in 1897. Returning to Pennsylvania, he first worked for Westinghouse in Pittsburgh before becoming construction engineer for the Continental Coke Company. When that company was absorbed by the H.C. Frick Coke Company in 1901, Porter continued in Frick's employ for three years, including a stint in West Virginia. He then became a private consultant, opening an office in Uniontown with Hogg. Like Hogg, he also conducted projects on his own. Among the coke ovens designed by Hogg and Porter were the 1905 addition of 100 ovens at the Orient Coal and Coke Company's works near Merrittstown in the Lower Connellsville coke region.[215]

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[214] John W. Jordon and James Hadden, eds., <u>Genealogical and Personal History of Fayette County, Pennsylvania</u>, Vol. I (New York: Lewis Historical Publishing Company, 1912), 207-208; advertizement for Hogg and Porter, Connellsville <u>Weekly Courier</u> 26 (19 May 1905): 8.

[215] John W. Jordon and James Hadden, eds., <u>Genealogical and Personal History of Fayette County, Pennsylvania</u>, Vol. II (New York: Lewis Historical Publishing Company, 1912), 412; Connellsville <u>Weekly Courier</u> 26 (28 July 1905): 2.

W.G. Wilkins Company was a major construction firm in the Connellsville region. A Pittsburgh native, William G. Wilkins was born in 1854. After graduating in civil engineering from Rennsalaer Polytechnic Institute in 1879, he worked for railroads, government surveys, and a Pittsburgh consulting engineer before forming his own firm of Wilkins and Davidson in 1890. W.G. Wilkins Company, architects and engineers, was the successor firm, with Wilkins joining as principal with Joseph E. Kuntz, architect, and Wilbur M. Judd, civil and mining engineer. Kuntz had been with Wilkins since 1880. Judd joined the firm shortly after it became W.G. Wilkins Company about 1900 and he became one of the more prominent engineers of coke works in the Connellsville region. Judd graduated from Union College of Schenectady in 1884. Before joining the Wilkins Company, he worked as a sanitary and municipal engineer and then as a mining and civil engineer and then on the staffs of the Illinois Steel Company, the Eureka Fuel Company, and the American Steel & Wire Company. While working for the Eureka Fuel Company, which supplied coke to the Illinois Steel Company, Judd had the opportunity to work with Selwyn Taylor, a Pittsburgh mining engineer who designed Eureka's Buffington, Footedale, and Lechrone works in the Lower Connellsville coke region. He then served for a brief time as the Eureka Fuel Company's resident engineer. In 1908, the Wilkins Company claimed to have designed over 40 coking plants totalling more than 5,000 ovens. In addition to designing Shoaf, Yorkrun, and Bitner for the H.C. Frick Coke Company, the Wilkins Company designed coke plants for the Oliver & Snyder Steel Company, the Hecla Coke Company, and the Cascade Coal & Coke Company. Judd also authored a number of articles and papers describing the design and construction of coke ovens, workers' housing, and mining towns.[216]

One of the important mining engineers in the Connellsville region was the Pittsburgh-based Selwyn M. Taylor. He was prominent for his early work in developing the Klondike region. Born in Allegheny, Pennsylvania, in 1864 and graduated from high school in 1880, he went to work for an engineer, R.L. McCully. After three years of training in that office, McCully made Taylor a partner in the firm McCully & Taylor. In 1890, Taylor left the partnership and established his own business as a mining and

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[216] "William G. Wilkins Dies at his Home," source unknown, obituary clipping on file at the Historical Society of Western Pennsylvania, Pittsburgh; The Story of Pittsburgh and Vicinity (Pittsburgh: The Pittsburgh Gazette Times, 1908), 103-104; J.P. Brennen, "The New Coke Plant of the Eureka Fuel Company in the Klondike Region, Pennsylvania, A Complete Modern Plant," Mines and Minerals 21 (April 1901): 388.

civil engineer. He was chiefly engaged in designing coal-mining and coking works throughout western Pennsylvania when the Illinois Steel Company contracted with him to design Leckrone, Buffington, and Footedale in 1898. Taylor died in 1904 while trying to rescue miners following an explosion in the Cheswick coal mine (not in the Connellsville region).[217]

In addition to Hogg and Porter and the Wilkins Company, there were other engineers who served the Connellsville coke region. Based in Pittsburgh, Heyl and Patterson was both a consulting engineering firm and a fabricator of mining and industrial equipment and of steel structures. The company produced coal washers used in the Lower Connellsville region and coke pushers and other equipment used about the coke ovens.[218] Shortly after Hogg and Porter opened their office, several other consulting engineers followed their lead in the coke region, including the Fayette Engineering and Contracting Company of Uniontown and the Waynesburg Engineering and Construction Company. Both engaged in design and construction.[219]

Since at least the 1880s, the H.C. Frick Coke Company had maintained an engineering office at Scottdale. One of the early chief engineers was J.H. Paddock. He supervised an office of engineers and draftsmen, including assistant chief engineer H.L. Auchmuty. Paddock and Auchmuty undertook the design of significant improvements to the ventilation and surface works of Frick mines in the early 1890s, including new steel headframes. Paddock was killed during the strike of 1894. J.P.K. Miller, who had been chief engineer for the McClure Coke Company, succeeded Paddock as Frick's chief engineer. Miller was born in 1857 at Martinsburg, West Virginia, where he attended Lonoak College. He also studied engineering under the tutelage of his maternal grandfather before moving to Pittsburgh to seek employment as a civil and mining engineer. After working on the construction of the Peemickey Railroad, Miller moved to Scottdale in 1885 and became chief engineer for McClure. With Frick absorbing the McClure Company shortly after Paddock's death, Miller became chief engineer, a position he held for 21 years until his death in 1916. By the time the other coke producers brought together

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[217] George Irving Reed, et al, eds., Century Cyclopedia of History & Biography of Pennsylvania, Vol. II (Chicago: Century Publishing Company, 1910), 177-179.

[218] The Story of Pittsburgh, 279.

[219] The Weekly Courier 29 (27 February 1908): 8 (advertisements).

by the formation of U.S. Steel had been merged into the Frick Company in 1903, Miller's engineering staff consisted of some 80 engineers, draftsmen, and clerks, with offices at Scottdale. G.E. Huttelmaier, a mechanical engineer, was Miller's chief assistant.[220]

In addition to an engineering staff, the Frick Company employed a chemist beginning in the 1890s. Alexander Fleming was born in Scotland in 1872 and moved to the United States with his family two years later. His father was a blast furnace superintendent in Ohio and Pennsylvania. Young Alexander attended the Carnegie night school and studied at Lafayette College before working as a chemist for several furnace companies in the Pittsburgh area. In 1897, the Frick Company hired him as chief chemist, a position he held until 1904, when he established his own laboratory in Uniontown to serve the independent coke operators. Fleming conducted a variety of metallurgical tests, but specialized in improving the performance of firebrick in coke ovens. Meanwhile, J.R. Campbell, who succeeded Fleming in the Frick laboratory, continued to focus his attention as well on testing and improving the performance of refractory and silica brick for beehive ovens.[221]

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[220] William Duncan, "Fifth Bituminous District," Reports of Mines Inspectors for 1891, 396; The Weekly Courier 16 (11 January 1895): 2, (5 April 1895): 2; H.L. Auchmuty, "The Leith Mine," The Colliery Engineer 17 (September 1896): 46; Fenwick Y. Hedley, ed., Old and New Westmoreland (New York: The American Historical Society, Inc., 1918), 1114-1116; "Personnel Costs," records of departmental wage and salary expenses in Miscellaneous Agreements, Records of the H.C. Frick Coke Company, Room 16, Section-396, Shelf-5, Box-13, U.S. Steel Corporation Archives, Annondale.

[221] "Personnel Costs," records of departmental wage and salary expenses in Miscellaneous Agreements, Records of the H.C. Frick Coke Company; Jordon, History of Westmoreland County, Pennsylvania, Vol. II (New York: The Lewis Publishing Company, 1906), 215-216; Jordon, Genealogical and Personal History of Fayette County, Pennsylvania, Vol. II (New York: The Lewis Publishing Company, 1912), 555; J.R. Campbell, "Pyronometry of Beehive Coke Ovens," Mines and Minerals 30 (October 1909): 141-144; Campbell, "Refractories Used in the Construction of Coke Ovens--The Maximum Amounts of Impurities Allowable for Satisfactory Service," Mines and Minerals 28 (May 1908): 457-459.

Manufacturers of Mining and Coking Equipment

A half-century before producers began exporting coke from the Connellsville region, iron furnaces near Connellsville produced pig iron for export and for sale to local fabricators. Early businesses formed the basis for a local industrial base able to supply the coke industry with much of the equipment it needed for extracting coal and operating the ovens. Even after Pittsburgh grew to dominate the iron and steel industry in western Pennsylvania, many iron and steel mills in the Connellsville region continued to prosper, and others came into being as late as the turn of the 20th century. A glass industry also developed in the Connellsville area. Such basic producers further expanded the market for equipment which local fabricators served. This section will survey those businesses which produced materials and equipment for the Connellsville beehive coke industry.

Although it took on the name Boyts, Porter & Company in 1878, this Connellsville firm had its roots in the first foundry in Connellsville, established in 1829 by Robert Francis and John and Jacob Anderson. The business took in various partners over the years, including Samuel Porter in 1870 and B.F. Boyts in 1876. The original foundry, which produced plowshares, stoves, and general castings, was located along the Youghiogheny River on the future site of the B & O passenger depot. A fabricating shop was located across Water Street at North Alley between Peach Street and Witter Avenue. When the fabricating shop was destroyed by fire in 1877, a new brick structure that would become the long-time home of Boyts, Porter & Company was built. Extending east toward Hill Alley (now Arch Street), the building housed both the foundry and the machine shop. By the early 20th century the Boyts, Porter & Company physical plant had grown to include buildings on the north side of North Alley. The machine shop and pattern shop were in the 1877 building, the foundry and blacksmith shop were located in a 1890s building on the north side of the alley, and further east the company erected a pattern storehouse about 1910 (none of these buildings survive). Boyts, Porter & Company was perhaps best known for its Yough Steam Pump. Invented by foreman David B. Evans, the pump was said to have been popular among miners for de-watering mines because of its simplicity. Because water pumped from mines was littered with bits of wood, coal, and other debris and was often corrosive, it could wreak havoc on pumps with sensitive tolerances or materials, the Yough Pump boasted large openings, a minimum of moving parts, and wood and lead linings to resist corrosion. The firm also produced ore-crushers, which they shipped to mines in the western U.S., and pumps for other functions (boiler feed pumps, brewery pumps, etc.).[222]

In 1865, James McGrath, a machinist who was then a foreman at the Pittsburgh & Connellsville Railroad shops in Connellsville, leased land on Water Street at North Alley from Robert Francis. There, in partnership with Bernard Winslow, McGrath erected a machine and blacksmith shop. Within a year, Winslow sold his share to George B. and Joseph T. McCormick. Towards the end of the decade, other partners entered the business and in 1869 it became the Connellsville Machine & Car Company. The business produced parts and repaired cars for the railroad industry, but as the coke industry began to grow in the late 1860s, the firm added a carpenter shop and began producing coke cars, mine cars, and coke-making tools. Needing more room, Connellsville Machine & Car purchased land at the mouth of Mounts Creek where in 1872-73 they erected two buildings, one to fabricate cars and one to house a foundry, forge, and machine shop. The firm retained its old building on Water Street as a warehouse and sales office. Employing as many as sixty skilled workers, the firm produced cars and equipment for railroads, mines, coke plants as well as the brickyards, mills, and furnaces in the area.[223]

By the close of the 19th century, McGrath and Joseph McCormick were the only surviving partners. McGrath was born in Ireland in 1836, emigrated to the U.S. in the late 1840s, and apprenticed as a machinist in Buffalo before moving to Connellsville in 1859 to become a foreman for the Pittsburgh and Connellsville railroad. He was half-owner and superintendent of Connellsville Machine & Car. McCormick was born in Fayette County in 1830. His father, Provance, was one of the three men who floated that fabled first boat-load of coke from Connellsville to Cincinnati in 1841. After finishing school, Joseph worked in Connellsville as a public school teacher, then opened a drug business before moving to Harrisburg where he worked as a draftsman for the State Land Office. After five years, he returned to Connellsville to enter the partnership with McGrath. Besides being half-owner and

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[222] McClenathan, Centennial History of Connellsville, 488-490; The Weekly Courier, 1914 Special Number, 60; C.W. Hays, "Evolution of the Mine Pump," Coal & Coke Industrial Review (Supplement to the Uniontown Daily News Standard, 21 October 1913), 22; Sanborn Fire Insurance Maps for Connellsville, (1886) sheet 4, (1891) sheet 5, (1896) sheet 9, (1901) sheet 9, (1908) sheet 4, (1914) sheet 2, and (1924) sheet 4.

[223] McClenathan, Centennial History of Connellsville, 491-493.

treasurer of Connellsville Machine & Car, McCormick was president of the Second National Bank of Connellsville.[224]

McCormick died in 1904 and was succeeded in the partnership by his son, Louis. A year later, fire totally destroyed the plant on Mounts Creek, although much of the machinery and most of the drawings and patterns were saved. To capitalize the rebuilding of expanded shops, McGrath and McCormick formed a corporation, the Connellsville Machine and Car Company, and brought several other shareholders into the business. The new plant, designed by the Osborn Engineering Company of Cleveland, was opened in 1906. With a larger foundry, machine shop, and car shop, Connellsville Machine and Car continued to produce pumps, engines, fans, larries, pit cars, cages, crushers, sheave wheels, dump cars, and other equipment for area mines and coke operators. By 1924, perhaps as a result of the decline in beehive coking following World War I, the plant had changed hands to the Connellsville Foundry, Machine & Steel Casting Company. The site is now occupied by ballfields.[225]

By the 20th century, the market for mining and coking equipment appeared so promising that in 1901 several of Connellsville's leading entrepreneurs organized a new company to produce industrial equipment. With Rockwell Marietta as president, Clair Stillwagon as vice president, W.F. Soisson as secretary and treasurer, and D.F. Lepley as superintendent, the Connellsville Manufacturing and Mine Supply Company erected a large plant in New Haven (the west side of Yough). Marietta was born in Connellsville in 1849. As one of eighteen children, he had little formal education, working his way from a farmhand, to a prosperous entrepreneur. Along the way he was a fireman and engineer on the Pittsburg and Connellsville Railroad, and ran a stone quarry before entering the coal and coke business in West Virginia and in the Connellsville region. At the time he and others started Connellsville Manufacturing and Mine Supply, Marietta was co-owner, with his cousin William P. Stillwagon, of the Marietta and Stillwagon Coal Company's mine and coking plant

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224 S.B. Nelson, ed., Nelson's Biographical Dictionary and Historical Reference Book of Fayette County, Pennsylvania (Uniontown, PA: S.B. Nelson, Publisher, 1900), 783, 793.

225 McClenathan, Centennial History of Connellsville, 494; The Weekly Courier 24 (8 May 1903): 2, and 26 (7 July 1905): 1; Iron Trade Review 39 (5 July 1906): 43; Sanborn, Insurance Maps for Connellsville, (1886) sheet 4, (1891) sheet 5, (1896) sheet 10, (1901) sheet 10, (1908) sheet 17, (1914) sheet 18, and (1924) sheet 9.

near Connellsville. He had also helped found breweries in Connellsville and Uniontown. William's son, Clair Stillwagon, was born in Connellsville in 1869, and worked his way from miner to fire boss at the Davidson mine. Following a year in that position, he went to work for his father's company, taking over his father's interests when the latter died in 1893.[226]

Marietta and Stillwagon must have been well capitalized when they started the Connellsville Manufacturing and Mine Supply Company, because its physical plant was larger than that of the long-standing Connellsville Machine and Car Company (when the latter rebuilt following the 1904 fire, its new facility matched that of its new rival in size). Connellsville Manufacturing and Mine Supply's building housed all the departments necessary for producing mining equipment, including iron foundry, forge, brass foundry, pattern shop, machine shop, fabricating shop, and pattern storage. By 1908, the physical plant had grown to include two new separate buildings, a pattern storehouse and a fabricating shop. Producing such items as cages, skips, hoisting engines, pumps, fans, and air compressors, the company also advertized that it was the "sole manufacturer of the Lepley patents." D.F. Lepley, superintendent of Connellsville Manufacturing and Mine Supply, was the designer of a machine for pushing coke out of rectangular ovens as well as other labor-saving equipment.[227] Steel-clad industrial buildings stand on the site of Connellsville Manufacturing and Mine Supply's plant. Although most are new, it appears that fragments of the earlier structures have been incorporated into the present structures.

Not all coal and coke equipment manufacturing within the Connellsville coke region took place at Connellsville. Scottdale, claiming to be Westmoreland County's largest manufacturing town, was also home to a major equipment supplier, the Scottdale Foundry & Machinery Company. This firm had its origins as a partnership between Theodore C. Kenney and J.D. Hill. Born in Berks County, Pennsylvania, Kenney was the son of a mining engineer. As a young man, Kenney moved first to southern Illinois to work for a furnace builder, then to

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[226] McClenethan, Centennial History of Connellsville, 497-499; Nelson's Biographical Dictionary of Fayette County, 762-763, 785-786; Jordon and Hadden, History of Fayette County, Vol III, 711.

[227] Sanborn Fire Insurance Maps for Connellsville, (1886) sheet 4, (1891) sheet 5, (1896) sheet 9, (1901) sheet 9, (1908) sheet 4, (1914) sheet 2, and (1924) sheet 4; The Weekly Courier 26 (19 May 1905): 8; The Weekly Courier, 1914 Special Number, 24.

Pittsburgh to work for Laughlin & Company where he ran a blast engine. In 1872, he moved to Scottdale, where he was put in charge of the blast engine at the Charlotte Furnace Company, one of Scottdale's early large industries. Ready to enter business for himself in 1880, Kenney, with Hill, purchased the machine shop of Everson, Marcum & Company, which had founded of the Charlotte Furnace. Next to the machine shop, Kenney and Hill built a foundry and began fabricating iron and brass supplies for the coke industry. A.K. Stauffer purchased Hill's share in the business in 1884, and the named changed to Kenney & Company. Manufacturing hoist engines, boilers, pumps, cages, sheaves, larries, fans, crushers, and other equipment, the firm grew to be a prominent supplier not only to the coke region but to coal producers in the American West, Canada, and Mexico as well. Scottdale Manufacturing & Machinery also joined in the early-20th-century efforts to develop labor-saving equipment, for example successfully marketing a coke pusher used by some of the operators who built rectangular ovens. In 1901, Kenney & Company's enlarged plant burned. To capitalize the rebuilding effort, a new corporation was formed, the Scottdale Foundry & Machinery Company, with Stauffer as president and Kenney as general manager. A new facility was immediately built and production resumed. The 1901 building survives and is partially used, having passed through several subsequent hands, including the Scottdale Machine & Manufacturing Company (sometime between 1908 and 1914), the Marion Machine Foundry & Supply Company (sometime between 1914 and 1925) and the National Machine and Foundry Company (sometime between 1925 and 1944).[228]

Refractories

Each beehive oven required about 5,000 bricks for initial construction and just about than many each time it was rebuilt. The tens of thousands of beehive ovens in the Connellsville region meant a huge demand for brick, providing a basis for a

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228 Samuel T. Wiley, ed., Biographical and Historical Cyclopedia of Westmoreland County, Pennsylvania (Philadelphia: John M. Gresham & Co., 1890), 252; "Kenney & Company" in J. Harvey Luker, Historical Souvenir, published for the 1899 Firemen's Convention in Scottdale (Scottdale: The Independent Press, 1899); John W. Jordon, History of Westmoreland County, Pennsylvania (New York: The Lewis Publishing Company, 1906), 169-171; H.J. Springer, title unknown, cover missing (n.p., 1910), 11; Sanborn Map Company, Insurance Maps of Scottdale, (1908) sheet 11, (1914) sheet 18, (1925) sheet 11, and (1944) sheet 18; "Labor Saving Devices of Connellsville Coking Practice," The Weekly Courier, 1914 Special Number, 24.

sizable brick industry in the region. By far the largest brick manufacturer in the Connellsville coke region was the Joseph Soisson Fire Brick Company. Born in 1829 to a French family in Alsace-Lorraine, Joseph Soisson emigrated to the United States in 1849. After a brief stint in the tinning business in New York, he went to work for a brick manufacturer in New Jersey. From there he moved to Hollidaysburg, Pennsylvania, to work for the brickmaker Charles Hughes, eventually becoming a partner. On behalf of that firm, Soisson opened a brick manufacturing plant in Fayette County at Miltenberg (Miltonburger), in 1860. He produced the bricks for some of Fayette County's first beehive ovens, including Stewart Strickler's ten ovens near Dawson and Jim Cochran's Jimtown works. In 1869, he and Hughes dissolved their partnership and Siosson remained in Fayette County. Over the ensuing years, Soisson took in several partners, including his son, John F., and built several new plants in and near Connellsville, including the Moyer (1872), the Volcano (1882), and the Davidson (1886). In 1894, all of Soisson's various partnerships were merged into a single corporation, the Joseph Soisson Fire Brick Company, of which Joseph was president and son John was treasurer and general manager. When John died in 1899, his brother William F., who had been secretary, took over as treasurer and general manager.[229]

Soisson was not the first brickmaker in Fayette County. Shortly after Connellsville was founded in 1768, an Anthony Banning produced brick for the town's first brick residence. By 1823, David Barnes operated a factory providing the area with a regular supply of bricks. None of the early brickmakers achieved Soisson's level of production. On the other hand, Soisson was by no means the only large-scale producer of brick for the beehive coking industry in the Connellsville region. By the mid-1910s, the Harbison-Walker Company had plants at Layton and Hays Station, United Fire Brick Company had plants at Dunbar and Fairchance, and the Eureka Fire Brick Company had a plant at Mount Braddock. Moreover, the two largest coke producers in the region had their own brick works: the H.C. Frick Coke Company had a brickyard at Lemont and the W.J. Rainey Company had a plant at Mount Braddock. Nevertheless, Soisson's was by far the largest in the region. In addition to the Moyer, Volcano, and Davidson plants, he had built a silica brick plant at Layton and two other plants, Kingston and Columbia, in Westmoreland County. These six plants had a combined daily capacity of 100,000 brick at the turn of the century and 155,000 brick by 1914. In 1913, Soisson

[229] Jordon and Hadden, <u>History of Fayette County</u>, 507-509; <u>The Weekly Courier</u>, 1914 Special Number, 58; McClenethan, <u>Centennial History of Connellsville</u>, 500-503.

purchased the Bolivar Face Brick Company and the Phoenix Fire Brick Company, thus acquiring four more plants with combined daily capacity of 135,000 brick. That gave Soisson nearly two-thirds of the estimated 500,000-brick daily capacity of brickyards in the Connellsville coke region.[230]

As with equipment made of iron and steel, brick was a commodity for which the H.C. Frick Coke Company depended on other producers, even though it produced its own. For example, Frick appropriation records show that in the additional ovens built in 1906 at Bitner, Shoaf, Wynn, Lambert, and Buffington, the company purchased brick from three concerns, Soisson, Harbison-Walker, and the Monongahela Clay Manufacturing Company. Frick and others depended on Soisson and like companies for the special shapes used in beehive ovens. After 1900, they increasingly relied on the specialty refractory brick companies for silica brick as well. As already noted, silica brick could better withstand the high temperatures sustained in ovens burning coal from the Lower Connellsville region. Soisson claimed to have produced the first silica brick experimentally in about 1885 for Frick to use in experiments in a single crown at the Henry Clay works. Ganister rock provided the raw material for silica brick. Soisson quarried the rock, crushed it in a dry pan, and added either a lime or a clay binder. Although by 1914 brick manufacturers had mechanized the shaping of clay bricks, Soisson's workers had to mould silica brick by hand. Soisson developed the Layton works near Perryopolis specifically to produce silica brick.[231]

In 1914, the Joseph Soisson Fire Brick Company employed 950 men. It also provided the basis for the Soisson family to become quite prominent in other Connellsville business circles. Joseph Soisson helped capitalize several other new enterprises in Connellsville, such as Slaymaker-Barry Company, which made locks, and the Humbert Tin Plate, which was later absorbed by the American Tin Plate Company. He helped to found the Yough National Bank of Connellsville and served for several years as its president. His three sons assumed management positions in his brick company and likewise invested widely in other Connellsville industries. For example, son William F. was one of the investors in the rebuilding of the Connellsville Manufacturing and Car Company. Grandsons, such as Vincent H.,

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230 The Weekly Courier, 1914 Special Number, 58; McClenethan, Centennial History of Connellsville, 500, 503.

231 H.C. Frick Coke Co., Appropriation No. 89; The Weekly Courier, 1914 Special Number, 58; McClenethan, Centennial History of Connellsville, 503.

also worked for the Soisson Company. Joseph Soisson's brother Peter emigrated from Alsace-Lorraine to Hollidaysburg in 1851 and went to work for Hughes & Soisson. In 1862, he moved to South Connellsville and started his own brickyard, which he operated for a few years before pursuing other interests. In partnership with Rockwell Marietta and others, he helped form the Connellsville Brewery. His two sons, Augustin D. And William H. worked for the brewery in both its Connellsville and Uniontown locations and like the other Soissons invested widely in other Connellsville industries. Both, for example, were initial investors in the Connellsville Manufacturing and Mine Supply Company. The Soisson Company remained active in the Connellsville region through the end of the beehive coking era after World War II.[232]

The Connellsville Weekly Courier

The Courier served an important niche as the trade journal for the Connellsville coke region. It had its beginnings as a local newspaper founded by some of Connellsville's leading businessmen. Although Uniontown-based newspapers serving Fayette County dated to the late 18th century, Connellsville did not have its own paper until about 1815, when The Connellsville Herald appeared briefly. After other unsuccessful attempts to establish a newspaper in the 1850s and 1860s, Peter Stentz finally succeeded in printing a permanent local organ, The Fayette Monitor and Youghioghenian. Going through several titles, the paper eventually passed into the hands of prohibitionists and moved to Uniontown. Meanwhile, in late 1874, another local paper, The Connellsville Tribune, appeared. This new paper passed through several hands and was always on unsteady financial ground until 1879 when its plant was purchased by the Keystone Publishing Company, Limited, a new concern capitalized by the owners of some of Connellsville's important businesses, such as Joseph Soisson, the brickmaker, and Joseph T. McCormick of the Connellsville Manufacturing and Car Company. The group of investors chose one of its own, Henry P. Snyder, as the first editor. Snyder was a law-student who believed he could handle the editorial duties in his spare time. He soon found that was not possible and focused his attentions on the fledgling paper. He eventually bought out the other owners and became sole-proprietor in 1891, remaining as editor into the early 20th century. He sold the business in 1903

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[232] The Weekly Courier, 1914 Special Number, 58; Jordon and Hadden, History of Fayette County, Vol II, 507-514; Quivik, interview with Max Noble.

to The Courier Company, a corporation for which he was president and principal shareholder, as well as managing editor of the newspaper.[233]

The Courier began as a weekly called The Keystone Courier, publishing local news, editorials, and advertisements. In the early 1880s, Snyder recognized the importance of the coking trade to the Connellsville region and began to devote more space to the industry in his paper. In 1883 his weekly reviews of the coke trade became a regular feature of the paper. Because of the importance of Connellsville coke to the iron and steel industry and thus to the nation's economy, Snyder's weekly feature gained a much wider readership than those in the Connellsville region who read his paper first-hand. State and federal statisticians cited his statistics and numerous other trade and professional journals quoted coke news from The Courier. For example, Coal and Coke, a turn-of-the-century, Baltimore-based, national bi-monthly journal for producers, dealers, and shippers of coal and coke featured a regular column on the Connellsville coke trade based on verbatim excerpts from The Courier's weekly review.[234]

By-Product Coking Surpasses Bee-Hive Coking

Despite the efforts of the Connellsville coke operators to mechanize their operations and despite the efforts of the independent coke operators to insure their place in the market through orchestrated actions, the life of the Connellsville coke region was finite. People knew it would be finite in the older Connellsville region because there was a limited supply of Pittsburgh coal there, but beehive operators harbored hopes that their industry would follow the lead of the Klondike or Lower Connellsville region, in which coal was likewise made into coke in beehive ovens located at the mines. The coke from the Klondike did not possess the exact quality of that produced in the old Connellsville region, but furnacemen and others in the iron and steel industry had learned that it was nevertheless a very high-quality product which performed as they required in their furnaces. Beehive operators and businessmen of the Connellsville region hoped that Greene and Washington counties, to the west of Fayette and Westmoreland counties, would eventually provide Pittsburgh coal to take the place of the Connellsville seam. Conditions which had helped to retard the

[233] McClenethan, Centennial History of Connellsville, 160-166.

[234] McClenethan, Centennial History of Connellsville, 166; Coal and Coke, see volumes 1-18 (1894-1911).

growth of the by-product coke industry in the late 19th and early 20th centuries, however, were changing, and other factors would support growth of the by-product coke industry at the expense of the beehive coke industry.

Henry Clay Frick had been of the opinion in the late 19th century that there was not enough of a market for by-products to justify the capital expenditure in by-product ovens, and he believed that any significant rise in production of by-products would lower the price of by-products, thus reducing the return on investment. Indeed, Americans were so reluctant to enter the by-products market that Europeans dominated the business. Even when steel companies had by-product ovens built at their steel mills, European companies or American companies with close European ties built and paid for the actual installations. The steel companies provided the coal and, for a price, received coke and gas. The European firms kept the by-products.[235] Markets for derivatives of by-products were slow to grow in the United States. The first significant surge was that for ammonia for use in refrigeration and especially fertilizer. There were two other benefits of by-product coking: the process yielded a higher percentage of coke from a given charge of coal, thus lowering operating cost; and the surplus gas produced by the process made an excellent fuel. The latter advantage was mainly taken by steel companies, which found that, by building batteries of by-product ovens adjacent to their steel mills, they needed minimal piping to deliver the gas to various operations within the mills. Surplus gas was especially effective as open-hearth fuel. Nearly all the new by-product ovens in the United States were built by steel companies.[236]

Once the steel companies invested their capital in by-product ovens and made the necessary infrastructural adjustments to pipe surplus gas to their steel mills, it is not surprising that they tried to maintain steady production at their by-product facilities, diverting any impact of fluxuations in demand to the beehive coke industry. Whether the steel companies owned their own beehive ovens or purchased beehive coke on the market, such fluxuations had less adverse impact on return on capital

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[235] Discussion by W.L. Affelder, E.A. Moore, and A.W. Belden following William E. Hartman, "By-Product Coke Ovens," Proceedings of the Engineers' Society of Western Pennsylvania 28 (1912-1913): 347, 350.

[236] A good general description of the rise of by-product coking in the steel industry is in Hogan, Economic History of the Iron and Steel Industry in the United States, Vol 2: 378-389.

investment than allowing their by-product ovens to lie idle would have had. Whereas total production fluxuated significantly between 1900 and 1920, by-product production showed a remarkably steady increase. The only drops in by-product coke production were slight ones in 1908, 1914, and 1919, when there were much greater drops in total coke production. While beehive coke production remained roughly the same throughout that period, allowing for periodic peaks and valleys, by-product coke production constituted an ever greater share of total coke production until it was well over half in 1919 and 1920.

The relative rise of by-product coke production was even more marked within the United States Steel Corporation. Annual reports did not distinguish between by-product and beehive coke until 1908, when the 578,869 tons of by-product coke represented less than 8% of the corporation's total coke production (that same year, by-product ovens produced about 16% of the nation's total coke production). There was a constant increase in by-product coke production from 1908 onward, and as with the nationwide figures, U.S. Steel's by-product coke represented more than half the total following the drop in overall production in 1919. Once again, by-product coke production did not fluxuate nearly as dramatically as did beehive coke production as U.S. Steel sought to maintain production at its more expensive by-product ovens, allowing its cheaper beehives to lie idle. U.S. Steel was clearly committed to by-product ovens as the source of its growth in production by 1908.

Between 1901 and 1908, the corporation increased its inventory of Connellsville beehive ovens from about 16,000 to almost 21,000, and it developed more than 2,000 new ovens in West Virginia's Pocahontas region, and another 2,500 beehive ovens in Alabama with the acquisition of the Tennessee Coal, Iron & Railroad Company. After 1908, U.S. Steel did not add to its total number of beehive ovens. It may have built new beehive ovens, but they merely replaced older ovens taken out of service as adjacent coal was depleted. Meanwhile, the corporation embarked on a concerted program to build new by-product ovens and expand its output of by-product coke. U.S. Steel had assumed ownership of 357 by-product ovens in 1901: Carnegie Steel's 212 ovens at South Sharon, Pennsylvania and 25 at North Sharon, and National Tube's 120 ovens at Benwood, West Virginia. Following investigations by a U.S. Steel coke committee in 1906, the corporation decided to build 280 by-product ovens at Illinois Steel's Joliet, Illinois, plant and that the planned new complex at Gary, Indiana would also include by-product ovens. In the early 1910s U.S. Steel built 560 by-product ovens at its Gary steel mill, as well as 280 by-product ovens at Tennessee Coal & Iron mills in Alabama and 90 by-product ovens at the Minnesota Steel mill in Duluth. The midwest ovens were charged with mixtures of coal, including that mined in Illinois as well as the Pocahontas and Klondike regions.[237]

In 1906, when U.S. Steel made its announcement to fuel its Illinois and Indiana blast furnaces with by-product coke, the Courier recognized that, if the furnacemen's prejudice against such coke was unfounded and that it would support the weight of ore and limestone in the midwestern furnaces, by-product would soon be used in Pittsburgh furnaces as well. Indeed, that happened in 1916 when the corporation began construction of a by-product coke plant in the Monongahela Valley, marking the arrival major competition for Connellsville coke. The Clairton By-Product Coke Company was incorporated by U.S. Steel to manufacture coke in 640 by-product ovens, constituting the largest by-product coke plant built in the United States. Situated along the Monongahela River just south of Pittsburgh, the plant could receive coal by rail or barge from the Klondike, Greene County, and other regions of the upper Monongahela valley and deliver coke to U.S. Steel's Dusquesne, Edgar Thompson, Homestead, and other mills in greater Pittsburgh. Moreover, being close to those mills, the Clairton works could be connected to them by means of giant pipes to deliver surplus gas to local furnaces. With the United States' entry into World War I, the federal government needed greater supplies of toluol, benzol, and sulphate of ammonia for the manufacture of explosives. In response to this demand, U.S. Steel added 128 more ovens to its Clairton works, built new by-product coke plants at Cleveland and Lorain, Ohio, built new ovens at its Fairfield, Alabama, and Gary, Indiana, and added benzol recovery equipment at the Sharon, Joliet, and Duluth works. It is interesting to note that as the nation's by-product coking capacity during the war effort, the Courier recognized that any slump in demand for coke would be felt by the bee-hive coke industry rather than the by-product industry, yet the paper's editorial position reflected the patriotic fervor of the country, cheering reports of increases in production and capacity of by-product coke because it could undergird wartime production of iron and steel.[238]

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[237] Hartman, "By-Product Coke Ovens," 311; The Weekly Courier 28 (10 August 1906): 4; Hogan, Economic History of Iron and Steel, 386-387; "Annual Report of the United States Steel Corporation," 1902-1916.

[238] The Weekly Courier 28 (10 August 1906): 4 and 41 (7 March 1918: 1, (11 April 1918): 1; "Annual Report of the United States Steel Corporation," 1916-1919. For U.S. Steel's expansion of its by-product capacity in response to the United States' war

Operators in the Connellsville coke region were kept well-informed of future prospects for the coke market. In November 1918, the Courier reprinted portions of a paper given by T.A. Galligan at the recent meeting of the American Foundryman's Association, in which he noted that as of the beginning of August 1918 the capacity of the nation's by-product ovens plus that of those currently under construction equalled the capacity of the nation's beehive ovens. He predicted that the production curves of beehive and by-product ovens would intersect before the end of the year and "when this is accomplished it is doubtful if beehive production will ever again equal by-product tonnage."[239] At the end of 1918, U.S. Steel had 2,838 by-product ovens in operation and another 282 nearing completion. As the Courier had expected, when steel production and the demand for coke dropped in 1919 with the end of the war, almost all of the diminished production was at the expense of the beehive ovens. While U.S. Steel's total coke production dropped by 13% in 1919 to 15,463,649 tons, its by-product coke production actually increased 22% to 9,530,593 tons. This circumstance left production by the company's beehive ovens at 5,933,056 tons, 41% lower than it had been in 1918. A similar situation obtained throughout the Connellsville coke region, as the 10,254,640 tons of coke produced in 1919 proved to be the lowest total since 1900, when 10,166,234 tons were produced in the region.[240]

As Galligan predicted, the beehive coke industry never recovered its pre-World War I prominence. U.S. Steel's beehive ovens bottomed out in 1921 when they only produced only 1,698,178 tons. In mid-June of that year, every Frick Company oven in the Connellsville coke region was idle. Whereas the region as a whole was producing about 170,000 per week early in the year, by early July weekly output had dropped to some 18,400 tons. Total production in the region during 1921 was only 3,572,417, the lowest in 35 years. During the course of the year, the number of ovens burning never exceeded 40%. The region experienced a brief surge in demand in 1923, producing 13,114,340 tons of coke, of which Frick ovens accounted for 7,142,901 tons. Independent operators apparently did better in 1923 than coke companies directly tied to iron and steel mills. An average of 8,586

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effort, see "Annual Report of the United States Steel Corporation for the Fiscal Year Ended December 31, 1918," 32, 52.

239 T.A. Galligan, "By-Product Coke for Foundries," quoted in The Weekly Courier 42 (21 November 1918): 2.

240 "Annual Report of the United States Steel Corporation," 1918-1919; The Weekly Courier 42 (8 January 1920): 1.

(68.9%) of the merchant ovens operated that year, reaching a peak in April when 10,935 ovens (80.9%) were burning coke. Meanwhile, furnace ovens only averaged 58.6% of capacity during the year, reaching their high point in production in June when 14,984 furnace ovens (68.7%) were burning. Responding to a diminished need for beehive coke, U.S. Steel reduced the number of beehive ovens it kept active. The corporation idled all of its Pocahontas and Alabama beehive ovens in 1923, leaving the Connellsville region as its only source of beehive coke. U.S. Steel's Connellsville beehive ovens had gone from a peak of over 21,000 in 1911 to about 18,000 in 1920 and then dropped precipitously to about 13,000 following the disastrous year of 1921.[241]

In 1926, the year Shoaf was taken out of service, U.S. Steel idled about 6,000 of its Connellsville ovens as 348 new ovens at the Clairton works neared completion, giving that facility a capacity of over 6,600,000 tons per year and marking the beginning of the last phase in the decline of U.S. Steel's Connellsville coke production. In 1927, operators in the coke region produced only 4,681,700 tons of coke, of which the Frick Company accounted for 1.8 million tons. During that year, the Frick Company continued taking ovens out of service and by mid-summer had only one plant with 91 ovens operating. The Courier observed at the beginning of 1928 that it was now obvious that if the coke region were to ever enjoy prosperity in the future, it would be based on shipping raw coal and not on making coke. A year later, the paper could report that many operators had indeed made the shift from coke to coal and were doing the same volume of business. In 1928, the region had its lowest output of coke, at 2,604,950 tons, since the Courier began reporting such figures in 1880. Emblematic of the region having traveled that nearly fifty-year cycle, the Courier decided in mid-1929 to cease publishing its weekly edition. From that point onward, the paper published its weekly review of the coke trade each Thursday in its daily edition.[242]

The onset of the Great Depression proved devastating for the H.C. Frick Coke Company's remaining Connellsville plants. Production dropped from 51,390 tons in 1930 to below 10,000 tons in 1932 and

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[241] "Annual Report of the United States Steel Corporation," 1921-1923; The Weekly Courier 44 (20 October 1921): 3, (5 January 1922): 1, and 46 (3 January 1924): 1.

[242] "Annual Report of the United States Steel Corporation," 1926-1928; The Weekly Courier 48 (12 January 1928): 1, 4, and 49 (10 January 1920): 1, 4, (11 July 1929): 1, 4..

to zero in 1935. The following year, the corporation ceased distinguishing beehive from by-product coke production. During this period, U.S. Steel continued to take beehive ovens out of service so that by 1938 it had only 1,722 in operable condition in the region. For the region as a whole, independent operators staged a brief comeback during 1929. Production that year stood at 3,980,760 tons region-wide. But the following year, production dropped to its lowest point in recorded history. Only 1,257,850 tons were produced, about one-third of that in 1929. And things continued to grow worse for Connellsville beehive operators. The low point during the depression was 1932 when they produced only about 300,000 tons and earned gross revenues of less than a million dollars, with coke fetching less than $3.00 per ton. In 1934, they produced less than half of a million tons of coke.[243]

The decline of beehive coking did not mean a comparable decline in the H.C. Frick Coke Company's coal production in the Connellsville coke region, however. During the 20th century's first decade, the Frick Company had already developed coal docks at its Gates and Ronco mines on the Monongahela River for shipping coal by barge downstream. Frick also began shipping coal at these docks from the Edenborn and Leckrone mines, respectively. In 1924, the company began operation of an engineering marvel, the underground conveyor belt system linking the Colonial mines, acquired from the Pittsburgh Coal Company in 1911, with the newly built Colonial dock on the Monongahela River. A tunnel 4-1/3 miles long housed 20 belts arranged end to end, the longest underground conveyor in the world. It originally had a capacity of 1,220 tons per hour. In 1925, the system was modified by combining some of the belts, yielding one which was 2,435 feet long, itself the longest conveyor belt in the world. The new system had a capacity of 1,550 tons per hour. It proved so successful that in 1928 the Frick Company opened another underground conveyor system in a 3-12-mile tunnel linking the Palmer mine with a newly-built Palmer dock on the Monongahela. The Palmer system also collected coal mined at Ralph, Filbert, Lambert, Buffington, and Footedale. In 1930, the Frick Company purchased the Washington Run mines from the Washington Coal & Coke Company and began shipping coal from them out the Colonial conveyor system. Frick extended the system over

[243] "Annual Report of the United States Steel Corporation," 1929-1938; <u>The Daily Courier</u> 28 (2 January 1930): 8, 29 (8 January 1931): 8, 33 (10 January 1935): 8..

five miles in 1944 to draw upon coal from the Leisenring mines.[244] These developments, coupled with new mines in Washington and Greene counties, which also shipped coal down to Clairton by barge, helped seal the fate of the Connellsville beehive industry.

The shift from beehive to by-product coke production may have signaled an improvement in the utilization of natural resources and the diminution of air pollution from the beehive ovens, but it also singled a significant erosion of the economic base of the Connellsville coke region. Interestingly, the shift also marked a worsening of the workplace environment for coke workers, at least as measured by injuries and deaths at coke plants. Production of coke from by-product ovens exceeded that from beehives in 1919. That same year, employment at by-product ovens rose above that at beehives for the first time in U.S. coking history. Workers at by-product ovens, however, suffered fatality and injury rates more than twice those of workers at beehive works (the U.S. Bureau of Mines, which reported coke-oven accident rates annually, questioned whether beehive operators kept injury records as accurate as those kept by by-product operators). The normal method of measuring injury and fatality rates was to calculate incidents per thousand 300-day workers. For its annual report on coke-oven accidents for 1920, the Bureau of Mines also noted that more workers were killed or injured at by-product ovens the beehive ovens when measured according to production. In 1920, beehive ovens showed rates of 49 injuries per million tons of coke produced and .52 deaths per million tons produced, while by-product ovens showed rates of 77 injuries per million tons and 1.23 fatalities per million tons.[245]

During the late 1910s and early 1920s, injury rates at coking plants of both types were comparable to those at metallurgical plants, but about a third of those at coal mines and hardrock mines. Eventually, though, by-product plants became much safer places to work. From the post-World War I period to the early

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[244] "A River of Coal, 4-1/3 Miles Long!" and "H.C. Frick Coke Company," U.S. Steel News (December 1936): 16-18, 20-21; U.S. Steel Publications Department, "The Frick District: The First 100 Years," 20.

[245] William W. Adams, "Coke-Oven Accidents in the United States During the Calendar Year 1919," U.S. Department of the Interior, Bureau of Mines Technical Paper 266 (Washington, DC: Government Printing Office, 1920), 7; Adams, "Coke-Oven Accidents in the United States During the Calendar Year 1920," Bureau of Mines Technical Paper 293 (Washington, DC: GPO, 1921), 10-11.

1950s, injury and fatality rates at beehive works remained fairly constant, while those at by-product plants dropped significantly, due no doubt to a combination of improved design and safety programs better adapted to more mechanized methods of coke production. While beehive injury rates remained in the range of 30-50 incidents per million hours worked, rates at by-product ovens dropped from nearly 100 accidents per million hours worked in the years just after World War I to less than ten following World War II. Curiously, labor productivity for both types of ovens remained essentially equal and unchanged over the entire period: just over 1,000 tons per million hours worked.[246]

The trends in U.S. coke production established early in the 20th century, of by-product coke output showing fairly constant growth and beehive coke taking care of the steel industry's marginal needs, continued through mid-century. It should be emphasized that these trends were not due to the exhaustion of the Pittsburgh seam in the Connellsville and Lower Connellsville regions. For example, in 1912 Frick's Tip Top and Summit works had recently closed, due to the depletion of the coal under them, but numerous other large works, like Shoaf, Yorkrun, Standard, Lambert, and Buffington had reserves capable of supporting more than 20 years of operation, according to H.C. Frick Coke Company estimates of its holdings. By-product coke production increased to over 58 million tons nation-wide on the eve of the Great Depression in 1929, a year when beehive ovens produced only about 6 million tons of coke. By-product coke production declined during the Depression, but not nearly as much as did beehive coke, dropping below a million tons during four of the years of the 1930s. The number of active beehive ovens in the U.S. dropped to 10,816 during the decade. Steel production for World War II brought renewed demand for both kinds of coke. Numerous ovens, including those at Shoaf and others of the H.C. Frick Coke Company in the Connellsville region, were rehabilitated for the war effort, contributing to a national total at the close of 18,669 operable beehive ovens. Beehive coke production exceeded 8 million tons nationally in 1942. Post-war prosperity sustained total levels of coke production, but by-product coke was actually on the rise while the number of beehive ovens dropped to 12,179

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[246] K.M. Burr, "Safety in Coke-Oven Operations," Coal Age 10 (28 October 1916): 709-710; Adams, "Coke-Oven Accidents in the United States During the Calendar Year 1922," Bureau of Mines Technical Paper 349 (Washington, DC: GPO, 1923), 35-36; John C. Machisak and Naomi W. Kearney, "Injury Experience in the Coking Industry, 1955," U.S. Department of the Interior, Bureau of Mines Information Circular 7841 (Washington, DC: U.S. Government Printing Office, 1958), 18-20.

and beehive coke production fluxuated between 3 and 7 million tons. Finally, a new surge in the output of by-product coke in 1955, during which production exceeded 73 tons, drove beehive production below 2 million tons. From then until the 1970s, the few remaining beehive plants in the U.S. were phased out.[247]

In 1956, there were 79 by-product plants aggregating 15,923 ovens in the United States with an annual capacity of almost 80 million tons of coke. Of those, 1,567 ovens, almost exactly 10%, were located at U.S. Steel's giant Clairton works. That same year, there still 61 beehive coke plants with 9,549 ovens in operable condition in the U.S., but one third of those ovens sat idle the entire year. More than two-thirds of the operable beehive ovens were located in Fayette and Westmoreland counties, scattered throughout the old Connellsville coke region, the Lower Connellsville region, as well as the Upper Connellsville and the Greensburg-Connellsville coke regions. Most operators in the greater Connellsville region, aggregating 6,204 ovens, drew their coke with machines. The larger plants employed Covington coke-drawing machines, while smaller operations used bulldozers fitted with rams for extracting coke from the ovens. There were as well 628 ovens in the greater Connellsville region which were hand-drawn. U.S. Steel retained only three of its Connellsville coke plants in operable condition: Collier (389), Leisenring No. 2 (500 ovens), and Phillips (354 ovens). Shoaf was not on the list of operable plants. Several other former U.S. Steel/H.C. Frick Coke Company were still operable, owned by small local operators: Calumet, Davidson, Isabella, Mammoth, Marguerite, Redstone, Standard, United, and Wynn.[248]

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[247] "Life of Plants," H.C. Frick Coke Company, Miscellaneous Agreements, room 16, section 396, shelf 5, box 13, United States Steel Corporation Archives, Annondale; Machisak and Kearney, "Injury Experience," 20; Joseph A. DeCarlo and Emma E. Ryan, "Beehive-Coke Plants in the United States That Reported to the Bureau of Mines in 1956," Bureau of Mines Information Circular 7820 (Washington, DC: GPO, 1958), 1; "Fortieth Annual Report, United States Steel Corporation, 1941," 22.

[248] DeCarlo and Ryan, "Beehive-Coke Plants in the United States, 1-5; DeCarlo and Maxine M. Otero, "Oven-Coke Plants in the United States as of December 31, 1956," Bureau of Mines Information Circular 7816 (Washington, DC: 1958), 1. The beehive figures are based on reports of operators to the Bureau of Mines. The figures do not include ovens known to have produced coke, but for which no reports were submitted by their operators.

When Max Noble bought Shoaf in 1959, he was already operating ovens at Kyle (another former Frick plant) and Shamrock. Frick had not operated Shoaf since World War II and the ovens needed extensive repair and rebuilding. Noble was able to begin producing coke at Shoaf in 1965. Of the 302 ovens at Shoaf, he operated as many as 285. He charged them with a mixture of coal he stripped near the Shoaf works and coal he acquired from Sewell, West Virginia. Noble never reactivated the underground mine at Shoaf to recover coal from the Pittsburgh seam. He sold furnace coke to several of the major steel producers, including U.S. Steel, Bethlehem Steel, and Inland Steel. He sold foundry coke to some smaller brass and iron foundries in Pittsburgh. He even sold some coke made from Sewickley coal (a seam relatively high in sulphur) to Pittsburgh Plate Glass, which it used for calcining limestone. As 1970 approached and air pollution standards grew more stringent, Noble began experimenting with interconnections between his ovens to burn the smoke before passing the combustion gasses through a baghouse in an effort to meet those standards. He claims to have been able to eliminate 7/8 of the smoke produced by his beehive ovens, but in 1972 the State of Pennsylvania would no longer permit his coking operations. He continued mining his properties until 1984.[249]

[249] Fredric L. Quivik, personal interview with Max Noble, 29 August 1992.

APPENDIX A:

Beehive Coke Oven Construction

Although the first ovens built in the Connellsville region were apparently square in plan, the circular beehive oven quickly became the norm in the area. After some experimentation with such dimensions as diameter of the oven, the height of the dome, the diameter of the trunnel head, and the height and width of the door, by at least 1860 designs for beehive ovens were standardized and significant change in design and operation did not occur until the turn of the 20th century. Operators built ovens near their mines in batteries arranged either in single rows, called banks, or double, back-to-back rows, called blocks. In early days, operators often had workers run mine cars directly out of the mine and over the bank or block to charge the ovens. Eventually, however, the system was improved with the installation of coal bins between the mine and the ovens, usually at the tipple. With the buffer of coal storage, a brief interruption at the mine or the ovens did not require suspended operation of the other. Cars called larries delivered coal to the ovens on tracks along the tops of the ovens leading from the coal bins. Larries were sized so that each carried sufficient coal to charge one oven, again an improvement over the old system because mine cars had much less capacity. With several mine cars needed to charge a single oven, the resulting traffic over the ovens limited the old system to use at small plants. Larries discharged coal through the trunnel heads into the ovens.[250]

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[250] There are several good descriptions of standard beehive construction in the Connellsville region. The most detailed is International Library of Technology, <u>Coking in Beehive Ovens</u> (Scranton: International Textbook Company, 1907), section 69. Although this text dates from the early 20th century, evidence suggests that, with few exceptions, techniques for building ovens had changed little in two decades. This description is taken from that text, as well as from: Atwater, "The Effect of Coke Oven Construction on Coke, 73-86; Weeks, <u>Manufacture of Coke</u>, 88; Belden, <u>Metallurgical Coke</u>, 9-10; John Fulton, "On the Methods of Coking Coal for Furnace Use; Its Efficiency and Economy, as Compared with Anthracite Coal in the Metallurgy of Iron," in Platt, <u>Coke Manufacture</u>, 117-145; Howard N. Eavenson, "Bee Hive Oven Construction," paper given at the meeting of 4 November 1905, <u>Transactions of the Appalachian Engineering Association</u>, Bulletin No. 4 (Morgantown, WV: The Appalachian Engineering Association, n.d.), 1-7, and reprinted with illustrations in "Beehive Oven Construction: Plans and Details Showing Modern Practice in the Connellsville and Pocahontas Regions," <u>Mines and</u>

A battered masonry front wall ran along all the ovens. Arched openings through this wall served as the oven doors. The front wall retained earth fill which covered the ovens up to the level of the larry tracks to help retain the heat in the ovens. Adjacent to the ovens and about three feet below the oven doors was a strip of nearly level ground called the coke yard or wharf. Parallel to the coke yard were the rails of the yard track or coke track on which coke was carried away from the plant by railroad cars, either box cars or open-top coke cars. At very early plants, the yard was at the same level as the track, but operators soon learned that elevating the yard made it easier for laborers to load coke into cars. Plant builders initially used timber cribbing to maintain the elevation difference, but as the elevation of the yard grew higher, builders quickly adopted a battered, dry-stone retaining wall, called a wharf wall or yard wall. If coke was shipped in boxcars, the wharf wall would extend four to six feet about the tracks. This was the typical dimension at older plants. Later plants, adapting to newer gondolas with greater capacity and higher sides, had wharf walls eight to ten feet above the tracks, at which height mortar was required in the rubble masonry. At plants with higher wharf walls, periodic runways or chutes were often built through the wall to accommodate loading boxcars. Laborers at older plants with low yard walls typically used timber-plank ramps to wheel coke into gondolas. The yard usually sloped downward slightly toward the wharf wall to facilitate moving loaded wheelbarrows to the cars. Width of the yard ranged from 20 to 30 feet, depending on how much coke storage was required. If the operator could rely on timely delivery of cars, little storage was required, but if the operator expected frequent delays in the arrival of cars, then ample storage space for coke meant that the ovens could

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Minerals 27 (September 1906): 80-82; W.M. Judd, "Coke-Oven Construction," Proceedings of the Engineers' Society of Western Pennsylvania 22 (October 1906): 327-355, reprinted in Coal 4 (1 November 1906): 18-20; Mines and Minerals 27 (January 1907): 278-283, and partially reprinted as "Beehive Coke Oven Practice: Some Features of Construction and Operation," The Iron Age 79 (17 January 1907): 190-191. The discussion here is of 19th-century practice. Evidence that coke ovens changed little in the last 40 years of the 19th century may be found in Joseph Soisson's claim that the bricks he produced for Strickler and Cochran in the 1860s were essentially the same as those he was producing in the early 1900s, McClenethan, Centennial History of Connellsville, 501. Turn-of-the-century changes and improvements, such as the use of silica brick for the oven linings or the adaptation of the oven doors to accommodate coke-drawing machines, will be discussed in a later section.

continue to produce coke during the wait. Coke plants ran most profitably when they operated continuously, because, as already described, the first charge after a dormant period yielded inferior coke. On the other hand, an overly-wide yard was undesirable because it meant laborers had to haul coke farther from the ovens to the cars.

The relationship of ovens to mine and railroad meant that a plant needed to be on relatively flat ground along a creek bottom so that railroad tracks could reach the plant while negotiating a minimum grade. Banks of ovens were generally built along the base of the side hill. A bank of 100 ovens would be about 1,500 feet long. If the creek bottom was wide enough, then block ovens could be built as well. Building parallel banks and blocks of ovens made it possible to effect savings in track construction costs: a single set of larry tracks could serve a block of ovens, and a single set of yard tracks could serve two banks of ovens facing each other or a bank and half of a block of ovens. It was usually desirable to have the mine at the upstream end of the plant so that it was easier to move loaded larries to the ovens, and it was desirable to have extra track for storing empty coke cars at the upstream end so that they could be moved by hand into position for loading. Drainage of both surface and ground water was also an important consideration in construction, especially of bank ovens.

Generally built of stone, the front and wharf walls were set on dry-masonry stone foundation walls. The ovens were set on foundation walls of the same construction called ring walls. Loam mortar was used for the top 12 inches of the ring walls. Loam mortar was simply a mixture of light, sandy earth and water. Lime-based mortar could not be used because of the high temperatures to which it would be subjected. The areas within the ring walls were filled with compacted earth, preferably with a high clay content, to form the foundation for the oven floors. The walls of the ovens were built of specially shaped fire-clay brick, called liner brick, to a height even with the top of the oven doors, about 2-1/2 feet above the floor. Liner brick were 9 inches long, 2-1/2 inches tall, and of variable width: the end which would face the interior of the oven was 4 inches wide and the opposite end was 4-1/2 inches wide. When laid up with a minimum of loam mortar, this shape gave the oven its desired circular shape of 10-12 feet in diameter.

The front walls were built at the same time as the ovens. Built of coursed rubble masonry, the front walls were generally vertical and laid up in loam mortar to the level of the oven floor. From there to the top, the front walls were battered with the stone set in lime or cement mortar. Various methods were used to surround the oven doors. The opening itself consisted of specially-shaped fireclay voussoirs for the segmental arch and an iron door frame, a single piece of iron which formed sides and bottom of the opening. The bottom and the sides were each generally 2 feet 8 inches. Each side of the door frame had several notches into which workers placed horizontal iron bars to facilitate the use of long-handled tools for leveling coal and drawing coke. Brackets along the sides of the frames fitted in the joints of the surrounding masonry to hold the frames in place. In some instances the surrounding masonry was the same stone as was used for the rest of the front wall, laid right up to the frame. In other cases, a single vertical row of common red brick separated each side of the door frame from the stone masonry. The method for surrounding the door frame which best facilitated long-term maintenance of the ovens utilized a rectangular panel of brick about 6-1/2 feet square, extending about 18 inches beyond each side of the frame and as much as 3 feet above the top of the arch. This entire brick panel could easily be taken out of the front wall to facilitate the reconstruction of the oven, a periodic necessity during the life of a bank or block of ovens. Specially-shaped fireclay masonry units called door-jamb blocks were used for the transition between the door opening and the cylindrical wall of the oven. Taking the shape of a segment of an arch, the jamb blocks had overall dimensions of about 29 inches in length, 9 inches in width, and 7-1/2 inches in thickness.

Once the vertical portions of the door openings and the oven walls were complete, construction of the oven crowns and the arches over the openings could commence. The fireclay blocks which formed the arch came in three complex shapes: skew backs (which sat at the haunch), arch blocks, and key blocks. While the ends of the blocks which faced outward were designed to simply be flush with the front wall, the ends which faced inward to the oven were much more complex because they had to support the crown, and thus when put in place had to assume the geometric form created where a cylinder (the arch) intersects a sphere (the crown). These blocks were about 2 feet long, 11 inches wide, and 8 inches thick. Two rowlock courses of standard red brick formed an arch above the arch blocks. Erected as soon as the door masonry was complete, the crown of the oven also was built of specially-shaped fireclay brick. The first course of the crown, which sat atop the oven wall, consisted of a shape called a crown skew brick: 9 inches long; 4 inches wide and 1 inch thick at the inner end; and 4-1/2 inches wide and 2-1/2 inches thick at the outer end. The crown was built of crown brick: 9 inches long; 4 inches wide and 2-1/4 inches thick at the inner end; and 4-1/2 inches wide and 2-1/2 inches thick at the outer end. The crown was laid up in a mortar of fireclay, the joints being very thin.

The top of the crown was finished with the trunnel head, a circular shape made of fireclay having an outer diameter of 24 inches, a thickness of 10 inches, and a hole through the middle 12 inches in diameter. The charge of coal would be poured through the trunnel head and the combustion gasses given off during coking would escape through the trunnel head. After the trunnel head was placed, masons would coat the entire exterior of the crown with fireclay mortar. There were differences of opinion from region to region concerning the preferred height of the crown. General sentiment in the Connellsville coke region favored a crown 8 or 9 feet high. Other regions had other preferences. Higher crowns were stronger, but cost more to build because of the addition material required for front walls, piers, etc. Lower crowns cost less to build, but also flattened more readily with use, requiring more frequent maintenance.

While the front walls and ovens were being built, masons also erected the larry-track piers in the interstices between the ovens. These were necessary so that the weight of the larries and their loads could be carried directly to the ground rather than being transmitted to the fill on top of the ovens. The constant extreme heating and cooling of the ovens made the crowns subject to flattening, even without the added burden of the larry tracks. Piers were built of stone or brick, and in either case they had a capstone on which the tracks sat. Tracks were placed in grooves in the capstones, at a elevation about 1 foot 4 inches above the tops of the trunnel heads, and secured with iron pins. The size of the ovens dictated that there be about a 15-foot span between piers. Two or three iron straps, called bridles, were attached to the tracks to maintain the gauge between the piers. After the piers were built, the spaces between front walls, ovens, and piers were filled with clay earth. The fill around the oven walls was compacted, while that placed over the domes was left loose to allow movement as the dome experienced thermal expansion and contraction. Sand or loam were not used for fill because they did not yield as readily to the expanding crowns, thus placing undue pressure on the masonry. Limestone clay was also avoided because it fused when heated, making it more difficult to repair the ovens. Often a second fireclay ring, called an upper trunnel head, was placed atop the trunnel head to prevent fill from dropping through the hole and into the oven. The last step in completing the ovens was the placement of the floor. The fill within the rings was sloped downward toward the door to allow water to drain from the ovens and to make the job of hand-drawing coke from the ovens easier. Fireclay floor tiles, 12 inches square and 3 inches thick, were placed atop the fill.

In addition to the larry tracks and the coke tracks, the only fixtures built at the ovens to support their operations were those of the water supply system. Quenching coke require lots of water: it would take 500 to 800 gallons to quench a single oven, so a 100-oven plant charging its ovens every two days would need a system capable of delivering 25,000 to 40,000 gallons per day. When possible, reservoirs or water tanks were located on a hill near the works so that gravity at a head of 30 or 40 feet would provide the needed 15 or 20 pounds of water pressure. The main leading from water storage to the ovens was cast-iron pipe, 4 inches in diameter if serving a small plant, 6 inches in diameter if serving a larger plant of less than 300 ovens, and 8 inches in diameter if serving more than 300. Branches from the main, called yard pipes, ran parallel to the front wall of each bank or block and were buried in the coke yard about 2 feet deep and 1 foot away from the front wall. Yard pipes were of cast iron, 6 inches in diameter. The main was equipped with a gate valve near the storage end, and each yard pipe was equipped with a gate valve at each end, as well as in the middle in the case a long yard. Wrought-iron pipes 3-1/2 feet long and 1 inch in diameter extended from the yard pipes up along the front walls between every other oven. At the upper end of each pipe was a coke-oven valve (faucet) and hose coupling.

APPENDIX B:

Making Coke

Making coke involved a routine which, under ideal conditions, was carried on week in, week out. As already stated, the heat retained in an oven from the previous charge was sufficient to fire the next one. Larries carried the coal from the tipple to the ovens, with each larry holding the volume needed to charge a single oven. At the bottom of each larry was either one or two chutes, depending on whether it served a bank or a block of ovens. The chutes could be raised and lowered and were the proper length and size to discharge the load directly into the trunnel head. Coking plants operated seven days a week, but workers had Sundays off. Therefore, charging the ovens with coal had to be sequenced accordingly. Monday through Thursday, ovens were charged with a volume of coal that would coke in 48 hours. On Friday and Saturday the ovens were charged with a larger volume of coal that would take 72 hours to coke (because coking time effected the quality, 48-hour coke was generally marketed as "furnace coke" and 72-hour coke as "foundry coke").

Using this sequence, all the ovens at a plant could be drawn and recharged on alternate days with no work required on Sundays. Workers called chargers filled the larries at the tipple using marks within the larries, rather than weighing, to determine the correct size of the load. Under ideal siting conditions, the grade of the larry tracks was downhill from the tipple to the ovens so the charger could let the loaded larries coast to the proper position over an oven before setting the brakes. Motive power for hauling empty larries back to the tipple or loaded larries up-grade was provided by horses, mules, or towards the end of the 19th century, small steam locomotives called dinkies. When the coal was charged into an oven, the door of which had already been bricked up to the level of the notches on the door frame, the coal fell into a cone-shaped pile. A man called a leveler used a long-handled hoe more than 12 feet long, with a specially-designed scraper head, to level the coal by resting the handle of his tool on an iron bar set in the notches of the door frame and sliding the instrument back and forth across the pile. As soon as the pile was leveled, a dauber would brick up the remainder of the door opening to within an inch of the top. This small opening would admit the only air allowed into the oven during coking. To seal joints in the bricks of the opening, the dauber would smear loam mortar over the outside surface.

Soon after the oven was charged, the coal would begin to make a faint crackling sound as it expanded. This first stage was called "sweating." As the coal continued to be heated by the oven, it would enter the second stage, called "gassing," in which it began to give off volatiles in the form of smoke. At first the smoke would be pale blue. Then, as it became more voluminous, it would become denser and whiter, finally changing to a dark brownish yellow. The smoke at this stage had a pitchy, bituminous smell. In the third stage, called "striking" or "going off," the volatiles explosively ignited into a blaze, first along the liner brick and spreading along the surface of the coal. Smoke increased in volume and turned black, its darkest during the coking process. As air to the oven was reduced by the bricking of the oven door, leaving only the half-inch gap at along the arch, the smoke turned brown. The flame would increase to two or three feet in height, but would not exit the trunnel. The heat from the combustion was absorbed by the crown and radiated back onto the bed of coal as the coking process progressed. Both the size of the flame and the volume of smoke would progressively diminish. About 15 minutes after striking, a crust would form over the surface of the bed, cracking to allow gases to continue escaping. These cracks would open deeper into the bed and the smoke turned gray-black, gradually increasing again in volume. About four or six hours into the burn, the smoke would reach its greatest volume, hold steady for several hours, and then begin to decline, turning light-gray. During this course of the process, the color of the flame changed from cherry red to full red, deep orange, and if burning well, to lemon yellow and then yellow-white. The flame appeared as small jets, called candles, jumping about the surface of the bed as gases issued from the cracks.[251]

When coking was complete, the coke itself would be a clear red and the walls of the oven almost the same color. When the coking process was complete, it had reached its fourth stage "burnt-off," and there would be no more smoke. At that time, to prevent the fixed carbon in the coke from combusting, the oven boss would daub over the crack at the top of the door opening and place an iron lid, or damper, over the trunnel head to completely close off the supply of air to the oven. When a coke puller was ready to draw coke from the oven, he'd remove the brick in the door and quench the contents of the oven by means of a 15-foot pipe on the end of a hose attached to the water line nearest the oven. Working systematically from the front of the oven to the rear, the coke puller took between 45 minutes and an hour to apply the 500 to 800 gallons of water on the coke, taking care to allow a minimum of water to spray against the hot bricks of the crown,

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[251] This detailed description of the visual, aural, and olfactory characteristics of the coking process appeared in The Weekly Courier 16 (14 June 1895): 3.

which would cause them to spall. A skilled puller could apply the proper amount of water in quenching. Too little water would result in coke re-igniting during pulling, requiring additional quenching. Too much water would yield wet coke and would cool off the oven, delaying the firing of the next charge.

After quenching the coke, the coke puller would break the coke loose using the same scraper-headed tool used by the leveler. Turning the head on its end, he would break individual pieces of coke loose along the vertical fissures which characterize its columnar structure. Turning the head on its side, he would draw pieces of coke out through the door and let them drop in a pile on the yard. Periodically, as the pile grew, he would have to move coke to new piles nearer the wharf wall. This he would do with the coke fork, which would only pick up the large pieces of coke preferred by furnace men. Coke ash and smaller pieces of coke, called breeze, would fall through the tines of the fork and be considered waste. At the end of the day, after all the ovens had been drawn and cleaned, workers pushed a cart along the yard to collect the breeze and carry it to the ash dump. Occasionally the breeze was screened to separate the ash from the fine coke so that the latter could be sold to other industrial customers or burned in boilers at the plant, but generally a substantial quantity of coke was discarded as breeze.

Coke was loaded into railroad cars by hand, either directly with a fork or with the aid of a large, special wheelbarrows. Shippers used both boxcars and gondolas with racks on the sides to increase the capacity. Because of the irregularity of the delivery of cars to coke plants, operators usually hired contractors to load the cars rather than using their regular day laborers. If cars did not arrive for a few days, coke could be stacked on the wharf, but after a while there would be no more room for drawing the ovens. Operations could be suspended and the ovens kept hot for a few more days by sealing the doors and placing dampers on the trunnel heads, a process called banking. Well-built ovens, when banked, were known to have retained enough heat through several summer weeks to re-ignite a subsequent charge. If cars still had not arrived, the ovens would have to be allowed to cool. Ovens sitting idle long also meant that much of the work in the adjacent mine had to be suspended.

It took about 3 hours to draw and recharge a 19th-century beehive oven. A coke puller could draw the coke from three ovens per day in the early days, but only two per day as the size of ovens grew. Therefore, each man was given responsibility for sets of four or six ovens. Each oven was drawn every other day. The job of a coke puller was made more arduous by the extreme temperatures in which he had to work. Only his clothing, hat, and perhaps a leather shield protected his hands, head, and body from the heat radiating from the door. It was especially difficult for operators to find coke pullers during the summer months. One of the techniques used by operators to make coke drawing more attractive during summer months was to allow them to work a shift during the cooler morning hours from 2:00 to 10:00 (this shift schedule also allowed much of the coke to be loaded into cars before train crews arrived to deliver empties and take away loaded cars).[252] Thus seasonal labor shortages and irregularity in the supply of railroad cars were the main obstacles to operators achieving the regular routine in which their ovens functioned best. If the ovens got too cool to adequately fire the next charge, or if they had to be re-fired after lying dormant for a time, they yielded coke of inferior quality characterized by black heads (ends of coke which had been incompletely carbonized), high content of volatiles material (which caused undesirable combustion qualities in the blast furnace), and a lower percentage of fixed carbon.

An 1888 experiment in devising a means for refiring an idle oven without yielding inferior coke points to the difficulty operators had in making practical improvements to the standard coke ovens and the methods of operating them. With experimental equipment supplied by the Southwest Natural Gas Company, the Central Connellsville Coke Company used natural gas to heat its ovens before placing the first charge of coal. Although the coke drawn from these ovens was of superior quality, operators in the region, such as the H.C. Frick Coke Company, concluded that the apparatus would simply get in the way because an oven might run two years before being shut down, and the loss incurred from one batch of inferior coke would never offset the cost of the gas heating equipment. Operators continued to use wood to place the first fire in their ovens.[253]

Routine maintenance was required of the ovens every year. After a few years' use, the crown would begin to flatten, the arch over the door would lose its alignment, and bricks might begin to fall out, making it more difficult to regulate the supply of air to the oven. In some instances, damage might be limited to the top

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[252] "Labor Saving Devices of Connellsville Coking Practice," <u>The Weekly Courier</u>, 1914 Special Number, 26; "Machine for Drawing Coke from Bee-Hive Ovens," <u>Coal</u> 4 (25 October 1906): 20; <u>The Weekly Courier</u> 27 (6 July 1906): 3; Fredric L. Quivik, personal interview with Max Noble, retired coke operator, 29 August 1992.

[253] "Gas Fuel for Coke-Ovens," <u>The Engineering and Mining Journal</u> 46 (8 December 1888): 481-482.

of the crown, in which case only the trunnel head and some of the masonry could be replaced to make the oven serviceable. Generally, however, the fill would be removed from around the oven and the masonry of the liner, crown, floor, and brick insert in the front wall, completely taken down. The oven seat would then be re-leveled and compacted, the oven entirely rebuilt, and perhaps even the door frame replaced. It was rare that an oven would last more than 10 or 12 years.

APPENDIX C:

19th-Century Mining Techniques in the Connellsville Coke Region

As already described in the first section, the anticlines and synclines of the Pittsburgh coal seam intersected with the surface topography of the Connellsville region in the form of outcroppings. John Enman's PhD dissertation clearly describes the relationship of these geological/ topographical intersections to the chronological location of coal mines in the Connellsville region. At some locations where the coal cropped, the seam would continue upward into a hill, while at others it would extend downward into the earth. Early miners could extract a bit of coal anywhere it cropped with little difficulty, but to follow the seam further into the ground required methods of haulage to bring the coal to surface. This was most easily done where the seam extended upward into a hill, because gravity aided the movement of loaded wagons or carts down to the mine opening and when empty they could be relatively easily moved back to the working face of the mine using human or animal power. Such mines, called drift mines, had the added advantage that they drained themselves of water naturally. Mining the drift was called "hill-top mining." Conditions allowing for drift mines obtained along the Youghiogheny near Hickman's Run and Broad Ford, so it is not surprising that several of Fayette County's mining operations which antedated the rise in beehive coking were located in that area. By 1877, during the recovery from the Panic of 1873, Joseph Platt reported 46 mines in the region supplying coal to coke works. Of these, 61% (28 mines) were drift mines.[254]

Mines which enter a seam and follow it downslope into the earth are called slope mines. They are more difficult to operate because of the relative difficulty of hoisting coal from the working face up to the mine opening and the need to pump water from the mine. The major advantage of a slope mine was that dangerous gasses given off by coal in the mine evacuated naturally, while drift mines had to be mechanically ventilated to eliminate the gasses, if encountered. Of the 46 mines Platt reported in the region, 35% (16 mines) were slope mines.[255] Thousands of acres of ground in the Connellsville region were

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[254] John Aubrey Enman, "The Relationship of Coal Mining and Coke Making to the Distribution of Population Agglomerations in the Connellsville (Pennsylvania) Beehive Coke Region," (PhD diss., University of Pittsburgh, 1962), 69-85.

[255] Ibid., 74.

underlain with coal in the Pittsburgh seam which had no nearby outcrop, so it could be readily extracted by neither drift nor slope mines. The two other means of getting to such coal, then, were to sink a shaft to the level of the seam or to develop a rock slope mine. The latter involved driving an inclined opening through the rock overburden until encountering a sloping seam. Haulage in such a mine was the same as that in a simple slope mine.

Shaft mines had all of the disadvantages of both the slope and the drift mines and none of the advantages. All the coal had to hoisted to surface, water had to pumped from the mines, and they had to be ventilated to supply fresh air and to exhaust dangerous gasses. In 1877, only two of the mines in the Connellsville region were shaft mines, as the coke works had been concentrated at outcrops in the area where the Youghiogheny had eroded through the Pittsburgh seam. Mines and ovens were found in two clusters, the southern end of the Latrobe syncline and the northern end of the Uniontown syncline (there were also a few slope mines along the eastern edge of the Uniontown syncline). In subsequent years, as available coal lands adjacent to outcrops disappeared, newer mines and works were developed in areas susceptible only to shaft mining, and as a consequence the percentage of shaft mines in the region increased.[256] Shaft mines were developed in creek bottoms for two reasons: creek bottoms offered sites with the least vertical distance between the surface and the seam, and creek bottoms were the only areas readily accessible by rail and therefore suitable for shipping coke to market. Of the 94 mines in the Connellsville region in 1900, 38 were drift mines, 32 were slope mines, and 24 had shafts. In the newer Lower Connellsville region that year there were 20 mines; exactly half were drift mines and a quarter each were slope and shaft mines.[257]

In the early years of coke manufacture in the Connellsville region, underground mining techniques were relatively crude and wasteful. Miners used picks and worked from the mine opening or shaft toward the boundaries of the property. Horse- or mule-drawn mine cars hauled coal to the entry (the mule was the preferred animal in the mines because it was "better to handle and [took] care of himself better in the mine," but the horse was necessary for pulling pit wagons up steep grades).[258] Such a

[256] Ibid., 77, 138-142.

[257] Howard N. Eavenson, "The Connellsville Region," Mines and Minerals 23 (August 1902): 27.

[258] Weekly Courier 26 (5 May 1905): 2.

system provided immediate profits because the distance from the working face to the opening or shaft was small, but the system also left quite a bit of coal behind, as much as 50%. Economic circumstances at the time did not foster more efficient extraction of coal. Although labor was abundant and relatively cheap, so was coal land, so there was not an economic incentive to get the most coal possible out of a given property. Although the demand for coke was growing, the price remained low, inducing operators to extract coal at the least cost over the short term. Such an inefficient approach to mining was called "hogging the pit."[259]

Beginning in 1882, as the price of coal land increased, operators adopted methods of extracting as much coal as possible in order to realize the most profit from their investment in land as well as physical plant. They employed mining engineers to plan the development of the underground workings and they practiced a different approach to extracting the coal. Rather than mining from the opening or shaft towards the property boundaries, miners drove headings toward the boundaries, leaving most of the coal in place. Then beginning at the boundaries, they worked back towards the entry or shaft extracting coal from rooms separated by ribs or pillars, which were long partitions of coal left in place to support the roof. Rooms and ribs were laid out perpendicular to the headings and were spaced as much as 80 feet on center. The last step was to begin at the boundaries taking out large portions of the ribs. Miners placed rows of vertical props against the roof to protect them while extracting coal from the face of the rib. As this last step progressed, miners moved the props along with them, allowing the roof to settle or collapse onto the mined out areas, called the gob. By this technique, less than 15% of the coal in the seam was left in the ground. W.J. Rainey was one of the early operators to adopt this system at his Fort Hill mine. By the early 20th century, there were generally three entries to a mine: 1) a ventilation opening or shaft for the supply of fresh air, 2) a haulage opening or shaft, out which coal was hauled, but which also served to

[259] "Modern Methods of Coal Mining and Coke Making," 32, and Fred C. Keighley, "Mining and Coking Practise [sic] in the Connellsville Region," 44, both in The Weekly Courier, 1914 Special; Elias Phillips, "Latest Methods of Rib Drawing," Proceedings of the Coal Mining Institute of America 3 (1905): 294.

exhaust air, and 3) the manway, the last opening to become a standard feature of a mine, providing emergency egress from the mine.[260]

With more efficient mining methods came improved mining tools. Miners used explosives to break up larger blocks of coal. Towards the end of the century, machines began to replace men wielding picks in some parts of the bituminous region. Electric undercutting machines were used in non-gaseous mines, and punching machines driven by compressed air were used in gaseous mines. The machines were not readily adopted in the Connellsville region because, it was claimed, local conditions made them impractical. The local conditions may have had more to do with foremen's and miners' prejudices, however, than the actual physical nature of the Connellsville mines. In any case, coal in the Connellsville region's Pittsburgh seam is quite soft and was mined relatively easily by pick, so miners and operators had less incentive there to experiment with machines than did miners in areas where the coal is harder. Among the first companies in the region to install mining machines were the Washington Coal & Coke Company at its Washington Run mines, the Pittsburgh Coal Company at its Colonial mines (which the Frick Company acquired in 1911), and the Keystone Coal & Coke Company at its Greensburg mine. These companies, none of which were located in the old core of the Connellsville coke region, installed their machines around the turn of the century. During the early 20th century, the Connellsville region still lagged far behind those in other parts of Pennsylvania's bituminous region in adopting machine mining.[261]

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[260] "Modern Methods of Coal Mining and Coke Making," 32; John Fulton, "Coal Mining in the Connellsville Coke Region," Engineering and Mining Journal 38 (13 September 1884): 170-171; Phillips, "Latest Methods of Rib Drawing," 296-297; Fred C. Keighley, "Fifth Bituminous District," in Reports of the Inspectors of Mines of the Anthracite and Bituminous Coal Regions of Pennsylvania for the Year 1889 (Harrisburg: Edwin K. Meyers, State Printer, 1890), 360.

[261] Clay F. Lynch to W.H. Clingerman, letter dated 11 May 1909, A. King to W.H. Clingerman, letter dated 1 October 1907, and Clay F. Lynch to W.H. Clingerman, letter dated 31 August 1909, all three letters in a packet dealing with machine mining found in Miscellaneous Agreements, H.C. Frick Coke Company, room 16, seotion 396, shelf 5, box 13, United States Steel Corporation Archives, Annondale. On the softness of coal in the Connellsville region and the late arrival there of machine methods, see also The Weekly Courier 28 (19 October 1906): 2, 4.

In 1905, while there were over 500 mining machines operating in some of Pennsylvania's bituminous mining districts, the districts which comprised the coke region (second, fifth, ninth, eleventh, and sixteenth) had far fewer machines, as few as 21 in the fifth and only 39 in the eleventh. Whereas some districts, like the first, were producing 80% of their coal with machines, several of the districts in the coke region (second, ninth, and eleventh) still produced 80% or more of their coal with traditional pick mining and the fifth, at the heart of the old Connellsville coke region, produced 98% of its coal with picks. Although more machines had been introduced in the coke region by 1915, the overall proportions had changed little by that time. There were actually fewer machines in some of the other districts of the bituminous region, yet the percentages of coal produced by machine in those regions remained at 75-80%, suggesting that new machines had been introduced which mined more coal per machine. The second, fifth, ninth, and eleventh districts still had fewer than 100 machines and 68-81% of the coal in these districts was still mined by pick.[262]

Mechanization also began to replace the horses and mules in the mines. Single-rope haulage systems driven by steam engines began to replace horses and mules, especially were the coal seam sloped steeply. Tail-rope haulage used one rope to pull loaded cars to the opening or shaft-bottom and a separate tail rope to pull the empties back again. Endless-rope systems, in which mines cars brought out of headings were attached to a continuously running loop of rope, pulled the loaded cars to the opening or shaft-bottom, and empties back to the headings. Endless-rope systems were used in some mines where the coal sloped both upward and downward. Towards the end of the century, electricity and compressed air also began to be used for haulage, with electrical locomotives being less expensive to operate than compressed air locomotives, but limited to non-gaseous mines. Some electric hoisting was introduced, but it was limited to steeply sloping sections within the mine rather hoisting to the mine entry or surface. Yet horses and mules continued to play an important role in the Connellsville region, even after the turn of the century. In 1905, the Frick Company employed about 2,300 horses and mules in its mines in the Connellsville region. Mining was even more dangerous for the animals than for the miners; 60-70 died or were injured in the Frick mines each month. Unless

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[262] Report of the Department of Mines of Pennsylvania, Part II: Bituminous, 1905 (Harrisburg: Harrisburg Publishing Co., State Printer, 1906), xlvii; Report of the Department of Mines of Pennsylvania, Part II: Bituminous, 1915 (Harrisburg: Wm. Stanley Ray, State Printer, 1916), 79.

otherwise killed or injured, stock lasted about three years in the mines. Each animal had to be replaced at a cost of $200-225. The Frick Company employed a salaried purchasing agent based in St. Louis, who traveled the West looking for fresh stock for the Connellsville mines.[263]

As operations grew in size and complexity, the design and layout of mines moved from the hands of the practical mine superintendent, who gained his expertise through experience, to the professional engineer, who was usually college-trained and then apprenticed with an older professional. Mining engineers possessed expertise in geology and civil and mechanical engineering. They applied engineering principles to planning a mine by, for example, drilling test holes prior to mine development so that the dip of the coal could be ascertained and a scheme for working the coal could be devised before the mine was opened. Civil engineers designed the large structures associated with a mine and mechanical engineers designed and specified the systems of haulage, hoisting, ventilation and power delivery to be employed. By the turn of the 20th century, engineers were employed to insure that the all the components of a plant were integrated to operate efficiently together.[264]

Virtually all the pumps in the mines were steam-driven, with "the celebrated Yough pumps," developed and manufactured locally by the Connellsville firm of Boyts, Porter & Company, being the most

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[263] "Modern Methods of Coal Mining and Coke Making," 32; W.G. Wilkins, "Electricity in Coal Mining," Proceedings of Engineers' Society of Western Pennsylvania, Vol. 13 (Pittsburgh: Engineers' Society of Western Pennsylvania, 1897), 135-178; Patrick Mullen, "New Methods for Mining Bituminous Coal as Practiced by the H.C. Frick Coke Company," Engineers' Society of Western Pennsylvania, Proceedings 32 (November 1916): 714, also published as "New Mining Method in the Connellsville Region, Coal Age 10 (28 October 1916): 700-702; B.F. Jones, "Different Methods of Mine Haulage Compared--The Good and the Bad Methods Found as Parts of All the Systems," Mines and Minerals 23 (August 1902): 8-12; Weekly Courier 26 (5 May 1905): 2.

[264] W. Glyde Wilkins, "Mechanical Engineering As Applied to Coal Mines and Its Relation to Economical and Successful Operation of the Same," Journal of the Central Mining Institute of Western Pennsylvania 2 (1900-1903): 116-126.

common in the region.[265] Development of mines was planned so that water would drain along the headings to a sump. Water from several sumps was pumped to the mine opening, in the case of a slope mine, or to a sump adjacent to the hoisting shaft. A pump room was also located next to the shaft and all water was pushed to the surface through a pipe compartment in the shaft. Located on surface, the boiler for the hoisting engine also delivered steam to the underground pumps through pipes in the same compartment. In some mines, more water, measured in tons, was pumped than coal was hoisted to the surface. This reached an extreme situation at the H.C. Frick Coke Company's United mine where, at the end of the century, in the course of a year 173,000 tons of coal was produced and almost 2 million tons of water were pumped.[266]

As mines in the region grew in complexity and drove deeper into the earth they became more dangerous. Prior to 1880, there were, of course, accidents in the Connellsville mines, but evidently no disasters. Because of the otherwise wasteful techniques used, there were few collapses in the mines, and hill-top mining exploited seams which were not gaseous. As such mines went deeper into the hillsides, fresh air for breathing was thought to be the only need. Furnaces were the first devices installed in such mines to warm exhaust air, allowing gravity to help it escape and be replaced by cooler fresh air. Early gaseous mines were shallow, so natural ventilation allowed gasses to escape and miners to avoid disaster. As mines went deeper, natural ventilation was not sufficient and gasses began to accumulate in mines. The first disaster in the Connellsville region took place in 1884 when about 19 miners were killed in an explosion at the Connellsville Coke and Iron Company's Leisenring No. 2 shaft. Later that year, an explosion in the Youngstown Coke Company's Youngstown mine at Stambaugh killed 14 more men. Furnaces were obviously of no use in ventilating gaseous mines, so fans were introduced. Some mines used fans to force fresh air into the workings, while others used fans to draw exhaust air out. Another dangerous factor in the mines was lighting, the open flame being used until after 1880. Safety lamps were used through the end of the century, but electric lights did not come

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[265] J.J. Davis, "Fifth Bituminous District," in Reports of the Inspectors of Mines of the Anthracite and Bituminous Coal Regions of Pennsylvania for the Year 1888 (Harrisburg: Edwin K. Meyers, State Printer, 1889), 335.

[266] H.L. Auchmuty, "The Leith Mine," The Colliery Engineer 17 (September 1896): 41; "Modern Methods of Coal Mining and Coke Making," 32; Eavenson, "The Connellsville Region," 29.

into use in the mines, except for stationary placements at principal locations such as shaft bottoms and headings, until after the turn of the century. Meanwhile, the Connellsville mines continued to be dangerous places to work through the end of the 1890s, with numerous disasters following the Leisenring and Youngstown events.[267]

The surface works of mines in the Connellsville region consisted of timber and brick-masonry structures. The plant at Leisenring No. 3, built by the Connellsville Coke and Iron Company in 1888, may have been typical. Built to supply coal for 500 ovens, the Leisenring mine had a hoisting shaft 542 feet deep and divided into three compartments, two for hoisting and one for pipes. The structures were considered modern for the time and consisted of a brick boiler house and a brick engine house, the latter housing a hoist with conical drums. A fan house over the nearby airshaft housed a 25-foot fan equipped with baffles allowing the shaft to serve as either a downcast or updraft shaft. The 73-foot-tall timber headframe was supported on stone footings set 18 feet deep in the ground and reaching bedrock. Cast-iron sheave wheels were 12 feet 10 inches in diameter. Flat-floor cages were used for hoisting mine cars and the headframe was equipped with an apparatus which, by means of a steam cylinder, pushed an empty car onto the cage, thus pushing a loaded car off the cage and across a bridge toward the bins. The car would roll by gravity to the dump, then when empty back to the headframe by gravity to a transfer truck, which would raise it by means of another steam cylinder to the position where it could be pushed onto the cage to replace the next loaded car. Two timber bins, each with a capacity of 600 tons, stood over the larry tracks, which would convey coal to the ovens. The plant was designed by J.K. Taggart, superintendent and engineer of Connellsville Coke and Iron's plants. By the end of the century, the most visible change in the typical compliment of surface structures was the introduction of steel headframes. By 1895, the Oliver Nos. 1 and 2, Leisenring No. 2, and Leith mines each had steel headframes. A more subtle change in the hoisting works at a shaft was the configuration in which a coal tipple was attached to the

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[267] "Modern Methods of Coal Mining and Coke Making," 32; "Safety and Welfare in the Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 16; Keighley, "Mining and Coking Practise [sic] in the Connellsville Region," 45; Keighley, "Presidential Address," December 1904 meeting in Proceedings of the Coal Mining Institute of America (Pittsburgh: Coal Mining Institute of America, 1906), 137-138; Keighley, "The Connellsville Coke Region," The Engineering Magazine 20 (October 1900): 38; Eavenson, "The Connellsville Region," 28.

headframe, and the cage dumped the contents of mine cars directly into chutes, rather than directing them across a bridge to the bins.[268]

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[268] Davis, "Fifth Bituminous District," 335-338; Eavenson, "The Connellsville Region," 27-28; Milo S. Ketchum, The Design of Mine Structures (New York: McGraw-Hill Book Company, Inc., 1912), 188-194; The Weekly Courier 16 (12 April 1895): 3.

APPENDIX D:

Brief biographical sketches of prominent figures in management of the H.C. Frick Coke Company

Thomas Lynch was born Irish-immigrant parents at Uniontown in 1854, attending public schools there as well as the Fayette Institute. Upon graduating from high school at the age of eighteen, he went to work as a clerk for the Dunbar Furnace Company's store at Dunbar and then the store of the Atlas Coal and Coke Company. After being promoted to yard boss for the latter's ovens, Lynch next moved to Pittsburgh, where he clerked for the Allen Kirkpatrick Grocery Company. Moving back to the coke region in 1875, Lynch took the position of clerk at Frick's Broad Ford store, where a life-long relationship with Henry Clay Frick began. Lynch quickly rose through Frick's organization, becoming superintendent of the Anchor mine and in 1877 superintendent of the Valley and Tip Top mines, the Valley coking ovens, and the Valley store. In 1882, when the Carnegies invested in Frick operations and the H.C. Frick Coke Company was formed, Lynch was made general superintendent of the new company's mining and coking operations in the Connellsville region. In 1892, he became general manager and in 1896, with the resignation of Frick, Lynch was named president, a position he held until his death at his home in Greensburg in 1914.[269] Lynch's background in business, rather than in mining or engineering, is typical of the leading managers in the Frick Company.

James W. Anawalt became the president of the Union Supply Company in 1906, after serving the company for 20 years as a bookkeeper, superintendent of the operating department, general superintendent, and vice president. He began his career with the Frick interests at the age of 23, after working for several years in his father's store in Somerset County, where he was born in 1863. Like Lynch, Anawalt had only a high school education.[270]

Orran W. Kennedy succeeded Lynch as general superintendent when the latter became president of the H.C. Frick Coke Company. Kennedy, likewise, had his early beginnings in business, rather

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[269] William Dickson, History of Carnegie Veteran Association (Montclair, NJ: Mountain Press, 1938), 88; Fenwick Y. Hedley, Old and New Westmoreland, Vol. III (New York: The American Historical Society, Inc., 1918), 288-291.

[270] The Book of Prominent Pennsylvanians, (Pittsburgh: Leader Publishing Company, 1913), 113.

than technical training. Born in 1854 in Lawrence County, Pennsylvania, he followed his family's footsteps by apprenticing in the milling business after finishing public school. After only two years, he left the milling trade, moving to Pittsburgh in 1874 to work as a clerk for the Pennsylvania Railroad. By 1890, he was chief clerk in the freight department. That year, he quit the railroad to work in Frick's Pittsburgh office and the following year was appointed auditor. Later in 1891, he was transferred to Scottdale to be Lynch's assistant. When the Frick Company took over the McClure Coke Company, Kennedy was put in charge of McClure operations, which were not merged into the Frick Company until 1903. Shortly after that merger (in 1904), Kennedy resigned from the Frick Company to become general manager of the newly organized Orient Coke Company, which opened a new plant in the Lower Connellsville region.[271] He was succeeded by W.H. Clingerman.

Several of the superintendents at Frick plants in the Connellsville region also came to those positions through experience in stores. **James A. Cowan** was born in 1852 in Westmoreland County. As a young man, he taught in local schools and served as principal for several years before, in 1879, going to work for the Connellsville Coke Company as a weigh master. Three years later he took employment as a bookkeeper for Stanton Stoner Company. In 1884, he became a clerk at the Union Supply Company's store at Tarr. Five years later, he transferred to the position of payroll clerk for the Southwest Connellsville Coke Company at Tarr. In 1893, Cowan become superintendent of the coking works at Tarr. Although the Southwest Connellsville Coke Company was not formally incorporated into the Frick Company until 1903, Frick made management decisions for the Southwest Company the decade previously. Thus, in 1896, the Frick Company appointed Cowan general superintendent of the Southwest Connellsville Coke Company. After the merger under U.S. Steel, Cowan retained his position, but it was then called division superintendent for the north end of the region. Although his position received new names in subsequent years, it essentially remained the same, and Cowan occupied it until 1930, serving the Frick Company for about a half century.[272]

Charles B. Franks was born in Fayette County in 1867. After attending public schools and graduating from the Mt. Pleasant

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[271] Nelson's Biographical Dictionary, 679-681; The Weekly Courier 41 (28 February 1918): 22.

[272] Walkinshaw, Annals of Southwestern Pennsylvania, Vol. IV, 401.

Institute, he worked on his father's farm for another year before moving to Broad Ford to work at the Post Office and then as a clerk in the Union Supply Company's store at Frick's Valley works. In 1890, the company transferred him to Mammoth, where he worked as shipping clerk. Following the 1891 mine disaster at Mammoth, Franks was named assistant superintendent and within the year superintendent at Mammoth. After eight years, Frick transferred him to Leisenring No. 1, where he served as superintendent until he retired from the Frick Company after 32 years.[273]

Not all Frick superintendents, however, had business backgrounds. Some had engineering educations and actual experience in the mines. **Robert Ramsay**, for example, claimed to be a self-taught engineer, seeking to learn skills of that profession in his native Scotland. Emigrating to Pennsylvania with his wife and parents in 1863 at the age of 23, Ramsay first worked as a machinist in Pittsburgh and then as a winding engineer for the Shafton Mining Company in Westmoreland County. By 1870, he was superintendent, a position he held for eleven years. He then went to work for the Carnegies, who were natives of the same part of Scotland. Ramsay was superintendent and engineer at the Carnegies' Monastery mine, which was merged into the H.C. Frick Coke Company's roster in 1882. The following year, Frick transferred Ramsay to Mt. Pleasant to superintend the Standard mine. In 1886, he took charge of the design and construction of the new shaft opening and plant at Standard. He also designed and supervised construction of the Mt. Pleasant water works. Robert Ramsay died in 1899. His younger brother, **Morris Ramsay**, also learned machinists skills in Scotland. Beginning work for the Frick Company in 1882, he superintended at various times the Morewood, Warden, Killinger, Alice, and Tarr's mines coke plants. Like his brother, he held the title of engineer for Frick Company as well. Among the facilities he designed were the tipple at Rist, the air shaft at Morewood, and the plants at Trotter and Henry Clay. Shortly before his death in 1892, he was made general manager of the Southwest Coal and Coke Company.[274]

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[273] Jordon, <u>Genealogical and Personal History of Fayette County</u>, Vol. II, 575; Charles Alexander Rook, et al, eds., <u>Western Pennsylvanians: A Work for Newspaper and Library Reference</u> (Pittsburgh: Western Pennsylvania Biographical Association, 1923), 550, 569.

[274] Wiley, <u>Cyclopedia of Westmoreland County</u>, 214-215; Jordon, <u>History of Westmoreland County</u>, Vol. II, 203-205, 334-335.

APPENDIX E:

New Companies Absorbed by Frick

The H.C. Frick Coke Company acquired most of its ovens not by building them but by purchasing them after others had built and operated them. The following table lists works purchased by the Frick Company, arranged by companies from which they were bought. In many cases, the owner at the time Frick purchased the works was not the owner which developed them. The chain of owners is listed in the source for this table, "Historical Data: H.C. Frick Coke Company's Plants" (ca. 1923). That document also lists a few plants the company acquired from Carnegie Steel located in the Irwin District (outside of the Connellsville coke region and its closely related regions, the Lower Connellsville, the Upper Connellsville, and the Greensburg-Connellsville) and one located in Greene County. Those plants not located in the Connellsville region or its relatives are not listed here.[275]

[275] Prior to 1886, the Irwin field was included with the Upper Connellsville and the Greensburg-Connellsville regions as a single coal field called the Irwin-Latrobe field (also the "washed-coal" district because coal had to be washed prior to coking). In 1886, the USGS separated them into three district fields, and only the product of the Upper Connellsville and the Greensburg-Connellsville could be marketed with the favorable reputation of "Connellsville Coke." Slate had to be removed from the coal in both regions prior to coking. In the Greensburg-Connellsville region this was generally done by washing. Operators in the Upper Connellsville region found that their coal, which was harder than that in the Connellsville region, coked better if broken and screened first. This also removed the slate, obviating the need for washing. Coal in the Upper Connellsville region had a slightly higher sulphur content than did that in the Connellsville region. Most coke operators in both the Upper Connellsville and the Greensburg-Connellsville regions crushed their coke before marketing it, shipping most of it east to foundries. "Upper Connellsville Coke Region" and "Greensburg-Connellsville Coke Region," The Weekly Courier, 1914 Special Number, 12-13 and 14-15.

Company From Which Purchased	Name of Operation	Date Operations Began	Date Acquired by Frick
American Coke Company	Baggaley	1897	1903
	Dorothy	1899	1903
	Egenborn	1899	1903
	Gates	1899	1901
	Lambert	1900	1901
American Steel Hoop Company	Isabella	1871	1903
Atlas Coke Company	Crossland (Atlas)	1892	1905
Charles Armstrong	Tip Top	1878	1879
Calumet Coke Company	Calumet	1888	1889 & 1898
Carnegie Steel Company	Monastery	1880	1882
Chicago & Connellsville Coke Company	Leith	1881	1889
Connellsville Coke & Iron Company	Leisenring #1	1880	1890
	Leisenring #2	1882	1890
	Leisenring #3	1886	1890
Connellsville Gas & Coke Company	Davidson (Dravo, Plummer)	1862	1885
Consolidated Connellsville Coke Company	Trotter	1880	1883
Continental Coke Company	Continental #1	1901	1911
	Continental #2	1900	1903
	Continental #3	1900	1901
	Marguerite	1898	1904
Eureka Fuel Company	Leckrone	1899	1902
Fairchance Fuel Company	Kyle (Fairchance)	pre-1860	1895
Fayette Furnace	Oliphant	1873	1899

Company			
Hecla Coke Company	Hecla #1	1882	1906
	Hecla #2	1890	1906
	Hecla #3	1903	1906
Hurst, Moore & Company	Summit	1874	1880
A.A. Hutchinson & Brother	Standard	1872	1883
	White (Globe)	1873	1877
Juniata Coke Company	Juniata	1890	1906
McClure Coke Company	Alverton #1Alverton	1878	1895
	#2BessemerBuckeyeCoa	1878	1895
	lbrookDiamondEnterpr	1878	1895
	ise (Hawkeye)Hazlett	1872	1895
	(Myers)Lemont	1879	1895
	#1Lemont #2Mullin	1875	1895
	(Bridgeport)	1874	1895
	Painter (McClure)	1871	1895
	Rising SunStar	1871	1895
	Union	1890	1895
		1872	1895
		1871	1895
		1870	1895
		1871	1895
		1873	1895
J.W. Moore	Mammoth	1885	1889
	Wynn	1887	1889
Morgan & Company	Morgan	1869	1872
Pittsburgh Coal Company	Colonial #1	1884	1911
	Colonial #2	1884	1911
	Colonial #3	1906	1911
	Colonial #4	1889	1911
Redstone	Redstone	1881	1889 & 1893
River Coal Company	Bridgeport	1900	1909
Sharon Coke Company	Ronco	1901	1903
J.M. Schoonmaker	Sterling #1	1860	1889
	Sterling #2	1860	1889

Sherrick, Markle & Company	Eagle (Sherrick)	1870	1880
Southwest Connellsville Coke Company	Buffington	1900	1903
	Footedale	1900	1901
	South West #1 (Morewood)	1879	1903
	South West #2 (Alice)	1880	1903
	South West #3 (Red Top)	1873	1903
	South West #4 (American)	1873	1903
Strickler & Lane	Foundry	1870	1879
United Coal & Coke Company	Central	1887	1890 & 1896
	Mutual	1881	1889, 1893-5
	United	1881	1895
Wilson, Boyle & Playford	Valley (Clinton)	1869	1882
Youngstown	Youngstown	1880	1895

There were apparently two firms named United Coal and Coke Company which the H.C. Frick Coke Company, acquired at different times. The more recent of those firms was owned jointly by National Tube Company and American Steel Hoop Company and then was merged into the Frick Company in 1903 following the formation of U.S. Steel. No coking works in the Connellsville region are known to have been operated by this United Coal and Coke. The earlier United Coal and Coke Company filed its articles of incorporation in 1881. W.M. Stuart of Philadelphia was the principal shareholder, owning 7,175 of 8,000 original shares issued. B.K. Jamison, also of Philadelphia, owned 800 shares and the remaining 25 shares were divided into lots of five among five other individuals from Philadelphia, Greensburg, and Parnassus. The two men from Greensburg, George F. Huff and Robert S. Jamison, were prominent in the development of the coking industry in the Greensburg-Connellsville region. This earlier United Coal and Coke operated three works, Central, Mutual, and United, which the Frick Company acquired in 1895. Robert Jamison, a Westmoreland County farmer, developed the Mutual works near Mt. Pleasant in 1881. The ovens were eventually acquired by United

Coal and Coke in 1890, with the Mutual Mining & Manufacturing Company owning them in the interval.[276]

George Huff and others built ten ovens just south of Greensburg in the 1870s and in 1880 developed the Carbon works, which eventually became one of three Greensburg-area plants of the Keystone Coal & Coke Company. Huff joined Jamison and others in the late 1880s to form the New Alexandria Coal & Coke Company, named for another moniker given a portion of the Greensburg-Connellsville coke region. After passing through the hands of a Philadelphia capitalist, the plants of this company became the basis for the Jamison Coal & Coke Company, founded by Jamison and his three sons in 1892. Operating 1,407 ovens in 1914, the Jamison Coal & Coke Company was the largest coke producer in the Greensburg-Connellsville region. As the names of the Keystone and the Jamison companies suggest, both firms sold coal as well as coke. When coke demand and prices dropped, they would idle their ovens and enter the coal market directly. This did not signify a lack of interest in maintaining coke prices, however. For example, when coke producers meeting in Pittsburgh in 1903 formed a committee to devise a means of regulating production and stabilize prices, John M. Jamison, one of Robert's sons, served as treasurer of that committee.[277]

The Eureka Fuel Company was formed in 1899 by the Illinois Steel Company (by then part of the Federal Steel Company) to produce coke from coal lands recently purchased in the Lower Connellsville coke region. Charles H. Foote was president, T.J. Hyman vice president, C.P. Parker secretary and treasurer, and John P. Brennen general manager. Believing that coal in the Klondike region, which would soon become known as the Lower Connellsville coke region, could produce a coke of equal value to that produced in the old Connellsville region John C. Nef and John H. Hillman had purchased options on 6,000 acres of coal in that part of Fayette County. They contracted with John Fulton to prepare reports on the quality of the coal, with Selwyn Taylor to prepare reports on the feasibility of coking it, and with Brennen

[276] "H.C. Frick Coke Co. Absorbs Coke Companies," The Iron Trade Review 36 (9 April 1903): 35; Articles of Incorporation for the United Coal & Coke Company, filed 30 August 1881, Charter Book 14, Bureau of Corporations, Secretary of the Commonwealth of Pennsylvania, Harrisburg, 121; H.C. Frick Coke Company, "Historical Data,"5

[277] The Weekly Courier, 1914 Special Number, 13, 14; Walkinshaw, Annals of Southwestern Pennsylvania, Vol. IV, 333; The Weekly Courier 25 (13 November 1903): 2.

to compare its coke with that produced in the Connellsville region. Receiving favorable reports in 1897, Nef and Hillman were able to sell the coal to Herbert DuPuy of Pittsburgh, and he in turn sold it in 1899 to Foote. Foote hired to Brennen to manage Eureka Fuel's coking works, which were to be located at Leckrone, Footedale, and Buffington. Selwyn Taylor was contracted to design the coking ovens, the power plants, and the surface works at the mines as well as the water system which would deliver water to the works from the Huron Water Company. The water company was developed jointly by the Eureka Fuel Company and American Steel and Wire's American Coke Company.[278]

The designer of the Eureka Fuel Company's plants was Selwyn M. Taylor, a Pittsburgh-based mining engineer. Born in Allegheny, Pennsylvania, in 1864 and graduating from high school in 1880, he went to work for an engineer, R.L. McCully. After three years of training in that office, McCully made Taylor a partner in the firm McCully & Taylor. In 1890, Taylor left the partnership and established his own business as a mining and civil engineer. He was chiefly engaged in designing coal-mining and coking works throughout western Pennsylvania when the Illinois Steel Company contracted with him to design Leckrone, Buffington, and Footedale in 1898. Taylor died in 1904 while trying to rescue miners following an explosion in the Cheswick coal mine (not in the Connellsville region). Over 174 miners died in that disaster.[279]

Brennen, general manager of Eureka Fuel, was a prominent coke manager in the Connellsville region. Growing up in Pittsburgh, his first job was as a clerk in a Jones & Laughlin company store. After working in administrative positions for the B & O Railroad in both Pittsburgh and Baltimore, he moved to Connellsville in 1886 to serve as a manager of the McClure Coke Company, where he worked until it was absorbed by the H.C. Frick Coke Company in 1895. During his tenure at McClure, he supervised the construction of the works at Lemont No. 2. Upon joining the staff of Eureka Fuel, he managed the construction and then operations of Leckrone, Buffington, and Footedale until they, too, were absorbed into the Frick Company in 1901. Almost

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278 "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 10; Hart, History of the Three Towns, 44; J.P. Brennen, "The New Coke Plant of the Eureka Fuel Company in the Klondike Region, Pennsylvania," Mines and Minerals 21 (April 1901): 385-388.

279 George Irving Reed, et al, eds., Century Cyclopedia of History & Biography of Pennsylvania, Vol. II (Chicago: Century Publishing Company, 1910), 177-179.

immediately he went to work for the Sharon Steel Company, supervising its construction of the Ronco works. Before taking that position, he signed a three-year contract with Sharon steel stipulating that, if that company were to merge with U.S. Steel, he would have the option of quitting and receiving half of the compensation remaining in the contract. When Sharon sold out to U.S. Steel in 1903, shortly after Ronco was completed, Brennen quit and took his severance pay. Resolute in his desire to remain independent of the dominant player in the Connellsville region, he next joined the Central-Connellsville Coke Company as it developed the Herbert works near New Salem and then in 1906 became president and manager of the Thompson-Connellsville Coke Company, building and operating that firm's Thompson No. 1 and 2 works. These works produced coke from coal lands acquired by J.V. Thompson, a prominent speculator who had acquired vast tracts in the Lower Connellsville region and in the eastern portion of Greene County. Brennen was also president of Producers' Coke Company, the brokerage firm initiated in 1911 by merchant producers in the Connellsville region to market their coke.[280]

Brennen's first employer in the Connellsville region, the McClure Coke Company had grown out of a successful brokerage firm. E.W. McClure and Gilbert T. Rafferty began brokering coke in 1872. Like the H.C. Frick Coke Company, the McClure Company did not develop most of the ovens it owned. Of the fifteen works it operated when it was absorbed by the Frick Company, McClure had only built Lemont No. 2 itself. All of the others had initially been developed in the 1870s by small operators such as J.R. Stauffer (Star, 1871), Alexander Ewing (Lemont No. 1, 1871), and Cassius Markle (Bessemer, 1878).[281]

The American Steel and Wire Company joined Illinois Steel in developing the Huron Water Company to provide water for its new coal mines and coke works in the Lower Connellsville region. Operated by the American Coke Company, these were Gates (a coal mine only, located on the Monongahela River at the mouth of Middle Run), Edenborn, and Lambert. John McFayden was general manager of the American Coke Company and the works were designed by Louis W. Fogg. Born in Hoboken, New Jersey in 1862, Fogg went

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[280] "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 10; Connellsville Weekly Courier 24 (3 July 1903): 2.

[281] "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 8; H.C. Frick Coke Company, "Historical Data."

to work for the South Pennsylvania Railroad after graduating from high school in 1880. After working for the railroad for four years and learning the profession of civil engineering, he went west to work for several other railroads, including the Chicago, Burlington & Quincy and the Union Pacific. In 1892, Fogg moved to Latrobe, opening an office to practice civil and mining engineering. The American Coke Company hired him in 1899, at which time he moved to Uniontown. After the works of American Coke were merged into the H.C. Frick Coke Company, Fogg remained with the latter until 1907, when he became the general manager of the Tower Hill-Connellsville Coke Company, which developed works, including rectangular ovens, between New Salem and Brownsville.[282]

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[282] "The Connellsville and Lower Connellsville Coke Regions," The Weekly Courier, 1914 Special Number, 10; Hart, History of the Three Towns, 44; John W. Jordon and James Hadden, Genealogical and Personal History of Fayette and Greene Counties, Pennsylvania, Vol. I (New York: Lewis Historical Publishing Company, 1912), 151.

APPENDIX F:

Coke ovens and coke oven production in the Connellsville Region, 1880-1934

The following table shows the increases in the number of ovens and in coke production in the Connellsville coke region (including the Lower Connellsville coke region):[283]

Year	Number of Ovens	Tons of Coke Shipped	Average $/Ton
1880	7,211	2,205,946	1.79
1881	8,208	2,639,002	1.63
1882	9,283	3,043,394	1.47
1883	10,176	3,552,402	1.14
1884	10,543	3,192,105	1.13
1885	10,471	3,096,012	1.22
1886	10,952	4,180,521	1.36
1887	11,923	4,146,989	1.79
1888	13,975	4,955,553	1.19
1889	14,458	5,930,428	1.34
1890	16,020	6,464,156	1.94
1891	17,204	4,760,665	1.87
1892	17,256	6,329,452	1.83
1893	17,513	4,805,623	1.49
1894	17,834	5,454,451	1.00
1895	17,947	8,244,438	1.23
1896	18,351	5,411,602	1.90
1897	18,628	6,915,052	1.65
1898	18,643	8,460,112	1.55
1899	19,689	10,129,764	2.00
1900	20,954	10,166,234	2.37
1901	21,575	12,609,949	1.90
1902	26,329	14,138,740	2.37
1903	28,092	13,345,230	3.00
1904	29,119	12,427,468	1.75
1905	30,842	17,896,526	2.26
1906	34,059	19,999,326	2.75
1907	35,697	19,029,058	2.90
1908	37,842	10,700,022	1.80
1909	39,158	17,785,822	2.00
1910	39,137	18,689,722	2.10
1911	38,904	16,334,174	1.72
1912	38,884	20,000,873	1.92
1913	39,067	20,097,901	2.95

283 The Daily Courier 10 January 1935, 8.

1914	37,965	14,075,638	2.00
1915	38,986	17,921,216	1.80
1916	38,362	21,654,502	2.58
1917	38,110	17,806,181	6.25
1918	37,061	16,138,590	7.25
1919	35,758	10,254,640	4.70
1920	35,678	10,750,227	8.30
1921	35,473	3,572,417	4.07
1922	35,042	5,675,000	7.15
1923	34,611	13,114,340	5.90
1924	33,070	6,668,560	3.85
1925	26,809	7,395,120	3.67
1926	26,142	8,342,630	4.19
1927	25,878	4,681,700	3.78
1928	25,878	2,604,950	3.41
1929	25,828	3,980,760	3.38
1930	22,750	1,257,850	3.29
1931	15,660	573,730	3.20
1932	9,935	302,970	2.98
1933	9,249	436,390	2.99
1934	9,457	435,970	4.10

APPENDIX G:

Shoaf Works in the Context of Connellsville

On December 24, 1902, the H.C. Frick Coke Company appropriated an estimated $30,000 to open a new drift mine on the James Smiley tract in Georges Township, Fayette County, to supply coal to U.S. Steel's by-product coking ovens. Company and contractor crews completed construction of surface structures for this new mine, including dwellings for miners' families, by the end of January 1904 and at a total cost of $40,035. Coal from the Smiley mine would be shipped by way of the Masontown & Smithfield Branch of the Baltimore and Ohio. There were far fewer structures associated with the initial Smiley development than was the case for contemporary coking plants. In addition to ten double dwellings for miners and their families, there were a tipple and bins, a railroad trestle, a mule barn, and a two-story stable, all of wood-frame construction.[284]

The development marked Frick's opening of the Connellsville region to the supply of coal for by-product operations (as previously noted, the American Coke Company had already developed Gates in the Lower Connellsville region as a mine to supply coal for shipment downstream). At the same time as Frick was opening Smiley, however, the company also had a pressing need to build new beehive ovens in the Connellsville region. Demand for coke remained fairly steady as iron and steel production grew. Yet many of the old ovens in the Connellsville region were associated with coal lands under which the Pittsburgh seam had been exhausted. As Frick abandoned these ovens, the company had to build new ones just to maintain the pace of coke production. Some of the new ovens could be added to existing plants, such as those added to Mutual No. 4 in 1902 and 1904, but Frick also had to open new mines and build new coking works. Such a program

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[284] H.C. Frick Coke Company, Appropriation No. 3 dated 24 December 1902, Records of the Frick Coal Division, Box 8, Shelf 3, Section 72, room 17, United States Steel Corporation Archives, Annondale, PA; H.C. Frick Coke Company, "Shoaf Mines," collected in "H.C. Frick Coke Company General Plant Plans," 2 bound volumes (compiled by the company in 1928 and on file at Office of Resource Management, U.S. Diversified Group, USX, Uniontown, PA), 50.

began in 1904 with an appropriation to build new plants at Shoaf, which is adjacent to the Smiley tract, as well as at Yorkrun and Bitner.[285]

The original appropriation for these three plants called for 500 ovens at Yorkrun and 200 each at Shoaf and Bitner at an estimated a total cost of $1,373,000. As noted in Chapter V, the line-item cost sheets which accompany all other Frick appropriations have been lost for the Shoaf/Yorkrun/Bitner project, so details of all the contractors involved in the projects are not available. A report in Coal and Timber, however, indicates that Cornish Brothers of Uniontown had the contract to drive slope entries at Yorkrun and Shoaf, Owen Murphy of Connellsville had the contract for the ovens at Yorkrun and Thomas Stark of Greensburg had the contract for Shoaf's ovens.[286] Frick Company records of total costs do survive. All three plants were completed by the end of 1906, with Yorkrun costing $802,787.57, Bitner costing $218,552.27, and Shoaf costing $334,780.89 for a total of $1,356,120.73. The cost breakdown for Shoaf was as follows:[287]

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[285] H.C. Frick Coke Company, Appropriation No. 4 dated 7 January 1903, Appropriation No. 43 dated June 20 1904; "Connellsville Coke Region Approaches Maximum Output," The Iron Trade Review 39 (25 October 1906): 10.

[286] H.G. Lawrence, "Uniontown Letter," Coal and Timber 1 (April 1905): 21. This short notice states that 300 ovens, not 200, were being built at Shoaf, despite the fact that the Frick Appropriation No. 43 gives the lower number. There are three reasons for believing the higher number, and one is contained within the appropriation itself: at Yorkrun, the budget summary shows 500 ovens built at $540.19 each for $270,093.65; at Bitner, the summary shows 200 ovens built at $510.07 each for $102, 013.53. If the $146,856.31 spent for ovens at Shoaf was for only 200 of them, it would average $734.28 per oven. If that sum was used to build 300 ovens, it would average $489.52, much closer to the costs of the Bitner and Yorkrun ovens. Other evidence lies with the ovens at Shoaf themselves. The main block and bank of ovens currently total 302, and among these there is no sign that 200 were built first and the remainder later. The 143 ovens adjacent to Smiley, then, were probably those constructed under Appropriation No. 89, which states that 144 were built. Finally, reports in The Weekly Courier as Shoaf was nearing completion, for example 26 (26 May 1905): 2, show 300 ovens at that plant.

[287] H.C. Frick Coke Company, Appropr. No. 43.

Real Estate	$ 10,302.17
Engineering	14,276.91
General Expense	2,359.13
Mine Construction	6,678.81
Equipment	37,701.90
Water Works	6,197.54
Maintenance	3,117.42
Coke Ovens	146,856.31
Tenements	69,692.31
Temporary Structures	2,172.63
Insurance	279.54
Mine Buildings	48,503.84
TOTAL	334,780.89

Before work on Shoaf, Bitner, and Yorkrun was complete, however, the Frick Company was already making plans to expand Shoaf, Bitner, and other works. In February 1906, the company appropriated $523,829.50 to expand the works at Shoaf (144 more ovens, actually built at Smiley, and 15 more double dwellings), Bitner (100 more ovens, 10 more double dwellings, and a connection to the Trotter water system), Wynn (170 more ovens, three coke drawing machines, 20 double dwellings, and a store building), Lambert (60 new ovens), and Buffington (26 new ovens). The two largest contracts for the additions to Shoaf were let to H.F. Stark to build the ovens and to the Nicola Building Company for the new houses. Work costing $104,479.49 was completed at Shoaf by the end of May 1907.[288] In addition to the total of 344 ovens, Shoaf, like Smiley a drift mine, now had a steel tipple and bins, a brick power house, a frame oil house, a brick fan-motor house, a 120,000-gallon steel water tank, a frame supply house, frame blacksmith and carpenter shop, frame foreman's office, frame stable, and a lime and sand house of concrete and brick construction. At Smiley (which would come to be known as Shoaf No. 2) the company added two wood water tanks of 35,000 gallons each and a fan-motor house, a blacksmith and carpenter shop, and a foreman's office and emergency hospital, all of wood-frame construction. The townsite for workers at the two mines and associated ovens consisted of two 19th-century houses surviving from the previous owners, about 75 double dwellings (enough to house 150 families), two foreman's houses, and a Union Supply Company store.[289]

[288] H.C. Frick Coke Company, Appropr. No. 89 dated 1 February 1906.

[289] H.C. Frick Coke Company, "General Plant Plans," p. 50.

The H.C. Frick Coke Company operated the ovens at Shoaf until about 1926, when the larry tracks running over the ovens were dismantled. In the intervening time, the company had made other additions to the plant. For the townsite, the company built ten double dwellings in 1914, thirteen more double dwellings in 1916, ten single-family residences in 1917, and two five-car garages in 1922. At Shoaf mine, the company made additions to the supply house and blacksmith and carpenter shop and constructed an emergency hospital and new buildings to store lumber, an electric locomotive, and naphtha. At Smiley, the company built additions to the blacksmith and carpenter shop and the foreman's office/emergency hospital and constructed a new stable, fan-motor house, electric-locomotive house, and sand house. After World War I, however, when by-product coking operations supplanted beehive ovens as the major source of metallurgical coke in the United States, production in the Connellsville region declined and Frick began to close its plants. After taking up the larry tracks at Shoaf in 1926, the Frick Company dismantled its ovens there in 1929. This involved removing the water lines, but not actually demolishing the masonry of the ovens themselves. During the 1930s, the company demolished some of the housing at Shoaf. Between 1934 and 1938, 17 of the double dwellings associated with the Smiley mine were demolished along with all the surface buildings at the mine. In the Shoaf townsite, the company destroyed nine double dwellings, the mine foreman's house, and six smaller single-family residences. Most of the surface buildings at the Shoaf mine remained standing, however.[290]

Because by-product ovens represented a greater capital investment and because after World War I there was a greater market for by-products from coking, steel companies tried to keep the by-product ovens in continual operation. U.S. Steel, however, did not entirely abandon its beehive coking capabilities. Occasionally, iron and steel production rose to levels which could not be fueled with by-product coke alone. During such periods, the companies fired up their idle beehive ovens. There were still ample coal reserves at Shoaf.[291] Therefore, during

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[290] Ibid.; "Insurance Map of Shoaf Mine" dated 1909 with updates through 1951, drawing no. 67, and "Insurance Map of Smiley Mine" dated 1909 with updates through 1936, drawing no. 68, both on file at United States Steel, Uniontown, PA.

[291] In 1928, two years after the ovens at Shoaf and Smiley had been dismantled, the H.C. Frick Coke Company reported that 448 of the 902 minable acres at Shoaf had been mines, leaving about 434 acres with an estimated 4,820,643 tons of recoverable coal to be mined. There were also over 4 million tons of

World War II, the Frick Company completely rehabilitated the ovens at Shoaf (but not at Smiley), idling them again after the war. Frick sold the mine and coking plant at Shoaf in 1959 to Max and Helen Nobel. Max Nobel rehabilitated the ovens, began operating them in 1965, and continued to do so on a fairly steady basis until 1972, when the State of Pennsylvania forced him to shut down his ovens for failing to meet new air quality standards. Since that time, the ovens have sat idle, but they survive in a remarkable state of preservation. Numerous of the surface buildings at the mine also remain standing. The steel coal bin at the north end of the block of ovens is of relatively recent construction, and there is an even newer coal bin to the west. Just south of that bin and west of the end of the block of ovens stands a concrete-block sand-drying house, which existed in 1951. The 1951 concrete lumber-supply house just to the north, however, has been demolished. Across the creek to the west of the ovens the ovens, the ground slopes steeply upward. A wood-frame enclosure houses the slope mine entry, but the trestle connecting the mine opening with the bin no longer stands. Just above the mine opening a road runs parallel to the creek. The brick power house fronting the road and adjacent to the mine opening still stands, but the school house farther to the north is gone. Near the site of the school is the Nobles' house. The other surface buildings at the mine stand along the creek north of the mine opening. They include a brick blacksmith and carpenter shop (currently used by a graphite-recycling business) and a concrete-block supply house. Other buildings present in 1951 which have since been removed include an oil house, machine repair shop, lamp house and mine foreman's office, hospital and police office, and stables.[292]

There are numerous buildings surviving in the Shoaf townsite as well. Thirty-two double dwellings, many now converted to single-family residences, stand in the townsite associated with Shoaf itself, and six double dwellings, one now serving as the Shoaf Free Methodist Church, stand in the townsite associated with the

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recoverable coal estimated remaining in the Smiley mine. H.C. Frick Coke Company, "General Plant Plans," p. 50.

[292] The fire insurance map for Shoaf shows the rehabilitation took place prior to 1951. Max Noble, who purchased Shoaf from U.S. Steel in 1959 and operated the ovens until 1972 recalls that Shoaf was rehabilitated during World War II and then taken out of service until he bought it. "Insurance Map of Shoaf Mine" dated 1909 with updates through 1951, drawing no. 67; Fredric L. Quivik, personal interview with Max Noble, 29 August 1992.

Smiley mine. Surviving examples represent at least three distinct designs of double dwellings. On the hillside south of and facing the Shoaf townsite stands the superintendent's residence. This building may be one of the pre-existing single-family residences which the H.C. Frick Coke Company retained when it developed the Smiley and Shoaf tracts in the early 1900s. The Union Supply Company store and the store manager's residence are gone. There are, however, ruins of numerous other coke ovens at Shoaf. The largest set of ruins is the bank of 143 ovens that was associated with the Smiley mine. The west end of the bank is located south of Shoaf but north of the superintendent's residence, curving east and south along the north- and east-facing hill. Just west of the south end of the bank is the site of the Smiley mine. All that survives of the surface works are slack piles and equipment debris, especially steel pipe and tanks. Across the creek and east of the Smiley ovens is a bank of 40 ovens operated by the Whyel Coke Company of Uniontown in the early 20th century. Like the ovens at Smiley, the Whyel brothers' ovens are in the state of deterioration typical of coke ovens in the Connellsville region: they are overgrown with trees and brush and their fronts are caved. Nevertheless, they help to create an important context for the intact ovens at Shoaf.[293]

Although the Shoaf ovens themselves were rehabilitated around 1960, they differ little from their likely appearance when they were taken out of service in 1926.[294] Their overall configuration is that of beehive ovens even in the 19th century. There are a block of ovens (about 1,500 feet long with 100 ovens on each side) and a bank of ovens (about 1,550 feet long with 102 ovens) running north-south along the east side of the creek. A break constructed in the block midway along its length allowed workers to pass from one side to the other without having to walk all the way to the ends of the block. Coke tracks ran along the west side of the block and between the block and the bank, but the latter tracks and ties have been removed since the 1970s. Parallel to the coke tracks along the west side of the block are two other sidings, on which sit several railroad coal cars. These tracks served the western coal bin. As was the norm with coking plants prior to the introduction of coke-drawing machines,

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[293] H.C. Frick Coke Company, "General Plant Plans," p. 50; "Insurance Map of Shoaf Mine" and "Insurance Map of Smiley Mine."

[294] Compare the Shoaf ovens to the H.C. Frick Coke Company's "Standard Bee-Hive Coke Ovens," no date, and "Standard Plans of 12'-6" Dia. 7'-6" High Oven for Coke Drawing Machine," dated 1913, both on file at the office of the Diversified Group, U.S. Steel, Uniontown, PA.

the coke tracks at Shoaf are at a lower level than the coke yards. The retaining walls between the coal tracks and the coal yard and the front walls of the ovens are of rubble-stone masonry roughly laid in random ashlar. The oven door openings, spaced 14'-6" on center, consist of the conventional red brick sides, special arch blocks, and two courses of arched red bricks, all set into panels of red brick. The ovens themselves are 12'-6" in diameter. While much of the stone is likely original, the liner brick, openings, and red brick panels were installed when or since the ovens were rehabilitated. The panels, which measure about 7'-6" wide and 6'-0" tall, were intended to be taken out and replaced periodically when the ovens themselves were rebuilt. In the normal life of a beehive coking plant, one would only expect to find original material in the stone masonry. The several varieties of brick in the panels suggest that they were replaced at different times in the past.

While the ovens are probably very similar to their original condition, there are some details which differ. Whereas the original openings probably had iron door frames to support bars which aided the coke pullers inserting and withdrawing their tools from the ovens, the present openings simply have an iron bracket set into the masonry joint where each skew back meets the brick. Because coke-drawing machines were installed at Shoaf, the older door frames were not needed. The brackets were only needed to support the tool during the leveling process. Near the bottom of each side of the openings is an iron block installed to resist wear from the rams of the coke-drawing machines. Blocks such as these were not original but would have been installed when the coke-drawing machines were introduced to the site. As noted, the larry tracks were taken up in 1926. When new tracks were put in place during the WWII rehabilitation or Noble's, they did not follow the pattern typical of the early 20th century. Rather than the tracks resting directly on the piers, they rest on a second inverted track set on the piers. Instead of using bridles to maintain the gauge for the larry tracks, either Frick's workers during World War II or Noble's workers in the 1960s installed the new tracks using bolts welded to bars for stiffeners. At each pier, a pair of crossed bars are bolted through the webs of the tracks and the sub-tracks. Midway between the piers, a single rod, bolted through the webs, serves as stiffening.

Several kinds of equipment survive on the site illustrating how Shoaf operated. There are at least eight larries on the site (six on the block and two on the bank) and there are several others lying in a scrap heap near the driveway into the works. The larries on the ovens represent at least four different models of the vehicle. One carries a maker's plate reading: "BUILT BY CONNELLSVILLE IRON WORKS CONNELLSVILLE PA DATE 1942." Several tall iron poles with brackets hanging over the larry tracks survive along the east side of the block. The brackets supported the catenary wires feeding electricity through the larries' trolleys to their electric motors. Each pole also has a shorter bracket extending over the coal yard to support the catenary for the coke-drawing machine on the east side of the block. A set of smaller poles extends along the west side of the block to support the catenary for the coke-drawing machine on that side. There are three coke-drawing machines sitting on tracks at the north ends of the coke yards, one on each side of the block and one for the bank. Although similar to the Covington machines, these represent a later generation in which each machine had two drawing rams, allowing the operator to reach both sides of an oven without having to move the entire machine back and forth in front of the oven as much. This not only made it easier to draw the ovens; it also obviated the need to move the railroad cars back and forth with the coke-drawing machine as the conveyor loaded coke into them. The adaptation of the Covington machine was designed by Gus Werft and McGee, engineers for the Frick Company. The machines were fabricated by the Ricks Manufacturing and Supply Company, which had purchased the Covington Machine Company during the Depression.[295] The larries and coke-drawing machines are badly rusted but still give clear evidence of their construction and use. The tracks for the larries and for the coke-drawing machines on either side of the block are still in place, but the tracks for the coke-drawing machine along most of the bank have been removed. The water system used to quench the coke in the ovens is the only major category of plant infrastructure missing from the site. Although there are numerous pipes scattered about the site, they are not assembled into the delivery system which was used.

One other feature at the Shoaf ovens differs from normal early 20th century practice. In the last years that Max Noble operated Shoaf, he experimented to develop a method of reducing the amount of smoke the ovens discharged into the atmosphere. Towards the north end of the block of ovens, there are about three dozen ovens (half on each side of the block) which have some additional flues. One type of flue links back-to-back ovens, the other extends diagonally through the crown and the surface of the fill to a point near the trunnel. Noble's strategy was to pass smoke from one oven through another, where he supplied additional air, allowing most of the volatiles to burn. He then conducted the combustion gases to a bag house for filtering. Some of the flues used for ducting gases to the bag house still lie on the wharf along the east side of the block. The bag house still stands on the hill side near the south end of the bank of ovens. Noble claims to have been able to have removed 7/8 of the smoke normally produced by a beehive oven.[296]

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[295] Fredric L. Quivik, personal interview with Max Noble, 29 August 1992.

[296] Quivik, interview with Max Noble.

Despite some missing equipment and buildings, Shoaf retains a high level of historical integrity. The ovens themselves are virtually intact. Although numerous buildings are missing, key structures are in place including the coal bin, tipple and one of the shops. Although many buildings were demolished at the Shoaf townsite, over three dozen survive, showing the layout of the town itself and the relationship of the town to the works.

Shoaf is significant for its association with the H.C. Frick Coke Company immediately after it became a part of the United States Steel Corporation. It is significant as an excellent representative of the kinds of beehive coking plants built in the Connellsville coke region during the height of bee-hive coking there. Shoaf is a transitional site. It represents the way beehive ovens were built just prior to the mechanization of beehive coking, so its configuration is that of the labor-intensive plants of the 19th century. Shoaf's equipment and many of its details, however, stem from the mechanized period initiated just after the turn of the 20th century. Shoaf is also transitional in that it represents the Frick Company's move toward a program of building its own new coking plants. During the first stage of the transition, Frick contracted with a prominent engineering firm, W.G. Wilkins and Company, to design Shoaf, Yorkrun, and Bitner. Finally, Shoaf is significant as it depicts the relationships of the workplace to workers' homes in the company towns of the Connellsville coke region.