historic resource study
cambria iron company

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Iron Works

AMERICA'S INDUSTRIAL HERITAGE PROJECT·PENNSYLVANIA

historic resource study

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CAMBRIA IRON COMPANY

AMERICA'S INDUSTRIAL HERITAGE PROJECT • PENNSYLVANIA

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

CONTENTS

PREFACE

This historic resource study has been prepared to satisfy the research needs as stated in the task directive approved by Mid-Atlantic Regional Director James W. Coleman Jr., on February 13, 1987, concerning the America's Industrial Heritage Project under package 217. Data contained in this report will be used in determining the significance of the Cambria Iron Company site as it grew and evolved, and possible interpretation, preservation, and management needs.

The study focuses on the history of an iron and steel company on the Conemaugh River in Johnstown, Pennsylvania. Included is information concerning the significance and history of the iron and steel industry in America; and the history and significance of the Cambria Iron Company, subsequently, the Cambria Steel Company, the Johnstown plant of the Midvale Steel and Ordnance Company, and the Bar, Rod, and Wire Division of Bethlehem Steel Corporation.

Most of the research was conducted during field trips to Johnstown and Easton, Pennsylvania; Wilmington, Delaware; and Washington, D.C. in January, March, and May 1987. Additional data was collected throughout 1988 and 1989. Several people assisted in preparing this resource study. The author's thanks go to Randall Cooley, Director, America's Industrial Heritage Project, and Keith Dunbar, John Albright, Jere Krakow, and John Paige of the Denver Service Center for their encouragement and advice. Special thanks go to Joyce Atchery of Rocky Mountain Region Library for all of her interlibrary loan help. The staffs at the Hagley Museum and Library, American Red Cross National Headquarters, Library of Congress, Smithsonian Institution, Center for Canal History and Technology, Cambria County Historical Society, Cambria County Library, Johnstown Flood Museum, and The Historical Society of Pennsylvania were all very helpful. Richard Burkert offered sage observations about the entire Cambria documentation project while Lance Metz graciously shared primary research materials. Loretta Schmidt, James R. Alexander, and Donald Sayenga contributed helpful review comments which were very much appreciated. The Historic American Engineering Record team provided the excellent historical base maps. G. Gray Fitzsimons offered technical information and primary research materials for both the resource study and the landmark nomination. Gray also offered the friendship that springs from exploring Pennsylvania steel mills in January. Thank you Dean Shaver and Bethlehem Steel Corporation for your cooperation and access to the Johnstown plant.

INTRODUCTION

The Cambria Iron Company made an important contribution to American industrialism. Founded in 1852, the company was regarded as one of the greatest of the early modern iron and steel works. Forerunner of Bethlehem Steel Company, United States Steel Corporation, and other late nineteenth and early twentieth century steel companies, the Cambria plant became a model of the industry. In the 1850s, 1860s, and 1870s, Johnstown attracted the best and the brightest minds in the industry – William Kelly, George and John Fritz, Daniel J. Morrell, Robert W. Hunt, William R. Jones, and Alexander Holley. Together and individually, these men advanced iron and steel technology through invention and industrial design in Johnstown, work which was widely copied by other iron and steel companies. This enormous contribution signalled the end of America's reliance on British-produced rails and allowed the expansion of the nation's railroad network.

Several buildings remain in the "Lower Works" from this significant time period. Dated and surveyed by the Historic American Engineering Record (HAER), these include: the ca. 1864 blacksmith shop, ca. 1884 blacksmith shop annex, ca. 1870 pattern shop, ca. 1865 foundry, ca. 1880 foundry addition, ca. 1874 office building, ca. 1881 car shop, and portions of the 1870 rolling mill. Second generation buildings ca. 1890s associated with the original four blast furnaces remain, as do remnants of the 1878-1880 blast furnaces #5 and #6, and the second generation machine shop, ca. 1906.

Emphasis in research for this resource study was placed on the Cambria Iron Company's early years of influence and contributions to the technological progress made in the iron and steelmaking processes. The iron and steel masters associated with Cambria are nationally significant, and during the mid-1870s Cambria was the largest rail producer in America.

After Andrew Carnegie's entrance into the steelmaking business Cambria's influence diminished even though its growth did not. It remained a significant independent steel plant. This resource study traces Cambria's takeover by other steel corporations, and its social, economic, and labor impacts on the city of Johnstown. Mention is made of Franklin, Gautier, Rosedale, and other Cambria installations, and, lengthy descriptions of the Cambria plant in later years appear in the appendixes, included for reference purposes.

ILLUSTRATIONS

CHRONOLOGY

1852 – Cambria Iron Company founded on June 29 by George King and Peter Shoenberger

1853 – Company failed after partial completion of the works

1854 – David Reeves, Matthew Newkirk, George Trotter and others lease the plant, rolling mill completed; first iron rails rolled

1855 – Philadelphia company, Wood, Morrell & Company, lease the works to roll rail

1857 – First three-high rolling mill developed and put into use by John and George Fritz; rolling mill burned and rebuilt

1857-1862 – William Kelly experiments with converter

1862 – Wood, Morrell & Company lease expiration, company reorganized and named Cambria Iron Company

1867 – First commercially ordered Bessemer steel rails rolled at Cambria from ingots forged at the Pennsylvania Railroad's Pennsylvania Steel Works in Steelton, Pennsylvania

1869 – First Bessemer furnaces erected at Cambria, designed by George Fritz, Robert Hunt and Alexander Holley; sixth Bessemer plant in America

1871 – First blow with two six-ton converters, first steel rails rolled at Cambria

1873 – Cambria was the largest steelmaker in the country

1876 – Steel rail output at Cambria totals 10 percent of country's production

1878 – Two 10-ton open-hearth furnaces built

1889 – May 31 Johnstown Flood damaged Lower Works, destroyed Gautier Works, Mineral Point, Woodvale

1898 – Cambria Steel Company formed

1901 – Franklin Works started

1910-1911 – Rod and Wire Mill built

1916 – Midvale Steel and Ordnance Company bought Cambria Steel Company

1919 – Great Steel Strike

1923 – Bethlehem Steel Corporation acquired Cambria Steel Company

1937 – Little Steel Strike

1942 – USWA organized Johnstown Plant

1952 – Bessemer process discontinued and machinery demolished

1982 – Electric furnaces installed at Franklin

Altogether, the difficulties encountered were enough to appall the bravest hearts. My brother George once said, when at Cambria, that he did not believe there was a man who ever went into the Bessemer business, and was responsible for the result, who did not at times wish he had never gone into it; and so far as my experience goes I fully verify it. And, further, I think that, if it had not been for the interesting and exciting character of the business, but few men would have been willing to endure the trouble and anxiety and to endure the physical labor and danger to which he and the workmen were constantly exposed, long enough to have placed the business on a commercial basis.

John Fritz,
"The Development of Iron Manufacture in the United States."
Cassiers Magazine, April 1900, p. 467.

There is a glamor about the making of steel. The very size of things – the immensity of the tools, the scale of production – grips the mind with an overwhelming sense of power. Blast furnaces, eighty, ninety, one hundred feet tall, gaunt and insatiable, are continually gaping to admit ton after ton of ore, fuel, and stone. Bessemer converters dazzle the eye with their leaping flames. Steel ingots at white heat, weighing thousands of pounds, are carried from place to place and tossed about like toys. Electric cranes pick up steel rails or fifty-foot girders as jaunty as if their tons were ounces. These are the things that cast a spell over the visitor in these workshops of Vulcan. The display of power on every hand, majestic and illimitable, is overwhelming; you must go again and yet again before it is borne in upon you that there is a human problem in steel production.

John A. Fitch
The Steel Workers
1911, p. 3.

CHAPTER I: IRON AND STEEL INDUSTRY IN AMERICA

Johnstown, Pennsylvania, is a name synonymous with the words iron and steel. Blessed with abundant deposits of iron ore, coal, wood, a water supply and a developed transportation system via canal, Johnstown was a natural location for a growing industry. The Cambria Iron Company, founded in 1852, was preceded by early Pennsylvania iron forges, and subsequently consumed, almost 65 years later, by large steel conglomerates which formed part of the huge industrial base of America. The Cambria Iron Company's history is thus entwined like steel wire with other strands of iron and steel development both in Pennsylvania and the nation.

A wider view of the Cambria Iron Company's impact considers the human response to both the technological advances made in Johnstown, and to industrialism as a whole in the late nineteenth and early twentieth centuries. Industrialism had its first impact on American society during these years, and its implications were profound. All aspects of society were affected, from changes in working environments, to increased immigration, to the devastation of rural life as millions moved to the cities, to the growth of the urban middle class. The emergence of conglomerates, the rise of unions, the excesses of the wealthy, and the influence of various reform, political and intellectual climates are all major themes of American history characterizing the era when the Cambria Iron, and later, Steel Company was at its productive height.[1]

Thus, the Cambria Iron Company's story is more than an examination of the nationally significant technological advances made in the conversion from iron to steelmaking. It is also a look at the human, social, economic, and political responses to industrialism, in which Cambria played a significant, yet representative role.

The growth and development of the American iron and steel industry was one of the wonders of industrialism. It was the basis for American global power, as cheap steel helped build a modern navy, constructed the cities, and allowed for the rapid expansion of the railroad and automobile industries. Thus, the significance of the Cambria Iron Company has to be placed within the context of the evolution of the American iron and steel industry.

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1. For more information on the impact of industrialism, see Melvyn Dubofsky, *Industrialism and the American Worker, 1865-1920* (New York: Thomas Y. Crowell Company, 1975), and Samuel P. Hays, *The Response to Industrialism 1885-1914* (Chicago: The University of Chicago Press, 1957).

COLONIAL IRON INDUSTRY

Iron was at one time vital to everyday life in America. Its production provided a livelihood for towns like Carbondale, Illinois, and Ironton, Missouri, and words such as "ironware" and "iron horse" and "ironing" crept into American language. The production of iron was the basic staple of the American industrial revolution. In the late 1700s and early 1800s, most furnace cast items were housewares and anvils, wheels and small castings for farm equipment. By the 1820s and 1830s, however, the list of needed iron products grew to include "mandrels, gudgeons (or trunnions), iron parts for windmills and pumps, wagon parts, plows, lathes, plaster mills, wheels and tires, 'coulters' (or plow blades), rolling-mill castings, threshing-machine parts, and beams."[2]

Most of the early iron works were organized on plantations. The home of the ironmaster, workers' cabins, and stores stood next to the woodlands, farmlands, ironworks, gristmills, sawmills, and blacksmith shop to compose a self-contained community. Agriculture and industry were combined, and this type of industrial organization continued throughout the late 1700s and early 1800s to produce pig iron, castings, and bar iron. Most of these communities disappeared by the end of the

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2. David Weitzman, *Traces of the Past: A Field Guide to Industrial Archaeology* (New York: Charles Scribner's Sons, 1980), pp. 133-134. Weitzman provided an excellent description of the variety of uses for iron:

> If we could return to an early American city, village, or farm, we would rediscover the wonders of the furnace, foundry, and forge. Lifting our eyes to the rooftops, we would be greeted by a marvelous array of weather-vanes – galloping horses, swans, trumpeting angels, roosters, peacocks, locomotives, birds, and fanciful serpents – cast in sand molds, cut from flat-iron sheets, or hammered to shape in iron molds or templates. Passing through the iron gate, fence, and trellis on one of the houses and announcing our arrival with the tap of an iron door knocker, our attention would certainly be drawn to the hand-wrought door strap hinges and footscraper. Inside, all the doors of the house and the hutches would be hung and latched with iron hardware. Giving warmth would be a ten-plate stove or perhaps a Franklin fireplace decorated with the popular cast-iron patterns of the day: ships, flower and leaf motifs, peacocks, the shepherd, or the fox chase. Hanging from iron kettle hooks or sitting about the kitchens would be skillets, Dutch ovens, riddles (coarse sieves), waffle irons, bake plates, stew pans, and a teakettle – all of iron. Time was kept by iron clock weights; windows were counterbalanced with iron sash weights, hollow ware and iron utensils filled the drawers and cupboards – and there, under the table, would be a child's toy horse and wagon reflecting in its every detail the molder's art. Iron binders steadied the brickwork of the chimney, and in the yard wheeled implements of iron would sit by the barn awaiting their turn in the fields.
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> The iron in the barn was hardworking. There were the familiar shoes for horses and oxen, the ox yoke with its iron fittings, and some unfamiliar blocks of wood through which passed an iron stirrup secured with wing nuts; these were "bog shoes," clamped onto the horses hooves to act much like snowshoes, providing more support for the horse as it pulled the iron plow through soft, marshy soil. Iron hammers, knives, saws, a broadaz or two, peat cutters, froes (cleating tools), splitting wedges, and a cow bell would hang on the wall. The iron letters and symbols attached to wooden handles would be sheep markers and branding irons for cattle, and the gracefully curved handwrought iron blades attached to wooden footholds, which hang from buckled leather straps in the corner, would be recognizable even today as ice skates. Ibid.

The ship-building industry required iron for spikes, nails, rudders and anchors. Iron-clad ships were built in the 1830s while the 1840s saw the need of iron for locomotives. Ibid., p. 134.

nineteenth century because of the uncertainty of iron production, changes in technological processes, and the growth of large-scale production and consolidation which occurred after the Civil War.[3]

The remnants of many foundries, furnaces, and forges can be found in the eastern United States countryside. There were 160 furnaces in 19 Pennsylvania counties, including 18 in Blair County and 10 in Cambria County, and nearly 100 in New Jersey. In the 1890s Pennsylvania, Ohio and Illinois produced 90 percent of the nation's iron. Every part of the country saw the production of iron, however, for there were furnaces everywhere from New York to Minnesota, Washington, Colorado, Alabama, and Texas.[4]

Colonial ironmakers used several production techniques, all based on the use of wood charcoal as fuel. Heating iron ore on a stone hearth with a bellows and a charcoal fire produced iron refinable by reheating and hammering. This was wrought iron, slabs of which were called blooms, made in ironworks called a bloomery. Colonial blacksmiths could turn wrought iron into any type of implement, and their services were in high demand. Bloomeries had limited production, however, and larger scale demands could only be met by a blast furnace where large amounts of ore could be melted for use.[5]

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3. Arthur Cecil Bining, "The Rise of Iron Manufacture in Western Pennsylvania," *The Western Pennsylvania Historical Magazine* 16, no. 4 (November 1933): 238. For a full discussion of charcoal ironmaking on plantations in Pennsylvania, see Arthur Cecil Bining, *Pennsylvania Iron Manufacture in the Eighteenth Century* (Harrisburg: Pennsylvania Historical and Museum Commission, 1973).

4. Weitzman, *Traces*, pp. 135-138; Myron B. Sharp and William H. Thomas, *A Guide to the Old Stone Blast Furnaces in Western Pennsylvania* (Pittsburgh: The Historical Society of Western Pennsylvania, 1966), pp. 17-24, 27-30.

5. W. David Lewis, *Iron and Steel in America* (Greenville, Delaware: The Hagley Museum, 1976), p. 10. Historian W. David Lewis provided the following description of a blast furnace and its products:

> The blast furnace was the heart of any large colonial ironworks. Built in the shape of a flattened pyramid, it was usually twenty-five or thirty feet high. Hollow from top to bottom, it had thick stone outer walls and an inner lining of brick or other fire-resistant materials. A layer of clay or stone chips between the lining and the outer wall allowed the inwalls to expand under the enormous heat produced by the "smelting," the process of reducing the ore. From a small opening at the top, often called the "throat" or "tunnel head," the furnace shaft widened to a point about two-thirds of the way down known as the "bosh." Here it sloped inward and downward to support the materials with which the furnace was charged, directing them toward the "crucible," a chamber which received the melted iron and liquid sag that ran down from the fiery mass above. A small hole called the *tuyere* located near the bottom of the crucible admitted the nozzles of the bellows that supplied the air blast. The bellows were operated by a waterwheel, which required that the furnace be located near a stream. It was also usually built near a hill from which raw materials could be carried to the top of the furnace over a bridge for charging.
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> At ground level in front of the crucible was the "hearth," a working area hollowed out of the side of the furnace. A "damstone" prevented the contents of the crucible from spilling out into the hearth, and a part of the inner wall known as the "timp" came down behind the damstone, leaving a small opening through which workers could insert probing tools. Except when the furnace was being tapped, this opening was normally plugged with clay. The melted sag, lighter than the iron, collected in the upper part of the crucible and was drawn off through an opening known as the "cinder notch." The

Blast furnace pig iron could be used for objects needing to retain or withstand heat, but not for tools needing toughness under stress. Further processing at a "finery" or forge was needed. A forge converted pig iron into wrought iron, rather than making wrought iron from ore. During the colonial period and after, pig and wrought iron were sufficient for the nation's iron needs.[6] Some steel, an alloy of wrought iron and carbon, was used for swords and fine cutlery.[7] Steel was prized for centuries for its hardness. Bars of carbon-free wrought iron were heated in a sealed refractory box in carbonaceous powder for days and allowed to slowly cool. The iron absorbed the carbon under the right conditions, and would contain one percent of carbon. The gases which were produced in the process would give the iron a blistered surface. This was "blister steel" which was carefully forged to shape the tool. The process for incorporating the carbon was called "cementation." Steel was expensive and only used sparingly.[8]

By the 1850s reverbatory, or puddling, furnaces were used to refine blast furnace iron. In this furnace the fuel was burned in a fireplace or grate next to the hearth. The hearth was heated by

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liquid iron sank to the bottom. When the tapping hole was unplugged, it gushed out in a white-hot stream into a series of sand molds resembling a litter of pigs nursing at the belly of a mother sow. This explains why the product of a blast furnace became known as "pig iron," a term that persists to the present day.

The furnace was charged with three raw materials: iron ore, charcoal, and a third substance usually limestone, which promoted the separation of iron from impurities in the ore. Charcoal, an almost pure carbon fuel that burns with intense heat, was produced by the slow combustion of wood in pits or cone-shaped piles at the iron-works. Since large quantities of charcoal were needed for smelting, it was necessary for blast furnaces to be located on extensive tracts of woodland. Charcoal making called for extreme skill and care to prevent the wood from being completely burned instead of merely charred, and colliers were consequently among the highest paid employees at a colonial ironworks. Ibid., pp. 10, 12-13.

6. Ibid., pp. 14-15. David Weitzman offered a description of forge activities:

> At the forge the cast-iron pigs, scrap, and gate metal is remelted in the refining fire. This is the first step in converting the pigs into wrought iron. The process would be essentially the same at any forge. After kindling the fire, the finer's assistant would heap charcoal 12 to 18 inches high in the fireplace for gray metal, or up to 24 inches if white metal were to be worked. When the fire was just right, the finer would insert the ends of two or three pigs into the charcoal fire. The blast was now applied, and as the ends of the pigs in the fire softened, the rest was fed in and new pigs added until there were about 120 pounds of iron in the hearth. The iron was melted not to a fluid state again but just until it reached a pasty consistency. Using a long iron bar, the finer worked the pasty mass into a ball by continually raising and turning it until the iron was uniformly heated. When the finer felt the time was right, the bloom was lifted from the hearth with tongs, swung onto the anvil of a huge hammer, and beaten into a rectangular billet, 5 or 6 inches square and about 16 inches long. The carbon hed been brought to the surface of the bloom in the refining fire, and now the hammering would remove this carbon, combined with the cinders, and would lengthen the fibers – producing a much stronger and different iron than that which had emerged from the blast furnace. Weitzman, *Traces*, p. 170.

7. Lewis, *Iron and Steel*, p. 16.

8. Jack Chard, *Making Iron & Steel The Historic Processes*: 1700-1900 (Bogota, New Jersey: Roebling Chapter of the Society for Industrial Archaeology, 1986), pp. 8-9.

flames warming the furnace walls, but also from the heat reflecting off the furnace roof, thus the name, "reverbatory."[9]

The squeezer forced out much of the surplus slag and formed "blooms" which were then rolled into "muck bar," or flat sections. Because the quality of iron varied from furnace to furnace the muck bar was cut into sections, mixed with bar from other furnaces, and reheated and rolled again into ingots. Approximately 400 to 600 pounds of wrought iron was produced during a "heat," lasting about one and three-fourths hours. One puddler and one helper worked a "turn" of five or six heats.[10]

The wrought iron was put into finished form by passing the bars, ingots, and sheets through rolls arranged in pairs. The rolls had grooves of different sizes. These two-high rolls operated in one direction, meaning that the bars or ingots were passed through the largest groove and carried by hand around to the front to be passed again through the smaller groove. This process took time, allowing the bars to cool. They would have to be reheated several times, which took even more time. These two-high rolls were used exclusively before 1857.[11]

The puddlers, heaters, and rollers were skilled workers who controlled the entire process. Apprentices to these trades were hired, trained, and directed only by the skilled workers. Mechanical engineers began to improve the rolling process to increase production and save labor, thus changing

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9. Weitzman, *Traces*, p. 170. The puddling process was developed in 1784 in England by Henry Cort. Chard, *Making Iron & Steel*, p. 5. David Weitzman provided a description of puddling furnace activities:

> The iron floor of the hearth is covered with a layer of finely powdered cinders to a depth of 3 or 4 inches. A stone-coal fire is then kindled in the grate and left to burn for about five hours. The cinders eventually melt and are smoothed up onto the iron plates forming the sides of the hearth so that the entire 'hearth is covered with a lining of fused cinder. The door on the side of the furnace is opened, allowing the lining to cool and harden, and then the broken pigs are thrown in. The door is closed and the fire brought up to working temperature. As the helper stirs the fire, getting it hotter and hotter, the puddler breaks up the now-pasty pieces of iron and mixes them with the molten cinders using a puddling hook. Since the tools are in the furnace much of the time, a trough filled with water is attached alongside the furnace; in this trough the puddling hooks and bars may be cooled. The puddler continues to work the iron and cinder mixture until the metal is, as he would say, "coming to nature." At this stage little round balls of molten iron about the size of peas appear in the cinder. They grow larger and larger as they adhere to one another. The furnace is at its highest heat, and the puddler must work quickly now to keep the mass of cinder and iron turning and uniformly heated. Then, with his bar or hook, the puddler pushes the smaller lumps together into several larger round balls, 12 to 15 inches in diameter and weighing about 70 or 80 pounds. The door is closed; a final and thorough heat is given the iron, and the helper now stands ready beside the furnace with an iron handcart. The door is opened, the puddler and his helper grasp one of the white-hot balls of iron with a stout pair of tongs, drag it onto the cart, and wheel it over to the hammer or squeezer. Weitzman, *Traces*, p. 171.

10. John William Bennett, "Iron Workers in Woods Run and Johnstown: The Union Era 1865-1895," Ph.D. dissertation, University of Pittsburgh, 1977, p. 12.

11. Ibid., pp. 12-13.

the nature of the work from worker-directed to management controlled. Much of this change occurred at the Cambria Iron Company with the development of the three-high roll train, developed by John Fritz. (For further information see chapter III.) Because Cambria had so many engineers, it was one of the first major companies to "establish full management control over the means and methods of production."[12]

Pennsylvania was the most important iron manufacturing colony. It had abundant resources of raw materials and streams. Philadelphia merchants financed the ironmaking establishments, and by the end of the colonial era the industry was located west of the Susquehanna River in York County, the Cumberland Valley, and in the Juniata Valley area. By the time of the Revolutionary War iron production started in the western part of Pennsylvania. Eastern manufacturers had great difficulty sending heavy iron goods over the Allegheny Mountains, and western ironmasters thus were provided with some protection from competition. Blast furnaces and forges were set up close to ore, charcoal, and water sources, and the wrought and pig iron was shipped by animal or boat to Pittsburgh, where it was finished. Pittsburgh was an iron processor, but not yet an iron manufacturer.[13]

A large new source of iron ore was discovered in the upper peninsula of Michigan in 1844. It was almost immediately commercially exploited, and the Lake Superior area became an ore supplier for the eastern manufacturing centers after the Sault Ste. Marie Canal was finished in 1855, connecting Lake Superior and Lake Huron.[14] The discovery of this ore made the production of steel possible. The blast furnace industry was "completely revolutionized" after 1860 when more powerful engines and improved stoves were used, and by the use of anthracite and bituminous coal and the pure iron ores from the Lake Superior area.[15]

According to Historian W. David Lewis, "The adoption of european techniques, the discovery of the Lake Superior ore deposits, the rapidly expanding use of anthracite in iron manufacturing east of the Appalachians, and the slow but steady progress in the use of bituminous coal for ironmaking

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12. Ibid., pp. 13-15.

13. Lewis, *Iron and Steel*, pp. 20, 29.

14. Ibid., pp. 30-31.

15. James M. Swank, *Notes and Comments on Industrial, Economic, Political, and Historical Subjects* (Philadelphia: The American Iron and Steel Association, 1897), p. 145.

in Pittsburgh and elsewhere greatly increased the productive capacity of the American iron industry in the last two decades of the antebellum era.[16]

The market for iron grew tremendously in the years prior to the Civil War. Growth of cities, transportation, and industry created demand for iron products. Textile factories, machine shops, agricultural equipment, and steam machinery all demanded iron parts. Railroads increased in trackage, from 2,818 miles in 1840 to 30,626 miles in 1861, which created a demand for iron rail. Iron was used for railroad bridges, girders, and trusses. The telegraph spurred the growth of the iron wire industry, and iron and steel cable was used in suspension bridges. Urban growth promoted the use of iron water lines, iron heating equipment and iron columns, beams, window sashes, and door frames. Such use reduced the risk of fire.[17]

IRON RAIL

By the 1840s the technology of rolling iron "T" rail, a superior type of rail, was mastered in Great Britain. The very first rails used were wood or timber, and early wooden roadways were called tramways. The first iron rails to be used were cast in flat bars called plate rails. When flat rails were later rolled from malleable iron they were called strap rails. The next rails used were cast iron edge rails. These were later rolled from malleable iron, were changed in shape to a single head and called the T rail. The double head rail was then produced and called the double T, also known as the double head and bull head rail.[18] Another problem to be solved was that of the support for rails. Cast iron, stone, and wood were all considered. Wood was chosen because it could absorb shock from the impact of the locomotive wheels on the rail.[19]

British ironworkers who emigrated to America helped establish the industry. The Mount Savage Rolling Mill of Allegheny County, Maryland, made the first T rails in America in 1845, for use of the railroad from Fall River to Boston, Massachusetts. New Jersey and eastern Pennsylvania companies soon followed. The high cost of British rails eased competition and spurred American

16. Lewis, *Iron and Steel*, p. 31.

17. Ibid., pp. 31-33.

18. G.T. Raidabaugh, "History of the Rolling of Rails," *The Blast Furnace and Steel Plant* (April 1927): 197.

19. Peter Temin, *Iron and Steel in Nineteenth-Century America An Economic Inquiry* (Cambridge, Massachusetts: The M.I.T. Press, 1964), p. 48.

production, allowing companies such as the Lackawanna Iron and Coal Company in Scranton, Pennsylvania, to supply the Erie Railroad with locally made rails. By the mid-1850s, fifteen new American rail mills were built, primarily west of the Allegheny Mountains, including the Cambria Iron Company.[20]

American rail production increased, but, according to historian Peter Temin, the "major part of the demand for rails during the railway boom of the early 1850s was filled by British rail makers who supplied over three-quarters of the iron rails consumed by American railroads in these years." British rail suppliers dominated for two reasons. They were the low-cost suppliers in the industry, especially of bar iron. They also produced a cheap product which they exported to America, in contrast to the higher quality, more expensive American products made by older methods. American railroad builders were more interested in start-up costs and not maintenance, so they purchased the cheaper British rail, much to the anger of American railmakers. The British also supplied rail on credit.[21]

Western Pennsylvania became the domestic leader in the production of iron and steel rails because of the liberal supply of raw materials, but also because of protective legislation. Liberal grants of public lands to railroad companies, protective tariff policy, and the homestead policy all spurred the construction of thousands of miles of railroad. With the building of these railroads, the consumption of iron increased along with the population. The opening of farms and ranches in the Midwest and West expanded the market for iron products.[22]

A listing of active rail mills in the United States in 1856 reflects the early dominance of Pennsylvania in the trade.

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20. Lewis, *Iron and Steel*, p. 31.

21. Temin, *Economic Inquiry*, pp. 21-22. For more information on rolling iron and steel rails, see F. H. Kindl, *The Rolling Mill Industry* (Cleveland: Penton Publishing Company, 1913).

22. James M. Swank, "The Manufacture of Iron and Steel Rails in Western Pennsylvania," *The Pennsylvania Magazine of History and Biography* XXVIII, no. 1 (1904): 1-2.

> The rails mills of the United States are — Tons of rails made in 1856

The rails mills of the United States are	Tons of rails made in 1856
The Bay State, South Boston	17,871
The Rensselaer, Troy, N.Y.,	13,512
The Trenton, N.J.	about 13,000
The Phoenixville, Pa.	18,592
The Pottsville, Schuylkill Co., Pa.	3,021
The Lackawanna, Luzerne Co. Pa.,	11,338
The Rough and Ready, Danville, Pa.	5,259
The Montour, Danville, Pa.	17,538
The Safe Harbor, Lancaster Co. Pa.	7,347
The Mount Savage, Lancaster Co. Pa.	7,159
The Cambria, Cambria Co. Pa.	13,206
The Brady's Bend, Armstrong Co. Pa.	7,533
The Cosalo, Lawrence Co. Pa.	0
The Washington, at Wheeling, Va.	2,355
The McNickle, at Covington, Ken'y	1,976
The Newbury, near Cleveland, Ohio	0
The Rail Road Mill, at Cleveland	0
The Wyandotte, near Detroit, Mich.	1,848
The Chicago, in Illinois	0
The Indianapolis, in Indiana	0
Total above make of Rails in 1856	141,555

> The last four mills have been recently started with the intention of re-rolling western rails. The Fairmount at Philada., has been also recently adapted to rolling rails; and the Palo Alto at Pottsville, rolled a thousand tons or so, in 1856. There were therefore made 142,555 tons of railroad iron in 1856, of which two-thirds were made in Pennsylvania.[23]

It is easy to forget how important railroads were in America from 1850 to 1890. Railroads were the first dominating business, and therefore set the patterns for administration, financing, and scale. Railroad expansion sparked many changes in social, technological, and human terms. The railroads created the demand for iron, then steel rail, and the railroad men were some of the loudest boosters of the fledgling Bessemer steel industry. Of the first eleven Bessemer plants, all but one was organized for the rail business.[24]

In 1861 Congress passed the Morrill Tariff Act, which imposed stiff duties on iron and steel imports. American manufacturers were guaranteed protection from foreign competition. In 1870 a tariff of $28 a ton was put on imported Bessemer rails. In the United States in 1871 the price of a gross ton of rails was $91.70; in England they cost $57.70. In the next year British rails went for $67.30 while American rails cost $99.70. American importers could pay the $28 tariff plus a two to four dollar per ton transportation cost and still save money over buying American rails.

23. J.P. Lesley, secretary, *American Iron Association Bulletin 1856* (Philadelphia: American Iron Association, 1856, corrected to 1858), p. 171.

24. Elting E. Morison, *Men, Machines, and Modern Times* (Cambridge: The M.I.T. Press, 1966), pp. 170-171.

This situation did not last long, for the price of American rails soon dropped. In 1875 English rails cost $12 more than American, and by 1879 they were only $5 more. From 1875 to 1879 very few if any rails were imported from Great Britain.[25] This was due to the introduction of new, cheap steel rails.

THE AGE OF STEEL

The breakthroughs in the 1850s for making cheap steel were pioneered by two Englishmen, Henry Bessemer and Robert F. Mushet, and American William Kelly. The combination of their patents, bringing together the various technological, mechanical, and chemical aspects of the process, resulted in the establishment of the American steel industry. (For an in-depth discussion of these events, and the Cambria Iron Company's involvement, see chapter III.) Steel plants were established across the United States, and from 1870 to 1907, Bessemer steel comprised half the national production. (For a discussion of the Bessemer steel industry's beginnings, see chapter III.) Almost all of this steel went to the production of rails. American production of Bessemer steel rails surpassed that of Great Britain in 1879; by 1886 the United States was the largest steel maker in the world, with an output of more than 2,500,000 tons.[26]

Pig iron was produced when several ingredients, iron ore, coke and limestone, were heated together. Included in this mixture were phosphorous, manganese, sulphur, silicon, carbon, and iron. The same elements were present in steel, but in different proportions. Carbon in pig iron was 3.8 percent of the total while steel contained 0.4 percent of carbon in the whole. The primary challenge of steelmaking was to reduce the carbon content. The making of blister steel resulted in solid steel in limited quantities. These restrictive factors were conquered when Henry Bessemer announced his new process in 1856.[27]

The Bessemer process consisted of forcing cold air under pressure to a pear-shaped vessel known as a converter, partially filled with melted cast iron. The air's oxygen combined with the iron's carbon and silicon and eliminated it, not through cooling, but through combustion. The silicon, manganese, and carbon joined with the oxygen to form combustible gases which burned off, leaving

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25. Ibid., pp. 171-172.

26. Lewis, *Iron and Steel*, p.38; Swank, *Notes*, p. 156.

27. Morison, *Men, Machines, Modern*, p. 125.

pure iron. However, some carbon was needed to make steel, so after it was burned out of the mixture it was added back to the iron. Manganiferous pig iron (spiegeleisen), composed of carbon, manganese and iron, was added to the converter while its contents were still fusing. The manganese combined with the oxygen which united with the iron during the blast. The product was liquid Bessemer steel, produced in large quantities, which could then be poured into shapes. The commercial success of Bessemer steel laid in the control of the recarburization step of the process.[28]

In a Bessemer steel plant the pig iron was brought into the converting house by railroad cars. A ton at a time was dumped into the cupola where it was melted and run off into ladles. From there the melted iron was tipped into spouts which filled the converters. Fans were then started which blew air through the tuyeres and through the metal. Then began the blow, "one of the most impressive moments in American industrial history." When the blow was finished the molten steel was tipped into ingot molds. After cooling the ingots were moved to the blooming mill where they were hammered or rolled into blooms, or steel blocks. These could then pass through the rail mill, "which was like an old-fashioned laundry wringer with notches, rail size, cut in the rollers."[29]

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28. James M. Swank, *History of the Manufacture of Iron in All Ages, and Particularly in the United States from Colonial Times to 1891* (Philadelphia: The American Iron and Steel Association, 1892), p. 395; Morison, *Men, Machines, Modern*, pp. 126-127.

29. Morison, *Men, Machines, Modern*, pp. 166-167. Alexander L. Holley, an early advocate of the Bessemer process, wrote a description of the conversion process which was cited in the industry for years:

> The cavernous room is dark; the air sulphurous; the sounds of suppressed power are melancholy and deep. Half revealed monsters with piercing eyes crouch in the corners. Special shapes ever fit about the wall, and lurid beams of light anon flash in your face as some remorseless beast opens its red hot jaws for its iron ration. Then the melter thrusts a spear between the joints of its armor, and a glistening yellow stream spurts out for a moment, and then all is dark once more. Again and again he stabs it, until 6 tons of its hot and smoking blood fill a great cauldron to the brim. Then the foreman shouts to a 30 feet giant in the corner, who straightway stretches out his iron arm and gently lifts the cauldron away up into the air, and turns out the yellow blood in a hissing, sparkling stream which drives into the white hot jaws of another monster big as an elephant with a head like a frog and a scaly hide. The foreman shouts again, at which uprises the monster on its haunches, growling and snorting sparks and flame.
>
> What a conflict of elements is going on in that vast laboratory! A million balls of melted iron tearing away from the liquid mass, surging from side to side and plunging down again, only to be blown out more hot and angry than before. Column upon column of air, squeezed solid like rods of glass by the power of 500 horses, piercing and shattering the iron at every point, chasing it up and down, robbing it of its treasures, only to be itself decomposed and hurled out into the night in a roaring blaze. As the combustion progresses the surging mass grows hotter, throwing its flashes of liquid snag. And the discharge from its mouth changes from sparks and streaks of red and yellow gas to thick full white dazzling flame. But such batter cannot last long. In a quarter of an hour the iron is stripped of every combustible alloy and hangs out the white flag. The converter is then turned upon its side, the blast shut off, and the carburizer run in. Then for a moment the war of the elements rages again -- the mass boils and flames with higher intensity and with a rapidity of chemical reaction, sometimes throwing it violently out of the converter's mouth. Then all is quiet, and the product is steel, liquid, milky steel that pours out into the ladle from under its roof of slag, smooth, shiny, and almost transparent. Quoted in ibid., pp. 166-167.

It took years for the quirks in the Bessemer process to be solved. Improvements in the process were developed by English inventors Sidney G. Thomas and Percy C. Gilchrist in the late 1870s. They discovered that phosphorus could be eliminated from the steelmaking process by changing the acid lining of a furnace to a basic material. Despite these advancements, deficiencies of the Bessemer process led to the adoption of the open-hearth method of producing steel. This process was refined by William and Frederick Siemens, and Pierre Martin in 1865. Abram Hewitt of the Trenton Iron Works in Trenton, New Jersey, introduced the Siemens-Martin process into the United States.[30]

The open-hearth furnace had several advantages over the Bessemer converter. Various types of scrap metal could be mixed with pig iron over a period of time. Samples were tested until an exact metallurgical combination was achieved. The steel was made on a hearth beneath a roof, and it was accessible through furnace doors, whereas Bessemer steel could not be tested for quality while it was made. Open-hearth was slower than the Bessemer process, but had a high production capacity and a high level of scientific accuracy. The largest influence in the adoption of the open-hearth method over Bessemer was its ability to use phosphoric ores. After 1869 open-hearth production increased, reaching 10,980,000 tons in 1906. In 1908 open-hearth steel surpassed Bessemer steel in volume.[31] (See appendix 1 for a description of iron and steel processes. See illustration 1 for diagram of entire steel process, from ore to finished product.)

STEEL RAIL

Steel rail was preferred over iron rail because of its durability. It could support heavier weights of cars, locomotives, freight, and passengers, and allowed trains to travel at faster speeds. Carrying capacity increased while operating costs decreased. The use of steel rails prevented continual disruption on the lines due to replacement of iron rails.

The importance of steel rail to America's economic development can not be understated. According to James W. Swank in 1904:

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30. Lewis, *Iron and Steel*, p. 40; Temin, *Economic Inquiry*, p. 217.

31. Lewis, *Iron and Steel*, p. 40; Temin, *Economic Inquiry*, pp. 145-146; "Open Hearth Steel Soon to Pass Bessemer," *The Iron Age* (April 18, 1907): 1206; "Steel's Centennial - 1957, The First 100 Years of the Steel Age," American Iron and Steel Institute, New York, April 1957, p. 25. For further information on the development of the steel process, see G.E. Thackray, "Notes on the History of Iron and Steel," *Transactions of the American Society for Steel Treating* (October 1924): 443-490.

> But for our cheap steel rails flour and meat, lumber and coal, and numerous other heavy products could not have been cheaply distributed to consumers, the necessaries of life would have been largely enhanced in price through the high cost of transportation, and the whole country would have had a much less rapid growth than it has experienced.
>
> The benefits which this country has derived from cheap steel rails of home manufacture are so numerous that enter so largely into the daily life of all our people that they have ceased to excite special comment, like the natural blessings of light, air, and water.[32]

The expansion of the railroad system was a commercial boom for the American iron and steel industry. At the end of 1860 there were 30,626 miles of rail in use, but by 1895 this figure grew to 181,021 miles. But while the demand for iron and steel promoted the industries, so did the protective policy to increase production. In comparison with Great Britain, American production grew during these years.[33]

The first steel rails in America were rolled at the North Chicago Rolling Mill on May 24, 1864, from Bessemer steel ingots forged at a small experimental works at Wyandotte, Michigan. The first steel rails rolled in America on commercial order "in the way of regular business" were run at the Cambria Iron Company in August 1867, from Bessemer steel ingots cast by the Pennsylvania Steel Company in Steelton, Pennsylvania. The rails were rolled for the Pennsylvania Railroad Company. (For more information on this event see chapter II.) After that year Bessemer steel rails of American manufacture began to replace iron rails. The highest amount of iron rails made was 808,866 tons in 1872, but by 1877 iron rail production fell behind steel rail production. The iron rail industry was, by 1897, "practically extinct." In 1880 iron rails totaled 70.9 percent of the nation's railroad track; by 1895, 87.8 percent of track was laid with steel rail. Steel rails had, by 1904, entirely replaced iron rails.[34] In 1902 the nation produced 2,935,392 tons of Bessemer steel rails. Western Pennsylvania contributed 950,266 tons of this amount, or one-third of the total. This tonnage came almost entirely from the Edgar Thomson Steel Works at Braddock, Pennsylvania, operated by Andrew Carnegie, and the Cambria Iron Company.[35] (Appendixes 2 and 3 contain statistics on British and American rail, steel ingot, and open-hearth production.)

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32. Swank, "Manufacture,": 3-4.

33. Swank, *Notes*, pp. 154-155.

34. "Steel's Centennial," p. 15; Swank, *Notes*, p. 147; Swank, "Manufacture,": 7; Raidabaugh, "History,": 183.

35. Swank, "Manufacture,": 10.

The costs of shipping goods via railroad dropped steadily after the introduction of steel rail. From 1867 to 1877 the cost of transporting a bushel of wheat by railroad from Chicago to New York dropped from 44.2 cents a bushel to 20.3 cents; from 1870 to 1880 the cost of shipping a barrel of flour from Chicago to New York by rail was reduced from $1.60 to 86 cents. By 1903 the freight charge on the Pennsylvania Railroad in car-load lots from Chicago to New York was 36 cents per barrel.[36]

A vital development in the continued growth of the steel industry was the use of internal combustion engines to drive the rolling mills. In earlier years the mills were run by water wheels and then low-pressure steam engines. After 1890 the internal combustion engines operated on blast furnace gas and not only operated electric power generators for driving the rolling mills but ran the blowing equipment for the blast furnaces.[37]

AGE OF CONSOLIDATION AND INNOVATION

Important changes took place in the United States in the time period between 1890 and World War I. Many of the country's important public and private institutions emerged in their modern form, including corporations, trade and professional organizations, labor unions, regulatory boards, and other bureaucratic organizations. This transformation has been described by historians as "finance capitalism," "scientific management," "welfare capitalism," "business unionism," "industrial democracy," "Progressivism," and "corporate liberalism." It made no difference whether the terms referred to financial, social, industrial or political developments, they were all related and linked together.[38]

These interrelated developments can be seen in the restructuring of the iron and steel industry in America during this time period. Successful mergers were based on a growth strategy of vertical integration. Almost all of the primary metals companies gained control of ore and fuel supplies, and many moved into fabricating metal products. The 1901 formation of the United States Steel Corporation, which was a holding company, unified 60-70 percent of the country's steelmaking

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36. Ibid., 3.

37. "Steel's Centennial," p. 15.

38. Gerald G. Eggert, *Steelmasters and Labor Reform, 1886-1923* (Pittsburgh: University of Pittsburgh Press, 1981), p. xi.

capacity under a single structure. Even though U.S. Steel's production totaled only 23 percent of the country's steel in 1977, it and six other firms still dominated the industry.[39]

The House of Morgan played a crucial role in the creation, financing and control of U.S. Steel. Bankers and financiers reorganized the industry, inheriting the power once wielded by the steelmakers. This illustrated the "managerial revolution," when founders of steel mills and self-taught steelmakers were replaced in leadership roles by management specialists, all highly trained and well educated.[40]

Thus the American iron and steel industry underwent consolidation in the late nineteenth century, which accompanied the growth of large-scale markets and expansion of the railroads. Limited capacity ironworks simply could not compete. Companies saved money and operated more efficiently by controlling their sources of raw materials, and the integration of the conversion of pig iron into steel and then into products aided efficiency. Pittsburgh took advantage of its proximity to the Connellsville, Pennsylvania, coalfields, its rail and river transportation, and location near eastern markets to become the leader in steelmaking after the Civil War. Iron ore fields in upper Michigan and northern Wisconsin paled in comparison with the discoveries of ore in the Vermilion and Mesabi ranges, north of Duluth, Minnesota. The Mesabi Range supplied ore for the iron and steel industry for fifty years after the turn of the century.[41]

Coal was also a necessary fuel for the furnaces. Before the 1830s almost all pig iron was made with charcoal, but after this time coal began to be used. The coking process expelled gas from soft bituminous coal and left coke, which approached pure carbon. Hard anthracite coal contained very little gas and was called "natural coke." Eastern Pennsylvania contained heavy concentrations of anthracite coal which was used by eastern iron producers. Bituminous coal, more abundant west of the Alleghenies, was used both in its original form or coked, by western producers including the Cambria Iron Company. Another factor is this use of bituminous coal was transportation. The Allegheny Mountains prohibited easy shipment of coal east and west. Therefore, eastern iron

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39. Ibid., pp. xi-xii. A vertical combination brought under single control all of the stages of an industrial process, from the raw materials to the finished product, while a horizontal combination unified independent firms all in the same business under single control. After U.S. Steel, known as "Big Steel," the six largest companies, producing 70 percent of American steel in 1977, were: Bethlehem Steel Company (13.6%), National Steel (7.2%), Republic Steel Corporation (7.2%), Inland Steel Company (6.4%), Armco or American Rolling Mill (6.4%), and Jones and Laughlin (6%). Ibid., note, p. 177; Alfred D. Chandler Jr., "The Structure of American Industry in the Twentieth Century: A Historical Overview," *Business History Review*, XLIII, no. 3 (Autumn 1969): 271.

40. Eggert, *Steelmasters*, p. xii.

41. Lewis, *Iron and Steel*, pp. 43-44.

producers used anthracite coal even though coke technology was used in England and became the standard in America. Anthracite coal burned too slowly for efficiency in smelting, however, and soon the manufacture of coke from bituminous coal became widely accepted. Beehive ovens were first used, and then supplanted in the 1890s, in the urban centers at least, by the by-product ovens, which were designed to capture gases, tars, and other substances.[42]

Competition spurred the innovations in extracting, processing, and transporting iron ore. The Bessemer process needed iron ore low in phosphorus while hard driving in the blast furnace needed fuel which would burn rapidly and not crush. Local iron ores were soon replaced with Lake Superior and foreign ores. The use of Lake Superior ores began gradually because of transportation problems, but costs were lessened with the increased capacity of ore boats and with the introduction of mechanical unloading. One-fourth of the nation's iron ore was mined from the Lake Superior area in the 1870s. This amount rose after 1880 to one-half in 1890 and two-thirds in 1900.[43]

Basic procedures for smelting, refining, and rolling steel had come from Europe, but Americans continually improved the processes. After 1870 trained chemists brought scientific methods to bear in metallurgical problems. Machinery was improved to move materials at the furnaces. Refining processes were also improved for both Bessemer converters and open-hearth furnaces. The integration of production stages soon occurred. William "Captain Bill" Jones developed new machines, improved equipment, and devised plant layouts which promoted coordination and efficiency. Jones, who got his start at Cambria, then incorporated all of the technological

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42. Ibid., pp. 44, 46; Temin, *Iron and Steel*, pp. 52-53.

43. Lewis, *Iron and Steel*, pp. 43-44; Temin, *Economic Inquiry*, pp. 194-196. Peter Temin described how iron was moved from Minnesota to Pennsylvania:

> Mechanization lowered the transportation costs of using Lake ores, both by increasing the facility of moving the ores and by increasing the ease of transshipping, loading, and unloading. The ore itself helped in this process by being a granular substance found virtually on the surface of the ground. The ore was scooped out of the ground by giant steam shovels, which were enabled to operate so crudely by the fineness of the ore and the isolated location of the mines. The giant steam shovels loaded the ore into railroad cars already joined into an ore train which was towed down a gradual incline to the shores of the Lake. It was then loaded onto a boat to be carried to Illinois, Ohio, or Pennsylvania, there to be unloaded at a steelworks or put onto trains for additional transport. The loading and unloading of railroad cars and ore boats was gradually mechanized, beginning in the 1880's. Ore was transferred from the railway to the boats by use of gravity, but the reverse procedure was obviously not subject to such a powering device. Hand unloading with powered lifts was used initially, but self-loading devices were introduced, and then buffer holding devices between boat and railway car further speeded the work. Speed was as important as direct cost in figuring the advantage of unloading docks as the Lake shipping season lasted only from May to November and the year's supply of ore had to be transported in that time. By the turn of the century the transport of Lake ores had become an intricate ballet of large and complex machines. Ibid., p. 197.

developments at the Edgar Thomson plant for Andrew Carnegie, with no expense spared. Open-hearth technology was also improved with changes in configuration and operation.[44]

Rolling mill processes were improved, with a continuous, mechanical operation the goal. Ingots arriving at a rolling mill were mechanically transferred from railroad cars, heated, and conveyed to heavy metal rolls mounted in adjustable stands. Before the Civil War, iron-rolling mills used two rolls to a set, whereas three-high stands were used after the war. The three-high roll was pioneered by John Fritz at Cambria. (For more information on the technological improvements in rolling mills see chapter III.) Bars were passed back and forth with ease, and the final step of mechanizing the lift upward for the return pass was accomplished by Robert W. Hunt in 1884, also a former Cambria employee.[45]

Advancements in technology were the result of intense competition in the American steel industry. A certain psychology existed in those who headed the steel mills. Andrew Carnegie was preoccupied with economy in steelmaking, and this was considered to be the key to American success in the field. Charles M. Schwab, president of U.S. Steel, remarked: "Carnegie never wanted to know the profits. He always wanted to know the cost." Economy and the reduction of production costs were essential to economic survival and achievement. According to steel historian David Brody:

> That impulse for economy shaped American steel manufacture. It inspired the inventiveness that mechanized the productive operations. It formed the calculating objective mentality of the industry. It selected and hardened the managerial ranks. Its technological and psychological consequences, finally, defined the treatment of the steelworkers. Long hours, low wages, bleak conditions, anti-unionism, flowed alike from the economizing drive that made the American steel industry the wonder of the manufacturing world.[46]

The need for economy was dictated by the demands of competition which preceded the mergers of the 1890s. Steelmaking was considered a "merciless game" because the demand for steel, primarily for railroads, was unstable. The unceasing disparity between supply and demand fostered competition. Steel companies cut prices to keep orders during depressed years. From the boom year

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44. Lewis, *Iron and Steel*, p. 47.

45. Ibid., p. 48; David Brody, *Steelworkers in America: The Nonunion Era* (New York: Harper Torchbooks, 1960), pp. 9-11.

46. Brody, *Steelworkers*, p. 2.

of 1880 to the "collapsed" market of 1885, steel rail prices fell from $85.00 to $27.00 a ton. Only the most economic and efficient could survive.[47]

Mechanization greatly improved production. Profits from increased output outweighed the costs of rapid wear and replacement. The top producers in the industry garnered fame and fortune. Andrew Carnegie became a steel titan by controlling raw materials to assure continuity of operation at minimal cost. He hired men with scientific and technological expertise and insisted on the most up-to-date equipment.[48]

Carnegie's methods forced other steel businesses to adapt to survive. During the depression years of the 1890s many small producers were absorbed by mergers. Eleven major reorganizations or consolidations occurred in the industry between 1898 and 1899. It was during these years that the Cambria Iron Company reorganized, becoming the Cambria Steel Company. The future, however, lay with the Carnegie Company because of Carnegie's ability to consistently undersell his competitors, and grow in the face of increasing economy. The iron and steel trade was "disastrous" in 1893, with many firms failing. Carnegie was able to monopolize the depressed market and to further perfect economical steelmaking. By 1897 Carnegie could charge only $14.00 per ton for rails on some orders and still make a profit. Only rising prices in 1899 saved eastern producers. They learned a lesson from Carnegie; only economy, efficiency, and control of raw resources could ensure a place in the market.[49]

The need for economy, spurred by competition, supported the technological advancements. This technology, in turn, promoted economy. The two forces affected the mentality of the steelmakers. They were extremely calculating and rational. When a Briton visited the United States in 1890 he was amazed at the rapid rate of driving blast furnaces which wrecked their interiors every three years. The American furnaces smelted six times as much iron as those at the Clarence works in England, but the English furnaces were performing as well as they did seventeen and one-half years

47. Ibid., pp. 2-3.

48. Lewis, *Iron and Steel*, p. 50. For more information on Andrew Carnegie's life and career see: Harold C. Livesay, *Andrew Carnegie and the Rise of Big Business* (Boston: Little, Brown and Company, 1975) and Joseph Frazier Wall, *Andrew Carnegie* (New York: Oxford University Press, 1970). See also *Dictionary of American Biography*, 1930 ed., S.v. "Carnegie, Andrew," by Burton Jesse Hendrick.

49. Lewis, *Iron and Steel*, p. 50; Brody, *Steelworkers*, pp. 5-7.

ago. Cambria's Superintendent Charles S. Price remarked: "We think that a lining is good for so much iron and the sooner it makes it the better.[50]

By 1900 the major characteristics of American steelmaking were in place. Mechanization of the process had occurred, management ruled with logic and economy, and the place of labor had already been defined. Labor was looked at only in terms of economy because it was a cost item. American accomplishment in steel was based, in part, on labor savings. According to historian John Brody:

> Every effort was directed toward lowering the labor cost per ton of steel. Cost per ton, however, had only bookkeeping meaning. The individual workman was the actual unit, and the variables in labor cost were his productivity and earnings over the same period. The goal of economy, as it related to labor, was to multiply the worker's output in relation to his income. Complex enough in its details, the steelmasters' labor policy reduced to that simple objective.[51]

Productivity was more important than labor. Whenever possible the labor force was decreased with increases in the pace of work. Mechanization was the key to multiplying worker productivity. As the years went by, gangs of laborers were no longer needed as production procedures were mechanized. Manual operations in the blast furnaces, rolling mills and finishing mills quickly disappeared. The role of the steelworkers thus changed. Highly skilled workers who once handled hot steel in the rolling mills became semiskilled machine operators. Judgment and expertise were no longer required. But also eliminated was much of the intense, hot labor required to feed furnaces and other equipment. Heavy work did remain, but by 1900 it was generally recognized that American steel labor's work was easier.[52]

Labor was affected by economy through technological changes and labor costs were reduced through the development of efficient machinery. However, labor was directly touched by issues such as wages and hours, and these were looked at with the same scrutiny which the steelmakers applied to the entire business. The relationship between hours of work and mechanization was recognized with maximum productivity the objective. Hours were dictated by both the mechanization and integration of the steelmaking process and by the economic health of the industry. Boom periods demanded longer hours while panics and depressions closed plants. Half-speed operations were not

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50. Quoted in Brody, *Steelworkers*, p. 17.

51. Ibid., p. 28.

52. Ibid., pp. 31 34.

efficient, and plants were often shut down until orders sparked their reopening. Continuous employment was possible only during excellent economic conditions.[53]

The determination of wages was another consideration affected by productivity. Basically, there was no connection between them. In earlier years workers were paid on a tonnage basis, which reflected their output. Mechanization, however, separated the amount of a worker's labor from his earnings because the growth of productivity of a blast furnace came from capital expenditure, not human effort. Even though working hours were increased, the increases in workers' productivity led to the reduction of the cost of labor. How much a steelworker earned was based on both market conditions and the supply of labor. During good years labor shortages developed which led to higher pay. This was no problem since prices were also up. During economic depressions, however, workers often accepted wage reductions. In 1893 Cambria's Powell Stackhouse remarked: "We were looking everywhere to reduce our costs, and labor got its share of it. . . . We got them down low. We had to." If prices dropped, wages did too.[54]

The results for the steel industry were spectacular. During the 20 years following 1890 a furnace worker's output tripled while his income rose one-half. A steelworker doubled his productivity while receiving only one-fifth more pay. This was possible only because the labor force could not oppose decisions made by the steelmakers. The drive of economy dictated the position of labor and labor unions in the steel industry.[55] (For more information on labor unions and the steel industry see chapter V.)

From 1865 to 1985 continuous change occurred in the production of iron and steel, with the following results: the numbers of workers per ton of metal rolled was reduced, some skilled positions were rendered obsolete, skilled workers lost control over how they performed their jobs, only semiskilled jobs were required to produce Bessemer steel, and managers could train new

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53. Ibid., pp. 34-40. For information on how technology affected the jobs involved with making steel, see Katherine Stone, "The Origin of Job Structures in the Steel Industry," *Radical America* 7, no. 6 (November-December 1973): 19-64.

54. Quoted in Brody, *Steelworkers*, pp. 40-42.

55. Ibid., pp. 48-49.

employees. This was the background for how steel workers related to each other, whether skilled or unskilled, and with management.[56]

CONTINUED GROWTH OF STEEL INDUSTRY

Steel use continued to expand after the flurry of railroad construction. In 1890 heavy armor plates were first made by the Bethlehem Iron Company. The plate was used in the building of steel vessels, and in the construction and armament of the U.S. Navy.[57] Other industries which boomed at the end of the century included the production of structural steel, steel wire, and wire rod. A vital development in the growth of steel was the use of the continuous rod mill, first built in 1869, which produced wire for telegraph lines, fences, and suspension bridges. The invention of barbed wire in 1873 also increased the demand for wire, along with the use of wire nails which replaced traditional cut nails. Another development was seamless steel tubing, made by rotary piercing, and first produced in 1895 in Ellwood City, Pennsylvania. It was then possible to produce tubing for the bicycle, automotive, and petroleum industries. A promising newcomer in the late nineteenth century was the tinplate industry.[58]

Open-hearth technology was challenged by the introduction of the electric furnace, which was suitable for making specialized alloy steels. The first direct-arc furnace was built in Syracuse, New York, by the Halcomb Steel Company, and was first used on April 5, 1906. The furnace was charged with scrap metal and heat from the arc melted the charge. Steel produced by this method increased as cheaper electricity became available, as the supply of scrap metal increased, and as the demand for special steels increased.[59]

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56. Bennett, "Iron Workers," p. 38. For detailed information on the variety of workers and their tasks in making steel, see pp. 27-33 of Bennett, "Iron Workers," and John A. Fitch's descriptions of steelworkers in Allegheny County in 1910, in *The Steel Workers* (New York: Charities Publication Committee, 1911; reprint ed. New York: Arno & The New York Times, 1969), chapter III "The Blast Furnace Crews," chapter IV "Puddlers and Iron Rollers," and chapter VI "The Men of the Rolling Mills." For a discussion of the tasks involved with operating the blast furnaces (bottom-fillers, weighers, barrowmen, larrymen, etc.) and the open-hearth furnaces what types of worker performed these tasks and how mechanization eliminated many positions, see Charles Reitell, "Machinery and Its Benefits to Labor in the Crude Iron & Steel Industries." (Ph.D. dissertation, University of Pennsylvania, 1917), pp. 8-36.

57. Swank, *Notes*, pp. 147-148. For a thorough history of the Navy's search for armor and armament before World War I which gave rise to a military-industrial complex, see Benjamin Franklin Cooling, *Gray Steel and Blue Water Navy The Formative Years of America's Military-Industrial Complex 1881-1917* (Hamden, Connecticut: Archon Books, 1979).

58. Swank, *Notes*, pp. 148-150; "Steel's Centennial-1957," pp. 15-16; Temin, *Economic Inquiry*, p. 227.

59. "Steel's Centennial-1957," pp. 14, 25.

The modern mass-production mass-consumption economy was marked by the appearance of the automobile. This industry influenced production and technological change in the steel industry just as the railroad industry had done in the nineteenth century. By 1929 the car industry consumed 6 million tons of steel a year. Highway construction established the need for reinforcement bars, 55 tons per mile. Railroads were still expanding, and construction of skyscrapers created demand for structural steel. The growth of the appliance industry consumed even more steel. Production of steel soared from 11,400,000 tons in 1900 to 63,205,490 tons in 1929.[60]

Another vital development for steel's growth was the first use of a continuous rolling mill for producing wide "strip" or sheet metal. This was first used in 1923-1924. John Butler Tytus successfully designed a mill which produced a continuous sheet of steel from an ingot without buckling or variation in the gauge. By 1955 steel sheets and strip accounted for 47 percent of the industry's hot rolled production.[61]

Consolidation continued into the twentieth century. By 1929 only a few giant steel corporations existed, having swallowed smaller firms. During this era the Cambria Steel Company was taken over by the Midvale Steel and Ordnance Company and then by the Bethlehem Steel Company. U.S. Steel was the largest steel company, with four times the income of the next largest, Bethlehem Steel. Other firms included Youngstown Sheet and Tube Company, Jones and Laughlin Steel Corporation, Republic Steel Corporation, National Steel Company, Inland Steel Company, and the American Rolling Mill Company, or "Armco."[62] (See appendix 4 for the ten largest steel companies in selected years, 1904-1950.)

Technological and scientific discoveries in steelmaking continued. Among the most dramatic was the mixing of iron and steel with other metals to produce alloys such as nickel steel armor plate, vanadium steel, tungsten steel, and others. Stainless steel was commercially produced in the 1920s, and advances were made in galvanizing. Consumers also became accustomed to the "tin can," actually a can of steel, coated with a thin layer of tin.[63]

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60. Lewis, *Iron and Steel*, p. 55; Temin, *Economic Inquiry*, p. 230.

61. "Steel's Centennial-1957," p. 16.

62. Lewis, *Iron and Steel*, p. 55.

63. Ibid., pp. 57-58.

By the time of World War II, the steel industry had weathered many changes. At that time American steel production equalled that of the rest of the world. The drastic decline in the American steel industry in the 1970s and 1980s was the result of many interrelated forces. The dramatic growth of foreign steel; the resultant excess steelmaking capacity; increased use of plastics, aluminum, and other substitute materials; the decline of the labor movement; and the deterioration of the American system of industrial relations were all factors.[64] Directions for the future and coping with the change incurred by this loss of leadership in the steel industry are issues facing the nation today.

Steel was once a source of American pride.[65] The Cambria Iron Company played a role in the development of the American iron and steel industry during its formative years. Established in direct response to the burgeoning growth of railroads, Cambria not only trained a generation of iron and steel experts, but contributed to the immense output of iron and steel rail in the late nineteenth century as well.

64. Ibid., p. 60; John P. Hoerr, *And the Wolf Finally Came The Decline of the American Steel Industry*, (Pittsburgh: University of Pittsburgh Press, 1988), pp. 13-14.

65. There are several texts which provide detailed overview histories of the iron and steel industry in the United States. See William T. Hogan, *Economic History of the Iron and Steel Industry in the United States*, 5 vols. (Lexington, Massachusetts: Lexington Books, 1971). Hogan's text traces the industry's development from 1860 until the early 1970s, and discusses corporative organization and development, the mobilizations for war, labor relations and other topics. See also Kenneth Warren, *The American Steel Industry 1850-1970 A Geographical Interpretation* (Oxford: Clarendon Press, 1973) and Victor S. Clark, *History of Manufactures in the United States*, 3 vols. (New York: Carnegie Institution of Washington, 1929; reprint ed., New York: Peter Smith, 1949). All three of these texts contain numerous references to the Cambria Iron Company. A detailed history of iron and steel technology is A.O. Backert, ed., *The ABC of Iron and Steel* (Cleveland: The Penton Publishing Company, 1925).

CHAPTER II: THE CAMBRIA IRON COMPANY 1852-1880

The Cambria Iron Company's greatest contribution to the burgeoning iron and steel industry in America came during three critical decades before, during, and after the Civil War. At a time when the nation was moving westward the company was founded to provide the iron and steel rails for that impulse. At a time when technological advances were made almost yearly in the transition from iron to Bessemer steel manufacture, workers at the Cambria Iron Company were involved at the innovative forefront. All of this activity was governed from the Wood, Morrell & Co. and Cambria Iron Company office at 218 S. 4th Street in Philadelphia, and took place in Cambria County, Pennsylvania, at the junction of Stoney Creek and the Conemaugh River. Topography dictated the location of the industry which was so crucial to the nation's development and growth.

CAMBRIA COUNTY

Cambria County was formed in 1804 from parts of Huntington, Somerset, and Bedford counties. It was the 41st county to be established in the Commonwealth of Pennsylvania and contained 695 square miles of very sparsely settled wilderness. The word "Cambria," related to the word Cumberland, is an old designation for Wales, the "land of the Cymry or Cumbri," interpreted as "compatriots." The only white settlements were located in the Johnstown area, Ebensburg and Loretto; elsewhere farms and cabins had been established. Ebensburg was designated as the county seat in March 1805, but two years passed until the county was able to organize and administer its own affairs; Somerset County kept its books until 1807. When organized Cambria County had three political subdivisions – Allegheny, Cambria, and Conemaugh townships; in 1810 Summershill Township was created. In the 1808 presidential election there existed only five polling places in the county; 22 votes were cast in Allegheny Township, 29 in Cambria Township and 18 in Conemaugh, which included Johnstown. This reflects the sparse population.[1]

Most of the county's land is rolling plateau, but in the southwest the Conemaugh Valley is a deep gorge between Laurel Hill to the southwest and Chestnut Ridge in the northeast. Elevations range

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1. *Commemorating the Sesquicentennial of Cambria County 1804-1954* (Ebensburg, Pennsylvania: The Cambria County Historical Society, 1954), n.p.; A. Howry Espenshade, *Pennsylvania Place Names* (State College: The Pennsylvania State College, 1925), pp. 160-161. For general histories of Pennsylvania, see Writers' Program of the Work Projects Administration, compilers, *Pennsylvania A Guide to the Keystone State* (New York: Oxford University Press, 1940; Thomas C. Cochran, *Pennsylvania A Bicentennial History* (New York: W.W. Norton & Company, Inc., 1978); Wayland F. Dunaway, *A History of Pennsylvania* (New York: Prentice-Hall, Inc., 1948).

from 1,147 feet in the valley at Johnstown to almost 3,000 feet in the Alleghenies. The Dividing Range separates the northeast section of the county from the southwest. Streams on opposite sides of the ridge flow eventually either to the Gulf of Mexico or Chesapeake Bay.[2]

When Cambria County was founded two native American paths passed through the area. The Kittanning Path was a main east-west route. The Conemaugh Path entered the county from the south, extending from Bedford to Johnstown, following the Conemaugh River to Pittsburgh and Ohio. South of the county lay the Raystown Path, predecessor of the Forbes Road. Settlers passed through Bedford on the path to the Stonycreek Valley, which they followed into the Johnstown area.[3]

The county lies in bituminous coal formations which stretch from the western summit of the Alleghenies to the eastern slope of Laurel Hill. Ironmaking became a major industry in the county because of the presence of these raw materials so plentiful in the hills surrounding Johnstown.[4]

JOHNSTOWN, PENNSYLVANIA

Gen. Charles Campbell of Philadelphia laid claim to the future site of Johnstown on April 3, 1769. It was near an old Indian town called Kickenapawling's old town. The property became known as "Conemaugh Old Town" and it changed hands repeatedly until it was purchased by Joseph Yahns, or Johns, who was considered the first permanent settler in 1791. Johnstown was founded on November 3, 1800, when Joseph Johns filed a charter for "the town of Conemaugh." The town limits extended from the Point (formed by the juncture of the Conemaugh River with Stony Creek) east to Franklin Street. A total of 10 streets, six alleys, a market square, and 141 lots were laid out. A one acre cemetery was included, as well as a designation of a lot for a county court house, and other public buildings on Main Street. The Point was set aside for commons and public amusements for the use of the town inhabitants "forever.[5]

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2. *Commemorating the Sesquicentennial*, n.p.

3. Ibid.

4. For a brief overview of the iron industry in Cambria County see Harold M. Craig, "The Iron Industry in Cambria County from Founding to 1885," Thesis, Gettysburg College, 1932.

5. J.J. McLaurin, *The Story of Johnstown: Its Early Settlement, Rise and Progress, Industrial Growth, and Appalling Flood on May 31st, 1889* (Harrisburg: James M. Place, Publisher, 1890), pp. 30-36; I. Daniel Rupp, "1848 History of Cambria County Pennsylvania," reprint ed. from The History and Topography of Dauphin, Cumberland, Franklin, Bedford, Adams, Perry, Somerset, Cambria and Indiana Counties, Southwest Pennsylvania Genealogical Services, Laughlintown, Pennsylvania, n.y., p. 582.

One of the very first businesses in town was a small iron forge, erected in 1806, which took advantage of the nearby coal and ore deposits. Horses and mules carried the products to Pittsburgh before rafts and flatboats were used. The first keel boat was used in 1816 to carry freight and passengers to Pittsburgh. Pig iron from surrounding forges were carried into Johnstown on the Frankstown Road, and were stored in warehouses north of Stony Creek below Franklin Street, before being shipped by flatboats on the Conemaugh. According to historian James M. Swank, "It can be most positively stated that Johnstown owes its start as an industrial and commercial centre to the fact that its location at the head of flatboat navigation on the Conemaugh furnished an outlet for the iron of the Juniata Valley at the beginning of the present century."[6]

Growth occurred after 1828 when work began on the Pennsylvania Mainline Canal and the Allegheny Portage Railroad. The settlement of Conemaugh lay in the Conemaugh Valley at the foot of the western slope of the main range ridge of the Allegheny Mountains. It was situated between the Alleghenies and the Laurel Ridge to the west. The Western Division of the Pennsylvania Canal was completed along the Conemaugh River, to join the western terminus of the Allegheny Portage Railroad which ran 36 miles over the Allegheny ridge. The first boat arrived in Conemaugh in 1830 to great ceremony and jubilation.[7]

Being the western terminus of the portage railroad where cargo and passengers were transferred from the railroad to canal boats served the community well. A canal basin, depot, warehouses, and other support facilities were soon constructed in the area of Centre, Portage, and Railroad streets. In 1831 when the town was incorporated as Conemaugh, the population stood at 700. On April 14, 1834, the name was changed to Johnstown, and by 1840 the population had increased to 1,000.[8]

The heyday of the canal and portage railroad system was not long-lasting, and the rails of the Pennsylvania Railroad soon superceded the inclines. Around 1858 the canal was abandoned in favor of the railroad. Rapid transportation east and west was available, and the iron manufacturers recognized the potential for their operations. One of these operations, the Cambria Iron Company, was responsible for the unprecedented change and progress in Johnstown. (See appendix 5 for a description of Johnstown's potential as an iron producer.)

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6. James M. Swank, "Early Iron Enterprises in Cambria, Somerset, Westmoreland, and Indiana Counties," in "Johnstown Centennial 1800-1900," 1900, pp. 4-6; McLaurin, *Johnstown*, p. 36.

7. McLaurin, *Johnstown*, p. 38.

8. Ibid.

Prospect Hill, part of the Laurel Hill range, stands at the northern edge of Johnstown, from Woodvale to Hinckston's Run. The hill is divided into Upper and Lower Prospect, and the hill's first bench is on Lower Prospect and the second on Upper Prospect. From 1846 when Rhey's Furnace was built at the hill's foot, until 1868 when the Bessemer steel process was adopted, Prospect Hill was the source of superior ore and coal. The Cambria Iron Company located at the base of Prospect Hill because it contained the best iron on the market. This ore ceased to be a factor only when the Bessemer process required higher grades for making steel.[9]

Traveler Eli Bowen provided a first-hand description of Johnstown in 1852, the year the Cambria Iron Company was founded:

> Running along the northwestern bank of the Conemaugh, we reach JOHNSTOWN, two miles below. At this place the western division of the Pennsylvania canal commences, and the miserable Portage Railroad, with its short splintery rails and curvatures, its stationary steam-engines and abominable inclined plains, terminates. The traveller, who has crossed the mountain over it, will not regret to leave it, but will thank the stars that a better road will soon supersede it. The friendly Conemaugh, as it passed this place, shakes hands with the Stony Creek, and the two proceed together, in a nearly northern course, around Laurel hill, where they strike due west. Johnstown lies on a level flat, surrounded by steep hills. It is pleasantly situated, but is without the least interior attraction. The buildings are small and without ornament, and the population, consisting of about two thousand, embraces a conglomerate of character, or which the most part follow the "raging canawl," or business appertaining to the trade of which it is the distributor. The original settlers

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9. Henry Wilson Storey, *History of Cambria County Pennsylvania*, 3 vols. (New York: The Lewis Publishing Company, 1907), 1: 420; Johnstown *Tribune-Democrat*, January 31, 1953.

John B. Pearse offered a description of the Cambria County's geology upon which the Cambria Iron Company depended in 1876:

> Coal is principally mined in the Stoystown and Johnstown subdivisions of the basin. In the region about Johnstown the Sharon coal is represented by a thin vein, and the Clarion and Freeport groups by veins of good thickness. The Brookville or the Clarion bed, the lowest, is 3-1/2 feet thick at Johnstown. Above it lies the ferriferous coal-bed, with its limestone, each very variable, the coal from 1 to 4 feet and limestone 3 to 8 feet. The ferriferous limestone changes locally into carbonate ore. The Kittanning vein, thin at Johnstown, is 4 feet thick at other places. The Lower and Upper Freeport coals are respectively 4 feet on Laurel Hill creek and about 4 feet on the Conemaugh. The Pittsburg bed does not appear. Sixty feet over the highest coal is a double bed of compact carbonate ore, the upper band 18 inches to 2-1/2 feet thick; the lower 6 inches to 2 feet; the total average thickness being 2 to 3-1/2 feet of ore, containing about 51 per cent of iron. This ore is smelted with local coke; but the Cambria Company depends largely on the brown hematites of Springfield, &c. and the fossil ores of Frankstown, Hollidaysburg, &c. For a better class of iron and for Bessemer pig iron Lake Superior ore is used.

John B. Pearse, *A Concise History of the Iron Manufacture of the American Colonies Up to the Revolution and of Pennsylvania Until the Present Time* (Philadelphia: Allen, Lana & Scott, Publishers and Printers, 1876), p. 164.

> of the county were Welsh, Scotch and Irish, and the latter appear to have the "megority" here.[10]

Johnstown changed drastically with the founding of the Cambria Iron Company. The city proper was soon surrounded by boroughs which incorporated and which contained the myriad businesses owned and operated by the company. Johnstown's population switched its orientation from the canal to the railroad and business it attracted. The Cambria Iron Company was formed to take advantage of the region's coal and iron ore resources, and its transportation links.

CAMBRIA IRON COMPANY PREDECESSORS

In 1833, 24-year-old George Shryock King, a merchant of Mercersburg, Franklin County, arrived in Johnstown to pursue business opportunities. (See illustration 16 for a sketch of George S. King.) He opened a store on the northeast corner of Franklin and Main streets, and for several years conducted a mercantile business. He sold out in 1840 to John K. and William L. Shryock, intending to go to Pittsburgh to open a business. However, the panic of 1837 brought hardship, misery, and business stagnation. In 1839 and 1840 he saw the need for the manufacture of pig iron, and he began searching for available, accessible iron ore. He found it in such quantities that he undertook a pig iron venture himself.[11]

Years later, in 1888, George S. King described his motives and activities in starting a pig iron business in Johnstown. Because of the depressed conditions in business due to the compromise tariff of 1833, many people were out of work, including King. He thought a way might be found to change economic conditions by utilizing the iron ore deposits in the hills around Johnstown. After searching several months he found, in 1839 or 1840, a deposit of ore which justified building a

10. Eli Bowen, *The Pictorial Sketch-Book of Pennsylvania or Its Scenery, Internal Improvements, Resources and Agriculture* (Philadelphia: Willis P. Hazard, 1852), pp. 156-157.

11. James M. Swank, *Cambria County Pioneers* (Philadelphia: Allen, Lane & Scott, 1910), p. 64; Storey, *Cambria*, 1: 400. George S. King was born in Hagerstown, Maryland, on October 28, 1809, and died in Johnstown on December 8, 1903, aged over 94 years. Swank, *Pioneers*, note, p. 70. For Pennsylvania ironmakers' perspectives on the iron trade, the economic problems associated with it, and a plea for government protection to foster fair competition, see *Documents Relating to the Manufacture of Iron in Pennsylvania Published on Behalf of the Convention of Ironmasters* (Philadelphia: General Committee, 1850).

furnace to work it. King wanted to process the iron and trade it for merchandise to pay his workingmen with because there was so little money then in circulation.[12]

King associated with David Stewart and John K. and William L. Shryock in the undertaking and he gave the name "Cambria" to the charcoal furnace, which they built on Laurel Run, about three miles from Johnstown. In late 1843 Dr. Peter Shoenberger, of Pittsburgh, purchased David Stewart's interest, and in 1844 Dr. Shoenberger and King bought the interests of the Shyrocks, to become equal owners of Cambria Furnace.[13] Theirs was the first furnace in the county, being finished and blown in in 1842. The pig iron was shipped to Pittsburgh in exchange for dry goods, and King and Stewart continued to operate King's former store.[14] (See illustration 2 of the Cambria Furnace.)

The tariff of 1842 went into effect which afforded protection for the new business. Dr. Shoenberger and King responded by building two new charcoal furnaces, Mill Creek Furnace and Ben's Creek Furnace, situated about four miles from Johnstown in the opposite direction from Cambria Furnace. John Bell joined in this work for one or two years before Dr. Shoenberger and King purchased his interest.[15]

The tariff of 1846 greatly depressed all business, damaging much of the iron manufacturing then done in America. David Stewart, formerly associated with King, had built the Black Lick Furnace in Indiana County. Stewart offered to sell the furnace to King and Shoenberger, which they accepted. The pair then had four furnaces which they kept in operation during depressed times with

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12. Swank, *Pioneers*, pp. 66-67. Henry Wilson Storey, chronicler of Cambria County history, stated that King, along with David Stewart, who had operated a foundry on the "Island" with Samuel Kennedy before the panic caused the firm's dissolving, started prospecting for iron ore in the hills around Johnstown. The search continued for quite a while before a vein of sufficient size was found. In 1840 they found ore on the John Sigh farm on the Laurel run, above the "Bucket" factory, now in West Taylor township. They sank a shaft 37 feet, and found a 15 inch seam. They hauled sample ore over Laurel Hill to the Ross Furnace, in Westmoreland County, to be made into pig iron to test its quality. At a forge on the Juniata River in Blair County, the metal proved to be very good bar iron, except that it was excessively brittle. King and Stewart decided to purchase the Seigh property. Storey, *Cambria*, 1: 401-402.

13. Swank, *Pioneers*, p. 67.

14. Storey, *Cambria*, 1: 402. For more information on Dr. Peter Shoenberger, see Calvin W. Hetrick, *The Iron King The Story of Dr. Peter Shoenberger, Early Ironmaster of Central Pennsylvania – His Industrial Empire, His Family, His Times*, (Martinsburg, Pennsylvania: Morrisons Cove Herald, 1961).

15. Swank, *Pioneers*, p. 67. In 1843 King found a better vein of ore in Benshoff's Hill. The vein of ore on the upper and lower sides of Hinckston's Run proved excellent, and was mined by the Cambria Iron Company. The ore mines on Millcreek were opened in 1843 or 1844. Dr. Peter Shoeberger bought David Stewart's interest in the Cambria Furnace and store for $6,000. On February 9, 1846, King and Shoeberger bought the Shryock interests for $9,000. In 1845-1846, King and Shoeberger joined with John Bell, of Indiana County, to form John Bell & Co. The same men, now calling themselves, George S. King & Co., built the Benscreek Furnace, which was soon operated under the name of King & Shoenberger. Bell soon sold his interest, left Johnstown, and headed to the California gold fields. Storey, *History*, 1: 402-403.

little or no profit. The two businessmen were soon evaluating their position in terms of making a living. Dr. Shoenberger wanted to build a large foundry, to cast large sugar kettles for the New Orleans market.[16]

But once the pig iron industry in Cambria County was established, George S. King recognized the potential of manufacturing iron rails. The Pennsylvania Railroad was completed to Pittsburgh in 1852, and King knew a market lay waiting. There were no rail mills in Pittsburgh at the time, and the closest one to Johnstown was at Brady's Bend in Armstrong County. In 1852 King went to New York and Boston to attract capital for building a rolling mill in Johnstown.[17]

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16. Swank, *Pioneers*, pp. 67-68. In addition to the four charcoal furnaces, the firm operated a block coal furnace they built at Sharon, Mercer County. Storey, *History*, 1: 403. For modern directions to find these furnace remnants, see Sharp and Thomas, *Guide to the Old Stone Blast Furnaces*, pp. 28, 30. These four blast furnaces used charcoal as fuel. Their capacity was 4,000 tons of pig iron per year, with 4 to 5 tons of pig metal per day and 22 to 35 tons per week for each furnace. Selling prices ranged from $17.00 to $35.00, with an average of $22.00 to $25.00 per ton. King and Shoenberger produced 125 tons of pig metal per week, with a market value of $3,000. Their products reached Pittsburgh on the canal. Geo. D. Thackray, "Brief History of Cambria Plant, Johnstown, Penna." Office of Special Engineer, Bethlehem Steel Company, Bethlehem, Pennsylvania, January 26th, 1925, in "History of Cambria and Coatesville Plants B.S. Co." typed manuscript, p. 2, box: Plants-Danville-Johnstown, Acc 1699, Bethlehem Steel Corporation Papers (BSC), Hagley Museum and Library, Manuscripts and Archives Department (HagM), Wilmington, Delaware; Storey, *Cambria*, p. 405. The managers of the furnaces were: Cambria – John Galbreath, George Long and James Cooper; Bens Creek – Samuel Bracken and William McCormick; Black Lick – John Mathoitt and David F. Gordon; and Mill Creek – John Bell, Gordon Clifford, John Stewart and W.L. Shryock. Ibid. An 1859 guide to furnaces in the United States offered the following description of the King and Schoenberger operations, then owned by the Cambria Iron Company:

> Black Lick Steam Hot-blast Charcoal Furnace, owned by the Cambria Iron Works, Wood, Morrell & Co, lessees, and situated in Indiana county, Pennsylvania, twelve miles northeast from Johnstown, was built in 1846, is 8 feet across the bosh by 35 feet figh, and made in thirty-five weeks of 1856 955 tons of metal. . . . Mill Creek Steam Hot-blast Coke Furnace, owned by the Cambria Iron Works, and leased by Wood, Morrell and Company, Johnstown P.O. Cambria County, Pennsylvania, stands on Mill Creek, three and a half miles southwest of Johnstown Railroad Station, is 12 feet across the bosh by 40 high. Built in 1845 and rebuilt in 1856 it went into blast in April of that year, and made in the remaining thirty-five weeks 2,720 tons of metal, out of coal measure carbonate ore. Ben's Creek Hot-blast Charcoal Furnace, owned and leased as the last, stands at the mouth of Ben's Creek, near the plank road crossing, three miles south of Johnstown Station; was built in 1846, 9 feet across the bosh by 35 feet figh, and made in thirty-nine weeks of 1856 902 tons of metal, out of coal measure ore. Old Cambria Steam Hot-blast Coke Furnace, owned and leased like the two last, on Laurel Run, three quarters of a mile from the Pennsylvania Canal, three miles north of Johnstown station, was built in 1842, rebuilt in 1854, 9-1/2 feet across the bosh by 38 feet high, and made in fifty weeks of 1856 2,225 tons of metal out of carbonate and fossil ores. Here [William] Kelly's process has just been tried with great success. J.P. Lesley, *The Iron Manufacturer's Guide to the Furnaces, Forges and Rolling Mills of the United States with Discussions of Iron as a Chemical Element, an American Ore, and a Manufactured Article, in Commerce and in Industry* (New York: John Wiley Publisher, 1859), pp. 91-92.

17. Swank, *Pioneers*, p. 66. The Great Western Iron Company, later known as Brady's Bend Iron Works, first rolled rails in 1842. The works consisted of four blast furnaces which used coke as fuel for its production of pig iron. Manufacturers in Pittsburgh refused to use coke pig iron. An extensive rolling mill was then built to utilize the furnace's products. Bining, "Rise of Iron Manufacture,": 250.

ORGANIZATION OF THE CAMBRIA IRON COMPANY

George S. King described how the search began for funding the new business:

> I think that it was in February, 1852, when I left Johnstown to go East to get parties to become interested in the new enterprise. I went first to New York City, and being unacquainted with any one there I was placed at a disadvantage. Among those I could hear of as being most likely to invest in the enterprise was Simeon Draper, a broker, and whom I had heard of quite often. When I called at his office I found him absent, but I presented the matter to his chief business man, George W. Hodges.
>
> Finding but little encouragement in New York I concluded to go to Boston. My first efforts in Boston were not flattering and resulted in my discovering the fountain-head of a concern that I knew something about before. I was taken by a party to the office of an alleged large and wealthy "iron company," and found the office grandly fitted up and well equipped with advertising material, consisting of pamphlets, circulars, etc., one of which was handed to me. It set forth that this "iron company" represented a capital of $500,000 and their works were said to be located near Hollidaysburg, Blair county, where they owned two hundred acres of land and a furnace under construction. I was aware before this that an attempt had been made to build a furnace as mentioned in the pamphlet, and knew all about the matter so well that I got out of that office as soon as possible. I said nothing to them about my matter, nor did I tell them what I knew about theirs.
>
> I next met a party, Mr. Daniel Wide, to whom I talked about the object I had in view. He called on me at the hotel and we had our second talk, and he proposed that we go and see Mr. John Hartshorn, a broker. We went to his office, I taking with me a schedule of the property Dr. Shoenberger and I intended to put into the business. We saw Mr. Hartshorn and him with the matter, I laying before him our proposition, which was that Dr. Shoenberger and I should put in our four furnaces, with tools, teams, all the firm's property, except goods in stores and metal on hand, and twenty-five thousand acres of land, all valued at $300,000, of which we would retain shares in stock to the amount of $100,000 and the rest to be paid to us by the company. Mr. Hartshorn and Mr. Wide agreed to get up the company within six months' time from date. I then wrote to Dr. Shoenberger to come on to Boston, and on his reaching there he and I signed the articles of agreement as above stated.[18]

With financing in hand, George S. King set out for the state capital in Harrisburg to obtain a charter for his business. Of his own choice, without consultation with Dr. Shoenberger, King gave the names "Cambria Iron Company" and "Cambria Iron Works" to the new business. The capital was set at $1 million. King then discovered a general law which limited the quantity of land an organization could hold in one county. He went to the legislature, then in session, and obtained an additional section to the original law which permitted the holding of lands in more than one county

18. Ibid., pp. 68-69.

without a limit. King then went to Philadelphia and succeeded in acquiring subscriptions totaling $30,000 in stock from merchants he knew.[19] In the course of his efforts to secure the charter, King had to produce evidence that 25 percent of the stock, or $250,000, was actually paid. King had to go to New York to broker and banker Simeon Draper to obtain a certificate of deposit for $250,000. King then returned to Harrisburg, showed the document, then tried to have Governor William Bigler draw up the charter. Arriving in town at a late hour to discover the governor was leaving town in the morning, King got him out of bed. Wearing his nightrobe, the governor signed the charter on June 29, 1852.[20]

At the end of six months the Boston parties failed in the efforts to raise money, and after an additional six months the Johnstowners moved their efforts to New York and called on Simeon Draper, whom King had initially tried to enlist. Draper subscribed to the stock and vouched for other subscribers to the amount of $300,000. King then held a meeting to organize the company, and held an election: Dr. Peter Shoenberger was chosen president; Simeon Draper, treasurer; George W. Hodges, secretary; and King as general manager.[21]

The Cambria Iron Company was organized by articles of association dated August 21, 1852, under the Pennsylvania Acts of Legislature dated June 16, 1836, and supplemented June 29, 1852. The Pennsylvania attorney general certified the organization on August 26, 1852, and other state officials approved on August 29, 1852.[22] (See appendix 6 for the August 21, 1852, articles of association and other organizing agreements.)

The capital stock was $7 million, composed of 80,000 shares at $12.50 each. At the time of organization the company's properties were scattered over Cambria, Indiana, Somerset, and Westmoreland counties and consisted of 14,000 acres of coal, iron ore, and timber lands. The property lay adjacent to the Pennsylvania State Canal and the Pennsylvania Railroad. It contained five veins of coal and several seams of iron ore.[23]

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19. Ibid., p. 69.

20. Storey, *History*, 1: 410; Johnstown *Weekly Tribune*, July 2, 1897.

21. Swank, *Pioneers*, p. 70.

22. Thackray, "Brief History," p. 1, Acc 1699, BSC, HagM. The 1836 Pennsylvania act encouraged the manufacture of iron with coke or mineral coal.

23. Thackray, "Brief History," p. 2, Acc 1699, BSC, HagM. According to this secondary source, the directors of the company were: Daniel M. Wilson, president; Peter Shoenberger, Samuel H. Jones, John Hartshorn, Edward F. Grant, George S. King and Wm. A. Shepard. Ibid., p. 1.

Construction began within the year on the site, purchased from Peter Levergood for $3,000, accompanied almost simultaneously by an order for rails. Starting in August 1852 stone was split from the face of Laurel Hill for the rolling mill and blast furnace foundations. In March 1853 work commenced on the four coke furnaces.[24] Just after construction of the furnaces and rolling mill began, a trust agent for the Ohio & Toledo Railroad arrived in New York with a proposition to purchase rails. He had no money, but offered to exchange bonds of the railroad company worth $200,000 for railroad rails. Simeon Draper agreed and promised to deliver the rails at $85.00 per ton. This agreement was made before the mill was even completed. The bonds were sold, and the fledgling Cambria Iron Company got the order for rails at $55.00 per ton even though their market value was $80.00. The order was so large and the company eager to start business that the rails eventually were furnished, but only after considerable difficulty and delay.[25]

In December 1853 company President Dr. Peter Shoenberger reported on the infant business:

> Iron Ores semi-bituminous Coal, Limestone, and nearly every article required for the manufacture of Iron, exist, in inexhaustible quantities on the spot; and these deposits are now worked, and the minerals delivered cheaper than at any other known point now occupied for the manufacture of Iron. The Pennsylvania Canal and Central Railroad pass through the property, and cross each other at the spot where the mineral veins are most thoroughly opened out; and which location, for its other advantages for facility of manufacturing, and vicinity to a populous borough, has been selected for the establishment of Railroad Iron Works, and for the erection of other Blast furnaces, in addition to those now in operation. . . .
>
> The valuable property of Shoenberger and King, comprising about 25,000 acres of land in the neighbourhood of Johnstown, was secured a year ago, and some additional tracts have been since bought, making the whole purchase stand in about $350,000. Upon the property are four blast furnaces, which cost, including the buildings and personal property accompanying them, about $250,000. These furnaces are now in successful operation, using charcoal for fuel, and producing some four thousand tons of Pig Iron per annum, at a cost of about $15 per ton. At the present selling price of Pig Iron at Johnstown and Pittsburg, their production of pig metal will alone pay a six per cent. dividend upon $1,000,000 of capital; and the

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24. Nathan Daniel Shappee, "A History of Johnstown and the Great Flood of 1889: A Study of Disaster and Rehabilitation" (Ph.D. dissertation, University of Pittsburgh, 1940), p. 63; Judge Jos. Masters, "Brief History of the Early Iron and Steel Industry of the Wood, Morrell & Co., and the Cambria Iron Co. at Johnstown, Pa. in "Official Souvenir Program, Eleventh Department Encampment, United Spanish War Veterans, Johnstown, Pennsylvania, June 7, 8 & 9, 1915," n.p., Miscellaneous Collection IV, (Mcol), Box V: Johnstown's Iron and Steel Industry, Johnstown Flood Museum (JFM), Johnstown, Pennsylvania. Judge Masters reminisced that in 1852 he helped make 5,000 heavy clay picks, 37 each day, which were used to dig the seats for the four blast furnaces and the coke and ore yard. The coal and ore was mined in the hill behind the furnaces. "Coal was coked in pits and the ore was burned in very large piles by carrying wood and coal on the ore pile, as ore was dumped from the mine cars as it was brought from the mine." Ibid.

25. Storey, *History*, 1: 409.

alternations in preparation for adopting them to the use of coke for fuel, will treble their production by next spring.[26]

By the end of December 1853 more than $400,000 was paid on the capital stock, with $520,625 having been subscribed. President Schoenberger knew more money was needed to carry out all of the company's plans and he planned to raise it through additional stock subscriptions or from the sales of the bonds. An issue of bonds had been prepared, secured by a mortgage on the company's real estate which was worth more than $1,000,000. The issue was of $500,000, six percent bonds, due January 1, 1864, in New York. The coupons were payable January 1 and July 1, at the Ohio Life and Trust Company, in New York.[27]

Progress on the physical construction of the plant moved fast. Construction had started in February 1853, and by mid-December many of the necessary structures for operations were in place. The brickyards were in business by June, and workers had made 12,000 bricks at a cost of $2.50 per thousand. Fire brick was also made on the premises. S.A. Cox, a Cambria engineer, reported to the company president on the status of the works, providing technical detail on the machinery:

> A foundry has been completed, and is in operation, capable of making all the castings we shall require, from the finest machinery castings up to castings of twenty tons to the piece.
>
> A machine-shop has been finished and put in work, with lathes, planers and other tools, suitable for building any and all of the rolling-mill and blast-furnace machinery required. Also, a blacksmith-shop with six forge-fires, capable of doing all the repairs of the rolling mill, blast-furnace, mines, and of building all the cars for the ore and coal drifts.
>
> A pattern-shop, with all the tools requisite for making any and all kinds of patterns necessary for all the Company's works.
>
> All the above are in successful operation turning out the work for the blast furnaces, rolling-mill and mines.
>
> The rolling-mill will be making iron by the last of January, or first of February, and can turn out, when completed, one hundred and twenty tons of rails per twenty-four hours, or average six hundred tons per week; the mill has sixty puddling furnaces, five top and bottom, and scrap furnaces, and twelve rail pile furnaces, also two of Winslow's patent rotary squeezers, and two alligator squeezers, four sets of roughing, and top and bottom rolls, and four sets of rail rolls, four pair sheers for

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26. Peter Shoenberger, *Cambria Iron Company of Johnstown, Pa.* (New York: George F. Nesbitt and Co., Printers, 1853), pp. 3-4.

27. Ibid.

cutting up bars, six six-feet blowers, for blowing a blast to all the furnaces – this enables us to make a better quality of iron. The engine for driving the squeezers is forty-two inch strike, eighteen-inch bore, and eighty horse-power; the engine to drive the roughing rolls, is of six-feet stroke, and twenty-six inch bore, and one hundred and fifty horse-power; the engine to drive the rail mill, is of four and a-half feet stroke, and twenty-six inch bore, and one hundred and fifty horsepower; and one engine of forty-two inch stroke, and sixteen inch bore, for driving blowers, sheers, pumps, saws for cutting off the ends of rails, &c. Sixteen boilers of thirty-six inch diameter, [sic] and forty feet long, to drive these four engines. The main stack is seventeen feet square at base, eleven feet square at top, and one hundred and fifty feet high; the flue is nine feet square, and took four hundred thousand bricks to build it. The aggregate horse-power of the mill is four hundred and forty. The mill building is in the form of a cross: the main is six hundred feet long and one hundred feet wide; the wings are, from out to out, three hundred and fifty feet long by seventy-two wide; the machinery is of the best model, and no mill in the states can produce anything which can equal it. The puddling and heating furnaces are of a new model, and work the iron every saving as to waste, and make it very strong. The engine for the four new blast-furnaces will be completed in two weeks, is our hundred horse-power, and is of very superior model and workmanship. To drive this engine, we put eight boilers to each furnace – thirty-two boilers, sixteen of them forty feet long and thirty-six inches diameter, and sixteen of them thirty-four feet long and thirty inches diameter. The steam cylinders of this engine are two, of twenty-eight inches bore, and eight feet stroke; and the blast-tubs or cylinders are of seventy-two inches bore and six feet stroke – making, when at full speed, seventeen thousand cubic feet of blast per minute.[28]

Dr. Peter Schoenberger also commented on the works' construction:

The works of the Company are rapidly progressing. They are erecting several blast furnaces for smelting, with coke, the iron ores at Johnstown, two of which are nearly finished; and each furnace is calculated to produce 5,000 tons of pig metal per annum. They have also nearly finished a large rolling mill, six hundred by three hundred and fifty feet, with sixty puddling stocks and twelve heating furnaces, four scrap furnaces, &c. which should, when in full operation, produce over 100 tons per day of Railroad Iron. A large machine shop, foundry, and blacksmith's shopps, are finished, and in work. The whole machinery, comprising six large steam-engines, has been purchased, and is on the ground. It is entirely new, mostly of the manufacture of Otis Tufts, of Boston, and will bear comparison with any in the United States.[29]

Not only were shops for the business built, but so was housing for workers. Tenements for forty families were completed by December 1853, and others were being built. The housing was of brick,

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28. S.A. Cox, "Engineer's Report," to the President of the Cambria Iron Company, December 15, 1853, Mcol IV, JFM. Cox also provided an excellent, detailed description of the coal and iron ore veins which were first tapped for the company's furnaces.

29. Schoenberger, *Cambria Iron Company*, pp. 4-5.

made in the company's own brickyards on-site.[30] (See illustration 3 of 1853 plan of Cambria Iron Works.)

The four furnaces were built on the Johnstown flats, 1/2-mile north of the railroad station, and north of the Cambria rolling mill. Each of them had a 13-foot bosh and was 48 feet high. No. 1 and No. 2 were built in 1854, No. 3 in 1856, and No. 4 was started in 1857 but was not immediately finished. One engine furnished blast for all three of the completed furnaces. In 1855 No. 1 made 6,543 tons, Nos. 2 and 3 made 6,547 and 5,996 tons of mill metal from coal measure carbonate of iron ore which was mined in almost horizontal layers in the hills behind the furnaces.[31]

REORGANIZATIONS OF THE COMPANY

Before the works were finished the Cambria Iron Company suffered financial setbacks due to drops in prices for iron and rail. Simeon Draper failed and the company was unable to keep operating. It suspended business in 1854. Philadelphians David Reeves, Matthew Newkirk, George Trotter, and a few others joined together as a group and leased the plant. At this time, John Fritz, the superintendent of the rail mill, arrived in town to oversee the mill's completion. Just when Fritz's crew was able to get the mill into "pretty good shape" the financial problems arose concerning the prior Ohio & Toledo rail agreement. Draper had pledged the property of the company as security for fulfilling the rail contract. No money was to be had to make rails, however, and a United States marshal and county sheriffs appeared to confiscate the property.[32]

"It was a gloomy day for Cambria," Fritz remembered. "The workmen were restless and threatened to quit work."[33] He convinced the marshal and the Ohio & Toledo Railroad to allow him to roll rails for paying customers while also producing the already promised rails. This plan cleared up the problem, "But," according to Fritz, "at all times it [the works] was on the verge of bankruptcy, and the lessee company, tired of being harassed, not only by its own debts, but also by the obligations

30. Ibid., p. 5.

31. Lesley, *Iron Manufacturer's*, pp. 92-93; Engineering Department, "History of the Evolution of the Cambria Plant Bethlehem Steel Company 1852-1935," January 10, 1935, manuscript, p. 2, Bethlehem Steel Corporation Collection (BSC), Center for Canal History and Technology (CCHT), Hugh Moore Historical Park and Museum Incorporated, Easton, Pennsylvania.

32. Shappee, "History of Johnstown," pp. 64-65; John Fritz, *The Autobiography of John Fritz* (New York: John Wiley & Sons, 1912), pp. 101-102.

33. Fritz, *Autobiography*, p. 102.

of the parent company, concluded it must in some way secure more capital. This at that time was no easy matter, especially when the concern was in such a complicated financial position as Cambria then was."[34]

A search was started for new capital in an effort to keep the company going. One of its creditors in Philadelphia was Martin, Morrell & Company. Money was due this firm for goods, and at a meeting of the creditors Daniel J. Morrell, a merchant, was appointed head of a committee to visit the works, recommend ways for the creditors to realize their investments and to save the company from bankruptcy. Morrell recommended more capital be invested and for the company to resume its business. Wealthy Philadelphian Matthew Newkirk was persuaded to invest in the company's stock, and he became company president. George S. King resigned as manager.[35]

Fritz was under tremendous pressure to get the mill operating. Correspondence between him and the Cambria Iron Company owners in Philadelphia reveal the extent of the anxiety. Matthew Newkirk wrote Fritz on August 12, 1854, giving him direction.

> We have purchased the blowing engine of Morris & Co. and it is to be shipped to you immediately and when it arrives I want you to have it st up immediately. They will send you the drawings and have all ready. . . . I want you to turn your main attention to getting all the furnaces to making pig metal as soon as you can.[36]

The pressure on Fritz continued into the coming months to get the plant functioning smoothly. On September 2, Newkirk wrote Fritz:

> We have a contract with the state for 3,500 tons of rails. You must not put the steam on the mill in good earnest or we shall be behind with our debts.[37]

This was followed by a letter from Newkirk's associate, John Anderson:

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34. Ibid., p. 103. According to Cambria County historian Henry Wilson Storey, "it is a fact worthy of note that the profits of this order was the only money that went into the original rolling mill, as Simeon Draper, who had secured the subscription of $300,000, had failed." Storey, *History*, 1: 409.

35. *The Manufactories and Manufacturers of Pennsylvania of the Nineteenth Century* (Philadelphia: Galaxy Publishing Company, 1875), p. 221; Masters, "Brief History," n.p.; Storey, *History*, 1: 413; Shappee, "History of Johnstown," p. 65.

36. Matthew Newkirk to John Fritz, August 12, 1854, John Fritz Collection, CCHT.

37. Newkirk to Fritz, September 2, 1854, John Fritz Collection, CCHT.

> I am pleased to hear you say you are going to turn your attention particularly to the blast furnaces. Finish one as soon as you can and start her then follow with the others as fast as you can. We want you to finish the mill, work as hard as you can and we will furnish you with the necessary quantity of iron and or the kind you want if it can be found. For if we do not begin to press the matter of rails now we shall certainly fall behind with our engagements. . . . I am pleased to see that you are making arrangements to protect the rolling mill against fire as well as you can. . . . We must not let the mill lie idle.[38]

The effort to keep Cambria afloat continued into the winter of 1855. Employee morale declined as the threat of bankruptcy hung over the works. Matthew Newkirk offered some hope to John Fritz in January:

> . . . and say to all the mechanicks and labouring men about the works and furnaces, in the town and country to go on and work with full confidence that they are all going to be paid for their labour and under any & all circumstances; that no man or sett of men shall get any advantage over them. By the 20th of Feby we expect to receive enough cash to settle up our payroll.[39]

Despite his best efforts, Matthew Newkirk failed to find the money for the payroll, and he pleaded with John Fritz to "try and keep your puddlers and rail men at work you may assure them in a short time they will get their pay if they make the iron. . . . You must do all that you can to quiet the men and keep them at work."[40]

Newkirk's efforts soon failed, however, and the company suspended again in 1855. Proper management was needed. It was Daniel Morrell who kept faith in the venture, and formed a new company with new credit. On May 21, 1855, Matthew Newkirk, president, and John T. Kille, secretary, of the Cambria Iron Company, leased the property to the newly organized Wood, Morrell & Co., composed of Charles S. Wood, David Reeves, Richard D. Wood, Daniel J. Morrell, Edward Y. Townsend, George Trotter, Matthew Newkirk, Wyatt W. Miller, William H. Oliver, and Thomas Conarroe. The works were leased for a five-year period, until June 30, 1860. Daniel Morrell gave

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38. John Anderson to Fritz, September 9, 1854, John Fritz Collection, CCHT.

39. Newkirk to Fritz, January 24, 1855, John Fritz Collection, CCHT.

40. Newkirk to Fritz, March 5, 1855, John Fritz Collection, CCHT.

up his home in Philadelphia and moved to Johnstown to manage the new firm's business.[41] (See appendix 16 for biographical data on Daniel J. Morrell. Illustrations 4 and 5 are views of Wood, Morrell & Co. in 1854 and 1856.)

When Wood, Morrell & Co., leased the Cambria Iron Company on May 21, 1855, the property at the plant was worth $192,378.32. The inventory of equipment was as follows:

Lumber	$5,200.00
Red brick burnt and unburnt	1,500.
14 carts	450.
5 wagons	200.
21 head horses	1,890.
Tools, shovels and picks, etc.	600.
12 cars, at $90	1,080.
6 cars, stone, at $60	360.
Coal and ore cars	450.
Foundry tools and flasks	1,000.
Blacksmiths' tools, etc.	1,500.
Machine shop tools, etc.	5,000.
Ore raised	2,000.
Castings for puddling and blast	5,000.
Fire brick	5,000.
Rolls, etc.	2,000.
Bedplates, etc.	2,000.
Squeezers, etc.	2,000.
AT FURNACES	
About 1400 tons metal, part in town @ $40	$46,000.
Addition to charcoal at furnaces	16,000.
Tolls, teams, etc., at furnaces	32,239.03[42]

41. *Manufactories and Manufacturers*, p. 221; Storey, *History*, 1: 414. The properties included 8,570 acres of Cambria Furnace lands, 3,723 Black Lick lands; 5,930 Ben's Creek lands, 5,044 of Mill Creek lands, plus lands along the river and railroad, and in Johnstown. The total acreage was 25,844. The rents were as follows: For one month and eleven days ending June 30, 1855 – "$44,555.55; for the year ending June 30, 1856 – $40,000; for year ending June 30, 1857 – $60,000; for the year ending June 30, 1858 – $70,000; and for the year ending June 30, 1859 – $80,000. Oliver was from New York, Miller from Safe Harbor, Lancaster County, while Trotter, Wood, Wood, Morrell, Townsend and Conarroe were from Philadelphia. In 1855 Charles S. Wood was a merchant at 131 Market, who lived at 327 Spruce. Richard D. Wood, also a merchant, had a business at 127 Market and a home at 421 Arch. Edward Y. Townsend, a merchant at 127 Market, lived at 57 N. 15th. Merchant George Trotter had a business at 36 N. Front and a home at 11 Franklin Sq. Thomas Conarroe was an accountant at 36 N. Front, who lived at 560 N. 7th. John T. Kille was a merchant at 30 N. Front with a home at 240 N. 5th. Daniel J. Morrell was a merchant at 24 N. 4th and lived at 345 Vine. Matthew Newkirk was a merchant at 123 Walnut, who lived in a "cool white Ionic mansion" at SW 13th and Arch. He was active in both Presbyterian church activities and the Union Benevolent Association in Philadelphia. 1855 Philadelphia directory, pp. 99, 293, 397, 414, 561, 563, 611; William Harbeson, "Mediaeval Philadelphia," *The Pennsylvania Magazine of History and Biography* LXVII, no. 3 (July 1943); O.A. Pendleton, "Poor Relief in Philadelphia 1790-1840," *The Pennsylvania Magazine of History and Biography* LXX, no. 2 (April 1946): 171. Abbreviations for city directories are used here for simplicity. For a full citation see the bibliography. The sources used to piece together the business failures of the Cambria Iron Company provide different names of the businessmen involved. All those found are included here.

42. Storey, *History*, 1: 415.

Each of the partners contributed $30,000 and Daniel Morrell and Charles S. Wood received $5,000 per year for their work as active managers. The lease was extended in 1860 for two years, and in December 1861 another reorganization took place, precipitated by the death of several partners. The stockholders of the Cambria Iron Company decided to reclaim the property and operate it, paying Wood, Morrell & Co., funds totaling $51,099.35 for its equity in the works. This occurred on January 1, 1862. However, the bonds came due, and the Cambria Iron Company could not redeem them. Wood, Morrell & Co. bought all the outstanding stock at 10 percent, and paid $160,000 to King and Schoenberger for their old interests. The bonded indebtedness was thus cancelled. In 1862 the Cambria Iron Company was reorganized with Charles S. Wood as president, Edward Y. Townsend as vice-president, and Daniel J. Morrell as superintendent of the works. The lease was abandoned, and the property was conveyed by deed in September 1862. The works kept its original name of Cambria Iron Company.[43] (See appendix 7 for a listing of all Cambria administrations.)

ROLLING IRON RAILS AT CAMBRIA

The first iron railroad rail was rolled at Cambria on June 27, 1854. The Cambria *Tribune* reported on July 31, 1854:

> On Thursday the Cambria Iron Company made a fair and, we are gratified to say, satisfactory trial of the entire machinery of the rolling mill. It worked admirably. Four large T rails were rolled and pronounced perfect by competent judges. Thursday may be regarded as the commencement of an era in the history of the iron manufacture of Pennsylvania, worthy of special remembrance.[44]

The newspaper reported in September 1854 that the mill was producing one hundred rails a day. The first 30-foot rails rolled in America are claimed to have been rolled at the Cambria Iron Company in 1855. They were perfectly made, but were used in the company's tracks because there

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43. *Manufactories and Manufacturers*, p. 221; Storey, *History*, 1: 416-417; Shappee, "History of Johnstown," pp. 65-66. Interestingly, Judge Jos. Masters, a Cambria employee during these years, stated that "We had not one cash payday during the seven year lease with Wood, Morrell & Co. – all orders on their store for goods." Masters, "Brief History," n.p. Short histories of the Cambria Iron Company's unsteady early years of organization can be found in the Johnstown *Daily Tribune*, June 23, 1897, Johnstown *Tribune*, September 15, 1928, and the Johnstown *Tribune-Democrat*, September 17, 1952.

44. Quoted in Storey, *History*, 1: 413-414.

was no demand for them.[45] During the week of May 14, 1859, Cambria's output of iron rails was 722, a record unmatched by any other American mills.[46]

In 1857 the Pennsylvania Railroad Company's directors, Cambria's largest customer for the rails, endorsed Cambria's product: "The iron manufactured at the Cambria Iron Works, at Johnstown, has given the most satisfactory proof of its strength, and if the manufacturers finish it with a good wearing head of refined iron, it will make, I think, the best American rail that I have seen.[47] (For in-depth information on Cambria's technological contributions to rolling rail, see chapter III.)

The iron rails made by the Cambria Iron Company were known for the superior quality and were judged better than others in open competition. They had flexibility which other manufacturers could not duplicate, owing to the quality of ore in Prospect Hill. Winter conditions wreaked havoc on iron rails which often broke, posing great danger to travelers. Daniel J. Morrell frequently told the story of an incident on a western railroad when a flood washed away the foundation of a culvert. The tracks were suspended across it by the Cambria rails, and an engine and train were able to pass safely across. Evidently Morrell was profoundly satisfied by this story and thought it a great recommendation for Cambria rail.[48]

In 1876 the Cambria Iron Company exhibited rails at the Centennial Exhibition in Philadelphia. It chose to exhibit, in addition to products made at the plant, rails which had long histories of service on the line. Eleven rails were shown and their length of service histories provided, along with the two iron rails which bridged the twelve-foot wide, twelve-foot deep gap washed from under the

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45. Swank, "Manufacture,": 11.

46. Thackray, "History of Cambria," p. 5, Acc 1699, BSC, HagM. Iron rails were manufactured in the following manner:

> The ore is taken from the mines near the works, and after being put through the roasting process, which requires some time, it is thrown into the blast furnace, of which there are four in number, capable of running 190 tons per week; thence the metal is transferred to the puddling furnaces, and after undergoing the process of puddling, it goes thence through the squeezers, and thence through the puddle rolls, when it is ready for the heating furnaces. After being heated in the latter, it is prepared for its final rolling into bars. Thomas J. Chapman, as quoted in Storey, *History*, 1: 418.

47. *Tenth Annual Report of the Directors of the Pennsylvania Railroad Co. to the Stockholders, February 2, 1857* (Philadelphia: Crissy & Marley, Printers, 1857), p. 53.

48. Storey, *History*, 1: 420.

Grand Rapids & Ft. Wayne Railroad track, which successfully carried an engine and train of seven cars.[49]

CAMBRIA GROWTH AND EXPANSION

After Wood, Morrell & Co. began leasing the Cambria Iron Company financial footing was surer and in the following years the company and the works continued to grow, becoming by the mid-1870s, the largest iron and steel works in the country. From just a few buildings in the "Lower Works," the company grew to include the Gautier Works and collateral businesses, spread for miles along the Little Conemaugh River in Johnstown and surrounding boroughs. The quality of its iron and then steel rail secured the company's fame and fortune.

From uncertain beginnings in 1852-1853, the works, by 1856, included:

> Rolling Mill, 650 feet by 350 feet, with 56 puddling furnaces and 5 steam engines; a Machine Shop, two stories high, with a Blacksmith Shop attached; a Foundry, with a Pattern Shop upstairs; a Pig-metal House, for storing the metal previous to puddling; a covered Brick-yard, of ample dimensions, in which a small engine furnishes power to grind the clay for two brick-making machines; four Furnaces, of double the usual capacity, two of which only are yet in operation; besides wagonmaking shops, saddler shops, blacksmith shops, carpenter shops, stables., &c. Two hundred dwelling houses are erected for the operatives, besides a boarding-house of three stories, offices, storehouses, &c.
>
> About 1500 men and 300 horses and mules are employed directly in these Works, exclusive of thom engaged at the four other furnaces in connection with them.[50]

(For Cambria's production, wages, and the price of iron rails sold between 1857 and 1875, see appendix 8.)

The three furnaces increased their production throughout 1856, 1857, and 1858.

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49. Cambria Iron Company, Manufacturer of Iron and Steel Railway Bars, Johnstown, Cambria County, Penn'a, *Centennial Exhibition 1876*, 1876, pp. 4-5.

50. A.J. Hite, "The Handbook of Johnstown for 1856," typed manuscript, p. 5.

CAMBRIA Furnaces Nos. 1, 2, 3, 4 (the last not yet lined), stand on the Johnstown flat, and are all of one size and blown by one engine, with 2 cyl. 6 x 6, 15 rev. to blow the three. Steam cyl. 28 inch x 8 feet stroke. The following table shows the time in blast and production in 1856: –

1856	No. 1	No. 2	No. 3	1857	No. 1	No. 2	No: 3	wks.
January	501	520	419		out	875	789	5
February	294½	316	315		for	598	622¼	4
March	541	491	498		repairs	570¼	553	4
April	540	582	545		blown	622	766¼	4
May	565	574	561		in	951	856¼	5
June	536¼	567	483		again	705	568½	4
July	490	511	451		265¼	733½	31½	4
August	went	537	417		799½	875½	went	5
September	out	310	313		746	817½	out	5
October	for	657	669		716¼	797½	for	5
November	repairs	739	627		681	630¼	--	4
December	..	743	698		631	630¼	--	4
Total	3,468	6,547	5,996		3,839¼	8,880¼	4,187	53

1858			wks.
January	797½	954½	5
February	502¼	583½	3

All three furnaces will probably be blown this year, and the Mill Creek and Old Cambria be idle.

The make of No. 2 for the first seven weeks of this year (1858) is seen in the following table:–

		No. of charges.	Tons ore.	Tons coke.	Tons iron made.
January	1st week	315	551,,5	283,,14	194,,14
	2nd week	314	549,,10	282,,12	199,19
	3d week	305	533,,15	274,,10	197,,2¼
	4th week	277	484,,15	248,,6	193,,0
	5th week	242	423,,10	217,,16	169,,3
February	1st week	301	526,,15	270,,18	201,,7
	2d week	285	498,,15	256,,10	201,,12¼
Total	7 weeks	2,039	3,568,,5	1,833,,6	1,356,,18

Average make per week, 194 tons nearly. Proportion of ore to iron, 2,625: 1; that is, the available amount of iron in the ore is 35 per cent. Proportion of coke to iron made, 1.352: 1.–Ore: coke:iron::2⅝ ton:1⅜ ton:1 ton.

Furnace No. 3 was blown in January 2, 1856. In Feb. 1856, casting house, stock house, engine and boiler house were burned down, stopping the furnaces 10 or 12 days. Total of the Cambria Iron Co. production for 1856, 20,956 tons of coke iron, and 1,837 tons of charcoal iron; total 22,813 tons. The coal and ore are mined in the hill behind the furnaces and rolling mill, which a quarry of sandstone caps.[51]

A more thorough description of the works appeared in 1858, and mentioned two developments which would radically affect iron and steel technology – the use of John Fritz's three-high mill and William Kelly's experiments in making steel.

> CAMBRIA Rolling Mill – Is situated on the river flat between the Johnstown depot and Penns. R.R. bridge and the three furnaces. The main building is 612 feet long, and the transept is 372 feet long; the two make a Roman cross, in the head of which (towards the north) are two rows of double puddling furnaces, 25 feet apart, 4 on each side of an alley 25 feet wide: in the right arm (towards the east, are two rows, 5 on each side; in the left arm are two rows partially completed, 4 on each side; and two more turn the corner of the centre and stand on the west side of the beginning of the body of the cross. In line with these last are three heating furnaces and further on, beyond an open space into a side house, there are three more; opposite which, against the east wall, are three pairs more. The centre line of the body of the cross is occupied by two Burden squeezers (at the crossing of the

51. Lesley, *Bulletin*, p. 120.

transept) and a line of much rolls, ending with a powerful engine; and near the south end are the rail rolls set crosswise, with an engine alongside and the saws in front. This engine (30 inc. cyl. and 26 in. stroke) has no gearing, but drives the rail rolls by a rapid and powerful direct action (about 85 per minute), the velocity and power of which can be varied by means of three holes in a solid steel disc instead of a crank. The rail train is three high, being the only ones of the kind in this country, introducing a much more perfect method of rolling heavy iron. Each set of rolls consists not of two but of three, placed one above the other, and massively and accurately housed, by which plan a *return motion* is obtained, and the pile, after passing forward between the lowest and middle rolls, passes back between the middle and upper rolls. So that when a pile happens to gap at the forward end, instead of having to reverse it, and perhaps getting it between the rolls too late to have it weld, it is sent immediately back between the upper rolls and welded perfectly. The operation is extremely beautiful for its rapidity and certainty.–The small house on the west side of the cross body (or nave) mentioned above, contains a small bar mill with boilers and a tall stack outside; but the steam for the great engine and the rail mill engine and a third engine for the two squeezers placed at the S.W. crossing pier (to speak architecturally) is generated over the various puddling furnaces, and conveyed along central steam pipes. A large *tank* stands high up over the great engine. The building was burned down last year, and a new and better plan of roof adopted, giving great strength and plenty of light, and practically fire proof.–North of the north end of the mill is the machine shop and lathe house and forge with six fires, and a stack at the corner. Beyond this to the north is the large foundry building, and then comes the stock yards going towards the furnaces. Here also stands the new experimental furnace, erected under the superintendence of Wm. Kelly, of Eddyville, Kentucky, inventor of a process for refining iron by blowing cold air at a high pressure into the run-out metal similar to the Martien and Bessemer processes. . . . After various late experiments, none of them satisfactory, a small round furnace for re-melting pig has been mounted on columns beside a low Bessemer vessel, into which its metal is run and there blown into. The experiments continue with a result still doubtful. (May 12, '58.) –The workmen's dwellings form a rectangular village between the mill and the railroad.–The production from May 1854 to May 1855 was 2368½ tons. From May 1833 the monthly production was 308, 608, 654, 722, 297, 1038, 810, 836; Jan. 1856 660, 978, 618, 781, 1093, 1168, 881, 1100, 1135, 1522, 1543 and 1406 tons, total in 1856 12,883 tons. The production of 1838 may reach 25 or even 30,000 tons.[52]

Growth continued throughout the 1860s and 1870s as the Cambria Iron Company added collateral companies to its initial operation. Expansion occurred not only in the production of iron and steel, but in the formation and acquisition of related businesses as well. The company began with brickyards and expanded to control transportation means, plant access, raw material and product refining, and other basic needs such as farms to produce hay for company horses. (See appendix 9 for a description of Cambria in 1868 and illustration 6 of the plant in 1863.)

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52. Ibid., p. 149.

In the Lower Works itself expansion occurred after 1869 when the Bessemer steel works were built. (For in-depth information on the Bessemer steel works in Cambria see chapter III.) The rolling mill, occupying seven acres, was almost destroyed by fire on October 12, 1872. In only 10 days a temporary roof was put up, new machinery built, and the mill was in operation. This was replaced by permanent brick and iron fireproof buildings. The Bessemer steel works began operating in 1872 and construction began on another blast furnace, No. 5.[53] The company was authorized on April 2, 1860, to construct a lateral railroad from the Lower Works across the Conemaugh River. The bridge connected with the Pennsylvania Railroad.[54]

Three furnaces were purchased from Watson, Dennison & Co., of Hollidaysburg on July 20, 1863. The Blair Coal and Iron Company was formed to manage the three furnaces in Blair County, known as Chimney Rock, Gaysport and Frankstown. These were located along the Frankstown branch of the Juniata River near Hollidaysburg. The company also obtained the Bennington Furnace at Bennington, near Gallitzin in Cambria County. The Conemaugh Furnace, located three miles northeast of Johnstown, was acquired from George W. Hodges and his wife in 1869.[55]

The Johnstown Mechanical Works, located in Conemaugh Borough, was incorporated November 2, 1864. The 100-employee business included a carpenter shop, machine shop and a shop to manufacture wooden pumps, cutting boxes and sash. There was also a brick foundry and a blacksmith shop. According to a Johnstown city directory, the company had 60-70 employees who worked "in the wood department, in the erection of dwelling houses, and other buildings, bridges, cars, and the like, and the manufacture of doors, sash, flooring boards, moldings, etc., and in the other departments, in engines, machinery, shafting, metal castings, iron, and brass turned work and moldings, and in blacksmith work." The business was tied to the Pennsylvania Railroad via the Cambria Iron Company's internal railroad.[56]

In 1869 the company's lumber mills at Mineral Point had the "best machinery," and manufactured turned wood, sash, wheelbarrows, boards, and heavy lumber for building.[57]

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53. *Manufactories and Manufacturers*, p. 222; A.L. Holley and Lenox Smith, "American Iron and Steel Works, The Cambria Iron and Steel Works," London *Engineering* XXV, (May 31, 1878): 422.

54. Storey, *History*, p. 422.

55. Ibid., Thackray, "History of Cambria," pp. 4-5, Acc. 1699, BSC, HagM.

56. 1869 Johnstown directory, p. 7.

57. Ibid., p. 5.

The Johnstown Manufacturing Company was located in Woodvale. It consisted of a woolen factory, flouring mill, and a "Steam Press Brick Establishment." The woolen factory was a four-story brick building, run by steam power, which contained six sets of wool machinery. Approximately 600 pounds of wool per day was used, with a daily output of 1,200 yards of cloth in 1869. This production increased to monthly output of 50,000 yards of finished kerseymeres in 1878. The products were sold in Johnstown, New York, Philadelphia, and places west. Hiring preference was given to widows and daughters of mill workers, offering the sole employment for women in the entire Cambria complex. The brick establishment supplied pressed brick for the Johnstown market, and probably for the Cambria Iron Company as well, since it was the parent company. The Woodvale Flouring Mills were also located nearby, producing 100 barrels a day in 1878. Another flouring mill was in Hollidaysburg.[58]

Cambria also had controlling interest or owned the gasworks and waterworks. Water was supplied from 10 miles away, and was used both in town and in the mills.[59]

Josiah H. Gautier moved his steel products company to Johnstown from Jersey City, New Jersey, in 1878 to be near sources of raw materials and to tie into western markets. The plant was built on the south bank of the Little Conemaugh River on what was called the "Island," the junction of the western water route with the Allegheny Portage Railroad to the east. For three years Gautier was a distinct subsidiary of the Cambria Iron Company and was a limited partner. Its capital was $300,000, which was increased in May 1879 to $500,000. The firm's members included Daniel J. Morrell, George Webb, Daniel N. Jones, Josiah H. Gautier, Thomas B. Gautier, and Dudley G. Gautier. In July 1881 the partnership was dissolved, and Daniel J. Morrell, Powell Stackhouse, and W.S. Robinson were the liquidating trustees. After December 1881 the Gautier works were a department of the Cambria Iron Company.[60] (See appendix 10 for Gautier trade catalog.)

The Gautier Department was bounded by the Conemaugh River and Center Street, on the east by the Woodvale Bridge, and on the west by the Cambria railroad bridge. In 1888 the department had a brick building 200 feet by 500 feet where wire was annealed, drawn, and finished. A 50 feet

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58. Ibid., pp. 7-8; Holley and Smith, "Cambria Iron and Steel Works," XXV: 422. Kerseymere is a "fine woolen fabric with a close nap made in fancy twill weaves." *Webster's Third New International Dictionary*, 1971, p. 1238.

59. Holley and Smith, "Cambria Iron and Steel Works," XXV: 422.

60. Storey, *History*, I 432-433; Thackray, "History of Cambria," p. 8, Acc 1699, BSC, HagM. Gautier was a Frenchman whose products were known for their qualities of precision and finish. In 1925 the term "Gautier Finish" was a synonym for the "highest class of bar products, with respect to accuracy, size, finish and, quality." Ibid.

by 256 feet building contained the barb wire mill where the famous "Cambria Link" barb wire was made. A merchant mill building 725 feet by 250 feet produced wire rod, shafting, springs, plow shares, rake, and harrow teeth and agricultural steel. A cold rolling shop also operated.[61]

The entire Gautier Department was destroyed in the May 31, 1889, Johnstown flood. The only remnants were foundations and portions of engines and roll trains. The Cambria Iron Company leased a mill in Cumberland, Maryland, which it used until the Gautier mills were replaced.[62]

CAMBRIA AT ITS HEIGHT

In 1855 the Cambria Iron Company produced 10,000 tons of iron rails, and every year after the company's output equaled 10 percent of all rails rolled in America. By the mid-1870s it was the largest iron and steel works in the country. The company rolled rails for many railroads, including the Union Pacific Railroad, part of the first transcontinental line. Before the Civil War Cambria and the Brady's Bend Iron Works produced one-seventh of the 150,000 tons of rail made in the country. In 1873 the plant produced 30,000 tons of coke pig iron, while the Bessemer plant produced 28,479 tons of steel rail. In 1876 these works rolled the largest aggregate tonnage of rails that had been rolled in one year by one mill in this country up to that time. Total production reached 1 million tons, and the works had the capacity to produce 100,000 tons of iron and steel rails per year. In that year, 103,743 tons of rails were produced, of which 47,643 tons were iron rails and 56,100 were steel rails. In 1876 the company produced 1,800 to 2,000 tons of rails per week, and by 1882, 125,000 tons per year. Production of steel ingots by 1887 averaged between 800 and 900 tons every 24 hours.[63] (See illustration 7 for "nip and break" test of steel rails in 1876. See illustrations 8-12 for the Cambria Lower Works in 1874, 1875, 1876 and two undated stereoviews.)

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61. General Manager to R.E. Hough, Quincy Bent, Kenneth B. Lewis, October 13, 1947, Folder: SM History-Johnstown Plant, Acc 1699, BSC, HagM.

62. Storey, *History*, 1: 433.

63. Bennett, "Iron Workers," p. 154; Cambria Iron Company, *Centennial Exhibition*, 1876, p. 8; Engineering, "History," p. 3; Pearse, *Concise History*, pp. 172-173; Swank, "Manufacture,": 11. George W. Hughes, "The Pioneer Iron Industry in Western Pennsylvania," *Western Pennsylvania Historical Magazine* 14 (1931): 216; Bining, "Rise of Iron Manufacture,": 250-251. In 1876 the company offices were located at 218 S. 4th in Philadelphia. Edward Y. Townsend and John M. Kennedy were the general managers, along with Daniel J. Morrell. Townsend lived at 1903 Spruce while Kennedy lived at 1423 Arch in Philadelphia. Morrell was listed in the Philadelphia city directory as having a home in "Cambria co." 1876 Philadelphia directory, pp. 274, 823, 1097, 1504, 1630. Industry analyst John B. Pearse offered an assessment of the company in 1876: "The commercial management of the company has been very successful, and both by precept and by example it has long been one of the mainstays of the interests of American industry." Pearse, *Concise History*, p. 167.

According to historian John William Bennett, Cambria employed workers at all stages of iron and steel production along with support positions. The following workers were employed in 1874-1875:

220	ore miners	60	foundrymen
300	coal miners	50	blacksmiths
60	coke burners	40	brick masons
110	furnacemen	25	stone masons
400	puddlers	10	painters
50	heaters	20	wagonmakers
175	teamsters	270	laborers
300	steel mill hands	950	rolling mill hands
100	machinists	30	carpenters[64]

In 1878 a total of 4,075 employees worked for the company in its various departments:

Mines and coke yards	350
Blast furnaces	400
Bessemer steel works	375
Rolling mills	1000
Shops	550
The Blair Iron and Coal Company	900
Wood, Morrell, and Company [company store]	500
Total	4075[65]

An eyewitness account of Cambria's fortunes appeared in 1878, written by one of the industry's best informed critics, Alexander L. Holley. (See chapter III for Holley's activities regarding obtaining the Bessemer process for Johnstown.) In a series of articles appearing in London *Engineering*, Holley not only provided details of the company's history, but information on the plant's layout, machinery, and operating procedures as well. The Cambria Iron Company's best years were thus documented. (For a map of the lower works in 1878 with Holley's description of the buildings, see appendix 11. For drawings and description of the boilers and blowing engine, blast furnace, and a wire rod train and Siemens' heating furnace at Cambria in 1878, see appendixes 12-14.)

In 1878 the works extended over sixty acres of land; the rolling mills alone covered seven acres. Company-owned land extended throughout seven Pennsylvania counties (Cambria, Indiana, Westmoreland, Somerset, Bedford, Blair, and Huntingdon) and totaled 46,403 acres, of which

64. Bennett, "Iron Workers," p. 153.

65. Holley and Smith, "Cambria Iron and Steel Works," XXV: 423.

41,000 acres contained iron or coal or both. Mining operations occurred in four counties (Cambria, Blair, Huntingdon, and Bedford) while smelting took place in Cambria and Blair counties. Railway lines crisscrossed company property. More than 56 miles of standard (4 foot, 8-1/2 inches) and narrow (36 inches) gauge railroad existed; 22 miles of this line was underground. Thirteen locomotives hauled coal and ores from the mines to the blast furnaces and mills, and the pig metal to respective work sites. About 700 standard gauge cars carried coal, coke, ore and limestone while 1,000 narrow gauge cars carried ore and coal.[66] The Pennsylvania Railroad carried finished products to east, west and northwest markets directly, while southwest markets were reached by slackwater navigation of the Ohio River out of Pittsburgh.[67]

Alexander Holley compared Johnstown to Pittsburgh in that it was located in "the area of an amphitheatral cutting in the lower coal measures" formed by the Stoney Creek and Little Conemaugh River to form the Conemaugh, "just as the Monongahela and Allegheny rivers have hewn out a seat in the upper coal measures" for Pittsburgh. The slopes of Johnstown's amphitheater were terraced with coal bed outcrops, surmounted with carbonate iron ore, capped with barren earth. The coal and iron beds were opened above water level and mined at minimum cost. The large body of coal and iron ore lands in the various surrounding counties allowed the company to carefully select specific coal and ore used in the processes involved with making iron and steel. According to Holley, the possession of abundant raw resources allowed the company to "control and regulate supplies, to produce with the utmost economy, and to combine the wide selection of ores and fuel at its command, so as to produce the very best materials of each kind. They [the resources] also render the company independent of the fluctuations and vicissitudes of the general market, and enable it to sustain a high degree of uniformity in the quality of its productions."[68] (For Holley's descriptions of the Cambria Iron Company mines see appendix 15.)

Johnstown's fledgling iron and steel industry at Cambria went through several stages of change which paralleled and at times, even preceded, that of the industry as a whole. From 1830-1855 the industry was characterized by the production of pig iron in blast furnaces while refining

66. Ibid; 422.

67. Ibid.

68. A.L. Holley and Lenox Smith, "American Iron and Steel Works, Works of the Cambria Iron Company," London *Engineering* XXV (June 21, 1878): 485, 487. For a detailed description of Johnstown's coal resources in 1873, see James MacFarlane, *The Coal Regions of America: Their Topography, Geology, and Development* (New York: D. Appleton and Company, 1873), pp. 176-178. For a discussion of geographical factors which affect the location of iron and steel mills, including raw materials, proximity to markets, water supply, and availability of transportation facilities, see John E. Benhart, "Location Factors and Location Theory Influencing the Iron and Steel Industry," *The Pennsylvania Geographer*, X, no. 4 (December 1972): 3-11.

processes took place in forges and foundries. The work was not integrated at a single location. This was true of the early King and Shoenberger enterprises. The location of their blast furnaces was determined by the location of ore and charcoal resources. Their goods were sold locally and the surplus shipped to Pittsburgh.[69]

The expansion of the railroad changed the industry. From 1855-1870 the refining and smelting processes were integrated to satisfy the appetite of the new market for rails. Competition with England to meet demand meant that the plantation pace of life at rural blast furnaces was at an end. Railroads insisted on high volume and prompt deliveries, and the older refineries were not capable of meeting the need. Technical problems had to be solved, such as building a rolling mill which could produce a high volume of rails. Cambria was in the forefront of this change. The need to operate the rolling mills continuously meant that greater control over raw resources was required. Backward integration was the result as a rolling mill could devour the output of several blast furnaces. The substitution of coal for wood as furnace fuel moved the furnaces away from the forests and toward coal fields. The development of the puddling process, which superceded hammering to reduce carbon in the metal, was another technological change. All of these developments led to the integration of the blast furnace, puddling furnace, and rolling mill. It was at this time that the Cambria Iron Company was established, with the raw resources, smelting, and refining processes all on-site.[70]

The next era of development in the industry involved the discovery of the Bessemer process. Here again, experiments at Cambria led to some of the technological changes which fed the spectacular growth in the industry. Mechanization, increased scale and mass of the operation, high costs, and organizational structure all followed, as Cambria entered the age of steel.[71] As early as 1860 the Cambria Iron Company was one of four iron mills in America with more than 1,000 employees. By 1870 both Cambria and Bethlehem Steel were the only steel plants with more than 2,000 employees, and Cambria was one of the largest, if not the largest iron and steel mill in the United States. By 1880, after the Bessemer steel process was in place and the Gautier Works were absorbed, Cambria was the largest iron and steel company in America. Its nearest competitor was Lackawanna Iron and Steel Company, with a thousand less employees, and the only other American

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69. Dennis P. Kelley, "The Contrasting Structures of Johnstown, PA. Binghamton, N.Y., 1850-1880," Ph.D. dissertation, University of Pittsburgh, 1977, pp. 18-20, 30.

70. Ibid., pp. 21-26, 30.

71. Ibid., pp. 27-30.

industries which approached Cambria's size were a few textile mills. In 1897 the company had a capital stock of $8 million, employed 7,600 people, and produced rails, axles structural beams, and materials for agricultural implements. By 1900 Cambria was one of four plants to employ more than 8,000 workers, and only two plants, Jones and Laughlin in Pittsburgh, and the Homestead complex in Homestead, Pennsylvania, compared in size.[72]

In terms of steelmaking capacity, Cambria was among the largest in 1880. Four companies in the East had the capability to produce over 100,000 tons of steel, including Albany and Rensselaer Iron and Steel Company, 180,000; Lackawanna Iron and Steel Company, 168,000; Bethlehem Steel Company, 135,000; and Pennsylvania Steel Company, 250,000. To the west of the Alleghenies, the Cambria Iron Company could produce 20,000 net tons of ingots; Edgar Thompson Steel Works, 450,000; and the Cleveland Rolling Mill Company, 110,000. Out near Chicago, the Joliet Steel Works produced 150,000 tons, and the North Chicago Rolling Mill Company produced 200,000.[73]

The Cambria Iron Company was founded in response to a need – a need for ending American dependence on foreign iron imports, and for promoting the domestic production of iron rails to feed the expanding railroad system. The company faced difficult economic times in the first years of production, but through refinancing and belief in the company's potential, its owners and workers kept the iron rails rolling. The risks were tremendous; John Fritz was experimenting with unknown processes and untried machinery, sometimes to the opposite of what management wanted. All of the experimentation was a learning process; learning how ore reacted under heat, learning how pieces of machinery fit together, learning how much stress a wheel or a bar could take, learning how much heat and stress an iron worker could withstand.

All of the learning led to even newer discoveries which fueled the forces of industrialization. Cambria workers were involved with the process of making steel from the first experimentation to building steel plants from the ground up to witnessing the impact steel had on the American landscape. The Cambria Iron Company did not retain its technological or production dominance, but it did remain a contributing force in the field as an independent steelmaker for many years.

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72. Bennett, "Iron Workers," p. 152; Hogan, *Economic History*, 1: 95, 933.

73. Hogan, *Economic History*, 1: 235.

CHAPTER III: TECHNOLOGICAL CONTRIBUTIONS OF THE CAMBRIA IRON COMPANY

Several years of seemingly endless experimentation and testing accompanied the change in technology from ironmaking to the production of Bessemer steel. Not only was the process of making Bessemer steel little understood, but all new infrastructure was needed to make the rails and other steel products. Iron plants had to be completely redesigned and processes integrated for a company to be able to produce Bessemer steel cheaply and efficiently. A handful of iron experts were the ones who not only took the lead in developing the steel processes and machinery, but who also had the vision of what a strong steel industry would do for America.

Many of the leaders in the field had some connection with the Cambria Iron Company. After early years spent in Johnstown, using trial and error to perfect both machinery and steelmaking, they went on to greater glories in their work for other companies. Several lived long enough to see how the fruit of their labors changed most Americans lives.

JOHN FRITZ AND THE THREE-HIGH MILL

In 1854 when David Reeves, Matthew Newkirk, and George Trotter leased the Cambria Iron Company they sent for a mechanical genius named John Fritz to come and complete the mill and be its superintendent. (See appendix 15 for bibliographical information on John Fritz.) Fritz and his family arrived in Johnstown at night, and to him the town seemed a "dark and uninviting place. Looking down the Conemaugh in the direction of the works, the only light that could be seen was the reflection from the coke ovens."[1] After taking a "birds-eye" look at the plant Fritz took a look at the unfinished mill and was not happy. He did not like its design, but thought the construction was too far advanced to change. He was resigned to completing the plant as designed even though he knew trouble lay ahead. A glaring problem was that the operating blast furnaces were producing inferior metal.[2] (See illustration 13 of 1853 rolling mill.)

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1. Fritz, *Autobiography*, p. 91. Fritz provided a humorous recollection of his first impressions of Johnstown:

> The next morning, while waiting for breakfast, I went out to see how the town looked in daytime, and I can truly say it was the most unattractive place I had ever been in. The streets were of clay, or rather of a dark loam, and organic matter; the sidewalks, with few exceptions, were of boards or plank, and in a great part of the town were of the same material as the streets. Cows, hogs, and dogs, all ran at large; the dogs would get after the pigs, they would squeal, the cows would bawl, the dogs would bark, and fight. I should have been amused if I had not been there to stay. Ibid.

2. Ibid., pp. 91-92.

A description of how iron rails were handled is needed to understand Fritz's frustration. Rails were made on a roll "stand" consisting of two large, grooved rolls. The iron was passed successively through smaller and smaller grooves until it was rolled from an iron bar into a finished rail. The iron bar, or "pile," was made of wrought iron strips welded together by rolling or hammering. A steam engine operated the rolls in one direction only, so the rail was passed back over the rolls each time before the next "pass." The operation took time, during which the rail cooled and became brittle. Then the rails would split in the rolls with the welding in the rail piles coming loose. The rail would cool further as it was fixed. All of these problems cost money and time, in addition to damaged machinery.[3]

As thought, Fritz's first efforts at rolling rails were failures:

> When we at last got to work and rolled a few rails, the edges of their flanges looked like saw-teeth, and the head was rough and full of small holes, and everybody about the mill, from the owners to the water-boy, was disgusted and sick. This was especially true concerning the heaters and the men about the rolls, for they were paid by the ton of finished rails. It was the general conclusion that something would have to be done, and right quickly, too. There were three charcoal blast-furnaces that belonged to the company, one of which happened to be in blast at the time, so we got some charcoal-pig and puddled it and rolled it into covers for the bottoms of the rails, the common iron being above them. These piles were rolled so as to put the charcoal-iron on the edges of the flanges. This worked pretty well as far as the flanges went, but it did not cure the trouble with the heads; so we had to roll other covers for the tops of the piles, to make the head of the rail good; and with hot and cold patching, and a liberal use of putty, we managed to get some rails that passed muster. By continually experimenting in the piling of the iron, and changing mixtures, we finally got out some fairly good rails; but the engine and fly-wheel driving the train were of such a construction that it was not safe to run it over fifty revolutions per minute, which was too slow to make rails out of the materials we were using.
>
> One of the most serious troubles was, that the forward end of the pile would split open in the rolls, so that, when we came to enter it in the next pass, it refused to go in, and much time was lost in bunting it in the buggy, consequently cooling the pile to such an extent that, when the rolls did get hold of it, spindles, coupling-boxes, and sometimes the rolls themselves, would break, causing both expense and

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3. Temin, *Iron and Steel*, p. 104. Rolls, either two, three, or four of them, were mounted in a "roll stand" or a "stand." When two or more stands were geared or belted to each other so they can be used in sequence, the sequence was called a "train of rolls" or a "train." More than one stand was needed to have a train. Iron and steel used for railroad rails exhibited two metallurgical phenomena called "cold short" and "red or hot short." If iron is cold short it is cold and will not withstand rolling; instead it will break into particles. If the iron breaks up after it is heated to a red heat it is hot short. Iron was going to be cold short or red short regardless of the rolling begins. Rolling was easiest with hot metal, so Fritz and his men tried to reduce the metal into rails as much as possible while the metal was hot. If the metal cooled too much, rolling was impossible because the rolls were not strong enough to perform the work. Donald Sayenga to Sharon Brown, n.d.

> delay, which, in connection with the general depression in business, led to troubles that brought the enterprise to an end.[4]

By the time Fritz's crew was able to get the mill into "pretty good shape" the financial problems occurred with the Ohio & Toledo Railroad agreement for rails. (See chapter II.) Only after all the financial problems were solved, and Wood, Morrell & Company came in as the plant's lessees, was Fritz able to devote his time to solving the problem of making quality iron rails. His previous failures had led him to make a fateful decision: "I had now fully made up my mind that there was not one thing to do and that was to build practically a new mill, making it three-high.[5]

Fritz received permission to build a totally new mill only after considerable time and difficulties convincing Wood, Morrell & Company's managers and stockholders of the necessity of the changes. In his view:

> To continue to run the mill as it was, I could see nothing ahead but a most disastrous failure. Having previously given the whole subject my most thoughtful considerable, even to its most minute detail, I was prepared to submit my plans and recommendations to the new company. My proposal was to build a new train of rolls, three high, and twenty inches in diameter. This involved a new engine that would run with safety one hundred revolutions per minute, and it practically meant an entirely new mill.[6]

He convinced some of the representative stockholders of the necessity of the changes, and the matter was then taken up before the board, which decided to build an 18-inch, two-high train to replace the one the company possessed. This was a "severe setback" to Fritz, who announced he would not build such a mill, "as it would be money thrown away and time lost."[7] The board accused Fritz of being "high-handed and most arbitrary." He assented to this but told them "if they persisted in running their works on the lines they had laid down for me, there would be a humiliating funeral, and I did not want to remain to attend it, especially as one of the mourners."[8]

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4. John Fritz, "Early Days of the Iron Manufacture, Presidential Address at the Bridgeport Meeting of the American Institute of Mining Engineers, October 1894," Author's Edition, 1894, p. 8.

5. Fritz, *Autobiography*, p. 97.

6. Ibid., p. 108.

7. Ibid., p. 109.

8. Ibid.

The board finally agreed to let him build a mill, only an 18-inch diameter roll instead of 20 as Fritz wanted.

Just when the patterns were completed, the managing directors were notified in a legal document that they would be held responsible by the minority partners in the firm for building the new mill. "This was a most unexpected setback," for Fritz and once again the directors tried to convince him to build another two-high mill. Fritz understood the dilemma the managers were in. They would be responsible for Fritz's untried plan. "On the other hand, I was absolutely refusing to build the mill they wanted, and besides all this, they ridiculed the idea of adopting a new and untried method that was against all practice in this and the old country, from which at that time we obtained our most experienced iron workers."[9] Not only did prominent iron makers in the country tell Daniel Morrell that Fritz was "crack-brained" and the experiment would fail, but the heaters and rollers all opposed the mill.

Fritz remembered how the decision to go ahead with the three-high mill was made:

> As I now look back to that eventful Sunday morning, many long years ago, sitting on a pile of discarded rails, with evidences of failure on every side, Mr. [E.Y.] Townsend and myself quietly and seriously talking over the history of the past, the difficulties of the present, and the uncertainties of the future, I cannot but feel, in view of what since has come to pass, that it was not only a critical epoch in the history of the Cambria Company, but that as well the future well-being of my life was in the balance. For, as Mr. Townsend was about to leave, after a full discussion of the Cambria Iron Company's condition at that time, he turned to me and said: "Fritz, go ahead and build the mill as you want it." I asked, "Do you say that officially?" to which he replied: "I will make it official," and he did so; and here I wish to say that to no other person so deservedly belongs the credit, not only of the introduction of the three-high-roll train but also of the wonderful prosperity that came to the Cambria Company, as it does to Mr. Edward Y. Townsend, then its Vice-President.[10]

The work proceeded with great speed. In building the rail train John Fritz broke away from the practice of placing breaking parts, such as coupling-boxes and spindles, on the mill. These parts were designed to break under stress to prevent more severe damage to the mill. Fritz thought these a nuisance and left them off, taking the chance of having major damage occur rather than the continual stoppages when the breaking parts failed. He also changed the breaking-box on top of the

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9. Ibid., p. 110.

10. Ibid., pp. 110-111.

rolls which held them in position. This box was hollow, to crush under strain, but Fritz had the pattern-maker make the box solid.[11]

The three-high roll train eliminated much unnecessary labor and saved much time. Instead of having to be carried from back to front to roll the iron again through the grooves in a two-high roll, a bar or ingot could be rolled in one direction through grooves in the bottom two rolls. The iron was then rolled in the opposite direction through the grooves in the top two rolls. Two rails could even be rolled at the same time, with one moving in one direction and the other moving opposite.[12]

The old mill was stopped on July 3, 1857, and was torn out after the Fourth of July. The rail department was remodeled and the floor line raised two feet. On July 29 the mill was completed. It was an "extremely anxious time" for Fritz. The heaters were all opposed to the idea so the "most reasonable" among them was chosen to heat the piles; the furnace had been kept smoking for a few days "as a blind." After six piles were charged everything was finally ready.[13]

John Fritz recalled the first attempt at rolling rail on the new mill:

> At about ten o'clock in the morning the first pile was drawn, and it went through the rolls without the least hitch of any kind, making a perfect rail. You can judge what my feelings were as I looked upon that perfect and first rail ever made on a three-high mill, and you may know in part how grateful I felt toward the few faithful and anxious men who were about me and who stood by me during all my trials and difficulties, among whom were Alexander Hamilton, the Superintendent of the mill, Thomas Lapsley, who had charge of the rail department, William Canam, and my brother, George.[14]

The group then began rolling the other five piles, but after two more "perfect" rails were rolled the engine malfunctioned because it was not monitored; the men were all watching the rolls. Time was needed to straighten the bent eccentric rod and reset the valves, so the remaining piles were drawn from the furnace. The heaters, hearing the engine, came into the mill and saw the unrolled piles on the floor. Thinking the roll train was a failure they made uncomplimentary remarks, but were chastised by Alexander Hamilton who told them "that if they would go down to the other end

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11. Fritz, "Early Days," p. 7.

12. Bennett, "Iron Workers," p. 18.

13. Fritz, *Autobiography*, p. 114.

14. Ibid., pp. 114 115.

of the mill they would see three handsomer rails than had ever been made in Wales, where the greater part of the rails used in this country at that time came from, as well as the heaters who were so bitterly opposed to the three-high mill."[15] (See appendixes 17 and 18 for the remembrances of Patrick Graham, a worker involved with the first trial of the new rail mill and for John Fritz's patent for the three-high mill, and illustration 14 of the three-high mill.)

Two shifts worked the next day, a Friday, and on Saturday rolling was stopped about twelve noon. Fritz left the mill about 6:00 p.m., only to hear the fire-alarm an hour later. He rushed back to the mill and saw "one mass of flames from one end to the other," realizing that no part of the mill could be saved. It was essential to save the shops, which were close to the mill building; the machine shop was within 25 feet of the mill. All of the shops were frame with wood shingle roofs, and all – pattern shop, foundry and machine shop – were "regular fire traps and all huddled together." A company boarding house was nearby and Fritz ordered men to obtain carpets and blankets, while others got ladders, fire hoses, buckets, ropes, and hooks in an attempt to save the shops. The mill burned within an hour and fortunately it fell inward, thereby avoiding more disaster.[16]

John Fritz remembered his feelings at the end of the day:

> The situation of Cambria affairs on that Saturday night was such as might appall the bravest heart. The result of our unremitting labors and anxieties lay there, a mass of black and smoking ruins, and the money that had been so hard to get, with which the new mill was built, was gone. The prospect was gloomy, but there was a gleam of light amid all the darkness, and that the pile of new and perfect rails which Mr. Hamilton had said had never been beaten by Wales, . . . Above all, the mill had been tried and was a most magnificent success, and it was these two facts that cheered us up and renewed our courage with a determination to rebuild the mill.[17]

By Monday night the mill was clear of rubbish; rebuilding began on Tuesday. Twenty-eight days after the fire the mill was running full time, but with only a temporary frame for a building. Fritz insisted the building be rebuilt with brick, and it was finished by January 1, 1858. Construction

15. Ibid., p. 115.

16. Ibid., pp. 116-117.

17. Ibid., p. 118.

occurred above the heads and all around the mill workers who kept at their jobs producing rail.[18] This was a very difficult time for Fritz, worried about his workers' safety: "I was on the building while every member of every truss was being raised and put in place. This was the most trying ordeal that I ever had. The falling of a member of the truss, or a bolt, nut, wrench or tool of any kind, striking a man on the head, would cause instant death; and no person but myself knew what a load was off my mind when the last truss was in place, and I came down off the building for the last time.[19] (See appendix 19 for a description of the new mill building and of changes incorporated in the puddling furnaces and coke ovens.)

Two authors, Lance Metz and Donald Sayenga, have noted that the use of small three-high mills was well known to many American iron masters, including Abram S. Hewitt, who knew of them being used in France and other European countries. Fritz may have also gotten his inspiration from William Truran's *The Iron Manufacture of Great Britain*, published in 1854, which described features of the three-high mill utilized in Fritz's mill patents, and which mentioned that the mill was used to make rails. A copy of this text located at the center for Canal History and Technology in Easton, Pennsylvania, is noted with a handwritten inscription of Reeves, Buck and Company. David Reeves was a partner in Wood, Morrell and Company, so it is possible that John Fritz saw and utilized the ideas presented within the book.[20]

In June 1858 John Fritz attempted to obtain patent rights for his new mill. He hired A.B. Stoughton, a patent agent to process the application wherein he described a new way to roll rails and other iron shapes. An application was filed. The patent office, however, rejected the application on June 24, 1858. The examiner cited several prior inventions:

> For the same invention see Truran on Manufacture of Iron in G. Britain pages 153-4. See also [?] appl of Wm Borrow for rolling bar iron July 27/53, and the patent of Stephens & Jenkins June 1, 1858. Guides to direct the bar into & out of the rolls have before been used, & to retain the rolled article in shape see Benj Norton's patent for rolling iron Sept 25, '46.[21]

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18. Ibid., pp. 118-120.

19. Ibid., p. 120. John Fritz authored a short article about the first use of the three-high roll mill which parallels the version given later in his autobiography. See John Fritz, "The First Three-High Roll Train," *Cassier's Magazine* 7, no. 6, April 1895, pp. 468-472.

20. Lance E. Metz and Donald Sayenga, "The Role of John Fritz in the Development of the Three High Rail Mill, 1855-1863," typed manuscript, n.y., pp. 1, 11-12.

21. [name unintelligible] to John Fritz, June 24, 1858, photocopy in John Fritz Collection, CCHT.

The Cambria Iron Company was extremely interested in obtaining the patent for Fritz's work, and an attempt was made to rewrite the patent. The inventors Stephens & Jenkins were approached, and they disclaimed rights to parts of the Fritz mill. The words "three high rolls" were added to the patent, and Stoughton reapplied to the patent office. He asserted to the commissioner of patents that John Fritz's patent specified special arrangements of the rolls which did not appear in any of the references, "viz: rolling down of the fin formed at each pass, *without turning over the bar or beam.*" Stoughton also stated that Fritz could "roll a much longer bar at one heat than has ever been done before, and secondly that he can roll out *twice as long a bar*, at one heat, than has been ever done before." Fritz did not claim to first invent "three high roll", rather he claimed the "so arranging of the high rolls" &c, as will produce, what he believes never has been heretofore produced by any other person." As far as the guides were concerned, Fritz did not claim to have invented them, instead, he claimed a "special kind of guide viz: A *yielding one,*" that would "follow the roll every time it (the roll) is adjusted, . . ." with these claims Stoughton asked that Fritz's patent be reconsidered.[22]

The effort was successful because the patent office granted John Fritz patent no. 21,666 on October 5, 1858. It was based on the arrangement of three-high rolls to roll down fins, and on the yielding guides which followed faster rolling.[23] The three-high rail train became the industry standard. By 1865 John Fritz's invention was used in one-third of all the country's rail mills. By 1880 the three-high rolls were used exclusively.[24] A description of the machinery, written in 1876 by John B. Pearse, manager of the Pennsylvania Steel Company, provided details of the operation:

> This really consists of 2 pairs of rolls, the middle roll being the *top* roll of each pair, and the 3 rolls lengthened enough to receive the additional passes necessitated by inability to use the same *forming pass* on both sets of rolls. The uppermost roll is thus the bottom of the second set, and Mr. Fritz's invention consisted in arranging *hanging guards*, kept up against the roll by weights pulling vertically, and connected inside the fulcrum of the guard (or lever); also, in so forming the successive passed that a rail can be rolled always with the same side up (without turning over, and so that no seams or fins would be formed on the flanges. This was done by reducing the section somewhat at the point where, in the next pass, it is pressed against an opening between the *former* and the collars which make the *pass*. Further, a feeding-roller was arranged in front of each set of rolls, so to speak, to facilitate the introduction of the bar between the rolls. Thus no time was lost in returning the

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22. A.B. Stoughton to Hon. J. Holt, Comm of Patents, September 17, 1858, photocopy in John Fritz Collection, CCHT.

23. Metz and Sayenga, "Role of John Fritz," p. 18.

24. Bennett, "Iron Workers," p. 18.

> bar to the front of the rolls, as in the *2-inch* sets, nor in turning the bar over, and the immediate effect of this was to increase the product over 30 per cent. In the usual 3-high rolls it is extremely difficult to roll an accurate rail section both halves of which shall be alike, as is required in Europe. In order to meet this difficulty, which in one case I have known to destroy a set of rolls in the course of adjustment, Mr. John Fritz has since, at Bethlehem, built an improved form in which the middle roll is fixed and the top and bottom roll accurately held and adjusted by stout screws, the whole so arranged that the rolls can be very easily changed.[25]

John Fritz continued his work at Cambria for several more years. He overcame management and labor difficulties by coercing men to work together for the good of the company and by training mechanics. They were "desirous to learn and energetic," proved themselves up to the work, and by the time the mill was in good operating condition, "the Cambria Works had," according to Fritz, "the best set of men about them in the country. In proof of this I can point with pride to the number of men that have gained prominent positions in other works. The training they received at Cambria was such as to well qualify them to fill any position they might assume. The men would frequently say that all the passport they wanted was to say they had worked in the Cambria Iron Works."[26]

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25. Pearse, *Concise History*, p. 166.

26. Fritz, *Autobiography*, pp. 126-128. In a speech made in 1894 John Fritz paid further homage to the men who worked with him in these early efforts:

> I would not feel that I had done my whole duty in my reference to the iron-making of the past, in which I had a part, did I not place on record my admiration of, and my obligation to, the trusty, faithful and stalwart men who during these many years, from time to time, I had about me. They were, for the most part, uneducated young men from off the adjoining farms, or had received their training as woodsmen or as workers in the collieries, charcoal-furnaces, or bloomeries scattered about in the hills; they knew little of science or of school-training; but they were courageous, faithful, hard workers, who knew nothing of short hours or of resting when there was important work to be done, and they had lots of good common-sense, which helped them and me out of many a tight place. There were, in addition . . . a large number of puddlers, who, for the most part, in the early days of iron-making, were Welshmen, and in addition to their being skillful iron workers, generally good men and good citizens. Fritz, "Early Days," p. 15.

> Improvements were constantly made on the machinery. Fritz described changes in the rail roll workings:

> . . . the mills, practically speaking, were all geared, and all the trains of rolls were driven by one engine of long stroke, consequently slow-running, the power being transmitted from the engine to the rolls through gear wheels, with the diameter 50 arranged as to give the roll trains the proper number of revolutions per minute, the engine practically running at a given speed all the time. The shafts at that time were of cast iron and the space on the shaft occupied by the wheel was increased in size. The shafts were generally hexagonal, but sometimes were cast square and the wheel was secured in its position by hard-wood keys about one-half to three quarters of an inch in thickness. After the wheel was set true and the space between the wheel and the shaft all driven full of hard wood, wedges of thin steel were driven in the wood on both sides of the wheel. While this was not at all mechanical, yet if the wood was hard and dry, and if the work was well done, they gave but little trouble. The housings that contained the rolls were used just as they came out of the sand. Practically no work was done on them at all, except to chip the bumps or swells off the casting. The housings rested on a narrow shoe that was bolted to a large timber placed on the top of the foundation; the plate had lugs cast on it corresponding to the size of the base of the housing; the lugs were dovetailed and the base

As machinery changed a different type of worker was required. Millwrights were no longer needed; the machinist who was skilled with a hammer, chisel, and file was an important man. All the work done on a rolling mill housing was done by hand by a machinist. At times, opposition to further improvements came from the workers themselves. When Fritz put two feed rollers on the train workers thought the attempt would fail; once on, however, the men who "opposed them now thought it was impossible to run the mill without them."[27]

Although the mill was developed in 1857, it was not widely used until after the Civil War. By 1870 most of the rail mills in the country were three-high mills. Benjamin Franklin Jones of Jones and Laughlin, Pittsburgh, told Fritz years later that the mill was the beginning of the improvements in the iron industry which led the way to the adoption of the Bessemer process.[28]

With the introduction of Bessemer steel in the late 1860's, the first primary mill, a blooming mill, was developed. This mill reduced the size of the steel ingot so it could be rolled into rails on the rail mill. There was no need for this mill prior to this time because blast furnaces produced iron in pigs which were refined into wrought iron in a puddling furnace. The first blooming mill in the

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> of the housing was made with the same angles as the lugs on the shoe. The housing was set in this shoe and bolted fast. Another and a much better plan was at times used. This was to make a casting with two shoes combined in it, the shoes forming part of the basting and being placed the proper distance apart so as to conform to the length of the roll. This was a great improvement over the two separate shoes.
>
> When I built the Cambria mill, we got the shoes made the whole length of the train. They were made by James Moore of the Bush Hill Iron Works and were a great improvement over the old style. The shoes were planed the whole length of the train and as a result the housings could be placed at any point and at any distance apart. Ibid., pp. 130-131.

27. Fritz, *Autobiography*, pp. 131-133. Writing in 1912, Fritz provided a perspective on how technology changed in the mills over the years:

> It is not possible for a mechanical engineer of to-day, who is well posted in the use of our modern tools, electric traveling cranes, and all the general facilities that are in use at this time for doing work promptly and correctly (with money galore), and with electric light, so that work can be done by night as correctly as in the day, to realize the condition of affairs at the time the changes and improvements were made at the Cambria Iron Works over fifty years ago, practically speaking without tools. For all parts of the work that could not be done with chisel, hammer, and file, special makeshift tools had to be designed and gotten up to suit the occasion. This required much time, money, and inventive talent of a high order. Energy, determination, and patience of a staying quality were the great requisites for doing work under the then existing conditions. We had no crane for handling or erecting the work, and had to build a kind of portable derrick which could be moved from place to place, as it was wanted, by either horses, mules, or men, but generally the last. It proved to be a most efficient machine as a makeshift for a crane. It did all the erecting and changing of rolls. It was so essential and so powerful that the men named it Uncle Sam. We had no electric light to work by at night, or even gas when we commenced. All the light we had was made by the use of lamps filled with smoky rosin oil, as it was called. Ibid., pp. 131-132.

28. Ibid., p. 133; Hogan, *Economic History* 1: 40.

nation was built in 1966 by George Fritz at the Cambria Iron Company. He used a set of 21-inch diameter blooming rolls in a rail mill stand. With these rolls, Fritz could reduce an eight and one-half inch square ingot to a six and one-half inch square bloom, ready for the rail mill.[29]

All three rolls were stationary on George Fritz's first blooming mill, so only a standard size ingot could be finished to one set of dimensions aligning with the roll grooves. This was later changed when the center roll remained stationary the top and bottom rolls being movable. In Troy, New york, Alexander Holley built a three-high mill in 1871 which featured a movable center roll with the top and bottom rolls remaining stationary.[30]

Other improvements to the blooming mills concerned the tables on both sides of the mills. Lifting tables were used to handle the ingots which weighed 1,300 to 1,600 pounds. The ingot was placed on the table at the mill's entry side, and moved to the mill proper, where it was passed between the first and second rolls. After this pass was completed, the ingot was raised by the lifting table on the mill's exit side. The table was elevated again so the ingot could pass through the second and third rolls, where it was received by the first lifting table, now elevated. This table on the entry side was lowered, and the ingot was reduced again when it passed through the first and second rolls. This process was repeated until the ingot's desired size was obtained. For smooth operation of this system a means was developed to reverse the small rollers in both of the lifting tables, as well as a way to shift the ingot. These problems were solved through the genius of George Fritz and Alexander Holley.[31]

Other labor-saving devices were pioneered, some of them at Cambria, or by former Cambria employees. In 1884 and 1885 former Cambria employees Robert W. Hunt and William R. Jones engineered power-driven tables in front and behind the roughing and finishing rolls. The number of roll hands needed to handle the rails was reduced from roughly fifteen to seventeen to five, including the roller.[32] The number of times a rail could be passed through the rolls before it needed reheating was increased. In 1888 William R. Jones developed a process at the Edgar Thomson works at Braddock, Pennsylvania, wherein steel blooms were moved on power-driven roll tables

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29. Hogan, *Economic History*, 1: 42.

30. Ibid.

31. Ibid., pp. 42, 44.

32. Bennett, "Iron Workers," p. 19.

through a heating furnace between the blooming mill and the rail trains.[33] (See illustration 15 for three-high mill with lifting tables.)

These changes increased the pace of production while eliminating the need for extensive labor. Rolled iron and steel in the United States increased from 3.4 million tons in 1880 to 8.3 million tons in 1890. Simultaneously, only 215 roll trains and 290 heating furnaces were built in that time. In 1876 the Cambria Iron Company employed 72 puddlers and the same amount of helpers, by 1887 the puddle mill had been reduced to four furnaces melting scrap.[34] In 1900 an English engineer visiting American steel plants to observe production methods noticed: "It is no exaggeration to say that in a mill rolling three thousand tons of rails a day, not a dozen men are to be seen on the mill floor.[35]

John Fritz himself soon left Cambria. After six years fighting "dire predictions" and the "equally ignorant," Fritz felt he had accomplished a great deal under very difficult conditions. In his view, Cambria was home for the revolutions in rolling rails, and where production was increased fourfold. Fritz described the improvements in the rolling mills by saying:

> . . . out of the two small driven rollers came the present system of handling the work in mills, by the use of live rollers, by the heavier, stronger, and better fitting up of the mill without breaking points, by the improvement in the arrangement and better fitting up of the side guards, by the closing of the grooves in the roughing mills, by the increase in the width of the pile, by the increased length of the furnace, and by the increased height of the furnace roof, which carried the heat much farther, thereby enabling us to charge eight nine-inch piles instead of six five- and six-inch piles.[36]

The improvements were made not only in rail production, but in all aspects of the iron trade, and none of them were made without opposition. Finally, John Fritz just "became tired," and after "six years of as hard, laborious, and vexatious work as ever fell to the lot of a man to do," he decided

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33. Ibid., pp. 19-20.

34. Ibid., pp. 20, 37

35. Ibid., p. 20.

36. Fritz, *Autobiography*, p. 134.

to move elsewhere. On July 5, 1860, he left Cambria and reported the next morning, July 6, to the Bethlehem Iron Company in Bethlehem, Pennsylvania.[37]

WILLIAM BESSEMER'S STEEL

The discovery of the Bessemer steel process was a critical step in the development of the steel and railroad industries, and it was a discovery surrounded with controversy. In 1855 William Bessemer, an Englishman of French heritage, was trying to improve wrought iron for military use, and discovered that blowing air through molten pig iron removed the carbon and also kept the iron in a molten state. He had been packing a furnace with pig iron and accidently placed two pigs where they were exposed to draft air. When Bessemer opened the furnace door he noticed they had become "thin shells of decarburized iron" or steel. Bessemer also discovered he could stop the process in the middle to produce steel. The timing of the stop was critical, and if not performed correctly, the process resulted in uneven quality steel.[38]

With three weeks of his experiments in France, conducted for Emperor Napoleon III, Bessemer applied for a patent for "Improvements in the Manufacture of Iron and Steel." This patent discussed the fusion of steel with pig or cast iron, although this step was only the first in the Bessemer process. These experiments with the furnace were the ground work for Bessemer's later work. He described his work in his British patent of October 17, 1885, wherein he proposed to convert his

37. Ibid., pp. 134-135. Robert Sayre of the Lehigh Valley Rail Road encouraged Fritz to leave Johnstown and come work for the Bethlehem Iron Company. He wrote Fritz on May 1, 1860, with favorable words and hopeful predictions:

> I can fully appreciate the objections that would naturally arise to your leaving an establishment that you have become so thoroughly identified with at the same time if the country does not suit you or your family and you an change to a location that will suit you without suffering pecuniarily and with a prospect of adding to instead of detracting from your reputation as an Iron Master. I think you are justifiable in making the change. You say truly that a mans merit is measured by his success. You will also bear in mind that the more generally a mans success is known to the public the faster & higher he will raise in public favor. You can leave Johnstown in complete & thorough order mechanically and I presume all right financially. The establishment of a good Mill at this place producing a first rate quality of rails will establish your reputation in a Section of Country that is destined to be in my opinion the most populous & wealthy in this or any other state. When I see the rapid Strides that business has taken in the Valley for the past 10 years and think of the impetus that the improvements now in contemplation will give to it in the next 10, I predict a Future for it that will surprise its most sanguine citizens, to make our growth healthy we must have no failures hence my desire to have the Bethlehem Mill start upon a good basis. Robt A. Sayre to John Fritz, May 1, 1860, John Fritz Collection, CCHT.

38. Morison, *Men, Machines, Modern*, pp. 127-128; Temin, *Iron and Steel*, p. 125.

steel in crucibles to be arranged in a furnace. Each would have a vertical tuyere, through which air would be forced through the molten metal.[39]

Bessemer first made his findings known in a paper he delivered on August 13, 1856, before the British Association for the Advancement of Science. His paper's importance was immediately recognized, and it brought responses which contested Bessemer's theories and claimed priority of invention. The resultant controversies focused on the use of the cold air blast to raise the molten metal's temperature, and the addition of manganese to control the carbon and oxygen content. Two American men claimed prior invention; Joseph Gilbert Martien, of Newark, New Jersey, who worked at the Ebbw Vale Iron Works in South Wales and was granted a provisional patent a month before Bessemer, and William Kelly of Eddyville, Kentucky, who opposed the granting of an American patent to Bessemer and claimed that honor for himself.[40]

A third man was involved in the dispute over the invention. Robert Forester Mushet of Coleford, Gloucestershire, was a metallurgist working as a consultant to the Ebbw Vale Iron Works. He claimed that he had developed the means whereby Martien's and Bessemer's ideas could make the jump from dreams to reality. Because Bessemer was the only one to make money from the process, it was widely believed that Bessemer exploited the other men's inventions, if, in fact, he did not steal them.[41]

Almost immediately after Henry Bessemer delivered his address, he sold licenses to several ironmasters outside Sheffield, and obtained money to continue his work. However, he refused to sell his patents to the Ebbw Vale Iron Works and made an enemy of its operator, Thomas Brown. For the next three years, 1856 to 1859, while controversy raged in the technical journals of the day, Bessemer made no comment, and worked steadily in his steel works in Sheffield. He finally appeared in May 1859 before the Institution of Civil Engineers in London, but by this time, his process was considered practical, and Robert Mushet was demanding very loudly to share in Bessemer's success.[42]

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39. Philip W. Bishop, *The Beginnings of Cheap Steel* United States National Museum Bulletin 218 (Washington, D.C.: Smithsonian Institution, 1959), p. 31.

40. Ibid., p. 29.

41. Ibid.

42. Ibid., p. 33.

The small upright converters used in the Bessemer licensed plants all failed initially. When the ingots were hammered they would splinter into fragments. Eventually it was discovered that phosphorus caused brittleness in the metal, but phosphorus, along with sulphur, did not reduce in the converter. For over a year Bessemer tested, and experimented, building converter after converter, and he searched for a phosphorus-free iron. In the meantime, Robert Mushet experimented at the Ebbw Vale Iron Company with the use of spiegeleisen, an alloy of iron and manganese found in Rhenish Prussia. He placed the material into the molten metal in the crucible, and it served to reduce the effects of sulphur, remove the oxygen, and leave the carbon which provided hardness and strength, the qualities of steel. Realizing what he had achieved, Mushet applied for a British patent in September 1856, citing Joseph Gilbert Martien's invention, which had proved impractical, as containing the core idea for the Bessemer process, and for a U.S. patent on March 25, 1857.[43]

Due to an oversight, Mushet's British patent was allowed to lapse and the process came into the public domain. Mushet held onto his American patent. Henry Bessemer was still conducting his experiments at his Sheffield plant, and he came to know about adding manganese to the process. He remarked, "Events which shape and control lives and fortunes often have no possible connection." He never admitted obtaining the idea from Mushet, and he may have learned of it elsewhere. In any case, Bessemer used the Mushet patent without a license from 1857 until 1860, and was able to produce quality steel. Mushet's patent then lapsed, and Bessemer had the legal right to use his process. Already angry with Thomas Brown and the Ebbw Vale Iron Company, and anything connected to it, Bessemer refused to acknowledge Mushet's achievement. Mushet never went to court on the matter, but began attacking Bessemer in public print, seeking recognition for his contribution to the Bessemer process. After a time, Bessemer did provide Mushet with an allowance, but it did not compare with the 1 million pounds sterling which Bessemer earned from his patent before it expired. Bessemer's name became renowned around the world before Mushet died in 1891, while the latter was scarcely remembered.[44]

Ten years passed between the time Bessemer announced his discovery and the time when commercial manufacture of Bessemer steel occurred in America. Not until 1866 were the legal, technical, and financial problems managed, let alone solved. Legal problems focused on patent disputes, technical problems centered on understanding the chemistry involved with the Bessemer

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43. Jeanne McHugh, *Alexander Holley and the Makers of Steel* (Baltimore: The Johns Hopkins University Press, 1980), pp. 101-104, 150-154, 156; Donald Sayenga, "Canals, Converters, and Cheap Steel," *Canal History and Technology Proceedings* VIII (March 18, 1989): 86-87.

44. McHugh, *Alexander Holley*, pp. 156-159, 162, 165.

process, and the financial problems revolved around the effort to educate iron and steelmakers about the process, adapting machinery to make and handle steel instead of iron, and convincing people to use the process.[45] From the start, the Cambria Iron Company, its managers and workers, were involved to different degrees with solving the problems with the Bessemer process between 1856 and 1866.

WILLIAM KELLY'S CONVERTER

The controversy surrounding Bessemer did not end with Mushet. Soon after news of Bessemer's discovery reached the United States articles about the process were printed in *Scientific American*. The articles were noticed, and spurred the writing of a letter by one William Kelly of Eddyville, Kentucky, an unknown iron maker, claiming he had thought of the process, which he called "air boiling." The letter was printed in *Scientific American* on October 18, 1856. It read:

> In November 1851, I commenced a series of experiments with a view of converting fluid pig metal into malleable iron, with the aid of a strong blast of air, and without the use of fuel, which process I term "air boiling." My object was to drive off the carbon in the iron and to make powerful blasts of air do the work of the fire and the manipulation of the puddler's bar in the puddling process. My first efforts were quite satisfactory, as with a blast taken from my furnace and introduced into a suitable cupola with liquid metal taken directly from the furnace I produced a fair article of malleable iron. I found when using gray iron cold blast answered my purpose but when the metal was white I found hot air had a better effect. I therefore had a small furnace erected to heat the air in blast pipes.
>
> My experiments were conducted publicly at this establishment; hundreds of persons called to see the trials I made, and the subject was discussed amongst the iron masters, etc. of this section, all of whom are perfectly familiar with the whole principle and object I had in view, as discovered by me nearly five years ago.
>
> I was surprised to notice in *Scientific American* of the 13th of September an account of a similar process of converting pig iron into malleable iron, claimed as the discovery of Mr. Bessemer of London, and made within the past two years, the process not differing in the slightest from that I had in practical operation nearly five years since.
>
> I have reason to believe my discovery was known in England three or four years ago as a number of English puddlers visited this place to see my new process. Several of them have since returned to England and may have spoken of my invention there.

45. Temin, *Iron and Steel*, p. 127. Elting E. Morison described the "learning process" involved, with the conditions governing how a new idea is generated in an inventor's mind and how the idea gains a wider audience, as it related to Kelly's and Bessemer's discoveries. See Morison, *Men, Machines, Modern*, p. 135.

A charcoal furnace such as I found had to be treated in the air boiling process with some variation; this caused difficulties which I have succeeded in removing and expect shortly to have the invention perfected, and bring it before the public.

William Kelly
Suwannee Iron Works Eddyville, Kentucky
30th September 1856[46]

William Bessemer had already applied for an American patent which was granted on November 11, 1856. William Kelly applied for one in January 1857, claiming prior invention. He provided evidence, including witnesses who were employees or former employees, to the U.S commissioner of patents to support his claim. After hearings, the patent office agreed to Kelly's priority. Kelly was awarded priority on April 13, 1857, and U.S. Patent 17628 was granted to him on June 23, 1857. Bessemer made no appeal, and was allowed to keep the patent covering the machinery. Kelly had used a stationary converter, while Bessemer's was a tilting converter.[47]

Kelly claimed that his process, based on his experiments at Eddyville, would apply to the refining of iron for rolling mills. He sought out Daniel J. Morrell to demonstrate his process. Morrell brought Kelly to Cambria in 1856, where Kelly experimented further with the process in 1857 and 1858. Morrell gave Kelly a corner of the Cambria yard in which to experiment and enlisted the help of a young man to help build the converter for a demonstration.[48] (See illustrations 16 and 17 of William Kelly and his converter.)

A description of Kelly's experiments and where they occurred at Cambria appeared in an *American Iron Association Bulletin* in 1858.

> North of the north end of the mill is the machine shop and lathe house and forge with six fires, and a stack at the corner. Beyond this to the north is the large foundry building, and then comes the stock yards going towards the furnaces. Here also stands the new experimental furnace, erected under the superintendence of Wm. Kelly, of Eddyville, Kentucky, inventor of a process for refining iron by blowing cold air at a high pressure into the run-out metal similar to the Martien and Bessemer processes, . . . After various late experiments, none of them satisfactory, a small round furnace for re-melting pig has been mounted on columns beside a low

46. Quoted in McHugh, *Alexander Holley*, pp. 112-113.

47. Ibid., pp. 113-116; Bishop, *Cheap Steel*, p. 43.

48. John Newton Boucher, *William Kelly: A True History of the So-Called Bessemer Process* (Greensburg, Pennsylvania: Published by the Author, 1924), p. 80; Swank, *History of Manufacture*, p. 399.

Bessemer vessels into which its metal is run and there blown into. The experiments continue with a result still doubtful. (May 12, '58).[49]

Many of the workers at Cambria laughingly referred to Kelly as the "Irish crank," probably because they looked with disfavor on the experiments. According to James H. Geer, the young assistant, at the trial demonstration Kelly was very nervous, and afraid that the blast would not be strong enough, he asked the engineer for the strongest blast he could blow. This was a mistake because "the greater part of the contents of the converter was sent flying into the air in a brilliant tornado of sparks. This greatly amused the spectators, hundreds of whom were present." The spectacle was known afterwards as "Kelly's fireworks." Roars of laughter poured forth for days, and the joke lasted for at least 10 years in the trade.[50]

Kelly immediately prepared for his second demonstration. He managed to control the blast, but knew little about the chemical reactions which changed the metal when the cold air was blown into the converter. Kelly did not know when to turn off the blast so when sparks flew he would hit them with a hammer as they fell to the ground. For a half hour the sparks crumbled under the hammer blows, but one finally flattened. Kelly ordered the blast turned off, the converter was tapped and the metal poured into a mold. After the metal cooled Kelly took a piece of it and hammered it into a thin plate.[51]

John E. Fry, who later became superintendent of the Bessemer works at Cambria, and worked as a foundry molder when Kelly was in Johnstown, offered another version of the early experiments, noting that the molten pig iron was produced from local ores and fuel:

> The apparatus was assembled from scrap heap material and was indescribably primitive. The entire operation consisted of blowing air into the molten iron through a blast pipe thrust from above into the liquid metal. The only agreeable result was to change this very poor quality of iron for most purposes into a practically worthless one for any. Repeat experiments continuing to give constant results, and the metal being disposed to chill in this small quantity, the next experiment was an attempt to blow air, similarly to the former trials, into the metal in the crucible of old No. 1 blast furnace, when the crucible was full just before tapping, but the blast could not be made to penetrate the iron and the attempt was promptly abandoned. Mr. Kelly's next effort was to permeate a small quantity of grey foundry iron – crucible-melted – with carbonic acid gas, on the supposition that the metalloids of

49. Lesley, *Bulletin*, p. 149.

50. Boucher, *William Kelly*, pp. 81-82; McHugh, *Alexander Holley*, pp. 125-126.

51. McHugh, *Alexander Holley*, p. 126.

the iron could thus be instantaneously eliminated. The apparatus, like the first, was crude and inefficient, and no effect was produced upon the iron because of failure to get the insignificant supply of gas through it. But two trials of this character were made, and then the method was abandoned. Mr. Kelly desponding of success at this time.

Next a quite large apparatus was installed in the old mill metal yard, consisting of a cupola to melt pig-iron, extemporization of circular foundry flasks to form a fixed converter, and beds of run-out chills, the entire system connected by clay lined troughs. Blast was supplied from the foundry engine directly into the converter, was blown with air-blast through a pipe inserted through the converter side into and just below the surface of the liquid iron. Here a fair article of desiliconized iron was produced from grey cast iron, a poor modification. After several trials with this it was abandoned and relegated to the scrapheap, its last operation having set fire to the temporary building surrounding it, which was totally consumed.[52]

Kelly himself sent information concerning his experiments on June 29, 1858, to the American Iron Association.

I have now fairly got it in successful operation at Cambria furnace 4 miles from this place. It works well; not the slightest difficulty in converting crude pig into refined plate metal, by blowing into it for about 15 to 25 minutes. I have not consulted the manager Mr. Fritz as to the exact amount saved in the manufacture of Rails but I think it will be found something like this:

Say difference in puddler's wages per ton........................$1.00
8 per cent. of increased weight on one ton of metal
over the charge of crude pig ~ $20................................1.60
25 per cent. saved in fuel, fixings for furnace &c............... .50
One reheat saved c 50, one rerolling saved c 50..................1.00
5 per cent. saved in loss of reheating and rerolling
(the iron at this stage being worth $25)..........................1.25
Total saving per ton..$5.35
I have no doubt that the above is nearly correct, the time saved in puddling a heat is about 3/4 of an hour. It makes a bar very different in quality from the crude pig.[53]

Near the end of 1859 William Kelley wrote to John Fritz from Pittsburgh, detailing his experimentation with his process at Oliphant's Furnace.

I had an interview this afternoon with Mr. Morrell, and was informing him of the results of my experiments at Oliphants' furnace with my new process, when he

52. Quoted in McHugh, *Alexander Holley*, p. 127.

53. Lesley, *Bulletin*, p. 166.

suggested that I would communicate to you in detail the results, which I now take much pleasure in doing.

> My object was to take the metal from the furnace and put it into an air boiling furnace – & after refining it perfectly, inject a stream of Carbonic Acid into the iron so as to bring the iron "to nature" – and then run it into ingots ready for the rolls. I found that thin iron would not stand blowing, after giving it four tryals, the iron would always sett before I could get through with the rifining, before it sett however I let on the Carbonic Acid, and it turned in the short time I applied it (two minutes) to have the desired effect of bringing the iron to nature. I was not able to tap the furnace, as it always sett, but I took out some lumps of iron that forged with a good deal of maleability, so much so that I felt satisfied that if it had been "Cambria" or any other iron that would refine, I would have been successfull.[54]

No more experiments were held the rest of 1859, and because of economic hard times and the start of the Civil War, no more were held in 1860 and 1861. Interest in the process emerged again in 1861. Kelly had left Johnstown, but he came back to Cambria in 1862. Cambria employee John E. Fry wrote that Kelly returned to perform a final series of experiments with a Bessemer converter "made abroad and imported for his purpose." This converter contained several of Bessemer patented features. This was the only tilting vessel that Kelly ever used. Fry later said Kelly's 1862 experiments were only copying Bessemer's methods.[55]

Considerable controversy raged for years over who actually had priority claim to the Bessemer process. Even when the Kelly converter was exhibited by the Cambria Steel Company at the Panama-Pacific International Exposition in San Francisco in 1915, *The Iron Age* reported, "No attempt is made by anything in the exhibit to open up the dispute relative to priority of claims to the invention credited to Sir Henry Bessemer of the pneumatic process of making steel, a question which was agitated somewhat warmly in 1896."[56]

Alexander Holley's biographer, Jeanne McHugh, stated that there never has been a satisfactory answer to the Kelly-Bessemer controversy. The question was dormant until 1896 when it was raised again by Joseph D. Weeks, editor of the *American Manufacturer*. He made charges against

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54. William Kelly to John Fritz, November 5, 1859, John Fritz Collection, CCHT.

55. McHugh, *Alexander Holley*, pp. 126 127; Bishop, *Cheap Steel* p. 44. Kelly's 1862 converter was at first put on the scrap heap, but was salvaged after the 1889 Johnstown Flood, and in 1892 displayed on the front lawn near the Cambria office. In 1893 the converter was exhibited at the Columbian Exposition in Chicago, and later preserved in the lobby of the Johnstown plant's offices by the Bethlehem Steel Company. It was, in 1987, on permanent loan to the Smithsonian Institution, where it was in storage. McHugh, *Alexander Holley* note, p. 134. Bishop wrote in 1959 that investigations were under way at the Smithsonian Institution to determine if Kelly's "pioneer converter" was actually the 1862 converter.

56. "A Historic Converter," *The Iron Age* (August 5, 1915): 313.

Bessemer, who died two years later, in an address he gave upon his retirement as president of the American Institute of Mining Engineers. Both Kelly and Bessemer supporters got into the argument, and English and American journals received letters stating their cases.[57]

In 1896 the American Society for Mechanical Engineers elected Henry Bessemer an honorary member. He could not attend their meeting, but sent a paper to be read, "Historical and Technical Sketch of the Origin of the Bessemer Process." Discussion followed, and Robert W. Hunt, formerly of the Cambria Iron Company, expressed his opinion of the Kelly-Bessemer controversy:

> He [Kelly] was not a chemist and he labored under great disadvantage. In fact chemistry at that time was not generally applied to any of the developments of the iron and steel business and if Kelly had possessed a knowledge of metallurgical chemistry, even as then existed he would have undoubtgedly gone much further than he did. But we find that Mr. Bessemer himself was not any too sure of his chemistry, because in his original paper he states that the oxide of iron which was produced eliminated the sulphur from the bath. This was about as direct a chemical mistake or as great a one as a man could make. We know that sulphur is not eliminated, unfortunately, in the process. Again, in some of his early papers, he defined the amount of phosphorus it was Possible to use, as 0.02 percent, so that he groped in the dark and took advantage of the developments as they progressed. . . . I have great respect for Mr. Bessemer and it is with great hesitation that in his advanced age I would permit myself to say anything which would seem to take away an atom from his honor and glory, but I wish he were just a little more generous and a little more just.[58]

The right of Kelly to be considered the joint discoverer of the Kelly-Bessemer process has also been questioned. He did experiment in treating molten metal by air blasts, but it is not clear he progressed beyond experimentation. He never had the objective of making steel, as did Bessemer. There is no evidence that Kelly's process was ever developed beyond experimentation by the Cambria Iron Company.[59]

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57. McHugh, *Alexander Holley*, p. 130.

58. Quoted in ibid., p. 131.

59. Bishop, *Cheap Steel*, pp. 46-47.

American patents covered the three aspects of making Bessemer steel: the Kelly patent covered the process, the Bessemer patent covered the machinery, and the Mushet patent covered the additive. The battles over the Kelly, Mushet and Bessemer patents which had to be won before full use of the Bessemer process could be made started in 1861 when Capt. Eber Brock Ward, of Detroit, and Zoheth Shearman Durfee, of New Bedford, gained control of William Kelly's patents. Ward, together with William F. Durfee, a cousin of Zoheth S. Durfee, began building a steel plant at Wyandotte, Michigan, in 1862 to produce Bessemer steel. In May 1863 Daniel J. Morrell of the Cambria Iron Company in Johnstown, and William M. Lyon and James Park Jr. of Pittsburgh, became Ward and Zoheth S. Durfee's partners in controlling the Kelly patents. Together they formed the Kelly Pneumatic Process Company, and William Kelly retained an interest in any profits the company obtained. The company also acquired Robert Mushet's patent for the use of spiegeleisen as a recarburizing agent, granted in England in 1856 and the United States in 1857. Zoheth S. Durfee got the patent on October 24, 1864, and the membership of the Kelly Pneumatic Process Company was enlarged through the addition of Robert Mushet, Thomas D. Clare, and John N. Brown, all of England. On September 5, 1865, more new members were added, Charles P. Chouteau, James Harrison, and Felix Vale of St. Louis, Missouri.[60]

On September 6, 1864, William F. Durfee was successful in making Bessemer steel at the plant in Wyandotte after two years of experimentation. Daniel Morrell, James Park, and William Lyons of the Kelly Pneumatic Process Company were on the scene for the event. To quote steel industry historian James M. Swank, "*This was the first Bessemer steel made in the United States.*" It was also an infringement on the Bessemer patents.[61]

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60. Swank, *History of Manufacture*, p. 409, Morison, *Men, Machines, Modern*, p. 138. Many years later William Durfee described the men of the Kelly Pneumatic Process Company:

> These gentlemen were selected because of their well-known business ability and their influential association with or ownership of some of the largest and best-appointed iron and steel works of the country, and it was confidently expected that they would take a lively interest in the new process by promptly employing it in the works with which they were identified, and that their example would be very generally followed by the larger iron and steel works of the United States. In this expectation Captain Ward and Z.S. Durfee were greatly disappointed, as neither Mr. Lyon nor Mr. Parke ever adopted the process in their works, and Mr. Morrell only succeeded in overcoming the objections of his associates in the Cambria Iron Company of which he was general manager in such time as to enable him to commence making steel eight years after he was admitted as a member of "The Kelly Process Company." Quoted in McHugh, *Alexander Holley*, p. 178.

61. Swank, *History of Manufacture*, p. 409. McHugh, *Alexander Holley*, p. 179.

Alexander L. Holley, John F. Winslow, and John A. Griswold, all from Troy, New York, gained control of William Bessemer's patents in 1864. Holley succeeded in making Bessemer steel in Troy at the Albany and Rensselaer Iron and Steel Company that same year. Holley's use of Mushet's recarburizing method was also a patent infringement.[62] Historian Elting M. Morison offered insight into the long struggle to develop the Bessemer machinery against a "field of resistance created by men and machines." He drew attention to the records of three trial blows in February 1865 at Troy:

> Blast 10 pounds. Blew twenty-two minutes. Vessel not hot enough. Ladle nozzle too small – 1 1/8" .29.8% scrap. 20.2% loss. Metal came through bottom by side of tuyere, stopped it with water. Shafting of water wheel (for blower) rotten, necessitated a stop. During it vessel was lengthened 18". The pit was enlarged. New tuyeres and nozzle substituted. Recarburizing furnace raised 6".[63]

In Morison's estimation, "Short trials and little errors; trial and tinker; trial, breakdown, change, and tinker was the way in which the machinery was slowly put together."[64]

The question of patent rights was not yet settled. In Wyandotte the plant used Mushet and Kelly patents and parts of the Bessemer machinery patents. Meanwhile, in Troy, Holley added improvements to the Bessemer machinery but still infringed on the Kelly and Mushet patents. Because the Kelly Process Company could not operate without Bessemer's machinery and the Holley group could not make steel without Mushet's improvements, an arrangement was made to consolidate all of the American patents early in 1866. Titles to the Kelly, Bessemer, and Mushet patents were given to Winslow, Griswold, and Morrell; the first two owned seven-tenths of the property while Daniel Morrell held three-tenths in trust for the Kelly Process Company. This agreement worked until the gentlemen involved formed the Pneumatic Steel Association, a joint-stock company organized in New York. The patents were then owned by the Bessemer Steel Company Limited, an association organized in 1877 in Pennsylvania. This group then owned the consolidated patents.[65]

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62. Swank, *History of Manufacture*, pp. 409-410.

63. Morison, *Men, Machines, Modern*, p. 154.

64. Ibid.

65. Swank, *History of Manufacture*, p. 410; McHugh, *Alexander Holley*, p. 196. After 1877 the patents were vested in the Bessemer Steel Company Limited, organized in Pennsylvania. This company was succeeded in 1890 by the Steel Patents Company. One incentive for the two Bessemer groups to combine their efforts was the increasing demand for steel rails by the railroads, dissatisfied with iron rails.

December 1866 marked the end of the experimental stage of Bessemer steel and the beginning of the capability to produce enough steel for commercial purposes. The manufacturing rights had been consolidated, two companies had succeeded in producing Bessemer steel, and a third company was licensed to start operations. Thus, the consolidation of patents was followed by the business of making Bessemer steel. Notices were immediately placed in the American Iron and Steel Association *Bulletin* starting in 1867, advertising that the "Pneumatic or Bessemer Process" had been consolidated. Zoheth S. Durfee was the agent who issued licenses. All companies which held licenses were members of the Pneumatic Steel Association, and paid royalties for the tons of steel they produced. A pamphlet on the cost of the process was issued by the group. A plant with two three-ton converters cost $80,000; a five-ton plant with steam power cost $125,000; and apparatus with fireproof buildings and machinery making 50 tons of ingots in 24 hours cost $200,000. Only 30 men were needed to run a five-ton Bessemer plant. There was an additional initial cost of $5,000, for which the licensee received plans of a plant and information on the Bessemer process from Winslow, Griswold, and Morrell.[66] (See illustration 18 for notice of "The Pneumatic or Bessemer Process," 1867.)

Alexander Holley drew all the plans from which most of the Bessemer works were built. By 1880 eleven plants were in operation and of these, Holley designed six, consulted on three more constructions, and was the inspiration for two more which were copied from one of the first six. The five top engineers met often to discuss problems. These were: Holley; John Fritz, formerly of Cambria and then of Bethlehem Iron Company; George Fritz of Cambria; Capt. Robert W. Hunt, formerly of Cambria and then manager of the Troy works; and Capt. William Jones, formerly of Cambria and manager of Carnegie's Edgar Thomson works. Holley also wrote a series of technical reports on the industry for the use of this group, and it was he who was the greatest influence in establishing a communication network in the early Bessemer steel industry.[67] (See appendix 16 for biographies of these men, and illustration 16 for portraits of Jones, John Fritz, and Holley.) In 1877 when Robert W. Hunt was general superintendent of the Albany and Rensselaer Iron and Steel Company in Troy, New York, he wrote of the interaction and sharing of information which occurred between the principals in developing both the Bessemer process and the working plants:

> While I am not able to mention all of the very many good things accomplished by the gentlemen at each and all the various works, I am, at the same time, well

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66. Morison, *Men, Machines, Modern*, pp. 143-144, 172; Swank *History of Manufacture*, pp. 132-133. Many more people and events contributed to the Kelly, Mushet, and the controversies surrounding Bessemer steel patents. The best sources for additional details are Sayenga, McHugh, and Philips.

67. Swank, *History of Manufacture*, p. 133 135.

> aware they have all done their share toward achieving the great end; and fortunately, their mutual relations have been so pleasant, that each one's experiences have been freely imparted to the others. This has done wonders to advance the science. But without one element, all skill and all mechanical talent would have been wasted, and with it nearly all things have been possible. That element has been, and is, "American push."[68]

The pioneer Bessemer steel works were established from 1876 to 1881. These were, according to James Swank:

1. Kelly Pneumatic Process Company, Wyandotte, Wayne County, Michigan. The first blow on a two-and-one-half ton experimental converter was in September 1864. The experimental works were connected to an iron rolling mill.

2. Albany and Rensselaer Iron and Steel Company, Troy, New York. This experimental Bessemer plant had one two-and-one-half ton converter which first blew on February 15, 1865. The Bessemer plant was added to an iron rail mill.

3. Pennsylvania Steel Works, Pennsylvania Steel Company, Steelton, Dauphin County, Pennsylvania. This was an entirely new works with two seven-ton converters. The first blow was in June 1867.

4. Freedom Iron and Steel Works, Lewistown, Mifflin County, Pennsylvania. Two five-ton converters were added to the works of the Freedom Iron Company, and the first blow was on May 1, 1868. These works failed in 1869 and most of the Bessemer machinery was moved to Joliet, Illinois.

5. Cleveland Rolling Mill Company, Cleveland, Ohio. Two six-and-one-fourth ton converters were added to an iron rail mill. The first blow was on October 15, 1868.

6. Cambria Iron and Steel Works, Cambria Iron Company, Johnstown, Pennsylvania. Two six-ton converters were added to an iron rail mill and the first blow was on July 10, 1871.

7. Union Steel Company, Chicago, Illinois. Two six-ton converters were added to an iron rail mill and the first blow was on July 26, 1871.

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68. Robert W. Hunt, "A History of the Bessemer Manufacture in America," *Transactions of the American Institute of Mining Engineers* V (May 1876 to February 1877): 216.

8. North Chicago Rolling Mill Company, Chicago, Illinois. Two six-ton converters were added to an iron rail mill. The first blow was on April 10, 1872.

9. Joliet Steel Works, Joliet Steel Company, Joliet, Illinois. This was an entirely new plant, with two eight-ton converters. The first blow was on January 26, 1873, and the first steel rail on March 15, 1873.

10. Bethlehem Iron Company, Bethlehem, Pennsylvania. Two seven-ton converters were added to an iron rail mill. The first blow was on October 4, 1873, and the first steel rail on October 18, 1873.

11. Edgar Thomson Steel Works, Carnegie Brothers & Co. Limited, Bessemer Station, Allegheny County, Pennsylvania. These were entirely new works with two seven-ton converters. The first blow was on August 25, 1875, and the first steel rail September 1, 1875.

12. Lackawanna Iron and Steel Works, Lackawanna Iron and Coal Company, Scranton, Lackawanna County, Pennsylvania. Two five-ton converters were added to an iron rail mill. The first blow was on October 23, 1875, and the first steel rail made December 29, 1875.

13. St. Louis Ore and Steel Company, St. Louis, Missouri. Two seven-ton converters were added to an iron rail mill and the first blow was on September 1, 1876.[69] (See appendix 20 for Cambria's steel production, 1871-1892, and appendix 21 for steel tonnage produced by 11 of these early Bessemer plants in 1878-1879.)

The influence of the tariff, the railroad demand for rail, and the pool of the essential patents all combined to establish an atmosphere for steel production. The tariff blocked foreign competition, the licensed companies worked exclusively on rolling rails, and the railroads established the demand. They stated their need, the Pneumatic Steel Association apportioned annual production between its members, and in the absence of foreign competition the price of rails were fixed. Exactly how the association conducted its business is not known, but licensees met to discuss production and prices, assisted by railroad representatives.[70] One participant remembered:

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69. Swank, *History of Manufacture*, pp. 411-412.

70. Morison, *Men, Machines, Modern*, pp. 173-174.

> The Pennsylvania Railroad was practically the fixer of the price of rails for a long period. The Penn. RR divided its tonnage between the 3 mills on its main line of road between the Penn. [Steel] works, the Cambria Works at Johnstown and the J. Edgar Thomson works. For a long period rails were not purchased by other roads until the Penn RR led off with its or order and after it placed its order the other roads would come in.[71]

This was not always a simple process because of depressions in the national economy. In the terrible year of 1877 very skilled negotiations were needed to determine production and prices, based on individual interests. Total production was determined and each plant given a quota, in addition to the setting of rail prices in the different cities. The Vulcan Works in St. Louis were even shut down for the year and were paid a large amount of money for doing so out of the association fund. Prices and production were thus controlled.[72]

According to technology historian Elting M. Morison, "Here are assembled all the dark forces of American economic history – the dominant industry controlling its supplies, the tariff, the pool. Here are also the spectacular rewards that in many a historical syllogism have been used to demonstrate that the sordid methods were consciously designed to ensure equally sordid, selfish ends of exaggerated personal gain."[73] In Morison's interpretation, these men were presiding over an industry which was in no way economically stable or as yet, completely out of the experimental stage. Initial costs of Bessemer plants had been paid, but continuing, fast-coming developmental costs were high. It was just as true in the 1880s as it had been in the 1870s that the industry depended upon continuing design and technique changes which were obtained only at great costs and risk. Members of the Pneumatic Steel Association sought stability for the industry by trying to limit uncontrollable economic factors, to maintain flexibility in adopting new technologies, and to share progressive industry information. No one could survive alone.[74]

Alexander Holley designed and built Bessemer plants from the ground up because he saw the entire production system of furnaces, converter, bloomeries, and rolling mills as the center of the process, not just the novel converter alone. In his view the potential of the process lay in the development

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71. Quoted in ibid., p. 173.

72. Ibid., pp. 174-175.

73. Ibid., p. 175. Morison cited the Edgar Thomson Steel Company's dividend of 41 and 3/4 percent in 1877 and the Pennsylvania Steel Company's 1879 dividend of 77 percent with $2,000,000 capital and unspent profits of $2,461,423.51. Ibid.

74. Ibid., pp. 176-179.

and control of the entire Bessemer process from iron ore to finished steel products all in one plant. This was the driving motivation for the development of Holley's works at Troy.[75]

The second new idea which evolved from the Bessemer process was the need for laboratories to be associated with iron and steel works. Alexander Holley and William F. Durfee at Wyandotte were the first to promote the idea, to little avail. Holley knew that the success of the Bessemer process depended upon new theory, experimentation and analysis, rather than common practice. He believed the lack of understanding between the practitioners and the scientists to be "deplorable," and urged all engineers to obtain practical hands-on experience so they would profit later from their studies of abstract science.[76]

The introduction and spread of the Bessemer steel process was intimately related to the rail industry. A group of Pennsylvania railroad men were the ones who first approached John F. Winslow and John A. Griswold to obtain a license for the Bessemer patents in 1865. They organized as the Pennsylvania Steel Company in an attempt to produce domestic steel rail, thereby ending their dependence upon a foreign source of supply. These men, including John Edgar Thomson, president of the Pennsylvania Railroad; Samuel Felton, former president of Philadelphia, Wilmington, and Baltimore Railroad; Nathaniel Thayer from the Baldwin Locomotive Works; and William Sellers, who was an inventor and machine-tool maker from Philadelphia, had a vision for an integrated production system for rolling steel rails.[77]

Thomson and Felton especially were influential in bringing the first Bessemer plant to Pennsylvania. They were motivated by the high maintenance costs of iron rail, by the price of English rails, and by the experimental rolling of rails in North Chicago in 1865. Their efforts resulted in the construction of the works in Steelton, located on the Susquehanna River near Harrisburg in the coal and iron regions bound together by the Pennsylvania Railroad's main line.[78]

The first steel rails rolled in the United States were produced at the North Chicago Rolling Mill in 1865 from ingots produced by the Wyandotte experimental works. These first rails were laid on the track of a railroad running out of Chicago, and were still in use in 1875. The American

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75. Morison, *Men, Machines, Modern*, p. 157.

76. Ibid., p. 160.

77. Ibid., pp. 163-164.

78. Ibid., pp. 163-165.

Iron and Steel Association was meeting in Chicago at the time the rails were rolled, and several members, including George Fritz, witnessed the feat.[79] This operation is considered by historians to be an experimental rolling. Not until August 1867 was steel rail produced on a commercial scale in this country and it first took place at the Cambria Iron Company.

In 1867 Alexander Holley of the Pneumatic Steel Association was helping to build the Bessemer plant at the Pennsylvania Steel Works in Steelton, near Harrisburg. Delays in getting the rail mill built, and pressure from the Pennsylvania Railroad to lay American-made rail, resulted in a plan to roll Bessemer ingots at the rail mill at Cambria in Johnstown. It was here that Holley first met Cambria's chief engineer, George Fritz.[80]

ROLLING STEEL RAIL AT CAMBRIA

When the steel ingots arrived at Cambria from Harrisburg several problems became immediately apparent. The rolling mill had been designed to roll iron rails, and could not handle steel. Parts broke, rolls split, and the engines could not drive the machinery. The rolling ceased before the ingots could get through their first pass. Alexander Holley was heard to mutter, "There is an inherent cussedness about rolls, which, so far, no man has been able to find.[81] Together the engineers solved the problems with the mill. Robert W. Hunt, in charge of rolling the Pennsylvania Steel Company's steel at Cambria in August 1867 remembered "with what proud satisfaction Mr. Holley visited Johnstown and proclaimed to us all that at last his dream was realized; that the Pennsylvania works were making four conversions on each turn, or eight per day, producing forty tons of ingots."[82]

The first ingots made at Harrisburg and delivered to Johnstown were drawn into blooms under a five-ton hammer. Some of the ingots were hammered at Seyfert, McManus & Co., in Reading, Pennsylvania, before being sent to Cambria. George Fritz, looking at the behavior of the steel under the hammer, was convinced that this was not the right way to treat the material. He and Alexander Holley discussed the problem many times, and Fritz finally set up blooming mills with

79. Swank, *History of Manufacture*, p. 412.

80. McHugh, *Alexander Holley*, p. 213.

81. Ibid., p. 214.

82. Hunt, "History of Bessemer," pp. 15-16.

a 21-inch rail train, Holley cast and sent eight-and-one-fourth inch ingots to Fritz which were drawn to six-and-one-half inches square, recharged, washheated, and then rolled into rails. This procedure was such a success that Holley adopted the system in the Pennsylvania Steel Company's rail.[83] (See illustration 19 for sketch of first Bessemer steel rail rolled at Cambria.)

MAKING STEEL AT CAMBRIA

The Cambria Iron Company was the sixth company in the United States to convert to the Bessemer steel process. Even though William Kelly's early experiments had occurred in Johnstown and Daniel J. Morrell was an early believer, enough to get involved with the Pneumatic Steel Association, the process was not adopted until 1871. Morrell had tried to interest the Cambria Iron Company's board of directors to put the value of Morrell's company stock into the construction of a Bessemer converter. This plan was resisted, and Morrell ceased pressing the matter.[84]

Elting E. Morison provided an analysis of why the men in power at Cambria resisted Daniel J. Morrell's attempts to interest them in the new process. They probably did understand what the Bessemer process would mean but were unwilling to deal with the risks of implementing it. They had already invested courage and resourcefulness into the revolution which had occurred in the iron industry when they improved the blast furnace, bloomeries, and rolling mills. They knew and understood these improvements. The Bessemer process was totally different, involving new technologies and chemical reactions. Cambria's officers could not understand or control the changes the new process would unleash.[85]

They were additionally enmeshed in intricate relationships revolving around the manufacture and sale of iron. Years of work with employees, competitors, and customers had resulted in Cambria's success in crafting and selling iron. The Bessemer process would not improve iron but replace it, and according to Elting M. Morison, many questions were asked: "Would not this new thing destroy the competitive advantage, so hardly won, by forcing every man to start over again in the same degree of innocence and from the same level? Would it not, by replacement of an old reagent,

83. Ibid., pp. 16-17.

84. McHugh, *Alexander Holley*, p. 228.

85. Morison, *Men, Machines, Modern*, pp. 148-149.

iron, with the new element of steel, replace also the customs, habits, procedures, and hierarchical arrangements upon which the security of life in the iron trade depended?"[86]

Elting M. Morison knew of no other way to explain why the Cambria officers, who stood so close to the potential riches of the Bessemer process promised, failed to seize the opportunity in 1857. They did not respond to the changes in the industry until five Bessemer plants had been built and steel rails were being rolled by competitors. In 1870 Alexander Holley designed Cambria Iron Company's Bessemer plant and George Fritz was ordered to proceed with the construction.[87]

John B. Pearse, manager of the Pennsylvania Steel Company works in Harrisburg after Holley, wrote of Cambria's Bessemer construction:

> The Cambria works are built with the idea of making the Bessemer details independent of the walls of the building, which, with the roof, serve the purpose of an enclosure from the weather, and furnish the basis for the support of the hydraulic cranes which are on the usual Worthington designs. The converters, chimneys, cupola-ladles, cupolas, and spiegle-furnaces, are all mounted on columns and iron platforms supported on cast-iron girders spring between the columns and fitting at the ends with a dovetail joint caked in with iron cement. Three levels are formed – the cupolas, the spiegel-furnaces on the highest, the pig-iron ladles on the next, and the vessels and working-platform on the third and lowest level. The cupolas are supplied by a single-cylinder hydraulic-hoist, the stroke of the piston being half the lift.
>
> Blast is furnished the converters by two independent Fritz & Moore blowing-engines, in which the steam and blast cylinders are placed side by side on a common foundation, and the piston-rods are attached direct to a cross-head working over a fly-wheel on each side; the connecting-rods secure parallelism so easily that their brasses are scarcely worn, even after use for many years.
>
> The largest product of Bessemer ingots these works have made is 297 gross tons in one day, 1475 gross tons in one week, and in the month of March last, 6051 gross tons. They are bloomed in a train of 39-inch rolls, 3 high, with box-grooves so proportioned that two or more passages may be made through the same groove, the top and bottom rolls being adjustable by screws worked by power. In the original mill of Mr. Holley the middle roll moved, and the top and bottom rolls were fixed. Mr. George Fritz invented a table, with feed-rollers, that could be raised and lowered by hydraulic power, the rollers being driven by power transmitted through double-rocking friction-gears, which came into gear in each position of the table at which the ingots enter the rolls. The ingots are turned over by their own weight, one corner being hold up by a pusher (projecting between the rolls) while the table falls, and they are moved from one side of the table to the other by the

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86. Ibid., p. 149.

87. Ibid., p. 150; McHugh, *Alexander Holley*, p. 228.

same pusher. These feed-tables have been improved at Bethlehem, so that the feed-rolls may be driven in any position of the table. The Bessemer works and machinery form a monument to the late George Fritz fit to crown the career of any man.[88]

George Fritz's two new features in the blooming mill, that of the driven rollers in the tables and the hydraulic pusher for turning over and moving the ingots were different from those at Alexander Holley's operation at Troy. The number of men required to operate the mill was reduced from eight to four -- three men and a boy. The mill's design became the standard for American Bessemer works.[89] (See illustration 20 for a diagram of the Bessemer plant at Cambria in 1890.)

Robert W. Hunt believed a factor in Cambria's success was in its labor organization. In compliance with "the policy decided upon," Cambria's Bessemer works were started without workers who had ever been involved with the process. With few exceptions of skilled rolling mill men, the workers were selected from "intelligent laborers." This policy resulted in what engineers thought were "willing pupils with no prejudices, and without any reminiscences of what they had done in the old country or at any other works." When the works were in operation George Fritz had the able help of William R. Jones, John E. Fry, Charles Kennedy, Alexander Hamilton, and Daniel N. Jones.[90]

The first Bessemer blow occurred at the Cambria Iron Company on July 10, 1871. Robert W. Hunt was in charge as superintendent of the Bessemer department, with Alexander Holley and George Fritz observing. The rails which were rolled from the first blow were sold for $104 per ton. More than 70 men helped build and get the plant operating, but probably only Hunt, Holley, and Fritz had ever seen a blow.[91]

The 40th anniversary of the first Bessemer steel blow at Cambria was celebrated in Johnstown on October 5, 1911. Even though the blow occurred on July 10, 1871, the reunion was held in the cooler weather of autumn. Many steelworkers present at the first blow were present, and Robert W. Hunt, then of Chicago, presided over the ceremonies. Hunt reminisced:

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88. Pearse, *Concise History*, pp. 171-172.

89. McHugh, *Alexander Holley*, p. 228.

90. Hunt, "History of Bessemer," p. 25.

91. McHugh, *Alexander Holley*, p. 229. For a description of all the considerations in making steel rail, see Robert W. Hunt, "Steel Rails and Specifications for Their Manufacture," *Transactions of the American Institute of Mining Engineers* XVII (May 1888 to February 1889): 226-248.

On July 10, 1871, came the fateful day. I was the only one on the job who had ever seen a heat of Bessemer steel made. Such conditions made the work far from easy for any of us, but I can truthfully say that, from that first day until I left the company's employ in September, 1873, if ever there was a body of men who worked together with the feeling of one for all, and all for one, and everybody for the success of the work, they were the men of the Bessemer department of the Cambria Iron Company.[92]

(See appendices 22 and 23 for officers of Cambria at the time of the first Bessemer steel blow, a list of steelworkers present at the first blow, and a poem written for the anniversary. See illustration 21 of the steelworkers' reunion.)

One of the best descriptions of the early difficulties and dangers in making Bessemer steel was provided by John Fritz. His recollections bore witness to both the spectacle and the fear which accompanied each conversion:

In witnessing the beautiful and interesting but simple process of blowing a heat of metal, and the regularity with which it is done at this time, and the quantity turned out, it is impossible for one wholly unacquainted with history to even in a measure realize the fear and anxiety of those who were responsible for the result. When a charge of metal was poured into the vessel anxiety commenced, and as the heat increased, anxiety increased in a corresponding ratio, until both became intense. It was when the heat was greatest that accidents were most likely to happen. The refractory material with which the converters were lined, especially the bottoms, would become plastic and when in that condition the effect of the heat and the blast would waste the tuyeres and bottoms away so rapidly that from one to three heats were all we could get off of one bottom. Frequently they would give out at the first heat; then out would come the metal through the bottom; and having to use much water about the converter, the place under the vessel was at all times wet, and the result was explosions, often very dangerous, as the hot metal was blown in all directions, frequently inflicting serious injuries on the workmen, a calamity greatly dreaded and the cause of the gravest anxiety to those in charge.

When an accident would occur anywhere about the works the first question asked would be: – "is any one hurt?" If not, we would go to work at once to repair with that object only in mind. If, on the contrary, some of the workmen were killed or seriously injured, it was impossible to describe the distress of mind that the person in charge had to endure. The anxiety one had when the charge was put in the vessel was increased with the heat until the heat was blown; but it did not end with the blowing of the heat. When the vessel was turned down it sometimes went too far and some of the metal ran out, resulting frequently in a grand pyrotechnic display of an exceedingly dangerous character. The next operation was to get the metal in the ladle, which was generally not a very difficult one, but it would frequently burn through the ladle, and then the only thing that could be done was to let it run into the pit and order all hands out of the way, for fear of an explosion. As soon as the metal was set, all hands commenced to clean the pit, which was no easy task. Here

92. "Cambria Steel Workers' Reunion," *The Iron Age* 88, no. 14 (October 5, 1911): 740-741.

were eight tons of molten steel in the pit burned fast to ingot moulds, bottom and sides of the pit, and to everything that would not burn up. If we were so fortunate as to get the ladle over the pit in good shape our anxiety was not yet at an end. It quite frequently happened that the stopper would pull off the end of the rod; then we had to use what we called a pricker to open the nozzle from the bottom. If the metal happened to be cold, which at that time it was apt, to be, the nozzle would freeze up, as we called it; then the metal would have to be poured out of the top of the ladle into the mould, cinder and steel all together, with the result that generally the most of it got into the pit; then, again, if we escaped an explosion, we still had a mess in the pit.

Altogether, the difficulties we encountered were enough to appall the bravest hearts. My brother George once said, when at Cambria, that he did not believe there was a man who ever went into the Bessemer business, and was responsible for the result, who did not at times wish he had never gone into it; and so far as my experience goes I can fully verify it. And, further, I think that, if it had not been for the interesting and exciting character of the business, but few men would have been willing to endure the trouble and anxiety and to endure the physical labour and danger to which he and the workmen were constantly exposed, long enough to have placed the business on a commercial basis.[93]

(See illustration 22 for a view of the manufacture of rails from Bessemer steel, illustration 23 of a Bessemer converter blowing, and illustration 24 for sample Cambria steel rails.)

LOSS OF LEADERSHIP

Ten new Bessemer plants opened between 1881-1885; five of these produced steel rail. The Pneumatic Steel Association now had competition. New firms were not admitted to the group, and did not have access to the Bessemer-Kelly-Mushet patents. This placed them at a disadvantage, but eight firms were still in operation in 1886. The association found itself unable to regulate or control the growth of the steel industry.[94]

In their attempt to build a perfect world for themselves the association members failed to recognize their own limitations. According to historian Elting E. Morison, the association did not see the danger in depending exclusively on railroads. In 1870 between 85 percent and 90 percent of Bessemer steel was used for rails, whereas in England Bessemer steel was used for a variety of goods. Secondly, the closed circle of communication affected the quality of rails. Even though

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93. John Fritz, "The Development of Iron Manufacture in the United States," *Cassier's Magazine* 17, April 1900, p. 467.

94. Temin, *Iron and Steel*, p. 179. For further information on the association and continued growth of the industry, including Carnegie's entry, see Temin, chapter 8, "The Second Decade" and "The Third Decade," pp. 174-193.

production techniques continually improved, the quality of rails did not. In the late 1860s the English referred to poor grade metal as "American rails," and even in the 1870s the American product did not measure up to that made in Europe. Only the development of scientific methods could have an effect. Thirdly, the exclusiveness of the association, combined with the advantages of the open-hearth process, led to the eventual take-over of the steel industry by the latter.[95]

Another critical defect of the Pneumatic Steel Association's arrangements was that they could be undermined, which they were by a man from Scotland. When the Cambria Iron Company installed its Bessemer plant in 1871 the Pittsburgh companies of Andrew Carnegie had not yet made the conversion. This changed when Carnegie and several partners decided to enter the field and build a new plant on 107 acres of farmland 12 miles outside Pittsburgh, at a place called Braddock's Field, part of the French and Indian War battlefield. Alexander Holley was hired to furnish the plans and supervise the construction in September 1872. He had all the room he needed to build the finest Bessemer plant to date, the Edgar Thomson Works.[96]

There were several reasons why Carnegie's venture into the Bessemer process met ultimate success. There was a continuing demand for steel rails, Carnegie waited to enter the business until after the experimental pioneering stage, the Edgar Thomson Works benefitted from the years of Alexander Holley's accumulated experience, and because Daniel Morrell adopted unwise employee policies at the Cambria Iron Company, Carnegie's chief competitor. Morrell believed in paying the lowest possible wages, a policy with which George Fritz and William R. Jones disagreed. As a result, after Fritz died in August 1873, Cambria's directors, influenced by Morrell, refused to promote Jones to Fritz's position, choosing Daniel Jones instead. Not only did Bill Jones disagree with Morrell's wage policy, but he was in Morrell's disfavor for his unorthodox treatment of his workers. He spurred more work from his men than could other supervisors, but he did so by shutting down his department to take the men to baseball games or the horse races.[97]

Bill Jones and Daniel Jones were friends and long-time coworkers, and Daniel Jones' promotion was embarrassing to both men. Believing his friend deserved the job, Daniel Jones offered to refuse it, but Bill Jones decided to look elsewhere for employment. He did not have to look far, as he found work at the new Carnegie works at Braddock. Labor problems emerged at Cambria and

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95. Morison, *Men, Machines, Modern*, pp. 188-190.

96. McHugh, *Alexander Holley*, pp. 250-251.

97. Ibid., pp. 251-252; Cochran, *Pennsylvania*, p. 151.

Daniel Morrell offered his workers a choice: either end the difficulties or lose their jobs. Around 200 workers decided to quit, and left Cambria for Braddock to work with the famed Captain Bill Jones.[98]

Armed with experienced workers, the latest in plant design and technology, and a tested Bessemer procedure, Andrew Carnegie set out to undo the Pneumatic Steel Association. The group had the potential of becoming a pool to control prices by regulating production in market areas. Carnegie skillfully bought a few shares in each competitor's company and received their annual reports. His company, on the other hand, was closed with no shares on the market, thereby preventing similar investigation. Carnegie attended the next association meeting in 1876 in Philadelphia wherein they wanted to develop the coming year's production and prices. He watched as allotments were designated for the individual plants, thereby forming a pool to fix prices and dividing up the market. All of the heavyweights of the industry were there, including Samuel Felton of Pennsylvania Steel; Edward Y. Townsend and Daniel Morrell of Cambria; Walter Scranton of Scranton Iron and Steel; Benjamin Jones of Jones and Laughlin, and Joseph Wharton of Bethlehem Steel. They had already divided the market with the following market shares as examples: Pennsylvania Steel 15 percent, and Cambria 19 percent. Carnegie did not accept this share quietly, as the Edgar Thomson works received only nine percent.[99]

He got up and made a speech:

> I informed each of the other representatives, all Presidents of their companies, that I was a stockholder in their concerns and as such had access to their financial reports. I singled out each president and said, "I find that you receive a salary of $20,000 a year and expenses of $80,000," etc. – instancing each one, telling him just what his salary was, and how much he spent in expenses, etc. Then I told him that the President of Edgar Thomson received a salary of $5,000 a year and no expense allowance. Moreover, I said Mr. [Alexander] Holley, the engineer who built the Edgar Thomson works had informed me that it was the most complete and perfect in the world and would turn out steel rails at cost far lower than its competition. "So gentlemen," I concluded, "you may be interested to know that I can roll steel rails at $9 a ton." [Pure bravado on Carnegie's part, the lowest cost he could achieve at that time being just $50 a ton, but apparently an effective bluff.] "If Edgar Thomson Co. isn't given as high a percentage of this pool as the highest, I shall withdraw from it and undersell you all in the market – and make good

98. McHugh, *Alexander Holley*, p. 252. Carnegie, who knew the iron and steel industry only theoretically, managed to obtain "one of the most innovative and popular plant managers in history," along with the highly skilled and experienced Cambria Bessemer workers. Ibid.; Cochran, *Pennsylvania*, pp. 151.

99. Morison, *Men, Machines, Modern*, pp. 192-193; Wall, *Andrew Carnegie*, pp. 330-331.

money doing it." The committee at once got off its high horse, stopped snickering at me and met my demands.[100]

The association gave in to his demands, but Carnegie never intended to stay in the pool, as the very idea of it went against his spirit of competition. He remained in as long as his business could "run full." He pushed for pools on specific products, such as beams, plates or rails, but would break the agreement, take orders and run his mills whenever the market was weak or when he had bested his competitors with a new technological development. When Carnegie continually offered his products at lower prices than the association, he was informed that the "Cambria people" were becoming "bitter." Carnegie responded: "Of course Cambria is bitter – she has herself to blame. . . . Let us manage our own business – take orders whenever a fair profit is secure."[101]

Carnegie ended the Pneumatic Steel Association's reign with his continual drive for economy, his judgment of people, his understanding of the new technologies, and his vision of the industry's future. Carnegie took over the industry and moved it forward. The steelmakers won out over foreign competitors through tariffs, but they did not trust each other. Carnegie showed them that a "gentlemen's agreement" could not stop competition; only destroying the competitors would achieve that.[102]

Andrew Carnegie continued to make short term arrangements with the association for the sake of temporary advantages.[103] He especially wanted to stay friendly with the Cambria Iron Company, a powerful competitor. In June 1876 Carnegie wrote to Edward Y. Townsend, offering to share an order for 5,000 tons of steel rail from Montreal's Grand Trunk line. He wrote: "If we must fight – fight it is but it doesn't seem sane to me to do it in this case." In 1877 Carnegie wrote Townsend again:

> The Pennsylvania and Westmoreland Coal Cos. are exactly in point, – a short war and they came together probably ten years ago – . . . In like manner, if our two works obtain a lead & go forward prosperously, we shall both grow in various directions & make always a large proportion of the steel made in this country – I have been charged with demoralizing the Rail Mkt. but should war between our

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100. Quoted in Wall, *Andrew Carnegie*, pp. 331-332; Livesay, *Carnegie*, pp. 104-105.

101. Livesay, *Carnegie*, pp. 105-106; Wall, *Andrew Carnegie*, p. 332.

102. Morison, *Men, Machines, Modern*, pp. 192-195, 204; Wall, *Andrew Carnegie*, pp. 333-334

103. Wall, *Andrew Carnegie*, p. 334.

concerns result in prices now almost undreamt of, I decline to share the responsibility.[104]

Carnegie's efforts at achieving a truce with Cambria were largely successful throughout the rest of the 1870s, as they shared orders and divided profits. Cambria and Carnegie, McCandless & Company also combined efforts to obtain phosphorus-free iron from Michigan. Daniel Morrell bought the ore and transported it for the use of both companies. The greater volume meant lower costs on both the ore and the transportation in barges. Carnegie even asked Townsend about acquiring foreign ores in an effort to save even more money.[105]

These arrangements with his chief rival worked well when Carnegie's Edgar Thomson plant was just getting started. He was especially concerned with knowing how much it cost his competitors to make steel, and belonging to a pool helped him gather information. He consistently compared his production costs with those of the other steel plants. By plowing boom year profits back into his equipment and by cutting costs, Carnegie was able to survive the years of recessions and even buy out his competitors.[106]

The future of the steel industry thus lay in Carnegie's "truth of economy." In such a way did the Pneumatic Steel Association, including the Cambria Iron Company, not only lose its technical edge, but its dominance in the industry. They were not set up to deny themselves and their stockholders the profits in order to prepare for the harsh competitive days ahead. During its heyday, Cambria's engineers were the competent geniuses. Cambria was the school where everyone learned at the hands of the masters who then left to run other plants for the association, still maintaining their affection, regard, and communication for and with each other. They were the men who picked up on a new idea and devoted themselves to developing it. Unfortunately for Cambria, Andrew Carnegie was the one who had the foresight to move on once the idea of the Bessemer process was generally accepted.[107]

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104. Quoted in ibid., p. 335.

105. Ibid., pp. 335-336.

106. Ibid., pp. 336-337.

107. Ibid., p. 338; Morison, *Men, Machines, Modern*, pp. 181, 201-202. A good overall history of early steel efforts and the rise of the Carnegie empire, written in the high spirits of the time, is Herbert N. Casson, *The Romance of Steel The Story of a Thousand Millionaires* (New York: A.S. Barnes & Company, 1907).

The situation regarding rail manufacture in the late 1880s was unique. A few large concerns dominated the demand, there was only one use for the rail, and it was made by equipment which cost more to install than that for almost all other categories of steel. Rail was the cheapest finished product of the iron and steel industry, but was the most difficult to make. A $3 million investment was required before a single rail could be made. In 1884 there were 71 rail mills in the United States, and most of these were small iron mills. In August 1887 the first rail pool had only 15 of the largest mills as members and they tried to avoid a struggle which would eliminate the weak mills and leave the powerful ones with operational costs inadequately covered. The firms divided an allotment of 800,000 tons, and another 250,000 tons was provided for equal adjustment of differences. In 1888 output was less than two-thirds that of 1887 but as a result of the pool, prices did not collapse.[108]

The east and central Pennsylvania pool members received 34.8 percent of the total allotment, but these two groups made 41.5 percent of the nation's rail output. The North Chicago Company had a 12.5 percent of the allotment, but made 162,000 tons of rails, for a total of 11.6 percent. Carnegie made 148,000 tons of rail at Edgar Thompson, and even excluding Homestead, the production was below the company's allocation.[109]

The 1888 rail tonnage allotments among rail pool members (percentage) were as follows:

Eastern:	Bethlehem	9.0	
	Lackawanna	8.0	
	Scranton	8.0	
	Pennsylvania	9.8	40.7
	Troy	4.5	
	Worcester	1.4	
Western Pennsylvania and Ohio:			
	Cambria	8.0	
	Carnegie	13.5	26.3
	Cleveland	4.8	
Western:	North Chicago	12.5	
	Joliet	8.0	
	Springfield Iron Company -- Union	8.0	33.0
	Western Steel Co.	4.5[110]	

108. Warren, *American Steel Industry*, p. 96.

109. Ibid.

110. Ibid., p. 97

In 1893 during a depression, the rail pool collapsed. Edgar Thompson's output dropped from 21.4 percent in 1892 to 12.3 percent in 1893. Worse yet was the decline in eastern Pennsylvania, primarily at Bethlehem, but Cambria and Lackawanna did better. The national output dropped 26.7 percent from the previous year but in Illinois rail manufacture dropped 48.3 percent. During 1893 every mill in the Chicago area was closed for some time. The pool was reestablished in the autumn of 1893 but business did not run smoothly. Negotiations continued and attempts were made to control the industry's ups and downs throughout the 1890s, but competition from new mills and between western and eastern producers ran high throughout the period. The eastern rail mills had to be reorganized to meet this competition, and this was difficult for some firms. Troy Steel Company's rail mill was idle by the late 1890s, and in 1902 the plant was sold at auction. Bethlehem withdrew from the rail business by 1902, and while Cambria was in better shape, it could not do much more than hold its own throughout the 1890s.[111]

Rail production gradually shifted to the west for many reasons, including the changing methods of the delivery of raw resources. Some of these factors were outside an individual company's control, but in some cases individual initiative determined how well integration, the control of mineral supply, would work. It was a cut-throat business and little things mattered. Carnegie's "unrivalled excellence" of organization assured his success. Other companies were public concerns, held accountable by shareholders who wanted dividends, but Carnegie Steel was a partnership where only young men with ability ran the operation. The policy of using profits from good times to improve plants for operation during rough times allowed Carnegie to go after business in the 1890s at prices which broke other companies. It was Carnegie's "ruthless pursuit of business efficiency" which was his legacy for American business.[112]

In February 1952 a small newspaper article appeared which spoke of the end of an era in Johnstown:

> Bethlehem Steel Company's Johnstown, Pa., plant has discontinued the Bessemer steel process. . . . The Bessemer process was first introduced at the Bethlehem plant there about 100 years ago.

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111. Ibid., 96-101.

112. Ibid., 102-106.

> On February 24th, the last three of four Bessemer converters went down, and all raw steel at the Johnstown plant will be produced in 21 open hearth furnaces, in line with Bethlehem's expansion program.[113]

(See illustration 25 of Bessemer converters in the Lower Works in 1952.)

The story of steel in Johnstown did not end with Andrew Carnegie's entry into the market; rather, new chapters followed with the Cambria Iron Company's embracing the open-hearth method, surviving the disastrous 1889 Johnstown Flood, reorganizing itself to survive in the age of consolidation, and ultimately, being absorbed by much more powerful steel companies. The Cambria Iron Company's story was representative of the steel industry's as a whole, as it neared and entered the twentieth century.

113. "Bessemer Process discontinued after 100 Years Use at Johnstown," February 28, 1952, unknown newspaper clipping, folder: Companies-Bethlehem Steel Company-Plants-Johnstown, box: C-11, Acc 1631, American Iron and Steel Institute Papers (AISI), HagM.

CHAPTER IV: THE CAMBRIA IRON AND STEEL COMPANY 1880-PRESENT

The Cambria Iron Company's history did not end with the onslaught of competition from the Carnegie Company. Its history paralleled that of the steel industry as a whole as it underwent consolidation and reorganization, experienced plant expansion and change in ownership, suffered the fluctuations in market demand, and was challenged by steel technologies developed in foreign countries. The Cambria Iron Company not only managed to survive the disastrous Johnstown Flood of 1889, but was back in operation within a month and starting to rebuild.

The works continued to grow and became a fully integrated steelmaking complex. By 1888 the Cambria Iron Company's Lower Works had six blast furnaces. The Bessemer plant was 102 feet wide and 165 feet long, with an eight-and-one-half-ton capacity in each one of its converters. The open-hearth steel department had three 15-ton Pernot furnaces. There were two blooming trains where 6,500 pound ingots were rolled into seven-inch blooms. Each ingot made eight to ten rails. The rolling mill held six trains of rolls, and the axle shop produced 100 steel railroad axles each day. The Gautier Department produced 50,000 tons of agricultural products.[1] (See illustrations 26 and 27 of Cambria in 1881 and 1888. Appendixes 24 and 25 are descriptions of Cambria in 1888 and 1890.)

JOHNSTOWN FLOOD OF 1889

With such a thriving business in Johnstown, it is no wonder Daniel Morrell became concerned when he heard rumors about the South Fork Dam. Built in 1853 for the Pennsylvania Main Line Canal, the dam on the south fork of the Little Conemaugh was sold in 1857 to the Pennsylvania Railroad, and sold twice more before it was used by the South Fork Fishing and Hunting Club of Pittsburgh as a resort area. Reconstruction of the dam started in 1880 with substantial changes to the original configuration.[2]

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1. Richard A. Burkert and George Hand, "Iron and Steelmaking in the Conemaugh Valley," in *Johnstown The Story of a Unique Valley*, ed. Karl Berger (Johnstown: Johnstown Flood Museum, 1984), p. 283.

2. Paula Degen and Carl Degen, *The Johnstown Flood of 1889 The Tragedy of the Conemaugh* (n.p.: Eastern Acorn Press, 1984), pp. 12-16.

Morrell heard of the changes and sent engineer John Fulton to look at the dam in November 1880. Fulton's report charged the repairs were not done with care or necessary consideration. The dam's owner, Benjamin Ruff, disputed Fulton's observations, prompting Morrell to write again and offer to help pay for a safe reconstruction. This offer was refused and Daniel Morrell's death ended any further action in the matter.[3]

The dam survived for several more years of severe rain and flooding, and rumors of the dam's breaking often plagued people in the valley below. The massive rains of May 30 through June 1, 1889, were more than the dam could handle and the infamous Johnstown Flood of May 31, 1889 was the result. Almost 7,000 men and women were on the Cambria payrolls when the flood desolated the Conemaugh Valley.[4]

The Cambria Iron Company planing mill and furniture factory at Mineral Point were destroyed, along with most of the town. Woodvale's woolen mill, flouring mill, brickworks, 225 houses, and 314 people were washed away. Nothing was left of the Cambria Iron Company's model town except portions of walls of the mills, and a foot bridge span over a railway. In downtown Johnstown, the company store survived, but it was severely damaged and its contents were mired in mud. Cambria also lost 256 workers' homes out of 500 existing in Johnstown and Millville. Heavy machinery from the mills appeared in strange sites all over the city. Steam pumps from the Woodvale woolen mill, each weighing fifty tons, were pushed by the waters 350 feet from their bases. Eight-ton ingots from the blooming mill were rolled away and 100,000 bricks from the company brickyard lodged at the Franklin bridge.[5]

The Gautier Department, located in Woodvale and Conemaugh, was destroyed, and little remained except for foundations and portions of engines and roll trains. About 200 rolls of steel cable and barbed wire weighing 200,000 pounds added to the flood debris which roared toward Johnstown. Two months were required to reinstall machines and to build temporary sheds. Workers untangled, cleaned, and straightened wire which was sold at a lower price. Carpenters built temporary shelters to house the equipment while other workers searched the river and streams for missing patterns. By August 5 a shearing machine was in operation and a "cold roll" shop five days later. The temporary

3. Ibid., p. 16.

4. Ibid., p. 19; McLaurin, *Johnstown*, p. 45.

5. Degen and Degen, *Johnstown Flood*, pp. 23-24, 26; Shappee, "History of Johnstown," p. 287-289.

plant was in operation by September 1889. Permanent structures and an enlarged plant were constructed immediately west of the temporary structures beginning in 1891-1892.[6]

The Lower Works survived the flood because they were located below the Pennsylvania Railroad stone bridge and Westmont Hill, which broke the force of the massive flood wave. However, the Lower Works were overflowed and covered with several feet of debris causing much damage to buildings and machinery. From three to four feet of mud covered the entire flat where the works stood. The eastern end of the rolling mills, blooming mill, and open-hearth were damaged and tracks and trains destroyed. Other furnaces were not injured and production could resume. Gautier employees worked at the Lower Works, clearing mud and debris. Sections of the Lower Works were put into operation between two to five weeks after the flood. Gas lines were repaired by June 8, men reported to their specific jobs on June 10, the rod mill was operating by June 13, and the furnaces were lit on June 18. Employees retrieved correspondence and records at the company offices downtown and tried to dry them out over slow fires. The first payday occurred on June 21, with 3,500 of 5,000 Lower Works employees and 950 of 1,350 Gautier workers receiving well-earned pay totaling $95,000 and $54,000 respectively. A second payday occurred on June 29. The entire works were in full operation on June 24. The number of Cambria employees lost in the flood was estimated at 225.[7]

Johnstown's survivors did not immediately know whether their principal employer would remain in business after the devastating flood. Cambria engineer John Fulton wrote in his autobiography a poignant story of how Johnstown citizens learned the plant would survive:

> I met Vice President [Powell] Stackhouse at the Railroad Station. He informed me that the Directors of the Cambria Iron Company at a meeting decided to repair and rebuild the works. In this glad conference plans were made that each superintendent would put his men to work and clean up each Department. For the present the Gautier Works were held in abeyance. I immediately found some of our men and got together some of the superintendents. The blast furnaces were not injured. Nearly all the locomotives were run up to higher ground. I required the men at the blast furnaces to begin sounding the great whistle at the usual hour and keep it up for ten minutes. The locomotive men were similarly instructed, so on Tuesday morning, June 4th, whistles sounded the glad news of the resumption of the work, beginning with the clean up of the Works. The men subsequently declared that the music of

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6. Local Reception Committee. "The Iron, Steel and Allied Industries of Johnstown, Penn'a for the Information of the Visiting Members of the Foreign and American Technical Societies," October 1890, p. 17; Burkert, "Iron and Steelmaking," p. 288; Degen and Degen, *Johnstown Flood*, p. 26; Shappee, "History of Johnstown," p. 515.

7. "Iron, Steel and Allied Industries," p. 17; Burkert, "Iron and Steelmaking," pp. 287-288; Shappee, "History of Johnstown," pp. 514-515.

the whistles was the most inspiring and hopeful that they had ever listened to in their previous experience.[8]

The flood had no severe long term effects on Cambria, and general economic prosperity aided in the recovery. The amount of damages was never revealed, although it was estimated at $3 million.[9] (See illustrations 28-31 of damage to Cambria in the 1889 flood.)

THE CAMBRIA STEEL COMPANY

On October 26, 1898, stockholders of the Cambria Iron Company were asked to attend a meeting on the company's offices in the Harrison building, 15th and Market, Philadelphia, to vote for or against leasing all of the company's property to a corporation to be organized under the general corporation laws of the state of Pennsylvania. The rent was to be four percent per year on the capital stock of $8.5 million, and the board of directors and executive officers of the new company would be the same as those of the Cambria Iron Company. Shareholders had the privilege of subscribing for all the stock of the new company, totaling $24 million, the Cambria Iron Company's assets in 1898 were worth $20 million.[10]

Continued growth of business required a yearly expenditure of $1 million for new property, equipment purchases, and other improvements. The present company could not successfully meet these financial needs. The new corporation was to have a $16 million capital, divided into 320,000

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8. Quoted in Shappee, "History of Johnstown," pp. 513-514.

9. Ibid., p. 516; Burkert, "Iron and Steelmaking," p. 287. For an account of the human abuse of Johnstown's physical environment, including the role of the Cambria Iron Company, which contributed to the 1889 flood damage, see Nathan D. Shappee, "Spoilation and Encroachment in the Conemaugh Valley before the Johnstown Flood of 1889," *The Western Pennsylvania Historical Magazine* 23, no. 1 (March 1940): 25-48.

10. W.S. Robinson to the Stockholders of the Cambria Iron Company, September 24, 1898, box: Cambria Iron and Steel, Acc 1699, BSC, HagM; Clark, *History of Manufactures*, 3: 41. For biographical data on several of Cambria's later managers, including Powell Stackhouse, Charles S. Price, J. Leonard Replogle and Hartley C. Woe, see "The Cambria Steel Company's Presidency," *The Iron Age* (November 25, 1909): 1630, and *Biographical Directory of the American Iron and Steel Institute* (New York: American Iron and Steel Institute, 1911).

shares of $50 each. The Cambria Iron Company shareholders were offered the chance to convert their shares.[11]

The Cambria Steel Company was incorporated on November 14, 1898. It leased the Cambria Iron Company's property, including ore mines, coal lands and works, for 999 years starting December 1, 1898, with a fixed guarantee of four percent per year on its stock. This arrangement lasted three years, when increased business needed more capital. The Conemaugh Steel Company was chartered on July 1, 1901, with a capital of $45 million. This company combined with the Cambria Steel Company to form the Cambria Steel Company, incorporated on August 22, 1901, with $50 million capital. Under the lease terms the steel company agreed to improve the iron company property by spending $5 million in five years. The steel company exceeded this amount, and spent $6,052,774.82 in the years before the consolidation with Conemaugh Steel Company.[12] (See appendix 26 for description of Cambria Steel Company in 1907.)

The 999-year lease of Cambria Iron Company held through several administrative changes until 1942. Then owner Bethlehem Steel Company, holder of the lease dated December 1, 1898, between the Cambria Iron Company and Cambria Steel Company, offered to buy from the iron company all its rights, title, and interest as lessor under the lease for $55 per share of capital stock. On June 5, 1942, the iron company board of directors unanimously adopted resolutions accepting Bethlehem's offer, subject to shareholder approval. Bethlehem bought the stock by June 30, 1942. Notice of the merger appeared in Bethlehem, Pennsylvania, newspapers in September 1942.[13]

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11. Robinson to Stockholders, September 24, 1898; "Agreement," [Lease of Cambria Iron Company to Cambria Steel Company] December 1, 1898, box: Acc 1699 Bethlehem Steel, Cambria Iron and Steel, Acc 1699, BSC, HagM. Stock in allied corporations belonging to the iron company were included in the lease to protect water supply and control of raw materials. The stocks were as follows: 15,144 shares of Penn Iron Mining Company; 995 shares Cambria Inclined Plane Co.; 1,500 shares Mahoning Ore & Steel Co.; 1,893 shares Johnstown Water Company; and 5/8 interest Juniata Limestone Company, Ltd. Ibid.

12. Storey, *History*, 1: 437-438; "Cambria Steel Company Incorporated November 14, 1898 and Conemaugh Steel Company Incorporated June 15, 1901 were Consolidated and merged into Cambria Steel Company," typed report, folder: Cambria Iron Co., box: V Johnstown's Iron and Steel Industry, Mbol IV, JFM.

13. R.E. McGrath, vice-president, Bethlehem Steel Company to the Board of Directors of Cambria Iron Company, June 1, 1942, box: Acc 1699 Bethlehem Steel Cambria Iron and Steel, Acc 1699, BSC, HagM; Daniel M. Stackhouse, president, to the Shareholders of Cambria Iron Company, June 5, 1942, Ibid.; Bethlehem *Globe-Times*, September 18, 1942. At this time the officers of the Cambria Iron Company, located at No. 1048 Broad Street Station building, 16th and Filbert streets in Philadelphia, were Daniel M. Stackhouse, president, Samuel J. Reeves, vice-president, John W. Townsend, Jr. vice-president; Frank J. Krouse, secretary and treasurer, and William G. Laister, assistant secretary and assistant treasurer.

WORLD WAR I

The Cambria Steel Company continued to do well. In 1904 it was the third largest steel company in the United States, exceeded only by U.S. Steel and Jones & Laughlin Steel Corporation. Between 1901 and 1913 Cambria increased its product from 467,000 to 1,193,000 tons, a growth of 155 percent. However, the coming of World War I significantly changed the fate of Cambria Steel. The plant changed hands twice, during and after the war, as a result of major upheavals in the industry due to the tremendous growth of business. The U.S. Steel Corporation, incorporated in 1901, dominated the industry before 1914, but the rush of European war orders helped competition acquire a larger part of the market. The growth of two firms, Midvale Steel and Ordnance Company, and Bethlehem Steel Company, occurred at U.S. Steel's expense.[14]

When the war started few in the industry expected foreign orders and few could meet the demand. The exception was Bethlehem Steel, which readily picked up the war orders and profits because of the foresight of its president, Charles M. Schwab. A former president of Carnegie Steel, Schwab had purchased Bethlehem Steel, a nearly bankrupt company in 1904. He soon reorganized the company as a corporation by adding ore works and shipbuilding companies. By 1914 Bethlehem made ships and ordnance, and several European countries had placed munitions orders even before the war began. After a trip to Europe in fall 1914 Schwab returned to America with more than $50 million in Allied contracts.[15]

So lucrative were the foreign war contracts that by the time President Woodrow Wilson's administration began preparing the United States for war, all the domestic steel mills were swamped with the foreign orders. Bethlehem received more than $246 million in contracts before April 1917. Lackawanna received $28 million in contracts, American Steel & Foundry received more than $55 million and Youngstown Sheet and Tube received $41 million. U.S. Steel filled $124 million of Allied orders. Before the United States even entered the war, the steel industry filled more than $1 billion in foreign contracts. The rewards were so lucrative that a new holding company was formed to take advantage of the bounty.[16]

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14. Melvin I. Urofsky, *Big Steel and the Wilson Administration A Study in Business-Government Relations* (Columbus, Ohio: Ohio State University Press, 1969), p. 86. Gertrude Schroeder, *The Growth of Major Steel Companies, 1900-1950* (Baltimore: The Johns Hopkins Press, 1953), p. 96; Clark, *History of the Manufactures*, 3: 64.

15. Urofsky, *Big Steel*, pp. 87, 90.

16. Ibid., pp. 87, 93

MIDVALE STEEL AND ORDNANCE COMPANY

Midvale Steel and Ordnance Company was established in 1866 as The William Butcher Steel Works, when Philadelphia iron merchant Philip S. Justice and English steel maker William Butcher built a plant in the Nicetown section of Philadelphia to produce steel "tyres," or driving wheels of steam locomotives. The name changed to Midvale Steel Works in 1872. The manufacture of steel for ordnance began at Midvale in 1875 when the U.S. Navy sought its first ordnance order from an American steel works. In 1870 the company supplied chrome steel for the Eads Bridge over the Mississippi River at St. Louis, and steel for the superstructure of the Brooklyn Bridge in 1879. By 1900 work began on marine engines and gun carriages, battleship armor plate, finished guns, and mounts. The outbreak of World War I in August 1914 did not immediately affect the company. The president of Midvale Steel Company, Charles J. Harrah, avoided selling arms to the European countries at war after 1914 because he had a daughter married to an Englishman and a second daughter married to a German. Thus, Midvale stayed neutral until taken over by the Midvale Steel and Ordnance Company in September 1915. Harrah retired and avoided "further moral turmoil." The Midvale Steel and Ordnance Company purchased the entire capital stock of the Midvale Steel Company, and turned largely to manufacturing war material. Almost its entire output was armor piercing projectiles, explosive shells, artillery, and armor plate.[17]

The Midvale Steel and Ordnance Company was a holding company chartered in Delaware with an initial capital of $100 million. With the promise of war profits as incentive, former U.S. Steel executives William Brown Dickson and William E. Corey entered a syndicate of manufacturers and New York investors to create a major steel combine. Bankers and some armaments manufacturers joined with the syndicate members on the board of directors. Alva C. Dinkey, former president of Carnegie Steel, headed the new firm. Dickson was the vice-president and treasurer while Corey presided over the board of directors. The syndicate of manufacturers included Ambrose Monell, president of International Nickel, and Samuel Vauclain, president of Baldwin Locomotive. The New York investors were Percy A. Rockefeller, M. Hartley Dodge, and Frank A. Vanderlip, president of National City Bank. The bankers and armaments manufacturers were Albert H. Wiggin, president of Chase National Bank; Charles H. Sabin, president of Guaranty Trust Company; Joseph W. Harriman, president of Harriman National Bank; Frederick W. Allen of Lee, Higginson &

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17. "1867-1942 The Seventy-Fifth Anniversary of the Midvale Company Steel," The Midvale Company, 1942, pp. 11-21; Richard T. Nalle, *Midvale – and its Pioneers* (New York: The Newcomen Society of England, 1948), pp. 10-22; Eggert, *Steelmasters*, p. 97.

Company; Samuel F. Pryor, vice-president of the Metallic Cartridge Company; and W.P. Barba, vice-president of the Midvale Steel Company.[18]

The firm decided to purchase three companies, all located in the Philadelphia area: the Midvale Steel Company at Nicetown, Worth Brothers at Coatesville, and the Remington Arms Company at Eddystone. The property cost Corey and his associates $60.5 million. In February 1916 the firm of Kuhn, Loeb & Company of New York decided not to finance a merger of the Lackawanna and Youngstown Steel companies with Cambria Steel Company. Learning of Cambria's availability, William Brown Dickson urged William E. Corey to buy the company. A J.P. Morgan & Company agent helped in the negotiations, and Midvale thus acquired an additional output of 1,500,000 tons of steel ingots per year to Coatesville's 300,000 tons. Midvale's total capacity, after its purchase of Cambria, was somewhat less than that of Jones & Laughlin Steel Company. Midvale, which was basically a munitions company, acquired Cambria with its rails, specialty steel, structural shapes, plates, and freight cars as a hedge against the ending of the war and the end of munitions orders.[19]

Midvale was able to purchase Cambria Steel because of a recent change of control of company stock. J. Leonard Replogle, a 25-year employee and vice-president and general sales manager of Cambria Steel, resigned in 1914 to become vice-president of the American Vanadium Company. By Thursday, November 11, 1915, he had purchased 224,000 to 240,000 shares of Cambria Steel Company stock which had been held by the Pennsylvania Railroad. He paid an estimated $14 million to $15 million. Replogle represented a syndicate, whose known members were E.V. Babcock, Charles J. Graham, and Frank J. Lanahan, all of Pittsburgh. Replogle additionally had other holdings in the company.[20]

It was believed that "harmony" existed between Cambria management, including Cambria President W.H. Donner, and the purchasers of the Pennsylvania Railroad holdings. The Pennsylvania Railroad representatives on Cambria's board, Effingham B. Morris and Theodore N. Ely, were expected to

18. Eggert, *Steelmasters*, pp. 96-97.

19. Ibid., pp. 97-99; "The Midvale Acquisition of Cambria," *The Iron Age* (February 17, 1916): 441.

20. "J. Leonard Replogle and Others Buy Large Cambria Steel Company Holdings," *The Iron Age* (November 18, 1915): 1192. Babcock was interested in lumber, coal and coke properties, and was the director of two Pittsburgh banks; Graham was vice-president of the Graham Nut Company; and Lanahan was president of Fort Pitt Malleable Iron Company, McKees Rocks, Pennsylvania. J. Leonard Replogle started his career at Cambria at age 12. He invented a bolt-cutting machine during the construction of the Hudson tubes which expedited the work, and became superintendent of Cambria before he attained his majority. He moved up the ranks quickly, but left to head the American Vanadium Company. Replogle was chief of the Steel Division of the War Industries Board during World War I. Urofsky, *Big Steel*, note, p. 155.

resign, and Replogle and an associate take their place. President Donner issued the following statement from the Cambria Steel Company's office in Philadelphia:

> Mr. Donner confirmed the report that the Pennsylvania company had disposed of the balance of its Cambria Steel Company stock. He understands that the syndicate of purchasers is composed of very substantial business people who have taken over the stock largely as an investment and will undoubtedly be interested in seeing Cambria's valuable properties further developed. Mr. Donner stated that the improvements made last year were proving quite profitable and that not only was present business very satisfactory but the future outlook most promising. Mr. Donner said there had been no fight for control and that insofar as he knew no such controversy would occur.[21]

The Replogle interests had control of the Cambria Steel Company and resold the plant six months later to the Midvale Steel and Ordnance Company. The terms of Midvale's financing for the purchase of Cambria was revealed in a circular from William B. Dickinson to stockholders on February 11, 1916. Stockholders were entitled to subscribe to the $25 million of new stock (500,000 shares at $50 par value) at $60 per share, to the extent of one-third of the stock they currently held. This new stock exhausted the company's authorized capital stock, and a stockholders' meeting was held March 11 to vote on increasing the capital stock from $100 million to $150 million. The $50 million of five percent bonds issued as part of the Cambria financing were convertible into stock at a price of $100 for $50 par value. In order to satisfy the conversion privilege of the bonds, 500,000 shares of the new stock, at $50 per share, were required and were reserved from the new stock issue of $50 million which left $25 million par value of unissued stock to meet any future needs.[22]

Capital investment in the Cambria plant occurred under the new management. During this time major improvements to the various works took place. The Cambria Steel Company had built a new steelmaking and coke plant in Franklin Borough, as well as a rod and wire plant in Johnstown. Midvale worked with the Edison Company to establish a benzol recovery plant at the Franklin coke plant for recovering by-products. Several more mills were added in 1917-1918. The existing blast furnaces were modernized, two more blast furnaces, No. 10 and 11, were built in 1916, stock bins at the Franklin furnaces were built in 1920, a sintering plant was constructed in 1920, the Rosedale coke plant was built in 1918-1922, and the Franklin by-product plant was built in 1920.[23]

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21. "Replogle and Others.": 1192.

22. Ibid.; Burkert, "Iron and Steelmaking," p. 303; "Midvale Acquisition,": 441.

23. Engineering, "History," p. 6, BSC, CCHT.

(See appendixes 27 and 28 for Cambria's principal products in 1916 and a list of the major departments in 1920.)

After the war effort Midvale was unprepared for the depression which followed. Between 1921 and 1922 Midvale earnings dropped 143 percent. All government work on armor and guns for the navy was halted and the company's fortunes fell. In an effort to save itself, Midvale tried to merge with other independent steel companies. Its officials urged a merger among seven companies which, as a single firm, would supply 20 percent of the industry's production. Midvale, Lackawanna, Youngstown Sheet & Tube, Republic, Inland, the Steel & Tube Company of America, and Briar Hill Steel Company, would compete with U.S. Steel, with 45 percent of the industry's production, and Bethlehem Steel Company's 6.38 percent. This merger did not occur because of disagreements among the various officials involved and other merger attempts.[24]

By spring of 1922 an agreement existed between Midvale and Republic to buy Inland Steel and form the North American Steel Company. On August 31, 1922 the Federal Trade Commission issued a complaint against the proposal and the three presidents involved publicly announced the abandonment of their merger plans on September 28. Within the month William E. Corey had arranged to sell the Coatesville and Cambria plants to Bethlehem Steel Corporation when it offered a merger proposal. Midvale's owners accepted after three weeks of negotiations.[25]

BETHLEHEM STEEL CORPORATION

Eugene R. Grace, president of Bethlehem Steel Corporation, announced on November 24, 1922, that corporation directors had authorized contracts for purchasing Midvale Steel and Ordnance Company plants, including Cambria Steel. The Nicetown plant was not acquired, and it continued to be run by Midvale, with Alva C. Dinkey as president. The purchase made Bethlehem the second largest steel company in the United States, and ended the rivalry between Charles M. Schwab,

24. Eggert, *Steelmasters*, pp. 146-148.

25. Ibid. , p. 148; Burkert, "Iron and Steelmaking," p. 304; A. C. Dinkey to the Stockholders of Cambria Steel Company, January 8, 1923, box: Cambria Iron and Steel, Acc 1699, BSC, HagM; Schroeder, *Major Steel Companies*, p. 101.

chairman of Bethlehem, and William E. Corey, head of Midvale, which had existed since both had worked for Andrew Carnegie.[26]

An exchange of Bethlehem Steel common stock was made for the outstanding shares of Midvale and Cambria. Midvale had $100 million stock and $52,131,500 of funded debt. Cambria had $45 million in stock outstanding of an authorized total of $50 million. Midvale owned $43,764,750 of outstanding Cambria stock. The acquisition resulted in the issuance of $97,650,000 par value of Bethlehem common stock, of which $93 million was given to Midvale for distribution to its stockholders at dissolution. The rest went to Cambria Steel stock holders.[27]

Bethlehem made the purchase to follow a policy of building a complete line of steel products. The purchase of Cambria brought with it developed iron ore properties in Michigan and Minnesota, and coal property in Pennsylvania. Operating costs were expected to be reduced because of the ability to mix Cambria coal and ores with Bethlehem's holdings. The merger also provided Bethlehem with lines of steel products it had not manufactured, such as wire products, steel cars, and agricultural implement parts. An additional advantage of the merger was geographic, as Bethlehem increased its capability to economically distribute products into the Midwest.[28]

Bethlehem Steel Company had its origins in 1857 with the formation of the Saucona Iron Company in Bethlehem, Pennsylvania. In 1859 the company name changed to Bethlehem Rolling Mills and Iron Company, and in 1861 the name changed again to Bethlehem Iron Company. The blast furnace was "blown in" in January 1863, puddling operations began in July, and the first iron rails were rolled in September. The Bessemer steel process was installed in 1868 and the first steel rails rolled in 1873, under the direction of John Fritz. In April 1899 Bethlehem Steel Company was incorporated, and in turn, became a subsidiary of Bethlehem Steel Corporation in 1904, formed by Charles M. Schwab. Corporation properties included the steel plant in Bethlehem, iron ore mines

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26. New York *American*, November 25, 1922; Nalle, *Midvale*, p. 23. Alva C. Dinkey was a brother-in-law to Charles M. Schwab. Eggert, *Steelmasters*, p. 98.

27. New York *American*, November 25, 1922.

28. Ibid.; "Midvale Merged with Bethlehem," *The Iron Trade Review*, November 30, 1922, pp. 1468-1469.

in Cuba, the Union Iron Works with shipbuilding facilities at San Francisco and Hunter's Point, California, and other shipbuilding and manufacturing establishments.[29]

Schwab developed Bethlehem with the idea of having a steel empire east of Pittsburgh. This idea differed from the dictates of the time which thought the costs and distances involved with shipping ore from the Lake Superior fields prohibited such a geographic location. But Schwab utilized the cheap ores of Cuba and South America, made steel in eastern Pennsylvania, and took advantage of low freight rates to the east coast. Between 1907 and 1912 Schwab earned a profit of $9 million, but poured the money back into the firm for enlargements and modernizing. Following the example of Andrew Carnegie, he chose good men, promoted from within the firm, and rewarded good work with bonuses.[30]

Unable to keep pace with the gut of World War I munitions orders, Charles Schwab decided to buy operating plants instead of building new ones. In 1916 the corporation bought the Pennsylvania Steel Company, with plants at Steelton, Pennsylvania, and Sparrows Point, Maryland. The next acquisition was the American Iron and Steel Manufacturing Company in Lebanon, Pennsylvania. Following his belief in reinvesting profits into equipment, Schwab was able to handle the war contracts, and to finally deliver dividends to his investors. Earnings rose from $9,649,668 in 1914 to $43,593,968 in 1916. The corporation earned 112 percent on its stock in 1915 and paid a 30 percent dividend on common shares. In 1917 Bethlehem earned 280 percent on its capitalization, and paid a dividend of 200 percent. The prosperity was due to Allied war business.[31]

Bethlehem continued to expand. The 1922 acquisition of the Lackawanna Steel Company plant at Lackawanna, New York, provided access to Midwest rails and markets. This was followed by the purchase of the Cambria plant of Midvale Steel and Ordnance Company on March 30, 1923.

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29. Commonwealth of Pennsylvania, Department of Internal Affairs, *Monthly Bulletin* 20, no. 6, "A Brief History of Bethlehem Steel Company," May 1952, pp. 17-18; Sylvester K. Stevens, *Pennsylvania Titan of Industry*, 3 vols. (New York: Lewis Historical Publishing Co., Inc., 1948) 2: 104-105; *Bethlehem of Pennsylvania The Golden Years* (Bethlehem: Bethlehem Book Committee, 1976), p. 115. Schwab entered the steel industry in 1879 at age 17. He drove stakes at the Edgar Thomson Works for $1.00 a day and became friends with former Cambria employee, Captain William R. Jones. Carnegie also liked him and recognized his remarkable abilities. At age 25 Schwab was superintendent of the Homestead Works. As president of Carnegie Steel he managed the sale of the company to John Pierpont Morgan. Differing with Elbert H. Gary over policy, Schwab resigned in 1903 and bought Bethlehem Steel. He was president of Bethlehem Steel Corporation in 1904, became chairman of the board in 1916 and served until his death in 1939. For a biography of Charles M. Schwab, raised and educated in Loretto, Pennsylvania, see Robert Hessen, *Steel Titan The Life of Charles M. Schwab* (New York: Oxford University Press, 1975).

30. Urofsky, *Big Steel*, pp. 88-89.

31. Ibid., pp. 91-92.

Cambria was now Bethlehem's largest plant and possessed large ore, coal and limestone reserves, and Great Lakes ore vessels. Cambria also provided Bethlehem the capacity for producing car wheels and axles, freight cars, mine cars, and other rolled specialty steel products.[32] (See appendix 29 for operating and financial data of Bethlehem Steel, 1905-1957. Appendix 30 is a description of the Cambria plant in 1923.)

Almost all of Bethlehem Steel Corporation's growth during its first 11 years was due to expansion of its own facilities, including the construction of the plant in Bethlehem and the acquisition of iron ore mines in Cuba and Chile. The small shipyards were the only significant acquisitions. From 1916-1925, however, 16 companies were acquired, including Lackawanna and Midvale, with its Cambria subsidiary. From 1925 to 1950 Bethlehem took over 26 companies, including the Pacific Coast Steel Company, Southern California Iron and Steel Manufacturing Company, and the McClintic-Marshall Company. Only four of the 46 companies acquired were in receivership, all of the others were acquired through the purchase of assets.[33]

GROWTH AND EXPANSION

Throughout the years of mergers and consolidation the steel works at Cambria continued to grow. Even though the plant was no longer in the forefront of steelmaking technology or influence, it continued to expand in size and number of products and employees. After 1880 the steel industry changed immensely, with small independent firms swallowed by large self-sufficient corporations. World War I was a boon to the industry, but the lean years which followed, until the World War II build-up, were harsh. Faced with foreign competition and aging plants in the post-war years, the owners of the Cambria plant made improvements, but failed to keep up as domestic demand looked overseas. It was a repeat of the industry's early years when American consumers bought English iron and steel because of its price and quality.

Cambria's history through the 20th century was one of immense growth and eventual decline. After the 1889 flood the company continued to grow and expand its product line and its market, while eventually ceasing to use the old technology, first of Bessemer furnaces, and then open-hearth. The company even quit rolling rails in the 1920s, the product which gave it glory and profits. The

32. *Bulletin*, "History of Bethlehem," p. 18.

33. Schroeder, *Major Steel Companies*, pp. 87-88; For further data on Bethlehem Steel's history see numerous chapters of Hogan, *Economic History*.

legacy of this growth is still present in Johnstown, in the form of the expansive mills along the Little Conemaugh River. The physical evolution of the plant expanded beyond the Lower Works and Gautier as the types of products offered on the market increased. The Johnstown Plant of Bethlehem Steel Corporation eventually consisted of six divisions along twelve miles of the Conemaugh and Little Conemaugh rivers: Lower, Franklin, Gautier, Rod and Wire, Wheel, and Fabricating. By 1951 the plant employed 16,000 people, or 40 percent of the Johnstown area's population. The annual payroll reached $58 million.[34] Technological improvements in manufacturing processes occurred throughout the decades and Cambria management formed subsidiary companies to control sources of raw materials as well as to ensure continuous production and product distribution. (See illustration 32 for a diagram of an integrated steel company.)

These companies ensured integration of the steelmaking process. Both the Cambria Iron Company and Cambria Steel Company owned partial or total stock in companies offering services needed for making steel. In 1917 these included:

Full Stock Ownership

Penn Iron Mining Company of Michigan Company	(Stock owned by Cambria Iron Company)
Penn Iron Mining Company of Wisconsin	(Stock owned by Penn Iron Mining Company of Michigan)
Cambria Inclined Plane Company	(Stock owned by Cambria Iron Company)
The Manufacturers Water Company	(Stock owned by Cambria Iron Company)
Johnstown Steamship Company	(Stock owned by Cambria Steel Company)
Beaver Steamship Company	(Stock owned by Cambria Steel Company)
Juniata Limestone Company, Ltd.	(5/8 owned by Cambria Iron Company) (3/8 owned by Cambria Steel Company)

Partial Stock Ownership

Mahoning Ore & Steel Company	(50 percent of stock owned by Cambria Iron Company)
Cambria Steamship Company	(50 percent of stock owned by Cambria Steel Company)
Mahoning Steamship Company	(50 percent of stock owned by Cambria Steel Company)
Johnstown Water Company	(About 50 percent of stock owned by Cambria Iron Company)
Conemaugh & Franklin Water Company	(Owned by Johnstown Water Company)[35]

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34. "Johnstown Plant Bethlehem Steel Company," pamphlet, 1951, p. 1, folder: Plants-Johnstown, box: Plants-Danville-Johnstown, Acc 1699, BSC, HagM; Johnstown *Tribune-Democrat*, January 31, 1953.

35. "Seventeenth Annual Report of Cambria Steel Company for the year ended December 31st, 1917" pamphlet, p. 5, folder: Plants Johnstown Cambria Annual Reports, box: Cambria Steel Co. Misc papers, Acc 1699, BSC, HagM.

The plant's expansion and improvements in making steel brought changes in the quantities and types of raw resources needed. More water was needed, higher quality ores were needed, and the use of electricity led to more efficient production. Brief descriptions of several of the subsidiary services, the introduction of new technology, and the expansion of the physical plant follow.

MANUFACTURERS WATER COMPANY

In 1898 when the Cambria Steel Company was organized its owners made provisions for a large increase in capital for extending the plant. Thought was given to moving the plant from its inland site to the Great Lakes or the eastern seaboard. The decision of whether to make the plant extension or move it to a better location was made by a committee which reviewed the case. The members recommended proceeding with the expansion if adequate water could be obtained. Thus was formed the Manufacturers Water Company, on February 19, 1900, which was responsible for construction of water works to meet Cambria's needs. At the time, water was pumped from the Conemaugh River at Coopersdale, and gravity fed from Johnstown Water Company reservoirs.[36]

By 1958 the Johntown plant obtained 150 million gallons of water per day from four sources. The Hinckston Run reservoir was located in East and Middle Taylor townships of Cambria County and had a capacity of 1,123 million gallons. The earth rolled dam, 78-feet high was completed in 1905, and furnished water to the Lower Works and Gautier for drinking water and boiler supply. The company owned more than 17,000 feet of right of way for a 24-inch pipe line which carried purified water chlorinated at the dam.

The South Fork System consisted of a small intake dam located on the Little Conemaugh River near South Fork which supplied water to the Franklin Works. The timber intake, 14-feet high dam and pipeline were built in 1904 and the pipeline rebuilt in 1924 of Douglas fir from Washington state. A water treatment plant was built in 1926. The line was replaced in 1944, with a capacity of 30 million gallons per day.

The Manufacturers Water Company leased the Border Water System from the Johnstown Water Company to furnish water to the Lower Works and Gautier. A timber dam nine feet high was built across the Stony Creek River near Border Station on the Baltimore and Ohio Railroad, a cast iron

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36. Engineering, "History," pp. 5-6, BSC, CCHI; Engineering, "History of the Evolution," p. 25.

pipe line 7.6 miles long delivered 17 million gallons a day. A water treatment plant was built in 1930 at the dam.

The Quemahoning Water System consisted of the largest dam, located on the Quemahoning Creek. The dam was built from 1911-1913, and was made of earth, 90-feet high, 950-feet long on the crest, 20-feet wide, and 700-feet in width. The reservoir had a capacity of 11.5 billion gallons and supplied water to Franklin, Gautier, and the Lower Works via a 14-mile long 66-inch and 58-inch riveted steel pipeline. A concrete spillway was built in 1933, and treating plants were built in Franklin and the Lower Works in 1927 and 1931. Damage from the 1936 Johnstown Flood resulted in repairs being made to the channel taking discharge from the spillway. In 1937 the 36-inch Stoney Creek line was dynamited during a labor strike. An area on the west shore of the reservoir was used for recreation for many years by the Johnstown Plant supervisors. The area was known as "Betheo Pines."[37]

NATURAL GAS

In autumn 1886 natural gas was introduced into the works and into Johnstown as well. It was brought from the Westmoreland County fields, "the Grapeville region," by a 40-mile long pipeline. Gas arrived at the works with 18 pounds pressure, and reduced there for consumption at required pressures. The gas pipes in the works were located overhead to reduce danger from leakage into underground sewers.[38]

TELEGRAPH AND TELEPHONE

Communication by telegraph arrived in Johnstown along with the railroads. After the Baltimore and Ohio Railroad came into Johnstown in 1881 there were competing telegraph lines, but the Western Union Telegraph Company bought these lines and established a monopoly. Telephones

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37. Thackray, "History of Cambria", pp. 67-68, Acc 1699, BSC, HagM; Engineering, "History," pp. 13-15, BSC, CCHT; Engineering, "History of the Evolution," pp. 25-30.

38. John Newton Boucher, *The Cambria Iron Company* (Harrisburg: Meyers Printing and Publishing House, 1888), pp. 11-12.

arrived in 1889 when a public line and central office were established. The Cambria Iron Company had their own line installed several years earlier.[39]

ORE, COAL, AND LIMESTONE RESOURCES

Into the twentieth century Cambria used coal from company mines in Fayette, Cambria, Blair, and Bedford counties, as well as gas coal from Westmoreland County. The coal contained 18 percent volatile matter, 70 percent fixed carbon, and 12 percent ash. All the coal was washed and it was coked in beehive ovens and by-product ovens. In 1910 the Johnstown mines produced 132,000 gross tons per month, all of which was directly consumed. Coke production totaled 47,000 gross tons per month.[40] (Illustration 30 is of the Cambria Iron Company's mines in Johnstown in 1890.)

The Rolling Mill Mine provided coal for the Cambria plant ever since the first furnaces went into production. Opened in 1855, the mine had, in 1922, yielded 20,000,000 tons of coal. Nearly 40,000,000 tons of coal still remained, and the mine covered the largest area in the nation worked by a single opening. In 1922 it covered 10 square miles and the farthest working face was five miles from the entrance. Its roof was of black slate, in good condition, and it required little to no timbering.[41] The mine was finally closed in 1931.

The coal was originally transported by different kinds of haulage before being dumped in the tipple. These methods were mules, storage-battery locomotives, trolley locomotives, head-and-tail rope, grip-rope, and chain haulage. Up until 1881 mules carried all the coal from the mine across the Conemaugh River to the Cambria plant. All of the coal was mined by hand. Small steam locomotives were then introduced to haul the coal within the mine, followed in 1916-1917 with electric storage-battery locomotives. Portions of the mine were electrified in 1918. Electric trolley motors were then used, and in January 1919, an electric coal-cutting machine was installed. This was a first in the Rolling Mill Mine. The use of electricity meant the end of compressed-air locomotives, mules, and air-cutting machines.[42]

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39. 1889 Johnstown directory, p. 31.

40. "The Cambria Steel Works," *Railway Age Gazette* 49, no. 8 (August 19, 1910): 317.

41. George A. Richardson, "Cambria Steel Co. Drops Coal Down Well, Loads It at Bottom and Hauls It to Ovens," *Coal Age* 22, no. 9, (August 31, 1922): 313-314; Johnstown *Tribune-Democrat*, September 12, 1953.

42. Richardson, "Cambria Steel Co.,": 314-315.

Rolling Mill Mine coal was carried from the mine to a tipple located in the Cambria plant by a haulage until April 1922. The tipple was then abandoned and the coal was dumped into a shaft at Elk Run, loaded into mine cars, and hauled to Rosedale, Cambria's coking plant after 1918. There it was hoisted in a shaft and conveyed to the coke ovens.[43]

A serious gas explosion occurred in the Rolling Mill Mine on July 10, 1902, in which 112 miners lost their lives. An investigation determined that the explosion in the Klondike section of the mine was caused when a miner took an open lamp into a room where gas was known to exist. This, of course, was in direct violation of the Cambria Steel Company's mining rules and regulations.[44]

In 1884 Cambria operated several other captive mines in addition to the Rolling Mill mine. The Cushon and Lower Gautier Mines supplied Gautier, and produced from 80,000 to 100,000 tons of coal annually. The Woodvale Mine was located on the south bank of the Conemaugh River near Johnstown, and supplied coal to the woolen and flouring mills in Woodvale. The Conemaugh Mine was located north of the Conemaugh Furnace, and supplied coal for making coke. The Bennington Slope Mine was on the eastern slope of the Allegheny Mountain near Gallitzin, and its coal was coked in 100 beehive coke ovens located there. The coal was also excellent for smithing, and was shipped to Johnstown, Hollidaysburgh and Springfield The Morrell and Wheeler slope Miners near Connellsville supplied coal for 500 beehive coke ovens. These mines had an annual output of 300,000 tons and furnished coal for the coke used in Cambria's furnaces. In 1953 five local mines still supplied the Cambria plant with coal. These were Rosedale No. 72 and Franklin 73 and 74 in Johnstown, Heisley No. 31 in Nanty Glo, and Monroe 32 in Revloc.[45]

Iron ore was obtained from several local mines. The Benshoof's Mine was located in Johnstown and produced 30,000 tons of carbonate iron ore per year. The Frankstown fossil ore mines were three miles east of Hollidaysburg, and yielded 30,000 tons of ore yearly. The Springfield mines, located 70 miles southeast of Johnstown, had four sections of extensive hematite ore-range. These mines produced from 45,000 to 50,000 tons of excellent Bessemer ore every year. The Henrietta

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43. Ibid.,: 313, 315. The Richardson article contains much information about the whole coal haulage system, including photographs and drawings of the machinery.

44. Commonwealth of Pennsylvania, Department of Internal Affairs, *Report of Bureau of Mines*, Part V, "The Great Catastrophe at the Rolling Mill Mine, Johnstown, Pa., by an Explosion of Gas Which Caused the Loss of 112 Lives" ([Harrisburg]: 1902), p. 72. This report contains a description of the investigation and evidence provided by miners at an inquest held July 23 25, 1902, in Johnstown.

45 Lieutenant W.H. Jaques, "The Establishment of Steel Gun Factories in the United States," *Proceedings of the United States Naval Institute* X, no. 4 (1884): 808; Johnstown *Tribune Democrat*, September 12, 1953.

Mine also produced iron ore, but it was not as valuable as that obtained from the Springfield mines.[46]

In 1884 iron ore was also obtained from Michigan. The Memominee iron ore mines consisted of eight mines opened along the Menominee River Railroad, a branch of the Chicago and Northwestern Railroad. The mines extended along eight miles of the iron-ore range and had an annual capacity of 350,000 tons. The ore was excellent for Bessemer iron, and was shipped by rail to Escanaba on the Upper peninsula, by lake to Cleveland, and by rail to Johnstown. By 1910 Cambria used iron ore mined in Minnesota, as well as in Michigan. The Mahoning mine in the Mesabe Range in Minnesota was an open mine with a soft brown hematite ore removed by steam shovel. The Vulcan mine was on the Menominee Range and it produced a red hematite. The Republic mine was in the Marquette Range in northern Michigan and it produced a specular ore. In 1910 the output of these three mines was 2,200,000 tons. The ore was carried by company-owned lake vessels from the shipment point to Cleveland or Ashtabula, Ohio, with smaller shipments to Erie, Pennsylvania, and Conneaut, Ohio.[47]

These ores from Lake Superior were used instead of the local Johnstown iron ore because they were better suited for steel production, and were mined more economically. Local ores possessed a high sulphur and phosphorus content, contained a low percent of iron ore, and were expensive to mine because they occurred in thin seams. The iron content ran around 40 percent while the Lake Superior ores had an iron content of 50 to 65 percent.

Another controlled resource was limestone, needed as a fluxing agent in the steelmaking process. Cambria owned its own limestone quarries to ensure supply. In 1884 it received 150,000 tons of limestone yearly for use in the furnaces. Large quarries were located at Birmingham, near Tyrone in Blair County, which produced 76,000 tons. The company rented the Cresswell quarries at Hollidaysburg, controlled two others in the area, and had a dolomite limestone quarry near Henrietta, in Blair County.[48]

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46. Jaques, "Establishment," 809.

47. Ibid.; "Cambria Steel Works," *Railway Age* 317.

48. Jacques, "Establishment,": 809.

There was no slag pile at the Cambria plant in 1910. All the furnace slag was converted into by-products at a profit.[49]

COKE PLANTS

The most important coking districts in western Pennsylvania were in the Connellsville, Fayette County, area and in the Allegheny Mountain in Blair and Cambria counties. It is not known when coke was first produced at the Cambria Iron Company, but local coal was coked in open pits for use in the first blast furnaces. Coke was made in pits at East Conemaugh, as well as in pits and beehive ovens at Bennington, Blair County. Beehive ovens were used in the Connellsville region. An attempt to use Belgian ovens at Johnstown in 1875 failed, and a beehive oven complex in Conemaugh was destroyed in the 1889 Johnstown Flood. Cambria Iron company mining engineer John Fulton conducted experiments for the company using different coals and methods of coking. These were considered to be the "most careful and thorough" of any experiments made in the country and were of "great value" in the 1880s. Cambria's method of coking in open pits in the Allegheny Mountain region was considered to be the "most systematic and thorough" practice of any.[50]

About 1892 Cambria officials sent James A. Fronheiser to Europe to study German and Belgian by-product coke ovens. Three years passed before by-product coke ovens were built at Cambria, but two batteries of 50 ovens each started operation in November 1895 at Franklin. These were the Otto-Hoffman type from Germany. According to the company's engineering department, "This was the first by-product oven plant operated in conjunction with a blast furnace to be built in America." Foul gases were cooled, tar and ammonia recovered, and the clean gas returned to the batteries as fuel.[51]

When World War I started the Thomas A. Edison company collaborated with Midvale to build a benzol plant to recover the gas from the Otto-Hoffman ovens. They wanted to recover toluene

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49. "Cambria Steel Works,": 317.

50. Engineering, "History," pp. 2-3, 11, BSC, CCHT; "Bethlehem Steel Company, Johnstown Plant, A Brief History of Johnstown Coke Plants," typed manuscript, n.p., n.y.; U.S. Department of the Interior, Census Office, Tenth Census of the United States 1880. Vol. 10 Special Reports on Petroleum, Coke and Building Stones. "The Manufacture of Coke," by Joseph D. Weeks (Washington: Government Printing Office, 1884), p. 35. The Weeks text contains diagrams of both the coking pits and the beehive ovens located at Bennington, Blair County.

51. Thackray, "History of Cambria," p. 9, Acc 1699, BSC, HagM; Engineering, "History," p. 3, BSC, CCHT; "Bethlehem, Johnstown Plant, Brief History," n.p.

which was in high demand for making dynamite during the war. The plant also produced benzol, toluol, xylol, naphtha, aniline, para-coumarone, and naphthalene. This operation was very profitable and another was built in 1915. At the war's end the market was glutted with the benzol products. Both plants were destroyed by fire and rebuilt in 1917, but the Edison plant was dismantled in 1918 and the Cambria plant shut down in January 1919. Benzol products were produced again after a Semet-Solvey plant was built in December 1922.[52]

There were 11 batteries of by-product ovens in Franklin prior to 1918. In that year the Rosedale coke plant was started with the construction of two coke batteries and a by-product plant designed by the Koppers Company. Under Midvale's direction the Semet-Solvay Company built a by-product plant, with a benzol recovery plant, at Franklin, and two Semet-Solvay batteries at Rosedale. Both of these plants were used until 1930. Bethlehem built two batteries of Koppers Company, Becker-type ovens in 1927 and 1930. These two batteries replaced the original eleven batteries at Franklin.[53]

At Rosedale a hoisting shaft was sunk to a level which permitted the delivery of coal at its foot from the Rolling Mill Mine south of the river and from mines north of the river. Gas coals from the Latrobe, Westmoreland County, field and coking coal from Washington County and West Virginia also fed the coke ovens. Coal was dumped from mine cars into a crusher at Rosedale, and the crushed coal was carried by belt conveyor to the top of a building and fed into jigs flooded with water. The coal was washed and sent to a huge settling tank. The coke ovens were charged with this coal.[54] (See appendix 31 for wages and prices in the coke works, 1910.)

After 1929 a decline in the demand for coke forced the temporary closing of Rosedale. Any needed coke was made at Franklin, but Rosedale was soon placed into partial operation. In 1957 the demand for coke utilized three batteries at Franklin and two batteries at Rosedale, with a daily capacity of 3,500 and 1,200 gross tons per day respectively. The last battery at Franklin, no. 18, was closed down in 1983.[55]

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52. Engineering, "History," p. 17, BSC, CCHT; "Bethlehem, Johnstown Plant, Brief History," n.p.

53. Engineering, "History," p. 18, BSC, CCHT.

54. John E. Gable, *History of Cambria County Pennsylvania*, 2 vols. (Topeka: Historical Publishing Company, 1926), 1: 264.

55. Engineering, "History," p. 19, BSC, CCHT; *One Hundred Years of Steel Making in Johnstown 1857-1957*, "Coke Plants," (n.p.: Bethlehem Steel Co., [1957], n.p.). For detailed information about the Johnstown coke plant operations see all of "Bethlehem Steel Company, Johnstown Plant, A Brief History of Johnstown Coke Plants," typed manuscript.

JOHNSON STEEL STREET RAIL COMPANY

In 1883 the Johnson Steel Street Rail Company was chartered in Kentucky to produce a special type of girder rail used for horse-drawn or cable street car lines. The "Jay Bird" rail had an L face for use on street railways and the body and bottom of a T rail. The rail could be spiked onto cross ties on the road bed, thereby avoiding the use of wooden stringers. Arthur J. Moxham and Tom L. Johnson, holders of the patents for the rail, tried unsuccessfully to have iron makers roll the rail because its unique shape would not fit the standard rolling mills.[56]

Moxham then approached Daniel J. Morrell about rolling the special rails at Cambria. Five or six months of testing preceded a successful roll provided rails which could be attached to track work. The Cambria Iron Company rolled 47,000 tons of rail for Moxham's company in 1883. In the next year Cambria leased a recently abandoned mill in Woodvale to the fledgling industry for its operations. By 1885 increasing orders from street railway companies demanded Moxham and Johnson establish their own physical plant.[57]

The Johnson Steel Street Rail Company established itself in 1886 in Woodvale on several acres of land. Cambria continued to roll all the rail company's rail until 1888. Moxham then moved the plant, locating a large rolling mill on land two miles south of Johnstown on Stony Creek. The town of Moxham was laid out, and the works were afterwards located there.[58]

GAUTIER WORKS

Rebuilding the mills at the Gautier Works after the 1889 flood's destruction started in 1891-1892. A lot of filling was done, which raised the "level of the works high above any possible danger from floods." A cold drawing facility was established, but it was not a wire department because only rods were processed. By 1906 thirteen bar mills had been installed, ranging from 8-inch to 20-

56. James R. Alexander, "The Johnson Company: Its Role in the Industrial Heritage of Johnstown Pennsylvania," typed manuscript, July 1987, n.p.

57. Ibid.

58. Ibid.; 1889 Johnstown directory, pp. 31-32.

inch, two universal plate mills 22-inch and 36-inch, and other farm implement shops, including a cold roll shop, a rake shop, disc mill, and five roll trains. The main building covered 15 acres.[59]

In 1923 when Bethlehem bought Cambria from Midvale a large section of the plant was in a run-down condition, and almost inoperable. Between 1924 and 1926 Bethlehem modernized and rebuilt the plant, focusing on Gautier. Iron production costs were high at Johnstown compared to the other Bethlehem plants at Sparrows Point and Lackawanna. Concentration was put on products for local outlets or in which the costs of iron and raw steel were unimportant in the value of the finished product, such as Gautier's specialized products.[60] (See appendix 32 for Cambria's products in 1936.)

The complex extended for about 3,600 feet along the Little Conemaugh. It included the following shops and mills.: 12-inch No. 1, 9-inch No. 1, 9-inch No. 3, 8-inch No. 2, 8-inch No. 3, 14-inch, 10-18-inch, 10-inch No. 1, 13-inch, 20-inch bar mills, 22-inch plate mill, and 36-inch universal plate mill, rake shop, machine shop, disc shop and cold rolling and drawing shop. The entire Gautier plant was served by two coal fired boiler houses, independent of the steam system serving the rest of the Cambria plant.[61]

A major first improvement was the installation of a group of bar mills capable of producing large tonnages which were built from 1924-1926; four of them which replaced the obsolete 10-inch, 13-inch and 14-inch mills. The 8-inch No. 1, 8-inch No. 2 mills were relocated to make room for these new mills, and the 14-18-inch 14- inch, 10-18-inch, 10-inch No. 1 and 13-inch mills and the two boiler houses were scrapped. A trunk line was built connecting Gautier with the Lower Works steam system. In addition, several merchant bar mills were modernized, including the 9-inch No. 1, 9-inch No. 3, 12-inch, 8-inch No. 1 and 8-inch No. 2 mills.[62]

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59. General Manager to R.E. Hough, Quincy Bent, Kenneth B. Lewis, October 13, 1947, folder: SM History-Johnstown Plant, Acc 1699, BSC, HagM; *One Hundred Years*, "Gautier Mills," n.p.; "Improvements at Cambria and Gautier," *The Iron Age* (December 17, 1891): 1062-1063; Engineering "History of the Evolution," p. 67. Wire drawing did not resume at Gautier at this time. *The Iron Age* article stated the work was begun; however, a 1911 *The Iron Age* article stated that a wire-making capacity did not exist until construction of the Rod and Wire Division in 1910-1911. See footnote 67.

60. Burkert, "Iron and Steelmaking," p. 307. For a detailed description of all the machinery at Gautier in 1935, see pp. 30-34 of Engineering, "History," BSC, CCHT.

61. Burkert, "Iron and Steelmaking," p. 307; Engineering, "History of the Evolution," pp. 10, 54-56. For further data on the 9-inch mill with a Slick heating furnace, see "Cambria Steel Company's New Bar Mill," *The Iron Age* (May 6, 1915): 1002-1004.

62. Engineering, "History of the Evolution," pp. 10, 55.

The new mills were located in a group of 13 new buildings and were made up of the following: the 14-inch structural mill produced flats, angles, rails up to 45 pounds per yard, bevels, toes, mine ties, Z bars and auto rim sections; the 13-bar mill produced flats, rounds, squares, concave spring stock and reinforcing bars; the 10-inch bar mill produced flats, concave spring, rounds, squares, hexagons, special sections and reinforcing bars; the 9-inch No. 2 mill made window sash sections, flats, special auto sections, channels, small tees, angles and other special sections.[63]

New shear and warehouse buildings serving the new mills were built after studies were made of shipment problems. The warehouses were well adapted to efficiently handling large numbers of orders, large or small.[64]

In concert with Bethlehem's plans to coordinate products with the market, a concrete bar shop was built in 1931 after the acquisition of the Kalman Steel Company. The shop supplied concrete bars in any form needed. In 1946 a fabricating shop was established to make road reinforcement specialties. Bethlehem's Research Department developed a special design of a "road dowel unit," and special welders were bought to make them. In the next year equipment from the Chicago Wire Goods Company in Chicago, Illinois, was moved to Johnstown and set up in the fabricating shop, and building reinforcement items were then produced.[65]

By 1951 the Gautier Division's mills rolled steel bars in thousands of shapes and sizes. They were used for making automobile springs, wheel rims, brake shoes, hinges, window frames, rail anchors, and sled runners. Other finished products included light rails, reinforcing bars, steel ties, and fence posts. Specialty shops made items for reinforce concrete construction, and longspan joists for building construction. Another shop produced cut-and-formed blank shapes from steel plates. Gautier produced essentially any type of steel bar or specialty needed.[66]

In 1989 three bar mills remained active at Gautier: the 12-inch Mill No. 1, 14-inch Mill, and 9-inch Mill No. 2.

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63. Ibid., pp. 55-56.

64. Ibid., p. 56.

65. Ibid., pp. 58-59.

66. "Johnstown Plant Bethlehem Steel Company," 1951, pamphlet, p. 8, folder: Plants-Johnstown, box: Plants-Danville Johnstown, Acc 1699, BSC, HagM.

THE ROD AND WIRE DIVISION

Before the 1889 Johnstown Flood all wire products were produced at Gautier. After that plant's destruction no facilities for making wire existed until the Rod and Wire Division was built in 1910-1911, situated three miles northwest of Johnstown. Contracts were made with the Morgan Construction Company of Worcester, Massachusetts, for the mill's erection. The site encompassed 21 acres on the Pennsylvania Railroad's main line at Sheridan Station, west of Johnstown. This division contained a rod mill, wire drawing department and other machinery to produce nails, fence, barbed wire, and bale ties. Bethanizing and galvanizing equipment was later added, along with heat treatment facilities. This division underwent many changes throughout the years because of changes in the product requirements.[67]

The wire making process consisted of rolling heated billets down to rods in stages. The coiled rods were then drawn into wire then they were passed through a succession of dies of smaller sizes. This "cold-drawing" hardened the steel wire, so it was heated again before it was reduced to its final size. Much of the wire was galvanized by hot-dipping, while an electrolytic process gave bethanized wire a zinc coating. Nail machines made several hundred types and sizes of nails. Fence machines wove wire of different gauges into fencing needed for agriculture, including horse-and-cattle field fence, hog, poultry, and chicken fence. Barbed wire was also made.[68] (See appendix 33 for a trade catalog illustration of barbed wire in 1916.)

The original Rod and Wire Mill was divided into several units, including a stock yard, cleaning house, galvanizing and Bethanizing, bundling and shipping, nail room, patenting furnaces, drawing, drawing fine wire, fence, and warehouses. The original 1911 continuous rod mill was designed to roll 3/16-inch to 13/16-inch diameter rods in 300 pound bundles, at a rate of 350 tons every 24 hours. Its capacity was increased in 1948 and a hook conveyor was added in 1952 which allowed cooling and inspection. The mill was completely replaced in 1955 with a 23 stand rod mill.[69]

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67. Burkert, "Iron and Steelmaking," p. 297, 299; *One Hundred Years*, "Rod and Wire Division," n.p.; "The Cambria Steel Company's New Wire Plant," *The Iron Age* (March 23, 1911): 730; "The Cambria Steel Company to Enter the Wire Trade," *The Iron Age* (December 30, 1909): 1955. For a very detailed description of the rod and wire mills, the variety of products made and methods of production, see pp. 37-42 of Engineering, "History," BSC, CCHT, and the entire "New Wire Plant" article in *The Iron Age*. Both *The Iron Age* and *One Hundred Years* sources state wire was not made after Gautier's destruction until 1910-1911, disputing the earlier 1891 *The Iron Age* article.

68. "Johnstown Plant Bethlehem Steel Company," p. 12, folder: Plants-Johnstown, box: Plants-Danville-Johnstown, Acc 1699, BSC, HagM.

69. Engineering, "History of the Evolution," pp. 67-68.

Bethanizing was an electric plating process for putting zinc on steel wire. It was based on patents and agreements between Bethlehem Steel Company and Dr. Y. C. Tainton. Bethanizing was introduced in 1935, and an experimental station was developed in 1939 to continue technical research in the Bethanizing process. A unit was designed in 1944 using the heat of electric resistance, and a production unit went into operation in 1951. More Bethanizing units were added in 1952.[70]

By 1951 up to 150,000 different items were made from steel wire for farm, home and industrial use. Wire was made to order regarding grade, size, shape and finish. While some wire was used for fencing, barbed wire and nails, other wire was purchased by makers of coat hangers, fly screens, upholstery springs, bicycle spokes, paper clips and steel wool.[71]

The Rod and Wire Plant was an active plant in 1989.

FRANKLIN PLANT

A new plant was constructed in Franklin, approximately three miles up the Little Conemaugh River from the center of Johnstown, from 1898 to 1902. A site some distance away from town was utilized to take advantage of a large tract of land, totaling 160 acres. From the time of Cambria Steel Company's lease in 1898 until the Bethlehem Steel Corporation took over in 1923, plant additions totaled $70 million. At Franklin 22 large open-hearth furnaces were built, in addition to a car shop, a tank shop, a large beam yard and a structural shop, by-product ovens, blast furnaces, blooming mill, slabbing mill, two mills for rolling sheared plates, a universal plate mill, and a continuous bar mill.[72]

The plant's development began with the construction of Otto-Hoffman by-product ovens in 1895. These were followed in 1901 with construction of six 75 ton open-hearth furnaces. More furnaces followed in 1902-1907, 1912, and 1916. Runways were provided for electric traveling cranes in the buildings and in the yards. The open-hearth plant was contained in one long building 125 feet wide

70. Ibid., pp. 72-73.

71. "Johnstown Plant Bethlehem Steel Company," p. 12, Acc 1699, BSC, HagM.

72. Thackray, "History of Cambria," p. 9, Acc 1699, BSC, HagM; Burkert, "Iron and Steelmaking," p. 297; "The Cambria Steel Company's New Works," *The Iron Age* (February 6, 1902): 10.

by 525 feet long. The building was continuously lengthened so more furnaces could be added. The first steel was manufactured at Franklin in June 1901.[73]

The blooming mill occupied a building 75 to 125 feet wide and 300 feet long, and had six heating furnaces or soaking pits. The mill rolled all sizes of blooms from 14 inches square to 4 inches square, and had a capacity of 1,000 to 1,200 tons per day. The blooms were sheared into billets as needed, and were then shipped to other parts of the works for finishing.[74] The slabbing mill filled a building 75 to 150 feet wide by 350 feet long, while foundations were in place for the plate mill expected to be finished in spring 1902. Its building was 200 feet wide by 700 feet long.[75] A structural shop preceded the steel works by three years, and occupied a building 225 feet square. A plate stock yard was nearby, and in 1902 a permanent steel car department was built, consisting of three buildings, 82 by 508 feet each. This replaced a car department which began operating in spring 1902 in temporary cramped quarters, but which still managed to manufacture 36 steel railroad cars in one week.[76]

Blast furnaces were added at Franklin in 1916-1917 in record time. The No. 9 blast furnace, started March 12, 1916, was completed in 85 days. Blast furnaces No. 10 and 11 were also finished quickly in 1917. These were put in line with Franklin's other blast furnaces, Nos. 7, 8, and 9.[77] By 1923 Franklin had grown to include offices, five blast furnaces, twenty-two open-hearth furnaces, blooming mills, billet mill, slab mill, plate mills, beam yard, powerhouse, boilers, chemical laboratory, sintering plant and the steel car department.[78]

Bethlehem Steel's main goal in its long range improvement program after its purchase of Cambria was to concentrate ingot processing at the Franklin plant. Improvements made during the 1930s and

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73. "Cambria New Works,": 10, 12.

74. Ibid.,: 12-13.

75. Ibid.,: 14.

76. Ibid.,: 14-15.

77. "A Complete Blast Furnace in 85 Days," *The Iron Age* (June 15, 1916): 1441-1444; "Blast Furnace Completed in 57 Days," *The Iron Age* (July 12, 1917): 111; "Cambria's New Record," *The Iron Age* (July 26, 1917): 189. The "A Complete Blast Furnace" article described step-by-step, with photographs, how the blast furnace was built.

78. "History of Cambria and Coatesville Plants B.S. Co.," typed manuscript, 1925, pp. 52-57, box: Plants-Danville-Johnstown, Acc 1699, BSC, HagM. For detailed information on Franklin's development by 1935 see pp. 35-36 of Engineering, "History," BSC, CCHT. For detailed information on the sintering plant see H.V. Schiefer, "Sintering Flue Dust with Minimum Labor," *The Iron Age* (November 3, 1921): 1141-1146.

early 1940s were made primarily for reasons of economy. In 1935 and 1937 boilers were installed in the open-hearth shop at furnaces 58, 59, 60, and 54, 56, and 57. In 1935 the 55 furnace was completely rebuilt with full Danforth patented sloping backwall and two pass checkers. An attempt was made to burn unregenerated blast furnace gas in this furnace but the experiment failed. Extensive improvements were made in the open-hearth shop in 1949 when furnace 41 was rebuilt. The goal was to rebuild all 21 furnaces to a design developed by the Bethlehem office of the Chief Engineer of Construction. The last furnace was finished in 1953 and the results were immediate. In 1951 the shop record was 171,565 ingot tons per month. In 1953 the record was 201,803 ingot tons and in 1956 it rose to 213,327 ingot tons. Individual furnace records rose from 10,903 ingot tons in 1952 to 13,268 ingot tons in 1958.[79]

In 1950 the steam locomotives, some of which dated to 1870, at the open-hearth shop were replaced with 40-ton narrow gauge and 50-ton standard gauge General Electric Diesel Electric locomotives. The original 250-ton mixer, which was located in the middle of the shop, was removed in 1950. Hot metal cars of the 200-ton torpedo type were bought for the blast furnaces, and arrangements made for pours to be made directly from the 200-ton ladle into the open-hearth charging ladles. In 1951-1953 six new 10-ton Morgan charging machines, four 175-ton Morgan pit cranes and two 400 Morgan stripper trolleys were installed to service the rebuilt furnaces.[80]

As part of Bethlehem's long range improvement plan for Franklin concerning the concentration of ingot processing, existing slabbing and blooming facilities were replaced. In 1950-1951 a new 46-inch slabbing and blooming mill, driven by 8,000 HP twin motors, and a Mesta 30-inch billet mill with two vertical and two horizontal stands, each driven by a 75 HP motor, were installed. Six surface combustion soaking pits were added in 1955. The existing 34-inch slabbing mill was removed to make room for the improvements. In 1952, 12 stands of the 18-inch billet mill were taken from the Lower Works and installed in line with the new 30-inch mill. In 1954 the existing plate mill was replaced with a new United Engineering Company three-high, 26-inch by 44-inch by 134-inch plate mill. The 40-inch blooming mill was removed in 1957.[81]

79. Engineering, "History of the Evolution," pp. 63-65.

80. Ibid., pp. 64-65.

81. Ibid., pp. 65-66.

In July 1958 the mill production records were as follows: the 46-inch blooming mill rolled 217,532 tons in one month, the 34-inch billet mill rolled 63,238 finished tons in one month, the 18-inch billet mill rolled 75,267 finished tons in one month, and the 134-inch plate mill rolled 30,443 finished tons in one month.[82]

In 1989 the Franklin Plant was an active works, with primary mills, an intact steel car department, and modern steelmaking department with electric furnaces. Much historic machinery and structures have been removed, including the open-hearth furnaces, by-product coke plant, and the blast furnaces. (See appendix 34 for a chronological history of the Franklin mills.)

WHEEL PLANT DIVISION

Manufacturing rolled freight car wheels and another circular forms began at Cambria in 1917-1918 with the construction of the wheel plant. Midvale Steel and Ordnance Company brought much of its wheel rolling equipment from another plant in Nicetown to Cambria to get production started. The plant was composed of several units: blank preparation; No. 1 Mill rolling; No. 2 Mill rolling and forging; temperature control and heat treating; finishing, storage and shipping; and fuel, power, and hydraulic equipment.[83]

Two mills composed the heart of the plant, No. 1 Mill and No. 2 Mill. Edwin D. Slick designed and built the No. 1 Mill, also known as the Slick Mill, used for rolling circular products from 70 pounds to 1,850 pounds individually. This mill made specialty items such as gear blanks, crane track wheels, turbine disks, and miscellaneous circular forgings. The Slick Mill was developed to produce sections formed by circular rolling, geared towards producing railroad car wheels. The rolling mill used a combined rolling and pressing action between two revolving dies to form a wheel. In a separate operation the wheel's tread was formed in a tread rolling mill in an attempt to obtain a correct outline of tread, and obtain a harder wearing surface for the wheel. However, railroad car wheels made this way were structurally weak in the web. Efforts to eliminate the

82. Ibid., p. 66.

83. *One Hundred Years*, "Wheel Plant Division," n.p.; Engineering, "History of the Evolution," pp. 77-78; Thackray, "Brief History of Cambria," pp. 12-13. Acc 1699, BSC, HagM. For detailed information on the various aspects of how wheels were made at this plant, see pp. 43-47 of Engineering, "History," BSC, CCHT.

defects proved fruitless, and railroad car wheels were then made on the No. 2 Mill. The No. 1 Mill then manufactured a variety of circular rolled sections.[84]

The No. 2 Mill produced high speed electric car wheels and wheels for freight, passenger, Pullman, and other steam railroad machinery. The finishing department had boring, turning, and finishing machines. In the mid-1950s the plant remained as installed, with the exception of the addition of machine tools, heating furnaces, heat treatment facilities, and other facilities.[85] The operations at the Wheel Plant closed in the early 1980s.

RAILWAY AND INDUSTRIAL CAR DIVISION

The Steel Car Department began operations at Franklin in 1901 to manufacture freight and mine railroad cars. From 1901-1905 the development consisted of a car shop, forge shop, smith shop, paint shop, oil house, axle turning and finishing shop, with equipment such as hammers, presses, and machine tools. After Bethlehem acquired the plant the Tank Car Shop was added to produce 500-10,000-gallon tank cars. These were built from 1922-1925.[86]

The car shops in Franklin were the only ones in the nation which were an integral part of a steel company. They were almost independent of outside suppliers, as all parts needed to build a railroad car were made at the Cambria plant. This included all of the forged, pressed, and rolled parts in addition to bolts, nuts, and rivets. Major improvements occurred in the shops after Bethlehem's acquisition, and in 1924 they were capable of constructing steel freight and tank cars, and wood body and composite cars. In February 1924 an average of 30 cars were made on one turn.[87]

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84. *One Hundred Years*, "Wheel Plant Division," n.p.

85. Ibid. For a full discussion of the Slick Wheel Mill with diagrams, see "The Slick Wheel Mill," *The Iron Age* (August 29, 1918): 491-498.

86. *One Hundred Years*, "Railway and Industrial Car Division," n.p.; Engineering, "History," n.p., BSC, CCHT.

87. George A. Richardson, "Improvements in the Johnstown Car Shops," *Railway Review* (June 7, 1924): n.p. Reprint issued by Bethlehem Steel Company. This article contains many details of how railroad cars were made, materials and tools involved, in the shops in 1924.

Supervision of the Steel Car Department was removed from Bethlehem Steel and a new company was formed in 1956. The Railway and Industrial Car Division took over all the management and operation.[88]

In 1957 the car shop built mass produced hopper cars, gondola cars, ore cars, flat cars, box cars, and mine cars. Finished cars were painted, stenciled, and ready for delivery at the rate of one every 20 minutes on two major assembly lines. Freight cars were made on two tracks, with a daily per shift capacity of 15 to 20 riveted or welded cars. These tracks were fed with fabricated sections or sub-assemblies which were produced in adjacent bays. Each bay possessed all the necessary steel fabricating machinery. The basic underframe moved along the assembly line on dollies, and sections were added at each position. The car was then placed on its own truck, and assembled at the truck assembly shop in the Lower Works. All of the cars were built according to the specifications of the individual railroads, and based on American Association of Railroad standards.[89] (See illustration 34 of the Cambria car shop in 1922 and appendix 35 for a trade catalog description of steel cars in 1905.)

The car shops in Franklin were still active in 1989.

LOWER WORKS

Considered by Bethlehem Steel to be the "cradle of Johnstown's Steel Industry," the Lower Works witnessed every major development in the plant in the last half of the nineteenth century. (See illustrations 35 and 36 of the Lower Works in 1906, and of the Bessemer plant in 1908.) When the Franklin Works were built, becoming the "heart" of the plant, the Lower Works changed to finishing and maintenance shops. In 1925, soon after Bethlehem's takeover, the Lower Works had six blast furnaces, used primarily for Bessemer iron; four 65-ton and four 45-ton open-hearth furnaces, and a four vessel Bessemer plant. The rolling equipment was a 48-inch blooming mill, in operation since 1878, and a 40-inch blooming mill. There also was a 18-inch billet mill, a 30-inch and 22-inch structural mill, and a 28-inch rail mill, which was "quite old," and still produced rails. Shops included the smith shop, pattern shop, carpenter shop, machine shop, foundry, boiler shop,

88. Engineering, "History of the Evolution," pp. 95-96.

89. *One Hundred Years*, "Railway and Industrial Car Division," n.p.

and roll shop.[90] (See illustrations 37-39 of blast furnaces 1-4, illustration 40 of blast furnaces 5-6 and appendix 36 for machine shop orders in 1910.)

In 1925 the axle plant in the Lower Works contained forging equipment which was "rather ancient" and the building housing was "the oldest in the plant." Products made there included forged driving axles, piston rods, crank pins, street car axles and car axles. This plant was the first in the United States to produce a heat treated axle.[91] (See illustration 41 of axle turning shop, 1925.)

John Coffin invented the "Coffin" heat treating process which was used extensively in the manufacture of car axles. Introduced around 1890, all axles at Cambria were treated by the Coffin toughening process. The company was considered a "pioneer" in heat-treated axles, and believed in thoroughly annealing forgings after they were hammered. This heat treatment, as applied to axles, consisted of spinning the heated axle on rollers in water. In 20 years there were only 20 reports of car axle failures.[92]

In 1957, 100 years after the works were put into production, the Lower Works consisted of axle forging and finishing shops, truck and axle assembly shop, car repair shop, and mechanical and electrical maintenance shops. Blast furnaces "E" and "F," built during 1871-1876, still produced ferro-manganese. Open-hearth furnaces, first built in 1879, were used in the Lower Works until the Great Depression. These furnaces were dismantled in 1937. The "Mechanical Smith Shop Building" built in 1864 was still in use on its original site. Fabrication Shops which produced long

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90. *One Hundred Years*, "Open Hearth," "Blast Furnaces," n.p.; Thackray, "Brief History of Cambria," pp. 16-17, Acc 1699, BSC, HagM; "History of Cambria," pp. 40-41, Acc 1699, BSC, HagM. For information on improvements at the Lower Works in 1891, see "Improvements at Cambria and Gautier," *Iron Age* (December 17, 1891): 1062-1063. The first four blast furnaces in the Lower Works were known as Nos. 1-4, and as A,B,C,D. Blast furnaces No. 5 and No. 6 were also known as E and F. For further data on ingot transportation connected with the 48-inch mill see D.E. Renshaw, "Transporting Hot Ingots at Cambria Works," *The Iron Age* (December 29, 1932): 992-993.

91. Thackray, "Brief History of Cambria," p. 17, Acc 1699, BSC, HagM.

92. Engineering, "History," p. 4, BSC, CCHT; "Cambria Steel," *Railway Age Gazette*: 316. The axles were made in the following manner:

> After making a liberal discard from the ingot at the open hearth department, which insures freedom from piping and undue segregation, the bloom is taken to the axle department, chared in a long continuous furnace, the charging end of which is at a very low temperature, the blooms being pushed by hydraulic pressure to the drawing end of the furnace. The heating is thus very gradual, insuring a thoroughly uniform heat throughout the billet, and in this way preventing many trains which would otherwise result in hammering a billet which was not uniformly heated, as is usually the case when blooms are thrown direct into a high temperature. After coming from the hammer the axle is permitted to entirely cool, and is then again heated in a smaller continuous furnace, in which the same care is exercised to get uniformity, and after passing recalescent or critical temperature in the steel, thus eliminating any possible strains which may have been introduced in the forging process, it is treated to the Coffin toughening process, which gives a remarkable increase in elastic properties and makes the steel very ductile, the elongation being increased to a very marked degree. Ibid., 316-317.

and short span joists were opened in 1947 in buildings occupied by a Shell Forging Plant built by the U.S. Government during World War II.[93]

The Lower Works have several active operations remaining in 1989. An 11-inch mill, built in 1959-1961, is active, as well as the Blacksmith Shop and Roll Shop. The production of axles ended in 1982, but restarted in 1989.

ELECTRICAL DEPARTMENT

It is not known when electricity was first used in the plant, but some electric motors were utilized by the late 1800s. The original generating sources were "steam engines coupled to low voltage direct current generators." In 1908 the first steam driven turbine and alternating current generator was installed in the No. 1 Power House in the Lower Works. By 1914 the capacity of the turbo generators, which replaced the steam engines totaled 17,000 kilowatts. The No. 2 Power House was built in Franklin in the early 1900s, and the No. 3 Power House was built at Franklin in 1925. The No. 4 Power House was built in Franklin in 1948. The electrical department was responsible not only for operating and maintaining the generating system, but for maintaining motors and cranes.[94]

TRANSPORTATION DEPARTMENT AND YARDS

Transportation in and out of the Cambria plant evolved from use of the Pennsylvania Canal and horse-drawn cars, to railroads. Shifting engines were first used in 1856, obtained from the defunct Allegheny Portage Railroad, with names like "Coffee Pot" and "Wildcat." However, the topography around the plant called for a more sophisticated transportation system. When the Pennsylvania Railroad came into Johnstown the Lower Works were reached by connections at McConaughy Street for receiving and at Ten Acre Bridge for shipping. A track was then built from the railroad through the Swank Brick Company plant into Gautier. The Cambria Iron Company built its own track across

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93. *One Hundred Years*, "Open Hearth," "Blast Furnaces," n.p.; Thackray, "Brief History of Cambria," pp. 16-17, Acc 1699, BSC, HagM.

94. *One Hundred Years*, "Electrical Department," n.p. For information on the steam stations in the plant in 1935, see pp. 49-51 in Engineering, "History," BSC, CCHT. The powerhouse built in Franklin in 1925 is described in "Steel-Mill Power Plant has Many Unusual Features," *Power* 64, no. 22 (November 30, 1926): 798-801.

the Little Conemaugh to access the Woodvale Woolen and Flour Mills. The 1889 flood destroyed all the bridges except the Pennsylvania Railroad's stone bridge.[95]

In 1879 Daniel Morrell asked John W. Garrett, president of the Baltimore and Ohio Railroad, to build a line into Johnstown. Thus, after 1881 Johnstown and the Cambria plant were served by not one railroad, but two. The Somerset and Cambria branch of the Baltimore and Ohio Railroad connected with existing facilities. This branch was from the Pittsburgh division of the Baltimore and Ohio at Rockwood, Pennsylvania, through Somerset to Johnstown. The track provided a direct outlet south, and an indirect route east and west.[96]

In 1884, in agreement with the Pennsylvania Railroad, Cambria's tracks were extended along the Little Conemaugh on the old Allegheny Portage Railroad right-of-way. When the coke plant was established in Franklin in 1895 the tracks went up Coke Plant Hill. Around 1900 the Cambria Terminal Railroad was incorporated to build the Hinckston Run Dam. The tracks soon extended west to Dornick Point and east to the Wheel Plant. In 1921 the tracks extended across a bridge over the Pennsylvania Railroad near No. 6 bridge. The Little Conemaugh channel was changed and a bridge was built over it to gain access to the North Dump.[97]

The Conemaugh and Black Lick Railroad was incorporated on December 31, 1925, to serve the plant as a common carrier. It had four direct connections with the Pennsylvania Railroad and one with the Baltimore and Ohio Railroad for shipments. In 1935 the carrier had 52.424 miles of track with the main track extending from Dornick Point to North Dump, a length of eight miles. The railroad had 33 steam locomotives. In addition, the Bethlehem Steel Corporation owned 51.35 miles of standard gauge track and 12.58 miles of narrow gauge track which connected buildings to the Conemaugh and Black Lick Railroad. The corporation owned fourteen narrow gauge locomotives and two narrow gauge gasoline locomotives. By 1957 the Conemaugh and Black Lick operated 28 diesel locomotives on 47.5 miles of track in addition to 58.5 miles of steel plant tracks.[98]

Horses and mules were initially used to haul freight around the plant, and were quartered in a building in the Lower Works. Trucks and automobiles were then used, but still housed in "The

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95. *One Hundred Years*, "Transportation Department," n.p. Engineering, "History," p. 10, BSC, CCHT.

96. 1889 Johnstown directory, p. 31 ; Johnstown *Tribune-Democrat*, June 27, 1953.

97. Engineering, "History," p. 11, BSC, CCHT.

98. *One Hundred Years*, "Transportation Department," n.p. Engineering, "History," p. 11, BSC, CCHT.

Stables." Hard surface highways were built throughout the plant during 1930. In 1957 the plant used 38 trucks and 19 automobiles for inter-division use.[99]

After 1940 the Yard Department operated the scrap yards, slag dumps, and refuse dumps. It also maintained storage yards for raw materials. The handling of steel inventories, construction and maintenance of plant roads, and unloading, and stocking and shipping of materials was all handled by this division. Disposal for the Lower Works was in Hinckston Valley, and after the four original blast furnaces were razed more storage space was available.[100]

The Park Hill disposal area was started in 1920. A railroad bridge was built over the Pennsylvania Railroad right-of-way, just east of the No. 6 bridge. The Conemaugh River made a large loop there, with the Pennsylvania Railroad cutting across the narrow neck. In 1923 a cut 100 feet deep was made across the narrow neck, parallel to the railroad, which formed a relocated river channel. Approximately 7,500 feet of old river bed was opened and made available for dumping. The area was filled by 1953, and its capacity was expanded in 1955 when tracks were laid on higher ground surrounding the site.[101]

FUEL DEPARTMENT

Steam was the most important source of power for Cambria's early equipment. Both wood and coal fueled the steam engines, and after electricity was introduced into the plant the steam production was centralized instead of powering individual drives. There were three central stations in Franklin and two in the Lower Works in 1957 with a total capacity of 1,227,000 pounds per hour. The Fuel Department also distributed all fuels, including coal, coke, coke breeze, coke gas, blast furnace gas, natural gas, pitch, tar, and fuel oil.[102]

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99. *One Hundred Years*, "Transportation Department," n.p. Engineering, "History," p. 12, BSC, CCHT.

100. *One Hundred Years*, "Transportation Department," n.p.; Engineering, "History of the Evolution," p. 22.

101. Engineering, "History of the Evolution," p. 23.

102. *One Hundred Years*, "Fuel Department," n.p.

METALLURGICAL DEPARTMENT

Robert W. Hunt established the first analytical laboratory in American industry at the Cambria Iron Company in 1860 to obtain data on iron and alloys. This was followed by the first Steel Plant Metallurgical Department in the United States in 1902. Cambria was a leader in nineteenth and early twentieth century metallurgical research, and over the years much work was done to scientifically develop many types of steel. In November 1953 the first quality control engineer was appointed to run tests for improving quality of products. Groups of supervisors from the Operating and Metallurgical Departments served as quality control groups which met to dispense information on details and tests and investigations.[103]

POST-WORLD WAR I YEARS

The growth of the Cambria plant reflected the growth in the nation's demand for steel. After Bethlehem Steel Corporation acquired the plant its fortunes were tied directly to its parent's. Bethlehem's capacity and production rose dramatically during and after World War I. The Great Depression, however, had severe effects on the steel industry. Even though Bethlehem's capacity remained a little more than 10.5 million tons of steel, its production dropped to below 2 million tons in 1932. In Johnstown, employment in the 1930s was at 8,500 employees, down from 13,000 in 1923. Recovery was slow until World War II.[104]

After 1939 Bethlehem's production of steel rose dramatically, from a little under 5 million net tons in 1938 to more than 13 million net tons in 1944. From 1940-1945 Bethlehem earned a net income of $211,762,511 and produced 73,421,622 tons of steel. The company employed 212,366 workers to produce 14.9 percent of the total steel production in the nation.[105]

Improvements to the plant were announced in 1950. Franklin became the center of production as the Bessemer converters and 48-inch blooming mill were taken out of operation in the Lower Works. Consolidation of all the regular blast furnaces, open-hearths, blooming mills, and billet mills

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103. *One Hundred Years*, "Metallurgical Department," n.p. For a very detailed description of the Cambria plant in 1953, including descriptions of most of the machinery and data concerning their operation, see "Bethlehem's Johnstown Plant a century of pioneering," *Iron and Steel Engineer*, April 1953, pp. J2-J20.

104. Burkert, "Iron and Steelmaking," p. 307; "Annual Report to Employees for 1954," *Bethlehem Review* no. 66, March 1955, pamphlet, p. 7, box: Bethlehem Vertical File Material, Acc 1699, BSC, HagM.

105. "Annual Report to Employees," no. 49, May 1946, pamphlet, p. 6, box: Bethlehem Vertical File Material, Acc 1699, BSC, HagM.

occurred at Franklin. The rolling of blooms, billets, and slabs was concentrated there. Steelmaking capacity grew 15 percent with the rebuilding and enlarging of the open-hearth furnaces.[106]

By the 1950s the Johnstown facility employed 18,000 workers and produced 2.28 million tons of steel ingots a year. Between 1950 and 1956 Bethlehem's capacity to produce steel rose from 15 million to 20 million tons of steel ingots and castings, and in 1950, 1921, and 1953 production reached 100 percent of capacity, a record equal to the height of the war years.[107]

The 1960s were a period of modernization in the steel industry, not growth. However, Bethlehem failed to attract modernization capital, especially for its Johnstown plant. For the first time in more than 100 years competition arrived from foreign countries. During the 1970s the Environmental Protection Agency told the steel industry to reduce emissions, and gave a five-year time limit to meet standards. The plant at Johnstown was the oldest Bethlehem facility, and required costly cleanup. In 1973 Bethlehem announced that certain operations would be shut down, and workers laid off. The city responded by forming the Johnstown Area Regional Industries, composed of leading citizens, who raised $3 million for industrial development. Bethlehem Steel contributed $100,000 and matched 50 cents for each dollar raised in the city. An upturn in business in 1974 convinced Bethlehem not to cut back in Johnstown, and the plant was kept open.[108]

Bethlehem also announced in 1973 that Johnstown's blast furnace and open-hearth facilities would be replaced with a new electric furnace shop. In May 1974 the decision was made instead to install a two-vessel basic oxygen furnace complex. Following the devastating 1977 flood the plan was dropped. In February 1979 plans were made again to install a two-vessel electric furnace, which

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106. Burkert, "Iron and Steelmaking," p. 307; "Bethlehem Embarks on Major Modernization Program at Johnstown Plant," *Iron and Steel Engineer,* July 1950, pp. 132, 134. When Arthur B. Homer, president of Bethlehem Steel Company, announced these changes his remarks were prophetic, but had a ring of history to them: "In an industry like ours a plant must continually adapt itself to every important technological and engineering advance in order to keep ahead. Without the modernization program which we are now putting through, the Johnstown plant would soon lose out in the struggle for markets. Employment and payrolls would most certainly feel the effect." Ibid., p. 134.

107. John Strohmeyer, *Crisis in Bethlehem Big Steel's Struggle to Survive* (Bethesda, Maryland: Adler & Adler, 1986), p. 196; "Annual Report to Employees for 1956," *Bethlehem Review* no. 71, March 1957, pamphlet, p. 9, box: Bethlehem Vertical File Material, Acc 1699, BSC, HagM. In 1951 Bethlehem Steel Corporation operated ten steel plants in the following locations: Bethlehem, Johnstown, Lebanon, Steelton, Williamsport, all in Pennsylvania; Los Angeles, South San Francisco, Seattle, and Sparrows Point, Maryland. Shipbuilding and ship repair yards were in Baltimore; Beaumont, Texas; Boston; Brooklyn; Hoboken, New Jersey; Quincy, Massachusetts; San Francisco; San Pedro, California; Sparrows Point, and Staten Island, New York. Fabricating works were in Alameda, California; Beaumont; Bethlehem; Buffalo; Chicago; Johnstown; Leetsdale, Pennsylvania; Los Angeles; Pottstown, Pennsylvania; Rankin, Pennsylvania; Seattle; South San Francisco, and Steelton. "Johnstown Plant Bethlehem Steel Company," 1951, pamphlet, p. 19, folder: Plants-Johnstown, box: Plants-Danville-Johnstown, Acc 1699, BSC, HagM.

108. Burkert, "Iron and Steelmaking," p. 309; Strohmeyer, *Crisis*, pp. 196-197.

utilized scrap instead of ore, rendering the blast furnaces and coke works obsolete. Johnstown's electric direct-arc furnace was installed in Franklin in 1981.[109]

The year 1977 was especially hard for Bethlehem Steel. The Lackawanna plant suffered from blizzards, a coal mine fire cut off the supply of bituminous coal, and yet another flood hit Johnstown. The raging water shut down almost every operation and two months passed before the plant could start up again. Volunteers helped shovel mud and debris, but the cleanup and restoration cost $39 million and some facilities could not be saved. Three coal mines in the Johnstown area were also flooded. The devastation offered Bethlehem Steel the opportunity to close the Johnstown plant; steel markets had moved west, cheap rail transportation was no longer available, and there was no room for the plant to grow with a river and a town on all sides. But instead of closing the plant, the decision was made to close facilities and lay off workers. At Johnstown older facilities were closed, steelmaking capacity was reduced from 1.8 million tons per year to 1.2 million, and about 3,800 people lost their jobs. The work force shrank from pre-flood 11,400 to 7,600. By the end of 1982 only 2,100 people worked at the Johnstown plant.[110]

A recession in 1982 caused more problems. Bethlehem Steel experienced major losses but continued to invest in Johnstown throughout 1983. The company consolidated Johnstown's operations with those in Lackawanna, New York, keeping the steel operation in Johnstown. The combined steelmaking unit became Bethlehem's Bar, Rod and Wire Division.[111]

According to John Strohmeyer, when Bethlehem Steel began closing the mills in Johnstown the city fought back with "creative community survival strategies." The city's labor leaders cooperated and the rank and file made sacrifices to show commitment to the company. Bethlehem Steel did not leave the city, and labor-management breakthroughs occurred. Since 1852 the furnaces at Johnstown had survived the fluctuations of time, money, water, and technology. In Strohmeyer's view: "Such durability was achieved principally because Johnstown was innovative."[112]

The Cambria Iron Company underwent many changes after it converted to making Bessemer steel. It lost its leadership in the industry but continued to grow physically, expanding its operations up

109. Burkert, "Iron and Steelmaking," pp. 310 312.

110. Ibid., p. 312; Strohmeyer, *Crisis*, pp. 120-125; 197-198.

111. Burkert, "Iron and Steelmaking," p. 312; Strohmeyer, *Crisis*, p. 198.

112. Strohmeyer, *Crisis*, pp. 195-196.

and down the Conemaugh and Little Conemaugh rivers. The disastrous 1889 flood in Johnstown damaged the Lower Works considerably and destroyed other Cambria operations, but the rolling mills came back on line quickly, offering hope for the future to the city's flood victims. In order to survive in the changing steel world the company's managers consolidated to form the Cambria Steel Company, and remained an independent steel company until 1916. The Midvale Steel and Ordnance Company purchased the plant but failed to maintain standards of upkeep. When Bethlehem Steel Company bought Cambria in 1923 its capability to manufacture specialty steel products was expanded. Steel wheels, wire, and railroad cars became Cambria's main products instead of rails. The Johnstown plant of Bethlehem Steel Corporation continues to survive in the highly competitive and economically unstable world of steel, just as remnants of Cambria rail survive in forgotten side tracks across the country.

CHAPTER V: IMPACT OF THE CAMBRIA IRON COMPANY

The Cambria Iron Company and its successor firms dominated Johnstown in social, political, and economic terms. The company controlled not only the city, but thousands of people's lives as well. Upon the company's growth and economic health rested the health of the surrounding communities. Johnstown was not a company town in the true sense of the term, yet it was dominated by a single industry which employed people for miles around. This fact gave the company unlimited power.

A price was paid for Johnstown's close association with the Cambria Iron Company. Generations of company managers fought a war against any sort of union presence in the mills. Any worker even suspected of sympathizing with unionism was refused employment, and various attempts through the decades to obtain union recognition were crushed. Because Cambria refused any form of organized worker protest it assumed responsibility for the health and welfare of its workers and local residents. (See appendices 37 and 38 for Cambria Company rules in 1874 and 1910.)

In the spirit of company benevolence many social services were provided for the workers and members of the community. Company management spearheaded the introduction of the amen ties of city life, such as street paving and water supply. Company attitudes toward skilled and unskilled workers, natives and immigrants, and organized labor affected their place in and contributions to the city. Most, if not all, of the improvements in the standard of living sponsored by Cambria management was done so with the underlying motives of keeping out the hated unions and controlling methods of production.

COMPANY SOCIAL SERVICES

Cambria management viewed its welfare capitalism as being based on the desire to develop and maintain institutions for the benefit of its employees. The company sought to "help the workingman without creating in him a spirit of dependence," according to *The Iron Trade Review* in 1912.[1] Having no precedents, Cambria Steel Company was considered a pioneer in the field because it organized employees' associations years before other iron and steel companies. Because the members

1. "Helping the Workingmen to Help Themselves," *The Iron Trade Review*, June 6, 1912, p. 1213.

were in charge of their associations, despite large financial contributions from the company, "A feeling of paternalism, which might otherwise be engendered, is thereby entirely avoided."[2]

The truth of this statement is open to question, as is the assertion that the company's intent to help workers help themselves was based upon pure motives, and not paternalism and worker allegiance. It is apparent, however, that Cambria Iron Company owners and managers did take leadership roles in offering improvements for both its employees and the city of Johnstown. This responsibility was accepted early by Wood, Morrell and Company's resident manager, Daniel J. Morrell.

After 1855 a group of Philadelphians managed the Cambria Iron Company. These businessmen were not only interested in company profits but in Johnstown's civic welfare. The company aided many city improvements and its officials invested in commercial industrial enterprises in town. The Cambria Iron Company managers also controlled Johnstown's banks and utilities through interlocking directorates. Daniel Morrell was a partner in Wood, Morrell and Company in addition to being president of the Johnstown Water Works Company, Johnstown Gas Company, First National Bank of Johnstown, Johnstown Savings Bank, and the Johnstown and Somerset Railroad. Morrell was also president of the Johnstown Borough Council.[3]

Many of the Cambria managers were community figures, belonging to the same groups and working for the same community improvements. Daniel Morrell took great interest in the prosperity of Johnstown. "Mainly through his influence, and that of his business associates, gas and water-works have been established, streets paved, markets improved, and a new life infused into the wretched agriculture of the neighborhood. The thousands of employees at the works have been encouraged to invest their surplus earnings in homes and in savings banks."[4] The following chart illustrates the depth of Cambria involvement in Johnstown in 1881-1886:

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2. Ibid.

3. Bennett, "Iron Workers," p. 156.

4. *Manufactories and Manufacturers*, p. 222.

Name of Director	Corporation or Association									
	WMC	CC	CMBA	FNB	JSB	JWC	JWC	JWGC	CLA	NCTU
Daniel J Morrell	X	X	X	X	X	X	X	X	X	
George Webb		X			X					
John Fulton		X	X							X
Alex. Hamilton		X								
James Fronheiser		X	X							
James Cooper		X			X					
Cyrus Elder		X	X		X				X	
Pearson Fisher		X			X					
James McMillen	X				X		X	X		
Frank McMullen	X				X		X	X		X
John Lowman					X		X	X		
C.S. Ellis					X			X		
Howard J. Roberts					X		X			
H.A. Boggs		X			X					
William S. Robinson		X				X				
James Eldridge						X	X		X	
James Williams							X	X		
Alex. Kennedy	X		X							X
James O'Callaghan	X		X							
George Raush		X			X					
John C. Devine	X									X

Abbreviations

WMC – Wood, Morrell & Co.
CC – Cambria Iron Company
CMBA – Cambria Mutual Benefit Association
FNB – First National Bank
JSB – Johnstown Savings Bank
JMC – Johnstown Manufacturing Company
JWC – Johnstown Water Co.
JWGC – Johnstown Water & Gas Co.
CLA – Cambria Library Association
NCTU – National Christian Temperance Union[5]

The Cambria Iron Company attracted both businesses and people into the city. Johnstown proper was soon surrounded by independently incorporated boroughs whose economic health was tied to the company's fortunes. Conemaugh Borough, incorporated in 1849, took in the former canal site.

5. Bennett, "Iron Workers," p. 157. For a thorough discussion of which employees were chosen for the top management positions, and management behavior, including involvement in the local fire company, Civil War records, political affiliations, personal relationships, involvement in local baseball teams and social activities, see Bennett, "Iron Workers," pp. 178-197.

The Gautier mills were located there, and in 1889 the borough's population stood at 4,000. Prospect, on a hill north of Johnstown, contained 800 people, most of whom were Cambria Iron Company employees living in company housing. Millville, incorporated in 1858, was built and owned by the company, and 2,700 people lived there in 1889. It contained the rolling mills, foundries, machine shops, blast furnaces, and other structures. The majority of the 2,900 residents in Cambria City, laid out in 1853 and incorporated in 1862, worked at the Cambria Iron Company. Woodvale, founded in 1864, was home to 1,200 people in 1889, and contained chemical works, woolen mill, tannery, flouring mill, and brick works. East Conemaugh contained railroad yards and housed 1,700 people in 1889. The residential community of Franklin was home for 600 people. It would soon house the Franklin complex. The remaining villages of Kernville, Morrellville, Coopersdale, and Moxham were all connected to the Cambria Iron Company.[6]

A description of Johnstown in 1876, at the Cambria Iron Company's height of influence, is indicative of the company's impact on Johnstown's economic and social structure:

> The town and adjoining boroughs contain about 16,000 inhabitants, of various nationalities, the largest number of foreign birth being Irish, Welsh, and German. There are about five thousand workmen and employees in the employees departments of the Company's business. Males only are employed in the mines and iron and steel mills, but the woolen mills of the Johnstown Manufacturing Company, operated by Wood, Morrell & Co., at Woodvale, give work to a large number of women and girls. The place is noted for healthfulness, and the good order, thrift, and contentment of the people.[7]

HOUSING

Johnstown, along with many other steel towns, suffered from the lack of adequate, inexpensive housing. And like other steel companies, Cambria tried to resolve the crisis, thus attracting workers, by building low-cost homes. Cambria built homes in different areas of Johnstown for the purpose of holding down levels of rent. Not only did property ownership and low rents strengthen workers' attachment to the company, but it also allowed Cambria to exercise control over its employees.[8]

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6. McLaurin, *Johnstown*, pp. 39-40; Degen and Degen, *Johnstown Flood*, p. 8.

7. Cambria Iron, *Centennial Exhibition*, p. 6.

8. Brody, *Steelworkers*, pp. 88-89.

Views of Cambria's housing policy can be found in publications of both management and labor. In 1876 the *Bulletin* of the American Iron and Steel Association praised the company's policy of encouraging employees to save for homes:

> The thousands of employees at the Works have been encouraged to invest their surplus earnings in homes and in savings banks, and partly by consequence of this encouragement, there is not to be found anywhere a more thrifty and contented population than that of Johnstown.[9]

The *National Labor Tribune* on the other hand, viewed Cambria's policy in 1874 as little more than a scheme to create dependent workers:

> Take Johnstown as an example. . . . They know when men earn a little home with years of hard work and rigid economy, they will be slow to leave it. Knowing the love of home and the associations connected with it, the Johnstown manager has undertaken to use this sentiment to depress wages to their lowest limits, and to persecute men for their Unionism. Because they have homes they cannot leave. There they are, chained as it were. Their independence is a myth. They are not in a condition to enforce their rights. He keeps them so near poverty that hundreds of them cannot get away.[10]

Large numbers of Johnstown workers did own their own homes. In 1870 an estimated 35 percent of the miners and 30 percent of the iron mill employees owned homes; in the surrounding boroughs the numbers were lower. These percentages may be higher as 1870 census records reveal that 57 percent of identified iron mill workers possessed more than $100 in real and personal property. The percentage was still more than 50 percent even if clerical and supervisory people were not taken into account. The homes did not seem to differ greatly between the skilled and unskilled workers; only the skilled workers and supervisors owned property worth $500 or more but many homes of both workers and supervisors were valued between $200 to $500. Very few workers owned their homes in Millville, situated near the Lower Works. However, the rented houses were generally well kept by the company in an attempt to keep workers.[11]

As early as 1856 the Cambria Iron Company owned 200 dwelling houses in Johnstown. A severe shortage occurred after the Gautier mills opened, and in 1878 whole rows of tenements were built

9. Quoted in Bennett, "Iron Workers," p. 163.

10. Ibid.

11. Ibid., pp. 163-168. For more data on skilled and unskilled workers and the numbers who owned their homes, see ibid., pp. 165, 167.

in Conemaugh Borough. The rent for each house was $6.00 per month for four rooms. By 1887 the company owned 700 houses. By 1889 the Cambria Iron Company had built 800 tenement houses, most of them on Prospect Hill, for rent to employees. In 1911 the Cambria Steel Company owned 444 tenement houses which sheltered 2,267 people.[12] (See illustration 42 for an interior view of a company house in 1911.)

Conditions in company housing for the unskilled and the immigrants were sometimes less than ideal. The rows of tenements hurriedly thrown up to handle the influx of Gautier workers were not solidly built. A state official, writing in 1887, offered a first-hand view of Cambria worker housing:

> Johnstown depends upon the Cambria Iron Works for its existence as a town, and the houses of wage-earners are of all sizes and descriptions.
>
> Upon the hills, beyond the works and surrounded by huge piles of refuse from the furnaces, stand the wooden structures of the working men. These are not called houses, but "shanties." They are built of rough, unplaned boards, without clapboarding; the joints being covered by battens-thin strips of wood about three inches in width, and nailed perpendicularly from the eaves to the ground. The houses banked above ground, and some of them are built upon rough stone foundations, which give them the appearance of having cellars. Each house rents for about six dollars per month, and contains four rooms proper, all of them small with low ceilings. The yard is ample but the surroundings are barren and bare. Outside privies built upon vaults, and prominently exposed to the view of the passerby, are located near the houses. The drainage is surface, there being no escape for slops and other waste matter. In the heart of the city the houses are built indiscriminately of brick and wood, and rent at from eight to twelve dollars per month.
>
> At one end of the city and near the railroad is an old, dilapidated block containing six tenements of five rooms each. These tenements rent for five dollars per month each. The lower story is of brick, the upper floors of wood. One hydrant serves for all, and the waste water and garbage are thrown upon the front street. The kitchen and cellar are upon the same floor, and the upper rooms must be reached by going through the former. By reason of a high hill, which stands in the rear of the block and abutting against the second story there is no yard and the clothes must, of necessity, be dried in the kitchen. The outhouses are built at the upper end of the block, fully exposed to public view. There is no drainage, and the tenants complain of insufferable heat and stench during the summer months. . . . On the whole, the houses of the workmen are very shabby affairs.[13]

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12. Ibid., p. 168; McLaurin, *Johnstown*, p. 45; Dan J. Emmel, "The Community Improvements of the Cambria Iron Company at Johnstown, Pennsylvania," typed manuscript, 1965, box V, Johnstown's Iron and Steel Industry, Mcol IV, JFM, p. 21; "Tenements," typed manuscript, folder: Welfare Work 1911, box: Cambria Steel, Acc 1699, BSC, HagM; Shappee, "History of Johnstown," p. 173.

13. Quoted in Shappee, "History of Johnstown," pp. 174-175.

Contrary to these conditions, company homes for skilled workers were usually of good quality. They were kept in repair and were spacious with sanitation, gas, electricity, and water provided at minimal cost or free. Newcomers usually had long waits to get into the housing, and those living in the homes usually had good reasons for staying with the company. In the 1870s approximately one-third of Cambria's skilled workers owned their own homes.[14]

One of the outstanding company neighborhoods was that of Westmont, located on 600 acres of former Cambria Iron Company farms, and developed after the 1889 flood. The area was on Yoder's Hill, overlooking western Johnstown. Cambria foremen, assistant foremen, and superintendents lived in these homes. An inclined plane railway, which connected the community to Johnstown at Vine Street, was built as transportation to the development. Operated by the Cambria Inclined Plane Company, it opened for business on June 1, 1891. Landscape architect Charles R. Miller laid out the plot for houses. The Cambria Improvement Company was formed to oversee the new neighborhood's construction.[15] (See appendix 39 for a listing of company tenements in 1911, and appendix 40 for correspondence on company housing maintenance.)

Although the Cambria Iron Company rented a large number of houses, the housing policy was to induce employees to buy their homes. Large tracts of land were subdivided into lots, which were sold at low prices. The company built the houses, which were mortgaged at the usual commercial rate of interest. No rent was collected from occupants of houses who were pensioners or disabled.[16]

In the reforming spirit of the times, a 1912 article describing the Cambria Steel Company's welfare policies reported that housing conditions in Johnstown were much better than those in Pittsburgh or New York. There were 929 sleeping rooms available in the company's dwellings, occupied by 2,239 people, or an average of 2.4 people per room. American-born families were the predominant

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14. Brody, *Steelworkers*, pp. 88-89; Ewa Morawska, *For Bread with Butter The Life-Worlds of East Central Europeans in Johnstown, Pennsylvania, 1890-1940* (Cambridge: Cambridge University Press, 1985), p. 89.

15. Emmel, "Community Improvements," p. 20; "Helping the Workingmen," p. 1216; Shappee, "History of Johnstown," pp. 586-587. Further information on the Cambria Inclined Plane Co., including construction and inspection of the inclined plane can be found in the various boxes of manuscript material on the inclined plane in the Bethlehem Steel Corporation papers, Acc 1699 at the Hagley Museum and Library, Manuscripts and Archives Department. A map of the growth of Westmont, 1903-1908, is included in box: Cambria Inclined Plane, Cambria Steel Co., folder: Cambria Inclined Plane Co. 1911-1915. Also included are rates, schedules and regulations for the inclined plane from various years. See also: Richard A. Burkert and Eileen Mountjoy Cooper, "Uphill All the Way: The Story of Johnstown's Incline Plane," typed manuscript, 31 pp., 1984.

16. "Helping the Workingmen," p. 1216.

occupants, totaling 77.7 percent. Six percent were from Austria, 4.3 percent from England, 4 percent Italy, 3.3 percent Ireland, 2 percent Wales, 1.7 percent Germany, and 1 percent from Hungary.[17]

As late as 1916 the Cambria Steel Company was building housing for its employees. The town of Slickville, Pennsylvania, was home to miners employed in the company's mining operations outside of Johnstown. The street layout and house construction were planned, maintained, and managed by the company. The rent was "quite reasonable," and the company claimed not to be in the business for a profit. Rather, the houses were considered an asset to the mining operation. "indirectly the houses do pay for themselves, because contented help makes for better work." The community was directly under the steel company's management; it was not incorporated and had no local officials. But a company spokesman insisted: "Despite this, however, the attitude of the company is not paternalistic but rather cooperative in its nature. No attempt is made to interfere with private initiative of a legitimate character. . . ."[18]

Cambria Iron Company's housing policy can be interpreted as worthy in that it offered low-cost housing to its workers. It was also a method of insuring a workforce with allegiance to the company. People who owned their own homes were reluctant to be involved with any activities which could cost them their jobs and homes.

COMPANY STORE

The Cambria Iron Company's store had inauspicious beginnings as a small general store operated by Augustus Stiles and George D. Allen, and named Stiles, Allen and Company. On June 7, 1854, it was sold to George S. King, one of the founders of the Cambria Iron Company. King hired John S. Buchanan to manage the store, which was known as J.S. Buchanan and Company, or more commonly as King, Buchanan and Company. The store was enlarged into a department store with the name of Wood, Morrell and Company.[19] (See illustration 43 of the company store).

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17. Ibid., pp. 1215-1216.

18. George Atwell Richardson, "Cambria Steel Co. Finds that Good Housing Increases Output," *Coal Age* 23, no. 20 (May 17, 1923): 812, 815.

19. Emmel, "Community Improvements," pp. 12-13; Johnstown *Tribune Democrat*, April 18, 1953.

Five hundred people were employed at Wood, Morrell and Company in 1878. The store was divided into seven departments, each of which was entirely distinct and conducted as separate organizations. The departments included dry goods, millinery, clothing, furnishings goods, boots and shoes, groceries, provisions and meat and vegetable markets. The store featured meat from livestock raised on company farms, flour and cereal from the company flouring mill, and cloth from the company mills. In 1878 the store had 5,000 customers and transacted $1 million worth of business. The firm also had stores in Hollidaysburg, Bennington, Springfield, Frankstown, and Henrietta. An abattoir was in Johnstown, where 18-20 head of cattle and 75-100 head of hogs, sheep, and calves were slaughtered every week. A smaller abattoir was in Hollidaysburg.[20]

This three-story store was severely damaged in the 1889 flood. It was replaced by a four-story building in the early 1890s on the same site on Washington Street, and "stocked with an amazing variety of merchandise." Financial reorganization occurred in 1891 and the firm was renamed the Penn Traffic Limited. The retail store was separated from the Cambria Iron Company and incorporated as Penn Traffic Company. It became the largest merchandizing firm between Pittsburgh and Philadelphia. This building was destroyed by a fire in 1905. The present building was constructed in 1908.[21]

Wood, Morrell and Company was not intended to be a company store by the Cambria Iron Company, but this assertion was challenged in 1891 by investigators of the "truck system" in Pennsylvania.[22] The *Philadelphia Record* reported in July:

> The system [at] Cambria was made so thorough that a workingman in the employ of this corporation had no excuse for demanding payment of wages as such. The pass-book and store-order constituted the only currency with which its employees were familiar. Not only did the company supply them with all the necessaries and luxuries they required "at our current prices," but it also provided them with tailors and shoemakers. In case of illness and company physician was called in, and his fees paid in orders on the store. When there was a wedding or a christening, the company clergyman performed the ceremony. The great corporation, in its benevolence and paternal care of its workingmen, made the most thorough provision

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20. McLaurin, *Johnstown*, p. 45; Holley and Smith, "Cambria Iron and Steel Works," XXV: 422; Degen and Degen, *Johnstown Flood*, p. 8; Johnstown *Tribune-Democrat*, April 18, 1953. A floor by floor description of the 1862 Wood, Morrell & Co. store can be found in S. B. McCormick, *A Sketch of Johnstown*, pp. 17-23.

21. Emmel, "Community Improvements," pp. 14-15; Johnstown *Tribune-Democrat*, April 18, 1953.

22. Bennett, "Iron Workers," pp. 171-172.

that they should not waste their earnings in extravagance anywhere – save at the company store.[23]

The Cambria Iron Company did not pay its employees in store orders as a course of business, but this practice did occur during lean times when the company claimed to be short of cash. This can be interpreted as an attempt on the company's part to keep workers bound to the job, as strikers' passbooks were declared void if they refused to work.[24]

Wood, Morrell and Company tried to convince workers to invest in the company store stock in 1886-1887. It was to be a cooperative in which the workers would be the owners of their own store. Some workers did purchase stock, but most did not, even though the stock was offered at a low of $10 a share. The *National Labor Tribune* took notice of the Cambria Iron Company's low wages, most of which were probably spent at the store, and remarked in December 1886 that the plan was doomed because "the bulk of their employees could not buy up one share at $2 per share."[25]

OFFICE BUILDINGS

Just west of the company store stood a Cambria Iron Company office building, which provided space for the "regiment of clerks, book-keepers and heads of departments.[26] Built in 1879, with an addition in 1885, this brick office was located at the foot of Washington Street on the left bank of the Conemaugh River. It survived the 1889 flood, and by 1925 it contained the stores, employment, order and shipping, local purchasing, chief of scales, telegraph and telephone exchange, and car service departments.[27] (See illustrations 44-46 of office building on Washington Street.)

A seven-story steel and concrete block general office building was built in 1906-1907 on Locust Street. It contained the administrative, engineering, accounting, real estate, welfare and safety, and

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23. Quoted in ibid., p. 172.

24. Ibid.

25. Ibid., pp. 172-173.

26. McLaurin, *Johnstown*, pp. 45-46.

27. Thackray, "History of Cambria," p. 34, Acc 1699, BSC, HagM.

cashier departments. It also housed the Bethlehem Mines Corporations.[28] (See illustration 47 of payroll truck in front of Locust Street office, 1911.)

Construction on a third office building which doubled Bethlehem's office space began in 1954. It was five stories, brick and steel, and located on the corner of Locust and Walnut Streets, annexing the 1907 building. Frank M. Sheesley Company of Johnstown was the subcontractor for the excavation work and foundation, while the general contractor was Hegeman Harris. The building's architect was McKim, Mead and White.[29]

CLUB HOUSE

The Cambria Club House, built in 1881, stood at the corner of Main and Walnut streets, and was used as a hotel for the use of company employees and their guests. It was designed by Philadelphia architect Addison Hutton.[30]

UNION HALL

The Union Hall, at the corner of Washington and Franklin streets, was built in 1864 as a general meeting hall. The building was enlarged in 1885 for theater entertainment and was renamed the Johnstown Opera House. It did not survive the 1889 flood.[31]

CAMBRIA LIBRARY

The Cambria Library Association was organized in 1870 by the Assistance Fire Company, Johnstown's volunteer fire company. Its 65 members paid $3.00 apiece to buy books and this sum was matched by the Cambria Iron Company. In 1873 the company bought a lot at Washington and Walnut streets as the site for a library building, but by 1876 interest in the library association

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28. Ibid.; Johnstown *Tribune-Democrat*, August 14, 1956.

29. Johnstown *Tribune-Democrat*, August 14, 1956.

30. "Iron, Steel and Allied Industries," p. 17; 1884 Johnstown directory, p. 13.

31. Emmel, "Community Improvements," p. 8.

declined, memberships decreased, and the necessary funds were not raised. The iron company proceeded to rent the association's books, which were transferred from the fire hall to the company offices on Washington Street.[32]

Construction began on a library building in 1879, and at its dedication on March 5, 1881, it was considered a gift from the Cambria Iron Company to the people of Johnstown. The Cambria Library Association was endowed with $55,000 in stocks, bonds, and land by Cambria officials. This fund paid salaries, utilities, and bought books. By 1887 the library held 66,914 volumes and contained federal and state publications. Fifty dollars worth of magazine subscriptions per year was provided by the Cambria Iron Company. Any Johnstown citizen could use the library and if the minimal check out fee was not affordable the library's services were provided gratis.[33]

The library had "commodious reading-rooms," and started an educational system for the company's workmen in the winter of 1881-1882. Named the Cambria Scientific Institute, the free instruction included mechanical and free-hand drawing, mining, mathematics, chemistry, geology, and political economy.[34]

Cambria first established a night school for boys in 1857. In the years 1860 to 1889 these classes were offered free to employees, and subjects included mathematics, metallurgy, mechanics, and mechanical drawing. This program expanded after the library was built, and young workers could attend school three days and work three days.[35]

Existing reports on classes offered in winter 1921-1922 provide some details regarding attendance and available subjects. The classes were advertised in the daily Johnstown newspapers and posted in the mills. Only the classes which received enough applicants were taught, and starting October 3, 1921, these were: Monday – electricity and arithmetic; Tuesday – mechanical and structural drawing; Wednesday – shop mathematics and metallurgy; Thursday – mechanical and structural drawing; and on Friday – shop mathematics. H.T. Kelly, supervisor of night classes, considered the

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32. Ibid., p. 15.

33. Ibid., p. 16.

34. McLaurin, *Johnstown*, p. 46.

35. Bennett, "Ironworkers," pp. 160-161.

classes "very successful," especially for the older students "who were more interested in the work and realized the benefits to be derived.[36]

Students who did well in the courses were praised and singled out by name and department for mention in reports, which went to D.M. Stackhouse, assistant general superintendent of the company. The arithmetic class "felt the necessity of a more intimate knowledge of arithmetic, and had come here to make up the defect; they had no time to waste, only two of the members were under 21, the others being about 30. One was an Austrian, who has learning how to figure and think in English."[37]

After the library was destroyed in the 1889 flood a new building was built on the same site in 1892. Andrew Carnegie donated much of the construction cost, but the Cambria Iron Company and its successors maintained its operation. When built the library's first floor contained a 300-person capacity lecture room, the second floor held the library, reading rooms, and offices, while a gymnasium and classrooms were on the third floor. Other organizations used the building, including the Young Men's Christian Association, Johnstown Athletic Association, Johnstown Art League, Fortnightly Musical Club, and the Civic Club of Cambria County.[38]

CAMBRIA HOSPITAL

The Cambria Iron Company built a hospital on Prospect Hill in 1887. The company was the first in the United States to pay for, build, and maintain a hospital for its employees, which numbered 5,400 at the time. Before this hospital was built injured employees were treated at home, and company surgeons performed amputations and operations in houses where it was difficult to get

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36. M.G. Moore to D.M. Stackhouse, May 5, 1922, folder: Cambria Library Night School 1922-1923, box: Cambria Steel, Acc 1699, BSC, HagM. He recommended that the Cambria Library Association confer with Pennsylvania State College regarding adopting university extension courses, "to give the students the benefit of courses laid out by experienced teachers and leading to a definite end." Even though the classes were successful, Kelly believed the school "should be under the direction of a reliable educational institution." Ibid.

37. Ibid. A sample recommendation: "Mr. Aloysius L. Faix, Electrical Department, attended 84% of the sessions. His scholarship was good and he showed unusual interest in the work. He brought in many special problems and asked assistance in their solutions." Ibid.

38. Emmel, "Community Improvements," pp. 17-18.

clean towels or proper tables.[39] Dr. Webster Loman, a surgeon with the company since 1867, became surgeon-in-charge when the hospital opened in 1887. Writing in 1903, he described the conditions surgeons worked under from the time Cambria was established in 1852 until the hospital opened:

> . . . the men in their [Cambria Iron Company] employ, who were so unfortunate as to be injured, were from necessity compelled to have their injuries treated at their homes. Under these conditions, the surgeon had many embarrassments and complications to contend with in the care, treatment and operation which he was required to perform. No conveniences or suitable place to perform the simplest operation, no trained nurse to carry out your instructions; in fact, all sorts of complications handicapped the surgeon. Nothing aseptic, but everything in the surrounding atmosphere septic, not even a clean bandage or dressing to apply to a wound or a recent operation. No prepared ligatures, no absorbent cotton, lint or gauz [sic] -- in fact, at this period no dressing could be bought, but all had to be prepared by the surgeon himself, as the emergency required; no questions were asked as to the sterility of any dressing. . . . These were the times, where there was an emergency, that the young physician or surgeon was compelled to apply his ingenuity to the circumstances which surrounded him.[40]

When the hospital opened it had 12 beds, and was centrally located so that ambulances from the mills took no more than 20 minutes to arrive. It was an immediate success. Dr. Lowman described the hospital's popularity among the employees:

> The first fiscal year of the hospital, there were admitted for treatment as inpatients, thirty-two (32); and ambulant cases treated at dispensary, three hundred and sixty-three (363), or a total of three hundred and ninety five (395) the first fiscal year.[41]

In 1888 Cambria turned over the hospital free of rent to directors of the Cambria Mutual Benefit Association. Members having families or other dependents were admitted free and received boarding and medical services without charge. Association members having no families or dependents were charged the amount awarded for weekly benefits during the time spent in the hospital. Those not

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39. "Cambria Hospital," typed manuscript, folder: Welfare Work 1911, box: Cambria Steel, Acc 1699, BSC, HagM. For a floor by floor description of the hospital in 1888 see John N. Boucher, *The Cambria Iron Company*, pp. 19-20.

40. Quoted in Dr. T. Lyle Hazlett and William W. Hummel, *Industrial Medicine in Western Pennsylvania 1850-1950* (Pittsburgh: University of Pittsburgh Press, 1957), p. 42.

41. Quoted in ibid.

members of the association, employed by other corporation or firms, were admitted and charged $6.00 to $7.00 a week.[42]

By 1903 the hospital had expanded to a 40 bed capacity under the control of a surgeon and an assistant, paid by the Cambria Iron Company. Daily details were handled by a superintendent, six nurses and two orderlies. It is not known when the first nurses were hired as hospital staff, but oral tradition supported the theory that the first nurse was hired soon after the hospital opened in 1887. It is thought that the first nurse hired at the Cambria Iron Company Hospital was the first industrial nurse in America.[43]

A new hospital was built on the same site in 1920 due to increased need. By 1925 the three-story hospital contained wards, private rooms, operating rooms, solariums, kitchens, and 80 beds. Ambulance service was provided and it was asserted that "no injury can take place without being reached by the hospital authorities in ten minutes." First aid relief stations staffed by nurses were located at the various plants where immediate help was available. A home for housing 30 nurses was located next to the hospital.[44] The hospital continued to operate until November 1931 when high operating costs and decreased demand forced its closing. A dispensary was located in the building until 1934.

After Dr. Webster Lowman's death his son, Dr. John B. Lowman, directed the hospital. A believer in preventative medicine, Dr. Lowman initiated a program of physical examinations for all employees of the company around 1916. This program also extended to employees of the Lorain Steel Company in Johnstown. Examinations for current employees were not done with the intent of discharge, but to place employees into positions for which they were physically fitted. The exams for new employees was more rigorous than those for the old employees. According to Dr. Lowman:

> The physician is kept busy from 9 a.m. to 5 p.m. on the examinations, care being taken not to examine a man after he has finished a hard day's work. The cases are then rated; that is, No. 1 is a first class risk and good for any department; No. 2, fair and good for all departments except No. 1; No. 3 medium and good for all departments except those of Nos. 1 and 2; and No. 4 rejected. Special rooms are

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42. "Cambria Hospital," typed manuscript, Folder: Welfare Work 1911, box: Cambria Steel, Acc 1699, BSC, HagM.

43. Hazlett and Hummer, *Industrial Medicine*, p. 43. It is assumed that this first nurse was female, as Hazlett and Hummer discussed a documented case of a female nurse being hired in 1895 at the Vermont Marble Works. They then assert that the Cambria Iron Company Hospital nurse predates this case.

44. Thackray, *History of Cambria*, p. 64, Acc 1699, BSC, HagM; Hazlett and Hummel, *Industrial Medicine*, pp. 43 44.

> required for the convenience of the men. They are stripped and given a thorough examination in private. At first there was some objection by the men and some refused to be examined, but when told that no one was to be discharged and of the good derived from the same, not only for their own protection but also for the protection of others, they fell right into line and at present we have no trouble whatsoever. . . .[45]

Dr. Loman compiled statistics on 12,302 men examined by the company and he determined the value of the physical examination to the industry. Cases of defective vision and hearing were corrected, deformities were treated, and other diseases diagnosed. When active venereal diseases were found, the men were "discharged without argument, on the ground of being a nuisance to others," but they could return to work when they were cured. The value of the examinations to the company, in Dr. Loman's mind, was in "the efficiency of the man," for a "sound physical man was a good employee and a safer man whose family is well provided for."[46]

CITIZEN'S CEMETERY ASSOCIATION

Cambria Iron Company officials were the majority of members on the board of directors of the Citizen's Cemetery Association. In 1885 the association developed Grandview Cemetery on a hill overlooking Johnstown, on land owned by the iron company.[47]

JOHNSTOWN COUNTRY CLUB AND WESTMONT TENNIS CLUB

Two recreation and exercise organizations were maintained by the Cambria Steel Company. Much of the cost of laying-out the grounds and constructing the buildings was born by the company, with members bearing a small share of the maintenance costs. The Johnstown County Club dated to 1895, when Westmont residents built a small golf course. In 1903 Cambria donated a 120-acre tract for a nine-hole course. These links were abandoned in 1907 because of encroaching development, and a new course was laid out on company farmland south of the old links. The clubhouse's construction cost was defrayed by the company, while members paid for maintenance and social events. The club's privileges were extended to the "young men of Johnstown," especially Cambria

45. Quoted in Hazlett and Hummel, *Industrial Medicine*, p. 106.

46. Quoted in ibid., pp. 106-107.

47. Emmel, "Community Improvements," p. 5.

employees, for limited terms for a small monthly fee. The Westmont Tennis Club maintained six courts and had 150 members in its senior classes and 150 members in its junior classes. Members built the clubhouse while the grading and court construction costs were defrayed by Cambria.[48]

CAMBRIA MUTUAL BENEFIT ASSOCIATION

The first mutual benefit association to be established at Cambria was the Miners Association, founded in 1861 by the superintendent of mines. The company provided the association a room, fire, light, and $150.00 a year. This association paid $12,000 in benefits between 1861 and 1866 to members who subscribed.[49]

The Cambria Mills Relief Society was organized in 1877. Each of the 1,600 members paid $.25 per month for benefits of $5.00 per week in case of sickness or disability from accidents. Each member's family also received $25.00 at death for funeral expenses. By April 1883 the association dissolved because it was unable to pay its members.[50]

The Cambria Mutual Benefit Association organized on August 6, 1883, with a nine-person board of directors; four appointed by the company general manager and five chosen by an annual general committee, whose members were elected by 100 association members in a department. The association's goal was to accumulate a fund for the benefit of its members and families, in case of sickness, accident, or death. The company provided office space, clerical services, and acted as treasurer. By 1888 the association boasted a membership of 3,300 and distributed $30,000 per year in benefits. The dues paid were not sufficient to pay benefits, and the difference was paid by the Cambria Iron Company. The association paid death claims due to the 1889 flood totaling $8,940. After the 1902 explosion in the Rolling Mill Mine the Cambria Iron Company advanced $77,000 to the benefit association so benefits totaling $112,000 could be made to its members.[51]

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48. "Helping the Workingmen," pp. 1218-1219.

49. Bennett, "Iron Workers," p. 169.

50. Emmel, "Community Improvements," p. 10.

51. Ibid., pp. 10-11; "Helping the Workingmen," p. 1213; "Cambria Mutual Benefit Association," n.p., typed manuscript, folder: Welfare Work 1911, box: Cambria Steel, Acc 1699, BSC, HagM.

From 1883-1889 the schedule of dues and benefits were as follows for the different classes: First General Class, Second General Class, Third General Class, and Special Class paid monthly dues of $.30, $.40, $.50, and $.75 respectively, and received weekly benefits during sickness or accident of $3.00, $4.00, $5.00 and $5.00 respectively. Burial fees of $30.00, $40.00, $50.00, and $50.00 were paid respectively. Beneficiaries of the Special Class received an accidental death benefit of $11,000, loss of hand or foot $500.00, and for blindness $1,000.00. After 1889 the monthly dues were changed to a uniform rate $.90 and the first, second, and third general classes were dissolved and members united with the Special Class into a General Class. The benefits then became: weekly pay for accident or sickness $5.00, natural death $100, accidental death $1,000, loss of one hand or foot $500, loss of both hands or both feet $1,000, loss of one eye $200, loss of both eyes $1,000, and minor injuries $100 to $250.[52]

Cambria Iron Company management exerted considerable control over the association. This was managed through the placement of company officers on the association's board of directors:

Name	Position with the Company
John Fulton	General Superintendent
Fred Krebs, Jr.	Superintendent, Gautier Steel
Cyrus Elder	Solicitor
Thomas Matthews	Clerk
Joseph Masters	Real Estate Agent
Samuel Vaughn	Boss Engineer
Alexander Hamilton	Superintendent, Rolling Mill
Alexander Kennedy	Shoemaker, Wood, Morrell & Co.
James J. Fronheiser	Superintendent, Blast Furnace
Alex Stackhouse	Engine Boss
George W. Hamilton	Foreman, Rolling Mill[53]

PENSION FUND

A pension fund was established on March 1, 1910, for paying pensions both for service and permanent disability suffered while at work or on the way to or from work. This was only for members of the Cambria Mutual Benefit Association who paid $.10 monthly. A service pension was paid to association members in good standing who could prove they were above 70 years old

52. "Cambria Mutual," n.p.

53. Bennett, "Iron Workers," pp. 170 171.

and had worked for a "substantially continuous period of 30 years." Permanent disability pensions were paid to members who were totally disabled by injury, with no age limit or length of service required.[54]

POLICE AND FIRE DEPARTMENTS

Each plant had its own police and fire department. These reported to a central office and had instant communication with city police and fire department officials.[55]

IMMIGRANTS IN THE CAMBRIA WORKS

English-speaking workers dominated the work force of America's iron and steel plants before 1880, the Cambria Iron Company being no exception. Welsh miners from the northern sections of Cambria County moved into Johnstown after the iron works were started. Germans arrived in the town in the 1830s with the completion of the canal. Many more Hessians and Prussians came in the next few decades. New York contract agencies sent hundreds of Germans and Scandinavians to the town in the 1870s, and the first Irish settlers arrived with the railroad construction. By 1885 contract labor was outlawed in Cambria County.[56]

Groups of ethnic workers lived in distinct sections of the community. John William Bennett analyzed sections three in his discussion of ethnic settlement: A. Old Conemaugh Township, with Johnstown, Conemaugh, and Franklin; B. Old Taylor Township, composed of Taylor, Woodvale, Millville, Prospect, Coopersdale, and East Conemaugh; and C. Old Yoder Township, with Yoder and Cambria City. The chart shows the composition of the regions in 1870:

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54. "Cambria Hospital," typed manuscript, folder: Welfare Work 1911, box: Cambria Steel, Acc 1699, BSC, HagM.

55. Thackray, "History of Cambria," p. 66, Acc 1699, BSC, HagM.

56. Ewa Morawska. "Johnstown's Ethnic Groups," in *Johnstown The Story of a Unique Valley*, ed. Karl Berger (Johnstown: Johnstown Flood Museum, 1984), p. 489.

Region	Nationality												
	Welsh		Irish		American		English		German		Other		Totals
	%	#	%	#	%	#	%	#	%	#	%	#	
A	8	(26)	5	(15)	59	(196)	4	(13)	24	(81)	--	(1)	332
B	11	(20)	29	(52)	46	(82)	8	(14)	5	(9)	--	--	177
C	5	(7)	38	(51)	30	(41)	2	(3)	23	(31)	1	(2)	135[57]

Millville and the first two wards of Johnstown were home to 79 percent of the Welsh iron workers. A total of 69 percent of the Irish mill workers lived in Cambria or Millville. Sixty-seven percent of the German iron workers lived in Yoder, Cambria, Conemaugh, and Johnstown's First Ward. American-born workers composed 50 percent of the mill workforce living in all of Johnstown's wards, but only in one suburb, Coopersdale. Thus, the pattern was one of localized ethnic grouping into certain sections of the city and outlying communities.[58]

The Cambria Iron Company originally relied on local, native-born workers to fill its mills, but as the operation grew in the 1870s and 1880s foreign labor was recruited. This same pattern occurred in Pennsylvania and in the northeastern United States. Hundreds of Germans and Scandinavians arrived in Johnstown in the 1870s as contract laborers. In 1870 the foreign-born constituted 36.4 percent of the population in Johnstown, while in 1880 the numbers grew to 40 percent. Most of these immigrants were Welsh, German, Scandinavian, and Irish. By the turn of the century the immigration tide turned from West Europe to increased immigration from South and East Europe. These latest arrivals took over the unskilled jobs in the mills, which displaced the earlier immigrants and natives who moved either up into skilled work or out altogether. This pool of unskilled labor was very stable because the immigrants had only one goal: to make enough money to return to their native countries. Any job was bearable if it paid, and hard labor was thought necessary for a better life.[59]

Most of the immigrants were single or supported wives and families back home. Wages were barely enough to support a family in Pennsylvania. The few with families earned extra money by

57. Bennett, "Iron Workers," pp. 337-338.

58. Ibid., pp. 340, 342.

59. Morawska, "Ethnic," pp. 489, 491; Brody, *Steelworkers*, p. 96; Morawska, *Bread with Butter*, p. 92

taking in boarders. The value of their wages was in what could be sent back to Europe for purchasing land. In 1907 immigrants in Johnstown and Steelton sent $1,400,000 across the ocean.[60]

Most of the immigrants knew of the harsh working conditions in the steel mills, and only the hardiest went to work. Additionally, adjustment to life in the mill town was difficult. With the exceptions of sections of Hungary and Italy, immigrants came from agricultural regions. They came to America almost completely unacquainted with modern industry and labor organizations. Coming from rural villages, immigrants had to learn quickly how to get along and how to avoid accidents in the mills. Steelmaking was exceedingly dangerous to those who understood no English. Catastrophic illness or accident meant no income, and little or no network of friends and family to rely upon. Immigrants were rarely successful in claiming compensation because of ignorance of the law and language. If a worker were killed the family in Europe usually received no compensation at all.[61]

The immigrants soon established mutual help societies. They received information and guidance from local clubs, relatives, or people from their homeland. Those with a few years experience guided the new ones, and found them jobs and homes. Newspapers in their native language provided information about America and about their homes across the ocean. Churches allowed immigrants to maintain religious habits and traditions.[62]

Immigrants usually settled close to the steel plants, within walking distance. This was also within the reach of the noise, stench, and smoke of the mills, usually the dreariest sections of town. The first southern and eastern European immigrants who arrived in Johnstown were directed by Cambria management into the two sections closest to the mills -- Cambria City and Minersville. This settlement pattern became more pronounced over time: by 1880, 40 percent of Johnstown's inhabitants were immigrants, while in Cambria City the number was 85 percent; in Minersville, 50 percent; in Prospect, 80 percent; while in Conemaugh, 70 percent were immigrants.[63] (See appendix 41 for residences and nationality of Cambria workers in 1870 and 1880.)

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60. Brody, *Steelworkers*, pp. 88-89, note p. 89.

61. Ibid., pp. 99-101; Interchurch World Movement, *Public Opinion and the Steel Strike* (New York: Harcourt, Brace and Company, 1921; reprint ed., New York: DaCapo Press, 1970), p. 226.

62. Interchurch, *Public Opinion*, p. 227.

63. Brody, *Steelworkers*, pp. 102-103; Morawska, "Ethnic," p. 496.

The newcomers inherited the worst housing in the area, usually the dilapidated company tenements in Cambria City and Minersville, known locally as "Rotten Row." Johnstown Croatian workers lived in frame houses bordering on a courtyard. More than 50 groups used a four-room water closet which stood in the center of the courtyard over an exposed cesspool. The frame houses were in bad repair and were poorly ventilated.[64]

Employment was the most crucial factor for the immigrants in Johnstown. As long as the work continued times were considered good. When the unstable steel industry suffered from shutdowns, the immigrants were usually the first to be laid off. Most of the young immigrant men in Johnstown had no industrial skills or knowledge of English, and worked primarily as laborers in the open-hearth and blast furnace departments, and in the brickyards, coal mines, and construction works. By 1900 and 1905, 80 percent of southern and eastern European males worked in the Cambria mills while 15 percent labored in the company mines and brickyards.[65]

Many immigrants did eventually return to their villages, yet others stayed in America and sought to promote themselves. Many were able to rise in the ranks of the skilled workers. Life changed as workers stayed and earned more wages. Wives and families were sent for, living standards rose, better lodging was acquired, and sometimes a home was purchased. Eventually the immigrants assimilated with the other skilled steelworkers.[66]

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64. Brody, *Steelworkers*, pp. 102-103; Morawska, "Ethnic," pp. 496-497.

65. Brody, *Steelworkers*, pp. 105 106; Morawska, "Ethnic," p. 497.

66. Brody, *Steelworkers*, pp. 106-108. Discussion of women's work and involvement with the Cambria Iron Company and its successive owners is difficult because raw data gathering still needs to be done from census and other records. No mention of women working in the iron and steel mills of Johnstown has been found, other than their employment in the Woodvale woolen mills. Tracing the lives and careers of both immigrant and native-born women in Johnstown is a worthy project waiting to be done. Some of this historical analysis has been done for other cities and other occupations. The following sources are offered as comparable works: Elizabeth Beardsley Butler, *Women and the Trades Pittsburgh, 1907-1908* (New York: Charities Publication Committee, 1911) was a volume of the pioneering Pittsburgh Survey, focusing on working conditions and daily lives of workers in many trades, including the sheet and tin plate mills of Pittsburgh; U.S. Congress, *Report on the Conditions of Women and Child Wage Earners in the United States*, vol. 9: *History of Women in Industry in the United States* 61st Cong. 2nd sess., Sen. Doc. 645, (Washington: Government Printing Office, 1910) briefly mentions women's work in the tin-plate departments of steel works and rolling mills, where the women separated the sheets after the pickling process; Susan J. Kleinberg, "Technology and Women's Work: The Lives of Working Class Women in Pittsburgh, 1870-1900," *Labor History* (Winter, 1976): 58-72, and Corinne Azen Krause, "Urbanization Without Breakdown Italian, Jewish, and Slavic Immigrant Women in Pittsburgh, 1900 to 1945," *Journal of Urban History* (May 1978): 291 306, discussed immigrant women's daily lives and the assimilation process. Tamara K. Hareven, *Family Time and Industrial Time The Relationship Between the Family and Work in a New England Industrial Community* (Cambridge: Cambridge University Press, 1982), focused on industrialization's impact on family and work, and the adaptation of immigrants to factory work in the city. Even though the author's focus was on the textile industry, a comparative study could be done focusing on the iron and steel industry.

In Johnstown this process took many years. There existed a distinct "split labor market," with the native-born Americans and West European immigrants holding the jobs with better working conditions, higher wages, more stability and a chance for upward mobility. The second sphere of labor, held by the "Hungarians," a term applied to all South and East European immigrants, consisted of jobs with low pay, dangerous conditions, unstable employment, and little chance at improvement.[67]

This split market was maintained by the lack of skills on the part of the immigrants as well as by the demand for unskilled labor. Cambria's hiring and promotion policies were nativist and unchecked by outside influences, such as unions. Management attitude prevailed at the shop level by bosses who played favorites, shifted men from department to department, or gave promotions only to the native-born or West European. In 1907 Johnstown was actually two cities, with the American-born possessing very little knowledge of the immigrants living and working there. Until after 1937, according to historian Ewa Morawska, "there were in the city practically no institutions, clubs, halls or societies that could provide different immigrant groups with opportunities for systematic social and cultural integration."[68]

Conditions did not change much into the twentieth century. The Cambria Steel Company and subsequent Midvale and Bethlehem companies continued their divisive tactics among the population during the strikes of 1919 and 1937. The Lower Works and Gautier divisions were considered to be better places to work, and many skilled workers were employed there. The Franklin division with its open-hearth furnaces and coke ovens used primarily unskilled labor, composed mostly of South and East Europeans.[69] (See illustrations 48-51 for views of several groups of Cambria Iron Company workers.)

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67. Morawska, "Ethnic," pp. 497-498. For more information on immigrant labor in the steel mills, see Andrea Graziosi, "Common Laborers, Unskilled Workers: 1880-1915," *Labor History* 22 no. 4, (1981): 512-544.

68. Morawska, "Ethnic," pp. 498-499.

69. Ibid., p. 514. Ewa Morawska's text, *For Bread with Butter The Life-Worlds of East Central Europeans in Johnstown, Pennsylvania,* 1890-1940 is an excellent study of not only immigrant relations with the Cambria Iron Company, but of the quality of their lives as well. Other comparative studies of immigrants in steel towns include John Bodnar, Roger Simon, and Michael P. Weber, *Lives of Their Own Black, Italians, and Poles in Pittsburgh, 1900-1960* (Urbana: University of Illinois Press, 1982), and a study of immigrants in Steelton, Pennsylvania, by John Bodnar, *Immigration and Industrialization Ethnicity in an American Mill Town, 1870-1940* (Pittsburgh: University of Pittsburgh Press, 1977).

BLACKS IN JOHNSTOWN

The first blacks came to Johnstown before 1840 from Cumberland, Maryland. They worked in the Cambria Iron Company's tannery in Woodvale, and were employed in the Gautier works by 1875. In 1880 the company built a boarding house for the Gautier black workers in Conemaugh Borough, which was a "bachelor's hall" for the single males. It was two stories and 150 feet long, quartering 100 boarders.[70]

Black migration to the North occurred in two waves, between 1916-1917, and 1922-1923. Southern oppression and lack of economic opportunity led many blacks to leave farming and head north into the cities. Between 1915 and 1928 more than 1,200,000 blacks moved from the South to the North. Johnstown was a fast growing city whose population boomed from 8,380 in 1880 to 67,327 in 1920. Black migration joined the small community already existing in Johnstown; from 1910-1920 the black population rose from 462 to 1,671, and more arrived in 1922-1923. Johnstown's black inhabitants were estimated at 3,000 by summer 1923. They remained a small percentage of the total population but sparked suspicion and concern regardless.[71]

Mexicans as well as blacks were brought into the steel industry by Bethlehem during the great 1919 steel strike, and many settled in Johnstown. These people were segregated into the worst housing in Johnstown and could only work at the worst jobs. Almost all of the black workers toiled in the coke plant or in the foundry, which were known for their heat and din. Inside the mills the workers were segregated and utilized segregated lavatory facilities. Outside the mills the blacks lived in Rosedale, in inadequate tenements and bunkhouses. A visitor to Rosedale from Howard University in spring 1923 remarked that conditions there were "pitiable." Only two families owned their own homes, and the poor, illiterate southerners had no recreational facilities outside of "immorality and gambling." Johnstown did not meet the challenge of housing and caring for the hundreds of newcomers.[72]

Racial tension reached a peak in August 1923 with the presence of the Ku Klux Klan and problems which arose centering on the mayor of the city. White members of the community threatened to

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70. Emmel, "Community Improvement," p. 21; Shappee, "History of Johnstown," pp. 173-174.

71. Richard B. Sherman, "Johnstown v. The Negro: Southern Migrants and the Exodus of 1923" *Pennsylvania History* 30 (October 1963): 454-456.

72. Bruce T. Williams and Michael D. Yates, *Upward Struggle A Bicentennial Tribute to Labor in Cambria and Somerset Counties*, (n.p.: n.p. [1976]), n.p.; Sherman, "Johnstown vs. The Negro,": 456-457.

burn down Rosedale after a shooting incident between a drunken black man and police, wherein the man and several police officers were killed. The local police managed to keep order, and no race riot occurred. Fifteen blacks were arrested and others questioned, but investigations did not turn up evidence that others were involved other than the one drunk man. The Ku Klux Klan demonstrated on the night after the shooting and burned a cross, but no further violence occurred.[73]

Johnstown Mayor Joseph Cauffiel, noted for erratic actions in the past, responded to the incident by telling a local reporter he wanted all blacks who had lived in Johnstown less than seven years to leave town. In a newspaper article appearing September 7, 1922, he declared that "the negroes must go back from where they came. They are not wanted in Johnstown." Additionally, blacks were not allowed to hold public meetings, outside of church, and every black visitor to Johnstown was required to register with the proper authorities.[74]

Local reaction to the mayor's actions and words was minimal and criticism came only from outside the town. Cauffiel approached Bethlehem Steel and told the Cambria plant manager to get rid of its black workers. In fear and probably unaware of their civil rights, several hundred blacks left Johnstown because of the racial hostility and the mayor's remarks. The steel company, which was responsible for most of the blacks being in Johnstown, made no effort to come to its workers' aid.[75]

LABOR

Prior to the Civil War, the iron industries in America were largely rural operations. Workers lived in small villages near their place of work. Low wages, domineering owners, and difficult working conditions were the norm, yet the individual employee was still viewed as a person. Operations were not tightly controlled and workers often went home to help with harvests or other tasks. A well-developed sense of community existed under this arrangement. Labor and management relations were relatively peaceful for the first 125 years of the industry in Pennsylvania. The industry's expansion offered plenty of opportunity for advancement, discipline was not as rigid as in factories,

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73. Sherman, "Johnstown v. The Negro,": 458.

74. Ibid.,: 458-459; Williams and Yates, *Upward Struggle*, n.p.; Hope B. Johnson and B.T. duPont, "The Black Community," in *Johnstown The Story of a Unique Valley*, ed. Karl Berger (Johnstown: Johnstown Flood Museum, 1984), pp. 554-555.

75. Sherman, "Johnstown v. The Negro," 460-461; Williams and Yates, *Upward Struggle*, n.p.

and rural forges and furnaces operated intermittently without a day-in, day-out schedule. The paternalistic nature of the industry also precluded problems between ironmasters and employees over questions of working conditions, hours, and wages.[76]

This situation changed by 1900. The movement of workers to large urban centers destroyed the sense of community in the small iron towns. Owners of large companies were rarely seen by the employees. Immigration contributed to the division in the workforce; native-born Americans or persons of Anglo-Saxon heritage held the better jobs requiring skill and leadership while ethnic workers were relegated to menial labor or jobs suffering from harsh working conditions. Workers of different national ties and languages often could not communicate with each other, thereby limiting discussions of unhappiness or unrest.[77]

The change in the pace of work was another unsettling development. As steam power replaced water power the pace of operations moved faster. Entrepreneurs who cared only about costs, profits, and production also pushed the pace of work. The result was a grueling workday and work-week. The twelve-hour day and seven-day week were prevalent into the twentieth century. Changes in shifts sometimes required workers to stay on their jobs for up to 18 or 24 hours. Unskilled workers received low wages. Until 1910 many steel workers received less than $10.00 for an 84-hour workweek. Workers also toiled in steel mills where the air was polluted with smoke and stench. Steel towns were noted for their grime and dreary appearance, and Johnstown was no exception.[78] (See appendix 42 for daily wage and tonnage rate for Cambria workers, 1880-1900.)

Groups of workers began to agitate for better working conditions and wages. Strikes occurred, but usually only the skilled workers had a chance to get their grievances heard. Trade unions had been established early in the iron and steel industry with skilled workers covered by the Sons of Vulcan, the Heaters' and Rollers' Union, and the Roll Hands' Union. All of these unions joined in 1876 to

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76. Lewis, *Iron and Steel* p. 52; George Swetnam, "Labor-Management Relations in Pennsylvania's Steel Industry, 1800-1959," *Western Pennsylvania History Magazine* 62, no. 4 (1979): 321-332. The history of labor in the iron and steel industry is a significant one, filled with episodes of individual determination, sacrifice, and dignity. Only a brief sketch is presented in this resource study; for further information see William T. Hogan's *Economic History of the Iron and Steel Industry in the United States*. Volume 1, chapter 6 focuses on labor from 1860-1880; volume 1, chapter 13 discusses workers in the 1880-1900 period; volume 2, part III, chapter 20 details the Amalgamated Association's activities after 1900; volume 3, part IV, chapter 27 deals with labor during the 1920s; volume 3, part IV, chapter 35 focuses on the development of the United Steelworkers of America; and volume 4, part VI, chapter 42 discusses labor relations after World War II, from 1946 until the early 1970s.

77. Lewis, *Iron and Steel* p. 52. For a history of labor beginnings, composition, ideology, and comparison with labor movements in Russia, Germany, and Britain, see Selig Perlman, *A Theory of the Labor Movement* (New York: The Macmillan Company, 1928, reprint ed. New York: Augustus M. Kelley Publishers, 1970).

78. Lewis, *Iron and Steel*, pp. 52-53.

form the Amalgamated Association of Iron and Steel Workers. At its height in 1891 the association had 24,000 members, or two-thirds of the eligible workers. This union belonged to the American Federation of Labor (AFL).[79]

The amalgamated association's power lay mainly in the western iron mills. It was a stabilizing force in the iron industry because it equalized hours and working conditions, guaranteed a supply of highly-skilled puddlers and rollers, and negotiated annual uniform scales. The union was not able to spread into the growing steel industry as well as it did the iron industry. If an iron company began producing steel, the union could usually enter the new departments. But where the iron mills failed to organize, so did the steel mills. Cambria's management had always been anti-union, and the works were never organized.[80]

The amalgamated association tried to accommodate the changes which accompanied the new steel industry. It did not object to technological improvements even if it meant workers were displaced. It also did away with demands for a uniform standard wage, relying instead on each steel mill lodge negotiating its own rates. Nevertheless, the steelmakers considered the union to be in the way of economy because the union interfered with their control of labor. Abuses of power by strong lodges, and the multitude of rules which protected members led to an inevitable battle.[81]

The central issue of wages, and how to fix new rates after improvements led to the 1892 Amalgamated Association of Iron and Steel Workers strike against Andrew Carnegie's Homestead plant near Pittsburgh. It was a battle between strikers and nonunion labor backed by Pinkerton detectives. After considerable violence the strike ended in failure for the workers. The union was gone from the Carnegie mills.[82]

After this defeat the amalgamated association was unable to hold the line on wage cuts or even have a presence in other mills. By 1900 the union was not recognized in any major steel plants in

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79. Ibid., p. 53; Brody, *Steelworkers*, p. 50.

80. Brody, *Steelworkers*, pp. 50-51.

81. Ibid., pp. 51-53.

82. Ibid, pp. 53-57; Lewis, *Iron and Steel*, pp. 53 54. Much has been written about this well-known strike. For further information, see Leon Wolff, *Lockout The Story of the Homestead Strike of 1892: A Study of Violence, Unionism, and the Carnegie Steel Empire* (New York: Harper & Row, Publishers, 1965).

western Pennsylvania, and only a few years passed before it disappeared from western mills. Its fate was the same in the sheet and tin plate industries.[83]

The union's fatal weakness was in its limited membership of skilled men. In times of disagreement with employers the union would withhold its vital steelmaking skills. This worked as long as these men were needed. Once mechanization came into the mills the situation changed. No longer were union men irreplaceable, and during a strike it was only a matter of time before nonunion workers could be brought into a mill and taught the necessary skills. No longer were strikes tolerated; strikebreakers could be brought in to get the mills operating.[84]

Employee bargaining power ended with the union. The steelmaker's drive for economy was no longer impeded by unwanted wage demands. Now the responsibility for labor stability no longer belonged to the union but to the industry leaders. They were constantly on guard against any new formation of a union, and the AFL took on the challenge.[85]

After the 1890s depression, industry leaders began to see the benefits of improving working conditions. By 1900 management in some steel companies began to provide some worker benefits, such as planned housing, modest profit-sharing, stock-purchasing plans, and improvements in safety, sanitation, medical services, and recreational facilities.[86] Most of these improvements were viewed either cynically or realistically as paternalistic attempts to keep workers happy in an attempt to root out unionism.

Despite some improvements, the long workweeks continued and gains in wages were usually shortlived. The AFL moved in the wake of the amalgamated association's defeat to organize the steel workers. During the 1890s local trade unions were organized in areas never touched by the amalgamated association and into international unions rather than isolated locals. By 1909-1910 the structure of the union was in place; all steelworkers, skilled and unskilled, in all branches of

83. Brody, *Steelworkers*, pp. 57-58, 67.

84. Ibid., p. 58.

85. Ibid., pp. 79, 130.

86. Lewis, *Iron and Steel*, p. 54.

the industry, were under a single jurisdiction, with the exception of the blast furnace workers. The central challenge facing the AFL was organizing the East European immigrants.[87]

The problems were many. The peasant workers had no collective activity in their backgrounds, they were often hired as strikebreakers, much to the hatred of the native English-speaking workers, and they preferred working for low wages, just to keep working, rather than lose time during strikes for small increases in wages. In the long term the prospects for organizing immigrants were favorable because steady employment could not always be supplied. Unskilled workers resented being thrown out of work during times of depression. Added to a lack of dependence upon the employer in peak times, immigrants were known to strike and stay united until an agreement was reached. After 1910 union leaders believed the immigrants could be organized.[88]

The reorganization of skilled and unskilled workers into industrial unionism was accompanied by a liberalizing of labor policies. In an era when cutthroat competition no longer existed, reform appeared in the form of cooperation in the industry concerning prices, wage policy, and other matters. Other reforms came about in the era of muckraking journalism when critical eyes focused upon labor conditions in the steel industry. The Russell Sage Foundation and the Charity Organization Society of New York sponsored the Pittsburgh Survey in 1908, which described the working lives of steelworkers. Many more articles and investigations of the industry followed. Reforms in the way of safety committees, compensation plans, upgrading of employees' health and working comfort, and reduction of the work week, eliminating Sunday labor, became standard in the industry. There was no change, however, in the existing attitude toward labor. Unions were still not wanted.[89]

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87. Brody, *Steelworkers*, pp. 130-135.

88. Ibid., pp. 135-140.

89. Ibid., pp. 147-179. An excellent example of the journalism focusing on the steel industry is the writing of John A. Fitch, who described working conditions of steelworkers, by trade, in Allegheny County in 1911. His descriptions can be useful in making comparisons with working conditions and job requirements of workers at Cambria at the same time period. They were probably not much different. See *The Steel Workers* (New York: Charities Publication Committee, 1911; reprint ed., New York: Arno & The New York Times, 1969). Another landmark study of the time was of the conditions of workers and their families at Homestead. See Margaret Byington, *Homestead The Households of a Mill Town*, ([New York]: The Russell Sage Foundation, 1910; reprint ed., Pittsburgh: University of Pittsburgh, 1974.) The Pittsburgh Survey was basically a study concerning industrialization's impact on workers' living and working conditions. For an analysis of the survey and the reformers involved with it, see John F. McClymer, "The Pittsburgh Survey, 1907-1914: Forging an Ideology in the Steel District," *Pennsylvania History* 41 (April 1974): 169-186. The citation for the survey itself is Paul U. Kellogg, ed., *The Pittsburgh Survey* 6 vols. (New York: Charities Publication Committee, then Survey Associates, Inc., 1910-1914).

The reforms temporarily improved working conditions, but the coming of World War I radically changed the labor stability. The balance of labor supply and demand was upset when immigration into the country was effectively cut off. Worker unrest accompanied the upswing in business, as demands for wage increases were made. These problems were partially solved when wage concessions were made to settle unrest and attract workers. The importation of southern blacks helped to ease the shortage of labor. Thousands of migrants headed north in search of high wages, often to find discrimination, poor housing, and relegation to unskilled labor.[90]

The war also affected the role the steelworkers played in society. No longer were they just earning pay; they were now active participants in the war. Patriotic Americans who worked in steel mills were expected to make special sacrifices in order to keep the mills running for the war effort. Many production records fell as workers performed their patriotic duty on the job.[91]

The AFL stepped up its organizing efforts during the war, taking advantage of the labor shortage. The union found a wartime ally in a federal government which supported cooperation in the face of the war. Samuel Gompers of the AFL claimed that workers were indispensable in production, and therefore should have a say in the politics affecting them. In 1918 the War Labor Conference Board was established to ensure production without work stoppages, while the National War Labor Board was to handle disputes in war industries. Workers were given the right to organize in unions without any employer interference. It was time for an organizing drive, led by the National Committee for Organizing the Iron and Steel Workers. This committee was established in August 1918 after a conference of 24 trade unions met in Chicago to start the drive. Samuel Gompers was chosen honorary chairman, John Fitzpatrick as acting chairman, and William Z. Foster as secretary-treasurer.[92]

Unions seemed attractive to the workingmen now because it was relevant to their wartime experiences. The cause seemed necessary in order to preserve democracy and the appeal was couched in terms of wartime propaganda The immigrants were among the first to respond, and in 1918 and 1919 the national committee achieved remarkable success in organizing them. Native-

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90. Brody, *Steelworkers*, pp. 180-187.

91. Ibid., pp. 190-198.

92. Ibid., pp. 199-213; Robert Asher, "Painful Memories: The Historical Consciousness of Steelworkers and the Steel Strike of 1919," *Pennsylvania History* 45, no. 1, (1978): 81; Robert K. Murray, "Communism and the Great Steel Strike of 1919," *The Mississippi Valley Historical Review* 38 (December 1951): 447. For more information on Samuel Gompers see Harold C. Livesay, *Samuel Gompers and Organized Labor in America* (Boston: Little, Brown and Company, 1978).

born Americans followed. Blacks, however, had been put off earlier by the unions. They distrusted whites and looked for immediate reforms instead of long range ones. They did not, with few exceptions, join.[93]

The steelmakers could not openly oppose the organizing efforts. They attacked the union by introducing employee representation as a way to encourage "democracy" in the industry. Bethlehem Steel Corporation was a leader in taking the paternalistic welfare capitalism approach. Early on it had established pensions, relief and disability benefits, and in 1919 it introduced its Employee Representation Plan, known as a company union. It was never intended to be a collective bargaining instrument, and was used for communicating management's policies to the rank and file. The workers had no avenue for self-expression. Twenty years after the employee representation plan's introduction, a Senate investigating committee found the plan "failed to qualify in the minds of a substantial group of employees as a successful instrument for collective bargaining."[94]

During World War I Cambria was owned by the Midvale Steel and Ordnance Company. "Industrial Democracy," as it was called, came to Midvale and Cambria in September 1918, when a "comprehensive system of collective bargaining" was established. Employees from different departments of the Johnstown, Coatesville, and Nicetown plants met on September 23 to choose department representatives. Workers were also elected to a plant committee, which sent delegates to attend conferences at company headquarters in Philadelphia on September 25. The delegates from Midvale's three plants drew up a plan which was to be submitted to the workers for ratification. However, the plan was not submitted to the rank and file. At both the Coatesville and Nicetown plants the plan was adopted by plant committee members. At Johnstown the plant committee scrutinized the plan very carefully, and it was adopted, "subject to the ratification of the employees of the Cambria Steel Company." For whatever reason, that proviso was withdrawn and the plant committee adopted the plan. The employee representation plan went into effect on October 1, only 12 days after it was first authorized.[95]

93. Brody, *Steelworkers*, pp. 218-225; Murray, "Communism,": 447.

94. Donald S. McPherson, "The 'Little Steel' Strike of 1937 in Johnstown, Pennsylvania," *Pennsylvania History* 39 (April 1972): 220; Brody, *Steelworkers*, pp. 225-230.

95. "Midvale Plan of Employee Representation," *The Iron Age* 102, no. 13 (September 26, 1918): 763; "Midvale Plan of Employee Representation," *The Iron Age* 102 (October 3, 1918): 834-835; Eggert, *Steelmasters*, pp. 103-105. Eggert offered a detailed account of Midvale's employee representation plan:

> In its final form the plan called for the annual election of representatives to a plant conference committee on the basis of one for every 300 men in each plant division. The resulting committees consisted of 56 members at Johnstown, 25 at Coatesville, and 35 at Nicetown. These representatives, in turn, were to elect one representative for every 3,000 employees to serve on a company-wide general

Unionizers appeared at both Bethlehem and Midvale during the spring of 1918. By summer both companies were brought before the National War Labor Board because they refused to bargain collectively with their employees. Both companies' response was to set up their employee representation plans in order to avoid dealing with regular unions.[96] (See illustration 52 of Armistice Day parade, Franklin Street Bridge.)

Disillusionment among the steel workers did not take long to develop. At the war's end came employer resistance. Workers were denied the right to meet in some areas, while in others, including Johnstown, mass firings took place. The National War Labor Board was no longer able

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> conference committee. A representative was required to have worked in the plant for at least a year and would lose his position if he ceased to be an employee or was promoted to a salaried position. A representative could be recalled if two-thirds of the men he represented signed a petition against him.
>
> Those elected were to act as spokesmen for the men "in all matters pertaining to conditions of employment, the adjustment of differences, and all other matters affecting the relation of the employees to the Company." When a foreman or division superintendent failed to settle a workman's grievance, it could be appealed to the local plant conference committee which would discuss it with the general superintendent. If not satisfactorily adjusted, further appeal could be taken to a joint meeting of the general conference committee and general superintendents of all Midvale plants, to the president of the company, or, if need be, to binding arbitration.
>
> Under the plan the company's right to hire was unlimited, and it was free to suspend work in any department because of a "lack of orders or for any other legitimate business reason." Although such a suspension could be made without warning, it was "the duty of the officers to give as much advance notice as practicable."
>
> The right of the company to suspend or discharge individual employees was spelled out. A man could be discharged immediately and without notice for disloyalty by act or utterance to the U.S. government, any offense against the criminal law of the state, assault upon or attempt to injure another person, wanton destruction of property, refusal to obey a reasonable order of his superior, or intoxication while on duty. A man had to be warned at least once before being suspended or discharged for "carelessness," for failure to report for duty regularly and on time, or for "inefficiency, etc." A discharged man could demand that the cause "be clearly stated to him," and appeal could be taken to the plant general superintendent. The company promised not to require employees to purchase any goods or services from the company.
>
> The capstone of the plan . . . was the provision that all representatives from all Midvale plants were to meet four times a year with the officers of the company. At these sessions "all matters of general interest to both parties" could be discussed.

Ibid., pp. 114-115. For a first-hand account of the plan and what it was to accomplish, see Edward Wilson, "The Organization of an Open Shop Under the Midvale Plan," *Annals of the American Academy of Political and Social Science* 85 (September 1919): 214-219. Wilson, a patternmaker for the Midvale Steel and Ordnance Company, countered criticism of the plan:

> One of the adverse criticisms of this plan is that men meeting in company time on company property cannot truly represent their fellows, that only men favored by the company can be elected as representatives and that all their activities are inspired and controlled by the management. Criticism of this sort we respectfully submit is a severe arraignment of the capacity of the worker to govern himself. If he is not fit to govern himself in an open shop, his case is hopeless, for the law of averages applies here as it does everywhere and the workers in an open shop are just as conscientious and just as independent as they are anywhere else. A careful reading of the details of our plan should be answer enough to such criticism of the future of such a scheme. Ibid.,: 218.

96. Eggert, *Steelmasters*, p. 109.

to force its views on steelmakers, and unhappiness with employee representation plans was widespread. All of these grievances were compounded by high unemployment and long work days. The main issues were union recognition and the improvement of wages and abolition of the 12-hour workday. Rank and file pressure forced relations with the steel companies to a breaking point way before the leaders of the organizing drive were ready. A strike date was set for September 22 and Samuel Gompers and the national committee knew the strike was doomed to fail if the government failed to intervene.[97]

On September 22, 1919, steel plants were shut down in Pueblo, Chicago, Wheeling, Cleveland, Lackawanna, Youngstown, and Johnstown. It was known as the Great Steel Strike, and more than 365,000 workers walked off their jobs to meet strong opposition. Charges of bolshevism, radicalism, and revolution soon emerged in the politically hostile environment, the federal government failed to get involved, and there was no public support for the strikers. President Woodrow Wilson did not pressure the steel companies to negotiate with the national committee, and U.S. government officials, with the exception of Wilson who physically collapsed on September 26, were actively involved in breaking the strike. They viewed the strike as a "manifestation of a pernicious revolutionary mentality that was sweeping across the nation," and they advocated or condoned the use of the Army, Justice Department, and Immigration Bureau to break the strike.[98]

The steelmakers, in the wake of national hysteria over the strike, conducted a strategy of terrorism. In 1919 the steel companies possessed much financial strength. This fact, combined with the companies' political power in Pennsylvania state government and dominance of most local steel communities, resulted in widespread assault and arrests of striking workers. Indiscriminate arrests of strikers on sedition charges by police and U.S. government agents were widespread. Enough steel was made to ensure the strike's failure. Demoralization set in and after the sixth week the strike began to fail. By January 1920 less than 10,000 men remained on strike, steel production ran 70 percent, and the National Committee for Organizing Iron and Steel Workers voted to end the fight. No concessions had been made, 20 lives were lost, 17 of them strikers, and $112,000,000 in wages were lost.[99]

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97. Brody, *Steelworkers*, pp. 231-236; Asher, "Painful Memories,": 84.

98. Asher, "Painful Memories,": 84. For more information on the alleged connection between communism and the strike, see Robert K. Murray's entire article.

99. Brody, *Steelworkers*, pp. 242-262; Asher, "Painful Memories,": 82; Murray, "Communism,": 464.

The widespread charges of bolshevism effectively strangled the strike and two investigations of the real reasons for the conflict were undertaken. Both the Senate Committee on Education and Labor and a special commission of inquiry of the Interchurch World Movement, an organization of American Protestant Churches, released their findings before the strike was over. The Senate report concluded that "a considerable element of IWW's [Industrial Workers of the World], anarchists, revolutionists, and Russian Soviets" were behind the strike, while the commission of inquiry minimized the radical influence while attacking the role of the steel companies and denouncing the use of "strikebreakers," "undercover men," and "labor spies."[100]

No change occurred in mill conditions. Steelworkers still worked 12-hour days in 1920. One-quarter of the men in blast furnace, Bessemer, and open-hearth departments still worked seven-day weeks. In July 1920 when the Interchurch World Movement's Commission of Inquiry announced the final results of its investigation of the steel strike, their report soundly denounced the long hours of steel labor. Even the exposé of the strikebreaking methods used did not receive as much attention as that of the evils of the 12-hour day.[101]

The issue was in the public eye, and Secretary of Commerce Herbert C. Hoover and Secretary of Labor James J. Davis took the lead in ordering studies and gathering data. At Hoover's urging, President Warren G. Harding exerted pressure, but the steelmakers did not give in easily to the calls for change. Not until the end of 1923 was the 12-hour day eliminated and the 8-hour day instituted in the steel industry.[102]

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100. Murray, "Communism,": 462-463. For summaries of these investigations and other readings on the 1919 strike, see Colston E. Warne, ed., *The Steel Strike of 1919* (Lexington, Massachusetts: D.C. Heath and Company, 1963). For further information on the strike, see David Brody, *Labor in Crisis The Steel Strike of 1919* (Philadelphia: J.B. Lippincott Company, 1965); chapter 11 of Sidney Lens, *The Labor Wars From the Molly Maguires to the Sitdowns* (Garden City, New York: Anchor Books, 1974); and chapter VIII of Samuel Yellen, *American Labor Struggles* (New York: Harcourt, Brace and Company, 1936).

101. Brody, *Steelworkers*, pp. 270-271. The report stated: "The 12-hour day is the most iniquitous of the byproducts of the corporation's labor policy which is to get cheap labor and keep it cheap." Interchurch World Movement of North America, Commission of Inquiry. *Report on the Steel Strike of 1919* (New York: Harcourt, Brace and Howe, 1920; reprint ed., New York: DaCapo Press, 1971) p. 81.

102. Brody, *Steelworkers*, pp. 273-275; William T. Moye, "The End of the 12-hour Day in the Steel Industry" *Monthly Labor Review* 100, no. 9 (September 1977): 23. See also Charles Hill, "Fighting the Twelve-Hour Day in the American Steel Industry" *Labor History* 15, no. 1 (1974): 19-35 for further data on how a group of people, including the Interchurch World Movement, Hoover and Harding, and a handful of reformers, including John Fitch, conducted the campaign to provide steelworkers with a chance for more decent lives.

There was no change, however, in the position of labor. During the 1920s it seemed as though the steel industry would remain nonunion forever. Organized labor was so suspected by the public of being bolshevist, a fear fostered by antiunion propaganda, sensationalism in the press, and a few instances of radical activity, that the real issues involved in any subsequent industrial disputes were lost. The open shop campaign gained strength and few workers were willing to fight public opinion in further labor disputes. The Amalgamated Association of Iron and Steel Workers withdrew from the National Committee for Organizing Iron and Steel Workers, and of the 250,000 workers organized during the 1918-1919 campaign, only a minority remained in the unions in late 1920.[103]

After 1921 the number of disputes in the steel industry fell dramatically. Seventy-six occurred in 1919, but only ten in 1922, seven in 1924, and two each in the years 1926, 1927, and 1928. There were only five more in the first three years of the Great Depression The decline occurred because company power and poor union leadership made effective protests almost impossible. The 1919 defeat was overwhelming in its legacy. Additionally, working conditions had improved somewhat after the Interchurch World Movement drew attention to the mills.[104]

After 1919 all the steelworkers, whether skilled or unskilled, American or not, had memories of an unsuccessful fight against the steel companies. Through the 1920s there was a "mood of terror" in the steel towns, as workers feared informers, blacklisting, and a repeat of the physical intimidation which accompanied the 1919 strike. By the 1930s that historical tradition remained, but conditions for further agitation improved. After 1935 the unionization effort was led by a new organization, the Steel Workers Organizing Committee (SWOC) of the Committee for Industrial Organization (CIO), headed by Philip Murray, then vice president of the United Mine Workers of America. The SWOC and the CIO had no records of defeat as did the Amalgamated Association of Iron, Steel and Tin Workers. The SWOC organized the steel industry on an industrial basis and the CIO enthusiastically supported the effort. They collected no dues from members, using instead a loan of $500,000 recruited from CIO unions.[105]

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103. Murray, "Communism,": 465-466.

104. Robert R.R. Brooks, *As Steel Goes, . . . Unionism in a Basic Industry* (New Haven, Yale University Press, 1940), p. 42.

105. Asher, "Painful Memories,": 84-86. United Steelworkers of America, Education Department, compilers, *Then & Now; The Road Between The Story of the United Steelworkers of America* (n.p.: n.p., 1974), p. 51. After internal conflicts in AFL several dissident leaders, including John L. Lewis of the United Mine Workers, established the Committee for Industrial Organization. The CIO was then expelled from the AFL and proceeded to launch a steel organizing drive in 1936. The SWOC was composed of representatives from the Amalgamated Association of Iron, Steel and Tin Workers, United Mine Workers, CIO, Ladies' Garment Workers Union, and Amalgamated Clothing Workers Union.

A second new condition was the national government's highly visible support of trade union organization. It became an active ally instead of staying neutral or even repressive. The organized workers had new political influence both locally and statewide which prevented the use of state police and vigilantes against them. This changed atmosphere helped convince steel workers that the abuses of the past would not occur again, and that victory was possible.[106]

Labor-management relations deteriorated in the steel industry before World War II because the paternalistic welfare capitalism the steel companies employed as anti-union devices failed. Wages and working conditions were secondary issues in the upcoming strike; the core issues were recognition of the SWOC as a bargaining agent and the legitimacy which accompanied signed contracts.[107]

The passage of the National Industrial Recovery Act (NIRA) in 1933 revived steelworkers' interest in organizing. The NIRA's section 7A guaranteed labor the right of collective bargaining. The SWOC knew the time was right for a massive drive, and it established a general headquarters in Pittsburgh along with 42 additional subdistrict offices. Organizers did not seek individual employees, but wooed entire company and independent unions which had sprung up after passage of the NIRA. In January 1937 John L. Lewis, president of the United Mine Workers of America, discussed recognition of the SWOC with the U.S. Steel Corporation. For the first time in 28 years the corporation bargained with a union it did not control. A one-year contract was signed on March 17, 1937, between the five largest U.S. Steel subsidiaries and SWOC calling for limited recognition for the committee, a wage increase, with eight-hour days, and forty-hour weeks.[108]

The first battle for SWOC occurred at the Jones and Laughlin plant in Aliquippa, Pennsylvania. This was an independent company which wanted to avoid formal agreement with SWOC, but after a 36-hour strike in May 1937 by 25,000 workers, a preliminary agreement resulted. A collective bargaining election was held under the National Labor Relations Board's eye with the SWOC winning recognition and an agreement following that of U.S. Steel, known as "Big Steel."[109]

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106. Asher, "Painful Memories,": 86.

107. McPherson, "Little Steel": 19.

108. Philip Taft, *Organized Labor in American History* (New York: Harper & Row, Publishers, 1964), p. 504, 513 515; United Steelworkers, *Then & Now*, p. 53.

109. Taft, *Organized Labor*, p. 516.

These victories were followed by a defeat, but one which marked a change in the labor atmosphere. The steel companies won the Little Steel Strike of 1937, but for the first time there were no large scale espionage tactics. The use of armed guards and the denial of workers' civil rights had been exposed by Senator Robert M. La Follette's Senate Committee on Education and Labor, and these measures were never used again successfully in a labor conflict.[110]

The SWOC tried to negotiate agreements with the Republic Steel Corporation, Youngstown Sheet and Tube Corporation, Inland Steel, and the Bethlehem Steel Corporation, known collectively as "Little Steel." The companies refused to sign the CIO contract and a strike broke out in 27 plants. The main strike zones were in Youngstown, Ohio, and in Chicago, where the infamous Memorial Day incident occurred with the Chicago police clubbing marchers and killing ten men.[111]

The National Labor Relations Board met on June 21 with Lewis, Murray, and other leaders to promote ways to reach an agreement with the companies. On the same day the board met with company representatives, including President Eugene Grace of Bethlehem Steel Corporation. All four companies refused to enter into an agreement with the SWOC. Additional meetings were held with no basis for settlement found. The strike continued throughout the summer of 1937, and ended after Labor Day at Bethlehem Steel, Republic Steel, and Youngstown Sheet and Tube with back-to-work movements. Only Inland Steel made concessions. It was a costly and violent strike with 18 fatalities. In earlier times a return to work without a contract would have meant blacklisting and other stringent measures. In this instance the union had the protection of the Wagner Act and favorable public opinion. The SWOC did not disappear after the strike.[112]

The steel companies, including Bethlehem, were eventually forced to deal with the SWOC and sign contracts. This came about through the efforts of the union and the decisions of the National Labor Relations Board. The SWDC continued to grow, especially after the defense boom in 1939, and on May 19, a new organization was formed – the United Steelworkers of America. Bethlehem Steel Corporation signed a contract with the new United Steelworkers of America on August 13, 1942, after a series of small strikes.[113]

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110. Ibid.

111. Ibid., pp. 517-518.

112. Ibid., pp. 519-520. The National Labor Relations Act, known as the Wagner Act, replaced section 7A of the NIRA, which was declared unconstitutional by the U.S. Supreme Court.

113. Ibid., pp. 520-521; United Steelworkers, *Then & Now*, p. 60.

According to labor historian Philip Taft, "The final outcome of the Little Steel strike clearly demonstrated the importance of the government in shaping labor relations and influencing the effectiveness of organizing and the characteristics of the movement."[114] Without the Wagner Act the strike would have been just one more lost cause. The United Steelworkers of America grew to be one of the three largest unions in the United States.[115]

LABOR ISSUES IN JOHNSTOWN

The labor experience in Johnstown generally followed that of the industry as a whole. Unionism was vigorously attacked by Cambria Iron Company and subsequent management, and despite several lockouts and strikes, most notably in 1919, union entry was prevented until 1942. Some violence did occur in Johnstown, but not on a scale as in Homestead in 1892 or in Gary in 1919. Cambria's workforce was composed initially of local and native-born workers of Welsh, Irish, English and German heritage, later augmented by migration of southern blacks and immigration from South and East Europe. The history of labor is composed of many stories: that of attempts to organize skilled steelworkers, followed by the importation of black labor, and discrimination against the latest wave of immigrants. Labor and immigration patterns in Johnstown were impacted in many ways by the policies of the Cambria Iron Company.

From the very beginning the company forbid any union activity. Because the company's workforce consisted not only of iron and steelworkers, but coal miners and transportation workers as well, general labor unrest in several fields usually affected the company in some manner. Strikes against the company often occurred in conjunction with union efforts against the industry nationwide.

In the spring of 1858 the Cambria Iron Company announced a 20 percent cut in wages. When the miners and ore puddlers went on strike, Daniel Morrell hired other men to take their places. He also had arrest warrants issued for 11 men charged with conspiracy to raise wages or stop the mill's operation. The strike soon ended, and the 11 defendants in the conspiracy case went to trial,

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114. Taft, *Organized Labor*, p. 522.

115. Ibid. See chapter 10 of Irving Bernstein, *Turbulent Years A History of the American Worker 1933-1941* (Boston: Houghton Mifflin Company, 1971) for a history of the struggle to organize steel from 1892 to 1937.

resulting in an out-of-court settlement. This was only the first of many labor disputes wherein Daniel Morrell successfully fought any union organization in the company.[116]

In February 1866 a dispute arose between heaters and helpers over who was responsible for moving muck bar piles to the furnace. The heaters also wanted to control the hiring and training of their helpers. Cambria management sided with the helpers, ordering the heaters to do the work. The heaters quit work, and their helpers were hired in their place. One helper remarked: "The heaters advertise that they 'are standing,' [i.e., striking], which is true, and when they get tired they can sit down. Their actions can have no effect on the works." The helpers and the company won and the heaters' union, the Associated Brotherhood of Iron and Steel Heaters, Rollers, and Roughers of the United States, founded in Springfield, Illinois, in 1872, disappeared for seven years.[117]

Johnstown workers tried to persuade the Pennsylvania legislature to define a day's work to be eight hours in April 1866. They held a "large and orderly" meeting in the public square on April 5, and Jonathan Fincher, president of the Machinists Union, talked to the group about the issue.[118]

The United Sons of Vulcan puddlers, joined by their helpers, struck over wages in June 1866 at Cambria. The union tried to garner public support. According to the local Ebensburg *Alleghenian:*

> The men are very unanimous and hold daily meetings, at which they go through, individually, the most rigid examination, by the President of the meeting, as to their acts for the 24 hours interim. One of the rules of the Union, or association, to which most of the strikers belong, is that no liquor of any kind shall be drank during the time of the strike by any party thereto and the rule is rigidly adhered to by the men.[119]

Work was suspended for several weeks. Women related to the striking workers stood on the picket lines and verbally abused the "black sheep" who took the vacant jobs in the mills. The Johnstown *Tribune* reported: "Women have not only called 'black sheep' after the poor men who are at work in the mill, but have assailed the workmen and officers of justice with obscene epithets, with sticks

116. Robert John Hunter, "Biography of Daniel J. Morrell, Ironmaster (M.A. thesis, University of Pittsburgh, 1954), pp. 25-26. All the page numbers in the author's obtained copy had been changed in pencil.

117. Bennett, "Iron Workers," pp. 42, 48.

118. Ibid., p. 198.

119. Quoted in ibid.

and stones, and have torn the clothes from their backs.[120] Daniel Morrell hired a "large, special well armed police force" to protect property and "well-disposed workingmen." One striker was jailed and fined for calling a man a "black sheep" and strikers living in company housing were ordered to get out. The company refused to negotiate with the workers, considering them already fired. Only those who forswore the union were rehired.[121]

The striking puddlers did stage a parade of 200 workers who marched in the city streets with fife and drum, an American flag, and banners which read: "1. We, the Puddlers of the Cambria Iron Co., are out on a strike not for Conquest but Just Demands. 2. Union League. 3. Wide Awakes. 4. Puddlers and Boilers Union, United Sons of Vulcan. 5. 7 Dollars for Free men, 6 Dollars for Slaves.[122]

There was apparently very little cooperation among workers of different skills or crafts. They feared and mistrusted each other and attempts to unionize the workers failed every time. Strikes were easily broken because available replacement labor was close at hand. When a president of the Sons of Vulcan visited Johnstown in 1872 he found that puddlers did not know on what basis they were paid. Only three "black sheep" from the 1866 strike knew the wage rates, and others who even asked were subject to firing. Conditions went from bad to worse by 1873.[123]

STRIKE OF 1873-1874

The economic panic in 1873 caused severe distress in the country. Two lockouts occurred in coal mining areas, one involving the Cambria Iron Company, and the other involving mine operators in Tioga County, Pennsylvania. The central issues involved trade unionism, which the coal miners

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120. Quoted in ibid., p. 199.

121. Ibid., pp. 48-49, 199; Morawska, *Bread with Butter*, p. 87; Bruce Williams and Michael Yates, "Labor in Johnstown," in *Johnstown The Story of a Unique Valley*, ed. Karl Berger (Johnstown: Johnstown Flood Museum, 1984), p. 594; "Annual Report to the President and Directors of Cambria Iron Company, Johnstown, Pa., Jan. 6, 1866, by the hand of Daniel J. Morrell, supt." typed copy, p. 11, folder: Plants Johnstown Cambria, box: Plants-Danville-Johnstown, Acc 1699, BSC, HagM. Daniel Morrell believed that "Reson to a 'Strike' for the redress of wrongs which the laborer believes to be practiced upon him by his employer is a relic of the lower order of civilization existing among the working classes of Europe, but more especially of Great Britain, who, for want of better knowledge have generally expended their efforts in combinations for the control and advance of wages regardless of the condition of the markets, and with results alike disastrous to themselves and their employers." Ibid.

122. Bennett, "Iron Workers," p. 200.

123. Ibid., pp. 75-76.

embraced for self-protection. Even though the Cambria Iron Company and Daniel Morrell tried to mold Johnstown into a model industrial community with company sponsored improvements, their vision did not make room for unions.[124]

The labor force was very unstable and constantly changing, which did not allow for the introduction of unions anyway. Before 1873 only the skilled puddlers and coal miners belonged to unions. The puddlers were with the Sons of Vulcan, and the coal miners had, in 1871, successfully negotiated a sliding wage agreement with Cambria, based on the price of rails in New York. Even though this union ceased to exist in June 1873 the wage agreement stood until autumn.[125]

Soon after the depression set in the market for iron rails disappeared, causing economic problems for Cambria. The company responded by cutting costs and production and laying off workers. Wages dropped by 10 percent, and then in mid-November by 21 percent. The coal miners' sliding scale was changed downward and the new wage paid in store goods and credit, not cash. Dissatisfied men were told to find work elsewhere and the rest to accept the lower wages or lose their jobs. The Cambria Iron Company had hoped to survive the depression through such measures, but their actions spurred 400 coal and iron ore miners to join the reorganized local of the new Miners National Association. About 120 puddlers reorganized Mountain Lodge No. 7 of the Sons of Vulcan, the union's largest local, and approximately 170 rollers and roll hands joined the Keystone Lodge of the National Union of Iron and Steel Roll Hands. A small Heaters' Union lodge was also formed.[126]

Cambria owners refused to recognize the Johnstown mining local and did not listen to union representatives who asked for wage increases during the winter of 1873-1874. Some action did occur in February 1874 when cash wages were resumed and part of the wage cut reinstated. The uncomplaining iron workers received increases of 17 percent, while the dissident coal and ore miners received less than 8 percent. Rumors then circulated that the company was out to destroy the union and the miners held a protest meeting to demand equitable wage increases. They also threatened to strike. Daniel Morrell's response was to close down the entire Cambria Iron Works, throwing 200 men out of work. Market conditions favored this move because there was little

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124. Herbert G. Gutman, "Two Lockouts in Pennsylvania 1873-1874," *The Pennsylvania Magazine of History and Biography* LXXXIII, no. 3 (July 1959): 307, 309.

125. Ibid., 309.

126. Ibid., 316; Bennett, "Iron Workers," p. 76.

demand for rails anyway, which left the miners no choice but to accept whatever Morrell wanted to pay.[127]

The new miners' union was easily defeated. The company offered men their jobs back if they signed a new contract promising not to join a trade union and accepted the company manager's authority on wages and working conditions. Men could be fined for violations involving dishonesty or drunkenness, quarreling, stealing, damaging company-owned housing, or by engaging in careless or reckless behavior. First offenses meant fines, while second offenses meant immediate eviction from company housing and a public listing of the offender as unemployable. The workers also had to repudiate labor unions.[128]

The Cambria Iron Company managers refused any compromise and raised hysteria against the union. On March 26, the president of the Miners' National Association, John Siney, arrived in Johnstown and appointed a committee to meet with Daniel Morrell, who refused arbitration requests. He would meet with the miners individually, but not collectively. Neither could the locked-out iron and steel workers talk with Morrell. He took active action against the union by accusing miners of planning violence, thereby giving him a reason to deputize and arm 100 "special policemen" to protect company property. The company store ended credit for the workers who were still on strike. Siney, in return, asserted that Morrell had hired "bloated rascals" who were supplied with "rotgut whiskey and weapons." Morrell charged back that the new union, which he described as "this secret Union, this mysterious power, this veiled Gorgon," had threatened, assaulted, and almost murdered workers who supported the company. He continually attacked the union, claiming men could not go to work because they feared violence.[129]

The strikers were able to attract some local support and the concern of workers across the country because of their portrait of the Cambria Iron Company's paternalism. The *National Labor Tribune* reported one striker's comments:

> Our despots will hardly allow us to think our own thoughts. We must vote for them to be our rulers in Congress, in the legislature, in the Borough Council; we must be ready to spill our blood, and lose our lives and limbs in defense of the

127. Gutman, "Lockout," 316-317; *Workingman's Advocate*, April 11, 1874.

128. Gutman, "Lockout," 318-319.

129. Ibid., 318-319; *Workingman's Advocate*, 1874. See also Edward Pinkowski, *John Siney The Miners Martyr A Biography* (Philadelphia: Sunshine Press, 1963).

property and their interests; we must petition Congress to increase the tariff, and to enact such laws as will benefit them and swell their enormous profits, while they in turn will not allow us the privilege of holding an organization which is chartered by the government, and which is the right of every, and as we have seen of late, the only safeguard, of an American citizen, against the overreaching, grasping, and avaricious capitalists in their dealings with the tramped down workingmen.[130]

Both Daniel Morrell and the locked-out workers found support in the national press, but local conditions in Johnstown were a determinant in the lockout's success or failure. The company had the advantage because little support was given the strikers. Morrell played off against the craft distinctions among the workers by reopening the iron mill and offering jobs to old employees and new ones who would sign the contract. For a time the various unions cooperated and sought aid for the locked-out workers. Committees from the heaters, rollers, and puddlers unions went to Pittsburgh to raise money. Some Cambria laborers refused to break the strike and formed their own union. Women employees at the Wood, Morrell and Company woolen mill also joined the strike. Strikers were fed from a store put together in Fronheiser's building at Railroad and Clinton streets, and money from the Rolls Hands relief fund was used to buy food.[131]

A rally to support the strikers was held on June 13; the estimated number of attendees varied with the source, but anywhere from 443 to 900 or 1,000 workers paraded from the Sons of Vulcan headquarters on Clinton Street to the Point. Another rally, a Fourth of July Ball, was held to raise money and tickets for the event were sold in Pittsburgh as well as in Johnstown.[132]

Strength and confidence soon gave way, however, and enough men were found to handle orders on hand. These "black sheep" consisted not only of outsiders, but Johnstown residents as well. Division existed among the mill workers, and the strike tore friends and coworkers apart. Work resumed in the mills and furnaces, but not without fights between locked-out workers and "black sheep" which resulted in arrests for assault. Coal was then shipped in from outside areas, giving notice that the coal miners' services were not even required. Isolated and powerless, the miners knew that time was not on their side.[133]

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130. Quoted in Bennett, "Iron Workers," p. 202.

131. Gutman, "Lockout,": 320-321; Bennett, "Iron Workers," pp. 202-203.

132. Bennett, "Iron Workers," pp. 204-205.

133. Gutman, "Lockout,": 321; Bennett, "Iron Workers," pp. 77, 205-206.

The Miners' National Association was not strong enough to enforce miners' demands and the local union declared its failure in June 1874. The Johnstown *Tribune*, who had supported Cambria through the entire episode, reported the end of the lockout, and that the Johnstown workers had "rejected" trade unionism. Workers had no right to interfere with the ironworks, declared the newspaper, because "Their money did not build it."[134]

Trade unionism disappeared entirely in Johnstown. When the depression ended in 1875 and orders for rails were received, the workers were put on a seven-day work week. In 1876, at the height of the Cambria Iron Company's power, unskilled labor wages fell to $.75 per day while skilled labor wages were half as much as before the depression. Daniel Morrell still talked of his model industrial community, an "American system," but to trade-unionists he personified the "tyranny of the all-powerful entrepreneur." Finally, the *Iron Molder's Journal* described Johnstown: "If there is a town in Europe to compare with it in the actual serfdom of its inhabitants, we have failed to hear of it."[135]

After this struggle many union leaders left Johnstown, and few union activities took place from 1875 to 1895. Any problems which occurred involved only small groups of workers from a company department. Cambria dealt with them all in the same manner; workers were discharged and the strike collapsed. This was true in efforts by miners in 1877, wire cleaners in 1879, wire drawers in 1885, and two more with miners in 1883 and 1885.[136]

Only one major struggle to establish a union for all the Cambria iron workers occurred between 1875 and 1895. A Local Assembly of the Knights of Labor was organized in 1886 in Johnstown. This assembly accepted workers from outside Cambria, and its "Master Workman" was Charles T. Schubert, a local printer and editor of a German language newspaper, *Freie Presse*. Cambria management obtained a copy of the membership list and fired all employees on the list. At least 200 workers lost their jobs. The Local Assembly then held a rally in support of the fired workers in October.[137]

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134. Quoted in Gutman, "Lockout,": 321-322. For further data on the workers and incidents of violence during the strike see Bennett, "Iron Workers," pp. 206-213.

135. Quoted in Gutman, "Lockout": 325 326.

136. Bennett, "Iron Workers," p. 78.

137. Ibid., pp. 80-81.

The move to organize with the Knights of Labor came from new workers employed in the steel mill and the recently acquired Gautier Works. In February 1885 some Gautier workers wanted to form a union after Cambria reduced wages but did not reduce the rent on company houses. The first firings occurred in August and focused on 50 to 60 men employed at Gautier and the Lower Works. Other firings occurred in the Bessemer mill, steel blooming mill, and engineers and brakemen on the engines running throughout the plant. The company asked the Pennsylvania governor for 188 police to protect company property. The governor turned down the request after learning that Cambria already had 173 men on its own police force.[138]

Local Assembly 7249 did very little to get its fired workers reinstated, and no action was taken against the Cambria Iron Company. The Knights of Labor existed in Johnstown for several years but no more major efforts to organize the Cambria workers were made. Minor activity occurred in 1890 in other Johnstown companies, but the Cambria mill workers were not involved.[139]

In 1892 during the Homestead Strike very little violence took place in Johnstown. In May a group of Cambria Iron Company trainmen representing three Railroad Brotherhoods – Conductors, Trainmen, and Locomotive Firemen – asked Cambria General Manager Charles S. Price for a raise in pay. Price not only refused their request but immediately fired all five trainmen. Ten more men discovered to be union members were fired in the two days following. The local union men asked for help from their national officers and representatives from two of the Brotherhoods did journey to Johnstown, but did little. The fired workers were found other jobs.[140]

Soon after the Homestead problems occurred in July 1892 a Carnegie agent arrived in Johnstown to recruit strikebreakers. Several Johnstown residents worked at Homestead, and two were the first men killed in the struggle. As a result the Carnegie agent had little luck in hiring Johnstown workers and was nearly mobbed at the train station.[141]

Throughout the nineteenth century the story of labor at Cambria was repetitive in that workers of different trades did not cooperate in their strike efforts. Unionization was virtually nonexistent, with the exceptions in 1866, 1874, and 1886. In each of these years efforts did occur to bring

138. Ibid., pp. 81-82.

139. Ibid., pp. 82-84.

140. Ibid., pp. 86-87.

141. Ibid., pp. 87-88.

together Johnstown workers, but the company's strength was too overpowering. Workers were always found to replace those fired, and union leadership was not strong enough to hold the workers together.[142]

1919 STRIKE

In 1918 union activity began in Johnstown when the National Committee to Organize the Iron and Steel Workers came to town. William Z. Foster and the other organizers arrived when they heard the Midvale Steel and Ordnance Company planned to implement an employee representation plan. By mid-March 1919 the Midvale plan was functioning, and had won the endorsement of the National War Labor Board. The plan's true test occurred with the attempt to unionize the steel industry. If Midvale escaped a strike, employee representation would prove effective in handling worker grievances. But Johnstown was too important for the organizers to ignore, and Midvale managers were not against using force to keep out the union; they had no faith in the plan.[143]

By March 1919 organizers claimed 40 to 50 percent of Cambria's employees had joined the union, while management insisted the number was closer to 10 percent. The Midvale employee representation plan was a major concern, for while it was thought by union organizers to be a ploy to keep out unions, they wanted "to give it a fair trial by campaigning for and electing as representatives, union members who would demand the eight-hour day." Several union candidates were chosen in an election on January 13, 1919.[144]

Midvale's chairman, William E. Corey, responded by ordering Midvale President Alva C. Dinkey and Edwin E. Slick, a vice president of Midvale and president of the Cambria operation, to take charge of the situation. Slick proceeded to dismiss anyone belonging to the union or even suspected of being members. He also swore in almost a thousand loyal workers to serve as deputy sheriffs and stocked rifles to protect company property. Literally thousands of men were dismissed in February. Cambria managers took on a "policy of frightfulness," by firing selected employees with large families and mortgaged homes. Johnstown was an "extreme case" but the firings became

142. Ibid., p. 88.

143. Eggert, *Steelmasters*, pp. 124-125.

144. Ibid., pp. 128-129.

common in other mills.[145] (See appendix 43 for statements of workers discharged from Cambria in November 1919.) Labor organizer William Z. Foster described the layoffs:

> Never was a policy of industrial frightfulness more diabolically conceived or more rigorously executed than that of the Cambria Steel Company. The men sacrificed were the Company's oldest and best employees. Men who had worked faithfully for ten, twenty or thirty years were discharged at a moment's notice. The plan was to pick out the men economically most helpless; men who were old and crippled, or who had large families dependent upon them, or homes half paid for, and make examples of them to frighten the rest.[146]

The National Committee for Organizing Iron and Steel Workers met in Johnstown on March 8 to demand the company rehire those laid off and to end the discrimination against those belonging to a union. A committee of three men went to Washington to try to negotiate with Midvale. The assistant secretary of labor, H.L. Kerwin, had already sent one mediator to Johnstown, but now sent another from the Conciliation Service to New York to talk with prominent steelmakers. This resulted in Midvale telling the Department of Labor it would not fire employees for joining unions. Those let go, however, would not be rehired. Nevertheless, the tactics used by Midvale spread throughout the steel mills.[147]

The policy of mass layoffs in Johnstown soon backfired. Midvale vice-president William Brown Dickson, a reformer and the principal backer of the employee representation plan, hurriedly dismissed Slick's sheriffs and got rid of the guns, apparently with William E. Corey's approval. Dickson feared a confrontation like that in Homestead in 1892. He met with company officers and Edwin E. Slick was asked to resign. Alfred A. Corey Jr., superintendent of U.S. Steel's Homestead works and Midvale chairman Corey's younger brother, came in as Cambria's new president. Dickson then proceeded to head off any trouble at Johnstown.[148]

He conferred with Pennsylvania's governor and attorney general, and wrote to county officials saying that if a strike occurred Midvale would close down. No extra guards would be hired and

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145. Ibid., p. 129; Brody, *Steelworkers*, pp. 232-233; Interchurch, *Report*, p. 213; Williams and Yates, *Upward Struggle*, n.p. For a brief biography of Edwin E. Slick, see C.F. Williams, "Inventor, Engineer, Executive The Story of the Rise of One of the Most Successful of the Younger Generation of Steel Works Executives," *The Iron Trade Review*, January 21, 1915, pp. 179, 185.

146. William Z. Foster, *The Great Steel Strike and Its Lessons* (New York: B.W. Huebsch, Inc., 1920), p. 43.

147. Brody, *Labor in Crisis*, p. 87.

148. Eggert, *Steelmasters*, p. 130.

the state and local governments were to be held responsible for any damage to company property. On April 7 Alfred Corey was conciliatory in a letter to union officials in Johnstown. He offered to confer with the employees through the employee representation plan or through any other committee elected by the men, although he refused to deal with outside organizations about the company's relations with its employees. Dickson thought Corey had gone too far, and he sent another letter explaining that the company would bargain only with representatives chosen under the Midvale plan. The Cambria mills stayed quiet even though unionizing efforts continued.[149]

During the spring and summer of 1919 Midvale launched new employee programs. On May 7, 1919, the company adopted a pension plan, and formulated a uniform mutual benefit plan for all Midvale employees and a program for improving company housing. Loans would be made for employees who wanted to build their own homes. On June 4 the company directors approved millions of dollars for reconstructing the Johnstown plant. The Employee Representation Plan continued to operate as a company union, however, and during an Atlantic City meeting in late August of all company employee representatives, an anti-union statement was issued. Such a statement by the very group proclaiming to represent labor infuriated the workers, who then joined the union in larger numbers.[150]

As the strike drew closer Dickson urged his directors to honor the employee representation plan and not "revert to the high handed autocratic labor policy with which they were identified in the Carnegie Steel Co." He urged the adoption of the eight-hour day if efficiency increased, and wanted his company to go on record recognizing collective bargaining.[151]

William Z. Foster wrote of the strike's beginning: "On September 22 they struck throughout the entire industry with a discipline and universality that will be remembered so long as steel is made in America."[152] In Johnstown more than 11,800 workers went on strike.[153] Midvale placed no

149. Ibid., pp. 130-131.

150. Ibid., pp. 131-132; Williams and Yates, *Upward Struggle*, n.p.

151. Eggert, *Steelmasters*, pp. 132-133.

152. Foster, *Great Steel Strike*, p. 100.

restrictions on strikers' meetings in Johnstown, contrary to other western Pennsylvania towns. Daily meetings resulted in no violence, and picket lines were maintained with no problems. The only violence occurred when a Citizens Committee, led by YMCA secretary W.R. Lunk and other Johnstown citizens, ordered AFL organizers – T.J. Conboy, Dominick Gelotte, and Frank Kerowski – out of town. On the same day an armed mob forced organizer William Z. Foster, who was to speak to a mass meeting of strikers, out of town.[154]

For the first eight weeks of the strike there were no state police in Johnstown. When they arrived, they did so at the Cambria Steel Company's request, not the Johnstown sheriff's or mayor's. Many arrests and "other forms of intimidation common in steel communities in western Pennsylvania" occurred after the state police force's arrival. Midvale's William Brown Dickson believed his liberal policies aided in limiting the violence in Midvale plants during the strike. Nicetown's operations continued, and at Coatesville 30 percent of the employees struck for two weeks. There was trouble in Johnstown, but Dickson's no-confrontation policy helped prevent bloodshed.[155]

Reporter Mary Heaton Vorse wrote her impressions of Johnstown during the 1919 strike:

> . . . Johnstown lies in a cup of hills. The Cambria Steel Company is the core of the town. From the railway station I looked down into the yards. Rust was over all. Piles of scrap covered with rust, mounds of billets covered with rust, carloads of pig-iron covered with rust. Paint scaling from black chimneys. Rust crawling up chimneys. In this yard nothing stirred. There was no sign of life.
>
> A man walked slowly through the empty yard. It was startling to see anything move through that quiet place, through the mounds of iron on which rust had fallen like a red snow. It seemed the graveyard of industry. Johnstown's men had left the mills in rust and silence. Around the mills crowded wooden houses, desolate and blackened by years of falling soot.
>
> The main street is noisy. The stores are full of cheap, bright colored things; stores with violent colored clothing, stores with shiny furniture. Windows full of enamel kitchen ware. All the things the workers' wives want, shiny and new. Up and down

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153. Interchurch, *Report*, p. 193. This report offered a detailed breakdown of the numbers of strikers by trade: 503 blacksmiths, 137 boiler makers, 156 brick and clay workers, 122 brick layers, 719 electrical workers, 108 foundry employees, 4,452 iron, steel and tinworkers, 731 iron workers, 1,131 machinists, 437 mine, mill and smelter workers, 1,427 United Mine Workers, 71 molders, 566 railway carmen, 324 stationary engineers, 441 stationary firemen, 207 switchmen, 314 unclassified for a total of 11,846. Ibid., pp. 190-193. William Z. Foster cited the number of Johnstown strikers at 18,000. Foster, *Great Steel Strike*, p. 100. For information on organizing efforts among Cambria's miners, see Eileen Mountjoy Cooper, "To Organize the Unorganized," *Pennsylvania Heritage* 15, no. 1 (Winter 1989): 32-37.

154. Interchurch, *Report*, pp. 236-237; Interchurch, *Public Opinion*, p. 199. For a first-hand account of organizing activities in the Johnstown area, see John Brophy, *A Miner's Life* (Madison: University of Wisconsin Press, 1964).

155. Interchurch, *Public Opinion*, p. 199; Eggert, *Steelmasters*, p. 133.

walked groups of idle steel workers, big men drifting on the slack tide of idleness into the hall of their headquarters. Cambria Steel shut down. For eight weeks nothing moving and nothing making, and for eight weeks the encroaching rust thickening on the billets, crawling stealthily up the black chimneys.

During the first week in November a quarter of a million steel workers were still on strike. There was power and discipline in the self-control and quiet of the strikers. The roots of the strike went deep.[156]

When it became apparent the national strike was failing the tide also turned in Johnstown. Midvale announced operations would resume on November 17, after the Cambria plant had been closed for eight weeks. Even though a local newspaper reported the strike was broken, an Interchurch World Movement investigator saw only one-tenth of the workforce on hand at their jobs. The strike leaders could not make themselves heard against the propaganda, however, and both skilled and unskilled workers soon returned to work in the midst of the charges of "bolshevism" and anti-immigrant propaganda by steel officials.[157]

An additional development was the importation of thousands of strikebreakers near the end of October. Black steelworkers did not join the unions and only a few supported the strike. Others brought in as strikebreakers saw the situation as a chance to join the workforce, circumventing the discrimination which had previously kept them out. Even the labor unions largely ignored or segregated the black workers. Steel leaders exploited the racism by importing thousands of blacks from northern cities and from the South. An estimated 30,000 blacks joined the steel industry during the 1919 strike.[158]

Even though the strike failed by late 1919 there were some lessons learned, most notably that steel workers could be unionized. The movement would succeed only with the joining of native-born and immigrants alike.[159] (See appendix 44 for page from employee register, 1920s.)

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156. Mary Heaton Vorse, *Men and Steel* (New York: Boni & Liveright, Inc., 1920), pp. 108-109.

157. Williams and Yates, *Upward Struggle*, n.p. ; Brody, *Labor in Crisis*, pp. 161-162. For an analysis of how Midvale viewed its Employee Representation Plan in the face of the strike, see "Midvale Plan of Representation Tested," *The Iron Age* 105 (March 8, 1920): 815.

158. Brody, *Labor in Crisis*, p. 162.

159. Williams and Yates, *Upward Struggle*, n.p. For an analysis of immigrant participation in, and support for, the 1919 strike, see Interchurch, *Public Opinion*, pp. 226-242.

LITTLE STEEL STRIKE OF 1937

At the time of the Little Steel Strike, Bethlehem Steel Corporation employed 14,000 of a total city workforce of about 17,000 in Johnstown. The Cambria plant dispersed more than 72 percent of the community's wages. Bethlehem had long practiced its welfare capitalism with its pensions, relief, and disability benefits and its Employee Representation Plan. A paternalistic situation existed in Johnstown when the SWOC began organizing in July 1936. Most of the men who joined were of East European background and held the relatively unskilled jobs in the mills. Organizers frequently signed up workers in the ethnic bars and clubs in Conemaugh and Franklin.[160]

The Little Steel Strike reached the Cambria plant of the Bethlehem Steel Corporation on June 11 after several attempts to negotiate a contract failed. When SWOC Subregional Director David Watkins, who had been organizing in Johnstown since July 1936, met with Bethlehem management's Special Representative Sidney Evans, he was unable to even discuss a contract with Evans. This rejection was similar to that given the Brotherhood of Railroad Trainmen and Brotherhood of Locomotive Firemen and Engineers locals which had failed for the past year and a half to meet with Cambria's management. The railroaders' frustration grew and they called a strike against Cambria on June 10, 1937, as employees of the local captive Conemaugh and Blacklick Railroad. On June 12 SWOC struck the plant, followed by John L. Lewis' action in calling for strikes against Cambria by the captive miners in Johnstown. The Cambria plant was the only Bethlehem Steel Corporation plant which was struck. This action in Johnstown came at a time when the SWOC was fighting battles in Ohio and Illinois, and exactly why the SWOC decided to strike at Cambria has not been entirely resolved by historians. It is generally believed national SWOC leaders did not plan the Cambria strike; it was a spontaneous movement among the plant's employees.[161]

The strike hurt Johnstown, but not Bethlehem Steel Corporation, and in response company management, Johnstown Mayor Daniel J. Shields, and a newly formed Citizens' Committee united their efforts to break the strike.[162] Johnstown *Democrat* editor Hiram G. Andrews wrote in February 1939 why the Citizens Committee was formed:

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160. McPherson, "Little Steel,": 219-220; Taft, *Organized Labor*, p. 518; Williams and Yates, *Upward Struggle*, n.p.

161. McPherson, "Little Steel,": 220-224; Taft, *Organized Labor*, p. 518; Williams and Yates, *Upward Struggle*, n.p. It was reported that 346 of the 570 Conemaugh and Blacklick Railroad employees were involved in the strike. New York *Times*, June 11, 1937.

162. McPherson, "Little Steel,": 225.

There hasn't been very much testimony concerning the fact the Citizens Committee was organized for the purpose of breaking the strike and for no other purpose. Bethlehem's Mr. [Sidney D.] Evans was never under any misapprehension as to the actual purposes for which the committee was formed. That there were at least some members of the committee who knew what they were about must be taken for granted. The job at hand, from the Citizens Committee standpoint, was the breaking of the strike and the resumption of work in the mills. The academic members of the committee did the talking about the constitutional right of men to work. However, that right didn't amount to two whoops in Hades unless the strike was broken.[163]

The Johnstown Chamber of Commerce was the Citizens' Committee's parent. It was also financed by the Bethlehem Steel Corporation, which paid for 40 annual members and $1,000 of the $8,000 annual dues paid. Sidney D. Evans was Bethlehem's representative in the chamber of commerce.[164]

Even though violence had occurred in the national strike, none occurred in Johnstown previous to the Citizens' Committee's formation. Pickets had set up in front of the seven main gates and all was quiet on the lines for two days; on the third day fighting broke out between pickets and workers at the main Franklin gate. Many men stayed on the job either because they disagreed with the union, or because they needed the work in the wake of both the Great Depression's darkest days and the 1936 Johnstown flood. Fifteen people were injured in the "Franklin Riot."[165] It was reported that 200 to 300 pickets surrounded each gate.[166]

Mayor Shields secretly began purchasing tear gas and weapons while organizing "vigilantes." By June 13 he had sworn in 100 special deputies, and on June 14 he received a shipment of tear gas, 15 long range guns, 226 shells and 307 grenades, paid for by the Bethlehem Steel Corporation and the Pennsylvania Railroad. By the time Shields was forced to disband the vigilantes he had sworn in 600-700 men, his goal had been 3,000. Not only did Shields use Bethlehem money to buy arms, but he secretly accepted more than $30,000 from Cambria management through the Citizens' Committee; money which he later could not account for and which he used to pay personal creditors.[167]

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163. Quoted in Ibid.,: 226.

164. Ibid.,: 220.

165. Ibid.,: 227.

166. New York *Times*, June 12, 1937.

167. McPherson, "Little Steel,": 228-230. The New York *Times* reported that Mayor Shields announced he was deputizing 250 to 300 members of Johnstown Post No. 294, American Legion, for strike duty. New York *Times*, June 14, 1937.

On June 15, 1937, police used tear gas and pistol fire to end fights on the picket lines at Franklin's main gate which started when a worker brandished a revolver. Ten people were injured and seven arrested. After further disturbances on June 16 in which two white strikers and a black worker were stabbed, the state police surrounded each gate with troopers and allowed only 10 pickets each at the two main gates. With the picketing severely curtailed hundreds of workers returned to the plants. By June 19 the plant was estimated to be running at 75 percent capacity.[168]

In a last attempt to keep the strike alive, United Mine Workers officials threatened to march 40,000 miners into Johnstown for a rally. When Pennsylvania Governor George H. Earle heard that state police were blocking legitimate picketing activities he ordered them to retreat some distance from the gates. Picketing began again in earnest. Rumors of the miners' march encouraged Cambria County Sheriff Michael Boyle to ask Governor Earle for troops. The governor established a modified form of martial law on June 21, 1937, and asked Bethlehem to close Cambria. There was no interference with the city and county government. Because the state police took over the city instead of the National Guard, the governor's actions were probably extra-legal, and Mayor Shields, Bethlehem officials, the Citizens' Committee, the newspapers and citizens were furious.[169]

Bethlehem Steel Corporation's President Eugene Grace closed Cambria "under duress," only after Governor Earle had state police surround the plant. Pickets left the gates and the miners' march was cancelled. State and national pressure soon forced the governor to rescind the law on June 25. When the plants reopened, many men returned to work and the strike was effectively over. Another miners' march was scheduled for June 27, but only 3,000 people attended the outdoor rally. On June 28 the plant was operating at full capacity. Two Bethlehem water mains were bombed on June

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168. McPherson, "Little Steel,": 229, 231; New York *Times*, June 14, 1937; Ibid., June 17, 1937; Ibid., June 18, 1937. According to David Watkins, 10,000 of 15,000 steel workers were on strike on June 16, along with 2,400 coal miners, and 4,000 miners in Bethlehem mines outside Johnstown. The picket line was reported to be eight miles long. New York *Times* June 16, 1937.

169. McPherson, "Little Steel,": 231-232; Taft, *Organized Labor*, p. 518; Williams and Yates, *Upward Struggle*, n.p. According to the New York *Times*, "Except for the presence of state troopers in the streets, and the appearance of copies of the governor's proclamation posted on telegraph poles and elsewhere, strangers in the center of the city would not have known that a state of martial law existed. There are no National Guard troops present with fixed bayonets, contrary to the usual situation under martial law." New York *Times*, June 21, 1937. Mayor Shields sent the following telegram to President Franklin D. Roosevelt:

> Ninety percent of my citizens are opposed to the C.I.O. Its continuance in our community can only mean blood in the streets. Personally I am firmly convinced that it is a Russian Red organization gaining prestige by use of your name. Numerous non-citizens are found in the picket lines.
>
> Rule or ruin, control or murder, is the policy of the C.I.O. . . .
>
> Mr. President, I fought for you, I talked for you, and caused others to do likewise just because I looked to you as a real American. Now are you going to fail me by allowing their reign of terror to continue? Quoted in McPherson, "Little Steel,": 232.

29, and there were fears the huge reservoirs above the city would also be damaged in a replay of the 1889 tragedy. State police went on guard at the Quemahoning and North Fork dams, and those responsible for the bombings were never found. The strike was effectively over after nine days with no concessions made.[170]

After the strike ended the SWOC charged Bethlehem Steel Corporation with unfair labor practices. Hearings began in September and the National Labor Relations Board ruled Bethlehem had interfered with workers' rights to organize and bargain collectively, but it dismissed the allegations the company had interfered with picketing, employee rights, or arrests of union members, because of lack of evidence. The LaFollette Senate committee was later able to reveal the indirect ties to Bethlehem. Company management had attempted to break the strike through its dealings with the mayor and the Citizens' Committee, but the strikers were not without blame because disturbances did occur and people were hurt. In perspective it was a wonder more were not killed or hurt with 14,000 workers, 600-700 deputies, Johnstown police, state police, and townspeople all involved in the dispute. According to historian Donald S. McPherson, "The fact remains that the Company, the Mayor, and the Citizen's Committee participated in the organization of a vigilante group, the purchase of munitions, the incitement of community hate and fear and the expansion of public apprehension of violence. Understandable as the community's over-reaction may be in light of economic factors, it was an over-reaction."[171]

The SWOC campaign to obtain a contract with Bethlehem Steel Company failed because Johnstown's leaders united to bring negative community reaction against the strike effort. Robert

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170. Taft, *Organized Labor*, p. 518; Williams and Yates, *Upward Struggle*, n p.; McPherson, "Little Steel,": 232-234. SWOC's James Mark spoke to the strikers at the June 27 rally, and addressed some of his remarks to the many women present:

> It's you who have to suffer when there's suffering to be done, and you who have to worry when there's worrying. . . . Your husband, he can put on his coat and go out for a walk and even go on the picket line if he has a little nerve, but a lot of them don't have it.
>
> It's your duty, if you have a weak husband, it's your duty to take him in hand and to say to him, "John, you're a little weak in this proposition, but I don't want you to go into that mill. I don't want my children to grow up to be scabs."

Mark also told the women to "'play Maggie with the rolling pin' if necessary to get their husbands on the line." New York *Times*, June 28, 1937. For a thumb-nail sketch of the Johnstown strike see "Labor: Mr. Roosevelt Helps a Friend, as Strike Goes on Its 'American Way,'" *Newsweek* IX, no. 26, June 26, 1937, pp. 13-17.

171. McPherson, "Little Steel,": 235-236; New York *Times*, August 29, 1937; Ibid., September 5, 1937. Several articles written during and after the strike offer insight into the attitudes of Johnstown's business community about the strike, economic difficulties suffered by the strikers, divisions between friends and among families caused by the strike, and the investigations into Mayor Shields' activities and funding sources. See Frances Fink, "Scabs and Scars," *Literary Digest* 124 (August 7, 1937): 13-16; "Johnstown on Trial," *Business Week* (March 5, 1938), pp. 18, 20, 22; and Paul Y. Anderson, "Fascism – American Style," *The Nation* 146, March 26, 1938, pp. 347-348.

LaFollette's Senate committee concluded that strikers civil rights were violated with community acceptance of anti-union efforts under the name of "law and order."[172]

The struggle to obtain union recognition continued even though the strike failed. In August 1939 the National Labor Relations Board ordered Bethlehem to dismantle its employee representative plan and to stop interfering with the activities of SWOC. The Circuit Court of Appeals for the District of Columbia upheld the order on May 12, 1941. A special Bethlehem Steel Organizing Committee was created and a strike occurred at the Lackawanna plant in March 1941, followed by a National Labor Relations Board election. In the ensuing months 12 more elections were held in all of Bethlehem's mills. Johnstown complied with the order on June 13, 1941, and a National Labor Relations Board representative election was held twelve days later. Out of 12,975 eligible voters, 8,940 workers voted for SWOC and 2,018 voted against.[173]

Union representatives from the four Little Steel companies (Bethlehem, Republic, Youngstown Sheet and Tube, Inland) met on August 14, 1941, in Pittsburgh to plan strategy for negotiations with company management. Conferences took place during the week of September 15, 1941, but the results were inconclusive. After America's entry into World War II the War Labor Board was established to deal with all labor disputes. On August 5, 1942, in negotiations before the War Labor Board, Inland Steel became the first of Little Steel to sign a union contract. Youngstown Sheet and Tube signed on August 12, followed by Bethlehem and Republic on August 13, 1942.[174]

During the late 1930s the original union organization at the Cambria plant was Local 1074 of SWOC. This group ended after 1939, and five local unions were organized inside the plant. District 13 of the United Steel Workers included Franklin Local 2635 with 6,000 members, Lower Cambria Local 2644 had 4,200 members, Gautier Local 2634 boasted 2,300 workers, Wire Mill Local 2634 had 1,000 workers, and Wheel Plant Local 2633 had 650 members. Two unions were organized among the Conemaugh and Black Lick Railroad employees: Union 3176 for operators and Union 2734 for maintenance. White collar workers at Cambria were not immediately organized.[175]

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172. McPherson, "Little Steel,": 219.

173. Johnstown *Tribune-Democrat*, September 5, 1953; Hogan, *Economic History*, vol. 3, part IV, pp. 1182-1183.

174. Johnstown *Tribune-Democrat*, September 5, 1953; Hogan, *Economic History*, vol. 3, part IV, pp. 1183-1184.

175. Johnstown *Tribune-Democrat*, September 5, 1953.

The history of the Cambria Iron Company's involvement with the city of Johnstown over the decades was dominated by the company's desire to provide services for its employees. Basic needs such as housing and goods were offered, as well as more intellectual pursuits, including schooling and a library. The quality of these services, especially the housing, varied. The reputation of the company store goods and the hospital rank high, while the housing quality depended upon supply and demand, and composition of the workforce. The skilled and management employees, usually American-born, enjoyed better housing than did the immigrants, blacks, and the unskilled.

Hatred of the unions was a common theme throughout the decades of Cambria's management. Starting with Wood, Morrell and Company, the iron and steelmakers wanted no interference regarding wages or production from labor, and offered no quarter. Unionization efforts were dealt with swiftly, usually resulting in lost jobs and disruption of lives. Not until the federal government supported the effort, mistrust of the immigrants subsided, and competent union leadership emerged, were the unions able to settle with steel management.

Established a little more than 50 years after Johnstown's founding, the Cambria Iron Company and its successive management were involved in the economic pulse of Johnstown. Company attitudes and services dictated its relationship with the citizenry. Most of the workforce was employed at Cambria while the business sector relied on the company's good economic health. During periods of labor unrest, the business community was counted on to support management. Even though Johnstown is known throughout America as the site of one of the biggest disasters in national memory, its history and welfare are more inextricably linked with the ore and coal resources embedded in the surrounding hills.

SUMMARY

The Cambria Iron Company in Johnstown, Pennsylvania, made an important contribution to the history of American industrialism. Nationally significant from its founding in 1852 until surpassed in production and corporate leadership by Andrew Carnegie's steel empire after 1880, the Cambria Iron Company attracted and employed the brightest minds in the world of iron and steel engineering. At the Lower Works iron rails were rolled for railroad expansion, experiments in the steelmaking process were held, the first steel rails rolled on commercial order in America were produced, and technological advancements in the steel process were made. Nominated as a National Historic Landmark, the Cambria Iron Company was significant in the areas of industry, engineering, architecture, and European ethnic heritage. Several people associated with the Cambria Iron Company at the Lower Works are also nationally significant, including Alexander L. Holley, John Fritz, Robert W. Hunt, William R. Jones, George Fritz, William Kelly, and Daniel J. Morrell.

The Cambria Iron Company's history fills a void in several sections of National Park Service history themes, identified in *History and Prehistory in the National Park System and the National Historic Landmarks Program*, 1987.

XII. Business
- A. Extractive or Mining Industries
  - 1. Iron and Ferro Alloys
  - 3. Other Metals and Minerals
- B. Manufacturing Organizations
  - 4. Fabricated Metal and Glass Products

XVI. Architecture
- A. Vernacular Architecture (Industrial)

XVIII. Technology (Engineering and Invention)
- D. Tools and Machines
- F. Extraction and Conversion of Industrial Raw Materials
- G. Industrial Production Processes

XXX. American Ways of Life
- C. Industrial Towns
- E. Ethnic Communities

XXXI. Social and Humanitarian Movements
- H. Labor Organizations

Significant Dates

1852	establishment of Cambria Iron Company
1857	first use of three-high rolling mill
1857-1862	Kelly experiments
1867	first Bessemer steel rails rolled
1871	first blow from Bessemer furnace
1876	Cambria largest U.S. steel rail producer
1898	reorganized as Cambria Steel Company
1916	takeover by Midvale Steel Company
1923	takeover by Bethlehem Steel Company

The Cambria Iron Company's history is represented today by structures which survive from the time period of the company's greatest achievements in iron and steelmaking, and from the historical continuum of the present, on-going steel production of the Bethlehem Steel Company onsite. Significant extant structures in the Lower Works include: ca. 1864 blacksmith shop, ca. 1884 blacksmith shop annex, ca. 1870 pattern shop, ca. 1865 foundry, ca. 1880 foundry addition, ca. 1874 office building, ca. 1881 car shop, and portions of the 1870 rolling mill. Second generation buildings ca. 1890s associated with the original four blast furnaces remain, as do remnants of the 1878-1880 blast furnaces #5 and #6, and the second generation machine shop, ca. 1906.

Founded in 1852, the Cambria Iron Company was regarded as one of the greatest of the early modern iron and steel works. In the 1850s, 1860s, and 1870s, Johnstown attracted the best minds in the industry – William Kelly, George and John Fritz, Daniel J. Morrell, Robert W. Hunt, William R. Jones, and Alexander Holley. Together and individually, these men advanced iron and steel technology through invention and industrial design in Johnstown, work which was widely copied by other iron and steel companies. These contributions included early experimentation with the Kelly converter, first use of the three-high roll mill to produce iron railroad rails, early conversion to the Bessemer steel process, and first U.S. production of steel railroad rails, which ended this nation's reliance on English-produced rails and allowed the momentous expansion of the railroad network. The Cambria Iron Company trained a generation of iron and steel innovators and was the most productive iron and steel company of the late 1800s.

The site for the Cambria Iron Company was chosen because of the abundant coal and iron ore deposits, and available water in and around Johnstown. Early iron forges in the area used these local resources, and relied on Johnstown's geographic location to ship goods to far markets. Johnstown was the western terminus of the Allegheny Portage Railroad where passengers and freight were transferred onto canal boats for transport west on the Pennsylvania Mainline Canal. Location and raw resources dictated the early success of iron producing ventures.

The Cambria Iron Company had several predecessors, dating to early local efforts at producing iron. Local iron forges took advantage of the ore deposits and water transportation, and in the 1840s George Shryock King and a partner, Dr. Peter Shoenberger, operated four iron furnaces in the area. The two associates owned more than 25,000 acres of land in Cambria and Somerset counties, including the ore in Prospect Hill overlooking Johnstown.

When the Pennsylvania Railroad entered the Conemaugh Valley, George King recognized the potential of producing iron railroad rails. Construction of a rolling mill and four coke furnaces began in March 1853, after articles of association were signed August 21, 1852, and after New York financing was acquired. The location chosen for new plant was Millville bottom, bounded by the railroad, canal, Prospect Hill, and the Conemaugh River.

Further monetary problems resulted in the company's transfer from local and New York hands to those of Philadelphia businessmen. Wood, Morrell and Company leased the Cambria Iron Company for five years, starting May 21, 1855. In 1862 the company took over the plant through default.

Technical innovation was Cambria's early claim to fame. Engineer John Fritz developed and patented the three-high roll mill; his brother George patented the steel blooming mill. On July 29, 1857, iron railroad rails were first rolled on John Fritz's mill which economized on both labor and heat by allowing hot rails to be passed alternately through the rollers in both directions without removal. This mill burned immediately afterwards and was rebuilt by January 1858.

Other early experiments centered on the work of William Kelly. Cambria's general manager, Daniel J. Morrell, brought Kelly to Johnstown in 1857 where he experimented with the pneumatic process at same time that Henry Bessemer was perfecting the hot blast in England. Kelly had worked with small converters since 1851, and he produced enough steel to ask for a U.S. patent, which he obtained in 1857. At Cambria Kelly experimented with a tiltable converter before leaving Johnstown in 1862.

Daniel Morrell also hired chemist Captain Robert W. Hunt as a professional scientist, a first. By the early 1860s the process for steelmaking was understood chemically, but its commercial use was still hindered because of inadequate machinery, inadequate control over the process, and because suitable pig iron was hard to find. Lake Superior ores eventually became the source of supply, and the sturdier, longer-lasting steel rails soon replaced iron rails. Ten years passed between Kelly and Bessemer's discoveries and the full commercial use of steel because of the legal, technical, and financial problems involved.

Daniel Morrell with others obtained control of the Kelly patents, organizing the Kelly Pneumatic Process Company. In October 1864 the Kelly process was combined with Robert F. Mushet's patent for recarburizing pneumatic steel. In England Henry Bessemer patented his process and sold his American control to Alexander Holley and Associates of Troy, New York. Thus, the Kelly Company controlled the pneumatic principles and the Mushet patent while the Troy Company controlled the Bessemer patent.

Alexander Holley brought together the two groups and formed the Pneumatic Steel Association. The U.S. patent office recognized the Bessemer patent in 1866, and all the patents for the process and required machinery were consolidated. Members of the association designed and built a plant in 1867 at Steelton, outside Harrisburg, Pennsylvania, and began the business of making steel.

In 1867 the Cambria rolling mill produced the first Bessemer rails in the United States, made on commercial order from ingots forged at the Steelton plant. At the time Cambria was the largest iron rail producer in the country. By 1871 Alexander Holley had designed and installed Bessemer converters at Cambria. This was the sixth Bessemer furnace in America, and by 1876 commercial rail production at Johnstown reached 103,743 tons; 47,643 tons of iron rail and 56,100 tons of steel rail.

In 1878 the plant extended over sixty acres of land, with the rolling mills alone covering seven acres. Cambria-owned coal and iron ore land was spread over seven Pennsylvania counties, totaling 46,403 acres. Bessemer steel was the most important American steel until the end of the century, and Cambria was a major producer. However, the even newer open-hearth methods provided steel makers with greater control and it slowly gained on the Bessemer process, surpassing it in volume of production after 1900.

The Cambria Iron Company owned several subsidiary industries, principally the Gautier Steel Company. The Johnstown Mechanical Works specialized in fancy ironwork and wood-turned products. The Johnstown Manufacturing Company in Woodvale made bricks. Also affiliated were the Woodvale Flouring Mill and Woodvale Woolen Mills. The company possessed coal and iron ore veins in the adjacent hills and counties, and operated its own mines. The local iron ore was used until the 1870s, when purer iron ore from the Lake Superior region was needed for making steel. Efficient rail communication running east and west helped transform both Cambria into a major iron and steel producer and Johnstown into a thriving city.

Johnstown grew from a single borough of 1,300 people in 1850 to the focus for boroughs inhabited by 15,000 people in 1880. This population doubled within a decade. The Cambria Iron Company and its subsidiaries were the principal employers and the reason for the area's extraordinary growth. Cambria was the major determinant for Johnstown's development for more than 100 years.

Conemaugh Borough was the location of the Gautier Works. Most of Prospect Hill's residents rented houses from the company. The main rolling mills, foundries, machine shops, and blast furnaces were located in Millville. The majority of Cambria City's population was employed by Cambria. Woodvale had a Cambria Iron Company chemical works, woolen mill, tannery, flouring mill, and brick works. East Conemaugh was built around the railroad yards. Other boroughs and villages -- Kernville, Morrellville, Franklin, Coopersdale and Moxham -- were all connected economically to the Cambria Iron Company.

Continuing growth of the company's production was reflected in the expansion of the plant along the Little Conemaugh and Conemaugh rivers. Increased competition and costs forced many independent steel companies to merge or reorganize, and in 1898 the Cambria Iron Company leased its properties to the Cambria Steel Company. Expansion accompanied the reorganization. An additional steel plant, as well as by-product coke ovens, were constructed in Franklin and at Rosedale. Cambria had opened its first open-hearth unit in October 1879; by 1919, 22 furnaces had been built. Rod and wire mills and car shops were also added.

In later years Johnstown's industrial advantage was reduced as increasing competition in transportation put the steel plant at a disadvantage. Isolated to an extent from the Great Lakes or the eastern seaboard, Johnstown's traditional role as a supplier to distant markets was diminished. The steel industry grew only slowly after World War I, and Cambria was not spared. In 1916 Cambria became a subsidiary of the Midvale Steel and Ordnance Company of Philadelphia and was taken over again in 1923 by the Bethlehem Steel Corporation which still operates the plant today. Production of steel rail ceased and the plant produced specialty steel, such as axles and railroad cars.

The American steel industry underwent dramatic changes in the second half of the twentieth century. Dominant worldwide during World War I, and surviving the Great Depression to become even larger during World War II, the industry produced more than 90 million tons of steel ingots in 1946, an amount far above any other nation in the world. In America approximately 85 percent of all manufactured goods contained steel, and 40 percent of employed workers were tied to the steel industry directly or indirectly. By the early 1950s the Johnstown plant employed approximately 18,000 workers, and produced 2.28 million tons of steel ingots annually.

By the mid-1980s the steel industry's economic health had deteriorated. This fall signalled drastic changes in several areas, including the evident scaledown of large integrated plants, the emergence of mini-mills, and the use of concessionary bargaining as a union attempt to save jobs by keeping plants open. The continuing evolution of steelmaking regarding machinery and products is visible when the Johnstown Plant of the Bethlehem Steel Corporation is viewed in the context of its continuing history. The extant buildings, structures, and machinery either abandoned or still in use on the site are the result of decisions made in the interest of economics, competitiveness, and capacity in the reality of a modern world steel market. The Johnstown Plant, heir to the Cambria Iron Company, still survives and remains open with reduced operations, even though other plants have closed. This is due to several factors, the primary ones being the cooperation and sacrifices of the workforce and the support of the community.

Labor for the Cambria mills came from several different sources. Farm labor and German and Welsh migrations in the 1830s, 1840s, and 1850s supplied the initial manpower for the mills. South European and Slavic immigration came in waves after the 1870s. Southern black migrants arrived after World War I. More than 70 percent of the total male blue-collar force in Johnstown was employed at Cambria mills and coal mines, but there were very few opportunities for women's employment in Johnstown.

Cambria's influence directed not only the economic sphere, but the social, political, and cultural worlds as well. From the very beginning the company's managers actively opposed labor organizations and successfully suppressed strikes by local miners and mill workers between 1866 and 1874. Cambria workers participated in national steel strikes in 1919 and 1937 demanding union recognition, but these also met failure. The company engaged in a paternalistic form of welfare capitalism, assuming the promotion of worker welfare and civic improvements. The company built the first industrial hospital in America, funded the public library, built an opera house and club house, and ran a night school offering free classes for employees. The Cambria Iron Company was also the largest landlord in Johnstown, owning houses which it rented to workers thereby fostering their fealty or dependence.

The Cambria Iron Company's history can be placed in the context of the late nineteenth and early twentieth century industrialism of the United States. Domestic production of iron and steel changed the look of America, contributed to western expansion and the growth of modern cities, fostered the growth of transportation systems, and was a factor in America's becoming a world power. The iron and steel industry also radically affected human lives. The discipline of the mills imposed long work days and work weeks, intensive labor and low pay. Native-born and immigrants alike were often powerless to control their destinies, and thus, on occasion, became the most radical in demanding a better way of life. The Cambria Iron Company was the scene of some of the most dramatic and consequential events in the evolution of the iron and steel industry, and its history can still be found on the front pages of national concern as the American steel industry copes with the changing realities of modern economic life.

RECOMMENDATIONS FOR FURTHER RESEARCH

Research on the Cambria Iron Company could continue in several different directions. Very few original records of the company were found. Some were located in the Johnstown Flood Museum and others originally in the former Charles Schwab Library in Bethlehem Steel Corporation offices in Bethlehem, Pennsylvania, were split between the Hagley Museum and Library, Manuscripts Division, and the Center for Canal History and Technology. The Bethlehem Steel Corporation papers at the Hagley Manuscripts Division were not totally processed in 1987, and citations for those boxes of materials may change in the future. As this study was completed the Center for Canal History and Technology received original John Fritz correspondence from several direct descendants. These papers should be thoroughly researched for data on Cambria. Perhaps more original Cambria Iron/Steel Company documentation can be found and interpreted through active inquiries with Bethlehem Steel Corporation management in Johnstown and Bethlehem.

More research can be done concerning the labor strikes which occurred in Johnstown. Newspapers such as the New York *Times*, *Wall Street Journal*, and the Johnstown papers carried news of the strike developments. These papers need to be carefully read and data collected, keeping in mind the biases of the newspapers' editors. The National Labor Relations Board papers, Record Group 2, at the Federal Records Center, Suitland, Maryland, National Archives, should be looked at for data on "Employees vs. Midvale Steel and Ordnance Co." case file #129. The reports of the U.S. Senate Committee on Education and Labor which investigated the 1919 and 1937 strikes should offer detailed information. These are U.S. Senate, Committee on Education and Labor, *Investigation of Strike in the Steel Industry*, 2 vols. 66 Cong., 1st Sess., 1919, and U.S. Senate, Committee on Education and Labor, *The "Little Steel" Strike and Citizens' Committees*, Report no. 151, 77th Cong., 1st Sess., Washington, 1941. The records of the Interchurch World Movement Commission of Inquiry can be found at the State Historical Society of Wisconsin in the David Saposs Labor Collection; some of the commission's collected data focused on Johnstown and included interviews with workers. The Pennsylvania State University Library's Historical Collection and Labor Archives, located in University Park, Pennsylvania, contains David Saposs' report "Organizing the Steel Workers." The University of Pittsburgh Archives of Industrial Society, Heber Blankenhorn Papers, contains George Soule's typewritten manuscript "History of the Strike in Johnstown," written for the Interchurch World Movement's Commission of Inquiry. The AFL-CIO headquarters in Washington, D.C., could also be checked for data on Cambria, in addition to the Andrew Carnegie Papers at the Library of Congress. All of these suggestions should be sources of data for an in-depth analysis of the cause, effect, and legacy of the various strikes at the Cambria plant.

Runs of journals such as American Iron and Steel Association *Bulletin, The Iron Age, Coal Age,* and the *Amalgamated Journal* need to be read to gather all available data on Cambria. These journals would provide information on the labor organizing activities, as well as advances in technology and management practices at the plant.

More information on the lives of the iron and steelworkers themselves throughout the company's history needs to be gathered. The State Historical Society of Wisconsin, Madison, Wisconsin, contains interviews with Cambria workers in the David Saposs Papers, Personal Interviews with Steel Workers during the Summer of 1920. The U.S. Congress, *Reports of the Immigration Commission, Immigrants in Industries, Iron and Steel Manufacturing,* Part II, 61st Cong., 2nd Sess., Sen Doc 633, Washington, 1911, VIII, IX, also discussed immigrant workers at Johnstown, and should contain data for a more detailed look at the quality of life for Johnstown's ethnic inhabitants.

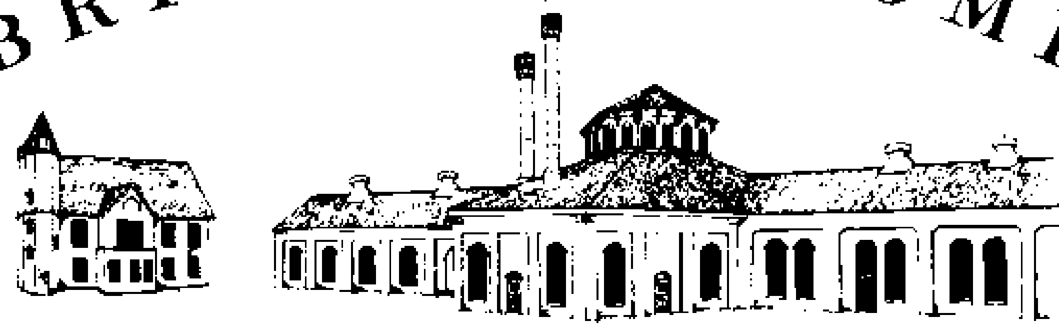
Specific details concerning Daniel Morrell's resuscitation of the Cambria Iron Company are needed to understand how Morrell's professional background helped Cambria survive its early troubled years. Details are also needed concerning how and why the Gautier operations moved to Johnstown and joined into a partnership with Cambria.

Further information on the Midvale era of Cambria can be possibly obtained from the William Brown Dickson Papers located in the Pennsylvania State University Library, University Park, Pennsylvania. These papers include data on the Midvale Employee Representation Plan.

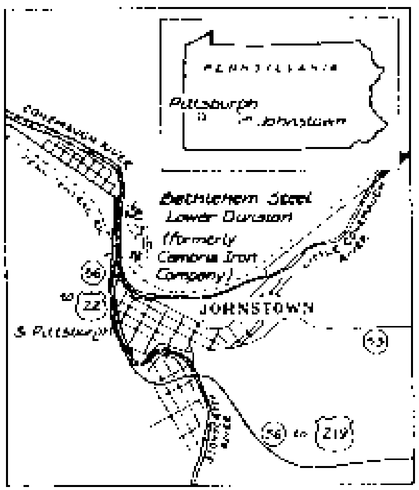
An American Studies approach can be used to study the effects of industrialization on the development of Johnstown. Shortages of housing occurred, but there were other impacts as well. A look at the following issues would shed light on the contextual meaning of the Cambria Iron Company's influence on both Johnstown and the nation: an administrative study of Cambria management; a study of product lines and marketing; arts and literature reflecting a steelmaking society; family histories, including generational employment in the mills; the company's contribution to the Civil War effort; the effects of mill and mining pollution, both psychologically and physically, on Johnstown inhabitants; the city's political response to Cambria management and policy in addition to the well-known responses during the strikes; an in-depth look at company policy concerning the importation and hiring of blacks and Mexicans during and after World War I; the development of transportation systems in Johnstown, for example, the street railway and the Inclined Plane, which profoundly affected the dispersion of worker housing from Cambria City to Franklin; the effects of strikes, layoffs, down time, and other industrial crises on workers' family life; the responses of churches and benevolent societies to the same industrial crises; the lack of significant employment opportunities for women; the status of worker housing and identifiable ethnic neighborhoods; and the impact of the unions since 1942.

Local sources need to be thoroughly explored. Photographs and original documents relating to Cambria are most likely located in former steelworkers' personal collections. Local steel enthusiasts probably possess items on Cambria as well. Copies and/or originals of this data should be collected. A well-constructed oral history program, conducted with former or current Cambria employees and their families, should provide rich details of life in a steel mill and town over the past 20-30, perhaps even 40 years. The recent oral history project, conducted among retired steel workers by Lehigh University and Bethlehem Steel Corporation may serve as a model or for precedent.

CAMBRIA IRON COMPANY



JOHNSTOWN, PENNSYLVANIA · CA. 1852-1898



BASED ON U.S.G.S. 7.5 MINUTE SERIES ... JOHNSTOWN QUADRANGLE

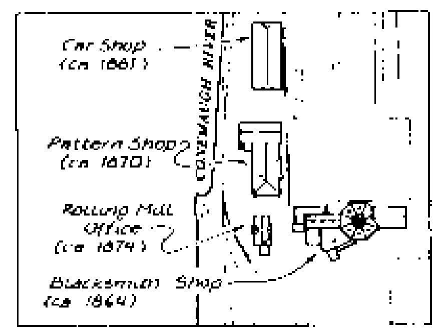
LOCATION MAP

SCALE

In 1852, a group of entrepeneurs from the Johnstown area including ironmasters George S. King and Dr. Peter Schoenberger, merged several independent charcoal iron furnace operations to form the Cambria Iron Company. With the advent of the Pennsylvania Railroad through Johnstown in 1850, King foresaw the need for iron rail for the nation's expanding railroad system. Having obtained financial backing from New York in 1853, King and Schoenberger began erecting a cruciform shaped rolling mill and four coke fired blast furnaces. They sought to produce a superior rail more economically than other American manufacturers and at a cost less than imported British rail. That same year, however, witnessed the failure of the company's principal investor and the ironworks remained only partially built. Subsequently, King and Schoenberger sold their interests in Cambria Iron. In 1854, Matthew Newkirk of Philadelphia became the company's second president, and John Fritz, who along with his brother George emerged as one of the nation's leading figures in the steel industry, was appointed mill superintendent. Finally in July 1854 the rolling mill and blast furnaces were completed and the company produced its first iron rail.

Cambria Iron Company continued to experience financial distress until about 1862 when it was reorganized by Wood, Morrell and Co. of Philadelphia with Daniel J. Morrell as company president. Cambria Iron prospered. From the early 1860s through the 1880s, Johnstown became one of the nation's leaders in iron and steel manufacturing. The construction of a Bessemer plant at Cambria in 1869 marked the sixth of its kind in America. Moreover, between 1857 and 1862, the ironworks was the site of William Kelly's experiments with a Bessemer like process for making steel and, during these early years, John Fritz developed his three-high rolling mill for the production of iron and steel rail. By the mid-1870s, Cambria Iron Company led the nation in rail production, manufacturing about 10 percent of America's rail.

Several buildings dating from the 1850s through the 1880s, a period when the Cambria Iron Works achieved national prominence in the iron and steel industry, remain standing. Four of them, the Blacksmith Shop, the Car Shop, the Pattern Shop and the Rolling Mill Office, were drawn by HAER in the summer of 1987. This recording project is part of a long-range program to document historically significant engineering and industrial works in the United States. The Southwestern Pennsylvania Survey and Recording Project was co-sponsored in 1987 by the Historic American Engineering Record (HAER) and the Allegheny Portage Railroad National Historic Site, Randall Cooley, Superintendent.



BASED ON BETHLEHEM STEEL CORPORATION DRAWINGS ... JOHNSTOWN, PA.

SITE MAP

SCALE 0 100 200 FEET

The fieldwork, measured drawings, historical reports and photographs were prepared under the general direction of Robert Kapsch, Chief, HABS/HAER Division, and Gray Fitzsimons, Historian. The recording team consisted of Michael Drasin, Architectural Supervisor; Ruth Goodman and Matthew Heppner, Architectural Technicians. Formal photography was done by Jet Lowe; historical documentation was done by Gray Fitzsimons.

Michael Drasin, Ruth Goodman, 1987

CAMBRIA IRON COMPANY - CA. 1852-1898

JOHNSTOWN · CAMBRIA COUNTY · PENNSYLVANIA

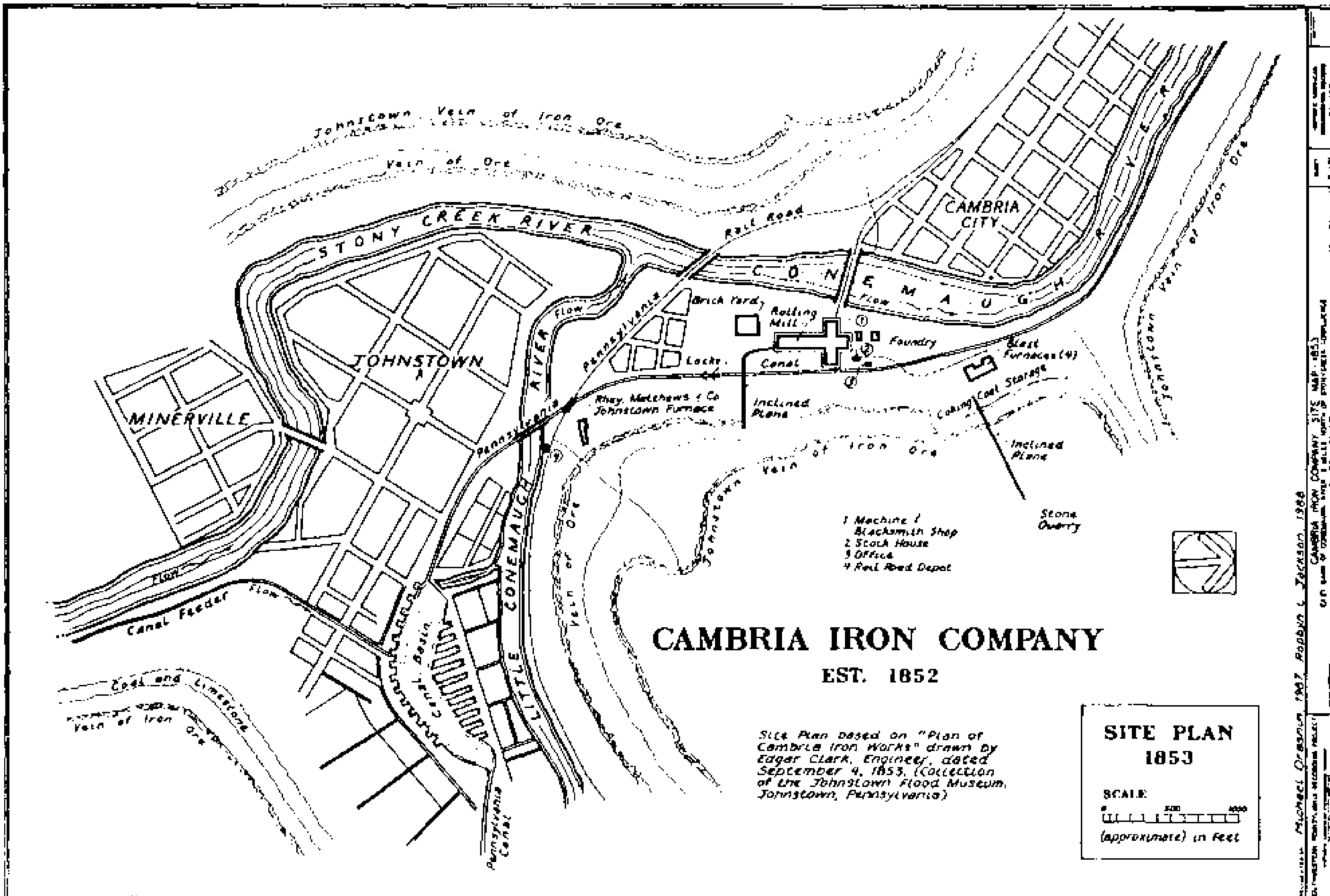
HISTORIC AMERICAN ENGINEERING RECORD PA-108

SHEET 1 OF 1

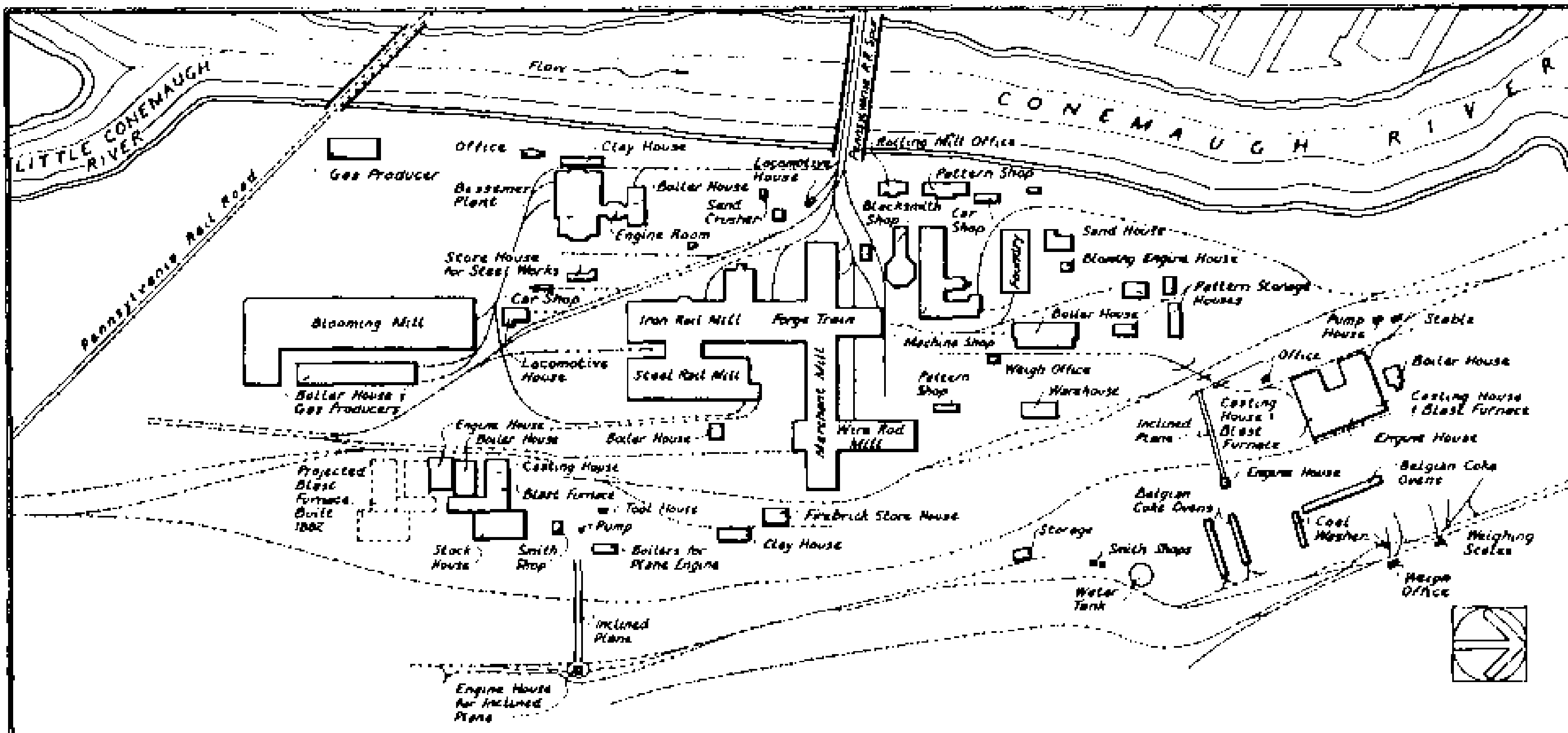
P97/25,000

HISTORICAL BASE MAPS

These historical base maps are Historic American Engineering Record drawings recording the Cambria Iron Company, Johnstown, Pennsylvania, ca. 1852-1898.


CAMBRIA IRON COMPANY
EST. 1852
SITE PLAN
1853
SCALE
(approximate) in feet
Site Plan based on "Plan of Cambria Iron Works" drawn by Edgar Clark, Engineer, dated September 4, 1853. (Collection of the Johnstown Flood Museum, Johnstown, Pennsylvania)
1 Machine & Blacksmith Shop
2 Stock House
3 Office
4 Rail Road Depot
JOHNSTOWN
MINERVILLE
CAMBRIA CITY
STONY CREEK RIVER
LITTLE CONEMAUGH RIVER
CONEMAUGH RIVER
Canal Basin
Pennsylvania Canal
Canal Feeder
Flow
Pennsylvania Rail Road
Brick Yard
Rolling Mill
Foundry
Blast Furnaces (4)
Locks
Canal
Rhey, Matthews & Co Johnstown Furnace
Inclined Plane
Coking Coal Storage
Stone Quarry
Johnstown Vein of Iron Ore
Vein of Ore
Vein of Iron Ore
Coal and Limestone
Michael Oresnin 1987, Robbyn L. Jackson, 1988
CAMBRIA IRON COMPANY SITE MAP 1853
CAMBRIA COUNTY

P97/25,000



OWNERS OF IRON WORKS

Cambria Iron Company
1852 - 1898

Cambria Steel Company
1898 - 1916

Midvale Steel & Ordnance Company, Cambria Plant
1916 - 1923

Bethlehem Steel Company
Cambria Plant
1923 - Present

CAMBRIA IRON COMPANY

1852 - 1898

SITE PLAN
1878

SCALE (approximate) in feet.
0 100 200 300 400

Based on a map by A. L. Holley and Lenox Smith, "American Iron and Steel Works. Works of the Cambria Iron Company," in Engineering. An Illustrated Weekly Journal, Vol. 26, (London 12 July, 1878) pp 21-22

Michael Drezhun 1987 Robbyn L. Jackson 1988

CAMBRIA IRON COMPANY SITE MAP 1878

CAMBRIA COUNTY

JOHNSTOWN

PENNSYLVANIA

PA-109

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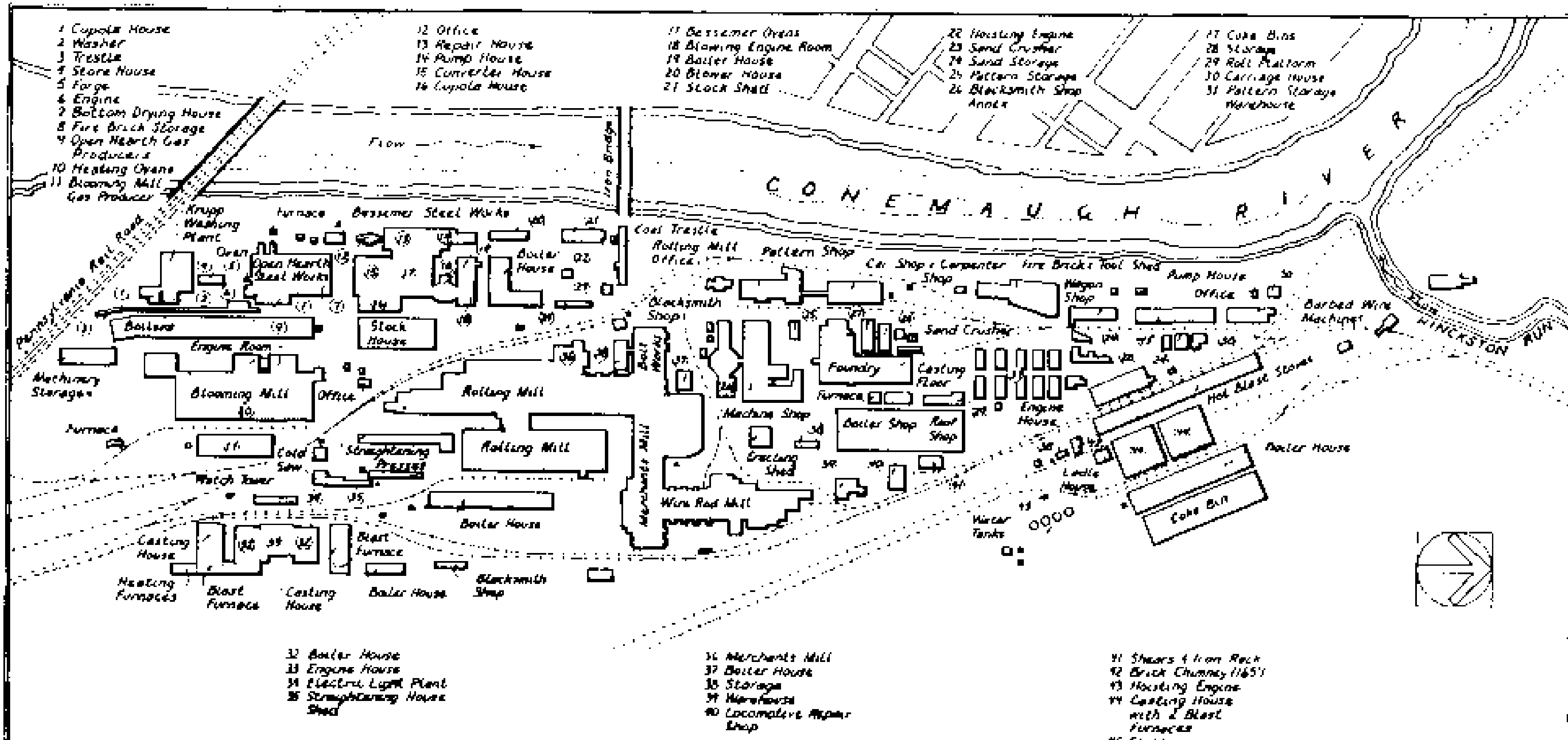


OWNERS OF IRON WORKS

Cambria Iron Company
1852 - 1898

Cambria Steel Company
1898 - 1916

Midvale Steel & Ordnance Company Cambria Plant
1916 - 1923

Bethlehem Steel Company Cambria Plant
1923 - Present

CAMBRIA IRON COMPANY

1852 - 1898

SITE PLAN 1891

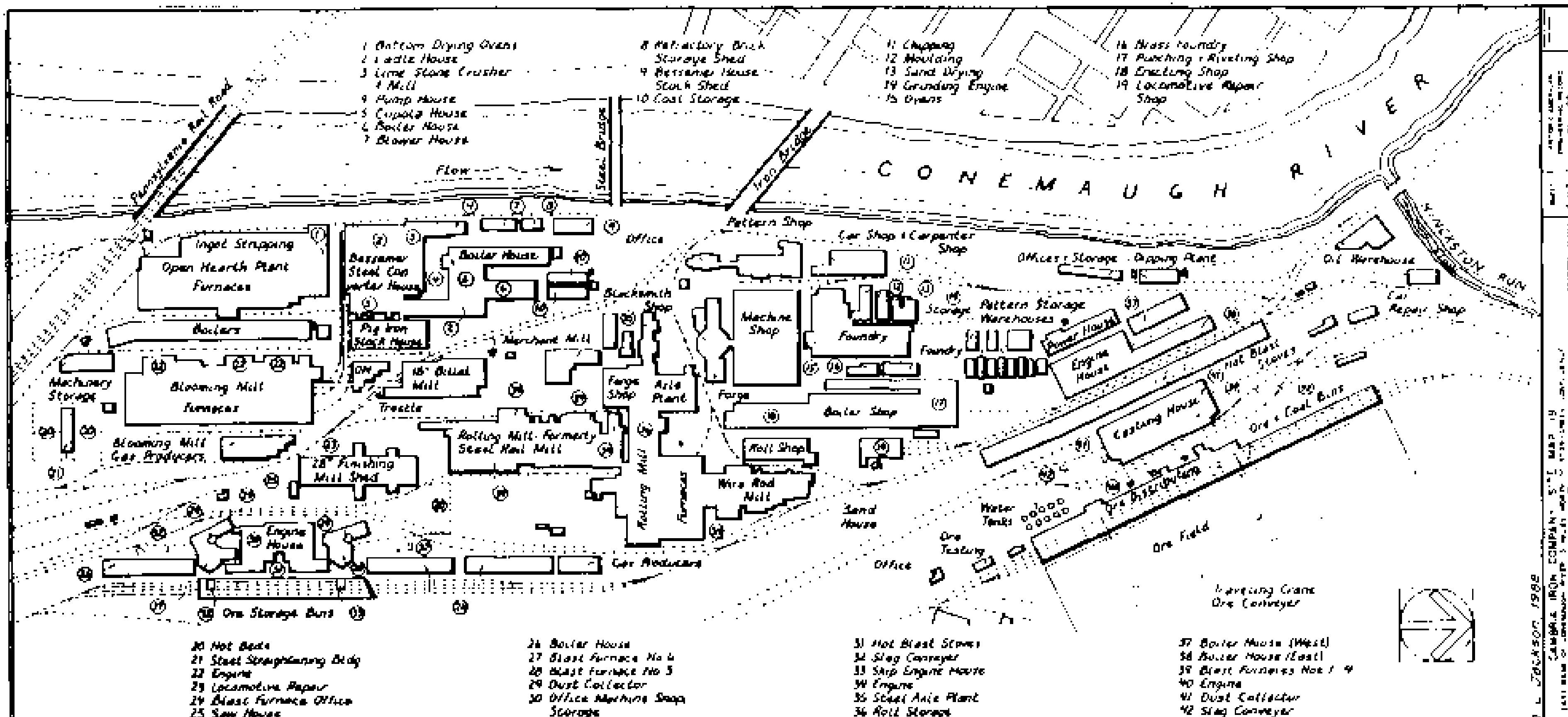
SCALE (approximate) in feet
0 100 200 300 400

Based on map by Sanborn Perris Map Company, Ltd., Johnstown, Pennsylvania, New York, 1891

Michael Drasnin 1987, Robbyn L. Jackson 1988

CAMBRIA IRON COMPANY SITE MAP - 1891

P97/25,000



OWNERS OF IRON WORKS

Cambria Iron Company
1852 - 1898

Cambria Steel Company
1898 - 1916

Midvale Steel & Ordnance Company Cambria Plant
1916 - 1923

Bethlehem Steel Company Cambria Plant
1923 - Present

CAMBRIA STEEL COMPANY

1898 - 1916

SITE PLAN 1911

SCALE (approximate) in feet
0 100 200 300 400

Based on map by Sanburn Map Company, "Johnstown & Environs, Pennsylvania," New York, 1911

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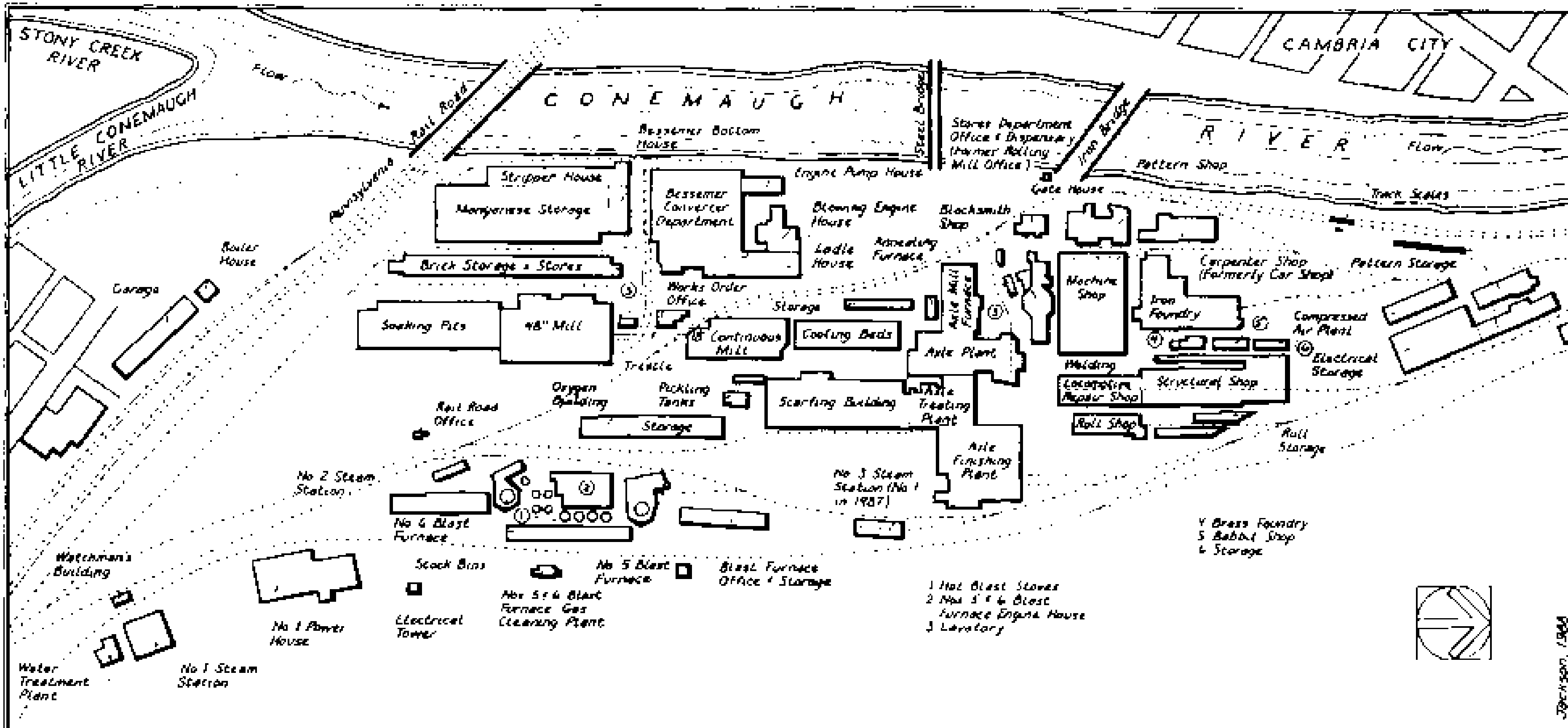


OWNERS OF IRON WORKS

Cambria Iron Company 1852 - 1898

Cambria Steel Company 1898 - 1916

Midvale Steel & Ordnance Company Cambria Plant 1916 - 1923

Bethlehem Steel Company: Cambria Plant 1923 - Present

BETHLEHEM STEEL COMPANY

1923 - PRESENT

SITE PLAN 1939

SCALE (approximate) in feet.
0 100 200 300 400

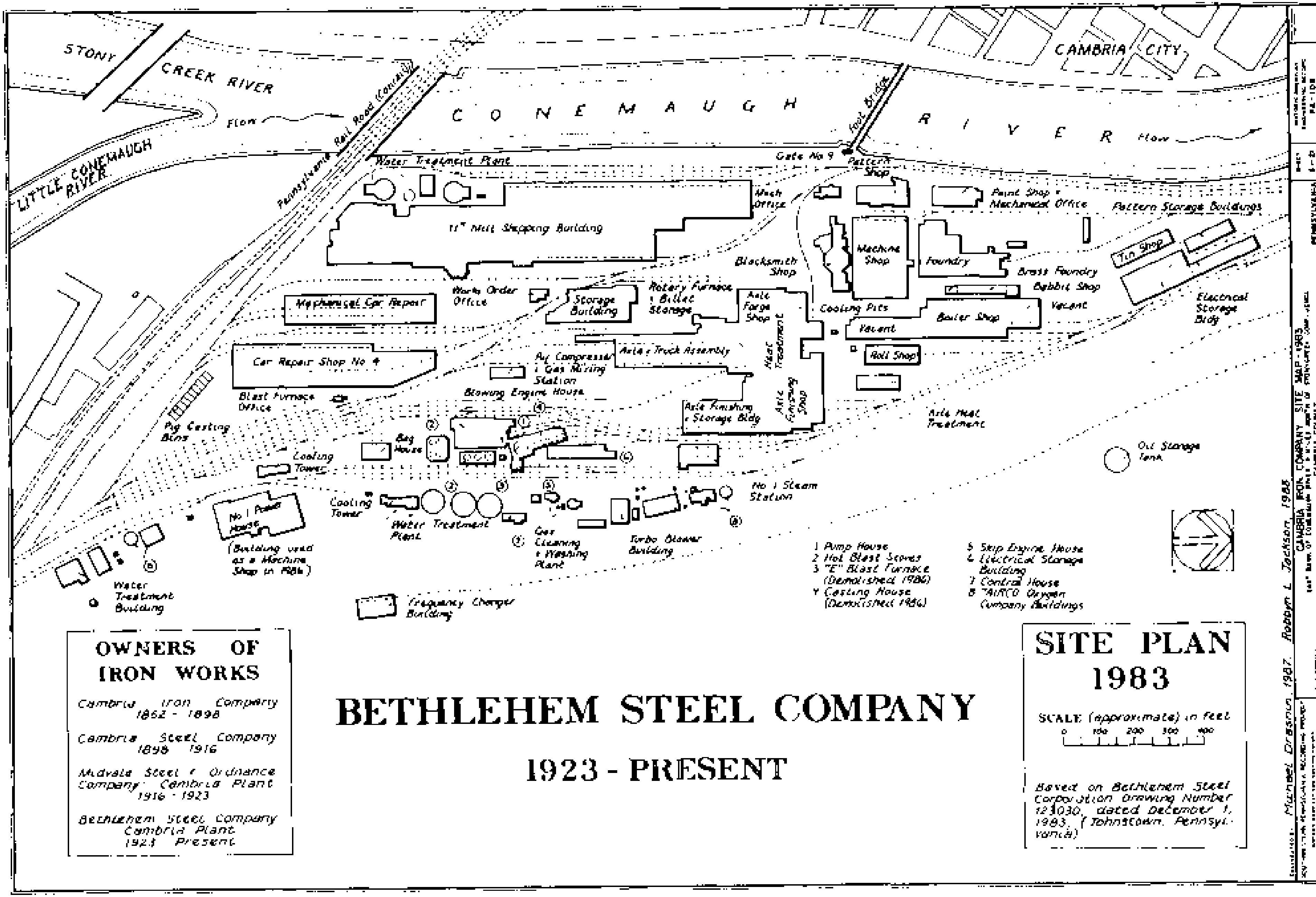
Based on Key Plan, Johnstown Plants, dated Feb 16, 1923, revised March 29, 1930, revised Feb 13, 1939. (Collection of the Canal Museum, Easton, Pennsylvania).

Michael Oresnun, 1987, Robbyn L. Jackson, 1988

CAMBRIA IRON COMPANY SITE MAP 1939

JOHNSTOWN CAMBRIA COUNTY PENNSYLVANIA

P97/25,000


STONY CREEK RIVER
LITTLE CONEMAUGH RIVER
Flow
Pennsylvania Rail Road (Conrail)
CONEMAUGH RIVER
Foot Bridge
CAMBRIA CITY
Water Treatment Plant
11" Mill Shipping Building
Gate No 9
Pattern Shop
Wash Office
Paint Shop & Mechanical Office
Pattern Storage Buildings
Machine Shop
Foundry
Brass Foundry
Babbit Shop
Tin Shop
Electrical Storage Bldg
Blacksmith Shop
Works Order Office
Rotary Furnace & Billet Storage
Storage Building
Mechanical Car Repair
Axle Forge Shop
Cooling Pits
Boiler Shop
Vacant
Roll Shop
Car Repair Shop No 4
Air Compressor & Gas Mixing Station
Axle & Truck Assembly
Heat Treatment
Blast Furnace Office
Blowing Engine House
Axle Finishing & Storage Bldg
Axle Finishing Shop
Axle Heat Treatment
Pig Casting Bins
Cooling Tower
Bag House
Oil Storage Tank
No 1 Steam Station
No 1 Power House (Building used as a Machine Shop in 1986)
Water Treatment Plant
Gas Cleaning & Washing Plant
Turbo Blower Building
Water Treatment Building
Frequency Changer Building
1 Pump House
2 Hot Blast Stoves
3 "E" Blast Furnace (Demolished 1986)
4 Casting House (Demolished 1986)
5 Skip Engine House
6 Electrical Storage Building
7 Control House
8 "AIRCO" Oxygen Company Buildings
OWNERS OF IRON WORKS
Cambria Iron Company 1852 - 1898
Cambria Steel Company 1898 1916
Midvale Steel & Ordnance Company Cambria Plant 1916 - 1923
Bethlehem Steel Company Cambria Plant 1923 Present
BETHLEHEM STEEL COMPANY
1923 - PRESENT
SITE PLAN 1983
SCALE (approximate) in feet
0 100 200 300 400
Based on Bethlehem Steel Corporation Drawing Number 123030, dated December 1, 1983, (Johnstown, Pennsylvania)
Michael Drasnin, 1987. Robbyn L. Jackson, 1988
CAMBRIA IRON COMPANY SITE MAP - 1983
CAMBRIA COUNTY
JOHNSTOWN
PENNSYLVANIA
PA-108

P97/25,UUU

APPENDIX 1

Description of Iron and Steelmaking

THE STORY OF IRON AND STEEL

Various Kinds of Iron

The molten iron as it comes from the blast furnace is called *pig-iron*. In old-fashioned works it flows through long channels called *sows* into molds of sand or iron laid out on the floor of the cast-house and known as *pigs*, where it is left to cool and harden. In large-scale modern practice it is carried in bucket-like *ladles*, while still molten, to the steel furnaces, or it is molded in the *pig-casting machine*. This consists of a series of metal molds carried by an endless belt under a spray or bath of water, to hasten the cooling of the iron, and finally to railway cars, into which the now solid pigs are dumped. Pig-iron is used for making cast-iron, wrought iron and steel.

Cast-iron is generally made in a *cupola*, constructed much like a miniature blast furnace. This is charged with pig-iron, scrap-iron and coke, and air is blown through, as in the blast furnace. The molten iron is poured into molds of sand, in which it is left to harden. Cast-iron takes the shape of the mold better than other kinds of iron and steel, as it is very fluid when melted and expands in solidifying. On account of the large amount of carbon it contains (3 or 4 per cent.) it is generally quite brittle, and cannot be hammered into various shapes,

Courtesy Carnegie Steel Co

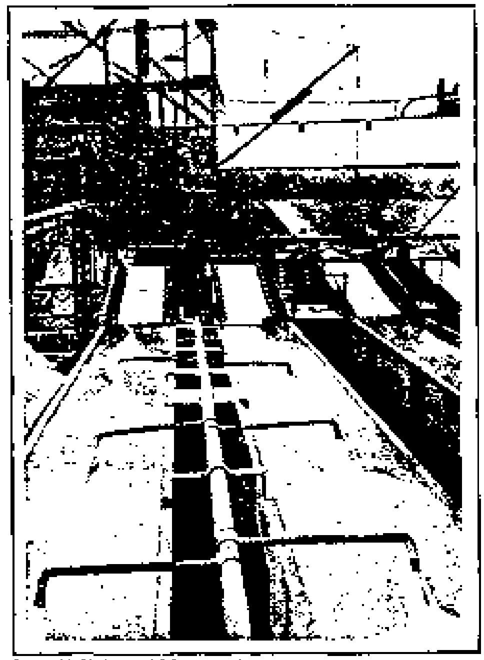
OPEN-HEARTH FURNACES

Filling ingot molds

Source: Charles Fitzhugh Talman, "The Story of Iron and Steel," *The Mentor* 7, no. 3 (March 15, 1919, serial no. 175): 7-11.

or, in technical language, it is not "malleable." There are, however, many kinds of cast-iron, differing in brittleness, hardness, etc., and some kinds can be made malleable by suitable heat treatment.

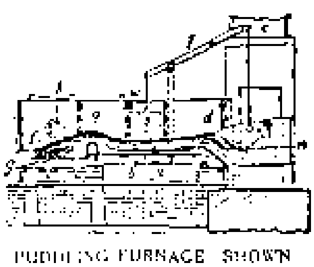
Wrought iron differs in composition from cast-iron in containing very little carbon (0.3 per cent. or less) and a considerable amount of slag. It is malleable, easily welded, and more durable for some purposes than steel, and was once the ordinary material for nails, wire, plates, bars, beams, rails, hoops, etc. Nowadays it has been displaced to a great extent by steel, on account of the large amount of hand-labor required in making it. Wrought iron is made in the *puddling furnace*. The fuel—coal, or sometimes gas—is burned in a chamber separated by a low wall from the adjacent hearth, on which is placed pig-iron, resting on a layer of iron oxide in the form of iron ore or *mill scale* (the crust that forms on hot steel in the rolling-mill). The flame, passing over the wall, beats down on the iron, which is melted. A workman, standing at the door of the furnace, stirs or *puddles* the melting iron and oxide with a long iron bar, called a *rabble*. After half an hour or so the iron begins to form in little pasty grains, which the puddler molds with his rabble into large balls, weighing 80 to 100 pounds. These balls are taken one at a time from the furnace, squeezed by machinery to remove most of the slag, rolled into bars, cut in pieces, re-heated, re-rolled, etc., to produce a compact product with a minimum of slag. Puddling is a conspicuous example of a tedious industrial process in which machinery has not yet replaced hand labor.



Copyright, Underwood & Underwood

COOLING FRESHLY MADE PIG-IRON

The pig iron is taken from the places where the molten metal is poured into the molds of the pig-casting machine, and passed through cooling troughs which are constantly being replenished with cold water in the manner shown above



PUDDLING FURNACE SHOWN IN PARTIAL CROSS-SECTION

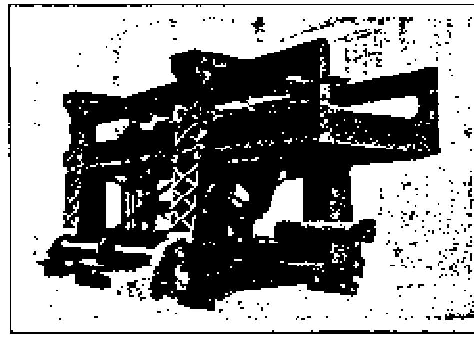
At the bottom of the fire-chamber (f) are the grate bars (g), the fuel being supplied at the firing-hole (n). The flames pass over the fire-bridge (e) to the iron-chamber (i) which has a bed (b), and over the flue bridge (d) through the neck (h) to the chimney (c). The lever (l) operates the working door (w), which is used for charging with pig and removing the puddled balls, while the stopper-hole (s) serves for the introduction of the rabble

"*Steel*" is a word of many meanings. Our grandfathers applied this term only to a kind of iron that could be made very hard and brittle by plunging into cold water (*quenching*) when red-hot, and then made less brittle by re-heating to a moderately high temperature—a process called *tempering*. In order to have these qualities steel must contain more carbon than wrought iron and considerably less than ordinary cast-iron (say from 0.6 to 1.5 per cent.). Our modern tools and cutlery of the better grades are made of this kind of steel, but the so-called steel now used on an enormous scale for bridges, buildings, ships, etc., contains very little carbon and cannot be hardened and tempered. It is known as *mild steel*, and is essentially a slagless wrought iron.

Steels whose properties depend chiefly upon the percentage of carbon they contain are classed as *carbon steels*. There are also many important kinds of steel, known as *special steels*, or *alloy steels*, which owe their varied and valuable properties to the presence of definite amounts of substances other than carbon. These

S

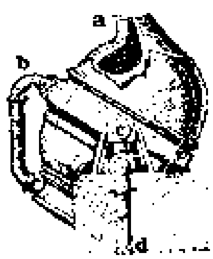
include manganese steel, nickel steel, chrome steel, tungsten steel, etc., each of which is appropriate for certain uses on account of its hardness, softness, toughness, elasticity, or some other quality.



THE WELLMAN HIGH TYPE OPEN-HEARTH FURNACE CHARGER

Steel-Making Processes

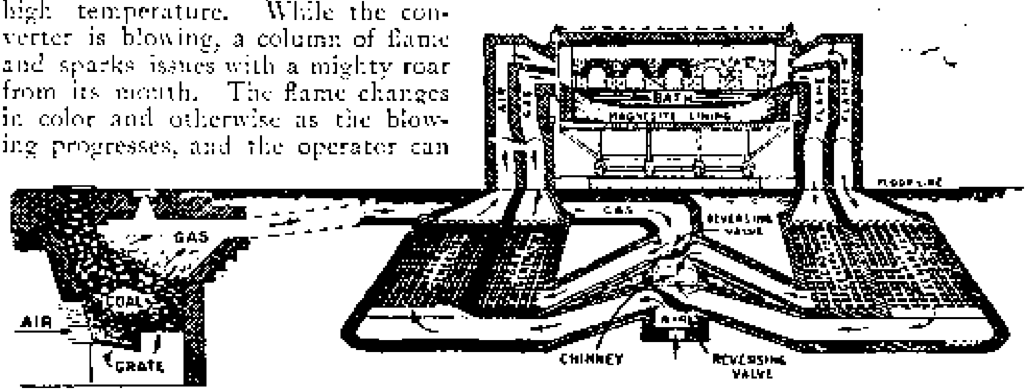
An old and once universal process of making steel, known as the *cementation process*, consists in packing bars of wrought iron in charcoal and heating them for several days. The iron absorbs the charcoal (carbon) without melting, and acquires the hardening property once regarded as the distinctive feature of steel. From the blisters that form on its surface it gets the name of *blister steel*. The outer layers of a bar thus treated absorb more carbon than the interior. In order to get a steel of more uniform quality the bars of blister steel may be cut in pieces, which are then piled together, reheated, hammered, rolled, etc., to produce what is called *shear steel*. A better plan is to melt pieces of blister steel in crucibles of clay or graphite, which are placed in a furnace burning gas, coal or coke. As in other modern steel-making processes, the molten metal is finally poured into molds and hardens into blocks known as *ingots*. Steel made by this process is called *crucible steel*, and ingots of it are rolled into bars and used for making high-grade tools. A somewhat inferior quality of tool steel is made by melting in crucibles bars of wrought iron or mild steel, mixed with charcoal, instead of using blister steel, as above described.



BESSEMER CONVERTER

a, mouth, with portion of side removed to show interior formation; *b*, blowpipe; *c*, trunnion; *d*, air-inlet pipe

In the middle of the last century Henry Bessemer in England and William Kelly in the United States invented, independently of each other, a process that revolutionized the art of steel-making. It is now called by the name of the English inventor. In the Bessemer process molten pig-iron is charged into a large egg-shaped steel vessel, mounted on trunnions, called a *converter*. The carbon and other impurities in the iron are then burned out by sending a powerful blast of air through or over the molten metal. The combustion of the impurities in the iron suffices, without the use of any external heat, to raise the metal to a very high temperature. While the converter is blowing, a column of flame and sparks issues with a mighty roar from its mouth. The flame changes in color and otherwise as the blowing progresses, and the operator can



From "Non-technical Chats on Iron and Steel" by L. W. Spring

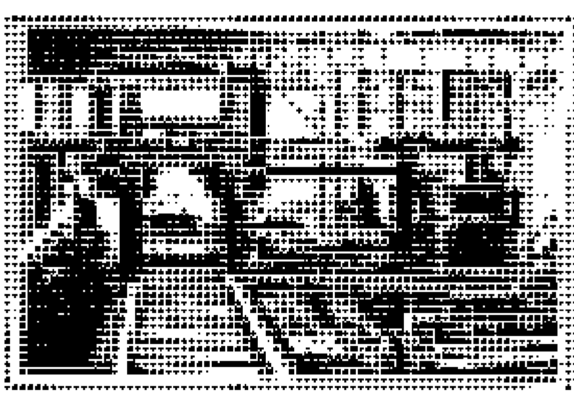
EARLY TYPE OF GAS PRODUCER, REGENERATORS, AND OPEN-HEARTH FURNACE

Course taken by air, gas, and products of combustion are plainly shown, as are the valves that reverse direction of flow tell from its appearance when the process of purification is complete. When almost perfectly pure iron has thus been produced, measured amounts of carbon and manganese are added, in order to give the steel just the qualities desired. The converter is then tilted and the metal is poured into what is called in the steel-mill a "ladle" but which looks to the layman more like a huge cauldron. From this it is poured into ingot-molds, standing on railway trucks, which take the ingots to the *stripper*, where the molds are lifted off. The white-hot ingots, each weighing about two tons, are finally lowered into so-called *soaking-pits*, which, despite their name, contain no liquid. These pits are heated by gas, and the ingots remain in them until they acquire uniform temperature and solidity. They are then ready for the rolling-mill.

Courtesy of Pittsburgh Furnace Co.
THREE TON PITTSBURGH ELECTRIC FURNACE
Maynard Steel Foundry Co.

About ten years after the introduction of Bessemer steel a new method of steel-making came into vogue, known as the *open-hearth* or *Siemens-Martin process*. About three-fourths of the steel now produced in the United States is made by this process. The open-hearth furnace is much like an enlarged puddling-furnace, but is heated in a peculiar manner. Below the level of the furnace are two pairs of chambers filled with brick checkerwork and known as *regenerators*. Gas and air are drawn through one pair of regenerators on their way to the furnace; the gas burns over the hearth, and the flame passes down into the other pair of regenerators, which it raises to a high temperature. The streams of gas and air are then diverted so as to pass through the heated chambers, while the flame passes into the first pair of regenerators, which it heats in their turn; this process being reversed every fifteen minutes or half hour. Thus while one pair of chambers is giving out heat the other is storing it up. The principle is much the same as that of the stoves attached to the blast furnace, already described.

The open-hearth furnace is charged with molten pig-iron, scrap steel, iron ore, and a little limestone or fluor-spar. Another important ingredient is the lining of the hearth, which is of different materials according to the particular impurities that need to be removed. While in the Bessemer converter the steel is made in a few minutes, in the open-hearth process the materials remain in the furnace from six to twelve hours, but a far larger amount of steel is produced at one time—seventy to a hundred tons in the larger furnaces. At the end of the *heat* the molten steel is drawn off into a ladle, poured into ingot-molds, and otherwise treated the same as Bessemer steel.



BUFFALO, N. Y.

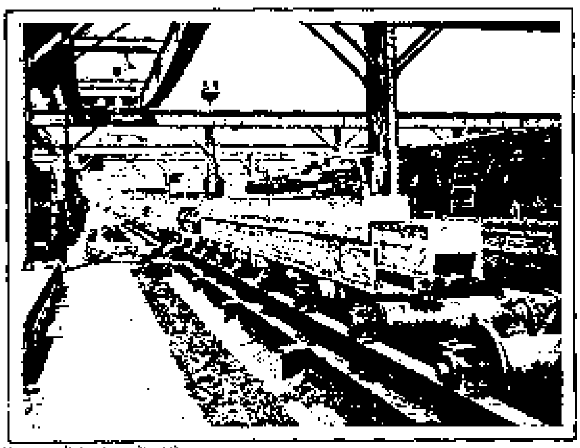
In the newest method of making steel an *electric furnace* is used; in other words, a furnace heated by electricity instead of by fuel. All kinds of steel can be made by this process, but the product is too expensive to compete with the common grades of open-hearth and Bessemer steel. High-grade steels are being more and more generally made by the electric process, which is thus rapidly displacing the crucible process. Both the temperatures and the chemical reactions involved in steel-making can be much more perfectly controlled by this process than by any of the older methods. The electric furnace is now often used for improving or "super-refining" Bessemer or open-hearth steel, and for making steel castings.

Courtesy of the U. S. Bureau of Mines

CUTTING HEAVY STEEL SLABS
Homestead Works of The Carnegie Steel Co.

The Final Operations

in the steel-mill consist of rolling, forging and sometimes drawing. The white-hot ingots, when taken from the soaking-pits, are placed on a long train of rollers which carry them along to the heavy rolls of the *cogging-mill* or *blooming-mill*, between which the ingot passes as wet clothes pass through a wringer. Then the rolls are set a little closer together, the mechanism is reversed, and the ingot passes through in the opposite direction; this process being repeated several times. An elongated block of metal is thus produced, which can be further rolled into a variety of finished products, such as rails, beams and plates, or into blocks of different shapes and sizes, known as *billets*, *blooms*, *slabs*, *bars*, etc., destined to be used, at the original plant or elsewhere, for forging, wire-drawing, and the manufacture of innumerable articles of steel.



Courtesy Bethlehem Steel Co.

STOCKYARD SHOWING STRUCTURAL STEEL BEAMS

Iron and steel are *forged* by hammering, either by hand or machinery; also by pressing with an hydraulic press. Forging is a much slower process than rolling, but is capable of producing a much greater variety of shapes.

Drawing is the process used in making wire. In this process metal rods are drawn through holes of successively smaller diameter until of the desired fineness. Unlike rolling and forging, the drawing of wire is done cold.

APPENDIX 2

Production of iron rails in the United States, 1849-1890.

Miles of steel and iron rails in the United States, 1880-1890.

The production of iron rails in the United States has been as follows in net tons from 1849 to 1890. Since the beginning of 1883 the manufacture of iron rails has been almost entirely superseded by the manufacture of steel rails. Such iron rails as have since been made have been chiefly street rails and light rails for mines and tramways.

Years.	Net tons.	Years.	Net tons.	Years.	Net tons.
1849	24,318	1863	275,768	1877	332,540
1850	44,083	1864	335,369	1878	322,890
1851	50,603	1865	356,292	1879	420,160
1852	62,478	1866	430,778	1880	493,762
1853	87,891	1867	459,558	1881	488,581
1854	108,016	1868	499,489	1882	227,874
1855	138,674	1869	583,936	1883	64,954
1856	180,018	1870	586,000	1884	25,590
1857	161,918	1871	737,483	1885	14,815
1858	163,712	1872	905,930	1886	23,679
1859	195,454	1873	761,062	1887	23,062
1860	205,038	1874	584,469	1888	14,252
1861	189,818	1875	501,649	1889	10,258
1862	213,912	1876	467,168	1890	15,548

In Poor's *Manual* for 1891 there appears the following table showing the extent to which steel rails had superseded iron rails in the United States down to 1890, double and side tracks being included in the figures given.

Years	Miles of steel rails.	Miles of iron rails.	Total miles.	Per cent. steel of total.
1880	33,680	81,967	115,647	29.1
1881	[illegible]	81,[illegible]	130,[illegible]	37.[illegible]
1882	66,498	73,599	140,[illegible]	47.5
1883	78,491	70,032	148,[illegible]	52.7
1884	90,216	66,251	156,[illegible]	57.6
1885	98,102	62,196	160,297	61.8
1886	109,2[illegible]	62,[illegible]	[illegible]	63.[illegible]
1887	127,170	58,[illegible]	185,[illegible]	67.[illegible]
1888	145,[illegible]	52,[illegible]	197,[illegible]	73.[illegible]
1889	161,7[illegible]	50,613	212,[illegible]	76.0
1890	167,[illegible]	40,[illegible]	208,[illegible]	[illegible]

Source: James M. Swank, *History of the Manufacture of Iron in All Ages, and Particularly in the United States from Colonial Times to 1891* (Philadelphia: The American Iron and Steel Association, 1892), pp. 440-441.

APPENDIX 3

Production of Bessemer steel rails in the United States, 1867-1890.

Production of open-hearth steel in the United States, 1870-1890.

Production of Bessemer steel ingots and Bessemer steel rails in the United States and in Great Britain, 1877-1890.

Production of open-hearth steel in Great Britain, 1879-1890.

Production of Bessemer steel ingots in the United States, 1867-1890.

The Association has also ascertained as follows the production of Bessemer steel rails in the United States in net tons since the commencement of their manufacture in this country as a commercial product in 1867. The total production of rails from 1867 to 1890 was 19,483,530 net tons.

Years.	Net tons.	Years.	Net tons.	Years.	Net tons.
1867	2,550	1875	290,863	1883	1,286,554
1868	7,225	1876	412,461	1884	1,116,621
1869	9,650	1877	432,169	1885	1,074,607
1870	34,000	1878	550,398	1886	1,763,667
1871	38,250	1879	683,964	1887	2,101,904
1872	94,070	1880	954,460	1888	1,552,631
1873	129,015	1881	1,330,302	1889	1,691,264
1874	144,944	1882	1,438,155	1890	2,091,978

A comparison of the production of ingots and rails will show approximately the quantity of Bessemer steel that has annually been used in miscellaneous forms. Virtually all of the Bessemer steel that has been produced in this country has been used at home; only a small quantity has been exported.

The following table shows in net tons the production of open-hearth steel in the United States from 1870 to 1890.

Years.	Net tons.	Years.	Net tons.	Years.	Net tons.
1870	1,500	1877	25,031	1884	131,617
1871	2,000	1878	36,126	1885	149,381
1872	3,000	1879	56,290	1886	245,250
1873	3,500	1880	112,953	1887	360,717
1874	7,000	1881	146,946	1888	352,036
1875	9,050	1882	160,542	1889	419,488
1876	[illegible]	1883	133,679	1890	574,820

Source: James M. Swank, *History of the Manufacture of Iron in All Ages, and Particularly in the United States from Colonial Times to 1891* (Philadelphia: The American Iron and Steel Association, 1892), pp. 414-415, 424-425.

The following table shows in gross tons the production of Bessemer steel ingots and Bessemer steel rails in the United States and in Great Britain from 1877 to 1890.

Years.	United States—Gross tons.		Great Britain—Gross tons.	
	Ingots.	Rails.	Ingots.	Rails.
1877	500,524	385,865	750,000	508,400
1878	653,773	491,427	807,527	622,390
1879	829,439	610,682	834,511	520,231
1880	1,074,262	852,196	1,044,382	732,910
1881	1,374,247	1,187,770	1,441,719	1,023,740
1882	1,514,687	1,284,067	1,673,649	1,235,785
1883	1,477,345	1,148,709	1,553,380	1,097,174
1884	1,375,531	996,983	1,299,676	784,968
1885	1,519,430	959,471	1,304,127	706,583
1886	2,269,190	1,574,703	1,570,520	730,343
1887	2,936,033	2,101,904	2,089,403	1,021,847
1888	2,511,161	1,386,277	2,032,794	979,083
1889	2,930,204	1,510,057	2,140,791	943,048
1890	3,688,871	1,867,837	2,014,843	1,019,606

Great Britain is the largest producer of open-hearth steel in the world, and in this branch of the steel industry the United States is still a long distance behind its great iron and steel rival. Only a small part of Great Britain's annual production is made by the basic process. The following table gives in gross tons the production of open-hearth steel in Great Britain from 1879 to 1890.

Years.	Gross tons.	Years.	Gross tons.	Years.	Gross tons.
1879	175,500	1883	455,500	1887	981,104
1880	251,000	1884	475,250	1888	1,292,742
1881	338,000	1885	583,918	1889	1,429,169
1882	436,000	1886	694,150	1890	1,564,200

Since 1867 the American Iron and Steel Association has annually ascertained the production of Bessemer steel ingots in the United States. It has been as follows, in net tons.

Years.	Net tons.	Years.	Net tons.	Years.	Net tons.
1867	3,000	1875	375,517	1883	1,654,627
1868	8,500	1876	525,996	1884	1,540,595
1869	12,000	1877	560,587	1885	1,701,762
1870	42,000	1878	732,226	1886	2,541,493
1871	45,000	1879	928,972	1887	3,288,357
1872	120,108	1880	1,203,173	1888	2,812,500
1873	170,652	1881	1,539,157	1889	3,281,829
1874	191,933	1882	1,696,450	1890	4,131,535

APPENDIX 4

Ten Largest Steel Companies, Selected Years 1904-1950.

TABLE 17

TEN LARGEST STEEL COMPANIES, SELECTED YEARS 1904–1950[1]

Rank	1904	1916	1926	1938	1950
1	United States Steel	United States Steel	United States Steel	United States Steel	United States Steel
2	Jones and Laughlin	Jones and Laughlin	Bethlehem Steel Corp.	Bethlehem Steel Corp.	Bethlehem Steel Corp.
3	Cambria Steel Co.	Penn. Steel Co.	Youngstown Sheet & Tube Company	Republic Steel Corp.	Republic Steel Corp.
4	Lackawanna Steel Co.	Bethlehem Steel Corp.	Jones and Laughlin	Jones and Laughlin	Jones and Laughlin
5	Colorado Fuel and Iron Corp.	Cambria Steel Co.	Inland Steel Co	National Steel Corp.	National Steel Corp.
6	Penn Steel Co.	Lackawanna Steel Co.	Wheeling Steel Corp.	Youngstown Sheet & Tube Company	Armco Steel Corp.
7	Republic Iron & Steel Co	Republic Iron & Steel Co.	Republic Steel Corp.	Inland Steel Co.	Youngstown Sheet & Tube Company
8	Maryland Steel Co.	Youngstown Sheet & Tube Company	Colorado Fuel & Iron Corp	Armco Steel Corp	Inland Steel Co.
9	Tenn. Coal, Iron & R R Co.	Colorado Fuel & Iron Corp	McKinney Steel Co	Wheeling Steel Corp	Wheeling Steel Corp.
10	La Belle Iron Works	Inland Steel Co.	United Alloy Steel Co.	Colorado Fuel & Iron Corp.	Colorado Fuel & Iron Corp.

[1] Size measured in terms of rated annual steel ingot capacity. "Captive" capacities excluded.

Source: Gertrude G. Schroeder, *The Growth of Major Steel Companies, 1900-1950*, (Baltimore: The Johns Hopkins Press, 1953), p. 199.

APPENDIX 5

Advantages of the Johnstown, Pennsylvania vicinity in manufacturing iron – 1853.

Peter Schoenberger, *Cambria Iron Company of Johnstown, Pa.* (New York: George F. Nesbitt and Co., Printers, 1853), pp. 15-22.

A STATEMENT,

MADE IN MARCH, 1853, OF SOME OF THE ADVANTAGES OF THE VICINITY OF JOHNSTOWN, PA., IN THE MANUFACTURE OF IRON.

ON the western slope of the Alleghanies, at and near JOHNSTOWN, CAMBRIA COUNTY, PENNSYLVANIA, there are found immense beds of Iron Ore, semi-bituminous Coal, Limestone, Fire Clay and Water Cement.

The Pennsylvania Canal and great Central Railroad from Philadelphia to Pittsburg and the West, pass through this district, and cross each other at Johnstown—which is thus placed in the direct line of the main East and West traffic of the country.

JOHNSTOWN is a borough of upwards of 3,000 inhabitants. It is situated on a bottom land of a few hundred acres, which has been hewn out of the surrounding gentle acclivities by the waters of Conemaugh River and Stony Creek, which here unite and flow westward to the Allegheny.

In no part of the United States are found combined so many advantages for the manufacture of iron, as at Johnstown.

Arrangements have been entered into for purchasing about 25,000 acres of land, upon which there are now four furnaces using charcoal for fuel, erected at a cost of upwards of $250,000, including the personal property. These furnaces are now in successful operation, and their product, at the present price of Pig Iron, would realize a net profit of six per cent. on $1,000,000 capital. Several parcels of land, adjoining the town, which should be connected with the above, would make the whole purchase stand in to the Company about $300,000. This sum includes all the personal property, valued at over $100,000. Three thousand acres lie in the immediate vicinity of the borough, and comprise nearly the whole (if not all) of the mineral deposits near the town. This tract extends two and a-half miles along the Pennsylvania Canal, and is crossed by the Central Railroad, which passes for some eight miles through the whole contemplated purchase, opening up some of the finest coal veins in the State. The main vein of iron ore of Cambria County extends over a large portion of this property. It is found in an unbroken layer of three to four feet thick, which has been opened out along the hill sides near the town for two miles in extent, and at numerous other points all over the district, and seems to vary but little in general character. The stratum inclines but about one foot in sixty, and crops out all along the sides of the hills bordering the rivers and ravines, at a moderate elevation above the river bed. At Johnstown, the elevation is about 120 feet above the Conemaugh. In connection with this ore-bed is a supply of limestone, amply sufficient to flux the oar in charcoal furnaces, and the ore works with the unscientific machinery and labor now used with the most extraordinary facility. In fact, the furnaces work themselves, running a clear liquid cinder, and producing an excellent cold short iron—soft, and well adapted for foundry purposes—and when the furnaces are run rather close, they produce an iron every way proper for forges.

This ore is got out for seventy-five cents per ton; and delivered at the trunnel-head of the furnaces, ready roasted, it costs less than one dollar per ton. Six other veins of iron ore of similar character, and from eight to fifteen inches thick, lie under the above-named main stratum, at intervals of about ten feet from each other; and under all these mineral deposits, and still some feet above the canal bed, there is a vein of rich black ore, strongly magnetic after roasting, but which has never yet been used in the blast furnaces of the district.

The upper or main vein of ore is an argillaceous peroxide of iron, and yields by analysis 53 2-10 per cent. of iron. Prof. J. R. CHILTON, who perfected the analysis, has also examined the black ore from the lower vein, and pronounced it an argillaceous carbonate of iron, a species of *black band*.

Twenty feet below the great ore-bed, and cropping out in a similar manner everywhere along the hill sides, there is spread out over the whole district, as the numerous detached workings and experimental openings show, a $3\frac{7}{12}$ feet layer of excellent SEMI-BITUMINOUS COAL. Under this vein, at intervals of about 30 feet, are two other 3 to 4 feet beds of the same quality of coal, with the smaller veins of iron ore between them. Coal from these three layers has been long used in the vicinity, and sold to the surrounding country in its crude state, as well as in the form of coke. It is very free from sulphur, and the U. S. Government Experiments class it, for strength and other useful qualities, as among the best in America—surpassing all the coal deposits beyond the Alleghanies. It is mined for 42c. per ton, and will not cost at the trunnel-heads over 55c. per ton of coal, ready made into coke, for use in the furnaces proposed to be erected. The COKE is of superior quality, sound, heavy, and of a silvery appearance, well calculated for smelting iron. It has recently been tested in the charcoal furnaces, and even there works well with these ores.

The second vein of coal reposes on a 1¼ feet layer of strong dark LIMESTONE, used by the limeburners of the county, and just of the character required for fluxing the ores, should coke furnaces, on trial, work better for some addition to the lime that is now found in contiguity with the ore.

There is also at Johnstown, on the property, and directly under one of the coal veins, a five and one-half feet layer of Water Cement, which is now worked at great advantage, and from its superior quality, which is equal to any ever before discovered, the demand is far beyond the present ability of the works to supply.

The best of sandstone for furnace linings, hearths and tympstones is found in large masses on the surface, within a few rods of all the furnaces. Excellent moulding sand abounds. Oak, and chestnut and pine lumber is abundant, at an average of $10 per thousand feet. Good red brick at $3,50 per thousand; fire brick, $10 per thousand: lime 15c. per bushel. Provisions are cheap and plentiful.

Most of the land in question is of good quality for farming purposes. Some 1,000 acres that have been cleared, produce great crops of wheat, corn and hay, and the rest of the property is covered by a dense growth of chestnut and oak timber.

On the Conemaugh River, about a quarter of a mile below the Borough of Johnstown, is a tract of some fifty acres of bottom land, which offers the most desirable spot imaginable for the location of rolling-mills and other buildings requisite for producing railroad iron.

This location is bounded by the canal and river, and crossed at one end by the railroad.

On the other side of the canal, and at an elevation of some twenty feet above it, and above the site of the rolling-mill, on

the side of a hill full of these mineral treasures, is an excellent location for blast furnaces. The trunnel-heads will be a little below the level of the upper coal vein, and below the great ore-bed.

And the location, it is confidently believed, combines advantages superior to any other, for stocking blast furnaces, and for removing the cinder and pig metal. Millions of tons of iron can be made here without going three-quarters of a mile for any portion of the coal, ore and lime, or for the stone and brick for the furnace building and hearths.

The following table of the cost of producing pig metal and railroad iron at Johnstown, is based upon actual experiments by practical men—and its accuracy is confirmed by the results of the furnaces which have been long working the minerals of the district.

COST OF RUNNING STOCK THROUGH ONE FURNACE PER DAY.

1 Founder, per day,	$3,00
6 Keepers or helpers, at $1,50 per day,	9,00
3 Gutter men, at $1,00 "	3,00
3 Carmen, at $1,00, "	3,00
6 Fillers, at $1,00, "	6,00
4 Ore setters, at $1,00, "	4,00
4 " pounders, at $1,00, "	4,00
3 Horses and Carts, at $1,50, "	4,50
2 Lime breakers, at $1,00, "	2,00
2 Blacksmiths, at $1,00 and $1,50,	2,50
Iron and steel, per day,	1,00
2 Engineers, at $2,00,	4,00
Oil,	1,00
Salaries, per day,	8,00
Repairs, "	4,00
Insurance, "	50
2 Lumpers, at $1,00,	2,00
Expense for one day,	$61,50
	7
Expense for one week,	$430,50
Divided by 100 tons, product of one week, costing this sum per ton,	$4,30
Incidental expenses,	70
2¾ Tons, Ore, at $1,00 per ton,	2,75
4 " Coal, coked, at 54 cts,	2,16
½ " Limestone, at 20 cts,	10
Full cost of one ton Pig Iron,	$10,71
Say 10 per cent. interest on capital invested,	1,00
	$11,91
If two Furnaces are worked together, it will cost, per ton,	[illegible]
	$11,0[illegible]

COST OF PIG METAL MADE INTO PUDDLE BARS

Pig Metal,	$11,91	
10 per cent. waste,	1,19	
Stocking to Puddle Furnaces,	15	
Puddling,	3,50	
Squeezing and Rolling,	65	
Dragging out and weighing,	57	$17,9[illegible]
Puddle bar cost,	$17 90	
Waste, 6 per cent.,	1,07	
Cutting and piling,	25	
Heating,	75	
Rolling,	45	
Dragging out and weighing,	57	$20,99
Reheated bar cost	$20,99	
Waste, 6 per cent.,	1,26	
Cutting and piling,	25	
Heating,	75	
Rolling,	45	
Dragging out and weighing,	57	$24,27
Re-reheated bar cost,	$24,27	

Rail piles are made up of one-third puddle, one-third of reheated, and one-third re-reheated.

Puddle bar cost	$17,90
Reheatd bar "	20,99
Re-reheated, "	24,27
	3) 63,16
	$21,06

Rail pile cost	$21,06	
Heating and rolling into rails,	2,02	
Taking from rolls, hot and cold, straightening and delivered to landing,	1,3[illegible]	
Three tons of coal to ton of iron,	1,5[illegible]	
Engine drivers, helpers, cleaning out ashes and cinders,	30	
Oil, horses and carts, and lumpers, watchmen and mill-wright,	50	
Repairs on furnaces and machinery,	35	
Salaries and insurances,	1,12	
	$29,21	
Cost of rail finished and delivered at the landing,		$29,21
Interest on capital invested for mill, &c., $300,000, at 10 per cent., will make an additional cost of		2,10
		$31,31
Contingencies		4,19
		$35,60

The preceding calculation for producing Pig Iron and Rails will, it is believed, be found by experience ample, and after paying insurance and dividends, or interest at the rate of 10 per cent. on a capital of $1,000,000, the cost of railroad iron made here would, under no circumstances, exceed $36 per ton, to say nothing about the advantage that would arise in consequence of the rails being produced at a point nearer the great Western market than the sea-board cities are, by a freight of $3 per ton. It is well known that iron rails have never been landed in New-York for less than about $36 per ton cash, and they usually command much more; in fact, they are more often worth double that price.

Every allowance has been made for contingencies; indeed, these estimates and allowances are in every instance taken upon the largest scale, from the separate calculations of the late proprietors, and from those of the machinists and iron manufacturers who have inspected the property, and who have examined most of the various localities for iron-making in the Union, and the causes which have generally led to the failure of similar enterprises. The individual calculations, in most instances, bring the cost of rails below $30; but the extreme outside estimates of each separate item have been taken, that no contingency can be anticipated to hereafter arise, to invalidate these estimates.

Besides the continued profit to arise on the sales of the rails, at any price over $35½, and at which price they will pay a dividend to Stockholders of 10 per cent. on a capital of $1,000,000, there still remain the following sources of revenue :—

CEMENT.—The Cement bed can, it is confidently believed, be made to yield $10,000 per annum, or worked on shares, yielding a proportionate profit. Call it $8,000, it would be 10 per cent. income on a capital of	$80,000
LUMBER can be sold, without sensibly diminishing the quantity on the lands, that is without cutting it away faster than it will renew itself, for $8,000, per annum, to the saw-mills in the county. Call it one-half that, and there will remain an income of 10 per cent. on a capital of	$40,000
RENTS of over 200 houses, now built for laborers and employees, an amount fully equal to 10 per cent. on a capital of	$40,000
COAL AND FIRE BRICK CLAY can be sold at a profit at the mines.	

THE REAL ESTATE would rise immensely, and parcels could at once be sold at a great advance for cash, for farming purposes.

The following is a Certificate of one of the largest Iron Manufacturers in Pittsburg :—

I have examined the calculations for making Railroad Iron at Johnstown, and believe that, with furnaces producing one hundred tons of metal per week, and mills calculated to turn out one hundred tons of Rails per day, and capital sufficient to carry on the business to the best advantage, that Rails can be made at a price not exceeding $35,50 per ton.

J. H. SHOENBERGER.

PITTSBURG, OCT. 15, 1852.

The following is a Letter from a large Iron Manufacturer of Norristown, Pennsylvania :—

NORRISTOWN, AUG. 19, 1852.

Sir :—Agreeably to your request, I herewith give you my views on the subject of your contemplated project of manufacturing *Rails* at Johnstown. I have never seen so great natural advantages for the manufacture of Iron. The location of the iron ore is such that it can be carried by railway to the trunnel-head of the furnace with but once handling, unless it requires roasting, and in that case, only twice. The coal is located in the same convenient position, and can both be transported or carried to the furnace or mill with but a single handling, unless it requires coking, and in that case, only twice. The cost of coal, mining and delivery, cannot exceed one dollar per ton, and probably, will come within your estimate ; and the ore cannot exceed one dollar per ton. Limestone cannot exceed in cost the coal or iron. In Conshehocken, iron ore costs, at the

furnace, two dollars per ton ; and coal, three dollars per ton ; and limestone about, one dollar per ton. Say it takes—

CONSHOHOCKEN AND NORRISTOWN.		JOHNSTOWN.	
3 tons of Ore, a $2	$6 00	3 tons Ore, a $1 per ton,	$3 00
2½ tons Coal, a $3	7 50	3 tons Coal, a $1	3 00
Labor, blacksmithing per ton of Iron,	2 60	Labor, &c.,	2 60
Other expenses,	3 00	Other expenses, and interest,	3 00
	$19 10		$11 60
		Making in your favor,	7 50
			$19 10

---

1 ton Metal,	$19 10	1 ton Pig Metal,	$11 60
Labor,	11 00	Labor for Mill,	11 00
Waste, 25 per cent	4 52	Waste, 25 per cent.,	2 90
2¼ tons Coal, a $3,	6 75	Coal, 3 tons, a $1,	3 00
Wear, tear and interest, &c.,	6 00	Wear and tear, interest, &c.,	6 00
	$47 37		$34 50

This is the estimate I make of the cost of a ton of Rails at either place, and I think I ought to add, perhaps, one dollar per ton to each for salaries, and other contingencies, which would make the iron cost at Johnstown, $35,50, and at Norristown $48,37, making $12 per ton in your favor ; and I think if the iron is what you represent it to be, and which I have no doubt of, I, as a practical iron manufacturer, would much prefer your position, at my estimate, than I would the best we have in eastern Pennsylvania. With sufficient capital, and with experienced practical men, I would not think that there was any risk of making fifteen per cent. for the stockholders after the first year. More, however, will depend upon the management than most men, without experience, will suppose. Arrangements, so as to save labor in every process, are very important ; and no man that has not had practical experience in Furnaces, either knows their wants or conveniences, or their proper location.

Respectfully,

M. R. MOORE.

Of the firm of MOORE & HOOVEN.

APPENDIX 6

Articles of Association of the Cambria Iron Company

ARTICLES OF ASSOCIATION

OF THE

CAMBRIA IRON COMPANY,

Made and entered into under and pursuant to an act of the Legislature of Pennsylvania, passed the sixteenth day of June, in the year of our Lord one thousand eight hundred and thirty-six, entitled "An Act to encourage the Manufacture of Iron with Coke, or Mineral Coal, and for other Purposes," and an act supplementary thereto, passed the twenty-ninth day of June, in the year of our Lord one thousand eight hundred and fifty-two;

WITNESS, that the subscribers, citizens of the United States, whose names are hereto affixed, have associated themselves under and pursuant to the acts aforesaid, for the purpose of making and manufacturing iron from the raw material with coke, mineral coal and charcoal, and mining the mineral and using the products of the land of the Association; and do certify and declare the articles and conditions of their association to be as follows:—

ARTICLE FIRST. The name, style and title of the Company shall be the CAMBRIA IRON COMPANY.

ARTICLE SECOND. The lands to be purchased and held by the Company shall be in the counties of Cambria, Indiana, Somerset and Westmoreland.

ARTICLE THIRD. The capital stock of the Company shall consist of one million of dollars.

ARTICLE FOURTH. The said capital stock shall be divided into eighty thousand shares, of twelve dollars and fifty cents each.

The subscribers have subscribed for the number of shares set opposite to their respective names, and appointed Daniel Wild as receiver, to receive two hundred and fifty thousand dollars, said sum being one-fourth part of the capital stock subscribed.

ARTICLE FIFTH. The Board of Directors shall consist of seven, one of whom shall be chosen President.

ARTICLE SIXTH. The Company shall in all things be subject to and governed by the provisions of the acts of Assembly under which it is created, and shall have the same and no other or greater powers, privileges and franchises than are conferred on it by virtue of the said acts.

Dated the twenty-first day of August, in the year of our Lord one thousand eight hundred and fifty-two.

PHILADELPHIA COUNTY, *ss.:* I, the undersigned, Attorney General of the Commonwealth of Pennsylvania, having examined the Articles of Association of the Cambria Iron Company, together with the objects, conditions, &c., therein set forth, do hereby certify that I am satisfied of the lawfulness of the objects, articles and conditions of the said association; that the capital stock has been subscribed *bona fide*, and a sufficient amount paid in to authorize your Excellency to direct the instrument of association to be enrolled according to the provisions of the act of Assembly of 16th of June, 1836, and the supplement thereto, dated the 29th of June, A. D. 1852.

Witness my hand, this 26th day of August, A. D. 1852.

JAMES CAMPBELL.

EXECUTIVE CHAMBER,

HARRISBURGH, August 27th, 1852

To FRANCIS W. HUGHES, Esq.

Secretary of the Commonwealth:

Having examined the Articles of Association of the Cambria Iron Company, and being satisfied of the lawfulness of the objects, articles and conditions therein set forth and contained, as stated in the certificate of the Attorney General, and that the capital stock of the said association, to the amount of one million of dollars, has been *bona fide* subscribed, and the one-fourth thereof actually paid in, as appears by the affidavit of Daniel Wild, annexed to the said articles, I do hereby direct the said instrument to be enrolled at the expense of the applicants.

WM. BIGLER.

SECRETARY'S OFFICE.

PENNSYLVANIA, *ss:* Enrolled in Charter Book, volume No. 7, pages 486, 487 and 488. Witness my hand and seal of the Secretary's Office, at Harrisburgh, this 27th day of August, A. D. 1852

E. S. GOODRICH,

[L. S.] *Deputy Secretary of the Commonwealth.*

APPENDIX 7

Administrations of the Cambria Iron Company

Cambria Iron Company	September 13, 1852 – May 1, 1855
Wood, Morrell & Company, lessees	May 1, 1855 – September 1, 1862
Cambria Iron Company	September 1, 1862 – November 14, 1898
Cambria Steel Company	November 14, 1898 – August 22, 1901
Cambria Steel Company merged with Conemaugh Steel Company to form Cambria Steel Company	August 22, 1901 – 1916
Midvale Steel & Ordnance Company	1916-1923
Bethlehem Steel Corporation	March 30, 1923 – present

APPENDIX 8

Cambria Production 1860, 1865, 1875

Cambria Table of Wages 1860-61, 1864, 1865, 1875

Price of Iron Rails Sold by Cambria Iron Company

Source: John B. Pearse, *A Concise History of the Iron Manufacture of the American Colonies Up to the Revolution and of Pennsylvania Until the Present Time*, (Philadelphia: Allen, Lane & Scott Publishers and Printers, 1876), pp. 168-169.

Table of Production.

Material.	1864—Tons.	1865—Tons.	1875—Tons.
Coal, tons mined,	152,155	148,789	190,847
Ore, tons mined,	124,530	76,729	60,613
Pig iron, tons made,	26,484	17,606	21,436
Pig iron, tons bought,	10,333	15,538	56,673
New railroad bars,	21,107	20,676	12,407
Rerolled railroad bars,	10,700	15,741	25,416
Steel rails,			42,326

Table of Wages.

Kind.	1860–61.	1864.	1865.	1875.
Day labor,	\$0 70 per day	\$1 45 per day	\$1 56 per day	\$1 10
Puddlers,	3 04 per ton	6 49 per ton	6 54 per ton	4 18
Rail-heaters,	35½ "	69½ "	71¼ "	35 12/100
Ore-miners,	85 "	1 68¾ "	1 87½ "	1 20
Coal-miners,	32 "	78 "	82 "	48
Mechanics,	1 33 per day	2 70 per day	2 75 per day	2 00

Price of Iron Rails sold by Cambria Iron Company.

Year.	Lowest Price.	Highest Price.	Average Price on Total Sales.
1857.	\$40 00	\$63 50	\$52 95
1858.	40 00	56 00	46 93
1859.	45 00	56 00	50 10
1860.	35 00	57 00	46 40
1861.	33 90	45 50	35 63
1862.	35 00	65 00	39 98
1863.	35 00	85 00	58 55
1864.	39 00	150 00	78 36
1865.	43 78	150 00	103 92
1866.	77 75	123 20	85 40
1867.	78 00	106 40	83 44
1868.	75 00	100 80	76 13
1869.	77 00	95 20	77 34
1870.	71 00	95 20	74 14
1871.	68 50	84 00	70 00
1872.	68 00	106 40	72 66
1873.	72 80	106 40	83 05
1874.	54 00	80 91	64 25
1875.	44 55	67 20	47 60

APPENDIX 9

Cambria Iron Works, 1868

Source: S.B. McCormick, *Sketch of Johnstown and Suburbs and the Cambria Iron Works* (Pittsburgh: Barr & Myers, 1868), pp. 12-17.

The main building, or the first rolling mill, was built in the shape of a Maltese cross, the length being six hundred feet and the width one hundred. The cross arm was three hundred and fifty feet in length and seventy-five feet in width. In this building were put up fifty-six heating and puddling furnaces, two set of squeezers, several pair of shears, one set of rolls for bar iron, and one set of three high rolls for rails. There are five engines of immense power used to propel this machinery. A second wing was built at the side of the main building for the boilers, and a large stack built one hundred and fifty feet high, but in order to economize fuel, the boilers were torn down and one boiler built in the brick work above each furnace, so that the same heat that was used to melt the metal might heat the water for the creation of steam. This having been found to work well, the wing that had con-

tained the boilers was converted into a rolling mill for merchant iron, and a set of rolls placed in that department. These made the third set of rolls in the first mill, in addition to saws, pinchers, hammers, shears, and other machinery.

This mill, though large, was found too small for the increasing business of the company, though they could then turn out one hundred and forty tons of rails every twenty-four hours. An addition was then built, extending along the east side of the other building, and opposite the wing that had been built for the boilers. This extension is three hundred feet long and one hundred feet wide, running in the same direction as the other mill, and about twenty feet from it. In this apartment is a double set of heavy three high rolls and twelve additional heating furnaces, with squeezers, shears, saws, straightening hammers and punches, all propelled by an immense vertical engine.

It was soon discovered, however, that the bar rolls had not sufficient capacity to supply all these rail rolls, and accordingly, a third mill was projected and built. This extension might be termed another cross, the main building extending three hundred feet in length down the river, and the width seventy-five feet, the cross arm being about two hundred feet long and fifty wide, the two crosses standing with the heads in opposite direction, and the left arm of the one connecting with the right arm of the other. In this building are an extended set of three high bar rolls and fourteen puddling furnaces, and a large vertical engine, with all other machinery necessary for making bar iron.

Another, or fourth mill, is soon to be erected, eastward of the second rolling mill, for the purpose of rolling Bessemer steel into rails. As this business requires heavy machinery, the building will have to be very large, not less than three hundred by one hundred feet.

The three high rolls used in this mill were invented and patented by John and George Fritz, Esqs., and save much time, labor and steam. John Fritz was for a long time Superintendent of the mechanical works in the mill. He left and was succeeded by his brother George, both of whom have superior skill in machinery of the kind described, and are very energetic business men.

These mills are all built of brick and have slate roofs. Between the columns of brick there are large doors that can be opened in summer, and closed in winter, and the works can thus be ventilated.

In addition to these mills there is a machine shop, a foundry, a smith shop, a pattern making shop, a boiler house, a metal house, an iron house and other buildings.

The machine and pattern making shop is a brick building, two hundred and ten feet long, fifty feet wide and one story high. This is filled with all kinds of machinery for planing and turning wood and iron, and for boring and riveting, and indeed for any description of work. The foundry is an ornamental brick building, one hundred and forty feet long and seventy-five feet wide, containing immense cupolas, cranes and other machinery for making and handling heavy castings. The rolls used in the rail mill are cast here and turned in the machine shop.

The smith shop is a brick building, eight square and has eight double furnaces, blasted by steam power. It contains a large crane and other conveniences for lifting heavy materials. This building is spacious and affords ample room for the smiths and helpers. Connected with it is an iron house, seventy-five feet long and twenty feet wide, also built of brick. The boiler shop is one hundred and fifty feet long and forty-two feet wide. A rail road runs through the centre, and there are platforms at each side to facilitate the loading and unloading of boilers. Near this is an office building, sixty feet long, thirty feet wide and two stories high, where the clerks of the mill keep the time and other accounts. There is also a large grist mill near the rolling mill, large stables, wagon makers and carpenter shops, metal sheds, saddler shops, and other buildings.

Nearly opposite, and about forty rods from the main works, and connected with them by rail road, is erected a stack of four furnaces of great capacity. Above them a large coke yard, and above it, around the hill, a rail road on the level with the ore, from which a number of main drifts are opened into the hills. These four furnaces will yield weekly about 800 tons of metal, which is taken by rail road to the mill, puddled and rolled into bars, cut, heated again and rolled into rails, then loaded on cars and taken by the Company's Rail Road a quarter of a mile, to the Pennsylvania Rail Road, where they intersect. From there it is shipped east and west. In addition to this amount of metal produced weekly, as much old iron, obtained from worn-out rails, is also used. The top and flanges of every rail are made of the tough Juniata iron, brought from the Company's furnace at Hollidaysburg. A large quantity of this metal is also used, perhaps one-fifth of the gross amount of the metal used for rails. Two of the Johnstown furnaces employ one hundred and twenty coal miners, two hundred and sixty ore miners, fifty men to break and roast ore, fifty to coke the coal, and sixty to attend to other work about the furnaces.

One and fifty-eight one-hundredth tons of coke are used to one ton of iron. Two and sixty-one one-hundredth tons of ore produce one ton of iron.

The Company have also about two hundred and fifty dwelling houses near their works. They pay out to furnaces and all, about $120,000 monthly. They are ready to fill all orders for any size of rail. The following is the best testimonial of its quality:

OFFICE PENNSYLVANIA RAIL ROAD,
Philadelphia, May 30, 1855.

Previous to purchasing eight hundred and fifty tons of Rail Road iron, made at the "CAMBRIA IRON WORKS," offered to this Company, we had its quality fully tested by our Chief Engineer, who pronounced the rails to be equal to any made in this country. J. EDGAR THOMSON, President.

The following list comprises the principal names of the persons forming the administrative force in and about the mill and store:

CHARLES S. WOOD, President of the Company.
E. Y. TOWNSEND, Vice " " "
JOHN T. KILLE, Secretary " "
DANIEL J. MORRELL, Local Superintendent.
POWELL STACKHOUSE, Assistant Superintendent.
GEO. FRITZ, Superintendent of the Mechanical Department.
ALEXANDER HAMILTON, Manager of the Rolling Mill.
JAMES MORLEY, Civil Engineer and Superintendent of the Mines.
WM. C. GRIST, Superintendent of the Coke Yard.
THOS. JUDGE, Ass't " " "
THOMAS COLLINS, Manager of the Blast Furnaces.
ROBERT W. HUNT, Chief of the Chemical Department.
DAVID PEELOR, Surveyor and Plotter.
JOHN ELDRIDGE, Collector of Rents, and Sup't of Rental Estate.
BARNEY ZIGLER, Overseer of the Puddlers.
JAMES DUNLAP, " " "
WM. PRICE, Superintendent of the Old Muck Rolls.
JOHN HOOHE, " " " " "
WM. DEVINE, Manager of Rolls in the New Mill.
JAMES WILLIAMS, " " " " "
CHARLES KENNEDY, Ass't Manager under Alexander Hamilton.
JAMES MOORE, " " " " "
JOHN GORE, Superintendent of Engines and Steam Power.
EDWARD THOMAS, " " " " " "
JACOB COON, Superintendent of the Machine Shop.
EVAN G. LEWIS, Foreman of the Pattern Shop.
JOSEPH LAYTON, Manager of the Smith Shops.

DANIEL SEIGH, Superintendent of the Boiler Shop.
JOHN E. FRY, " " Foundry.
JESSE OLDHAM, " " Shears, &c.
EDWARD MELDERN, " " Mining and Delivering Ore.
THOMAS BUTLER, " " " " " Coal.
JONATHAN LEWIS, Superintendent of Prospecting for Ore.
JACOB SEIGH, Boss of Blacksmith Shop at the Stables.
JOHN WOODS, Manager at Stone Quarries.
JAMES BELL, Foreman of the Rod Mill.
CHARLES CARTWRIGHT, Foreman of the Rail Mill.
THOMAS LAPSLEY, " " " "
JAMES COOPER, Superintendent of Animals and Stables.
SAMUEL MCKEEVER, Foreman of the Bricklayers.
JOHN WHITE, Overseer of the Inside Laborers.
JOHN CROUSE, " " Outside Laborers.
JAMES LANE, General Timekeeper in the Mill.
A. M. GREGG, Timekeeper in the Mechanical Department.
O. N. RAMSEY, Sup't of the Johnstown Manufacturing Company.
LEVI ENFIELD, Foreman of the Carpenters.
DAVID LUCAS, " " Wagonmakers' Shop.
ALEX. KENNEDY, " " Shoe "
ANDREW MOSES, " " Tailor "
EMANUEL YOUNG, " " Meat "
GALE HESLOP, " " Paint "
HENRY GORE, Contractor for the Delivery of Coal.
GEO. OILER, Overseer of the Coal Miners in Cambria Borough.
GEO. MCCLEAM, Overseer of Laborers around the Store.
JAMES MCMILLEN, Superintendent of the Stores.
PETER MASTERSON, " " Dry Goods Department.
JOHN S. BUCHANAN, " " Grocery Store.
JOHN V. SHAFFER, " " Clothing Store.
JAMES F. CRAVER, " " Shoe Store.
PERRY BOLSINGER, " " Feed Store.
PETER MASTERSON, " " Fancy Store.
J. S. BUCHANAN, " " Vegetable Store.
WILLIAM TIBBITT, Foreman of the Grist Mill.
HAMILTON MCDOWELL, Conductor of Hollidaysburg Metal Trains.
JOHN SHOFFNER, Superintendent of the Benscreek Property.
ALLEN ROSE, Overseer of the Laborers.
BENJAMIN JOSE, Boss of Laborers around the Mines.
JOHN LLEWELLYN, Boss of Roasting Ore.

The clerks employed in the upper office are as follows:

PIERCE FISHER, H. A. BOGGS, GEORGE RANDOLPH,
JACOB HOFFMAN, J. B. PRATT.

The clerks in the lower office are:

JOHN LITTLE, SAMUEL DOUGLASS, W. W. FREEMAN,
JONATHAN BOWEN, JACKSON DAVIS, JAMES ELDRIDGE,
FRANK GILBERT, GEORGE ENGLEBAUGH.

In addition to these there are many weighmasters at the mill, clerks in their store, engineers and others, swelling the active force to more than one hundred persons. This does not include the managers of the Hollidaysburg furnace and store, which would add an additional score to the number already noticed.

This administrative force is principally controlled by D. J. Morrell, Esq., who is undoubtedly a great business man, and eminently successful. Few men possess such energy of character combined with so genial a disposition. Bearing up all the responsibility of these immense works, one might expect he would be sullen and gloomy. Such is not the case. In all his intercourse with those in his employ, he has a smile and kind recognition for every one.

George Fritz, Esq., the manager of the Mechanical Department, relieves Mr. Morrell of much responsibility by his perfect knowledge of the iron making business, and by his adaptation to the position he occupies. As much may be said of many others, but eulogy is not our object in this pamphlet.

APPENDIX 10

Gautier Steel Department Trade Catalog, Wire, Terms, Finished Plow Shapes

JOHNSTOWN, July, 1883.

We are making and shipping, on an average, over **One Hundred Tons of Wire** every business day in the year, of various kinds, as follows:—

ANNEALED WIRE,
BRASSED WIRE,
BAIL WIRE,
BUCKLE WIRE,
BELT WIRE,
BRIGHT WIRE,
BELL WIRE,
BROOM WIRE,
BRAZIER RODS,
BARBING WIRE,

BONNET WIRE,
BLIND WIRE,
CHAIN WIRE,
CHECK ROWER WIRE,
DIAMOND SHAPE WIRE,
CRIMPING WIRE,
CAST STEEL WIRE,
CARD WIRE,
COPPERED WIRE,
FLAT WIRE,

FURNITURE SP'G WIRE,
FENCE WIRE,
GALVANIZED WIRE,
HAY BALING WIRE,
HARNESS WIRE,
FENCE STAPLES,
GUN SCREW WIRE,
HALF ROUND WIRE,
MARKET WIRE,
HAIR PIN WIRE,

HAT WIRE,
HORSE NAIL WIRE,
MACHINERY WIRE,
OVAL WIRE,
RIVET WIRE,
HOOK AND EYE WIRE,
NAIL WIRE,
PIN WIRE,
ROPE WIRE,
SQUARE WIRE,

RIVET RODS,
STRAND WIRE,
SCREW WIRE,
STRAIGHTENED WIRE,
TELEGRAPH WIRE,
SPRING WIRE,
STAPLE BARBS,
STONE WIRE,
TINNED WIRE,
TACK WIRE,

TELEPHONE WIRE,
VINEYARD WIRE,
WOOD SCREW WIRE,
TRIANGULAR WIRE,
WIRE RODS,
WEAVING WIRE.

"Gautier Fence Wire," annealed or galvanized, stands at the head of the trade, for excellence of quality, and our product is the largest of any wire mill in the world.

TERMS ON WIRE.

Nett 60 days' acceptance, or 2% for cash in 10 days from date of shipment, upon approved accounts.

F. O. B. Cars at Johnstown, with freight allowance to competitive points, as may be agreed, on quantity shipments.

We are prepared to contract with makers of Barb Wire Fencing, for season supplies or current daily or weekly shipments. Our immense production and unapproached facilities generally, render this the safest and surest base of supplies for Barb Fence makers who require a large and steady shipment of wire upon which they can always depend.

Our responsibility for goods sold with freight allowance, ceases as soon as they pass into the custody of the Railroad Company.

No freight allowance on shipments of less than 600 lbs.

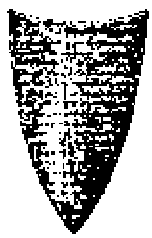
The Cambria Iron Co. will not be liable for any loss or damage arising from non-fulfillment of any contract by reason of fire, strikes, manufacturing contingencies or any cause beyond their control.

Source: Cambria Iron Company, Gautier Steel Department, *Gautier Steel Department of Cambria Iron Co., manufacturers of merchant steel of every description: springs, rake teeth, fingerbars, knife backs, harrow teeth, plow steel, finished plowshares, and wire of all kinds. Works and general office, Johnstown, Pa.* ([Johnstown, Pa.:] Cambria Iron Co., 1883), pp. 36-37, 118-119.

WESTERN PATTERNS.

DOUBLE SHOVEL.

Polished.



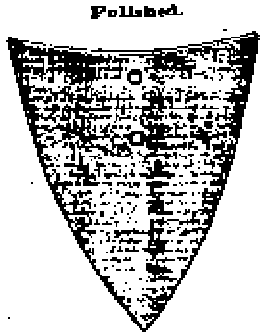
64

5×10, 6×10, 7×10, 8×10, 7×11, 8×11, 9×11, 8×12, 9×12, 9×13, 10×12×$\frac{3}{16}$ or $\frac{1}{4}$, with bolts in the work.

Any other sizes desired.

SINGLE SHOVEL.

Polished.



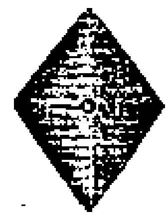
66

10×13, 12×14, 13×15, 14×16, 15×17×$\frac{3}{16}$ or $\frac{1}{4}$, with bolts in the work; ground lengthwise of the blade, and tempered in the most skillful manner.

Any other sizes desired.

GRASSHOPPER DIAMONDS.

Polished.



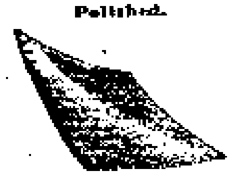
70

7×9, 8×10×$\frac{3}{16}$, with bolts in work, and carefully tempered.

Other sizes when desired.

DIAMOND REVERSIBLE STEEL TOOTH.

Polished.



72

Standard size, 5×9×$\frac{3}{16}$, with bolts in work, and carefully tempered.

Other sizes when desired.

APPENDIX 11

Cambria Iron Company 1878 with plan of the works

Source: Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXVI (July 12, 1878): 21-24.

AMERICAN IRON AND STEEL WORKS.

By A. L. Holley and Lenox Smith.

No. XXVII.—Works of the Cambria Iron Company.

(Continued from page 157, vol. xxv.)

General Arrangement of Plant at Johnstown.—This is shown by the plan, Fig. 1, page 22; the plant covers 60 acres of ground, upon seven of which stand the rolling mills.

References to Plan, Fig. 1 (see page 22).

1. Weigh scales.
2. Weigh office.
3. Belgian coke ovens.
4. Coal washer.
5. Belgian coke ovens.
6. " "
7. Water tank.
8. Smiths' shop.
9. " "
10. Stable.
11. Clay house.
12. Firebrick store house.
13. Boilers for plane engine.
14. Tool house.
15. Pump.
16. Smiths' shop.
17. Plane engine.
18. Stock house.
19. Hot blast.
20. Casting house.
21. Blast furnace, No. 3.
22. Boiler house.
23. Engine house.
24. Projected blast furnace.
25. Office.
26. Engine house.
27. Boiler house.
28. Blast furnace.
29. Engine house.
30. Blast furnace.
31. Office.
32. Stable.
33. Pump house.
34. Wash house.
35. Weigh office.
36. Pattern shop.
37. Wire rod mill.
38. Merchant mill.
39. Forge train.
40. Boiler house.
41. Steel rod mill.
42. Iron rail mill.
43. Store house for steel works.
44. Car shop.
45. Locomotive house.
46. Boiler house and gas producer.
47. Blooming mill.
48. Pattern house.
49. " "
50. Boiler house.
51. Pattern house.
52. " "
53. Blowing engine house.
54. Sand house.
55. Foundry.
56. Sand house.
57. " "
58. Carpenters' shop.
59. Machine shop.
60. Blacksmiths' shop.
61. Smiths' shop.
62. Pattern shop.
63. Drawing office.
64. Forge train.
65. Merchant mill.
66. Locomotive house.
67. Rock crusher.
68. Weigh office.
69. Boiler house.
70. Engine room.
71. Bessemer plant.
72. Pump house.
73. Clay house.
74. Office.
75. Projected steel works.
76. Projected Siemens-Martin plant.
77. Gas producers.

The coal washing and coking apparatus, as well as the stock houses of blast furnaces Nos. 1 to 4, are upon a high bank; the rest of the plant is on a level. Coal for coking is drawn up an incline (47) directly out of the mines under the works; that for mill use is drawn in mine cars across the Conemaugh river, down an easy grade directly from the workings on the opposite bank. The blast furnace No. 6 (24) is not yet completed. The second Bessemer plant shown (75) will not be built, but the open hearth plant (76) will be made quite large; it is already partly built. Two Pernot 15-ton furnaces will also be running during the year. Although the plant has grown from small beginnings to its present size, the arrangement of the departments is more than ordinarily convenient; the yard spaces are ample, and wide and narrow gauge railways afford abundant facilities for transportation.

Character of Buildings.—With a few exceptions, all the structures are of brick; the walls are thin and heavily buttressed, the buttresses sometimes being hollow. This construction obviously gives the greatest strength with the least material. The roofs of the rolling mills (excepting a small portion of the puddle mill), and of the Bessemer shop, blooming house, new furnace buildings, and some other buildings, have iron trusses and slate covering. A type of roof truss is shown by Fig. 9, page 23. The forms of iron are simple; they are all rolled in the company's trains and put together in its shops.

Sizes of Principal Buildings.

	ft.		ft.
Iron rail and puddle mill	489.8	by	68
Merchant wing shops	70	"	98.5
Puddling furnace wing	181.5	"	74.5
"	104	"	74.6
Puddle and merchant mill ...	816	"	74.6
" " rail wing	302	"	72
Steel rod mill	395	"	64
Bessemer shop	104	"	180
Blooming mill (completed) ...	680	"	120
Machine shop	210	"	65
" wing	85	"	65
Boiler shop	150	"	60
Foundry	145	"	75
Pattern shop	110	"	50
Carpenter shop	60	"	30
Drawing office	65	"	35
Open hearth building	145	"	96

Machine Shop.—The main building is of brick, 210 ft. long, 65 ft. wide, and 20 ft. high, with an extension 85 ft. in length, 65 ft. wide, and 45 ft. high. The main building contains three jib cranes of 10 tons capacity, eight lathes for turning rolls from 42 in. diameter and 9 ft. long (blooming) down to 7 in. diameter by 12 in. long (wire). One lathe turns rolls from 42 in. to 30 in. diameter, four lathes from 30 in. to 10 in. diameter, two from 24 in. to 10 in. diameter, and one from 12 in. down to the smallest size. Four complete sets of rail rolls may be turned out monthly in addition to ordinary repairs. There is a large planer 7 ft. by 7 ft. by 30 ft., a planer 4 ft. by 4 ft. by 24 ft., two planers 3 ft. by 3 ft. by 12 ft., and also compound planers, a slotting machine, a boring mill 13 ft. diameter and one 4 ft. diameter. There is also a 48 in. engine lathe with 24 ft. bed and twelve other lathes ranging from 40 in. down to 12 in. swing; five drill presses, upright and radial, and a complete range of tools for straightening, gear cutting, emery grinding, and for other purposes.

The power in the machine shops is furnished by a vertical engine with 19 in. cylinder and 24 in. stroke, making 80 revolutions per minute. The speed of the line shaft is 120 revolutions per minute. There are two Harrison boilers and two Corliss boilers which generate steam for the machine shops, blacksmith shops, and foundry. The machine shop also contains a 35-ton travelling crane.

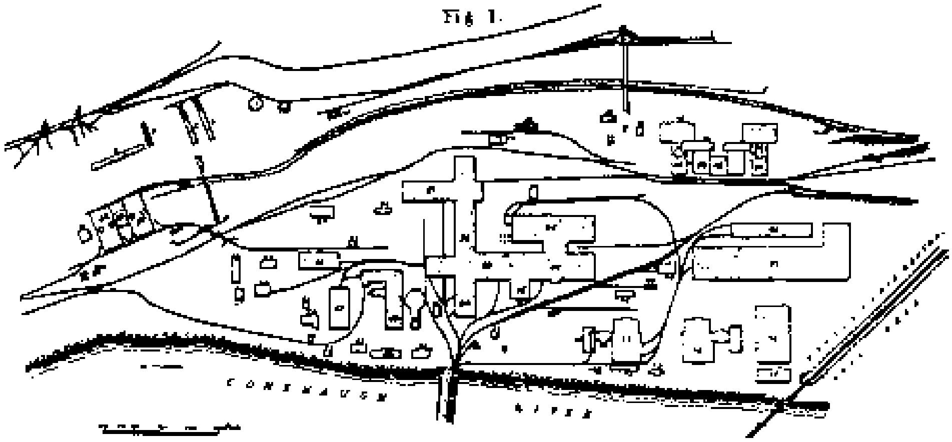
The Foundry is a brick building 145 ft. long by 75 ft. wide, and 25 ft. high, containing two 30-ton cranes, one 15-ton crane, three core ovens 12 ft. by 12 ft. and 10 ft. high, one 16-ton reverberatory air furnace, one 5 ft. cupola with capacity of 8 tons per hour, and one 4 ft. cupola with capacity of 5 tons per hour. There are one floor and three loam spindles. The heaviest casting made in this foundry was 36 tons, and the usual daily capacity is 16 tons of castings, including the heaviest kind of rolls up to 19 tons weight.

The Smith Shop is a brick octagonal building 100 ft. in diameter with a wooden trussed roof carried upon a cast-iron column in the centre; this forms a mast for a crane which serves eight fires. Four side cranes each reach from two outside forges and transfer to the centre of crane, which also serves two steam hammers located near the centre of the shop. A wing 60 ft. long and 34 ft. wide is used as a stock room for iron and steel. At the intersection of the two buildings a 4000 lb. steam hammer is located. The smoke from each pair of forges is conducted away through pipes connecting with a central stack, which carries off the smoke and gases so effectually that the workmen do not suffer any inconvenience from them.

The Rolling Mills.—The puddling and finishing mills are shown by Fig. 4. The directions of the

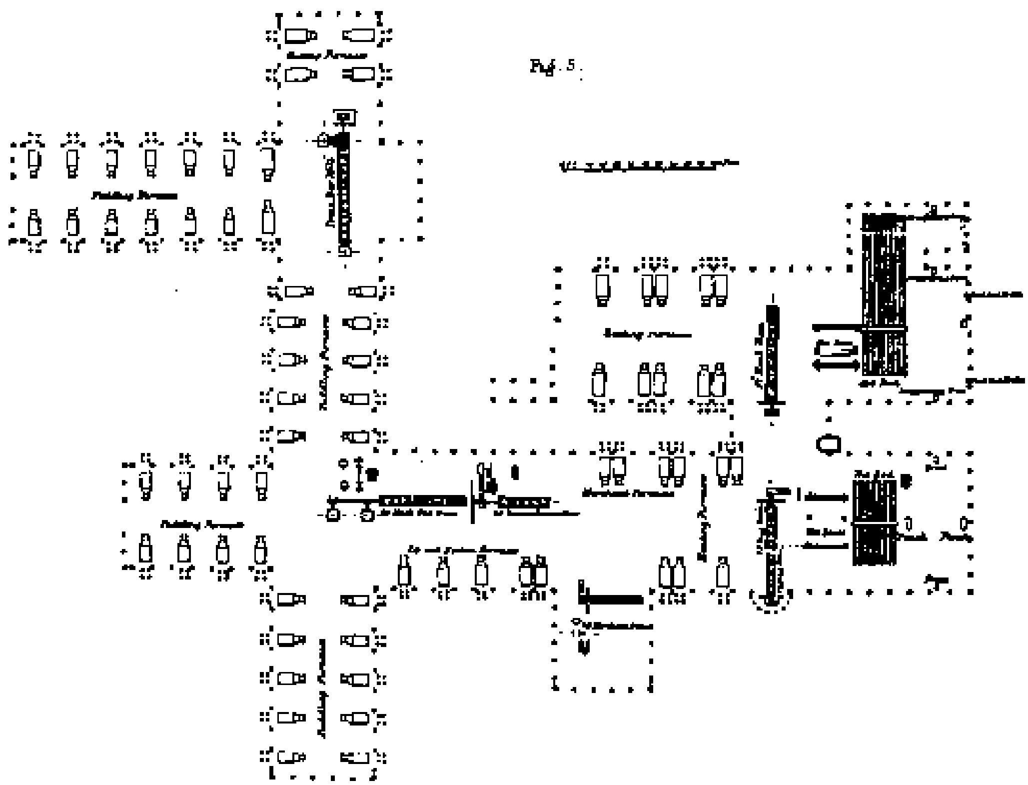
THE WORKS OF THE CAMBRIA IRON COMPANY AT JOHNSTOWN, U.S.A.

Fig. 1.



GENERAL PLAN OF WORKS.

Fig. 5.



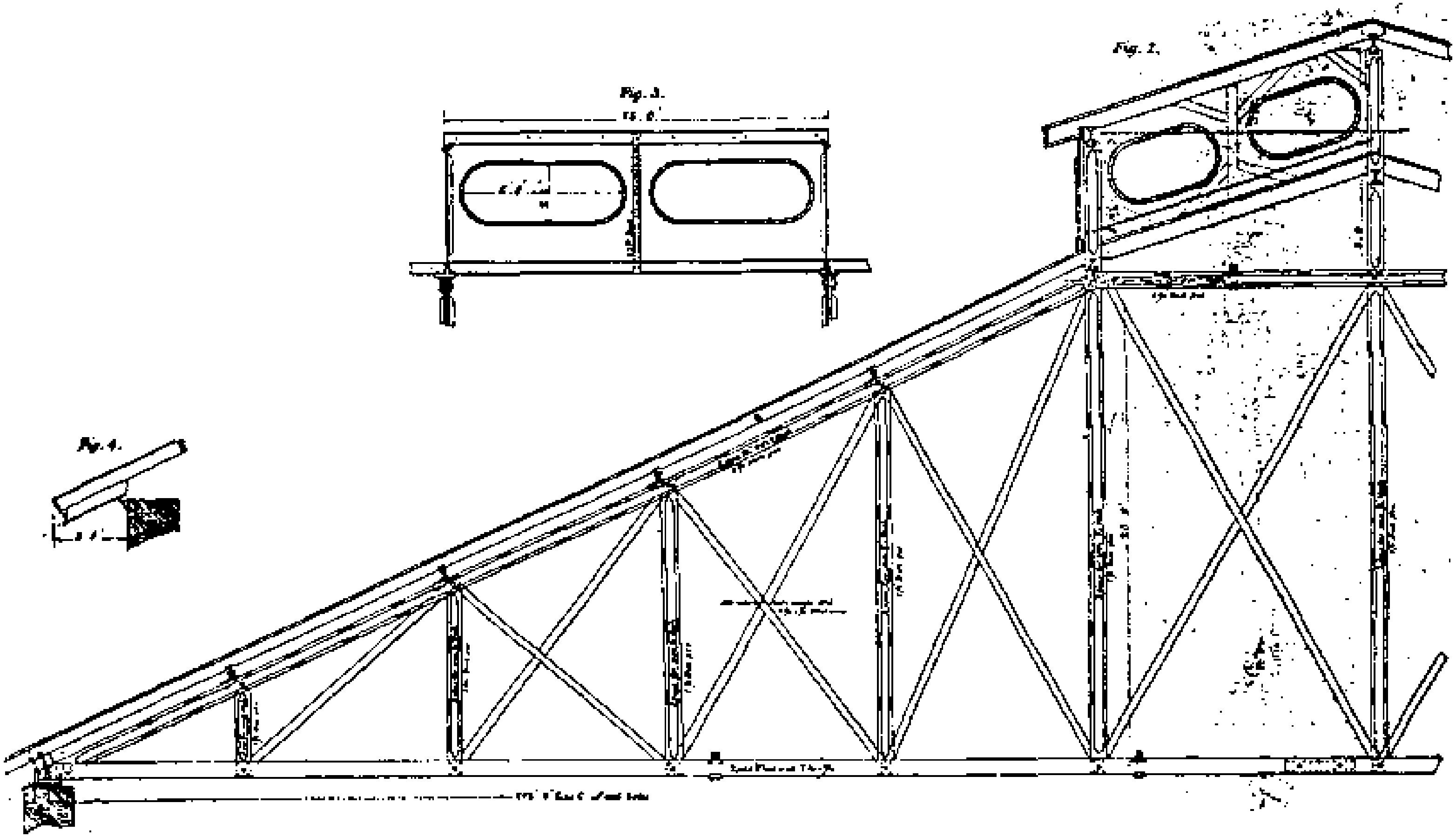
PLAN OF ROLLING MILL.

different trains and furnaces are correctly represented in the engraving, except that the puddling furnace wing on the extreme left has been enlarged and partly converted into a wire-rod mill.

The puddling department contains 42 double puddling furnaces with overhead horizontal boilers 40 in. in diameter, and 30 ft. long. The 22 in. forge train (Fig. 3) consists of 3 stands of 2-high rolls and 3 rotary squeezers on one side of the engine; on the other side there are two stands of top and bottom rolls. The engine is horizontal, non-condensing, and directly connected; it has 30 in. cylinder and 4 ft. stroke, with a 35-ton flywheel, 30 ft. in diameter, making 45 revolutions per minute.

The larger of the two rail mills contains a three-high 21 in. train consisting of three stands of rolls driven by a vertical condensing engine with cylinder 40 in. diameter and 32 in. stroke and 30-ton 24 ft. flywheel, making 58 revolutions per minute. This train has two stands of rolls for rolling iron rails and miscellaneous heavy sections, and is supplied with stock by ten coal-heating furnaces with overhead boilers, each 40 in. diameter, 30 ft. long, and having a 16 in. flue. The smaller rail mill has a three-high 18 in. train consisting of two stands of rolls for rolling iron rails, light steel rails, merchant bars, and heavy fishplates. This train is worked in connexion with nine coal-heating furnaces with plain cylinder boilers overhead, and is driven by a condensing engine with 38 in. diameter of cylinder and 30 in. stroke, making 98 revolutions per minute; the flywheel has 20 ft. diameter and 30 tons weight. These engines are made condensing by means of an independent vacuum engine having an 18 in. cylinder by 20 in. stroke and driving an air pump with 30 in. piston and 20 in. stroke.

IRON ROOF AT THE WORKS OF THE CAMBRIA IRON COMPANY, JOHNSTOWN, U.S.A.



The flywheel of the larger engine, and other wheels in these works, are put together in an uncommon manner. The rim is cast in one piece; the neck and arms in another piece. The arms being laid within the lugs on the rim made to receive them, the more or less large spaces are solidly packed with oakum, thus making a thoroughly strong and durable connexion without the expense of tool fitting. Oakum is also driven under the bedplates of engines and trains; it of course makes a perfect fit; it is harder than oak, and slightly elastic.

The Gustin rail curving and straightening apparatus, which is being generally adopted in American rail mills, is completed, and is about to be set up in this mill. It will be fully illustrated in a subsequent article about the Troy Steel Works.

In the steel rail mill there are nine heating furnaces. The usual work is seven blooms (7 in.) and seven rounds per turn. Sometimes three turns are made per 24 hours.

There are several merchant trains. In the smaller rail mill there is a three-high 19 in. train, with three stands of rails, driven by a direct vertical 24 in. by 24 in. engine having a 14-ft. 14-ton flywheel, and making 120 revolutions per minute. On this train are rolled very light iron rails, and light fishplates, rounds and squares.

The 16 in. train has three stands of two-high rolls, and is driven by a horizontal engine with 18 in. cylinder, 3 ft. stroke, and 16-ton 16-ft. flywheel; it makes 90 revolutions per minute.

The 21 in. three-high train next the wire-rod mill was formerly a puddle and top-and-bottom train; it worked up, and partly reworked the product of 40 double puddling furnaces; it has two rotary squeezers attached. It now contains six stands of rolls for squares and rounds of 6 in. down to 3 in., and flats from 10 in. wide; also for corrugated bars and various heavy steel and iron shapes. As three pieces are in the train at once, it is capable of turning out above 300 tons per turn, on heavy work. It is driven by a vertical engine having a 40-in. cylinder, 5 ft. stroke, and a 40-ton 30-ft. flywheel; it makes 45 revolutions per minute. It is supplied with stock by 19 coal-fired heating furnaces with overhead single flue boilers like those described above.

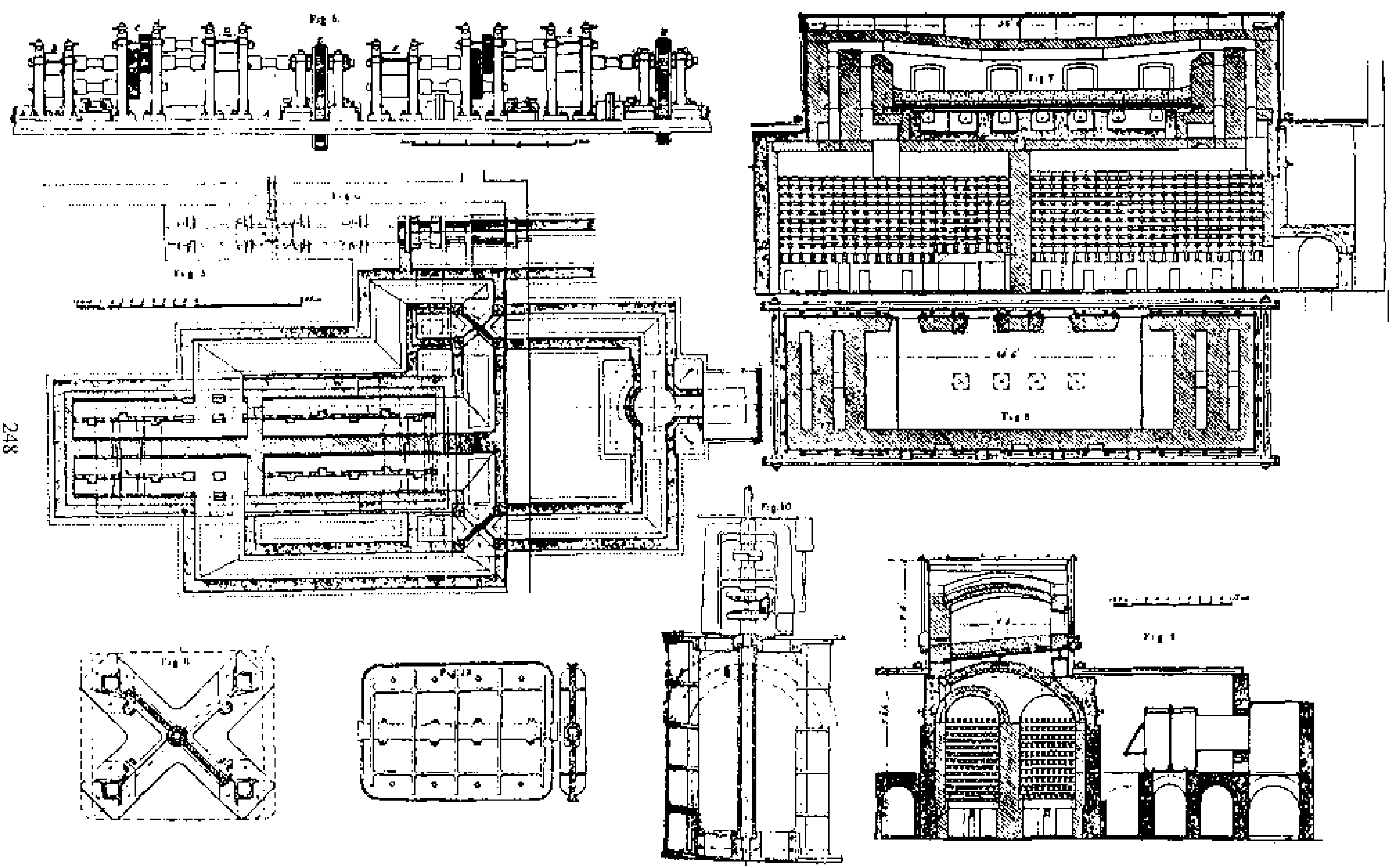
The product of the steel rail train averages about 1300 tons per week. The iron rail train turns out above 1100 tons per week. The 19 in. train makes 140 tons of fishplates, and the 16 in. train yields about the same tonnage of 1¼ in. wire-rod billets per week. As already remarked, the 21-in. merchant train having six stands of rolls, may produce 2000 tons or more per week. Of the remainder of the rolling mill arrangements we must defer our account until our next article.

APPENDIX 12

Cambria Iron Company 1878 with drawings of Wire Rod Train and Siemens Heating Furnaces

Source: Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXVI (July 19, 1878): 41-43.

WIRE ROD TRAIN AND SIEMENS' HEATING FURNACES AT THE WORKS OF THE CAMBRIA IRON COMPANY, U.S.A.



AMERICAN IRON AND STEEL WORKS.

By A. L. Holley and Lenox Smith.

No. XXVIII.—Works of the Cambria Iron Company—(continued).

The wire-rod train is illustrated by Fig. 5 of the two-page engraving which we publish this week, and is probably the best type of train for this purpose. It contains some novelties upon which the Cambria Iron Company own patents. When one end of the billet is in the roughing rolls, the other end, which has been rolled into No. 7 wire rod, is on the reel, and the intermediate parts of the piece are in the various grooves of the train. The lengthening of the piece must, therefore, be nearly uniform, and in order to accomplish this, with constantly reduced section, it is necessary that the speed of the periphery of rolls should be regularly increased. To do this by successively increasing the speed of rolls of uniform diameter, would give to the last rolls of the series an impracticable speed. To accomplish the same result by successfully increasing the diameter of rolls having uniform speed, would give to the last rolls of the series an impracticable diameter. The system covered by the Cambria Iron Company's patents is the combination of these methods, as will appear from the following description of the train. The roughing and finishing rolls stand in line on the same shoes, but they are independent. The engine of the roughing train has a 20-in. cylinder and 40-in. stroke, the revolutions of the train being 85 to 120, according to the size of rod. The finishing train is geared to a 24-in. by 40-in. engine running at 110 revolutions. The speed of the last finishing roll is about 460 revolutions. All the six stands of finishing rolls are geared to a shaft A (making about 250 revolutions per minute) which lies under the train. The driver of the first stand of rolls G has 39 teeth, the driven gear has 23 teeth. These rolls are 8 in. in diameter. The rolls in the second stand F have the same number of revolutions, and are 10 in. in diameter, so that their peripheries have the necessary increase of speed. The driver E (on the shaft below the train) of the third stand of rolls D, has 38 teeth, the driven gear having 18 teeth. The diameter of the rolls is again 8 in., and the speed of periphery is greater than that of the second stand of rolls. The fourth stand of rolls B is driven at the same number of revolutions, but the rolls are 10 in. diameter, so that the speed of periphery is suitably increased. It will be observed that the train is in principle a three-high train. There is a continuous line of rolls corresponding to the middle rolls of a three-high train. The engaging roll of the first stand G is above this continuous line of rolls; the engaging roll of the second stand F is below, and so on. The effect of this is that the first rolls deliver one way, the second the opposite way, the third the first way, and so on. The piece is thus passed backwards and forwards through the rolls, instead of being passed over without work, at every other pass, as would be the case in the ordinary two-high train. It will also be observed that a stand of three-high pinions C has to drive a pair of 10-in. and a pair of 8-in. rolls; the middle pinion has to drive a 10-in. roll at one end and an 8-in. roll at the other end; and the rolls and pinions should be in line to work smoothly. This difficulty is cleverly overcome by making the middle pinion double, giving it two diameters to engage the 8-in. and 10-in. pinions of the respective stands of rolls. The housings are open-topped, and the top roll is adjusted by a screw operated conveniently by a wormwheel. On the side of the pinion housings between the first and second, third and fourth, and fifth and sixth sets of finishing rolls are placed small rotary shears driven from a worm on the lower pinion; they are used for cutting the ragged ends of the rod while rolling.

The wire-rod billet is 1½ in. square. In rolling Nos. 4 and 5 W.G. rods, there are four roughing and six finishing passes. No. 7 rods require six roughing and six finishing passes. No. 9 rods, which have been successfully and exceptionally rolled, have eight roughing and six finishing passes. The product of the train is 26,000 lb. of No. 7 W.G. rod per turn average, and 36,000 lb. maximum.

The producers used in connexion with the heating furnaces for the iron rod mill are of the shape of a frustum of a cone and are made of wrought-iron plates lined with fire brick. The producers are worked with cold blast, which is applied under the grates. The fuel is charged through a sliding hopper, and the gases are taken off by a pipe near the top of the producer leading through the valve chamber to a flue underneath the furnaces. The roof of the flue is perforated, forming ports which pass up just behind the furnace bridge. The bottom of the furnace is formed into three flues through which cold blast is applied. The blast travels the entire length of the furnace before entering the second or return flue, and, after again traversing the length of the furnace, enters the third flue, from which it is conducted through hollow bricks and thence through ports parallel with the gas ports to the top of the bridge, where it unites with the gases. The products of combustion pass out at the opposite side of the furnace through flues underneath the boilers and thence to the stacks. There are four boilers 60 in. in diameter and 16 ft. in length.

The blooming train for 13-in. steel ingots is a three-high 60-in. train driven by a vertical condensing engine with 30-in. cylinder and 40-in. stroke, geared 2¼ to 1, and making 95 revolutions. The Fritz feeding tables were applied first to this train, and afterwards to all the American three-high blooming trains. The train as still running on not less, some months, than 6000 tons of ingots, is illustrated by the two-page engraving in our number of June 12, 1874, and by a detail engraving on page 438 of that number. This is the second train of the kind started in the United States, the one at Troy being the first.

There are two double, and two single Siemens furnaces for heating the ingots, which are, however, charged hot from the Bessemer works. These furnaces are worked by one heater and six helpers; there are also four changers and drawers. At the train there are one roller, one catcher, one screwman, one engine driver and a boy. At the hammer there are one cutter, two tongsmen, and two hookers. There are also in this department one weigher, two loaders, and a boy to keep the numbers of the heats.

An improved form of Siemens heating furnace and reversing valve is illustrated by Figs. 6 to 12 of the two-page engraving we give this week. The engravings are so complete that no farther description is necessary. The regenerators are of a type which is old, and is generally used in France, but the details are improved. The four furnaces are supplied with gas by twelve producers, which are worked by three gasmakers, one ashman, two firemen, and one cleaner.

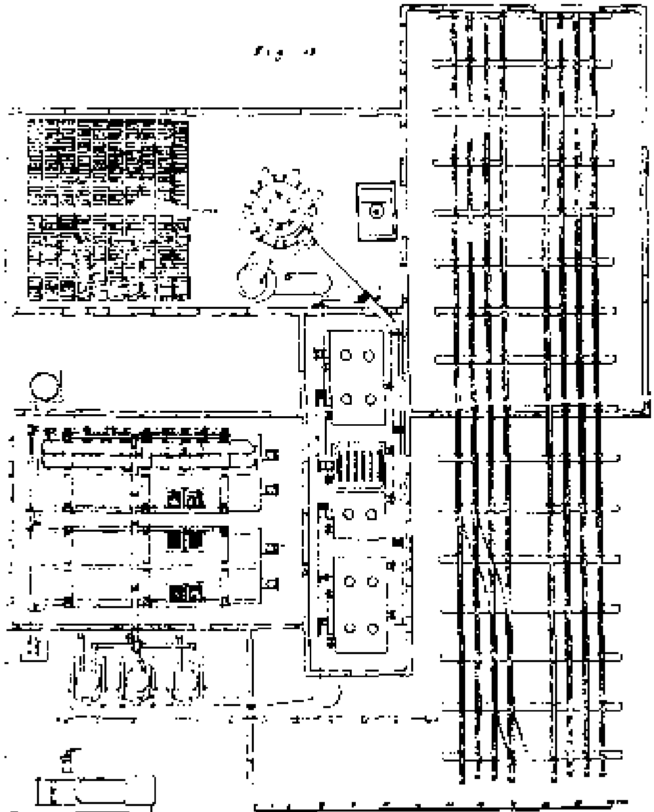
A new blooming train is nearly completed. It is two-high, having 42in. maximum and 38 in. minimum pitch. It is driven by a pair of horizontal reversing engines of the Ramsbottom type. They have 36 in. cylinders and 4 ft. stroke, and are geared 3 to 1. This engine was built by Messrs. Thwaites and Carbutt some ten years ago, and was set up at the Freedom Steel Works, in Pennsylvania, which were dismantled on account of the unsatisfactory character of the iron which was cheaply obtainable. These engines will be connected with an independent vacuum engine of 18-in. cylinder by 20-in. stroke, driving two 18-in. by 24-in. air pumps. The ingots will be rolled from 17½-in. (large end) to 7-in. blooms, and they will make from six to eight rails each.

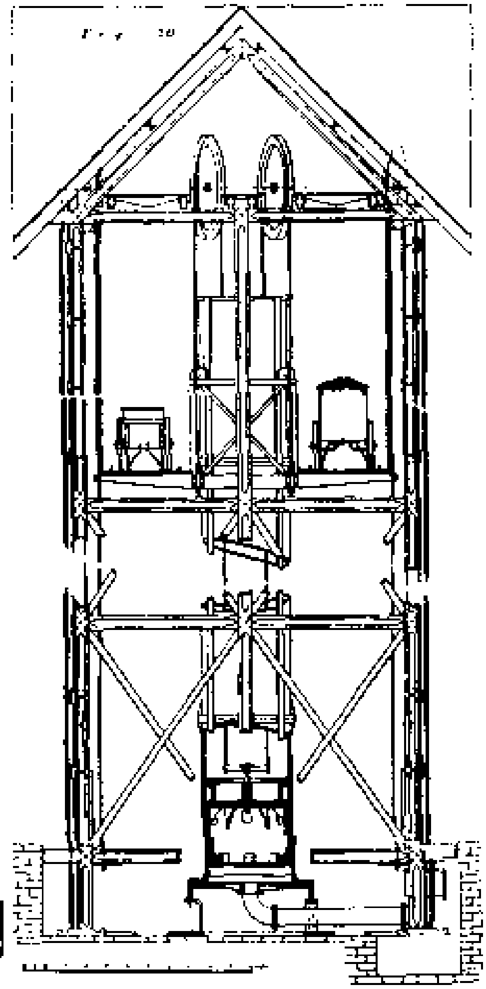
APPENDIX 13

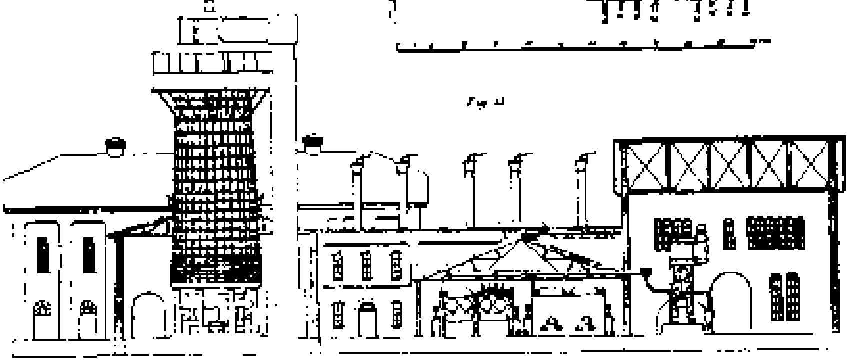
Cambria Iron Company 1878 with drawings of Blast Furnace

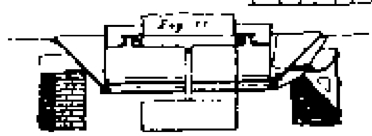
Source: Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXVI (August 23, 1878): 152-153.

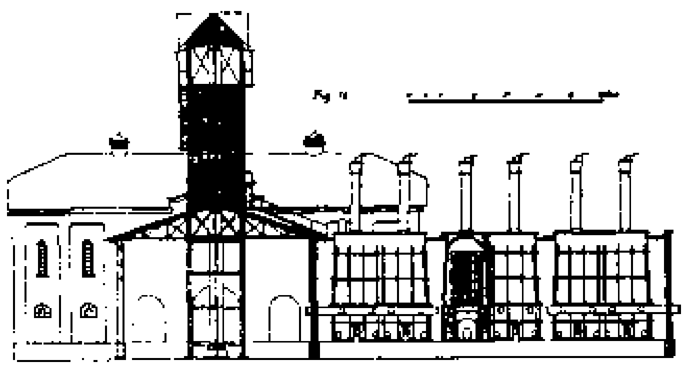
BLAST FURNACE PLANT AT THE WORKS OF THE CAMBRIA IRON COMPANY.

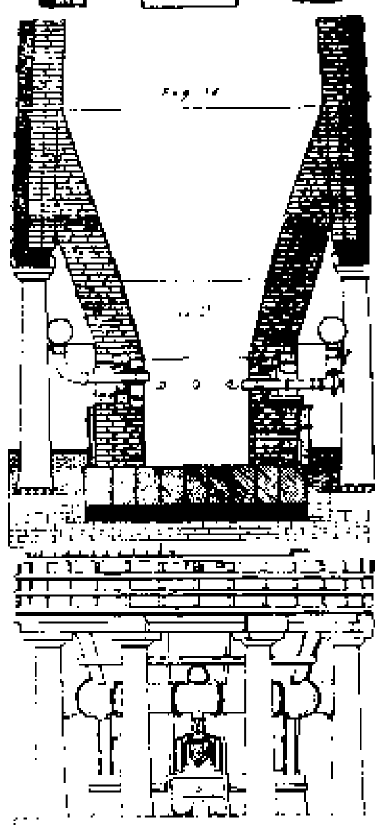


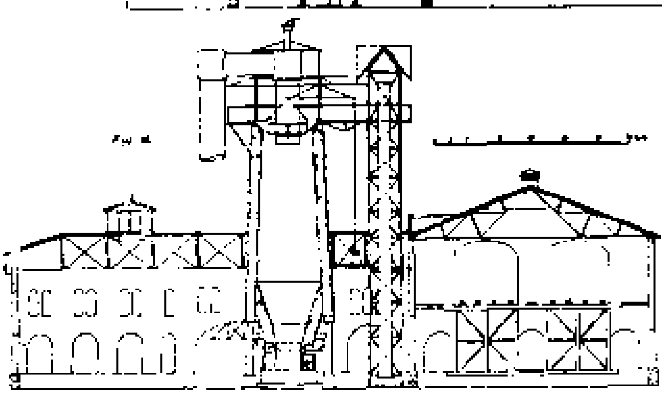












AMERICAN IRON AND STEEL WORKS.

By A. L. Holley and Lenox Smith.

No. XXIX.—Works of the Cambria Iron Company—(continued).

The Blast Furnace Plant.—Five of the blast furnaces are at Johnstown, one at Conemaugh, one at Bennington, two are at Hollidaysburgh, and one is at Frankstown. The engravings, Figs. 13 to 22, (see page 154, and the two-page engraving of this week) give the details of the No. 5 furnace at Johnstown, the last built by the company, and one of the best in the United States. The engravings, Figs. 23 and 24, illustrate the Conemaugh furnace, which is specially adapted to the production of spiegeleisen. The furnaces at Johnstown and the Conemaugh furnace are worked with close tops. Furnaces No. 4 and No. 5 at Johnstown and the Conemaugh furnace have the charging arrangement shown in the engravings.

The following Table shows the dimensions and product of the furnaces:

—	Height.	Diameter of Bosh.	Diameter of Hearth.	—
	ft. in.	ft. in.	ft. in.	
No. 1	70 0	15 0	4 0	Mill iron 350 tons per week.
„ 2	65 0	14 0	6 0	Not in blast.
„ 3	65 0	14 0	6 6	Bessemer iron 245 tons per week.
„ 4	65 0	14 0	6 6	„ „ 600 „ „
„ 5	75 0	20 0	6 0	„ „ „ „
Conemaugh	51 0	11 4	5 0	Spiegeleisen 153 „ „
Hollidaysburgh, 1	45 0	12 0	4 4	Bessemer „ 190 „ „
„ 2	51 0	10 4	4 4	„ „ 173 „ „
Bennington	41 0	8 8	3 4	„ „ 140 „ „
Frankstown	45 0	10 6	4 6	Foundry „ 125 „ „

Charges.—Mill iron is made in No. 1 at Johnstown from native spathic ore which fluxes itself, and yields about 37 per cent. iron in the furnace, 1 1/10 tons coke being used per ton of iron produced. The other furnace in which mill iron is made is at Frankstown; it uses fossil ore yielding 48 per cent. iron, 1 1/4 tons of coke being required per ton of metal produced.

The temperature of blast is from 550 deg. to 900 deg. Fahr.

The charge for mill iron is as follows:

	lb.
Johnstown ore ...	2800
Coke ...	1200

The mixture in all the furnaces in which Bessemer metal is made consists of:

One-half Springfield limonite ore averaging 50 per cent. of iron.

One-half Lake Superior specular ore containing 60 to 66 per cent. of iron.

The amount of fuel required is 1 1/10 tons per ton of iron.

The quantity of each charge is as follows:

	lb.
Ore ...	2000
Coke ...	1200
Limestone ...	1200

The following is an average analysis of the Bessemer metal:

Silicon ...	2.5	per cent.
Carbon ...	4.00	„
Sulphur ...	.012	„
Phosphorus ...	.08	„ to .10 per cent.

The phosphorus may be reduced to .07 per cent. when required for special steel.

The Conemaugh furnace is used for making spiegeleisen, the charge for which is as follows:

One-third Spanish ore (Carthagena).

One-third Springfield ore.

One-third Lake Superior brown hematite.

The quantity of the charge is as follows:

	lb.
Ore ...	1200
Coke ...	800
Limestone ...	400

The product of this furnace is 155 tons of spiegel per week of the following average analysis:

Manganese ...	15.00
Carbon ...	4.8
Silicon ...	0.2
Phosphorus ...	0.08

The quantity of manganese may be varied from 5 to 30 per cent. according to special use for which it is required.

No. 5 Furnace.—This furnace has been uniformly successful in its performance, which is largely due to its excellent management on chemical principles, and partly, of course, to its construction. Fig. 13 shows its arrangement in ground plan. The stoves are not as near as possible to the gas supply, but the transportation of stock is all the shorter for that reason. The arrangement of boilers and engines is obviously convenient. Fig. 14 is a section through the casting-house, boilers, and engine-house, showing the most common type of American blast furnace engine. Fig. 15 illustrates the stoves; Fig. 16 is a section through casting and stack-houses; Figs. 17, 18, and 19 give details of the stack and its appurtenances; Fig. 20 illustrates the pneumatic hoist and the construction of its framing; and the boilers and setting are shown by Figs. 21 and 22.

The furnace, Figs. 23 and 24, has a lining of refractory brick, consisting of a 12-in. and a 16-in. course, the thickness being the same all the way to the top. This lining is built solid, and is enveloped in red brick 12 in. thick without any space between the lining and the envelope. The stack is bound vertically on the outside by 60 lb. rails 2 ft. apart (the flanges being turned outward), and flush with the brickwork, which is grooved to receive them. The horizontal binders of the stack are formed of corrugated iron rings 7½ in. wide by 1 in. thick. The eight lower rings are placed 18 in. apart, and are rivetted at the intersections with each vertical binder. The remaining courses of rings are 3 ft. apart. The top of the furnace is supported on rails so arranged as to form brackets which are built in and bolted to the fifth binder from the top. The top is carried immediately on eight brackets of cast iron. The gases are conducted from the furnace by a pipe inserted into the centre of the stack, and supported by a square frame built of corrugated iron of the same form and dimensions as that composing the horizontal binders of the furnace. This frame also carries the fulcrum of the levers which operate the charging apparatus. The hearth and boshes are bound with vertical bars and horizontal rings in the same manner as the upper part of the stack, forming panels 3 ft. square.

The stack is supported on eight columns of cast iron 16 ft. high, 30 in. in diameter at the base, 23 in. in diameter at the top, 3 in. thick at the bottom, 2 in. thick at the top. The unusual height of the column exposes the bosh to the action of the air and prevents to a large extent the injurious effects of excessive heating of the brickwork.

The mantle of the furnace is of wrought iron built in four sections, each composed of three bars 1½ in. thick and 9 in. wide. These three bars are bolted together by 1¼ in. bolts at suitable intervals, forming a compact and solid ring, the four sections being firmly united by clamps extending across above and below and held together by 1½ in. bolts passing through the spaces between each section, the whole forming a continuous ring of twelve pieces of wrought iron supported by the columns which sustain the entire weight of the furnace above the bosh. A continuous cast-iron ring 1½ in. thick serves to protect the mantle and present a more pleasing architectural effect, but does not assist in supporting the weight of the stack.

The water boxes around the tuyeres project within 2 in. of the face of the hearth and are open and kept cool by means of a spray of cold water which is then collected on the bottom plate and conveyed away by an overflow pipe. The lower portion of the hearth is cooled by water circulation in hollow boxes with 4 in. spaces and diaphragms cast so as to direct the water and insure a circulation from one end of the box to the other.

The gases are taken off by means of a pipe of 5 ft. internal diameter lined with 9 in. of firebrick. The lower end of this pipe for a distance of 20 ft. is enveloped by a larger pipe of about 14 ft. internal diameter, the smaller pipe extending down into the larger within 6 ft. of the bottom. The gases are taken from the 14 ft. pipe near its upper end by an elbow through an underground flue, and thence passing by the hot blast and to the boilers, are taken off at each stove and boiler, and are regulated by a stop-valve, the quantity of air required for combustion being controlled by a register valve. At the upper end, and in the inside of the 14 ft. pipe, is placed a 2 in. water pipe which is perforated with small holes on the upper side for the purpose of spraying the water which in falling meets the upgoing gases, and is brought so intimately in contact with them, that nearly all the material which passes out mechanically from the furnace with the gases is eliminated, and the labour of cleaning the hot-blast pipes and boilers is materially lessened. The hoist is pneumatic, and the blast is applied on the lower side only of the counterweighted piston of a 46 in. cylinder, the top of which is open so that the load is taken up without employing power.

The hot blast is on the Player system, and consists of six stoves with 24 pipes of 9 in. internal diameter and 19 ft. length in each, four of the stoves being constantly at work; the other two are spare. A feature in the construction of the stoves is the method of binding, which consists of trussed rails and vertical rails built flush with the brickwork.

The furnace is supplied with steam by eight cylinder boilers each 60 ft. long and 48 in. in diameter. The boilers are set in pairs, each connected below on each outside sheet by short cross boilers 30 in. in diameter, and 6 ft. long with 18 in. connexions. The gases are admitted at the ends of the boilers into combustion chambers similar to those used in the Player stoves, and thence they pass through flues under the boilers. To provide for emergencies, a firing grate, 8 ft. by 6 ft., is placed 10 ft. from the ends of the boilers. Each pair of boilers is hung on wrought-iron trussed arches supported by sides walls. The boilers are suspended by bolts resting on spiral springs, and are perfectly free between walls; there is no trouble resulting from expansion and contraction. The cross boilers have each a branch 10 in. in diameter, extending through the side walls with 4 in. spaces all around them, the space being covered with loose plates of iron. The branches receive the feed water, and also serve to connect the blow off, which is inserted in the neck far enough to be bent, so as to reach the lowest point of the cross boiler. This arrangement enables each cross boiler to be blown off separately. The feed pipe is 10 in. in diameter, having connexion at each cross boiler. The boilers are so arranged that any pair can be cut off for any purpose without interfering with the working of the furnace. Under ordinary conditions of regular working six boilers are sufficient. The boiler fronts are built of wrought-iron plates ½ in. thick, bound with corrugated iron.

The chimney is 140 ft. in height, 8 ft. internal diameter, with a thickness of 21 in. red brick at the base; there are three off-sets of 4 in. each inside at suitable intervals, finishing at the top with 9 in. thickness of red brick. It is built on a masonry foundation 13 ft. deep, having a covering of heavy cast iron forming a base for the brickwork. Its construction is like that of the furnace stack. The first course of rails composing the vertical binders weigh 60 lb. per yard, and the finishing course at the top is composed of rails weighing 35 lb. per yard. The intervals between horizontal hoops is 2 ft. at the base, and increases gradually towards the top, where they are 4 ft. apart, the thickness also diminishing at the top. The chimney is capped with a cast-iron ring which projects sufficiently to shed rain water.

The stock-house is traversed by four standard gauge tracks upon trestle work 24 ft. high, which connect with the main line of the Pennsylvania Railroad. There are three vertical blowing engines with blowing cylinders above and steam cylinders underneath; the crosshead between the cylinders is connected to two overhanging flywheels each weighing 14 tons. The steam cylinders are 38 in. in diameter, the blowing cylinders are 7 ft., the stroke is 4 ft. 8 in. But two of the engines are used at one time, the speed averaging 24 revolutions per minute. The third engine is kept ready for use in an emergency. The engines are now worked non-condensing, but are fitted with complete condensing apparatus. Furnaces No. 3 and No. 4 have been remodelled, and the valuable features described in connexion with No. 5 have been added to them. They are almost identical excepting the charging apparatus, which in No. 4 is the same as in No. 5, but No. 3 has the ordinary bell and hopper.

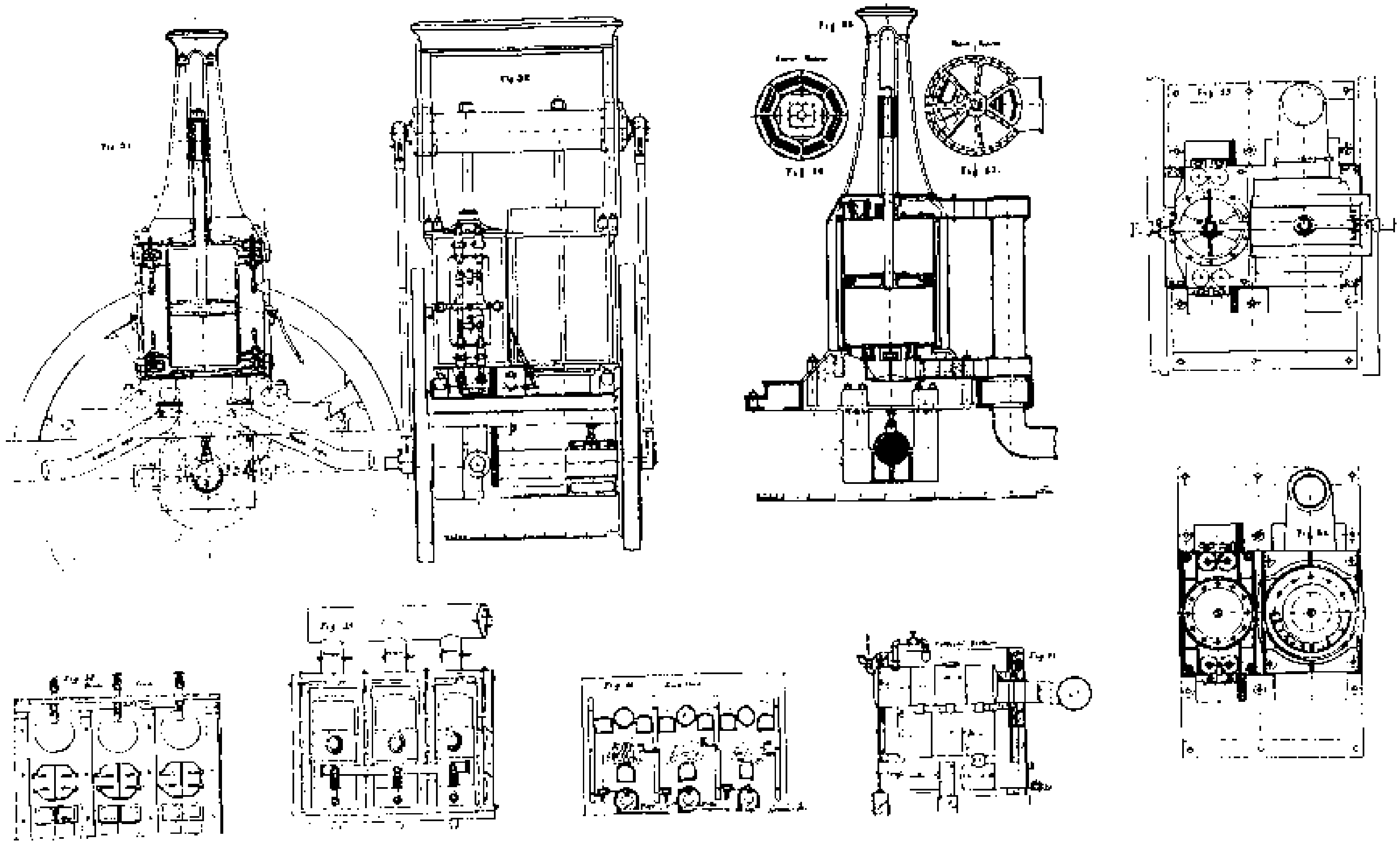
APPENDIX 14

Cambria Iron Company 1878 with drawings of Boilers and Blowing Engine

Source: Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company," London *Engineering* XXV (September 20, 1878): 233.

BOILERS AND BLOWING ENGINE AT THE WORKS OF THE CAMBRIA IRON COMPANY, PENNSYLVANIA, U.S.A.

(For Description, see Page [illegible].)



AMERICAN IRON AND STEEL WORKS.

By A. L. Holley and Lenox Smith.

No. XXX.—Works of the Cambria Iron Company—(concluded).

The Bessemer Plant.—This was the sixth started in the United States (July, 1871); while its general arrangement and many of its details were copied from drawings of the Troy and Harrisburg works, and while it conforms in principle to the American type of plant (already fully illustrated by the Vulcan Works in this series of articles), its builder, the late G. Fritz, made many minor changes, some of which have since been generally copied. The first deviation from previous designs was to put the melting department and the converting department in the same continuous building of equal height throughout. This gives the converting room ample height and ventilation. The cupola room has also proved capable of doing as large work in the long run as any in America, but later cupola houses have been made more comfortable and convenient by being high enough to have windows on all four sides, and by having inclined slag slides under the cupolas to remove the debris at once out of doors. The ground plan and the principal dimensions of the Bessemer house are given in Fig. 25 of the two-page plate, published in our issue of the 6th inst.

The four cupolas and the two reverberatory spiegel furnaces are shown in this plan, and also together with the cupola ladles by Fig. 26. Side and end elevations of these parts and also of the iron platform upon which they stand, are illustrated by Figs. 27 and 28 of the same plate. The original cupolas were smaller than these and oval in horizontal section. These have 7 ft. 8 in. diameter of shell, 6 ft. internal diameter above the tuyeres, and 5 ft. 6 in. in diameter of bosh and hearth. The maximum height from the top of the sand bottom to centre of tuyeres is 3 ft. There are six tuyeres 5½ in. diameter each, and they are peculiar in being water tuyeres. Although not yet long enough used to have reached perfect adjustment and practice, one of these cupolas melts nearly 100 tons of pig and scrap at a continuous blast. The lining above the tuyeres soon gets worn thin, but it is maintained by running a sheet of water down the outside of the shell—a practice long and successfully employed by Mr. Forsyth with spiegel cupolas at North Chicago.

The platform around the converters (Figs. 29 and 30) stands in the middle of the house, quite independent of any walls. The chimneys are upheld by light columns. This excellent arrangement gives ample space and ventilation around the converters, and it has been generally copied. When (as in the Vulcan and Edgar Thomson Works) the converting and cupola houses are separate buildings, the dividing wall being close behind the converters, this wall has been so cut away as to give the roominess of the Cambria arrangement.

Mr. Geo. Fritz was the first to do away with the awkward flat air-pipe joint, right under the converter trunnion; he took the air-pipe out of the side of the trunnion (Fig. 30), where there was room enough to put a round pipe and to get at the joint. The new Cambria converter (building) will have the more modern straight nose, and will be of 6½ tons maximum capacity; those shown are 5-ton converters.

The Bessemer blowing engines are independent and quite peculiar in construction. One of them is quite fully illustrated by Figs. 31 to 37. The engine is of the Fritz and Moore type. The steam and air cylinders stand side by side, and are connected to a common crosshead Fig. 3. The tendency of the steam piston to throw the crosshead out of line is of course counteracted by the connecting rods and the main shaft. The chief advantage of the arrangement is that the engine is low and hence rigid. This engine has run almost constantly, day and night, for seven years, and it has never broken down or required extraordinary repairs. The Cornish steam valves and the valve gear are shown in Fig. 31. The valves are actuated by adjustable cams on a countershaft driven by gearing from the main shaft. Metallic packing rings (now usual in the United States) have been substituted for the wooden rings, shown in the air cylinder Figs. 31 and 33. A good arrangement of air valves, giving but little clearance, is shown by Figs. 36 and 37. Puppet air valves are now generally employed, although a rubber-covered metallic flap valve works well. The engine has 54 in. air cylinder, 40 in. steam cylinder, and 5 ft. 6 in. stroke.

There are in the Bessemer works two Worthington compound pressure pumps, each having four 7¼ in. plungers with 16 in. stroke. The blooming mill new pump will be a Worthington compound duplex with four 8¼ in. plungers and 3 ft. stroke. One of these pumps will be illustrated in connexion with another works. All these pressure pumps will be connected with accumulators in the converting, blooming, and open-hearth departments, so that the pressure is likely to be constant and regular.

The boilers used at the Cambria Works are of two types. One type is shown in detail by Figs. 38 to 42. They have given good results. There are nine of them at the converting works and four at the blooming mill. The other type is the Corliss vertical, of which there are sixteen in the steel department; they are the boilers which were removed from the Corliss battery in Machinery Hall at the Philadelphia Exhibition. The best average, although not the very highest work done in the Bessemer department, is 70 heats of 5 tons (9840 lb.) each per 24 hours. In the new vessels it is expected to average 60 heats of 6 tons (of ingots) per 24 hours.

It may be mentioned, as of interest in connexion with the Cambria Bessemer manufacture, that the vessel is preserved as a relic, in which Kelly endeavoured to make steel in 1860. It has an external diameter of 38 in., the interior diameter is 30 in., and the height 4 ft. 6 in. The bottom was a perforated unburned brick. The blast pressure was 5 lb. For reasons which are now obvious, no malleable metal was produced.

The Open Hearth Plant in process of construction will have a pair of 15-ton Pernot revolving-hearth furnaces, fitted with all the recent improvements in roofs and ports devised by M. Pernot, and also arranged in accordance with the principles which have made the American Bessemer works so much more productive and economical than those which preceded them. The plant is expected to produce some 60,000 tons of ingots per year.

The iron and steel product of the Cambria Works already exceeds largely that of any other American works, and when the open-hearth plant and the merchant trains now constructing are completed, its output will be very extensive and varied, covering many of the larger specialties.

The technical management resident at the works is as follows: Chief engineer, Daniel N. Jones; manager of steel manufacture, John E. Fry; manager of rolling mills, Alex. Hamilton.

Beginning with a product of 10,000 tons of iron rails in 1855, the Cambrian Iron Company has made in each successive year one-tenth of the total product of American rails, its present capacity being 100,000 tons of iron and steel rails, bar iron, fish plates, bolts, nuts, steel wire, &c., per annum.

Prior to the introduction of the manufacture of steel rails in the United States the works produced iron rails only, the uniformity and durability of which have caused Cambria rails to be regarded for many years as a standard of excellence.

Visitors to the Philadelphia Exhibition of 1876 will remember as a conspicuous and interesting feature of the company's exhibit the series of iron rails taken from actual service, the record of which we append.

No. 1 was eleven years in north main track of Pennsylvania Railroad, near New Florence, Pennsylvania, on a down grade. During that time 36,635,060 tons passed over it. Its original weight was 67 lb. per lineal yard, and it lost by wear during service 3.713 per cent.

No. 2 was eleven years in south main track of Pennsylvania Railroad, near New Florence, Pennsylvania, on an up grade. During that time 46,117,731 tons passed over it. Its original weight was 64 lb. per lineal yard, and it lost in weight by wear in that service 5.913 per cent.

No. 3 was eleven years in north main track of Pennsylvania Railroad, near New Florence, Pennsylvania, on a down grade. During that time 36,434,060 tons passed over it. Its original weight was 67 lb. per lineal yard, and it lost by wear in that service 6.063 per cent.

No. 4 was ten years in north main track of Pennsylvania Railroad, near 170th mile-post, on an up grade. During that time 40,317,000 tons passed over it. Its original weight was 67 lb. per lineal yard, and it lost in weight by wear in that service 3.312 per cent.

No. 5 was ten years in north main track of Pennsylvania Railroad, near 170th mile-post, on an up grade. During that time 40,647,000 tons passed over it. Its original weight was 67 lb. per lineal yard, and it lost in weight by wear in that service 3.349 per cent.

No. 8 was nineteen years in main track of Playton and Michigan Railroad. It was not possible to obtain the record of tonnage service. Its original weight was 56 lb. per lineal yard, and it lost in weight by wear in that service 4.763 per cent.

No. 9 was ten years in north main track of Pennsylvania Railroad, near 170th mile-post, on an up grade. During that time 40,317,000 tons passed over it. Its original weight was 67 lb. per lineal yard, and it lost in weight by wear in that service 2.554 per cent.

No. 10 was ten years in north main track of Pennsylvania Railroad, near 170th mile-post, on an up grade. During that time 40,317,000 tons passed over it. Its original weight was 67 lb. per lineal yard, and it lost in weight by wear in that service 2.352 per cent.

No. 11 was ten years in north main track of Pennsylvania Railroad, near 170th mile-post on an up grade. During that time 40,647,000 tons passed over it. Its original weight was 67 lb. per lineal yard, and it lost in weight by wear in that service 3.352 per cent.

Two iron rails were also exhibited which bridged a gap 18 ft. wide and 13 ft. deep, washed out under the track of the Grand Rapids and Fort Wayne Railroad. They had carried safely an engine of 67,400 lb. and a train of seven cars.

APPENDIX 15

Cambria Iron Company, 1878

AMERICAN IRON AND STEEL WORKS.

By A. L. Holley and Lenox Smith.

No. XXVI.—Works of the Cambria Iron Company—(continued from page 477).

Mineral Resources—Mines.—Johnstown is a modified duplicate of Pittsburgh. It is built in the arena of an amphitheatral cutting in the lower coal measures formed by the waters of the Stony Creek and the Little Conemaugh river, which unite at this place, and form the Conemaugh, just as the Monongahela and Allegheny rivers have hewn out a seat in the upper coal measures for the city of Pittsburgh at their union in the Ohio river. The slopes of this natural amphitheatre at the works at Johnstown are terraced with the outcrop of the coal beds of the lower coal measures, surmounted with a valuable bed of carbonate iron ore, the whole capped with the barren measures. The coal and iron ore can thus be opened above water level, and obtained at a minimum cost at various points around the works, affording qualities of mineral fuel specially adapted to the various uses in the preparation of the materials, and finishing iron and steel rails.

The company own in fee simple, in the six counties into which their mining operations reach, 51,968 acres of mineral lands, located as follows: Around iron and steel works, Cambria County, 23,914 acres; Somerset County, 6311 acres; Indiana County, 1769 acres; Blair County, 7291 acres; Bedford County, 10,571 acres; and Huntingdon County, 2100 acres.

Coal Mines.—The Johnstown coal mines are situated in the middle of the great Appalachian field. The measures at the iron and steel works are on the east side of the second basin—dipping gently west—just sufficient to afford equalising gradients in mine hauling, and ready exit to mine waters.

The Blast Furnace Mine is located in the rolling mill yard at Johnstown in the second workable bed of the coal series, on the north side of the valley. The coal is semi bituminous, 3 ft. in thickness. This coal is best adapted for coking, but requires washing to remove lenticular deposits of slate and other impurities. The exit or gangway is a mile in length, with double tracks for empty and loaded trains. The coal is drawn up a plane to the washer, and is dumped into Belgian coke ovens. The coke is carried from the ovens to the blast furnaces in their immediate vicinity.

The Rolling Mill Mine is located in the south side of the valley, the Conemaugh dividing it from the iron and steel works. The seam is 3½ ft. thick. The mine workings are quite extensive. The mining face is three miles long with an outspread of coal in advance of five miles. The coal in this bed is specially adapted for puddling furnaces, iron working, and steam generating, from the fact that its sulphur is fixed in plates of selenite, and goes into the ash rather than into the iron, thus giving it a peculiar value for the uses to which it is applied.

The coal is hauled from the mine and delivered to all parts of the iron and steel works by mine locomotives, in the cars which come from the mine workings, without breaking bulk. The mine also supplies coal for domestic use to the employés of the Cambria Iron Company as well as to many of the citizens of Johnstown.

Iron Ore Coal Mine.—This mine is worked in the so-called Sermon seam. Its coal is used in calcining the carbonate iron ore mined 50 ft. above the coal bed. Ten per cent. of coal is used in calcining the raw iron ore.

The Woodvale Mine, at Woodvale in the eastern suburbs of Johnstown, is located on the north bank of the Conemaugh. It is in the same bed as the blast furnace mine, and supplies the extensive woollen and flouring mills at Woodvale.

The Conemaugh Mine is located near East Conemaugh furnace, and supplies coal for making the coke used at this furnace. It is nearly two miles east of Johnstown. The coal makes a very fair coke.

The Bennington Shaft at Bennington near the summit of the Allegheny Mountain, is worked in the second workable seam of the lower coal measures, here 3 ft. thick, from which about 110,000 tons of coal are mined annually. The coal produces a coke equal in all respects to the Connelsville. This mine supplies fuel for four furnaces, east of "the mountain" together with their associated works and ore mines.

The coal is coked for the Bennington furnace at present in open pits; at the Hollidaysburg furnaces, partly in Belgian ovens and partly in open pits; at Frankstown furnace in open pits. The company is now erecting at Bennington mine 100 Belgian coke ovens to coke a full supply for the four furnaces in Blair County. This coal is superior for blacksmithing purposes.

The actual output of the six coal mines worked by the company in 1877 was 260,058 tons. The estimated capacity for the year 1878 is 400,000 tons.

Iron Ore Mines—Benshoff's Mine.—The carbonate ore mine is the principal iron mine worked at Johnstown. It yields about 40,000 tons annually of coal measure ore, and is located immediately above the coal, which is utilised to the extent of 10 per cent. of the amount of ore mined in calcining it, which is done in heaps. The ore contains about 30 per cent. of metallic iron and a sufficient percentage of lime to flux it, so that it is charged in the blast furnace after calcination without the admixture of any limestone other than that associated with it.

The Frankstown fossil ore mines are located about three miles east of Hollidaysburg, and yield about 26,000 tons of iron ore per annum. The ore is 18 in. thick, and is a compact, dense red hematite, containing 50 per cent. of metallic iron and 0.3 per cent. of phosphorus. This is the only locality in Pennsylvania in which this quality of ore has been worked. The ore is found in the lower portion of the Clinton Group or No. V. of the Pennsylvania Survey.

The Springfield Mines are located in the great "auroral" limestone valley of Morrison's Cove, 52 miles eastward from Johnstown. The ore is found resting on a floor of mudstone. The deposit is canoe shaped, having near the bottom a sediment of excellent pure iron ore 3 ft. to 10 ft. in thickness. This is reached by a shaft 175 ft. deep. Above this bottom deposit is found the wash ore—pieces of ore mixed with clay and [illegible], which are separated from the ore by thorough washing. From the three series of mines and washers at Springfield, extending about two miles lengthwise with the great valley, 50,610 tons of iron ore were shipped to Johnstown in 1877. The ore is a brown hematite, very low in phosphorus, contributing alumina in the formation of slag in its association in the furnace with the Lake Superior ores. It is thus a very important auxiliary in the production of Bessemer pig iron.

Source: Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXV (June 21, 1878): 485-487.

ANALYSES OF MINERALS, FUELS, AND FLUXES USED IN THE MANUFACTURE OF IRON, STEEL, AND SPIEGELEISEN, AT THE CAMBRIA IRON AND STEEL WORKS, JOHNSTOWN, PENNSYLVANIA.

—	Peroxide of Iron.	Silica.	Alumina.	Bioxide of Manganese.	Carbonate of Lime.	Carbonate of Magnesia.	Phosphorus.	Sulphur.	Water.	Metallic Iron.
Bessemer Pig Ores From Mines of Cambria Iron Company.										
Springfield No. 1	79.09	13.66	1.73	[illegible]	0.17	0.11	0.027	trace	4.36	55.47
" 3	66.66	21.66	0.76	0.46	0.11	0.19	0.043	trace	9.66	46.49
" 4	68.74	23.09	1.91	trace	0.10*	0.09	0.054	trace	4.46	48.69
Lake Superior Ores contracted for.										
Specular—Republic	87.34	1.79	0.83	0.06	0.17	0.38	0.049	none	0.11	66.12
Magnetic	88.06	1.87	4.66	0.50	0.24	0.19	0.055	none	0.19	70.97
Barium	...	...	...		...	...	0.110			64.84
Hematite—Jackson	...	14.99	...	1.64	...	...	0.084	trace	...	60.59
Mill Iron Ores From Mines of Cambria Iron Company.										
Johnstown—Carbonate ...	17.64	5.84	1.64	1.30	60.10	1.45	0.176	0.31	[illegible]	34.86
Henrietta—Hard ore	81.56	15.46	0.66	0.85	5.06	0.14	0.411	trace	1.79	57.49
Henrietta—Spongy ore ...	84.86	4.31	1.31	0.41	9.39	0.17	0.183	trace	7.63	59.40
Frankstown—Red hematite ...	81.67	8.48	1.30	1.73	14.09	[illegible]	0.085	trace	5.11	48.43
Hopewell—Fossil	84.83	11.44	1.08	1.15	0.21	0.18	0.173	trace	3.10	59.19
Martinsburg	74.43	8.30	3.64	trace	trace	...	0.383	0.33	11.40	52.09
Other Ores contracted for.										
Lawrence—Tipton	73.96	13.91	1.93	(protoxide) trace	5.61	4.14	3.160	trace	0.41	51.67
Fossil—Berg	...	37.83	...		...	...	0.163	none	...	49.36
Brown hematite		...	...	(metallic) [illegible] 16.60	...	...	0.401	...	...	49.24
Spiegeleisen Ores From Mines of Cambria Iron Company.										
Henrietta, Blair County, Pennsylvania ...	4.66	4.66	1.01	48.16	0.30	0.05	0.064	trace	9.81	4.35
Other Ores contracted for.										
Ironton, Lehigh County, Pennsylvania ...	1.78	(metallic [illegible]) 6.10	...	40.19	(metallic [illegible]) 0.60	...	0.066	trace		
Spanish manganese	42.91	(metallic [illegible]) 10.51	...	(protoxide) 54.87	...	...	(0.021)	...	...	59.62

ANALYSES OF COALS, COKES, AND FLUXES.

—	Volatile Matter.	Fixed Carbon.	Sulphur.	Ash.	Coke.
Coals. (From Mines of Cambria Iron Company.)					
[illegible] seam	23.01	73.66	0.41*	3.33	76.99
Cement seam	19.30	76.67	0.47*	4.55	83.42
Limestone seam	19.89	72.07	0.54*	8.04	80.11
Coke yard seam	20.60	71.40	0.70*	6.65	80.84
Miller seam	29.09	68.30	1.12	8.90	70.85
Hopewell coal	22.79	60.12	0.50*	8.58	77.30
Cokes. (From Mines of Cambria Iron Company.)					
Belgian ovens, Johnstown		91.91	0.56	6.06	
" Hollidaysburg ...		93.14	0.23*	7.81	
Open pit, Hollidaysburg	...	82.04	0.24*	7.93	
" Huntingdon	...	86.66	0.96	12.69	
Other Coke Contracted for.					
Beehive oven, Connellsville		87.46	0.83	11.32	

Fluxes.	Insoluble Matter.	Carbonate of Lime.	Carbonate of Magnesia.	Phosphorus.	Sulphur.	Oxide of Iron and Alumina.	Water and Organic Matter.
(From Quarry near Altoona, Cambria Iron Company.)							
Cromwell limestone, Birdseye	2.75	97.32	0.19	0.017	None	0.58	1.21
" " Calico	1.15	97.82	0.31	0.003	None	1.34	0.59
(From Quarry near Henrietta, Blair County, Pennsylvania, Cambria Iron Company.)							
Dolomite limestone	4.75	49.05	43.87				

A short distance south-westward in the same valley, the Bloomfield Mine is worked. It is a member of the same family of wash-ore mines. It produces about 25,000 tons of ore per year, which is purchased by the Cambria Iron Company, and is also used in making Bessemer iron.

The Henrietta Mine is 12 miles south of Springfield, at the western base of Tussey's Mountain, near Martinsburg, in Blair County, and 68 miles from Johnstown. The ore is a brown hematite in a regular bed in the lower member of the "Marcellus" slates (No. III.), resting on the "auroral" limestone of No. II., having along its outcrop a zone of rich wash-ore, which has been extensively opened and washed. The mine is capable of yielding 25,000 tons to 35,000 tons of ore per year when in full operation. At present the mine is not worked, as a sufficient stock of ore has accumulated for one or two years in advance.

The actual output of the seven iron ore mines owned by the Cambria Iron Company during the year 1877 was 101,311 tons. Manganiferous and hematite ores are purchased from small mines in the valleys of the Juniata, which would increase the amount used, embracing Bloomfield, to 150,000 tons.

In addition to the iron ores mined on its own property, the company annually purchases large quantities of Lake Superior specular and magnetic ores, and New Jersey magnetites and Franklinite. It also imports quite largely for use in the production of spiegeleisen, the rich and uniform Spanish manganiferous ores.

Limestone.—About five miles south of Altoona, or 44 miles from Johnstown, on the Hollidaysburg branch of the Pennsylvania Railroad, the large quarries of excellent limestone are located. The limestone is in the lower Helderberg Group, No. VI. of the Pennsylvania Survey. It is found in great masses, and is dumped into the railroad cars from the quarries. Over 65,000 tons of very pure limestone are shipped from these quarries to the works at Johnstown, and are mainly used as a flux.

Sand and Ganister are procured from neighbouring localities, the latter mainly from the débris of the Levant sandstone (No. IV.) east of the Allegheny Mountains.

A careful approximate estimate of the mineral resources contained in the lands owned by the company has been made by Mr. John Fulton, its general mining engineer, as follows: Coal, 850,000,000 tons; iron ores, carbonates, 17,000,000 tons; red hematite, fossil, 3,977,000 tons; brown hematite, limonite, 5,175,000 tons; fireclay, 76,000,000 tons, besides large deposits of sand and ganister.

The large body of coal and iron ore land owned by the company around its works in Cambria and adjoining counties, all carefully selected for specific purposes in the special processes in the production of iron and steel rails, &c.—enable it to control and regulate supplies, to produce with the utmost economy, and to combine the wise selection of ores and fuel at its command, so as to produce the very best materials of each kind. They also render the company independent of the fluctuations and vicissitudes of the general market, and enable it to sustain a high degree of uniformity in the quality of its productions. The Tables on the preceding page give analyses of most of these materials.

APPENDIX 16

Biographies of Men Associated with the Cambria Iron Company

- John Fritz
- George Fritz
- Captain William Richard Jones
- Robert Woolston Hunt
- Daniel Johnson Morrell
- Alexander Lyman Holley

JOHN FRITZ (August 21, 1822 – February 13, 1913)

John Fritz was born in Londonderry, Chester County, Pennsylvania, the son of George and Mary Fritz. Oldest of seven children, John grew up in the country, and at 16 he became an apprentice as a blacksmith and machinist in Parkesburg, Pennsylvania. He gained much practical experience working in a rolling mill at Norristown, Pennsylvania, and later in a new rail mill and blast furnace at Safe Harbor, Pennsylvania. He married Ellen W. Maxwell in 1851; the couple had one daughter who died in childhood. In 1852 he rebuilt and improved the Kunzie blast furnace outside Philadelphia, followed by working with his brother George in building a foundry and machine shop at Catasauqua.

The turning point in his 16-year career occurred when he moved to Johnstown in 1853 to work at the Cambria Iron Company. He came with experience in the blast furnace, foundry, puddling furnace, heating furnace and the rolling mill, as well as experience in working with employees and employers. He needed all of these skills to survive at Cambria during its first rough years.

In 1860 he became general superintendent and chief engineer of the Bethlehem Iron Company, where he designed and erected the works, completed in 1863. In 1864 he was commissioned by the War Department to complete a mill in Chattanooga, Tennessee, where his brother William, once employed at both Cambria and Bethlehem, was made superintendent.

Returning to Bethlehem after the war John Fritz became a member of the select group which strived to introduce and apply the Bessemer steel process in America. He worked nearly 30 years in Bethlehem, retiring at age 70 in 1892. Twenty years of life and world-wide recognition for his achievements followed.

He was a member of numerous engineering and iron and steel societies, received many honors, and in 1902 he became the first recipient of the John Fritz medal, "for notable scientific or industrial achievement." He endowed, designed and built an engineering laboratory at Lehigh University in Bethlehem, as well as contributed to other philanthropic causes. Near death in winter 1912, Fritz had an abcess in his chest opened by his physician. Upon hearing the hissing of chloride of ethyl before the operation, Fritz reportedly turned towards the doctor and exclaimed, "Doctor, that sound remainds me of my first Bessemer blow!"

Sources

John Fritz, *Autobiography of John Fritz* (New York: John Wiley & Sons, 1912).

______. "Early Days of the Iron Manufacture," *Transactions of the American Institute of Mining Engineers,"* 24(1895): 594-609.

"John Fritz," *The Globe*, Bethlehem, Pennsylvania, August 21, 1912.

Rossiter W. Raymond and Henry Sturgis Drinker, "Biographical Notice of John Fritz," *Transactions of the American Institute of Mining Engineers*, John Fritz Collection, CCHT.

Jeanne McHugh, *Alexander Holley and the Makers of Steel* (Baltimore: The Johns Hopkins University Press, 1980).

Dictionary of American Biography, 1932 ed. s.v. Fritz, John," by Philip B. McDonald.

See also: Lance D. Metz, "John Fritz 1822-1913 His Role in the Development of the American Iron and Steel Industry and His Legacy to the Bethlehem Community," 1987.

GEORGE FRITZ (December 15, 1828 - August 5, 1873)

George Fritz was born in Londonderry Township, Chester County, Pennsylvania. He worked as a farm laborer and served apprenticeships to a carpenter and a patternmaker. Somehow he lost parts of all the fingers on his right hand. He was self-taught and his knowledge of ironmaking came from daily experience. The blooming mill he developed was adopted at Troy, North Chicago, Joliet and Bethlehem, and he helped his brother John develop the three-high rolling mill. George Fritz did not gain the fame of his brother, but he too put his mechanical genius to work in bettering the manufacture of rails and making the Bessemer process a feasible one. He conceived and installed the first blooming mill for breaking down ingots, the hydraulic manipulator for turning over and moving the ingots and the mechanical driving of rollers in the mill tables.

At the time of his death, at age 44, almost every business in Johnstown closed when the funeral cortege passed. The Cambria Iron Works, Johnstown Mechanical Works, and the Johnstown Manufacturing Company all closed, as did the Wood, Morrell & Company stores. He was buried in Sandy Vale Cemetery.

Sources

Johnstown *Tribune*, August 7, 1873, clipping in John Fritz Papers, CCHT.

Jeanne McHugh, *Alexander Holley and the Makers of Steel* (Baltimore: The Johns Hopkins University Press, 1980).

Engineering Department, "History of the Evolution of the Cambria Plant Bethlehem Steel Company 1852-1935," January 10, 1935, manuscript, p. 3, BSC, CCHT.

John Fritz, "The Development of Iron Manufacture in the United States Seventy-Five Years of Progress," *Cassier's Magazine* 17, no. 6, April 1895, p. 468.

CAPTAIN WILLIAM RICHARD JONES (February 23, 1839 - September 28, 1889)

William R. Jones was born at Hyde Park (Scranton), Luzerne County, Pennsylvania, the son of Welsh emigrants. At age 10 he was apprenticed to Crane Iron Company at Catasauqua, Pennsylvania, and at age 16 he worked in a machine shop at Janesville, Pennsylvania. He moved on to Philadelphia and Tyrone before coming to Johnstown in 1859, where he worked as a machinist for John Fritz. He left Cambria to work in Chattanooga, Tennessee, married Harriet Lloyd, and returned to Cambria in 1861. He left again to serve in the Union forces during the war, returning to Cambria as assistant to George Fritz. Jones assisted with the construction of Cambria's Bessemer steel works and blooming mill plant.

When George Fritz died, Jones left Cambria to take charge of the steel works and rail mill at the new Edgar Thomson plant. While there he made many improvements to the steel machinery, and under his guidance the plant became the most productive in the world. He held patents for washes for ingot molds, hot beds for bending rails and other improvements, but his greatest invention was the Jones mixer, a method for mixing molten pig iron before charging it into a converter.

Jones died horribly at Braddock when a furnace burst, letting loose a flood of hot ore, coke and limestone. Twenty workers were injured including Jones, who fell into a pit and struck his head when he tried to escape the deluge of material. He died the next day having never regained consciousness. At Jones' death, "The five thousand workmen at Braddock were frantic with grief. Never before or since has the iron and steel world had so great a sorrow. Carnegie, looking upon poor Jones as he lay in the hospital, sobbed like a child. Ten thousand wet-eyed men marched with him to his grave, and today the veteran steel-maker's most precious memory is 'I worked with Bill Jones.'"

Sources

Jeanne McHugh, *Alexander Holley and the Makers of Steel* (Baltimore: The Johns Hopkins University Press, 1980).

General Manager to Joseph B. Klinsky, April 25, 1945, box: Steel Industry Scrapbook, JFM.

Dictionary of American Biography, 1933 ed. s.v. "Jones, William Richard," by Philip Asher Isaacs.

ROBERT WOOLSTON HUNT (December 9, 1838 - July 11, 1923)

Robert W. Hunt was born in Falsington, Pennsylvania, the only child of a medical doctor. When Hunt was 18 years old, his father died, leaving him to run the family pharmacy in Covington, Kentucky. After two years Hunt and his mother moved to Pennsylvania where he worked with John Burnish & Company in Pottsville. He worked in a rolling mill where he learned the practical aspects of iron production. He took a course in analytical chemistry in the laboratories of Booth, Barrett & Blair of Philadelphia.

In 1860 the Cambria Iron Company employed him as a chemist for $20.00 per month, and in August Hunt set up the first laboratory for analytical studies of iron working in Johnstown, an industry milestone. After five years military service during the Civil War, he worked in Wyandotte, Michigan, to experiment with the Bessemer process. In 1866 he returned to Johnstown where he then supervised the rolling the first steel rails on commercial order at Cambria.

In 1867 he worked in association with John Fritz and Alexander Lyman Holley in the design and construction of Cambria's Bessemer plant. He took charge of this plant upon its completion. In 1873 he went to Troy, New York, to manage the John A. Griswold & Company steel plant. Two years later he was in charge of the combined Griswold firm and Erastus Corning & Company, which became the Troy Iron and Steel Company.

By 1888 Hunt had moved to Chicago to establish a consulting engineering service. He continued to work on installations for firms, sometimes rebuilding works, and erecting improved plants.

He wrote extensively, and only two years before his death at age 85 he proposed the "nick-and-break test" for testing individual ingots. He received the John Fritz Medal before his death for his contributions to manufacturing techniques in the steel industry.

Sources

Frank N. Jones, "Robert W. Hunt, Pioneer in Metallurgical Research," *American Metal Market* January 4, 1972, folder: Plants Johnstown Cambria, box: Plants-Danville-Johnstown, Acc 1699, BSC, HagM.

Jeanne McHugh, *Alexander Holley and the Makers of Steel* (Baltimore: The Johns Hopkins University Press, 1980).

Dictionary of American Biography, 1933 ed. s.v. "Hunt, Robert Woolston," by Robert C. Canby.

DANIEL JOHNSON MORRELL (August 8, 1821 - August 20, 1885)

Daniel Johnson Morrell was the seventh of ten children born to Quakers Thaddeus and Susannah Ayers Morrell of Berwick, York County, Maine. Daniel worked on his parents' farm as a child and only attended two years of school. When he was 16 he went to Philadelphia to work with his older brother David at a wholesale dry-goods firm, Trotter, Morrell & Co., at 32 North Fourth Street. Morrell worked as a clerk for five years until the firm dissolved in 1842. He and his brother then started their own business in the same building. After this business dissolved, Morrell joined Oliver Martin, a fancy dry good dealers, in a business at 28 North Fourth Street in 1845. He served as a clerk, and then as partner in Martin, Morrell & Co. Morrell ran the business for another year after Martin's death in 1854. Daniel Morrell then assumed management of the Cambria Iron Works, which was leased by Wood, Morrell & Co. He held this position until January 1884.

He regularly attended lectures of the Franklin Institute, considered himself a Whig, and was an admirer of Henry Clay. He also was a "great" reader, and through friendships with men connected to the book publishers, Grigg & Elliott, he was able to acquire the latest and best books. After 1855 Morrell lived in Johnstown, took an interest in its people, and "chose to regard himself as one of their number and to throw his influence in the scale in behalf of local improvements and an enlarged public spirit." After the Civil War he was elected to Congress as a representative in 1866 and 1868. He lost re-election in 1870 by 11 votes. In his years in Congress he was chairman of the committee on manufactures, and member of the committees on freedmen's affairs, the Pacific Railroad, and of the select committee on the decline of American commerce. His most memorable accomplishment was his introduction on March 9, 1870, of the bill providing for the 100th anniversary celebration in Philadelphia of the American Revolution. The bill passed on December 14, 1870, with Morrell's backing. He served as chairman of the executive committee of the Centennial Commission. In 1879 he was elected president of the American Iron and Steel Association.

In 1845 he married Quaker Susan Lower, daughter of Powell Stackhouse. Their only child, a daughter, married a general manager of the Cambria Iron Works, Captain Philip E. Chapin.

Sources

James M. Swank, *Cambria County Pioneers*, (Philadelphia: Allen, Lane & Scott, 1910).

The Manufactories and Manufacturers of Pennsylvania of the Nineteenth Century (Philadelphia: Galaxy Publishing Company, 1875).

Henry Wilson Storey, *History of Cambria County Pennsylvania* 3 vols. (New York: The Lewis Publishing Company, 1907).

John Newton Boucher, *The Cambria Iron Company* (Harrisburg: Meyers Printing and Publishing House, 1888).

See also: Robert John Hunter, "Biography of Daniel J. Morrell, Ironmaster" (MA Thesis, University of Pittsburgh, 1954).

Several of Daniel Morrell's letters concerning various interests are located in the Edward Carey Gardiner Collection, Henry C. Carey Papers, Folder 5, Morrell, Daniel J., in the Manuscripts Division of the Historical Society of Pennsylvania, Philadelphia.

ALEXANDER LYMAN HOLLEY (July 20, 1832 - January 29, 1882)

Alexander Lyman Holley was born in Lakeville, Connecticut, the son of Alexander H. and Jane M. Holley. He was educated in schools in Salisbury and Framington, Connecticut, and Stockbridge, Massachusetts, and attended Brown University in 1850. After graduation in 1853 he started work at Corliss & Nightingale, Providence, Rhode Island as a machinist and draftsman, working on experimental locomotives. By 1855 he worked at the New Jersey Locomotive Works at Jersey City, New Jersey.

A skilled technical writer, Holley published *Holley's Railroad Advocate* until 1857, and wrote hundreds of articles for the New York *Times*, edited the *American Railway Review*, and wrote and published *American and European Railway Practice*. He engaged himself in original engineering work by redesigning a locomotive in 1861 for the Camden & Amboy Railroad, and traveled to Europe to learn about ordnance and armor for the Stevens Institute, Hoboken, New Jersey. In England in 1862 he first learned of Henry Bessemer's process for making steel. He bought the American rights to the process in May 1863.

After bringing together the different patent holders for the Bessemer process Alexander Holley designed and built steel plants at Troy, North Chicago, Joliet, Pittsburgh, St. Louis, and consulted on the design of plants in Scranton, Bethlehem, and Cambria in Johnstown. He was the most prominent engineer and designer in the steel industry in the United States, and is known as the "father of modern American steel manufacture."

Holley received fifteen patents for machinery, ten of which were for Bessemer machinery, and was a member of several scientific and engineering societies. He was a prolific writer for both popular and engineering journals.

Holley was married to Mary Slade, and had two daughters. He died in Brooklyn.

Sources

Dictionary of American Biography, 1933 ed. s.v. "Holley, Alexander Lyman," by Carl W. Mitman.

Jeanne McHugh, *Alexander Holley and the Makers of Steel* (Baltimore: The Johns Hopkins University Press, 1980.)

APPENDIX 17

Patrick Graham's Remembrances

Johnstown, Pa Jany 27/1902

Mr. John Fritz
Dr Sir

in looking Back to Latter Part of the year 1855 and for your effort there to make Such improvements in manufacturing Rails as would (and did) Save Wood-Morrell & Co in the manufacturing Rails which you did by the 3 high Roles you certainly Remember the third and last effort i think in June 1857 when T. H. Lapsley - the Roller Made Succefs - i heated the first heat ever Sucesfully Rolled on 3 high Rolls - Remember distinctly of Lapsley telling me in the morning that he had ordered my furnace light up and he wanted me to Make the heat he was Jut 8 & 1/2 days from the time he commenced Putting the Mill in order until i was Ready to draw my heat. which i did Sucesfuly The field was then open for your enginuity which you & Brother George Carried through Succesfully about one month after starting the mill Burnt down it seemed as if the co was afraid to start but you did start and before the co finally agreed i Remember you can to me in the morning (i cant give date) and told me you wanted me to take my own time so i could be Ready to draw a heat about 11.00 and that you wo wanted the pile in the Roughing Rolls while the Rail in Finishing I think you Said your Engine Should Run up to 120 pr mint (i no it did run very fast) and i no a Gentleman afrom Philadelphia stood on No 1 Base with wach in hand timeing the rooling of the Heat after they Examined the Rails he Came Back to me and handed me a $10 bill he gave Lapsley $20 Well Mr Fritz i have been thinking of you many times and i feel as if i am not able to go to Bethleham now Physically or Financially if you come out our way will you please call and See me. My Eyesight is almost gone can hardly the lines i Rite on Please answer

Your Friend as Ever
Patrick Graham Born Nov 15=1817
824 Franklin Street
Johnstown
Pa

Please Send me Your age

Source: Patrick Graham to John Fritz, January 27, 1902, John Fritz Collection, CCHT.

John Fritz Patent for Three-High Rolls

UNITED STATES PATENT OFFICE.

JNO. FRITZ, OF JOHNSTOWN, PENNSYLVANIA.

ROLLING RAILWAY-IRON.

Specification of Letters Patent No. 21,600, dated October 5, 1858.

To all whom it may concern:

Be it known that I, JOHN FRITZ, of Johnstown, in the county of Cambria and State of Pennsylvania, have invented certain new and useful Improvements in Three-High Rolls for Rolling Railroad-Rails, Bars, Beams, &c.; and I do hereby declare the following to be a full, clear, and exact description of the construction and operation of the same, reference being had to the accompanying drawings, making a part of this specification, in which—

Figure 1, represents a perspective view, of the rolls, frame, and parts connected thereto. Fig. 2, represents a vertical cross section taken through the rolls. Fig. 3, represents a longitudinal vertical section through the rolls and frame.

Similar letters of reference where they occur in the separate figures, denote like parts of the apparatus in all of them.

In the rolling of railroad rails, bars, beams, &c., as at present pursued, the length of the rail, bar, or beam is limited by two almost insuperable causes, viz: first, the ability to give them the required number of passes through the rolls, while they retain a sufficiently high welding heat, and secondly, the difficulty of turning the rail, bar, or beam, when very long, which must be done to prevent, or roll down any partings of the fiber of the metal, and to roll down the fin that forms at the loose or free parts of the grooves of the rolls.

By my construction and arrangement of rolls, I effectually remove the difficulties heretofore encountered, and can roll at a single heat, and without welding on, a rail, bar or beam, one third longer, than can be done by any other arrangement of rolls hitherto known, or at least of which I have any knowledge. This I do by so contriving that, each succeeding pass shall roll down the fin formed by the preceding pass, and avoiding the turning over of the bar, rail, or beam, which, in a beam of 50, or 60 feet in length, is a very important saving. I also roll the bar, rail, or beam, in both its passages back and forth, which rolls down all and every part of the rail or beam that has a tendency to part or rise, and is moreover a better means of retaining the necessary heat in the metal than to pass the bar or beam back at each pass, over the rolls, to be reëntered at the same side of them, for it not only economizes time, but the metal retains more of its heat in passing back through the rolls, than it does in passing over them. It is known that, the tendency of the metal, in being passed through between rolls, is to follow the rolls, and any portion of the metal that detaches itself from the rail or beam, turns up in the direction of the rotation of the roll, and that by reversing the passage of the rail or beam through the rolls, such detached or parted portion is again rolled down into its place. When "too high" rolls are used, the rail or beam must be turned over, and when it must of necessity be turned over, its length must be limited. By my plan I can roll, with greater ease and facility, and in less time, a rail or beam 50 feet long, than can, by the old method, be rolled a 35 feet rail. Nor am I limited to 50 feet, as I believe I can economically roll a beam or rail 70 feet long without a weld, a thing hitherto unknown in this art.

My invention consists first, in the so arranging of "three high," rolls, for rolling bars, rails, or beams, as that the article shall be subjected to the rolls in each of its passes to and fro, and so that each succeeding pass,

Source: Copy in John Fritz Collection, CCHT.

shall roll down the fin formed at the preceding pass, and thus avoid the turning of the rail, bar, or beam, and secondly, in combining with the top roll of the series, or with the roll that performs its part of the operation, the elastic, or yielding guides, or their equivalents, for causing the bar, beam, or rail, to pass from the said roll, and not wind around it.

To enable others skilled in the art to make and use my invention, I will proceed to describe the same with reference to the drawings.

A, A, represents the base or bed of the frame with undercut grooves *a*, *a* formed in their tops. Upon these base pieces, are supported the pillar blocks, or side pieces of the frame B, B, which are screwed to, or otherwise united, to blocks that can move in said undercut grooves *a*, *a*.

C, D, E, represent three rolls, whose journals *c*, *d*, *e*, are supported in suitable boxes *f*, *g*, *h*, arranged in the side pieces B, B, of the frame. Over the tops of the journals *c*, *d*, *e*, of the rolls, are followers, *i*, *j*, *k*, which are adjustable to their respective journals, through the set screws F, F, at the tops of the pillar blocks B. There are also side bearers *s* to the journals for holding them in a proper vertical line. The tops of the pillar blocks are held together by stay rods G, G, and screw nuts thereon.

The rolls herein represented, are arranged for five passes, but may be arranged for a greater or less number of passes; they also have a duplicate of the finishing pass (which is the last one) because that groove should be more perfect than the others need be, and the working passes, will last as long without repair or renewal, as will two sets of finishing grooves. The shape or contour of the bar, rail or beam, is formed in reverse in the rolls, as is common in the art, and may be made with such gradual reductions or changes of form, as are found most advantageous. The top and bottom rolls C, E, are (what is termed) groove rolls, and sometimes flanged rolls, while the center roll D, of the series, is a tongue roll. The rolling surface of the roll D, is greater in circumference, than that of the roll E, for the purpose of throwing or keeping down the end of the bar or beam, and prevent it from winding on said roll D—it overhanging the lower roll, like a shelf. The guide H, receives the lower side of the bar, rail or beam, and keeps it in a direct line, as it leaves the rolls. Now as it is actually necessary that, the roll D, should have a greater rolling surface, than the one E, below it, and as the top roll C, must bear the same relative position (mechanically) to D, that D, does to E, (that is to prevent the bar from winding around itself) there would seem to be a mechanical impossibility, when it is understood that the roll C, is almost the duplicate of E, and yet in effect it must be as much larger than D, as D, is larger than E. To overcome this heretofore insuperable difficulty in the sizes of the rolls when used "three high", is one of the most important features of my invention, and consists in the introduction into the machine, of the elastic, yielding or self adjusting guides or clearers *m*, *m*, and *e*, whose points are made of steel, and shaped to fit, into the sharp angles of the grooves, and take the rail or bar upon themselves, the moment it passes the point of closest impact between the rolls, and thus not only prevent the bar or beam from winding itself around C, but guides and conducts it out between the stationary guides *n*, *n*, and thus these guides or clearers *m*, have the same effect, in keeping the bar or beam from winding on C, that the large diameter of D effects in protecting itself, while C, and E may thus have the same rolling surfaces, which they must have, to match with the center one D that works in common with both of them. These guides or clearers *m*, are represented as suspended by rods *o*, *o* &c., to levers *p*, *p*, &c., pivoted on the rod *q*, and furnished at their outer ends with weights *r*, *r* &c., to hold them into the corners of the grooves. Of course springs, or any other equivalent device may be used for holding up these clearers in their proper places, while their points may conform to the adjusted, and adjustable position of the rolls. The beam or cross bar I, prevents the heels of these clearers from rising above a fixed position, while their points, which can descend by the raising of the weight, cannot rise as it is in contact with the roll.

Suitable guides are furnished for keeping the bar, in its proper lateral position, while the stationary guides below, and the yielding or elastic ones above keep it in proper horizontal position, and prevent winding.

The operation is as follows. The pile or bolt of iron of which the bar or beam is to be made, being suitably heated, is first passed through the pass 1, (see Fig. 3), and returned back through the pass 2—and in coming through 2, a fin will be formed at the lower left hand corner of the pass—the drawing being slightly distorted to better show how the fin forms at the loose side of the groove. It is then passed through 3, (without being turned over), and the fin formed at 2, now comes in the tight or solid part of the groove and is rolled down, while another or a lesser one forms at the upper right hand corner, which is now the loose corner. Thence it is passed through 4, where the fin formed at 3, comes into the closed part of the groove and is rolled down, and a lesser one formed at the lower left hand corner, which in turn is rolled down at the 5th pass, and so on—each succeeding pass rolling down the fin formed in the preceding pass, and without at any time turning the bar. If any part of the bar or beam starts up, or detaches itself which often happens, and curves up, as it invariably does in the direction of the motion of the rolls, the return pass immediately rolls it down again, as the direction of the bar is reversed at each operation or pass, and thus the bar or beam need never be changed "end for end". Should it be necessary at any time to bring the bolt back after it has passed through 1, and before it passes through 2, it may be done by passing it through the pass *s*. As the bar or beam goes through the passes, it is received on the skeleton table J, and thence back between the guides as above stated.

By this construction and arrangement of "three high" rolls, I not only make a longer bar, and with less labor than heretofore, but I make a better bar inasmuch as it is made quicker, and while the heat is in a better welding condition. There would even be economy in the preservation of the heat, by returning the bar between the rolls, than over them, if not rolled or reduced on returning—as they lose less heat when passed between the rolls.

Having thus fully described the nature and object of my invention, what I claim therein as new and desire to secure by Letters Patent is—

1. The so arranging of "three high" rolls, for rolling rail-road rails, bars, or beams, as that said rails, bars, or beams may be rolled or reduced as they pass both forward and back, and so that each succeeding pass shall roll them down the fin formed at the preceding pass, and avoid any necessity of turning the bar as heretofore done, substantially as described.

2. I also claim in combination with the top roll of the series, or with any roll of a series which performs its duty, the yielding clearer or guide, or its equivalent, for preventing the bar, rail or beam from winding on said roll.

JOHN FRITZ.

Witnesses:
A. B. Stoughton,
Thos. H. Upperman.

No. 21,666. PATENTED OCT. 5, 1858.

J. FRITZ.

ROLLING RAILWAY IRON.

Fig. 1.

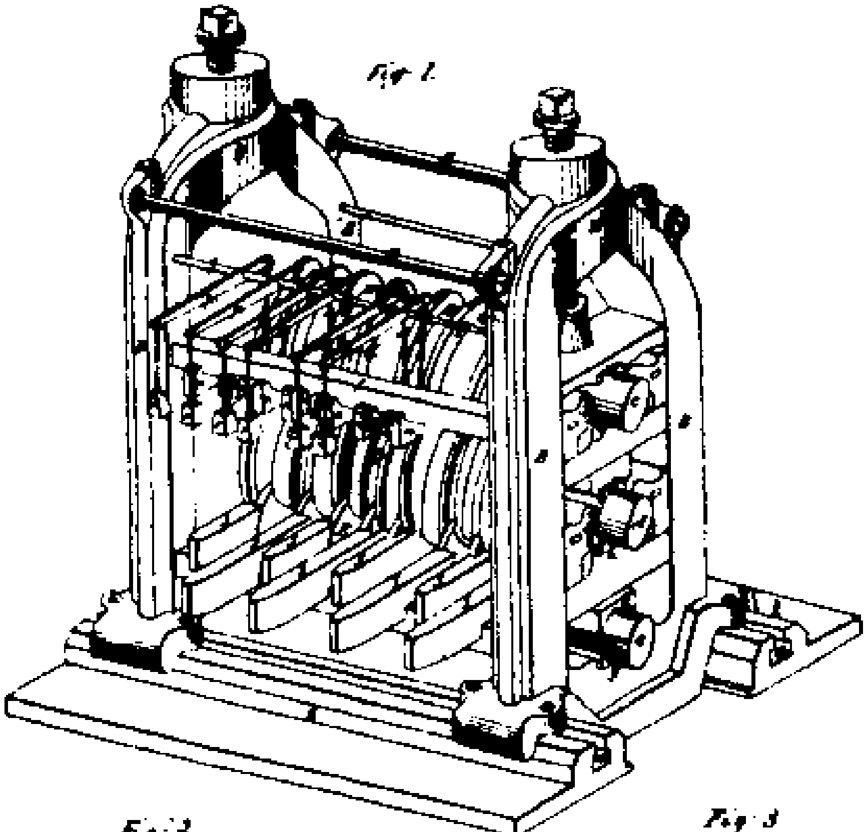


Fig. 2

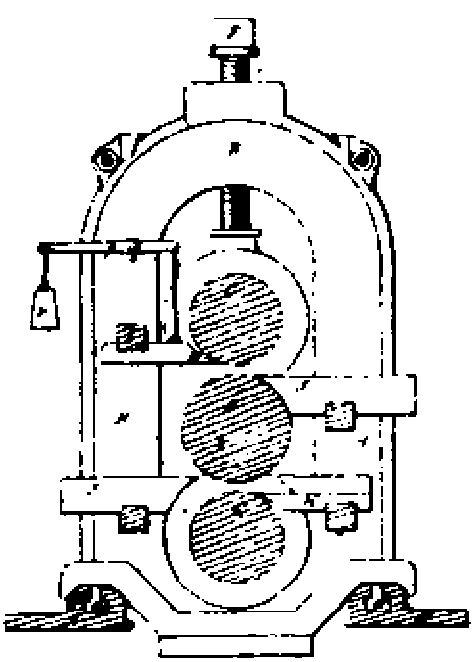
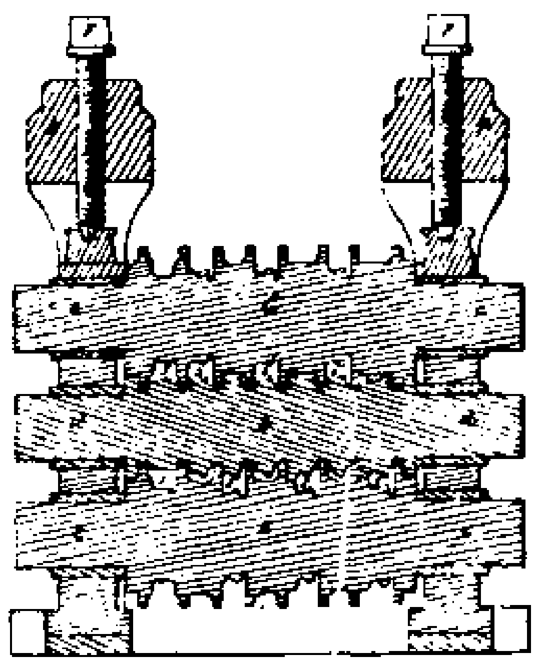


Fig. 3



APPENDIX 19

John Fritz's description of building the Cambria rolling mill, 1857.

Source: John Fritz, *The Autobiography of John Fritz* (New York: John Wiley & Sons, 1912), pp. 118-124.

On Monday morning we sent a number of axemen to cut poles or timbers, say about twenty feet long and eight or ten inches in diameter at the butt or large end, and we also sent teams to haul the logs into the works. On Tuesday morning, carpenters went to work to frame them together, and the men raised them and braced them in place to carry the steam pipe and feed-water pipe for the boilers. The larger and upper pipe was the steam pipe, about ten inches in diameter; the smaller and lower was the feed pipe for the boilers, four inches in diameter. The trestles were placed about twenty feet apart the whole length of the mill, — six hundred feet, — and were erected the same way in the transepts, which were two hundred feet long each, making the total length of ten-inch steam pipe about one thousand feet, and the same length of four-inch water pipe, all of cast iron, and cross pipe leading from the main steam and water pipes to the boilers, made of four-inch wrought iron and copper. The old cast-iron steam and water pipes were almost totally destroyed. Where the pipes were not broken in two, the branches on them for the boiler connections were broken, and the cross steam and water pipes, which were made of wrought iron with copper turns for expansion, were so bent and twisted that many of them could not be used. Shafting, pulleys, and all light machinery were badly injured. The engines were all more or less damaged. The roll bearings, being soft metal, were generally melted out, and the rolls all had to be taken out and new metal put in.

The outlook was most discouraging. The mill workmen were in sore distress, having been told by some persons that it would take a year at least to get the mill ready to run again. They came to me to know what they should do, as they could not live without work until the mill would start up again. I at once assured them that we would make rails inside of thirty days, and that we would give them all the

laboring work we could during that time. This cheered them up very much. In twenty-eight days from the time of the fire we were running the mill on full time, but without a building; we put up a temporary frame to carry the books, and the workmen were covered temporarily with boards throughout the mill.

The building that had just burned down was of wood, and I suggested that we rebuild with brick. This was vehemently opposed by some of the stockholders, but, there being a brickyard with good clay at the door of the mill, I at once made a contract with the men who had charge of the yard for all the brick that it would take to put up the building at $2.62½ per thousand. The building, whose total length, including transepts, was over one thousand feet and width one hundred feet, was put up and ventilator completed and under roof with slate by January 1, 1858. At that time it was the finest rolling-mill building in the world, and I think it was the best building ever put up in this country at the same cost. It was put up and roofed while every man was at work and the mill working up to its full capacity, and not a single person hurt. This was something that I was always proud of, but I never left the building while the trusses were being put in place. They could not be put together on the ground and raised as a body on account of the pipes and machinery and the hot iron that was constantly in motion on the mill floor; consequently they had to be put together in place over the heads of the workmen, while they were all at work. This was a most difficult task, requiring extreme care; consequently I was on the building while every member of every truss was being raised and put in place. This was the most trying ordeal that I ever had, not that there was any serious practical difficulty in doing the work in the manner we were doing it, but it was the danger that the men both above and below were constantly exposed to that rendered it so hazardous. The falling of a member of the truss, or a bolt, nut, wrench, or tool of any kind, striking a man on the head, would cause instant death, and no person but myself knew what a load was off my mind when the last truss was in place and I came down off the building for the last time, late in December, 1857, and could say that the building was practically completed and not a single person had in any way been hurt, so as to disable him even temporarily. This was a source of gratification that well rewarded me for the intense anxiety I had been laboring under from the commencement to the finish of the erection of the building. During all the time we were erecting the new building, the mill was working nicely and doing good work, which, under the circumstances, was also a source of untold satisfaction.

Previous to starting the three-high mill we had commenced to increase the output of puddled iron, as the new mill was capable of doing over four times the amount of work the old one could do. It was most important to take up this end of the work, which had, in a measure, been necessarily neglected. The puddling furnaces were originally all single, but we had already changed some of them to double. We now put on all the force we could and changed all the furnaces to double and built some new ones. This greatly increased the output. In order to roll the increased quantity of puddled iron, we had to build a new top and bottom mill, and at the end of the same we put in a set of rolls for flattening old rails so as to pile them in with the puddled iron in the rail pile. Up to this time the tops and bottoms for the rail pile had been rolled on the puddle train. By removing the rolls to the new train we had place for another set of puddle rolls. We also had to put in a Burden squeezer, as the Winslow squeezer originally installed could not take care of the increased quantity of puddled iron that was being made.

Up to this time, in order to make smooth heads and flanges, we were compelled to use two pieces of top and bottom with head on flange, an expensive method of manufacture. This led to the building of a sixteen-inch train to roll bars one and a half inches wide by five-eighths of an inch in thickness. In the middle of the pile next to top and bottom was placed a puddled bar five inches in width and five-eighths of an inch thick; on each side of this was placed a piece one and one-half inches wide by five-eighths of an inch thick. These bars were generally rolled out of old rails, thereby saving a large amount of reworked iron, and on the same sixteen-inch train was rolled all the bar iron that was used about the works. We also built two heating furnaces for this mill. From the first, the plant was short of steam. The boilers were plain cylinder, underfired, but as fast as the puddling and heating furnaces were changed and new ones built, boilers were put over them. At length we had all the steam that was wanted. The puddling furnaces, Burden squeezer, and puddle rolls, the top and bottom furnaces, and rolls were all working well, also the heating furnaces for the rail mill, and the new three-high rail mill worked most magnificently. All this made a better and more perfect rail and made cold-patching a thing of the past. We put in new hot beds and curving plates, substituted the straightening machine for the sixty-pound old-time sledge, greatly improved the punching machines, and by the introduction of the driven rollers on the rolls the mill could turn out four times as much work as could possibly have been done on the old mill and with less than half the labor and no wear and tear of muscle.

Having gotten all the furnaces of both kinds and all the rolls and machinery in the mill in good shape, we next took hold of the handling of the puddled and top and bottom iron to see what improvements could be made in that line. Up to that time the puddled and top and bottom iron, especially the puddled bar, had been dragged from the rolls, out on the bank, as it was called, and when cold taken to the cold shears, cut to length, and taken on a wheelbarrow to the heating furnaces and there piled. This made it impossible to keep the space about the furnaces clean and tidy, and the place was at all times cluttered up with puddled and top and bottom iron of various lengths which could not be used in the pile. To remedy this, we placed a pair of shears in front of each set of rolls, both puddled and top and bottom, and in an iron frame of proper length we placed rollers opposite to each shear. As the iron came from the rolls it was fed into the shears and cut to proper length for the piles. The iron was neatly laid at the shears, a two-horned buggy was put under it, and the bars were taken to the bed and let cool; then the same kind of buggy was used to take it to a place arranged for piling it. The iron was not touched by hand from the time the pig iron was charged into the puddling furnace until it came to the piler. This arrangement greatly lessened the cost and made the work much lighter for the men. We put rail tracks from the place of piling to each heating furnace and had cars made that would hold one heat of piles, and the iron was piled on the car and taken to the furnace as wanted. This arrangement worked admirably, and the mill looked like a parlor as compared with the other rolling mills of that day.

In regard to the blast furnaces, they were old-fashioned, and short of blast and water. We did not have sufficient water on the coke yard to properly extinguish the fire in the coke as it was drawn from the oven. The first and most important thing was more blowing capacity. As the furnaces were located on an abrupt rise in the ground, it made it very expensive to get a place for more blowing engines on account of the excavation that would have to be made to receive them, and, having already used so much money in making improvements in the mill department, I did not want to spend any money on the blast furnaces that was not absolutely essential. In carefully looking over the blowing-engine room, I concluded that I could design a short-stroke quick-running upright engine that would give all the blast needed, and would go in, one in each corner in the rear of the present engines, and save a great amount of expense. The engines were built by Matthews & Moore, of the Bush Hill Iron Works, Philadelphia, and they worked quite satisfactorily. While this engine was designed for a special plant and purpose, the design was adopted and used for a long time in Western Pennsylvania and Ohio. We also put in a new pump to get more water for the tuyeres. As water was very hard to get, we had to collect the tuyere water and pump it up to the coke ovens, to be used in putting the fire out of the coke as it was drawn out of the ovens. After these improvements were put in things went along much more comfortably about the furnaces and coke ovens than they had been doing for some time previous.

APPENDIX 20

Bessemer Production at Cambria, 1871-1892.

Source: "Bessemer Product for Fiscal Years," typed chart, folder: Plants Johnstown Cambria, box: Plants-Danville-Johnstown, Acc 1699, BSC, HagM.

E.T. Co. Bess Dept. Johnstown, Cambria

BESSEMER PRODUCTS FOR FISCAL YEARS.

Fiscal year ending Oct. 31	1871	1872	1873	1874	1875	1876	1877	1878
Nov.		1750.0	2384.[illegible]	[illegible]	4419.1	6381.1	6004.1	8632.7
Dec.		1773.8	2064.[illegible]	[illegible]	4008.7	6124.	4620.0	4010.6
Jan'y		2129.2	2404.[illegible]	[illegible]	3649.1	4740.0	7202.1	7193.6
Feb'y		2118.0	2002.[illegible]	[illegible]	4361.1	4400.	6021.4	6912.8
March		1678.0	1961.[illegible]	[illegible]	4092.7	4061.6	6301.2	8631.3
April		1963.4	2040.[illegible]	[illegible]	4442.	6104.1	6302.0	7310.7
May		2130.7	2676.[illegible]	[illegible]	4661.3	4713.	7276.3	10771.4
June		2925.1	2637.[illegible]	[illegible]	4551.8	4638.0	6348.8	7080.4
July		1427.8	3174.7	[illegible]	4067.8	4600.	4603.8	8306.
August	451.8	2795.8	3603.8	[illegible]	4898.3	6161.9	6370.5	7872.
Sept.	816.	2010.5	3061.0	[illegible]	4654.4	4371.9	6004.2	7414.1
Oct.	1127.2	1863.7	1510.2	2817.4	5100.7	4004.0	6420.5	8130.4
Totals	2391.0	24634.4	30567.	35661.	53627.0	63910.6	75194.8	86260.
Increase		22243.	5633.	[illegible]	22065.0	10287.6	11230.5	10152.7
Decrease								

Fiscal year ending Oct. 31	1879	1880	1881	1882	1883	1884	1885
Nov.	7033.4	8006.6	10847.0	13376.[illegible]	14916.7	14080.6	14460.8
Dec.	7230.4	9458.8	7814.1	14028.[illegible]	10634.8	11001.8	10300.9
Jan'y	7408.7	9272.3	13343.	14384.[illegible]	14630.9	14238.3	13766.7
Feb'y	8606.3	10428.1	11044.3	11306.[illegible]	13510.9	13406.4	13500.3
March	7734.0	11030.5	10447.1	13116.[illegible]	18204.1	16021.1	11278.
April	8862.6	8868.5	11784.1	10377.7	15044.0	15920.4	10824.4
May	9604.4	9881.6	10470.[illegible]	[illegible]	[illegible]	[illegible]	14580.7
June	9095.8	10368.6	11407.1	9394.8	12997.7	14209.4	14042.4
July	9180.6	9604.3	[illegible]	9060.4	13100.0	14816.4	11725.6
August	8014.	10241.7	11730.5	13231.	14428.8	17934.6	13343.1
Sept.	8830.	11877.2	11028.3	14012.4	12871.	14131.3	16467.0
Oct.	9159.3	11190.6	11997.	15063.1	16038.0	15420.	16566.1
Totals	98081.6	120206.	140142.4	145062.0	163410.0	167436.7	161710.0
Increase	8372.6	20140.4	19931.4	5430.5	17417.0	4026.7	
Decrease							*5727.6

Fiscal year ending Oct. 31	1886	1887	1888	1889	1890	1891	1892
Nov.	11000.5	18091.	20038.1	17403.4	14867.5	17945	22584.
Dec.	14030.5	17519.0	18643.3	13478.2	18381.4	20102.	16047.
Jan'y	14792.0	16427.4	17917.2	16767.7	22485.1	23047.	22492.
Feb'y	14348.9	15901.	17707.6	16087.3	16806.0	17432.	23791.
March	12835.0	20082.8	21004.3	18448.6	23440.	13157.	26765
April	9526.4	17817.6	17236.2	18247.9	21197.9	14876.	26728.
May	14007.	17324.	16088.7	16397.5	22361.6	14435.	29168.
June	17202.7	16060.7	18385.0	2733.6	19922.7	32254.	24563
July	16307.9	15748.0	18046.	11336.0	14402.	27440.	
August	15950.	17746.1	18347.6	16030.4	20448.6	20467.	
Sept.	15148.7	19219.0	17877.1	18128.4	20522.4	20379	
Oct.	17730.8	18307.8	17117.4	13351.7	22495.6	24679.	
Totals	180280.9	207437.8	215733.9	174473.[illegible]	243633.6	237530.	
Increase	18570.	27157.	8296.		69160.0		
Decrease				*41260.7		*6103.4	

APPENDIX 21

Steel tonnage of 11 steel plants, 1878-1879.

Source: Robert H. Sayre Collection, CCHT.

	March 1878	April	May	June	July	August	September	October	November	December	January 1879	February	Total for Year ending Feby 28 1879
Cambria Iron Co.	7664	7111	7612	7649	6555	7764	7393	7720	7103	7188	7623	2890	84356
Cleveland Rolling Mill Co.	6269	6615	6270	5486	3727	5603	5996	7001	6908	6229	4115	5344	66569
Albany and Rensselaer I & S Co.	5038	4017	5173	2204	1139	4270	5259	6609	6739	6667	4255	2160	51756
North Chicago Rolling Mill Co.	3611	4923	7606	6595	6516	6801	5997	7646	6679	4642	6869	6349	74217
Union Rolling Mill Co.	3105	5713	4530	4018	2152	4470	4967	6424	5317	5809	4455	4802	51696
Pennsylvania Steel Co.	6750	7101	7295	6813	1354	5265	6367	7955	7091	5181	7219	1965	71517
Vulcan Iron Works													
The Edgar Thomson Steel Co. Lim.	7346	7487	8527	7735	7653	7776	8318	8831	8830	6849	6603	8336	95475
The Bethlehem Iron Co.	5790	6484	6600	6607	6914	6717	5787	6176	6459	6714	7820	6693	71697
Lackawanna Iron & Coal Co.	4199	4347	3925	3089	4873	7156	4152	4411	5176	4150	4853	4624	55007
Joliet Iron and Steel Co.			2968	4479	3147	4661	4300	7387	7392	2471	6132	4027	51253
	50573	52017	60511	54479	45506	61930	58631	69143	67701	57620	57127	46195	612552

APPENDIX 22

Names of steelworkers present at first blow of Bessemer steel at Cambria, and Cambria officers on July 10, 1871.

Names of Steel Workers at the First Blow

Below is a list of steel workers who assisted in making the first blow of Bessemer steel at Johnstown:

Present at the Dinner.

Robert W. Hunt, Chicago, Ill.
Homer McHarvey, Johnstown, Pa.
Morgan I. Williams, Johnstown, Pa.
Jas. L. Cramer, Johnstown, Pa.
David [illegible], Johnstown, Pa.
Chas. W. Andrews, Johnstown, Pa.
Sidney Wilson, Johnstown, Pa.
John Haynes, Johnstown, Pa.
Peter L. Carpenter, Johnstown, Pa.
Jos. Griffith, Johnstown, Pa.
R. Emmett [illegible], Johnstown, Pa.
F. K. Jenkins, Johnstown, Pa.
Jas. M. Duncan, Johnstown, Pa.
Thomas McCoy, Johnstown, Pa.
Wm. Williams, Johnstown, Pa.
Andy Forrest, Johnstown, Pa.
John R. Sell, Johnstown, Pa.
John Horn, Johnstown, Pa.
Wm. [illegible], Johnstown, Pa.
Sol [illegible], Johnstown, Pa.
John C. Weir, Johnstown, Pa.
F. S. Miller, Johnstown, Pa.
Frank P. Weir, Johnstown, Pa.
Wm. Rhodes, Johnstown, Pa.
Richard Bauers, Johnstown, Pa.
David Barnhart, Johnstown, Pa.
Wm. T. Dawson, Johnstown, Pa.
Amos Wells, Johnstown, Pa.
[illegible] P. Griffith, Johnstown, Pa.
Mason Wagner, Johnstown, Pa.
[illegible] Bittner, Johnstown, Pa.
Jas. M. Dronsfield, Johnstown, Pa.
Noah Winokes, Johnstown, Pa.
Geo. E. Hamilton, Johnstown, Pa.
David J. Llewellyn, Johnstown, Pa.
Evan P. Jones, Johnstown, Pa.
Jos. Burns, Johnstown, Pa.
Jno. R. Donaldson, Johnstown, Pa.
Thomas Kephart, Johnstown, Pa.
John M. Davis, Johnstown, Pa.
Charles Ellis, Johnstown, Pa.
A. L. Carpenter, Johnstown, Pa.
George W. Gardner, Braddock, Pa.
Jonathan Lewis, Braddock, Pa.
G. S. Davies, Braddock, Pa.
Benj. Stutzman, Braddock, Pa.
Mike Forrest, Wheeling, W. Va.
Frank Cramer, Pennsville, Fayette County, Pa.
George Arbaugh, Lorain, Ohio.

Unable to be Present, but Sent Their Regrets.

Frank Heiner, Johnstown, Pa.
Kip Bennett, Johnstown, Pa.
Jack Williams, Johnstown, Pa.
Geo. Jordan, Johnstown, Pa.
Richard Bauers, Johnstown, Pa.
Cyrus Blouch, Johnstown, Pa.
Isaac Evans, Johnstown, Pa.
James W. Wilson, Johnstown, Pa.
Jos. Storrer, Johnstown, Pa.
Robert Marrow, Indiana Harbor, Ind.
C. Asbury Shomo, Johnstown, Pa.
Rev. P. Floram, Elizabeth, N. J.
James Stroup, Braddock, Pa.
Thomas Lowry, Braddock, Pa.
Robert Colbert, Braddock, Pa.
Joseph Abel, Eugene, Ore.
John Northcraft, Placerville, Cal.
John Stanton, Jamaica, N. Y.
Isaac Sager, Wichita, Kan.
Benj. Best, Ohio (Lorain).
Thomas H. Edwards, Pueblo, Col.
S. C. Trawatha, Pueblo, Col.

Powell Stackhouse, chairman of the board of the Cambria Steel Company, had to send his regrets on account of his recent absence in Europe and present pressing business engagements.

Other guests present at the reunion were as follows:

David D. Lewis, Philadelphia, Pa.
Charles S. Price, president Cambria Steel Company.
H. C. Wolle, general superintendent Cambria Steel Company.
J. L. Replogle, assistant to president Cambria Steel Company.
F. E. Thompson, superintendent Bessemer department, Cambria Steel Company.
Daniel Stackhouse, assistant general superintendent Cambria Steel Company.
E. G. Parker, former superintendent Bessemer Department.
Geo. E. Thackray, special engineer, Cambria Steel Company.
H. E. Winger and G. W. Moore, Johnstown representatives of Robert W. Hunt & Co.

Cambria officers on July 10, 1871

President - Charles R. Wood
Vice-president - E.Y. Townsend
General Manager - Daniel J. Morrell
Assistant General Manager - Powell Stackhouse
General Superintendent and Chief Engineer - George Fritz
Master Mechanic and Assistant to Mr. Fritz - William R. Jones
Superintendent of Blast Furnaces - Thomas Collins
Superintendent of Iron Mills - Alexander Hamilton
Hamilton's Assistant - Charles Kennedy
Night Superintendent - James Moore
Foremen of Puddle Mills - Barney Ziegler and Jacob B. Dunlap
Foreman of Machine Shops - Daniel N. Jones
Foreman of Foundry - Benjamin Watkins
Foreman of Blacksmith Shops - Joseph Layton
Foreman of Pattern Shop - Enoch Lewis
Superintendent of Bessemer Works - Robert W. Hunt
Superintendent of Blooming Mill - John E. Fry

Source: "Cambria Steelworkers' Reunion," *The Iron Age* 88, no. 14 (October 5, 1911): 741-743.

APPENDIX 23

[Poem] Written for the Pioneer Steel Workers' Reunion, held at Johnstown, Pa., September 20, 1911.

Written for the *Pioneer Steel Workers' Reunion*, held at Johnstown, Pa., September 20, 1911.

A jolly set of old-time friends have gather'd here today,
The faces are familiar, but the hair is getting gray;
For time and circumstances change all things here below,
And also old steel workers of forty years ago.

We've gather'd here from near and far, each other's hand to shake,
and mutu'ly refresh the mind for old acquaintance sake.
Some left our ranks, achiev'd success; steel working was too slow,
Though wealthy, are as chummy yet as forty years ago.

I'm happy to be here today, I know that you are, too,
To meet and greet the remnant left of Captain Hunt's old crew.
The nods, broad smiles and hearty shakes from Jim and Jack and Joe,
Familiar recollection wakes of forty years ago.

On July tenth of seventy-one, erected and complete,
The Cambria Bessemer steel plant made its initial heat.
'Twas Captain Hunt who had full charge to superintend and blow,
Who fill'd the bill successfully just forty years ago.

And who was Captain Hunt? perhaps you've heard someone inquire,
He was the only man that day, the man we all admire.
He took us green and ignorant who never saw a blow,
We followed his instructions; that was forty years ago.

We put the cupola in blast and got the iron out,
Weigh'd and pour'd it down the trough into the vessel's snout.
Spectators crowded all around to see the first heat blow,
"Pell mell" they went when it turned down just forty years ago.

The steel as specified for rails must be both tough and hard,
And if it did not fill the bill it never left the yard.
Where'er you saw those rails laid down if stamped C. I. C. O.,
Were O. K., as were specified just forty years ago.

The composition of the crew was also hard and tough,
But not in a degraded sense could we be counted rough.
"Hard" work we never whimper'd at if up, or down below,
And "tough" as hickory, you can bet, just forty years ago.

Why, yes, we old steel workers have a warm spot in our hearts,
And pray that Captain Hunt receive the blessings God imparts,
Long life, good health and happiness wherever he may go;
'Twas his delight to treat us right just forty years ago.

My final wish, that all may have the best this world can give
To recompense your faithfulness as long as you may live.
Should we be spared, and all goes well, another year or so,
Let's rally up, old yarns to tell, of forty years ago.

—Griffith R. Davies (Bachan), Braddock, Pa.

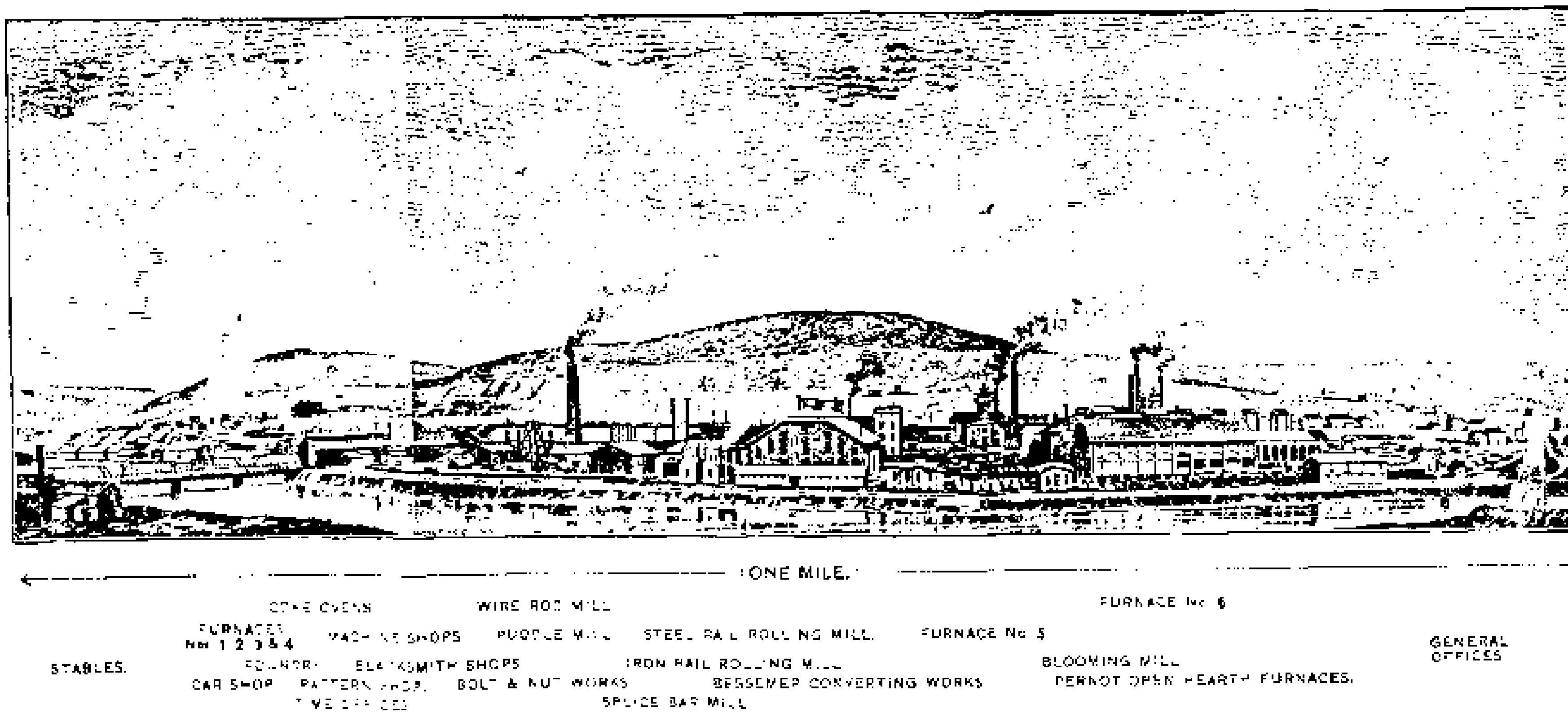
Source: Miscellaneous Collection IV, Box V, Johnstown's Iron and Steel Industry, JFM.

APPENDIX 24

Cambria Iron Company, 1884.

Source: Lieutenant W.H. Jaques, "The Establishment of Steel Gun Factories in the United States." *Proceedings of the United States Naval Institute* X no. 4 (1884): 800-813.

PLATE LXX.



CAMBRIA IRON AND STEEL WORKS, JOHNSTOWN, PA.

CONDITION OF STEEL MANUFACTURE.

"With a view to such experiments as their appropriations would justify, the Ordnance Bureaus of the War and Navy Departments have from time to time addressed the steel manufacturers of the country on the subject of furnishing steel for cannon, but thus far have met with only a partial success.

The reasons for this will be noticed farther on in this report, but the fact is here stated to emphasize the conclusion that the immense steel works of the United States, from lack of demand for this special material, have not the necessary plant for forging, and are in no condition at present to manufacture steel for cannon in such quantities and in such sizes as are essential for a suitable armament for the country." *

In December, 1881, Lieutenant C. W. Whipple, U. S. A., prepared an interesting report (published in the "Report of the Getty Board on Heavy Ordnance and Projectiles—1882") on the steel manufacturing facilities in this country for gun-construction, and presented a list of the manufactories with their furnace and forging capacities to produce ingots of the proper weight for tubes and hoops. In this report, Lieutenant Whipple gives the heaviest hammer that of Park Brothers & Co., Pittsburgh, Pa., a tup of 17 tons. "But with the steam it is computed at 67 tons." Nearly all European steel factors do not approve of the use of steam above, consequently the power of the heaviest hammer in this country may be recorded as 17 tons.

Since the preparation of the above report, open-hearth steel has been accepted by the majority of good authorities as the most uniform and the development of open-hearth plants in the United States finds, at the present time, the

Cambria Iron Company, Johnstown, Pa.,
Midvale Steel Company, Nicetown, Philadelphia, Pa.,
Springfield Iron Company, Springfield, Ill.,

the best prepared to cast the required material.

Cambria Iron Company.—These works, by gradual development and acquisitions, have grown to be the most extensive of their kind in the United States. They comprise large coal and iron mines; eleven blast-furnaces; Bessemer and open-hearth steel works; extensive mills for puddling and rolling iron and steel rails of all weights and patterns, and many special forms of both iron and steel, including

* Gun Foundry Board Report.

steel-wire; machine, smith and boiler shops; foundry and other mechanical accessories, beside many important collateral industries.

The principal establishment (Plate LXX.) is situated at Johnstown, Cambria County, Pennsylvania, at the base of the western slope of the Allegheny mountains (1184 feet above the sea), on the main line of the Pennsylvania Railroad, and 78 miles east of Pittsburgh. It is built in the deep level cutting at the junction of the Stoney Creek and Little Conemaugh River, which unite here and form the Conemaugh River. The works extend over an area of 60 acres, of which seven are covered by the rolling mills.

The occurrence of iron-ores in great variety and extent in the coal-measures at Johnstown and its vicinity having attracted attention to the region as a promising seat of iron manufacture, the working of the ores of Cambria County was begun as early as 1809, by the erection of a forge at Johnstown, which was subsequently removed to the Conemaugh River, where it was operated until about 1825. The Cambria Iron Company was organized, and obtained its first charter in 1852, at which time the property consisted of valuable and extensive tracts of mineral and timber land, and a number of blast-furnaces of rather primitive construction, situated at considerable distances from each other. In 1853, the construction of four coke furnaces was begun at Johnstown, but notwithstanding the great natural advantages offered by the situation, the operations of the Company were not successfully conducted. In 1855, the works having suspended, they were leased to Wood, Morrell & Co., who had become creditors. During the seven years' duration of the lease, notwithstanding the complete destruction of the rolling mill by fire in 1857, they developed the resources of the property, increased the capacity of the rolling mill to over 600 tons of iron rails per week (since increased five-fold), made many important improvements, and succeeded in establishing an extensive and profitable business. In 1862, on the termination of the lease, the Cambria Iron Company was re-organized, and the business since that time has been conducted in its name.

In 1868, the blast-furnace at Conemaugh, two miles east of Johnstown, was purchased, and about the same time, and under the name of the Blair Iron and Coal Company, four blast-furnaces, east of the Allegheny mountains, were added: one located at Bennington, one at Frankstown, and two at Hollidaysburgh.

In 1869, the erection of the Bessemer steel works was commenced, and at about the same time the valuable ore-banks of Springfield and

Henrietta were purchased. In 1872, a large portion of the rolling mills was again destroyed by fire, but such were the resources and energy of the management, and the co-operation of the employees, that within one week after the fire, the machinery was again in operation under temporary shelter, which was replaced by brick and iron fire-proof buildings, without stopping the manufacture.

The Bessemer steel works commenced operations in 1872, and in 1873 the construction of blast-furnace No. 5 was begun at Johnstown, although it was not put in blast until 1876.

The buildings for the greater part are built of brick; some are constructed of iron frames with brick panels; nearly all have iron rafters covered with slate or corrugated sheet-iron.

Dimensions of the principal buildings, (Plate LXX.):

	Feet.		Feet.
Rolling Mills	57	×	1900
Bessemer Steel Works	104	×	165
Open-Hearth Steel Works	103	×	162
Blooming Mill	120	×	355
Blooming Mill annexes, each	55	×	75
Boiler and Producer Houses, one	50	×	330
Boiler and Producer Houses, one	50	×	250
Machine Shop	65	×	215
Machine Shop, two story annex	40	×	85
Smithery	70 octagon.		
Smithery, two wings, each	40	×	110
Foundry, one	75	×	145
Foundry, one	75	×	165
Roll Turning and Boiler Shops	110	×	315
Pattern Shops, 2 stories	55	×	112
Car and Carpenter Shops, 2 stories	60	×	140
Drawing Rooms, 3 stories	55	×	65

The *blast-furnaces* of the Cambria Company are located: six at Johnstown and one at East Conemaugh in Cambria county; one at Bennington, two at Hollidaysburgh, and one at Frankstown, all in Blair county. Those at Johnstown, Conemaugh, and Hollidaysburgh, No. 1, are the newest and largest. Their principal dimensions and average weekly output are given in the following table:

Furnace.	Height in Feet.	Diameter of Bosh, Feet.	Diameter Hearth, Ft. In.	Weekly Output, Tons.
Johnstown, No. 1	76	16	8 6	900
" No. 2	76	16	8 6	970
" No. 3	76	16	8 6	900
" No. 4	76	16	8 6	900
" No. 5	76	19	10 0	800
" No. 6	76	19	10 0	1125
Conemaugh	65	12	6 6	250
Hollidaysburgh, No. 1	59	14	8 0	350

The other furnaces are of older date, averaging about 50 feet in height and 11 feet diameter of bosh.

The Johnstown furnaces Nos. 1, 2, 3, 4, forming together one complete plant, are at present (1884) being completely remodelled. Nos. 1 and 2 will go in blast during the summer, and Nos. 3 and 4 will follow about seven months later.

A full description of these furnaces, together with the *rolling*, *puddle*, and *wire-rod mills*, and *bolt works*, which are very extensive and well equipped, was published in "Iron," of March, 1884.

The *foundry* is a brick building 25 feet high, containing two Sellers improved steam-cranes of 25 tons capacity each, one 15-ton steam-crane, one 16-ton reverberatory air-furnace, and one 5 ft. cupola, with a capacity of 8 tons per hour. A brick addition, 30 feet high, with an iron roof, contains three 10-ton steam-cranes, one 5-ft. cupola of 8 tons capacity per hour, and one 30-inch cupola for chilled rolls and special heats. The largest casting made in the foundry weighed 35 tons. The average daily output of finished castings is 30 tons.

The *Bessemer plant* was the sixth started in the United States (July, 1871). While its general arrangement and many of its details were copied from drawings of the Troy, and Harrisburgh, works, and while it conforms in principle to the American type, there are many minor changes, some of which have been very generally copied. The first deviation from previous designs was to put the melting department and the converting section into the same building of equal height throughout. This gave the converting room ample height and ventilation.

The cupolas are five in number, 7 ft. 6 in. diameter of shell, with 6 ft. internal diameter above the tuyeres, and 5 ft. 4 in. diameter of bosh and hearth. The maximum height from the sand bottom to center of tuyeres is 3 feet. Each has six tuyeres of 6 in. diameter, through which blast is supplied from three Baker rotary pressure blowers, each driven directly by a Wilbraham engine, 16 in. x 24 in., at 110 revolutions per minute, and one No. 10 Sturtevant blower, furnishing to these and to four other *spiegel* cupolas, 33,000 cubic feet of blast per minute. The capacity of one cupola is 600 tons of iron and scrap melted at a continuous blast of 72 hours. The cupolas are located on either side of the main trough, into which they are tapped, and down which the melted metal is directed into either of two 10-ton ladles set on a hydraulic weighing platform, where it is stored until the converters are ready to receive it.

There are two vessels of 7½ tons capacity each, their product being distributed by a hydraulic ladle-crane. The Bessemer blowing-engines are independent and of peculiar construction. There are also two Worthington compound pressure-pumps, each with four plungers of 9½ in. diameter, 36 in. stroke. All of the pressure-pumps are connected with accumulators in the converting, blooming, and open-hearth departments, so that the pressure is constant and regular.

The Bessemer works are supplied with steam by a battery of nine 4 ft. tubular boilers of Matthew-Moore type, and eight 5-ft. plain horizontal tubular boilers. The best average, although not the very highest work done, in the Bessemer department, was 82 heats of 7½ tons each per 24 hours. The best weekly record reached 3700 tons of ingots, and the best monthly record, 16,000 tons. The best daily output was 670 tons.

Many grades of steel are made in the converters, from the softest wire and bridge-stock to spring-stock. All the special stock, that is, other than rail, is carefully analyzed at the company's *chemical laboratory*, heat by heat, and the physical properties are determined by a tension test made on a bar one inch square and measured on twelve inches. From the results thus obtained, the use to which it is to be applied is determined.

As a matter of interest, the fact may be mentioned, that the Cambria Company preserves as a relic the vessel in which Kelley endeavored to make steel in 1860. It has an external diameter of 38 inches, an interior diameter of 30 inches and a height of 4½ feet. The bottom was a perforated, unburned brick. The blast pressure was 5 pounds. For reasons that are now obvious, no malleable metal was produced.

The open-hearth plant consists of three Pernot revolving-hearth furnaces, fitted with all the recent improvements in roofs and ports, and also arranged in accordance with the principles which have made the American Bessemer works so much more productive and economical than those which preceded them. There are two 16-feet pans of 15 tons capacity each, and one 14½-feet pan of 12 tons capacity; each one is supplied with gas by four Siemens producers. A separate pit, with an independent hydraulic ladle-crane of twenty tons capacity, is located in front of each pan, and hydraulic cranes of smaller capacity, for delivering the ingots to train cars, are conveniently located. A Sellers steam-crane, of twenty-five tons capacity, is also in use for special purposes. A large part of the product of this plant is made in special castings, for use in and about the mills, for custom work, such as engine-shafts, gearing rolls, bridge-castings, etc. The smaller pan is now run on the Krupp dephosphorization process. The product of the two 16-ft. furnaces reaches 25,000 tons a year.

In the *blooming-mill* the 40-in. blooming train, for blooming 18½-in. ingots, is driven by a reversing engine with two cylinders, 40 in. in diameter, 48 in. stroke, and is geared to the train, three to one, with engine speed at 90 revolutions per minute. The train is two-high. The tables on both sides of the train are operated by hydraulic cylinders, and the screws for controlling the height of the top roll, are actuated by the same power, through a cylinder and gearing on the top of the housings. One-half of the weight of the upper roll is borne on steelyards by counter-weights, and the balance of the power required to raise it is supplied by hydraulic cylinders at each housing. The ingots weigh 5000 pounds each, and are rolled into seven-inch blooms, each ingot making six to eight rails. Eight Siemens heating furnaces are used, having an aggregate capacity of sixty-six ingots. They are supplied with drawing and charging apparatus, which is driven by an 18 in. by 20 in. vertical engine, power being taken from a line shaft extending along the ends of the furnaces. Twenty Siemens and four Wilson's producers are used, steam blast being gradually substituted for natural draught throughout.

The new blooming train now being built will be 48 in., two-high, driven by a pair of horizontal reversing engines, 44-in. cylinders, 60-in. stroke, speed 60 revolutions per minute, geared, two to one, to the train. The rolls, which are of steel, cast in the open-hearth department, are 8 ft. long between necks, 44 in. diameter, cored 20 in. diameter through the body, weigh about sixteen tons. The weight of the upper roll is carried as before described, the adjustable screws being actuated by a small two-cylinder reversing engine. The tables are 8 ft. by 30 ft., and are driven by bevel gearing on the end of each roller, power being supplied by a horizontal engine, placed at one end of the table. A pair of hydraulic cylinders push the finished bloom sidewise to the delivery rollers which carry it to the hot shears. The shears are driven by a 14-in. by 24-in. vertical engine.

The foundations of the train and engines are constructed in a most substantial and durable manner, of cut stone, 12 ft. deep, laid upon a concrete bed 3 ft. deep. Both blooming trains are served by 25-ton cranes for changing rolls, pinions, etc., besides the 4-ton hydraulic cranes for handling ingots. A Sellers 2½-ton, and Condie 5-ton steam-hammer are located conveniently near the trains.

Twelve soaking pits, of the Gjers type, are now in process of construction, being located within twenty feet of the 40-in. train. They are 21 in. square, 10 ft. deep below ground, covered by a hydraulic crane of 24-ft. jib. Hydraulic pressure is maintained by a Worthington compound duplex pump, 9½-in. plungers, 36-in. stroke, connected with accumulators giving 350 pounds pressure per square inch. The product of the 40-in. train for the past year reached 200,000 tons of ingots bloomed. Steam for the blooming mill and open-hearth plants is generated in twenty 48-in., and four 60-in. by 18-ft. tubular boilers.

The *roll-turning* department occupies the brick and iron building jointly with the *boiler* and *roof* shops. Ten lathes are set in line and are driven by an 18-in. x 20-in. vertical engine. The largest lathe will swing a 48-in. x 14-ft. blooming roll: the smallest is for wire-rod rolls of 7-in. diameter and 10 in. long. The heaviest rolls weigh 16 tons. The lathes are all served by a portable crane running on a narrow gauge track in front of them.

The *smithery* is a brick octagonal building, with a wooden trussed roof carried on a cast-iron column in the center; this forms a mast for a crane, which serves eight fires; four other cranes serve the remaining fires. There are two 1500-pound and one 2500-pound hammers. One wing serves as a store-room for iron and steel; another, 45 ft. x 60 ft., now being built on the opposite side of the octagon, will contain, when finished, a 2-ton steam-hammer, a large furnace, five single forges, and two 3-ton cranes.

The extension of the *machine-shop* is two stories in height; the lower story is used as a locomotive shop, and the upper, which is reached by an elevator, is employed for the manufacture of small tools, taps, dies, etc. It contains lathes, drill-presses, shapers, planer, gear-cutter, and oil-testing machinery, and is driven by an 8-in. diameter, 9-in. stroke, horizontal engine running at 200 revolutions per minute, which also furnishes power to the 3-ton elevator.

The main part of the shop contains a boring-mill with table 13 feet in diameter, one cylinder boring, and one 5-ft. boring mill; one floor boring-machine with iron floor-plate, 10 ft. x 20 ft., 5 planers, ranging from 2 ft. x 7 ft. to 7 ft. x 30 ft.; three shapers; ten lathes, including one 48-in. x 24 ft. bed, and a 7-ft. wheel lathe; a 100-ton hydraulic wheel

press, drill presses, gear cutters, and a complete range of modern tools for all purposes. For heavier work there is a combined slotter and boring-mill with a shifting table of 16 feet traverse. The slotter has a stroke of 4 feet, and the slotting head a movement of 12 feet across and 6 feet vertical. The boring-mill, being attached to the same cross-head as the slotting head, covers a like sectional area. The machine will therefore accommodate a piece of work 12 ft. x 6 ft. x 16 ft., and slot, plane, or bore it at one operation. For facilitating heavy work, the advantages of such a tool are obvious.

The power in the main shop is furnished by a vertical engine with 19-in. cylinder and 24-in. stroke, making 55 revolutions per minute, driving the line shaft at 150 revolutions per minute. The boilers, of tubular pattern, are located in a fire-proof building a short distance from the shop, and are six in number, 60 in. in diameter and 18 ft. long. They also furnish power to thirteen engines of various dimensions used in the foundry, boiler, and wood-working shops.

The machine-shop also contains two 25-ton and three 10-ton jib-cranes. The tool-room is 50 ft. x 50 ft., adjoining the main building, and is provided with stone and emery grinders, lathes, presses, and other tools.

The slopes of the hills flanking Johnstown have been cut through the coal measures, affording the outcrops of the lower five principal seams of coal, surmounted with a valuable bed of carbonate iron ore, the whole capped with the barren measures.

The coal and iron ore-beds can be readily opened by adits driven into the hill-sides, affording ready drainage and easy access, and supplying the works with coal at a minimum cost, and of such quality as is desired in the varied metallurgical operations.

The company own, in fee simple, 51,423 acres of mineral land, and have leased one thousand acres of Connellsville coking land, on which are five hundred bee-hive coke-ovens, which will afford a coke supply for the next thirty years.

It also owns several valuable tracts of land on the Menominee Iron Range in northern Michigan, on which have been opened eight large iron-ore mines, capable of producing 350,000 tons of Bessemer ore annually.

The home mines of the Cambria Iron Company are located in the middle of the great Apalachian coal field. The measures are nearly level, with sufficient inclination to afford equalizing gradients in mine-hauling, and ready exit to mine waters.

The *Rolling Mill Mine* is situated on the south side of the Conemaugh River, opposite the iron and steel works. It is the main source of supply for these works, delivering from 150,000 to 200,000 tons of coal per year. The seam is 3½ feet thick, and the mining-face is 3 miles broad, with an outspread of coal in advance 5 to 6 miles square. The coal in this bed is specially adapted for heating and puddling iron, and generating steam, from the fact that its sulphur is fixed in plates of selenite, and goes into the ash rather than into the iron. The coal is hauled in trains, by mine locomotives from a central point in the mine, 1½ miles underground, and distributed to all points of the works without breaking bulk. This mine also supplies coal for domestic use to the employees, as well as to many citizens of the towns.

The *Cushon and Lower Gautier Mines* supply the Gautier steel and wire works. The coal is a little more bituminous than the rolling-mill bed. It is 3¾ feet thick, of very clean coal without slate partings. These mines produce from 80,000 to 100,000 tons of coal annually.

The *Woodvale Mine* is located on the south bank of the Conemaugh, near Johnstown. It supplies coal to the large woolen and flouring mills at this place.

The *Conemaugh Mine* is situated north of the furnace of that name, supplying its coal for making coke. This coal is similar in quality to that of the Cushon Mine, and makes a good quality of coke.

The *Bennington Slope Mine*, on the eastern slope of the Allegheny mountains, near its summit at Gallitzin, is worked in the second coal bed of the lower measures. It is 3 feet thick and produces about 110,000 tons of coal annually. The main portion of its output is used to supply the 100 bee-hive coke-ovens at this mine. The coke produced is second only to the standard Connellsville coke. This coal is also excellent for smithing purposes, and is shipped to Johnstown, Hollidaysburgh and Springfield.

The *Morrell and Wheeler Slope Mines*, near Connellsville, in the great coke region, supply coal for 500 bee-hive coke-ovens. The coal bed is about 8 feet thick, soft and easily mined. These mines have an annual output of 300,000 tons and furnish coal for the principal supply of coke for the Cambria Iron Company's furnaces. It is the best coke that has yet been made in America.

The yearly output of all the company's coal mines is about 650,000 tons.

Benshoof's Mine, at Johnstown, has been producing 30,000 tons of carbonate iron-ore per year, until recently. The seam is from 18 to 20 inches thick. A small coal-mine attached supplies coal for burning this ore.

The *Frankstown fossil ore-mines* are three miles east of Hollidaysburgh, and have yielded 30,000 tons of ore yearly. The ore is 18 in., of good quality, and yields 45 per cent metallic iron.

It is a peculiar local deposit and has not been found at any other place in a workable condition. It is distinct from the regular and extensive fossil ore-beds in the higher portion of the Clinton Group formation.

The *Springfield mines* consist of four sections of an extensive hematite ore-range. The ore is found, mixed with clay, in large pits in limestone, resting, sometimes, on the Potsdam sandstone.

The ore is washed in a series of Thomas washers, and some of it is jigged in Bradford's jigs, affording an average of 40 to 45 per cent of metallic iron.

The four mines at this place produce from 45,000 to 50,000 tons of excellent Bessemer ore yearly. They are all about 70 miles south-east of Johnstown.

The *Henrietta Mine* is similar in general shape and mode of working to the Springfield mines, but the ore is not so valuable for Bessemer steel, and has therefore been suspended for the present.

The annual product of the "Home mines" ranges from 150,000 to 200,000 tons of ore.

Michigan Mines.—The *Menominee iron ore mines* consist of eight large mines opened on this range along the Menominee River R. R., a branch of the Chicago and Northwestern R. R. The mines occupy points along 8 miles of this iron-ore range and have an aggregate annual capacity of 350,000 tons. This ore is mainly of the best quality for Bessemer iron, and is shipped by rail to Escanaba, thence by lake to Cleveland, and thence by rail to Johnstown.

The mines are in good condition, with plants of modern winding and pumping machinery. The ore deposits are in lenticular masses from 6 to 200 feet thick.

The Cambria Company receives about 150,000 tons of limestone yearly for use at the home furnaces. It owns the large quarries at Birmingham, near Tyrone, from which 76,000 tons were shipped in 1883. It rents the Cresswell quarries at Hollidaysburgh, controls two others in that vicinity, and has a dolomite limestone quarry near Henrietta, in Blair county.

The company purchases manganiferous and other ores, of which an estimate would probably be 40,000 tons annually.

The following table will give the

		Tons.
Average yearly	coal output	650,000
" "	iron-ore output	450,000
" "	limestone "	150,000
" "	purchases	40,000
Total		1,290,000

The large tracts of coal, iron-ore and limestone lands, owned by the company, have all been carefully selected for specific purposes in the several metallurgical processes in the manufacture of iron and steel rails, and the other varied products of the works, enabling it to control and regulate these supplies so as to insure the utmost economy and to command a wide selection of ores and fuel for the production of the best materials of each kind. They also render the management independent of fluctuations and vicissitudes of the general market and enable it to sustain a high degree of uniformity in the quality of its productions.

The property is well provided with *railways*. The company owns and operates over 30 miles of standard, and 52 miles of narrow-gauge road, more than 40 miles of which are underground. The transportation of the coal and ores from the mines to the mills and blast-furnaces, and of the pig metal and crude and finished products to the various parts of the works as required, is done by locomotives, of which there are 25, varying from the largest, ordinary type of 37 tons, standard gauge, to the 6-ton narrow-gauge stackless locomotives that are used in the mines. There are in service 360 standard-gauge cars for carrying coal, coke, ore and limestone, and 1000 narrow-gauge cars for transporting ore and coal. The number of standard-gauge cars handled in and out of the works averages 9000 per month.

The products of the establishment are distributed by the Pennsylvania, and the Baltimore and Ohio railroads, the extensive connections controlled by them in every direction being thus reached directly: those of the southwest, including the extensive territory commanded by the navigation of the lower Mississippi, are reached by the slack-water navigation of the Ohio river from Pittsburgh.

An important feature of the organization consists in the extensive collateral industries that it has established and developed.

The *Woodvale Woolen Mill*, located a short distance east of Johnstown, on the Pennsylvania railroad, has twelve sets of cards and a monthly capacity of 50,000 yards of finished cassimeres, the product being chiefly sold in eastern markets. This mill largely employs the labor of the women of the families of operatives in the iron and steel mills.

The *Woodvale Flouring Mills*, situated here, have a daily capacity of 150 barrels. These mills are built of brick, are large and well adapted to their special needs, equipped with modern machinery, and protected from fire by the most recent fire-extinguishing devices. Power is supplied to the flouring mill by an 18-in. x 48-in. engine, and to the woolen mill by a 30-in. x 42-in. vertical engine. Another flouring mill is located at Hollidaysburgh, with a daily capacity of 50 barrels.

The firm of Wood, Morrell and Company, limited, has a large store at Johnstown, divided into seven departments, each of which is entirely distinct and conducted as a separate organization. The departments sell articles of all descriptions and transact an annual business of upwards of 1,000,000 dollars. The firm has stores also at Hollidaysburgh, Bennington, Springfield, Frankstown, Henrietta, Birmingham, and Morrell. It has an abattoir at Johnstown in which 20 to 25 head of heavy western cattle, and 75 to 100 head of hogs, sheep and calves are slaughtered per week. A smaller abattoir is situated at Hollidaysburgh.

Among other industries in which the company has a controlling interest may be mentioned *brickworks* that have a capacity of 25,000 machine-made red bricks per day; *gas-works* sufficiently large to supply not only Johnstown, but its numerous contiguous boroughs; *water-works*, supplying by gravity the mills and town from four main sources of supply. One, with a dam of 6,000,000 capacity, 170 feet head, is located on the Conemaugh River, 5½ miles distant; one, with a dam of 5,500,000 capacity, 165 feet head, on Laurel Creek, four miles distant; one with a dam of 21,000,000 capacity, on St. Clair Creek, 3 miles distant, in the mountains, from which the drinking water used throughout the mills and town is obtained; and one pumping station at Coopersdale, two miles below the works on the Conemaugh River, equipped with two Worthington compound duplex pumps with 21-in. and 36-in. steam cylinders, and 22-in. plunger of 3 ft. stroke, each with a capacity of 5,000,000 gallons per day; also a reserve pump at Woodvale woolen mills of same size. Numerous pressure pumps distributed throughout the mills and blast-furnaces, three steam fire-engines in the town, and automatic fire-sprinklers in the various shops, constitute a formidable safeguard against loss by fire.

The works are lighted by 95 *electric lights* of the Brush and the Thomson-Houston patterns. The dynamo-electric machines are centrally located and are driven by a Porter-Allen high speed engine of 100 horse-power, supplied with steam from blast-furnace boilers. All parts of the establishment are connected by *telephone*.

The Cambria Iron Company has taken every means to improve the condition of its workmen. The *library* is a large and handsome structure built by the company, endowed by the liberality of its stockholders, and especially designed for this purpose. Besides its collection of 6000 volumes, it contains a fine reading-room and an abundant supply of daily newspapers, periodicals and magazines. A chess-room occupies a part of the building. The upper story is used as a lecture and class room and is in constant use throughout six months of the year. Mechanical and free-hand drawing, mathematics, geology, physical geography, political economy, and chemistry are taught in the evenings by instructors provided by the company without expense to the pupils.

A *Mutual Benefit Association* and *Accident Insurance Company*, established under the supervision of the Administration, is in successful operation. A *surgeon* is employed to attend all employees injured in or about the mines or works, and an ambulance is always in readiness.

The workmen are encouraged to build their own houses; upon application, a lot is assigned by the company, the necessary building materials are furnished, and the price is deducted in small sums from the wages of the applicant until the debt is paid.

The Cambria Iron Company is entirely independent of "*unions*." After the strike of 1874, when the works were stopped for six weeks, a special police force was organized to protect the company's men, and a rule was established that any person belonging to any secret organization or open combination, whose aim was to control the wages, or stop the works, or any part thereof, should be promptly discharged. It is notable in this connection that during the labor riots at Pittsburgh and elsewhere in the summer of 1877, there was no strike among the Cambria's workmen.

At the time of first building the works at Johnstown, the popula-

tion of the town was about 2000. It now contains, with its four adjacent boroughs, more than 22,000 inhabitants, of whom the following numbers are employed in the various departments:

Mines and Coke Yards, Johnstown		375
Blast Furnaces	"	500
Bessemer Steel Works	"	600
Open-hearth " "	"	175
Rolling Mills	"	1000
Shops	"	1200
Gautier Steel Depart't	"	1500
Johnstown Manuf. Co.	"	300
Wood, Morrell & Co.	"	200
Blair Iron and Coal Co.		600
Connellsville Coke Works		500
Menominee		800
Springfield		125

Midvale Steel Works.—The works of the Midvale Steel Company (Plate LXXI.) are situated at Nicetown, within the city limits of Philadelphia, and on the line of the Germantown branch of the Philadelphia and Reading Railroad. The erection of the works was begun in 1866 by other than the present management. They were at first planned for the production of crucible steel only, with locomotive-tires as the principal finished product. In 1869–70, a rolling-mill was added to the plant, and a 25-inch train put in for the purpose of rolling the steel for the St. Louis bridge. This undertaking proved very disastrous, financially. The losses thereby incurred, together with former bad management, brought the works practically to a standstill as regards the manufacturing, although its financial credit was maintained.

In the meantime, a small open-hearth furnace had been added to the plant, but no satisfactory products were obtained.

After various vicissitudes, the works passed into the hands of the present management in 1873. From this date, the production of open-hearth steels received special attention, and rapidly replaced the crucible steels. At the present time, almost the entire product of the works is melted in open-hearth furnaces, small quantities of special steels only being made in crucibles.

In the development of the open-hearth process, the wide range of its capabilities was soon recognized, and the general principle was at an early date laid down, that, with a careful and systematic use of the chemical laboratory and testing machine, steels of almost any required

APPENDIX 25

Cambria Iron Company, 1890.

The Cambria Iron Company.

Johnstown, now a city of thirty thousand inhabitants, is situated in Cambria County, Pennsylvania, at the foot of the western slope of the Allegheny Mountains, and at the junction of the Little Conemaugh River and Stony Creek, which here unite to form the Conemaugh River. It is 366 miles from New York on the main line of the Pennsylvania Railroad, 78 miles east of Pittsburgh, and at an elevation of 1,200 feet above tidewater at Philadelphia. Location of Johnstown.

The Cambria Iron Company was chartered in 1852 under the law authorizing the incorporation of iron manufacturing companies. The original purpose was to operate four old-fashioned charcoal furnaces in and about Johnstown, which was then a village of thirteen hundred inhabitants. History.

Since that time the scope and size of the works have increased until the present time, when the following brief description will give an idea of their appliances and product: Growth.

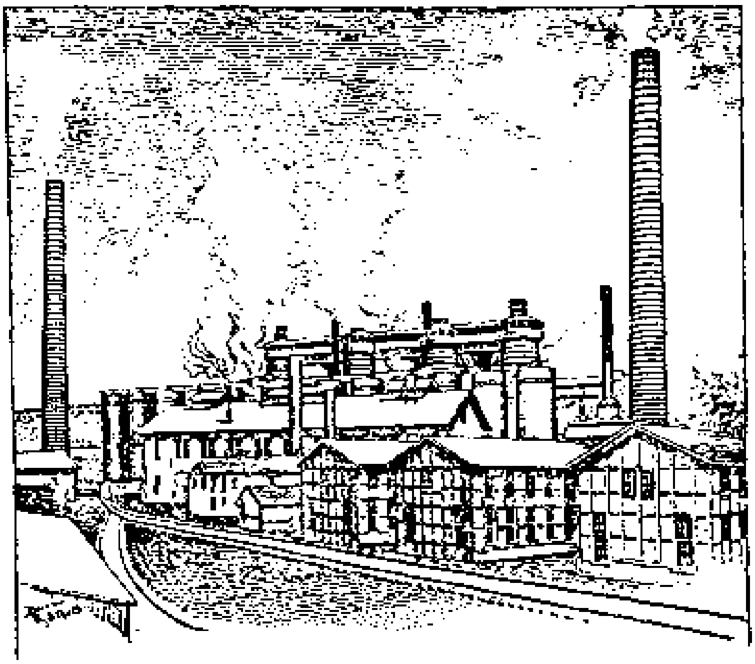
The works of the Cambria Iron Company in Johnstown are situated as shown on the accompanying maps, one department being known as the Cambria Iron and Steel Works, while the other is known as the Gautier Steel Department.

Cambria Iron and Steel Works.

At the northerly end of the works are the Blast Furnaces, known as Nos. 1, 2, 3, and 4, each furnace being eighteen feet in diameter at the bosh and seventy-five feet high. These furnaces are supplied with blast by eight blowing engines, each forty-five inches diameter steam cylinder, eighty-four inches diameter air cylinder, by fifty-four-inch stroke. These engines were built by the Company at its shops. The blast for these furnaces is heated by twelve brick hot-blast stoves, each nineteen feet in diameter by seventy feet high, and the steam for the engines is furnished by forty double union boilers and eight water tube boilers. Three of Blast Furnaces Nos. 1, 2, 3, 4.

Source: Local Reception Committee, "The Iron, Steel and Allied Industries of Johnstown, Penn'a. For the Information of the Visiting Members of the Foreign and American Technical Societies," October 1890, pp. 7-20.

these furnaces produce Bessemer iron for the Steel Works, while one is run on manganese ores for the production of spiegel and ferro-manganese. The stock for these furnaces is delivered to their



BLAST FURNACES NOS. 1, 2, 3, 4.

tops by three inclined hoists, the level of the stock-house floor being about midway between the casting-house floor and the furnace charging platforms.

Blast Furnaces Nos. 5 and 6. Near the south-east corner of the works and against the hill are located two Blast Furnaces known as Nos. 5 and 6, each furnace being nineteen feet diameter at the bosh and seventy-five feet high. These furnaces are supplied with blast by six eighty-four-inch blowing engines, the air being heated by four Cowper and four modified Whitwell hot-blast stoves, the latter stoves, now about completed, being twenty-two feet in diameter and eighty feet high.

The six blast furnaces at these works can produce regularly about eleven hundred tons of iron per day of twenty-four hours.

Open Hearth Plant. Near the south-west corner of the works is the Open-Hearth plant, where the finer grades of steel and steel castings are made.

The Open-Hearth Department contains two sixteen-ton steel melting furnaces of the Pernot type, having revolving and removable bottoms. These furnaces are served by the usual hydraulic ladle

BLOWING ENGINES, NOS. 1, 2, 3, 4 BLAST FURNACES.

and ingot cranes operated from a pulpit, besides which there is a large steam crane for pouring castings in a special pit.

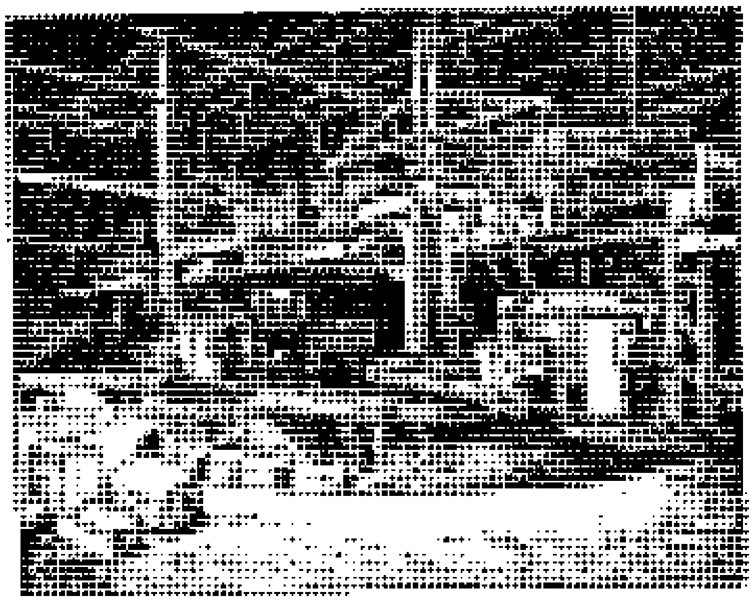
In the Open-Hearth building there is also a Krupp-Bell Dephosphorizing or Washing Furnace, supplied with molten iron from two cupolas. The purified iron from the washing furnace is cast in chills and afterwards used in the steel melting furnaces to produce the better grades of steel. Krupp-Bell Washing Plant.

Both the steel furnaces and the dephosphorizing furnace are heated by natural gas.

The Open-Hearth Department produces about one hundred tons of steel per day of twenty-four hours.

North of the Open-Hearth plant is the new Bessemer plant, containing two twelve-ton vessels, with five large cupolas for melting iron and two smaller ones for spiegel. The ladle cranes and New Bessemer Plant.

ingot cranes in this building are operated by hydraulic power, and all their motions—lifting, lowering, swinging, and racking in or out—are controlled by the movement of suitable valves situated in two pulpits at the corners of the building.



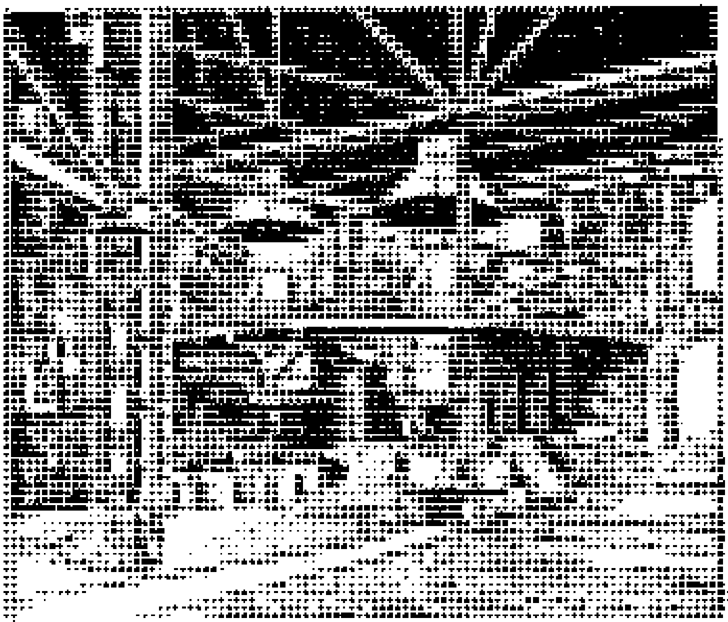
OPEN-HEARTH PLANT.

Air under a pressure of twenty-five pounds per square inch is supplied to the vessels by a large double horizontal Southwark blowing engine of special form, one of the features of which is the air valves with positive motion.

The air blast for the cupolas is supplied by eight large Baker blowers, and water under a pressure of four hundred pounds per square inch is supplied to the hydraulic machinery by two large Worthington pressure pumps.

The stock is lifted from the ground level to the vessel and cupola charging platforms by two hydraulic hoists. Vessel bottoms are lined up and repaired in a building adjoining the main building, and are carried and lifted by an hydraulic jack car running on a wide-gauge track from the bottom house to the converting house under the vessels.

The steel ladles are dried and heated by natural gas, and are placed for this purpose on cars in an upright position under hoods of conical form lined with fire-brick, the gas being delivered vertically downward, filling the ladle with flame if necessary and performing the work in a very convenient way.



NEW BESSEMER PLANT.

Refractories.

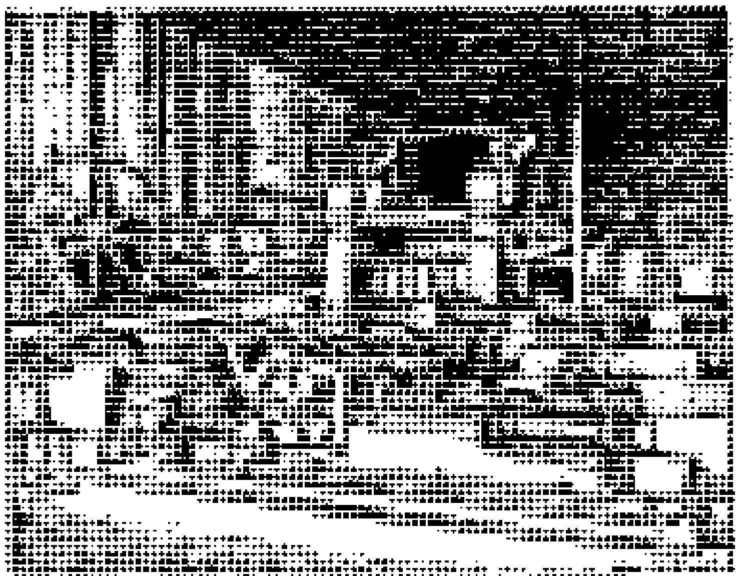
Quartz rock, fire clay, and necessary refractory materials of good quality are obtained along the lines of the railroads within short distances of the works.

The new Bessemer Works produce about one thousand tons of ingots per day of twenty-four hours, and are so arranged that a duplicate plant of two vessels can be added on the north side of present plant.

Blooming Mill.

East of the Open-Hearth plant is the Blooming Mill building, containing two two-high reversing blooming mills, one of forty inches and one of forty-eight inches train diameter, each one being driven by a pair of large reversing engines. Either mill is capable of rolling into blooms all the steel ingots made by the Bessemer and Open-Hearth plants.

In this building are six large four-hole vertical gas-fired regenerative furnaces and three horizontal Siemens furnaces for heating the ingots, which are charged while still red hot. Each pair of



FORTY-EIGHT-INCH BLOOMING TRAIN.

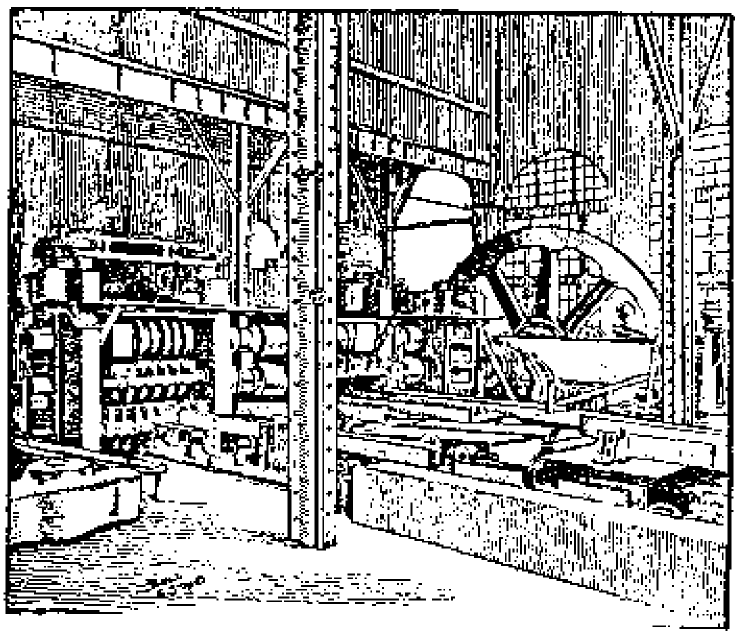
vertical furnaces is served by a large steam crane for charging and drawing, while the horizontal furnaces are charged and drawn with the aid of hydraulic cranes.

In this mill the blooms are cut to length by horizontal shears, and are delivered thence by troughs leading to the ground level below, where they are loaded on cars for transportation to the various mills.

Water under pressure of four hundred pounds per square inch is supplied to the hydraulic machinery by two pairs of large compound pressure pumps located in the engine rooms adjoining the mill building.

In this building are two steam hammers, one of 10,000 pounds and one of 5,000 pounds, for cutting special lengths of blooms, while there is also a 650-pound hammer for making test bars from bloom crops.

North from the Blooming Mill is the large building containing most of the rolling mills. The eastern wing of this building contains what is known as No. 1 Rail Mill, with which the ordinary sizes of T rails are made. This is a twenty-four-inch mill, with Rolling Mills. Rail Mill No. 1.



NO. 1 RAIL MILL.

two three-high stands of rolls, one for roughing and one for finishing, the former work being done in general in six passes and the latter in five. These rolls are supplied with heated blooms by a train of driven rollers extending along the front of the four bloom-heating furnaces, in line with the first pass of the roughing rolls. During the process of rolling, the hot steel is handled entirely by machinery, a combination of lifting tables, with driven rollers, turning guides, and a tilting transfer slide being used for this purpose. After leaving the finishing pass the rails are sawed hot, curved by a roller cambering machine, handled on the hot-bed by driven rollers and chain conveyers, and straightened and finished in the usual way. Rails are rolled in double lengths on this mill.

This rail train is supplied with heated blooms from four large horizontal regenerative gas furnaces of the Siemens type, at present fired with natural gas. These furnaces are placed end to end in a row with their fronts in line. Parallel with, and about fifteen feet distant from, the front of these furnaces is a train of driven rollers, slightly elevated above the floor level, which conveys blooms to and receives them from a charging and drawing apparatus carried on a traveler, which moves along the line of furnaces.

Rail Mill No. 2

The western wing of the Rolling Mill building contains another rail train, known as No. 2 Rail Train.

On this mill are rolled street rails, and the smaller sizes of T rails of various sections, together with the larger sizes of angle splice bars and other shapes. It is a twenty-one-inch mill, with three stands of three-high rolls, and is served by eight ordinary coal heating furnaces, which are at present adapted to use natural gas. The mill is driven by a 44-inch by 48-inch automatic engine.

Twelve-Inch Mill.

Adjoining and in line with this last mill is the Twelve-Inch Mill, upon which are rolled plain and angle splice bars, light rails, angles, and various sizes of merchant bar. This mill is served by two ordinary coal heating furnaces, fitted for using natural gas.

Sixteen-Inch Mill.

In the small wing at the western side of the Rolling Mill building is a Sixteen-Inch Mill with three stands of rolls. This mill is supplied with steel from two furnaces of the same type as those which serve the Twelve-Inch Mill. This mill makes splice and merchant bar.

Near the eastern end of the Rolling Mill building, in the wing extending in an easterly direction, are located two twenty-one-inch trains, known as No. 3 and No. 4.

Twenty-one Inch Mill. No. 3.

No. 3 Mill has three stands of three-high rolls, driven by a 40-inch by 48-inch automatic engine. Its product consists of the larger sizes of steel bars, rounds, squares, flats, and billets.

Twenty-one Inch Mill, No. 4.

No. 4. Mill is similar in construction and product to No. 3, but is driven by a 40-inch by 60-inch vertical engine.

Each of these trains is served by six ordinary coal heating furnaces, with boilers located above them for utilizing waste heat. These furnaces are equipped to use natural gas.

In the Rolling Mill building there is also a twenty-two-inch muck train, now used in rolling scrap bar. This train is served by three gas-fired scrapping furnaces of the usual form. Muck Mill.

This part of the mill and adjoining wings was formerly used as a puddle mill, and contained eighty double puddling furnaces, which were torn down and replaced by the present appliances.

The north-east corner of the Rolling Mill building contains the Rod Mill. This mill produces wire rods by a continuous process; the rod being formed and reduced in cross-sectional area in several places at the same time. Wire Rod Mill.

At the northerly end of the main building containing the rolling mills is the Axle Plant, containing three hammers of 6,000 pounds each, and one of 15,000 pounds, all direct-acting steam hammers. This plant contains five heating and two annealing furnaces for the manufacture of hammered steel axles, which are toughened by a patented process. Forge and Axle Plant.

At the north-west corner of the Rolling Mill building is the Bolt Shop, where are made various sizes of track and machine bolts. Bolt Shop.

North of the Bolt Shop is the Blacksmith Shop, which contains four steam hammers of various weights, three small furnaces, together with the necessary cranes, blowers, and other appurtenances. Smith Shop.

North of the Rolling Mill building are the Machine Shops, Foundry, Roof Shop, Roll Turning Shop, Boiler Shop, Car Shop, Carpenter, and Pattern Shops—all fully equipped with necessary machinery. Machine Shop and Other Shops.

On the property of the Company there are about forty miles of railway track; the various parts of all the mills and shops are connected by narrow-gauge tracks. Fourteen standard-gauge locomotives and an equal number of small ones are used in handling material about the works. Railroad Tracks.

At the Johnstown works of the Cambria Iron Company there are two hundred and eighty steam boilers of various types in operation, in addition to which there are sixty-one others in use at the different tributary plants of the same company in western Pennsylvania, besides a number at the now idle plants, and others in process of erection. Boilers.

Water Supply. The water supply for the works is obtained from three sources. There is a thirty-six-inch main from the pumping station at Cooperdale, on the Conemaugh River, two miles below the works. At this station there are five pumps with a combined capacity of twenty-three million gallons per day. In addition to this there is a sixteen-inch main from the Laurel Run Dam, about five miles north of the works, and a twenty-inch main from the Conemaugh Dam, on the Little Conemaugh, about four miles east of the works. The location of these dams is such as to give a head of one hundred and sixty-eight feet at the lower works.

Natural Gas. Natural gas is largely used under the mill and shop boilers, and all the melting and most of the heating furnaces are supplied with it. The gas is piped from the wells in the Grapeville field, about forty miles west of Johnstown.

Testing Laboratory. In connection with the works is a Physical Testing Laboratory, at present in temporary quarters. It is equipped with a one-hundred-thousand-pound Olsen machine for testing iron and steel; a one-thousand-pound Fairbanks Automatic Cement Testing Machine, and apparatus for testing oils. A three-hundred-thousand-pound Emery Machine was also in use before the flood, and this machine is now being rebuilt and new parts being made to replace those lost.

Gautier Steel Department.

On the accompanying map is shown the location of this department of the works of the Cambria Iron Company. In these works a portion of the steel made at the lower works is still further finished and is made into the smaller sizes of merchant bar, plates, sheets, and shapes; and again a portion of these is made into various forms for machines and agricultural implements, among which are cold-rolled shafting, finger bars, plow coulters, harrow teeth and disks, rake teeth, plow points, and cultivator teeth.

The operations at the Gautier Works are at present carried on in temporary buildings, pending the construction of a new plant to replace the one destroyed last year.

There is in operation at these works at present a Finger Bar Mill, a Nine-Inch, a Twelve-Inch, and a Twenty-Inch Train, and two trains for cold rolling, with the necessary furnaces, shears, and finishing machinery used in making the products above named. The Gautier Steel Department has also its own Machine Shop, Pattern Shop, and Blacksmith Shop. This department now operates a mill at Cumberland, Maryland, pending the completion of its new works.

General Information.

The Company also owns two blast furnaces at Hollidaysburg, one of which is in operation, and a blast furnace at Conemaugh, now out of blast.

General Offices. The Johnstown General Offices of the Company are located on Washington street, at its foot, on the left bank of the Little Conemaugh River. This building contains, besides the offices, the General Chemical Laboratory.

Club House. At the corner of Main and Walnut streets is the Cambria Club House, at present used as a hotel for the accommodation of the employes of the Company and its guests.

As a result of the flood of May 31, 1889, the main works of the Company were overflowed and covered with debris to a depth of several feet and much damage was done to buildings and machinery. This damage was repaired and portions of the main works started at intervals of two to five weeks after the flood, the whole works being started early in July.

The Gautier Department buildings were entirely destroyed and little left of the plant except foundations and heavy portions of engines and roll trains.

Re-instalment of machines and building of temporary sheds, as at present in use, took about two months after starting of main works, most of the temporary plant being put to work in the month of September. The new buildings of a permanent and enlarged plant are now being constructed immediately west of the temporary plant.

In its various departments the Cambria Iron Company employs more than eight thousand men, and an estimate of the number of Cambria employes lost in the flood places it at two hundred and twenty-five.

The Mines of the Cambria Iron Company.

The iron and steel works of the Cambria Iron Company draw upon widely-separated parts of the country for the raw materials used. The coke comes from the Connellsville coke region in Fayette County, Pennsylvania; the limestone from Blair County, Pennsylvania, and the iron ore from the Menominee iron ore range of Michigan.

Connellsville Coke Works. The principal coke works owned by the Cambria Iron Company are situated from one to four miles south of Connellsville, on the eastern edge of the Connellsville field, seventy-four miles from Johnstown. They consist of 680 bee-hive coke ovens, distributed as follows:

Wheeler	100 ovens	11 feet in diameter.
Morrell	400 ovens	11½ feet in diameter.
Atlas	80 ovens	12 feet in diameter.
Mahoning	100 ovens	11 feet in diameter.

These plants have an annual capacity of 390,000 net tons of coke, requiring 557,000 tons of coal. The coal is all mined below water level by slopes which follow the seam down from the outcrop.

The seam varies in thickness from 7½ to 9 feet, and is almost free from slate and other impurities. Its dip is about six degrees in a westerly direction. This coal makes a hard, bright, silvery coke, with well-developed cells, making it a most superior blast-furnace fuel.

Bennington Coke Works. At Bennington, on the summit of the Allegheny Mountains, twenty-eight miles east of Johnstown, the Cambria Iron Company owns 100 bee-hive coke ovens, the output of which is used at the Hollidaysburg blast furnaces.

The coal here used for coke is mined from what is locally known as the Lemon seam. It is the Upper Freeport bed, or "E" seam of the coal measures. It is from 4 to 4½ feet thick, lies about water level, and dips westerly about 2½ degrees. The coke produced is of an excellent quality, but is not considered to be quite as valuable a fuel for metallurgical purposes as Connellsville coke.

The Bennington works can produce annually 55,800 net tons of coke, requiring 90,000 net tons of coal.

There is also mined at Bennington about 40,000 net tons of coal annually from the Lower Kittanning or "B" seam for steam and blacksmith purposes.

Johnstown Coal Mines.

Previous to the introduction of natural gas into the works of the Cambria Iron Company, in October, 1886, the Company operated the following mines in the vicinity of Johnstown to supply the mills and works:

Rolling Mill Mine, annual capacity	217,000 net tons.
Cushun Mine, annual capacity	56,000 net tons.
Lower Gautier Mine, annual capacity	30,000 net tons.
Woodvale Mine, annual capacity	10,000 net tons.
Conemaugh Mine, annual capacity	30,000 net tons.
Total	343,000 net tons.

The Rolling Mill mine, the principal source of the coal supply, is in the Cement or Upper Kittanning seam, known as the "C'" bed of the lower coal measures. This seam is about 3½ feet thick, lies very flat, and is about sixty feet above the Stony Creek. Rolling Mill Coal Mine.

The mine was opened in 1856 to supply the various mills with coal, and was worked steadily until the introduction of natural gas. The work of re-opening this mine was commenced in June, 1890, and the mine will be in running order by December. A new Sturtevant blowing fan ten feet in diameter, with a capacity of 100,000 cubic feet per minute, has been erected. A pair of direct-acting 20×30-inch haulage engines (tail rope system) are being put into place to convey the coal from the interior workings of the mine to the mills, a distance of 11,600 feet, 2,600 feet of which is outside haul.

The mine workings are very extensive, the area now mined out being 660 acres. There is an immense territory adjacent to the mine which can be depended upon to furnish a large amount of coal for many years.

The Cushun mine, situated opposite Woodvale, and nearly two hundred feet above the little Conemaugh River, now produces about two hundred tons of coal per day for the use of the Gautier Cushun Coal Mine.

Works. Here the Upper Freeport seam or bed "E" of the coal measures is worked. It is about 4½ feet thick and affords an excellent steam coal.

Lower Gautier and Woodvale Coal Mines.

Lower Gautier and Woodvale mines, in the Lower Kittanning or "B" seam, immediately under the Coshun mine, are small mines that have been closed since the introduction of natural gas.

Conemaugh Coal Mine.

The Conemaugh mine, two miles east of Johnstown, furnished coal for sixty Belgian coke ovens at Conemaugh Furnace. The furnace was abandoned several years ago and the mine closed. The seam worked, bed "E," is above water level and makes a soft, spongy coke that does very well in a small furnace where a large output is not an important factor.

The Blast Furnace coal mine, the iron ore mines east of the works, and Benshoff's ore mine were abandoned about ten years ago.

Birmingham Limestone Quarry.

The Birmingham Limestone Quarry of the Cambria Iron Company is situated on the main line of the Pennsylvania Railroad fifty-six miles east of Johnstown. It produces all the limestone used at the works. A Gates crusher, with a capacity of 1,000 tons per day of ten hours, reduces all the stone to a suitable size for blast furnace use. A large air-compressor and an extensive system of pipes furnishes power to the quarry drills. If necessary this quarry could produce 320,000 tons of most superior limestone per year.

The Cambria Iron Company also owns and operates two ore mines at Springfield, in Blair County, where a deposit of brown hematite is worked.

Lake Superior Iron Mines.

The Cambria Iron Company owns and operates four iron mines in the Menominee iron range of Michigan. These mines, the East Vulcan, West Vulcan, Cyclops, and Norway, produce about three hundred thousand tons per year, which is smelted in the Johnstown furnaces.

APPENDIX 26

Cambria Steel Company, 1907.

DIRECTORY OF THE WORKS, MARCH 1, 1907.

Cambria Steel Company, P. O. drawer 1573, Central Post Office, Philadelphia; general offices, Arcade Building, southeast corner Fifteenth and Market streets, Philadelphia.

Sales Offices: Arcade Building, Philadelphia; 71 Broadway, New York; Paddock Building, Boston; Ellicott Square, Buffalo; 403 Center st., Baltimore; Park Building, Pittsburg; Citizens Building, Cleveland; Union Trust Building, Cincinnati; Century Building, Atlanta; Hennen Building, New Orleans; Western Union Building, Chicago; Chemical Building, St. Louis; 140 Kansas st., San Francisco; and 1501 Pacific ave., Tacoma, Washington.

Capital stock, $50,000,000; par value, $50 per share: issued and full paid, 900,000 shares, aggregating $45,000,000. The Cambria Steel Company operates the following works, which were leased from the Cambria Iron Company in 1898:

BLAST FURNACES—7 COMPLETED AND 1 BUILDING.

Cambria Steel Company, Johnstown, Pa. Cambria Plant, six completed stacks at Johnstown; Franklin Plant, one completed and one building stack at Franklin, a suburb of Johnstown.

Cambria Plant: Six completed stacks: Nos. 1, 2, 3, and 4 were built in 1853 and 1854; No. 1, 97 x 17½, was rebuilt in 1883, 1895, 1899, and 1901; No. 2, 98 x 21, was rebuilt in 1883, 1891, 1896, and 1901; No. 3, 95¾ x 20½, was rebuilt in 1886, 1894, and 1900; No. 4, 97 x 18, was rebuilt in 1886, 1892, and 1902; No. 5, 96 x 21, was built in 1873-6, blown in December 22, 1876, and rebuilt in 1890, 1896-7, and 1902; and No. 6, 87 x 22, was first blown in July 20, 1879, and rebuilt in 1893, 1896, 1900, and 1903; total annual capacity, 650,000 tons. The furnaces are equipped with twenty-four Cowper-Kennedy stoves and with 3 pig-iron casting machines.—*All active in 1906.*

Franklin Plant: One completed stack and one stack building: Completed stack, known as No. 7, 85 x 22, built in 1903-6 and

Source: Henry Wilson Storey, *History of Cambria County Pennsylvania*, 3 vols. (New York: The Lewis Publishing Company, 1907), I: 443-447.

blown in January 17, 1906; four Kennedy stoves, each 24 x 100; annual capacity, 150,000 tons. Equipped with 2 pig-iron casting machines. The stack will be known as No. 8 and will have an annual capacity of about 150,000 tons.—*No. 7 active in 1906.*

Fuel, Connellsville and Otto-Hoffmann coke; ores, Lake Superior hematite and native and foreign manganiferous; product, Bessemer and basic open-hearth pig iron and spiegeleisen and ferromanganese; total annual capacity of the completed furnaces, 800,000 tons; of the building furnace, 150,000 tons; total, 950,000 tons.

Cambria Steel Company, Johnstown. Three plants: Cambria Plant at Johnstown, Gautier Plant at Johnstown, and Franklin Plant at Franklin, a suburb of Johnstown.

Cambria Plant: Built as an iron rail mill in 1853; since greatly enlarged; first iron rail rolled July 27, 1854, and first steel rail rolled in 1871; now equipped with 7 Siemens ingot and 7 Siemens heating furnaces, 5 continuous furnaces, 19 reverberatory furnaces, and 11 trains of rolls (one 2-high 48-inch blooming mill, one set; one 2-high 40-inch blooming mill, one set; one 3-high 30-inch billet, slab, and shape mill, four sets; one 3-high 28-inch rail mill; three 3-high 22-inch mills; one 2-high 22-inch mill; one 2-high 16-inch mill; one 3-high 13-inch mill; and one 3-high 9 inch mill.)

Cambria Plant: Bessemer Steel Works; Completed in 1871; first blow made July 10, 1871; rebuilt and enlarged in 1889 and 1891 and remodeled in 1900; four 12½ gross-ton converters; annual capacity, 700,000 tons of ingots.

Cambria Plant: Open Hearth Plant No. 1; built originally in 1878-9; now contains two 20-gross-ton furnaces, (one acid and one basic,) one built in 1895 and one in 1896, and two 20-gross-ton basic Wellman furnaces built in 1897; annual capacity, 11,000 tons of acid ingots and 34,000 tons of basic ingots.

Gautier Plant: Built in 1878; 4 continuous heating furnaces, (3 recuperative and one reverberatory,) 10 reverberatory furnaces, 8 trains of hot rolls, (one 3-high 8-inch, one 3-high 9-inch, one 3-high 10-inch, one 3-high 12-inch, one 3-high 14-inch, one 2-high 20-inch, one 2-high 24-inch, and one 3-high 24-inch universal,) and one train of cold rolls. The universal mill was added in 1906 and can roll universal plates from 8 to 24 inches wide. By removing the vertical rolls plates 50 inches wide can be rolled. A cold-drawing plant, with full equipment of furnaces, shears, hammers, and special machinery, is connected with the plant.

Franklin Plant: Open Hearth Plant No. 2; built in 1900-1; fifteen 50-gross-ton stationary furnaces (14 basic and one acid); first open hearth steel made April 20, 1901; one 2-high 40-inch blooming mill, one set, and one 2-high 34-inch slabbing mill, one set, added in 1901-2, and one 134-inch plate mill added in

1902; annual capacity, 470,000 tons of basic and 30,000 tons of acid ingots.

Products, steel T rails from 8 pounds to 100 pounds per yard, angles and plain splice bars, standard and special track bolts and nuts; also beams, girders, columns, roof trusses and other fitted structural work, including finished steel work for buildings; steel axles for passenger and freight cars, street and mine cars, tender trucks, engine trucks, etc.; crank pins and piston rods; machine bolts, nuts, rivets, and pipe or tank bands with rolled threads; car and other steel forgings of carbon steel or nickel steel; tire, toe-calk, carriage spring, and other bar steel; finger bars, knife backs, rake teeth, spring harrow teeth, and other agricultural steel and shapes; bar and slab plow steel, flat and finished plow shapes, etc.; rounds, squares, hexagons, flats, shafting, and other cold-rolled steel; steel discs with rolled bevel from 10 inches to 20 inches in diameter for harrows, drills, cultivators, etc., and steel discs with rolled bevel from 23 inches to 28¼ inches in diameter for plows; pressed steel seats for agricultural implements; and all kinds of steel freight cars.

Fuel used in all departments, coal and producer gas.

Total annual capacity of the 3 rolling mills and steel works: 700,000 gross tons of Bessemer steel ingots, 545,000 tons of open-hearth steel ingots, 300,000 tons of steel rails, and 500,000 tons of structural shapes, universal and other plates, twisted and other bars for concrete work, plow steel, and steel for tire, spring, toe-calk, machinery, harrow discs, rake teeth, etc.

CAR-AXLES AND OTHER FORGINGS.

Cambria Plant: Car Axle Department. Product, forged open-hearth steel car and locomotive axles, crank pins, piston rods, and miscellaneous forgings toughened by the Coffin process or oil tempered and annealed: annual capacity, about 30,000 tons.

STEEL CARBUILDING AND BOLT, NUT AND RIVET WORKS.

Franklin Plant: Steel Carbuilding Department. Product, gondola, hopper gondola, hopper, flat and other steel freight cars; also composite cars with steel underframes; annual capacity, 9,000 cars. All cars are built of rolled shapes. This department is equipped with a 1,000-ton hydraulic press, with all the latest improvements. The entire product of the press is used by the car shops of the company.

Franklin Plant: Bolt, Nut and Rivet Department. Product, iron and steel bolts, nuts and rivets; annual capacity 9,000 tons.

COLD-ROLLED AND COLD-DRAWN SHAFTING.

Gautier Plant: Cold Rolling and Cold Drawing Departments. Product, cold-rolled, drawn and turned steel shafting, piston rods and car axles; cold-rolled and drawn screw rods, hexagons, key steel, flats and squares; also finger bars, knife backs; angles, zees, tees and other special shapes. Sizes: rounds, 3/16 of an inch to 7 inches; squares, 3/8 of an inch to 3 inches; flats, all sizes of merchant bars; and hexagons, 1/4 of an inch to 2 inches. Annual capacity, 18,000 tons. Does not cold-roll or cold-draw iron shapes.

COAL LANDS, COKE OVENS, IRON-ORE MINES, ETC.

The Cambria Steel Company operates extensive coal mines in Cambria county; also 260 Otto-Hoffmann coke ovens at its Franklin Plant. In addition it is building 112 new Otto-Hoffmann coke ovens at its Franklin Plant, which will be completed and ready for operations in 1907.

It also owns all the stock of the Penn Iron Mining Company, operating iron-ore mines in the Menominee Range in Michigan; over 99 per cent. of the stock of the Republic Iron Company, which operates the Republic mine, at Republic, Michigan; and one-half the stock of the Mahoning Ore and Steel Company, which operates the Mahoning mine in the Mesabi Range in Minnesota.

It also owns a controlling interest in the Juniata Limestone Company, Limited, which operates limestone quarries at Carlin, Blair county, Pa., and owns and operates the Naginey limestone quarries in Mifflin county, Pa.

The company has over eighteen thousand employes, of whom 16,500 are in Johnstown, one thousand in the ore fields in Michigan and Minnesota, and five hundred at the coke ovens and limestone quarries. There are several who have been in the service for more than fifty years. The oldest employe is Joseph Masters, who began in August, 1852, under Shoenberger and King. Evan G. Lewis, Isaac Jones, Peter Beemish, Irwin Horrell, John Herdman and Thomas Potts entered the service in 1853; George Banfield, John D. Murphy, Michael Ryan, Henry Brown, Henry Block and John Colbert in 1854; Daniel Beemish, Casper Hertzberger, William Hoover, Isaac Berringer and Thomas Leadbeater in 1855; Powell Stackhouse and John Leadbeater in 1856; James H. Geer, Fidell Knobelspeice, John Stork, and John James in 1857; James White, Bernard C. Riley, John H. Hamilton, William Tremellon, Patrick Fardy, Manges Hipp and John W. Price in 1858.

During the year 1906 the works consumed about 1,600,000 tons of coal, and 1,237,724 tons of ore, and used a daily average of 71,000,000 gallons of water. Its net profit was $4,964,003.15.

The average price for charcoal pig metal between 1840 and 1849 inclusive, was $29.22 per ton of 2,240 pounds. The highest was in 1840 at $32.75. It was not made for general use after '49.

Foundry pig metal was on the market in 1850 for the first time at $20.88. The average price for that decade was $26.47. Its highest value was in 1854 at $36.88. From 1860 to 1870 it was $37.83; its highest was in 1864, when it sold at $59.25. In 1880 it was $28.50; in 1890, $18.40; in 1900, it was $19.98, and in March, 1907, $26.

Iron rails were first on the market in 1847 at $69.00; in 1848, $62.25, and in 1849 at $53.38. In the decade beginning 1850 the average was $59.01, the highest being in 1854, at $80.13. The next decade was $75.96, with the highest price in 1864, at $126.00. In 1870 it was $72.25; in 1880, $49.25; and in 1882, $45.50. This is the last year iron rails are quoted, those of steel having taken their place.

Steel rails were sold in 1867 at $166; in 1868 at $158.50, and 1869 at $132.25. In 1870 they were $106.75; in 1875 sold at $68.75; in 1880, at $67.50; in 1882, the year they supplanted iron, at $48.50; in 1885 at $28.50; in 1890 at $31.75; in 1895 at $24.33; in 1900 at $32.29; in March, 1907, at $28.

APPENDIX 27

Principal products of the Cambria Steel Company, 1916.

PRINCIPAL PRODUCTS

BLOOMS, BILLETS, SLABS

Sheet Bar and Skelp

RAILS

Bessemer and Open Hearth — Standard and Light Sections

Rail Joints — Mine Ties — Guard Rails — Tie Plates

STRUCTURAL STEEL

Buildings and Bridges — Fabricated and Erected

Angles — Beams — Channels — Piling

PLATES—BESSEMER AND OPEN HEARTH

Universal — Sheared

AXLES AND FORGINGS

Car and Locomotive Axles — Crank Pins, Piston Rods and Side Rods

MERCHANT BAR AND AGRICULTURAL STEELS

Rounds — Squares — Flats — Tire — Toe Calk — Discs — Seats — Cold Rolled

Plow Shapes — Rake Teeth — Spring Harrow Teeth — Finger Bars

Automobile and other Special Sections — Pipe Bands

SPRING STEELS

Railroad — Carriage — Automobile

CONCRETE BARS

Twisted and Deformed

WIRE RODS AND WIRE PRODUCTS

Nails — Market Wire — Barbed Wire — Galvanized Wire

Staples — Woven Wire Fencing — Bale Ties

STEEL CARS

Gondola — Hopper — Flat — Underframes — Trucks

(12)

Source: "Sixteenth Annual Report of Cambria Steel Company," December 31, 1916, p. 12.

APPENDIX 28

Mines, Manufacturing Plants, Equipment, Etc., 1920

MINES, MANUFACTURING PLANTS, EQUIPMENT, ETC.

Manufacturing Site....546 acres.

RECAPITULATION OF DEPARTMENTS:—

Blast Furnaces	11
Bessemer Converters	4
Open Hearth Melting Furnaces	30
Blooming and Slabbing Mills	5
Billet Mills	1
Rail Mills	1
Universal Plate Mills	1
Sheared Plate Mills	2
Structural Shape Mills	3
Merchant Mills	13
Wire Rod Mills	1
Wire Drawing Department	1
Nail Department	1
Barbed and Woven Fence Department	1
Galvanizing Department	1
Structural Department	1
Steel Car Department	1
Car Wheel Department	1
Splice Bar and Rail Joint Department	1
Spike Bolt and Nut Department	1
Rail Anchor Department	1
Agricultural Implement Departments	3
Cold Rolled Department	1
Iron, Steel or Brass Foundries	3
Forging Departments	2
Finishing Shops	5
Coal Mines	7
Limestone Quarries	2
By-Product Coke Ovens	552
Coke Oven By-Product Recovery Plant	1
Brick Yard	1
Standard Gauge Locomotives	45
Narrow Gauge Locomotives	41
Cars—Standard Gauge	1181
Locomotive Cranes—Standard Gauge	16
Locomotive Cranes—Narrow Gauge	6
Tracks—Standard Gauge (Miles)	93
Steam Shovels	10
Dwellings (including Hospitals)	475

NOTE:—Equipment, Tracks and Dwellings at ore mines not included above.

(10)

Source: "Twentieth Annual Report of Cambria Steel Company for the Year Ended December 31st, 1920," pamphlet, p. 10, folder: Plants Johnstown Cambria Annual Reports, box: Cambria Steel Co. Misc papers, Acc 1699, BSC, HagM.

APPENDIX 29

Operating and Financial Data, Bethlehem Steel, 1905-1957

Source: "Annual Report to Employees for 1956," *Bethlehem Review* 71 (March 1957): 9-10, box: Bethlehem Vertical File Material, Acc 1699, BSC, HagM.

OPERATING DATA

Year	Rated Annual Capacity as of January 1 (N.T.): Pig Iron and Ferro-Manganese	Rated Annual Capacity as of January 1 (N.T.): Steel (Ingots and Castings)	Steel Production (Ingots and Castings): Net Tons	Steel Production (Ingots and Castings): Per Cent of Rated Capacity	Steel Products Shipped (N.T.)	Monthly Average No. of Employees (U.S. only) (See Note)	Payroll (U.S. only)	Average Earnings per Hour (U.S. only)
1905	224,000	212,800	115,428	54.2	54,648	4,882	$ 3,300,000	$ .200
1910	364,000	571,200	538,216	94.2	403,584	11,034	8,211,838	.220
1915	840,000	1,108,800	819,986	74.0	579,906	22,064	21,800,664	.292
1920	3,388,000	3,395,800	2,285,879	67.3	1,662,985	65,105	124,629,508	.682
1925	7,403,200	8,512,000	5,985,980	70.3	4,290,602	60,098	107,771,949	.645
1930	8,064,000	9,643,200	5,953,519	61.7	4,341,682	60,993	108,301,185	.701
1931	8,104,300	9,643,200	3,718,393	38.6	2,826,392	49,564	75,568,001	.697
1932	7,140,700	10,684,800	1,807,979	16.9	1,495,666	50,807	41,183,575	.605
1933	7,140,700	10,483,200	2,939,945	28.0	2,071,453	49,657	46,704,862	.594
1934	7,140,700	10,483,200	3,655,044	34.9	2,602,274	63,645	70,052,887	.709
1935	7,140,700	10,483,200	4,177,112	39.8	2,832,025	66,619	84,081,115	.740
1936	7,140,700	10,483,200	6,712,885	64.0	4,635,878	79,686	120,285,916	.746
1937	7,140,700	10,483,200	8,142,207	77.7	5,778,037	98,775	169,697,351	.891
1938	7,378,600	11,247,000	4,872,637	43.3	3,368,034	82,680	117,125,772	.912
1939	7,378,600	11,247,000	7,958,636	70.8	5,535,592	95,029	158,489,941	.916
1940	*7,461,900	11,468,800	10,704,741	93.3	7,663,010	118,439	212,232,884	.941
1941	*7,836,000	*11,981,400	12,155,476	101.5	8,971,869	165,678	364,354,322	1.070
1942	*8,640,000	12,700,000	12,451,692	98.0	8,921,775	238,272	646,272,085	1.217
1943	*9,510,000	12,900,000	13,015,755	100.9	9,188,028	289,232	896,143,185	1.321
1944	9,654,000	12,900,000	13,262,348	102.8	9,460,640	260,481	852,309,530	1.384
1945	9,654,000	12,900,000	11,831,610	91.7	8,545,957	202,095	629,023,253	1.411
1946	9,654,000	12,900,000	10,012,480	77.6	7,284,952	143,732	386,884,739	1.510
1947	9,330,000	12,900,000	12,806,940	99.3	9,403,067	132,557	413,351,449	1.621
1948	9,870,000	13,800,000	13,411,492	97.2	9,993,481	144,670	489,814,028	1.745
1949	9,870,000	14,200,000	12,596,949	88.7	9,217,188	131,183	449,131,876	1.840
1950	9,870,000	15,000,000	15,116,456	100.8	10,933,296	136,146	487,918,603	1.881
1951	10,350,000	16,000,000	16,405,677	102.5	12,138,732	152,578	616,599,561	2.072
1952	10,400,000	16,800,000	14,116,342	84.0	10,290,587	153,357	623,779,665	2.255
1953	11,500,000	17,600,000	17,662,687	100.4	12,712,994	157,380	721,975,123	2.386
1954	12,400,000	18,500,000	13,810,076	74.6	10,326,732	135,784	603,461,365	2.471
1955	12,600,000	19,100,000	18,820,912	98.5	13,553,823	144,853	717,946,594	2.592
1956	12,830,000	20,000,000	18,322,308	91.6	13,198,783	150,126	796,222,644	2.771
1957	12,830,000	20,500,000						

* Average for year

Note: For years subsequent to 1931 the average number of employees is based on number of employees receiving pay. For years prior to 1932 the figures represent average daily working force.

FINANCIAL DATA

(Dollars in Millions)

Year	Total Revenues	Employment Costs	Materials, Supplies, Freight and Other Services	Depreciation, Depletion and Amortization	Interest and Other Charges	Taxes (a)	Net Income (b)	Net Cost of Additions, Improvements and Acquisitions (Property Account)	Cash Dividends (c) Preferred Stock	Cash Dividends (c) Common Stock	Net Income per Dollar of Total Revenues
1905	$ 14.7	$ 3.4	$ 7.7	$ 0.5	$ 0.6	$ 0.1	$ 2.4	$ 18.0	$0.5	..	16.1¢
1910	26.3	8.5	13.2	0.8	1.6	0.2	2.0	5.4	..	..	7.6
1915	147.6	22.0	100.1	4.9	2.3	0.5	17.8	13.5	1.0	..	12.0
1920	275.8	123.2	111.5	14.9	7.9	3.8	14.5	42.2	3.4	$ 3.0	5.2
1925	276.6	108.3	120.5	14.7	13.1	6.1	13.9	34.5	4.3	..	5.0
1930	265.4	103.7	108.3	15.6	7.2	6.8	23.8	64.1	7.0	19.2	9.0
1931	190.5	75.0	85.7	16.9	7.4	5.4	0.1	46.7	6.9	6.4	0.1
1932	105.7	42.8	55.9	14.5	6.9	5.0	*19.4	3.5	1.6	..	*18.4
1933	126.1	47.5	59.8	15.7	6.7	5.1	* 8.7	2.0	..	..	* 6.9
1934	173.8	70.6	75.0	15.7	6.8	5.1	0.6	3.0	1.6	..	0.3
1935	198.7	83.4	79.7	17.6	7.2	6.5	4.3	24.4	3.3	..	2.2
1936	294.1	120.1	122.3	22.1	6.5	9.2	13.9	16.4	5.6	4.8	4.7
1937	424.5	171.1	179.8	21.9	7.0	12.9	31.8	45.4	7.5	15.9	7.5
1938	271.9	121.5	108.4	22.0	7.1	7.6	5.3	16.4	7.5	..	1.9
1939	414.9	164.1	179.2	25.8	7.5	13.7	24.6	12.1	7.5	4.8	5.9
1940	603.1	218.1	267.9	29.2	7.6	31.6	48.7	30.0	6.8	14.9	8.1
1941	962.2	375.6	408.3	43.0	6.0	94.8	34.5	42.2	6.5	17.9	3.6
1942	1,497.7	668.0	605.3	38.8	9.3	150.9	25.4	31.8	6.5	17.9	1.7
1943	1,906.2	926.6	746.1	55.3	5.7	140.4	32.1	48.3	6.5	17.9	1.7
1944	1,750.4	880.0	660.1	54.2	6.9	113.0	36.2	9.7	6.5	17.9	2.1
1945	1,329.5	652.1	533.0	75.4	14.3	19.8	34.9	31.2	6.5	17.9	2.6
1946	791.7	397.4	305.8	21.3	2.6	22.9	41.7	64.4	6.5	17.9	5.3
1947	1,034.9	428.0	484.0	25.5	3.9	42.4	51.1	105.6	6.5	17.9	4.9
1948	1,315.2	506.1	612.3	30.2	4.9	71.4	90.3	83.2	6.5	21.5	6.9
1949	1,271.0	477.4	573.3	33.0	5.3	82.7	99.3	64.8	6.5	23.0	7.8
1950	1,445.4	534.7	605.4	35.7	5.0	141.6	123.0	84.5	6.5	39.3	8.5
1951	1,799.5	664.6	788.3	45.9	6.2	188.0	106.5	92.2	6.5	38.3	5.9
1952	1,701.5	658.5	797.2	54.5	13.8	86.6	90.9	140.0	6.5	38.3	5.3
1953	2,094.9	780.6	905.4	73.7	10.6	190.7	133.9	120.1	6.5	38.3	6.4
1954	1,667.4	657.7	631.6	92.9	6.9	145.5	132.8	77.1	6.5	55.1	8.0
1955	2,114.6	779.8	830.4	102.6	8.6	213.0	180.2	98.5	6.5	69.5	8.5
1956	2,343.5	860.5	1,026.9	102.4	10.3	182.0	161.4	211.6	6.5	82.4	6.9

* *Loss.*

(a) Other than social security taxes, which taxes are included in column headed Employment Costs.

(b) Net income as reported in the Annual Reports to Stockholders.

(c) Does not include $18,677,740 Five Per Cent Cumulative Preferred Stock issued (subsequently called for redemption at par), or $933,887 paid in cash, to holders of Seven Per Cent Cumulative Preferred Stock of Bethlehem Steel Corporation (New Jersey) pursuant to Agreement of Merger effective February 26, 1936, in satisfaction of dividends accumulated on such Seven Per Cent Stock aggregating $19,611,627.

APPENDIX 30

Cambria Plant, Johnstown, Pennsylvania, 1923

Source: "History of Cambria and Coatesville Plants B.S. Co. typed manuscript, 1925, pp. 30-63, box: Plants-Danville-Johnstown, Acc 1699, BSC, HagM.

CAMBRIA PLANT, JOHNSTOWN, PENNSYLVANIA.

The Cambria Plant at Johnstown, Pennsylvania extends a distance of about eight miles in the valley of the Conemaugh and Little Conemaugh Rivers, the Rod and Wire Mill being furthest down the river and adjacent to that part of the City of Johnstown known as Morrelville and opposite Coopersdale.

The lower Cambria Works are upstream therefrom and extend along the Conemaugh River, to and a little above the stone bridge of the Pennsylvania Railroad Company. Thence there is a gap in the plant due to that part of the City of Johnstown which extends to the Little Conemaugh River above the stone bridge, and thence upstream.

The Gautier Department of the Cambria Plant begins above this gap and extends along the Little Conemaugh River, while still further up this stream is the Franklin Plant, a part of which lies in the Borough of Franklin adjacent to the City of Johnstown and opposite the Borough of East Conemaugh.

Above this are a slag recovery plant and, the Wheel Plant.

The Rod And Wire Mill has a continuous type rod mill and various wire finishing plants, auxiliary thereto, such as a nail mill, a barbed wire shop, woven wire fence plant, etc.

The lower works or the old Cambria Plant include six blast furnaces, old Nos. 1 and No. 3, however being obsolete, these furnaces having each a capacity of from 450 to 600 tons of iron per day. This lower plant also includes a Bessemer Plant comprising 4 vessels, cupolas, blowing engines and appurtenances and in addition to this there is an open hearth plant of eight furnaces aud auxiliaries.

There are two blooming mills, one 48 inches and one 40 inches diameter and there is also a 30 inch structural and billet mill adjacent to the 40 inch blooming mill.

Below this is an 18 inch continuous billet mill which is fed with blooms from the 48 inch blooming mill.

There is also in this plant a 21 inch structural, etc., mill, a 28 inch rail mill which is practically obsolete, and an axle blank mill and plant where car axles, locomotive driving axles, piston rods, crank pins, etc., are made.

The Gautier Department of the Cambria Plant contains thirteen different rolling mills, some of which however are now being torn down, including a universal plate mill, and two smaller mills for rolling thin plates, the balance being merchant and bar mills of various kinds which produce bars of all shapes and sections, and particularly special sections for automobile work, agricultural implements, window sash, concrete reinforcing bars, etc., etc.

The Gautier Department also includes five shops, namely, a disk shop, a rake shop, a shear shop, a rail anchor Department, and a cold rolled shop.

Above this at the Franklin Plant are 22 open hearth furnaces, a large universal slab mill, two blooming mills, a 134 inch plate mill, and a billet mill.

Within the Franklin Plant there is a car shop and auxiliaries arranged for the manufacture of steel freight cars of various kinds.

Above this on the Little Conemaugh River is the wheel plant with an equipment of furnaces, presses, and No. 1 and No. 2 wheel mills adapted to produce all kinds of railway car wheels, gear blanks, etc.

Adjacent to the works are coal mines forming a part thereof which deliver coal directly from mine cars into the works. At Rosedale and Franklin are a total of 700 by-product coke ovens which use local coal and Pittsburgh seam coal, saving many of the by-products. A list of all these items and others is given hereafter and a map of the neighborhood is also included.

Synopsis of

ROLLING MILLS, MANUFACTURING DEPARTMENTS

and

EQUIPMENT OF CAMBRIA PLANT

of

BETHLEHEM STEEL CO.

	Total
Plant Acreage	629.5
Blooming and Slabbing Mills	5
Billet Mills	1
Rail Mills	1
Universal Plate Mills	1
Sheared Plate Mills	2
Structural Shape Mills	2
Merchant Bar Mills	13
Wire Rod Mills	1
Wire Drawing Department	1
Nail Department	1
Barbed and Woven Fence Department	1
Galvanizing Department	1
Structural Department	1
Steel Car Department	1
Splice Bar and Rail Joint Department	1
Spike, Bolt and Nut Department	1
Rail Anchor Department............................	1
Agricultural Implement Department	3
Cold Rolled Department	1
Iron, Steel or Brass Foundries	3
Forging Departments, ...	2
Car Wheel Department	1
Finishing Shops	5
Coal Mines	7
By-Product Coke Ovens	700
Coke Oven By-Product Recovery Plant	2
Brick Yard	1
Standard Gauge Locomotives	45
Narrow Gauge Locomotives	42
Cars - Standard Gauge	1113
Locomotive Cranes - Standard Gauge	18
Standard Gauge Tracks (Miles)	110
Steam and Electric Shovels	13
Dwellings (Including Hotels and Hospitals)	609
Narrow Gauge Locomotive Cranes	5
Automobiles - Cars	13
Trucks	11
Horses	7

GENERAL OFFICES.

One seven story brick building on Locust Street in Second Ward of Johnstown, Pa., in which are the Administrative, Engineering, Accounting, Real Estate, Welfare and Safety, Cashier Departments and Bethlehem Mines Corporation.

One three story brick building on Washington Street, Second Ward, Johnstown, Pa., where are the Stores, Employment, Order and Shipping, Local Purchasing, Chief of Scales, Telegraph and Telephone Exchange and Car Service Departments.

ROD AND WIRE DEPARTMENT.

OFFICE

Office building, brick and steel construction, two stories and basement, size 38' x 43'.

ROD MILL

Continuous rod mill, 16 stands, double strand, 2-high, engine driven; with flying shear, eight rod reels, conveyor, scale, shears and furnace fired by gas from three 10 ft. producers. Building of brick and steel construction, size 83 ft. x 200 ft. with adjoining rod storage building 198 ft. x 200 ft. Two 5-ton cranes.

STOCK YARD

Stock yard, crane runway 100 ft. x 480 ft. and one 15-ton crane; also concrete loading wharf and scale.

BOILER PLANT

Station No. 25 complete with coal and ash conveying apparatus for boilers and producers. 2096 H.P. B. & W. boilers with superheaters and automatic stokers. Building of brick and steel construction, size 43 ft. x 85 ft.

LIME HOUSE

Lime slaking house 31 ft. x 55 ft., brick and steel construction.

CLEANING HOUSE

Wire rod cleaning plant with two radial steam cranes, 10 acid tubs, rusting conveyor and 99 truck bakers. Building 88 ft. x 100 ft., brick and steel construction.

DRAWING ROOM

Wire drawing room complete with five double and one single bench, having a capacity of 196 blocks. Building of brick and steel construction, size 110 ft. x 360 ft. One plate and die room also motor house in lean-to of above building 20 ft. x 360 ft.

ANNEALING AND
BALE TIE DEPT.

Annealing and bale tie room with 18 annealing pots, 4 straighteners and cut-off machine and 4 bale tie machines. Building brick and steel construction, size 46 ft. x 440 ft. with one electric crane.

GALVANIZING DEPARTMENT.

Galvanizing Department with three strings of galvanizing and annealing equipment. Building of brick and steel construction, size 110 ft. x 280 ft.

FENCE and BARB WIRE

Fence and Barb Wire Dept., complete with barb wire and fence making equipment. Building of brick and steel construction, size 110 ft. x 280 ft.

NAIL DEPT.

One Nail Dept. complete with 119 nail machines, 14 rumblers, cement coating machines, staple machinery, etc. Building of brick and steel construction, size 110 ft. x 280 ft.

WAREHOUSE

One Warehouse for storing all products of this equipment, about 75,000 tons storage capacity, equipped with railroad track and loading wharf. Building of brick and steel construction 280 ft. x 303 ft.

DIPPING PLANT

Dipping plant, fireproof building, brick and steel construction 23 ft. x 37 ft.

COOPERAGE PLANT

Cooperage Plant, two story building, brick and steel construction, 50 ft. x 150 ft. and equipped for making kegs; with corrugated iron storage shed in rear for staves.

WAREHOUSE

One oil and supply house, building of brick and steel construction, 21 ft. x 40 ft. two story fireproof.

SHOP

Machine shop complete with tools for maintaining entire plant. Building two stories, brick and steel construction, 44 ft. x 120 ft.

SCALE HOUSE

Scale house, brick and steel construction, 150-ton broad gauge track scale.

PRODUCTS

RODS, FENCE (All kinds of Field Fence), NAILS (Common, cement coated and galvanized), STAPLES, WIRE - (Barbed, galvanized, hard bright, soft bright, annealed, twisted, straightened and cut). BALE TIES.

LOWER WORKS

A-B-C-D
BLAST FURNACES

Four blast furnaces, rated capacity 500 tons each, with twenty hot stoves, gas washers, and three Mesta and one Turbo Blowing engines; cinder granulating pits and two bucket traveling cranes, etc. Steel ore, coke and limestone bins, 55 ft. wide x 900 ft. long and electric larries for charging stock into the furnace skips. Along the bins is an ore storage yard 236 ft. wide x 900 ft. long, having a capacity of 285,000 tons of ore. Bins and ore yard are served by one bridge.

E - F
BLAST FURNACES

Two modern blast furnaces, rated capacity 500 tons each, with seven hot stoves, dry gas cleaners and three horizontal blowing engines, each capable of blowing a furnace. Steel ore, coke and limestone bins 80 ft. wide x 500 ft. long and electric larries for charging stock into the furnace skips.

GENERAL

Convenient to these furnaces is a general ore storage yard 300 ft. wide x 1000 ft. long, having a capacity of 750,000 tons of ore. Yard is served by two 11 ton ore bridges and electric transfer car. Near the furnaces are a three string pig casting plant, car dumper, and a Dwight Lloyd Sintering plant, consisting of (1) 42 ft. x 57 ft. two strand Sintering Machine, hoppers, feeders, pug mills, furnaces and conveying system.

BESSEMER CONVERTERS

Four converters each rated at 12-1/2 tons capacity, with seven cupolas and modern blowers; also 250 ton and 300 ton hot metal receivers, cranes, pumps, etc. Buildings are of brick and steel construction.

OPEN HEARTH

Seven Basic and one Acid Open Hearth furnace, rated capacity four 40 tons each and four 50 tons each, arranged for melting with coke, gas or tar; also 250 ton hot metal receiver, three 90 ton ladle and one 30 ton clean up crane, etc. Main building is of brick and steel construction, size 103 ft. x 416 ft. There is also a stock yard 682 ft. long and refractory bins served by two 10 ton 65 ft. span gantry cranes.

STRIPPERS

Stripping building, size 48 ft. x 300 ft., steel construction with brick walls and tile roof, two 150 ton rope operated stripping cranes and a clean up crane.

BLOOMING MILLS
40" and 48"

One 40" and one 48" two high mills and reversing engines; also eight regenerative pit furnaces served by three charging cranes, shears, pumps, etc. Main building is of brick and steel construction, size 118 ft. x 300 ft.

PRODUCTS

Blooms, blanks, slabs, etc.

BEAM, BILLET and
SLAB MILLS

Four stands of 30" three high rolls and four traveling tables, steam engine, 75 ton, 15 and 10 ton cranes, two regenerative heating furnaces and one continuous furnace; also four cooling beds served by two crane runways and two 10 ton cranes, hot and cold saws, straighteners, shears, etc. Main building is of brick and steel construction, size 118 ft. x 180 ft.

PRODUCTS

Slabs, Billets, Beams, Channels and Tie Plates.

PRODUCER PLANT

Twenty 8 ft. and two 10 ft. gas producers with coal and ash handling equipment covered by a building of brick and steel construction, size 53 ft. x 138 ft. (Not operating).

BILLET MILL

Engine driven continuous mill for billets and tin bar, four stands of 21" and eight stands of 18" rolls; also two hot beds served by two 15 ton 118 ft. span cranes on runway 290 ft. long; billet shear, and electrical sub-station. There are no furnaces, as mill takes stock direct from the Blooming Mills. Building is of brick and steel construction, size 80 ft. x 180 ft. with 20 ton crane.

PRODUCTS

Billets and Sheet Bars.

RAIL MILL

Two stands of 28" three high roughing and one stand of 28" three high finishing mills with two engines, five regenerative heating furnaces, two cooling beds, saws. Building is of brick and steel construction, size 100 ft. x 354 ft. with two 75 ton cranes, etc. There is an additional continuous pre-heating furnace with crane and steel building 75 ft. x 130 ft.

The finishing department is a steel building containing drill presses, straighteners, saws, etc. Extending the length of the finishing building is a 60 ft. span crane runway and 20 ton magnet crane for shipping purposes. Twelve 8 ft. gas producers located in an adjacent brick and steel building with coal and ash handling equipment serve this mill.

PRODUCT

Rails - 30-lb. to 130-lb.

NO. 4 MILL

Three stands of 22" three high rolls, four traveling tables, steam engine, 50 ton crane, two continuous heating furnaces, two cooling beds, saws, straighteners, shipping bed and two 76 ft. span runways with 10 ton cranes.

The buildings over No. 4 Mill, size 75 ft. x 240 ft. and furnaces size 75 ft. x 240 ft., are of brick and steel construction. This mill is served by a stock yard 340 ft. long with two 10 ton 72 ft. span magnet cranes.

PRODUCT

Angles, beams, channels, ship channels and crane rails, crane tees, rounds.

AXLE PLANT and SHOP

Trolleys, six furnaces and cranes, also one 15,000 lb., one 6,000 lb. and two 8,000 lb. steam hammers, axle and crank pin finishing machines, test drops, 22" mill and tables. Buildings are of brick and steel construction, size 110 ft. x 160 ft. for mill, 75 ft. x 75 ft. for axle shop and 20 ft. x 260 ft. for crank pin shop.

PRODUCT

Freight car axles, driving axles, street car axles, crank pins, piston rods, forgings, armature shafts and mine car axles.

CONDENSING STATIONS

There are two central condensing stations, one for the 40"-48" Blooming Mills and Beam Mill, and one for the other mills and shops.

SHOPS

SMITH SHOP 8050 sq. ft. area, PATTERN SHOP, size 50 ft. x 113 ft. and 40 ft. x 85 ft., and CARPENTER SHOP, size 56 ft. x 136 ft. of brick construction with complete equipment for making forgings, patterns, etc. Pattern and Carpenter

Shops are two stories high, the lower floor of the Carpenter Shop being used for Foundry purposes. Twenty-one separate PATTERN STORAGE HOUSES constructed of brick with wooden roofs.

TWO FOUNDRY BUILDINGS of brick and steel construction, size 70 x 140 and 70 x 161 ft. with equipment for making iron and brass castings. In addition to these buildings the lower floor of the Carpenter Shop, size 56 x 136 ft. is also used for Foundry purposes.

Main MACHINE SHOP of brick and steel construction with a concrete roof, having 8-10ton, 32 ft. span cranes; 2-10 tons and one 50 ton 76 ft. span cranes and approximately 175 machine tools. Building has a main central erection bay 80 ft. x 240 ft. and two 40 ft. x 240 ft. bays on either side, each with two working floors, totaling 76,800 sq. ft. of floor area. In connection with main shop there is also a STORAGE YARD with 20 ton, 48 ft. span crane and runway, and a brick and steel ERECTING SHOP, size 64 ft. x 113 ft. with 20 and 40 ton cranes, miscellaneous equipment, electric sub-station, etc.

BOILER SHOP of brick and steel construction, size 87 ft. x 253 ft. with 20 ton 58 ft. span crane and three 10 ton riveting tower cranes; also hydraulic equipment, riveters, punches, shears and rolls for general boiler work. There is also equipment for making and testing large steel pipe and an independent steel building equipped for coating the pipe. In connection with the Boiler Shop there is a STRUCTURAL SHOP of brick and steel construction with equipment for fabricating general structural work, size of building 90 ft. x 95 ft.

ROLL SHOP, brick and steel building, size 55 ft. x 160 ft. with 30 ton crane and approximately 27 machines for finishing rolls; also storage yard, roll stands, etc.

Central AIR COMPRESSOR PLANT with brick and steel building, size 44 ft. x 182 ft. and six air compressors, having an approximate total capacity of 10,000 cubic feet of air per minute.

ELECTRIC

ELECTRIC POWER PLANT, brick and steel building, size 57 ft. x 243 ft. with 15-ton crane, containing one 3000 and two 6000 K.W. A.C. generators, surface condensers for the two 6000 machines and a general condensing station, also rotaries, switch board, etc. There is a leanto on the main building for repair shop, size 44 ft. x 143 ft. with 10-ton crane and approximately 18 machine tools for repairing electrical equipment.

ELECTRIC REPAIR SHOP

ELECTRIC REPAIR SHOP, 60 ft. x 240 ft. of brick and steel construction, with one 10-ton crane and 33 machine tools for all manner of electrical repairs.

BOILERS - Station No. 1, A-B-C-D - Station No. 2, E-F.

No. A Blast Furnace boiler house, brick and steel building, size 205'-6" x 41'-4", containing 3600 H.P. of gas fired water tube B. & W. boilers.

No. B Blast Furnace boiler house, brick and steel building, size 128 ft. x 40 ft. containing 2000 H.P. of gas fired water tube B. & W. boilers and feed water meter.

NO. C Blast Furnace boiler house, brick and steel building, size 192 ft. x 36 ft. containing 3600 H.P. of gas fired water tube B. & W. boilers and feed water meter.

No. D Blast Furnace boiler house, brick and steel building, size 145'-6" x 41'-6" containing 2400 H.P. of gas fired water tube B. & W. boilers.

No. E Blast Furnace boiler house, brick and steel building, size 206'-6" x 41'-4" containing 3600 H.P. of gas fired water tube B. & W. boilers and feed water meter.

No. F Blast Furnace boiler house, brick and steel building, size 235'-9" x 37'-10" containing 3900 H.P. of gas fired water tube B. & W. boilers and superheaters.

Station No. 3 (Rail Mill), brick and steel building, size 217 ft. x 41 ft. containing 3600 H.P. of coal fired water tube National boiler with superheaters, automatic stokers, forced draft system, coal and ash handling machinery and feed water meter.

Station No. 4 (Bessemer) brick and steel building, size 194'-4" x 41'-6", containing 2800 H.P. of coal fired water tube B. & W. boilers with coal handling machinery and stokers.

Station No. 5 (Blooming Mills) brick and steel building, size 488'-6" x 52 ft. containing 7700 H.P. of coal fired water tube B. & W. boilers with stokers and coal and ash handling equipment. Six hundred (600) H.P. of these boilers are equipped with turbo blowers.

Station No. 7 (Electric Plant) brick and steel building 90 ft. x 100 ft., containing 4000 H.P. of coal fired water tube B. & W. boilers with coal handling machinery and stokers.

WAREHOUSE

Three story brick building size 32 ft. x 64 ft. used for Warehouse and Emergency Hospital purposes.

General Labor Buildings, size 66 ft. x 166 ft. of brick construction, two stories high, 3652 sq. ft. ground area.

WORKS OFFICE

Six story brick and steel office building, total floor area 22,368 sq. ft. with passenger elevator. In this building are located the general mill offices and the chemical and physical laboratories.

GENERAL

Stables, wagon and smith shops, general refractory sheds, lumber yard, saw mill, miscellaneous weigh scales, mill offices, etc.

GAUTIER WORKS.

8" MILL NO. 1.

Engine driven mill, one 10" roughing stand 3-high, five 8" stands 3-high and one 8" finishing stand 2-high, with heating furnace, cooling bed, stretcher, shears, etc. Building is of brick and steel construction size 80 ft. x 125 ft. with electric hoist over the rolls.

8" MILL NO. 2.

Motor driven mill, one 10" roughing stand 3-high, five 8" stands 3-high and one 8" finishing stand 2-high, with heating furnace, cooling bed, stretcher shears, etc. Building is of brick and steel construction, size 80 ft. x 125 ft. with electric hoist over the rolls.

PRODUCTS

For 8" Mills No. 1 and 2 - rounds, squares, flats, bands, crescents, toe sled runners, ovals, half ovals, reach plate, Keystone shape nut lock, special shape toe caulks, half rounds, cotter pins, auto shapes, double bevel channels, hexagons, Slick bar, turbine sections, lightning rod sections, piano bar, round cornered squares.

8" MILL No. 3 - SEMI-CONT.

8" Mill 3 stands, 2-high, motor driven; 10" Mill 6 stands, 2-high, motor driven; complete with one furnace, hot bed, shears, roller runs, scales, etc. Modern fireproof building of brick and steel construction, size 80 ft. x 700 ft. with two cranes.

PRODUCTS

Rounds, squares, Slick reinforcing bar.

9" MILL NO. 1.

Engine driven mill, six 9" stands 3-high, one 9" finishing stand 2-high, one continuous furnace, hot bed, stretcher, shear, scales, etc. Building of brick and steel construction, size 75 ft. x 315 ft. with crane.

PRODUCTS

Flats, bands, angles, hexagons, octagons, channel tire, half ovals, reach plate, tee bar, special fence channels, channels, plow beams, turbine section, Fenestra section, Blum molding, mine tie, barn door rail, triangular grate bar, double half oval auger, barrel chimes, special toe caulks, auto section, splice bar section.

9" MILL NO. 3 - SEMI-CONT.

Motor driven mill, four 10" stands 2-high, two 9" stands 3-high and two 9" finishing stands 2-high, one continuous furnace, roller runs, hot bed, shears, scales, etc. Building of brick and steel construction, size 90 ft. x 360 ft. with two cranes.

PRODUCTS

Rounds, flats, concave spring, Slick reinforcing bar, Slick mine tie, splice bar sections, angles.

10" MILL

Engine driven mill, one 18" roughing stand, 3-high, six 10" stands, 3-high and one 10" finishing, 2-high, with continuous furnace, hot bed, stretcher, presses, shears and cut-off machines, etc. Building is of brick and steel construction, size 110 ft. x 400 ft. electric hoist over rolls.

PRODUCTS

Rounds, squares, flats, toe caulk, hexagons, Fenestra, Reliable stove angle, bands.

12" MILL NO. 1.

Engine driven mill, three 12" stands 3-high and one 12" finishing stand 2-high, continuous heating furnace, hot bed, run-out table, shear, scale, etc. Building of brick and steel construction, size 75 ft. x 250 ft. with one crane.

PRODUCTS

Rounds, squares, flats, angles, hexagons, ovals, half ovals, half rounds, tee bar, concave sleigh shoe, channels, elevator tee, Slick mine tie, Davis brake beam, plow beams, turbine section, Fenestra section, switch point, hollow half round, Blum molding, Blum door sill, special section - Goodman, Union Switch and Signal Office bar, tram rail section, auto section, miscellaneous sections.

12" MILL NO. 2 - SEMI-CONT.

12" Mill two stands 3-high and one stand 2-high motor driven. 18" Mill six stands, 2-high motor driven. Heating furnaces, roller run, shears, presses, hot beds, scales, etc. Building of brick and steel construction, size 80 ft. x 700 ft. with two cranes.

PRODUCTS

Rounds, squares, Slick bar, round cornered bleeder rod.

13" MILL

Engine driven mill, three stands of 3-high rolls complete with continuous furnace, lifting tables, hot bed, shears, straighteners, etc. Building of brick and steel construction, size 63-1/2 ft. x 433 ft. with one 10-ton, and one 15-ton cranes.

PRODUCTS

Angles, flats, splice bars, channels, beams, rails, truck bolsters, Otis tee bar, Slick mine tie, Davis brake beam, auto sections, Kelsey rim, Kelsey base bands.

14" MILL

Engine driven mill, two 18" roughing stands, 3-high, five 14" stands, 3-high and one 14" finishing stand, 2-high, with continuous furnace, hot bed, stretcher, presses, shears and cut-off machines, etc. This mill is in the same building as the 10" Mill.

PRODUCTS

Flats, bands, bevel edge, double bevel, Vaughn rail anchor section.

20" MILL

20" Mill, one roughing stand 3-high and one finishing stand 2-high.

22" MILL

22" Mill, one roughing stand 3-high and one finishing stand 2-high. Both of the above mills are driven by a steam engine. There are two heating furnaces, crane, hot bed, shears, presses, etc. Building is of brick and steel construction, size 75 ft. x 350 ft.

PRODUCTS

20" Mill - bands, flats, bevel edge (single bevel), bevel edge (double bevel), reinforced cutter bar, Van Brunt special shape shoe plate, special round cornered automobile band.

22" Mill - disk, plow shapes, seats.

24" UNIVERSAL MILL

One stand, engine driven roughing rolls and two stands of 2-high finishing rolls, driven by separate engine; two continuous heating furnaces, complete sets of roller runs, hot beds, straighteners, shears, scales, etc. Building of brick and steel construction, three bays each 75 ft. x 450 ft., large plate storage, all sevred by five electric cranes.

PRODUCTS

Regular U. M. plates, S. E. key steel, S. E. bars.

STOCK YARD

One steel crane runway 61 ft. x 800 ft. with three cranes for stock storage for mills.

CONDENSING STATION

One central condensing station and rotary converter station in fire proof building 40 ft. x 75 ft.

PUMP and COMPRESSOR HOUSE

One pump house with high and low pressure pumps, also air compressor. Brick and steel 35 ft. x 100 ft.

BOILER HOUSES - Station No. 11

(Gautier) brick and steel building, size 45 ft. x 148 ft. containing 3000 H.P. of coal fired water tube B. & W. boilers with superheaters, and coal and ash handling equipment.

(Gautier) brick and steel building, size 50'-10-1/2" x 181'-6" containing 3000 H.P. of coal fired water tube B. & W. boilers with superheaters. Eight 300 H.P. boilers have Murphy stokers and the one 600 H.P. boiler has automatic stoker, forced draft system. House equipped with coal and ash handling equipment.

SHEAR SHOP

Shear shop complete with finishing presses, shears, and scale for steel plates located in 24" Mill building.

PRODUCTS

Digger blades, bull tongues, colf tongues, cornplanter runners, cultivator points, all flat plow shapes, post hole digger blades, potato digger shovels, sheared shapes and plates, steel washers.

DISK SHOP

Disk Shop 75 ft. x 400 ft. of brick and steel construction, complete with furnaces, hammers, presses, grinders, polishers, lathes, etc., for finishing steel plates.

PRODUCTS

Plow disks, harrow disks, cutaway disks, cultivator disk rings, cotton planter wheels, rolling coulter blades, rolling coulter blanks, shear cut disks, sweeps, agricultural implement seats, brake drum circles, reversible cultivator points, disk for auto wheels, hammered lay steel.

COLD ROLL DEPARTMENT

Cold Roll Department complete with straightening machines, pointers, cut-offs, draw-benches, storage racks, etc. Wooden building, size 158 ft. x 236 ft.

PRODUCTS

Cold drawn rounds, cold turned and polished rounds, rough turned rounds, cold drawn hexagons, squares, flats, angles, triangular bars, cold drawn and turned bars key seated.

RAKE SHOP

Rake and Bar Shop complete with heating and tempering furnaces and machinery for forging and finishing agricultural steel. Building 75 ft. x 400 ft. with one crane.

PRODUCTS

Bundle carrier teeth, rake teeth, spring harrow teeth, drag harrow teeth, pressure springs, seat springs, suspension springs, tedder forks, tedder fork springs, tedder teeth, weeder teeth, bumper spring plates, box lid springs, cotton tie buckles, buffer springs, coil springs, cultivator springs, cushion springs, cutter shoes, finger bars, hinges, links and pins, motor cycle seat springs, mower bars, mine ties, potato digger tines, tie plates, scraper springs, supports for wagon tongues, cotter pins, concrete reinforcing bar clamps and wedges, steel washers, cultivator fenders.

SHIPPING WAREHOUSE

One 80 ft. x 450 ft. building of brick and steel construction, large loading wharf, storage racks served by two cranes.

MACHINE, SMITH and ROLL SHOPS

One complete Smith, Machine and Roll Shops for maintaining mills. New building of brick and steel construction, 75 ft. x 300 ft. with crane.

SPLICE BAR SHOPS

Two splice bar plants, hot and cold, complete with heating furnaces and tools. Frame building.

PRODUCTS

Splice bars "Angle", splice bars, "Fish", compromise joints, continuous rail joints.

OIL HOUSE

One oil fireproof house central station for storage and distributing oil and waste for entire works with transportation car, pumping system.

OFFICES

Office - General to this department. Frame two-story building 38 ft. x 67 ft.

Shops, offices - drawing room and toilet room building complete with lockers, etc. Brick and steel building 25 ft. x 225 ft.

GENERAL

One scale house, brick and steel; broad gauge track scales, 150-tons capacity.

One wood frame building 80 ft. x 200 ft. formerly old roll shop, used for straightening rails and storage purposes.

RAIL ANCHOR PLANTS

One steel frame and iron building for Vaughn and Yardley rail anchors complete with furnaces, tanks, presses, hammers, bull-dozers, shears and conveyors.

One wood frame and iron building for Henggi rail anchors complete with furnaces, presses, shears, tanks, etc.

PRODUCTS

Honggi rail anchors, Vaughn rail anchors, Yardley rail anchors, Fair rail anchors.

FRANKLIN WORKS.

OFFICES

Brick and steel building, two stories and basement used for office and physical testing purposes.

No. G-H-J BLAST FURNACES

Three modern blast furnaces, rated capacity 500 tons each, with twelve hot stoves and three vertical disconnected compound steam blowing engines, one horizontal steam blowing engines and one Turbo Blower, gas washing equipment, stock bins, roller drums, feeds and larries for charging into the furnace skip, capacity 5500 tons daily. Also ore storage yard 275 ft. wide x 1420 ft. long, having an approximate capacity of 720,000 tons of ore. Ore yard is served by two bridges and a traveling car dumper. Furnace cast houses are constructed of steel, and blowing engine house, and repair shop are of brick and steel construction. Engine house has a 40 ton crane; also lean-to over the pumps. There is also a two string casting plant with steel building and 30-ton ladles and 75-ton cranes, etc.

No. K-L BLAST FURNACES

Two modern blast furnaces, rated capacity 500 tons each, with eight hot stoves, and three steam turbine blowing engines. Stock bins with bins, roller drum feeds, and larries for charging into the furnace skip, capacity 3700 tons daily. Cast house of steel construction, blowing engines house of brick and steel construction.

OPEN HEARTH

Twenty-two open hearth furnaces, rated capacity 17-75 tons each and 5-100 tons each, arranged for melting with coke oven and producer gas; also 250-ton hot metal receiver, etc. Building is of brick and steel construction, size 131 ft. x 1730 ft. with four 150-ton 48 ft. span and three 50-ton 55 ft. span, and one 75-ton ladle cranes, and three 25-ton 48 ft. span clean-up cranes, also five low type charging machines. 1300 ton mixer located at end of building. Producer building of steel construction, housing 55-10 ft. gas producers with coal handling equipment. Steel and wood dolomite building size 28 ft. x 62 ft. with six cupolas; also grinding house, pans, etc. Steel frame stripping plant size 52 ft. x 100 ft. with electric stripping crane and second stripper building steel construction, with 200-ton crane.

There is also a stock yard between the furnaces and producers with six 10-ton, 80 ft. span magnet cranes, and along the opposite side of the furnace building there is a 15-ton 68 ft. span gantry crane. In connection with the above equipment there is a steel frame skull cracker with three 15-ton and one 25-ton cranes, located at Williams Farm.

40" BLOOMING MILL

One 40" two-high mill and steam reversing engine, 60-ton crane, six regenerative pit furnaces, two hydraulic shears and accumulators, two 10-ton charging and one 150-ton stripping cranes 54 ft. span, etc. Buildings are of brick and steel construction, size of mill building 75 ft. x 118 ft. and size of furnace building 78 ft. x 318 ft.

PRODUCTS

Blooms and slabs.

34" REVERSING BILLET MILL

One 34" two-high mill and steam reversing engine complete with tables, manipulators and steam-hydraulic shear, rolling direct from 40" Blooming Mill. One 25-ton and three 15-ton electric overhead cranes. Building 100 ft. x 860 ft.

PRODUCTS

Billets and small slabs.

32" BLOOMING MILL

One 32" two-high mill and steam reversing engine, rotary shear and engine, and transfer dumper from 40" to 32" Mill.

PRODUCTS

Wheel blanks, rounds and blooms.

SLAB MILL

One 34" two-high Slab Mill with two steam reversing engines, two 50-ton cranes, nine heating furnaces and two 20-ton charging cranes. Building are of brick and steel construction, size of mill building 110 ft. x 360 ft. and size of furnace building 78 ft. x 336 feet.

PRODUCTS

Slabs and Blooms.

STOCK HOUSES - 1 and 2.

Two stock houses for these mills, size 64 ft. x 365 ft. and 45 ft. x 308 ft. of brick and steel construction, with one 40-ton and four 10-ton cranes.

134" PLATE MILLS - No. 1 and 2.

Two 134" three-high mills with two tilting tables, steam engine, 60-ton cranes, ten heating furnaces, four charging machines, six hydraulic plate shears, rotary and scrap shears, cold saws, two 60" roll lathes, straightening rolls, annealing furnaces, etc. Buildings are of brick and steel construction, size of furnace house 120 ft. x 280 ft., mill building 89 ft. x 300 ft. and two shear buildings 89 ft. x 720 ft. each with eight 10-ton cranes. Also machine tool equipment for maintaining mills.

PRODUCTS

Plates, rectangular, circular and sketch.

MILLS - GENERAL

Producer building for Bloom, Slab and Plate Mills, of steel construction with 26-8 ft. and 6-10 ft. gas producers and coal handling equipment. Brick and steel pump house, size 44 ft. x 160 ft. with five pressure pumps, etc., also central condensing plant for Bloom, Slab and Plate Mill engines.

BEAM YARD

Shipping yard consisting of six panels of crane runway, four 76 ft. span; one 80 ft. span and one 72 ft. span, each with a crane, four of 20 tons and two of 40 tons capacity; also saws, punches, shears, scales, etc.

ELECTRIC POWER HOUSE

Brick and steel building size 61 ft. x 165 ft. containing two 750 K.W. rotary converters, and one 500 K.W. converter, one 425 and one 800 D.C. generators, and a condensing plant.

In the Beam Yard Power House are one 400 K.W. rotary and two 800 K.W. D.C. generators.

BEAM YARD POWER HOUSE

Brick and steel building size 60 ft. x 285 ft. containing 8 air compressors, condensing plant, pumps, etc.

BOILERS

Station No. 14 (No. G-H & J Blast Furnaces) brick and steel building, size 370 ft. x 44 ft. containing 8000 H.P. of gas fired water tube B. & W. boilers, with superheaters and feedwater heater.

Station No. 15 (No. K-L B.F.) brick and steel building, size 44 ft. x 300 ft., containing 7680 H.P. of gas fired water tube B. & W. boilers, with superheaters.

Station No. 16 (Open Hearth and Mills), brick and steel building, size 104 ft. x 45 ft. containing 6000 H.P. of coal fired water tube B. & W. boilers with stokers, coal and ash handling equipment, and feedwater heater.

Station No. 17 (Structural & Car Dept.) brick and steel building, size 423 ft. 10 ins. x 39 ft. 5 ins. containing 2400 H.P. of coal fired water tube B. & W. boilers with stokers, coal and ash handling equipment and feedwater heater.

CHEMICAL LABORATORY

Two story brick building and equipment used for Chemical Laboratory.

STEEL CAR DEPARTMENT.

BOLT SHOP

Brick and steel building size 61 ft. x 300 ft. with equipment and furnaces for making machine and track bolts, nuts and rivets.

FORGE SHOP

One brick and steel building size 86 ft. x 490 ft. with 20-ton cranes, 550-ton and 1000-ton hydraulic presses, bulldozers, forging machines, hammers, drills, punches, shears, furnaces, etc. One steel building adjoining, size 80 ft. x 360 ft. with corrugated steel siding, 20-ton crane, 2100-ton hydraulic press, furnace, shears, etc. Stock yard runway 380 ft. long with 20-ton 80 ft. span crane.

STEEL CAR SHOP

Two adjoining brick and steel buildings 80 ft. and 92 ft. span x 508 ft. long with five 20-ton cranes, punches, shears, spacing tables, riveters, furnaces, hoists, drills, grinders, etc. Brick and steel axle finishing shop, size 55 ft. x 86 ft. with concrete roof and wheel boring shop, steel frame with corrugated steel covering, size 13 ft. x 88 ft. having lathes, mills, etc. Stock yard crane runway along both sides of the car shop each with two 20-ton cranes. Car repair shop located between plate mill shear sheds with one 15-ton and one 25-ton cranes; also pressed steel side frame equipment.

COMPOSITE CAR SHOP

Frame building size 125 ft. x 30 ft. equipped with tools for doing wood work on steel cars.

CAR PAINT and DRYING SHOP

Frame building size 760 ft. x 50 ft. for steel cars.

CAR PAINT SHOP

Frame building for paint and drying shop, size 680 ft. x 30 ft.

PAINT and PIPE SHOP

Frame building size 25 ft. x 75 ft.

STRUCTURAL SHOP

Brick and steel building, size 225 ft. x 225 ft. with six 10-ton cranes, punches, shears, planers, riveters and furnaces, straighteners, drills, grinders, saws, etc. Stock yard crane runway along one end with one 20-ton 70 ft. span crane. All machine tool equipment for maintaining die shop.

TANK CAR SHOP

Brick and steel building, size 225 ft. x 200 ft. with two 10-ton cranes, 60 ft. span, one 20-ton crane, 60 ft. span, two 10-ton cranes, 30 ft. span, 2100-ton and 3500-ton presses, 40 ft. bending rolls, spacing tables, punches, hammers, 23 ft. tank riveters.

PRODUCTS - STEEL CAR DEPARTMENT.

Steel Cars - Gondolas
Hoppers
Clark Dump
Mine Car
Pressed steel side frames
Pressed steel truck bolsters
Pressed steel side frames
Miscellaneous car parts and drop forgings
Finished car axles
Buckle plates
Steel piling
Knuckle pins
Rivets
All kinds of car pins
Tie Plates.

WHEEL WORKS.

MILLS

Brick and steel buildings, covering 186,400 sq. ft. one 60-ton, four 15-ton, and three 5-ton cranes, three electric driven wheel mills with hydraulic pressure pumps, two 12,000 tons presses, 2970-ton dishing press, two 10,000 ton vertical presses, seven furnaces burning tar, five manipulating machines, machine tool equipment for finishing wheels and dies, three 750 K.W. converters.

PRODUCTS - No. 1 MILL

Gear Blanks - Railway motor
Industrial spur
Industrial bevel
Locomotive piston blanks
Locomotive piston centers blanks
Automobile fly wheel blanks
Automobile brake drum blanks
Industrial wheels
Mine locomotive wheels
Mine car wheels
Turbine Disk blanks
Turbine couplings
Shaft couplings
Wheel centers
Pipe flanges
Gear rings

No. 2 MILL

Wheels - Freight car
Tender truck
Passenger car
Engine truck
Interurban)
Street car) For
Subway and elevated) Electric
Trailer) Service.
Crane track wheels

COKE PLANT - ROSEDALE.

COAL HANDLING

Breaker building and loading out bin of steel and brick construction. Coal is delivered from the mine head frame to 1000 ton coal bin over breaker building, passing through (2) 12 ft. x 17 ft. Bradford breakers. The coarser coal from breaker is taken to 250 ton loading out bin over tracks where same is loaded into railroad cars for boiler use; balance of coal is taken to feed bin over washery.

WASHERY PLANT

Pit and washery buildings, brick and steel construction, 77 ft. x 569 ft. and 22 ft. x 384 ft. each, includes (72) coal washing tables and (10) draining pits each 1550 tons capacity. Two (2) coal re-claiming bridges dig coal from pits which is carried to mixing plant on belt conveyor.

COAL MIXING PLANT

Mixing plant consists of 250 ton bin for low volatile washed coal and 1000 tons bin for high volatile coal. High volatile coal is received from the cars in track hopper and sent through Bradford breaker and a double roll crusher, and delivered to 1000 ton high volatile coal bin. Coal is mixed by short proportioning feeders into (2) spiral moving conveyors and is delivered to 3000 ton bin over ovens by bucket elevators and belt conveyors.

OVENS

Ovens consist of (120) Cambria type ovens with a capacity of 10.4 gross tons of coal per oven and (88) Semet-Solvay type ovens with a capacity of 12.86 gross tons of coal per oven.

BY-PRODUCT EQUIPMENT

By-product and sulphate storage building, brick and steel construction, 56 ft. x 324 ft. with (1) 10-ton hand operated and (1) 5-ton electric crane. Gas is taken from ovens through 78" foul gas main to (4) 10-ft. diam. x 45 ft. high primary coolers arranged in parallel, by (2) electric driven and (2) steam engine driven 83.4 cu. ft. Roots positive displacement exhausters, and sent through (2) Koppers Company and (1) Semet-Solvay Company tar extractor, saturator and separate units and through (3) 13 ft. x 52 ft. final coolers and (3) 16 ft. x 90 ft. benzol absorbing towers to 50 ft. gas holder. Pumps for handling tar and liquor are contained in pump house adjacent to by-product plant. Ammonium sulphate is stored in storage building 56 ft. x 176 ft. and tar is stored in (2) 35 ft. x 35 ft. tanks.

LIGHT OIL EQUIPMENT

Light Oil Plant, brick and steel construction, 27 ft. x 74 ft. five stories high, including (3) 6 ft. diam. Semet-Solvay L.O. stills with pumps, cooling coils, heat exchangers, decanters and receiving tanks. Finished product is stored in (2) 30 ft. x 30 ft. tanks.

COKE HANDLING

Coke is delivered by quencher cars to 200 ft. inclined dock equipped with a rotary feeder at foot which delivers on to a 42" belt leading to screening station. Furnace coke is taken from screening station across the valley to a 250 ton coke storage bin.

BOILER HOUSE EQUIPMENT

Station No. 8 of brick and steel construction, 48 ft. x 108 ft. consists of 2304 H.P. B. & W. boilers with "Coxe" stokers and necessary fuel and ash handling equipment.

PRODUCTS

Coke
Tar
Gas (Coke Oven)
Sulphate of ammonia
Crude Napthalene.

COKE PLANT - FRANKLIN.

COAL BREAKER

Brick and steel building size 53 ft. x 62 ft. with five floors containing two breakers. Connecting with this building are conveyors from coal tipple and conveyors to storage and washery building. One 1500 ton gas coal bin, with conveyors, mixers, etc.

COAL WASHERY

Steel and concrete building size 24 ft. x 128 ft. three floors with coal storage and washing tables.

COAL DRYING BUILDING

Steel and concrete building size 420 ft. x 95 ft. with nine coal drying pits served by two coal digging cranes; also sluices and belt conveyors.

COAL BINS

Two steel and concrete storage bins over ovens, 600 tons and 1000 tons capacity with conveyors and galleries from pit building.

COKE OVENS

Eleven coke oven batteries, five batteries totaling 210 ovens, each with a capacity of 5-1/2 gross tons of coal, three batteries totaling 152 ovens, each with a capacity of 8-1/2 gross tons of coal and three batteries totaling 130 ovens, each with 9-1/4 gross tons. Grand total 492 ovens. Two coke handling systems from coke wharfs to furnace bins, screening stations and conveying systems. Batteries are equipped with charging larries, pushers and three independent quenching and loading stations.

BY-PRODUCT EQUIPMENT

Building of brick and steel construction, 83 ft. x 160 ft. Gas is carried from oven by (2) 60" foul gas lines through (3) 16 ft. x 45 ft. primary coolers, by (4) 14,000 cu. ft. DeLaval turbo exhausters and sent through (5) Semet-Solvay Company tar extractor, saturator and separator units, BY-PRODUCT EQUIPMENT - Cont'd.

and to (2) sets, three each, of 13 ft. x 45 ft. final coolers and through (2) sets, three each, of 13 ft. x 90 ft. benzol absorbing towers. Building includes (1) 10-ton hand operated and (1) 5-ton electric crane.

Tar and liquor is handled by pumps in pump house near by-product building. Ammonium sulphate is stored in building 83 ft. x 200 ft.

LIGHT OIL and BENZOL PLANT

Main building of brick and steel construction 40 ft. x 120 ft. with leanto 50 ft. x 72 ft. Equipment consists of (4) 6 ft. diameter Semet-Solvay Light Oil Stills with pumps, cooling coils, heat exchangers, decanters and receiving tanks, with light oil stored in (2) 30 ft. x 30 ft. tanks and (2) motor benzol stills and (3) intermittent stills for pure product and light oil washing equipment in building of brick and steel construction of 36 ft. x 42 ft. Also finished product storage tanks and drum loading station.

BOILER HOUSE EQUIPMENT

Station No. 18 equipment consists of (5) 768 H.P. B. & W. boilers with "Coxe" stokers and necessary fuel and ash handling equipment. Building of brick and steel construction 52 ft. x 144 ft.

OFFICE and LABORATORY

A thoroughly modern office and a chemical testing laboratory of the latest type are located at entrance to coke plant, all built of fireproof construction, two-story type, and equipped with every convenience.

The upper floor houses the executive forces of the Coke Plant Department proper, while the chemical testing laboratory is located in the basement. The chemical laboratory is fitted with Alberene stone equipment throughout, tile floors, tile walls, and has attached to it a pneumatic conveying system for transmitting and receiving samples from the Benzol Plant.

PRODUCTS

Coke
Tar
Gas (Coke Oven)
Pure Benzol
90% Benzol
Motor Benzol
Ammonia liquor (when ordered)
Sulphate of Ammonia
Refined Solvent Naptha
Crude Naphthalene
Solvent Naphtha
Toluol
Xylol

APPENDIX 31

Cambria Steel Company's Coke Works, Wages and Prices, 1910

Cambria Steel Company's Coke Works.

NOTICE

The following wages and prices have been established by the H. C. Frick Coke Company to go into effect on and after January 16th, 1910, until further notice.

As it has always been our custom to pay the same rates as they do, these new wages and prices will also go into effect at these works on and after January 16th, 1910, until further notice.

Mining and Loading Room and Rib Coal, per 100 bu.,	$1.35
Mining and Loading Heading Coal, per 100 bu.,	1.50
Mining and Loading Wet Heading Coal, per 100 bu.,	1.62
Drawing Coke, per 100 bu., charged	.78
(All the above by same measurement as at present.)	
Drivers and Rope Riders (Shafts and Slopes) per full run,	2.60
Drivers and Rope Riders (Drifts) per full run,	2.55
Cagers, per full run,	2.60
Tracklayers, Blasters and Timbermen (Shafts and Slopes) per day	2.60
Tracklayers, Blasters and Timbermen (Drifts) per day	2.55
Assistant Tracklayers and Inside Laborers, per day	2.00
Dumpers and Tipplemen, per full run	2.00
Leveling, per oven	.10½
Chargers, per oven	.04½
Chargers, per day	2.00
Forking Cars, 40,000 lbs. capacity and less	1.65
Forking Cars, 50,000 lbs. and 60,000 lbs. capacity	1.75
Forking Cars, over 60,000 lbs. capacity	1.90

The price for all other labor, regularly employed in the operation of the plants, will be proportionate with the above.

JAS. J. STOKER,
Lessee.

Dunbar, Pa., Jan. 3rd, 1910.

Source: Folder: Cambria Steel Company, Mcol IV, Box IX, Cambria Steel Company, JFM.

APPENDIX 32

Products of the Cambria Plant, 1936

PRODUCTS OF THE CAMBRIA PLANT

Pig Iron: standard and special grades. Ferro-Manganese.

Blooms, Billets and Slabs.

Steel Bars, open hearth and Bessemer.

Concrete Reinforcing Bars.

Special Rolled Sections. Crane rails.

Plates, universal and sheared.

Rods, Wire and Wire Products—Plain, bolt, screw, chain, extra-soft rivet and hard bright nail wire; bright-processed, annealed, normalized, heading and telephone wire; galvanized wire; bethanized (special zinc-coated) wire; wire rods; welding wire; extension wire; straightened and cut wire; hard-oil finish baling wire; clothesline wire; soft-processed wire; stapling wire; border wire; barbed wire; Silver Star bale ties. Bethanized field and poultry fence. Nails and staples.

Wheels and Axles—Wrought-steel wheels and axles for freight and passenger cars; for engine and tender trucks; for street and interurban cars; for mine cars; for cinder, ore and other industrial cars; crane wheels.

Light rails and accessories—Splice bars—Tie plates.

Trackwork for mine and industrial railways—Frogs, switches, switch stands, crossings.

Rail Anchors.

Steel Ties.

Highway Posts and Guard Rails.

Steel Fence Posts.

Steel Discs.

Steel Freight and Mine Cars.

Rolled Steel Blanks—For gears, pinions and flywheels. Tire moulds and mould rings, locomotive pistons, turbine-wheel blanks, shaft couplings, brake wheels and drums and other circular forgings.

Coke and By-Products, including tar, tar acid, oils, pitch, benzol, retort carbon, ammonia liquors, ammonium sulphate, crude naphthalene

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Source: "A Visit to the Cambria Plant of Bethlehem Steel Company in Connection with the 18th Annual Convention, Dept. of Pennsylvania, American Legion at Johnstown, August 20, 21 and 22, 1936," p. 11.

APPENDIX 33

Cambria Steel Company, Cambria Barbed Wire, 1916

CAMBRIA STEEL COMPANY

CAMBRIA BARBED WIRE

OUR line of Barbed Wire, as displayed on opposite page, embraces every style required by builders of fences. The strands are uniformly twisted, the barbs sharp, tightly wrapped and equally spaced. All standard barbed wire is furnished either galvanized or painted and put up on Catch Weight, Pony, or 80-rod Spools.

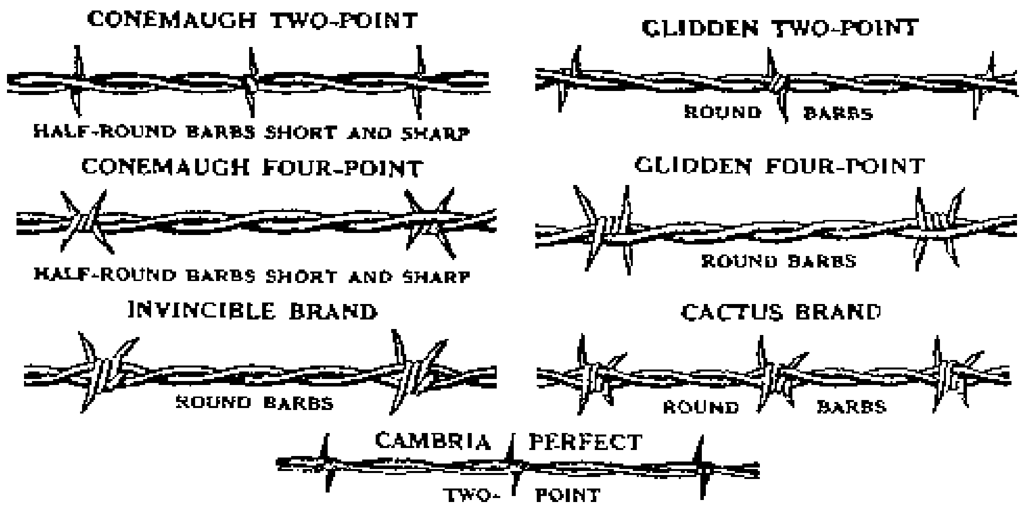
The special or light Barbed Wire is furnished only galvanized and on 80-rod Spools.

Barbs are spaced as follows:

Two-Point	Cattle	barbs	are	5	inches	apart.
Two-	"	Hog	"	"	3	"	"
Four-	"	Cattle	"	"	6	"	"
Four-	"	Hog	"	"	4	"	"

CAMBRIA STEEL COMPANY

CAMBRIA BARBED WIRE



Source: Cambria Steel Company, *Cambria Fence*. [Philadelphia] March 1, 1916, pp. 26-27.

APPENDIX 34

History – Franklin Mills Department

primary mill

HISTORY - FRANKLIN MILLS DEPARTMENT

April 20, 1901 - Franklin Open Hearth made the 1st heat.
June 7, 1901 - 40" Blooming Mill rolled 1st ingot.
August 14, 1902 - 35" Slab Mill rolled 1st ingot.
September 10, 1902 - Old #1 Plate Mill rolled first plate.
July 3, 1918 - New #2 Plate Mill rolled first plate.
March 17, 1924 - Old 34" Billet Mill rolled first ingot.
April 27, 1940 - New 34" Billet Mill (Birdsboro) rolled first ingot bloom.
November 1, 1951 - 46" Blooming & Slabbing Mill (Mesta) rolled first ingot.
February 1, 1952 - 30" Mill rolled first bloom (Mesta 4-stands, 2 vert.-2 horiz.)
March 3, 1952 - 18" Mill relocated from Lower Works rolled first billet from 30" Mill.
September 9, 1952 - 30" Mill converted to 8-3/8" rounds, instead of blooms.
November 21, 1954 - Old 134" Plate Mill rolled last plate.
December 14, 1954 - New 134" Plate Mill (United Engr. & Fdy.) rolled first plate.
November 29, 1955 - 40" Mill rolled for the last time - 1008 tons. (Dismantled & scrapped).
May 3, 1956 - New #7 Battery of Soaking Pits charged first steel.
October 24, 1956 - 34" Mill shutdown and did not resume operations until November 3, 1956 at 1:30 p.m. after being electrified with the old 40" Mill motor. Also, at this time 72' of Mill approach table and 94' of McKee Hot-Bed table was also installed and a new pressure cylinder was installed on shear.
December 1958 - Steel Conditioner at Lower Works started operations.
November 23, 19[illegible] - 134" Plate Mill shutdown at the close of the 7-3 turn for installation of the New Mechanized Shearline and resumed operations upon completion of installation on December 19, 1960.
December 30, 19[illegible] - New Billet [illegible] at #1 Yard started operations.
[illegible], 1962 - 1st Square [illegible] rolling on 46" Mill.
[illegible], 1962 - 1st 3½" [illegible] rolling on 30"-18" Mill.
[illegible], 1962 - 46" Pits began heating steel with 100% Coke Oven gas on 3-11 turn.
August 14, 1962 - New Marvel Saw placed in operation at #1 Yard.
February 12, 1963 - #1 Bung Furnace in #1 Yard began operations.
April 11, 1963 - #2 Bung Furnace in #1 Yard began operations.
June 6, 1963 - New Cold-Scarfer operated in #1 Yard for the first time.
September 7, 1963 - 30"-18" Mill shutdown at close of 11-7 turn for a 2-week period to convert to a 30"-21" Mill. Existing 18" Stands were eliminated and alterations made to nine 21" Stands and gearing with a new Morgan Electric Flying Shear installed. Operations resumed on the 7-3 turn, September 23, 1963.
October 4, 1963 - #3 Bung Furnace in #4 Yard began operations.
October 18, 1965 - 1st scheduled turn on the Billet Grinder in #4 Yard (Tysaman Machine).
May 1966 - TV-Camera at 30" Mill Hot-Scarfer Run and TV-Receiver at 21" Shearman's Station for viewing round, setting shear, cutting to length & max. yield.
July 11, 1967 - 1st scheduled Pickling Turn at #9 Yard, Lower Works.
April 20, 1968 - Last production on Billet Turners.
May 3, 1968 - #471 Pit Crane placed in operation at 46" Pits. (Total 4 pit cranes.)
January 6, 1969 - New 3½ million dollar 46" Mill Hot-Scarfer began operations on a permanent basis after several trial turns involving adjustments and pressure settings.
February 22, 1969 - 7-3 turn - Last Turn worked on Cold-Scarfer. Prior to dismantled and shipped back to Linde Co.
December 21, 1971 - New Centro-Billet Grinders began operations in #1 Yard. (#1 & #2 Machines).
January 6, 1973 - Billet Biter at 30"-21" Billet Mill placed in operation.
April 19, 1975 - Last ingots heated in 40" Pits. They were shutdown at 11:00 p.m.
May 1, 1976 - 15 Turn Operation due to permanent reduction in O.H. to 5 furnaces for the next 2½ years on account of new BOF installation.
July 14, 1976 - Last Plate (Ht. 655X010) rolled on 3-11 turn on 134" Plate Mill.
July 19, 1977 - Johnstown Flood occurred at night. (July 20 is the designated day.)
July 20, 1977 - Johnstown Flood - #9 Yd. was not reopened.
August 1, 1977 - 21" Grinder started up. Down 12 days.
August 8, 1977 - 34" Grinders " " . " 19 " .
August 28, 1977 - #4 Scarfing Yard " " . " 39 " .
September 14, 1977 - 46" & 30"-21" Mills started up. Down 56 days.
September 18, 1977 - #1 Scarfing Yard - " " . " 60 " .
September 29, 1977 - 34" Mill started up. Down 71 days.
November 1, 1977 - Franklin Mills Water Treatment Plant startedup.

(July 20, 1977 – November 1, 1977: Flood related.)

January 19, 1979 - 34" Mill began using pneumatic stamping gun to end stamp product.
May 18, 1980 - #9 Yd. reopened for scarfing only.

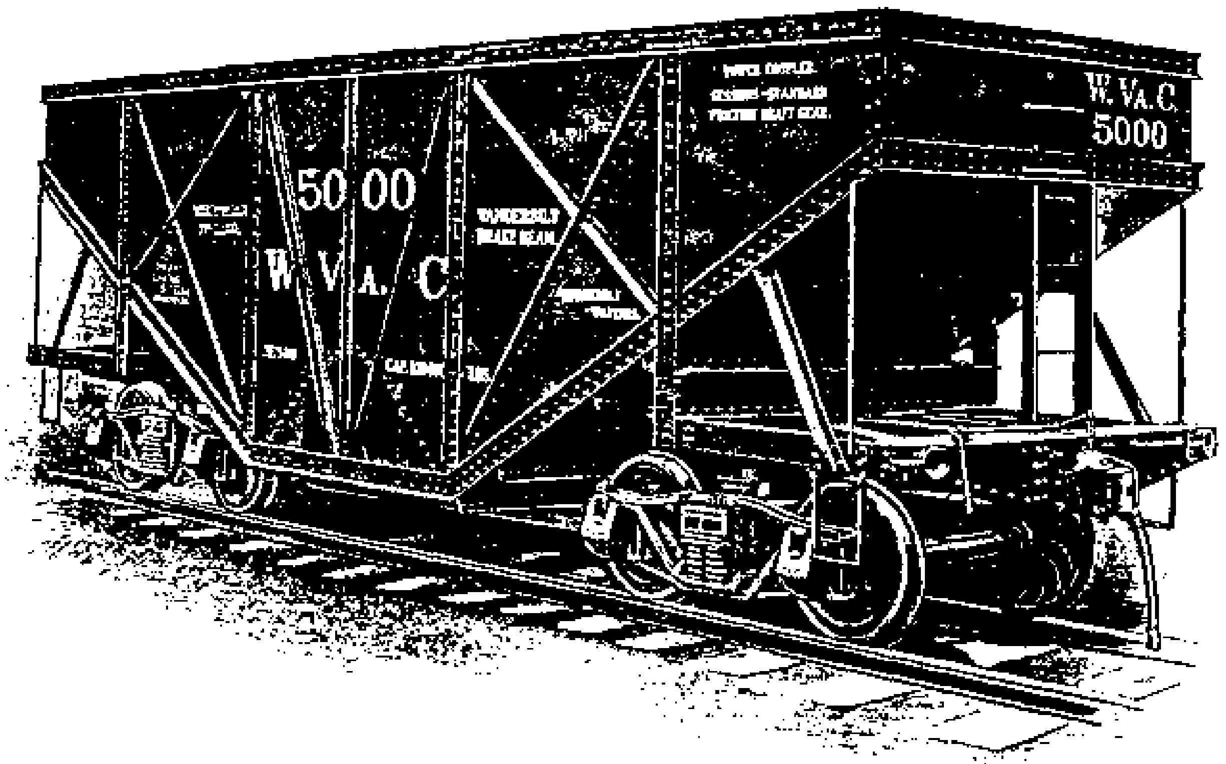
(Oct. 1, 1977 - Plant force cut to approx. 6,500 people, 1.2 million ingot tons from 1.8.)

Source: Bethlehem Steel Corporation

APPENDIX 35

Cambria Steel Cars, 1905

Source: Cambria Steel Company, *Cambria Steel Cars Built by Cambria Steel Company General Office Philadelphia, Pa. Works at Johnstown, Pa.* [New York: Chasmer-Winchel ca. 1905], pp. 14-15.

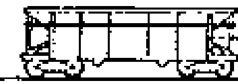


DESIGN D

HOPPER CAR WITH TRUSSED SIDES

Built for the W. Va. C. & P. R. R.

DESIGN D—HOPPER CAR WITH TRUSSED SIDES



Length over end sill webs	31 ft. ½ in.
Length, inside	30 ft. ⅝ in.
Length, center to center of trucks	20 ft.
Width, extreme over grab irons	9 ft. 3⅝ in.
Width, inside	8 ft. 8½ in.
Height, inside	9 ft. ½ in.
Height, top of rail to top of sides	10 ft. 7½ in.
Height, top of rail to top of center sill	3 ft. 8¼ in.
Height, top of rail to top of brake mast	11 ft. 3½ in.
Truck wheel base	5 ft. 2 in.
Size of journals	5½ x 10 in.
Number of doors	4
Size of door openings	2 ft. 5⅛ in. x 2 ft. 11 in.
Capacity	100,000 lbs.
Light weight	37,500 lbs.
Cubical capacity with heap	1,858 cu. ft.

THIS car is especially adapted for use in bituminous coal trade. Mr. Cornelius Vanderbilt is designer and patentee of the car. It was built from working drawings and specifications furnished by him. The center sills are composed of 15-inch channels passing through the body bolsters, which are arranged to take the loads carried by the trussed sides. The trussed sides are designed to take all the loads coming on them, the plates being used merely to confine the cargo. The car is equipped with friction draft gear, steel couplers, air brakes, Vanderbilt brake beams, and arch bars of channel section. The door operating mechanism is of a toggle joint type, and so arranged that all of the doors are operated on one shaft; 650-pound wheels, malleable iron journal boxes, and other M. C. B. standard devices are used in its construction. Plates and structural shapes are made of open hearth soft steel.

APPENDIX 36

Ledger, Mechanical Orders to Machine Shop, 1 September, 1910

Source: Ledger, Mechanical Orders to Machine Shop 1909-1910, Mcol IV, Box IV, Cambria Steel Company, JFM.

Mechanical Orders to Machine Shop

PRINT No.	DEPARTMENT	CHARGE	When Received	When Finished	FINISHED BY
	Blast Fur No 8 E R		9 20 10	9 23 10	Kennedy
	Lintu 22" Mill No 1 E R			9 23 10	McDaniel
	Water Works & Dams			9 24 10	Francis
	Rolling Mills No 4 E R			9 26 10	Wm Mullollen
	Steel Works			9 21 10	Francis
	Foundry			9 27 10	Wm A. Leckey
	No 1 Finishing Dept			9 23 11	[illegible]
	Cambria Open Hearth			9 24 10	Wm A. Leckey
	Billet Mill			8 31 11	Cancelled
	Cambria Open Hearth			12 20 10	A Leckey
	Forge Shop & Structural Shop			11 17 10	Kennedy
	Structural Shop			11 5 10	Kennedy
	Boiler Shop			9 23 10	Francis
	Steel Works			9 23 10	Francis
	Riggers & Lifters			9 23 10	Cancelled
	No 3 Mill			9 24 10	McDaniel
	Cambria Incline Plane Co			9 21 10	Wm Kennedy
	Axle Plant			9 23 10	Kennedy
	Roll Shop			9 23 10	Mullollen
	" "			9 23 10	Francis
	Foundry			9 23 10	Francis
	#4 Boiler House			[illegible] 21 11	Mullollen
	Foundry			10 12 11	Plans Dept
	No 8 Blast Furnace			3 21 11	Kennedy
	No 1 Mill Finishing			10 12 10	Mc Daniel
	Roll Shop			9 23 10	Francis
	Pig Metal Line			10 21 10	McDaniel
	Structural Dept			10 17 11	Kennedy
	No 6 Boiler House			[illegible] 28 13	Cancelled
	Steel Works		9 21 10	9 23 10	Francis
	Axle Plant			10 20 10	Kennedy
	Foundry			9 23 10	Francis
	Riggers & Lifters			9 23 10	A. Leckey
	North Mill Finishing Dept			10 5 11	Mc Daniel
	No 6 Boiler House			10 1 10	Mullollen
	Large Locomotive Dept			10 12 11	Kennedy
	Pipe Shop			9 23 10	Kennedy
	Large Locomotive Dept			3 1 11	Kennedy
	Rolling Mill Plant			12 6 10	Kennedy
	Electrical Dept			9 23 13	Mullollen
	No 7 Boiler House & [illegible]			9 23 10	Mullollen
	General Steam Plant			9 26 10	Wm Mullollen
	Heating Dept			9 23 10	Collins

APPENDIX 37

Rules of Cambria Iron and Steel Works, 1874

Source: Unnumbered, unnamed box, JFM.

CAMBRIA IRON AND STEEL WORKS.

[All persons entering into the service of the Cambria Iron Company, in any capacity whatever, shall be taken and held to have made the following RULES AND REGULATIONS a part of their agreement of hire, service or employ, and the Act of entering into its service or employment shall of itself be considered a sufficient assent thereto; nor shall any plea of ignorance of the said Rules and Regulations be offered or received in avoidance or derogation thereof.]

First, The GENERAL MANAGER shall have full and complete authority and control in every department of the Works, and will be alone responsible to the Company for the management of the same.

Second, The SUPERINTENDENTS and FOREMEN of the various departments will work under the sole direction of the General Manager, and in harmony with each other, and will make such reports and returns as may be required of them.

Third, CONTRACTORS will work under the direction of the Superintendent or Foremen of the respective departments in which they may be engaged; and they and their employes shall be subject to all the Rules and Regulations governing the immediate employes of the Company.

Fourth, The time of commencing and discontinuing work by those employed by the day will be announced by the OFFICE BELL or a STEAM WHISTLE, and the time and manner of doing all work paid for by the ton or piece will be regulated by the Foreman under whom the work is done.

Fifth, Any person or persons desiring to quit the employ of the Company, shall be required to give at least TWO WEEKS' previous notice of his or their wish so to do, said notice to be given to the Foreman under whom he or they work, and the Foreman so notified shall return said notice to the proper Clerk, who shall enter the same, giving date, name, time, and reasons for leaving, in a book to be kept in the Rolling-Mill Office for that purpose.

proper manner, or failing to do a satisfactory amount, may expect *to be dismissed* whenever it may suit the convenience of the Company.

Eleventh, Quarrelling or rioting about the Works, or on the Company's premises, shall be punished by a fine of not less than $5 nor more than $10, or the discharge of the offender, who may also be prosecuted for violation of the law.

Twelfth, All collections made of *Fines and Penalties* under these rules, other than those imposed for damages to property of the Company, will be set apart and reserved for the relief of such workmen as may become disabled by accident or sickness in the service of the Company. It being understood that the money will be distributed to the disabled workmen of the same department from which it was collected, as near as is practicable.

Thirteenth, Any person destroying or injuring any property of the Company, from careless or reckless conduct, will be charged with the full damage sustained, and the amount retained from his wages.

Fourteenth, Persons detected in stealing Coal will be charged the price of a load of Coal for every lump so stolen, and persons taking wood, fencing, mine timber, or other lumber, will be charged the price of a cord of wood for each and every stick so taken, and for a repetition of the offence will be discharged and punished according to law.

Sixth, Any person discharged from any part of the Works for DISHONESTY, DRUNKENNESS, INSUBORDINATION, or other *Blameable Cause*, will not be suffered to remain about the Works or in the employ of the Company, in any capacity whatever. Superintendents, Foremen, and Contractors are required to furnish to the proper Clerk for registry in the office the names of all persons discharged by them for offences, and any one of them who shall employ any person who has been discharged for cause from any department, will be fined from $1 to $5, at the discretion of the General Manager, and upon knowingly or wilfully repeating the offence, shall be *dismissed from the Works.*

Seventh, The time and manner of payment will be governed by the general condition of the business, and every change in this respect will be duly announced.

Eighth, Persons leaving the Works without having given the *Two Weeks' Notice*, and persons discharged for offences, will be settled with in the way, and at the time, they would have been had they continued at work.

Ninth, Any person or persons known to belong to any SECRET ASSOCIATION OR OPEN COMBINATION whose aim is to *control* wages or *stop the Works*, or any part thereof, shall be promptly and finally discharged. Persons not satisfied with their work or their wages can leave honorably by giving the required notice; and any person or persons quitting work, or inducing, or attempting to induce, others to quit work, other than in the manner prescribed in these Rules and Regulations, shall *forfeit* whatever may be due or owing to such person or persons, absolutely.

Tenth, Any person going to his work INTOXICATED, OR ABSENTING HIMSELF FROM WORK, without having previously given notice and obtained leave, will be *Discharged or Fined*, at the option of the Company. Any person failing to do his work in a

Fifteenth, Persons living in the Company's houses will be charged for all damages done the houses beyond the ordinary wear and tear, and will be compelled to leave at once upon ceasing to be employed by the Company. In renting the houses preference will always be given to those whose business requires them to live near the Works.

Sixteenth, Coal will be furnished to all persons in the employ of the Company, by leaving notice at the office, and to protect the workmen against imposition from parties contracting to deliver Coal, any person receiving it can have it weighed upon the scales of the Company, and if found deficient in weight it shall be delivered free of charge.

Seventeenth, Workmen, in any department, taking or allowing others to work with them, without the consent of the Foreman under whom they are employed, will not be allowed for the work so done, and will render themselves liable to be discharged from the Works.

Eighteenth, The Superintendents and Foremen shall have full power and authority in their respective departments, and are hereby required to exercise the same to enforce these Rules and Regulations; and to impose fines and penalties for violations thereof. All fines and penalties so imposed shall be rigorously exacted, unless upon full examination it shall appear to the General Manager that injustice has been done.

Nineteenth, In Hiring, Promoting, and Discharging Workmen Superintendents and Foremen must regard only the *interests of the Company and the qualifications and merits of employes.* The work must be allotted with due regard to the *skill and character of the men*, and any Superintendent or Foreman known to be engaged or interested in any business which may improperly influence his conduct towards those under him, or who shall wilfully neglect or refuse to enforce any of these Rules, shall be promptly discharged.

By order of the Board.

E. Y. TOWNSEND,
President Cambria Iron Company.

PHILADELPHIA, April 6, 1874.

N. B. Any Change from the above Regulations will be made known from time to time, as circumstances may require.

APPENDIX 38

Rules of Cambria Steel Company, 1910

Source: Folder Cambria Steel Company 1906 to 1913 Mcol IV, Box IX, Cambria Steel Company, JFM.

Missing's Friend of our Employees.

RULES

No. 375.

OF

Cambria Steel Company for Government of Its Employees at the Works.

All persons entering into the service of the Cambria Steel Company, in any capacity whatever, shall be taken and held to have made the following Rules and Regulations a part of their agreement of hiring, service, or employment; and the act of entering into its service or employment shall of itself be considered a sufficient assent thereto. Nor shall any plea of ignorance of said Rules and Regulations be received in avoidance or derogation thereof.

First. The General Superintendent and Heads of Departments will exercise such authority as is vested in them by the Board of Directors.

Second. Any person desiring to quit the employ of the Company must give at least two weeks' previous notice of his wish to do so—said notice to be given to the Foreman under whom he works, and the Foreman so notified shall return said notice to his Department Time Office Clerk, who shall promptly send the same to the General Time Office, giving the date, name, time, and reason for leaving.

Third. Any person discharged from any part of the Works for dishonesty, drunkenness, insubordination, or other cause will not be suffered to remain about the Works or in the employ of the Company in any capacity whatever. Superintendents and Foremen are required to furnish to the Auditor of the Company, for registry in his office, the name of each person discharged by them, stating the offense; and such person must not be employed again in any Department unless he furnish a written permit from the Superintendent or Foreman under whom he last worked, countersigned by the General Superintendent.

Fourth. The time and manner of payment of wages will be in accordance with General Orders, and every change in this respect will be duly announced. Employees must present themselves in person to receive and, if required, to receipt for the wages due them. The place of payment of all persons employed in and about Johnstown will be at the General Office, Locust street, Johnstown, Pennsylvania, unless payment is made in the several Departments by a Paymaster. In no case will wages be sent to an employee or his assignee, agent, or representative at a distance. All contracts of hiring shall be subject to such general reductions of pay as may be rendered necessary by the general condition of business, and such reduction shall take effect after two weeks' notice of the same posted in the Works. Employment shall be at a certain rate of wage per hour, or per gross ton of 2,240 pounds, except in the coal mines, where the net ton of 2,000 pounds shall govern.

Fifth. Persons leaving the employment of the Company without having given two weeks' notice will be settled with on the regular Department payday.

Sixth. The Company reserves the right under the Constitution and Laws of the Commonwealth of Pennsylvania and of the United States to deal with its employees respecting the nature and terms of their employment in their individual capacities. Persons not satisfied with their work, their wages, or their terms of employment can leave the service of the Company honorably by giving the required notice, and the General Superintendent may give to persons thus leaving a certificate of the fact.

Seventh. Any person absenting himself from work without having previously given notice and obtained leave, or going to or being about his work in an intoxicated condition, or failing from any cause to do his work in a proper manner or to do a satisfactory amount of work, may be suspended, discharged, or fined, at the option of the Company.

Eighth. No person engaged in the manufacture or sale of intoxicating liquors shall be employed in any Department of the Company.

Ninth. Employees guilty of a breach of the peace, or of quarreling, or of disorderly conduct, or of rioting in the vicinity of the Works or on the premises of the Company, or who shall violate any of the rules of the Company, or who shall carelessly, recklessly, or negligently injure or destroy any property of the Company, may be suspended or discharged, or punished by a fine of not less than \$1.00 nor more than \$10.00, at the discretion of the Superintendent of the Department in which such workmen are employed.

The punishment herein specified shall not prevent the prosecution of any offender for any offense punishable under the laws of Pennsylvania or the ordinances of the municipality in which the same may occur, nor shall it be construed as a waiver of the Company's right of action for recovery of damages in any civil action it may see fit to institute.

Tenth. All collections made by fines and penalties under these rules, other than those imposed for damages to property of the Company, will be turned over to the Cambria Mutual Benefit Association.

Eleventh. No workman in any Department shall, without the consent of his Foreman, procure others to work with him or for him.

Twelfth. Gate Watchmen shall not permit any person to enter the Works enclosures other than employees legitimately employed therein or persons who are provided with proper passes entitling them to admission to the Works.

Thirteenth. The Superintendents and Foremen shall have full power and authority in their respective Departments, and they are hereby required to exercise the same for the enforcement of these Ruls and Regulations and for the imposition of fines and penalties for violations thereof. All fines and penalties so imposed shall be rigorously exacted, unless upon full examination it shall appear to the General Superintendent that injustice has been done.

Fourteenth. In hiring, promoting, and discharging workmen, the Superintendents and Foremen must regard only the interest of the Company and the qualifications and merits of the employees.

Fifteenth. Every salaried employee shall devote his entire service to the Company's interests, and no information in regard to the operations, plans, or affairs of the Company shall be made public by any officer or employee thereof, except by such officer as the Board of Directors may authorize.

By Order of the Board,

April 21, 1910.

C. S. PRICE.

President Cambria Steel Company.

NOTE.---Changes in the above Rules and Regulations will be made from time to time as circumstances may require.

APPENDIX 39

Cambria Steel Company Tenements, 1911

Tioga Street and Third Avenue, Westmont Borough

Number of this type 10
Rent, $20 per month
Number of rooms 8
All Modern Improvements

Wyoming Street, Westmont Borough

Number of this type 7
Rent, $8.00 per month
Number of rooms 6
Water, gas and closet

Lehigh Street, Westmont Borough

Number of this type 9
Rent, $7.00 per month
Number of rooms
Water, gas and closet

Iron Street, Johnston City

Number of this type 37
Rent, $5.40 per month
Number of rooms
Water and closet

Poelor Street, Johnstown City

Number of this type 51
Rent, $6.00 per month
Number of rooms 5
Water and closet

Morgan Place, Johnstown City

Number of this type 6
Rent, $13.00 per month
Number of rooms 8
Water, bath and closet

Fifth Avenue, East Conemaugh Borough

Number of this type 20
Rent, $8.50 per month
Number of rooms 6
Water and closet

Birmingham, Blair County

Number of this type 14
Rent, $2.25 per month
Number of rooms 4

Source: "Tenements," typed manuscript, folder: Welfare Work 1911, box: Cambria Steel, Acc 1699, BSC, HagM.

APPENDIX 40

Maintenance on company housing, Westmont, 1921

BRANDT-CLEPPER CO.
HOUSING ENGINEERS AND ARCHITECTS
PITTSBURGH, PA.

CENTURY BUILDING
BELL TELEPHONE
[illegible]

[redacted]

Aug. 6, 1921.

Mr. E. T. Gray, Chief Civil Engineer,
Cambria Steel Company,
Johnstown, Pa.

Dear Sir:-

In reply to your letter of the 3d inst., we are giving as follows paint and stucco combination colors for houses on Westmont Ave., Area "B" and houses on Cox Street:-

WESTMONT AVENUE

HOUSE NO.	LOT NO.	STUCCO NO.	PAINT COLORS	
6621	2	4	261	Brown
6921	3	9	275	Green
6911	4	7	2002	Green
6422	5	6	261	Brown
6411	6	3	275	Green
6811-2	7 & 8	5	261	Brown
6412	9	8	311	Green
6422	10	9	275	Green
6922	11	6	261	Brown
6622	12	8	311	Green
6611	13	5	261	Brown
6911	14	7	2002	Green

COX STREET

HOUSE NO.	LOT NO.	STUCCO NO.	PAINT COLORS	
6922	1	9	275	Green
6422	2	6	261	Brown
6411	3	7	2002	Green
6821-2	4 & 5	6	261	Brown
6412	6	3	275	Green
6611	7	5	261	Brown
6622	8	9	275	Green
6811-2	9 & 10	6	261	Brown
6621	11	3	275	Green
6612	12	5	261	Brown
6922	13	4	244	Brown
6811-2	14 & 15	9	275	Green
6921	16	8	311	Green
6421	17	4	261	Brown
6911	18	6	261	Brown

The sash and outside doors in all cases to be painted a cream white.

HCC/L
Copy to Mr. Kissell.

Yours very truly,
H C Clepper

Source: H.C. Clepper to E.T. Gray, August 6, 1921, folder: Industrial Housing Shady Lane 1920-1923, box: Cambria Steel Co., Acc 1699, BSC, HagM.

APPENDIX 41

Ethnic Distribution of Iron Mill Workers in Johnstown, 1870

Nationality of Johnstown Iron Workers, 1880

Source: John William Bennett, "Iron Workers in Woods Run and Johnstown: The Union Era 1865-1895." Ph.D dissertation, University of Pittsburgh, 1977, pp. 341, 364.

TABLE 7-3. Ethnic Distribution of Iron Mill Workers, Johnstown and Neighboring Communities, 1870 Census.

Community	Parents' Place of Birth												
	Wales		Ireland		United States		England		Germany		Other		Total
	%	#	%	#	%	#	%	#	%	#	%	#	#
Johnstown													
Ward 1	14	(18)	5	(6)	50	(64)	5	(7)	27	(34)	--	--	(129)
Ward 2	17	(7)	7	(3)	54	(22)	7	(3)	15	(6)	--	--	(41)
Ward 3	--	--	--	--	64	(7)	9	(1)	27	(3)	--	--	(11)
Ward 4	--	--	8	(3)	69	(27)	3	(1)	21	(8)	--	--	(39)
Ward 5	2	(1)	--	--	80	(37)	--	--	15	(7)	2	(1)	(46)
Ward 6	--	--	--	--	75	(21)	4	(1)	21	(6)	--	--	(29)
Total	9	(26)	4	(12)	61	(178)	4	(13)	22	(64)	--	(1)	(294)
Neighboring Communities													
Cambria	3	(3)	48	(43)	24	(21)	2	(2)	21	(19)	1	(1)	(89)
Conemaugh	--	--	9	(3)	46	(16)	--	--	46	(16)	--	--	(35)
Cooperdale	4	(1)	--	--	85	(23)	4	(1)	7	(2)	--	--	(27)
Millville	15	(17)	35	(38)	38	(42)	11	(12)	1	(1)	--	--	(110)
Taylor	6	(2)	26	(9)	47	(16)	3	(1)	18	(6)	--	--	(34)
Yoder	9	(4)	17	(8)	43	(20)	2	(1)	26	(12)	2	(1)	(46)
Prospect	--	--	83	(5)	17	(1)	--	--	--	--	--	--	(6)
Others	--	--	--	--	67	(2)	--	--	33	(1)	--	--	(3)
Total	8	(37)	30	(106)	40	(141)	5	(17)	16	(57)	1	(2)	(356)
Grand Total	8	(53)	18	(118)	50	(319)	4	(30)	19	(121)	--	(3)	[illegible]

TABLE 7-14. Nationality of All Johnstown Iron Workers, 1880.

Community	Nationality												Total	
	Welsh		Irish		American		English		German		Other			
	%	#	%	#	%	#	%	#	%	#	%	#	#	
Johnstown														
Ward 1	9	(19)	8	(17)	52	(105)	7	(14)	22	(44)	1	(2)	(201)	
Ward 2	...	...	31	(5)	56	(9)	6	(1)	6	(1)	...	...	(16)	
Ward 3	2	(1)	20	(13)	59	(39)	2	(1)	15	(10)	3	(2)	(66)	
Ward 4	3	(5)	1	(1)	62	(91)	3	(4)	31	(45)	...	...	(146)	
Wards 5,6	...	...	3	(3)	73	(75)	2	(2)	21	(22)	1	(1)	(103)	
Total	3	(25)	7	(39)	60	(319)	4	(22)	23	(122)	1	(5)	(532)	
Neighboring Communities														
Cambria	...	...	47	(84)	15	(26)	2	(3)	34	(61)	2	(3)	(177)	
Conemaugh	1	(3)	20	(60)	24	(71)	20	(60)	31	(95)	4	(13)	(302)	
Cooperdale	4	(2)	...	...	95	(52)	2	(1)	...	...	...	...	(55)	
E. Conemaugh	...	...	...	...	93	(25)	...	...	7	(2)	...	...	(27)	
Franklin	...	...	2	(1)	80	(36)	...	...	11	(5)	7	(3)	(45)	
Millville	13	(14)	27	(29)	49	(53)	7	(8)	4	(4)	...	...	(108)	
Prospect	...	...	75	(36)	19	(9)	4	(2)	2	(1)	...	...	(48)	
Stonycreek	...	...	...	...	89	(82)	3	(3)	7	(6)	1	(1)	(92)	
Taylor/ Woodvale	2	(2)	26	(25)	61	(59)	3	(3)	3	(3)	4	(4)	(96)	
Yoder	7	(2)	...	...	64	(18)	4	(1)	25	(7)	...	...	(28)	
Total	2	(23)	24	(35)	42	(431)	8	(81)	19	(186)	2	(24)	(978)	978
Grand Total	3	(48)	18	(274)	50	(750)	7	(103)	20	(308)	2	(29)	(1510)	1510

APPENDIX 42

Daily wage scale of laborers at the Cambria Steel Company, 1880-1900

Tonnage rate (per hundred tons) scale for skilled workers at the Cambria Steel Company, 1880-1900

TABLE 1. Daily wage scale of laborers at the Cambria Steel Company, 1880–1900.

Classification	1880	1885	1890	1895	1900
Laborer, first class, blast furnace (12 hrs.)	1.10	1.04	1.00	1.00	1.20
Cinder man, blast furnace (12 hrs.)	1.55	1.15	1.20	1.26	1.40
Laborer, Bessemer dept. (10 hrs.)	1.23	1.00	1.10	1.10	1.10
Laborer, open-hearth (10 hrs.)	1.23	1.00	1.20	1.00	1.20
Ash man, blooming mill (10 hrs.)	1.23	1.50	1.30	1.00	—

TABLE 2. Tonnage rate (per hundred tons) scale for skilled workers at the Cambria Steel Company, 1880–1900.

Classification	1880	1885	1890	1895	1900
Rail mill roller	6.10	4.23	4.61	3.18	3.00
Rail mill heater	33.00	22.87	27.00	22.41	22.41
Blooming mill heater	2.60	1.68	1.76	0.42	—
Bessemer vesselman	3.83	1.89	1.60	0.80	0.88

Source: Quoted in David Brody, *Steelworkers in America The Nonunion Era*, (New York: Harper Torchbooks, 1960), pp. 44-45.

APPENDIX 43

Statements of Cambria workers, Strike of 1919

Source: Interchurch World Movement of North America, Commission of Inquiry, *Report on the Steel Strike of 1919* (New York: Harcourt, Brace and Howe, 1920; reprint ed., New York DaCapo Press, 1971), pp. 213-217.

In Johnstown where unionism spread through the entire Midvale-Cambria works, including even the office force, "examples" were not sufficient and literally thousands of men were summarily discharged. An investigator in November, 1919, obtained in two days about two hundred signed statements and sworn affidavits of discharged workmen who had been told or who believed that the cause was union affiliation. The forty pages of these statements make monotonous reading; specimens follow:

Joseph Yart, 216 Woodville Ave., Johnstown, was employed by the Cambria Steel Company for forty years in the car works and was never discharged before. He became a member of the union on February 3rd, and was discharged on May 12th by Superintendent Hill. When Mr. Yart asked him for the reason of his discharge, he was told "there is no more work for you here." He went to the employment agency to apply again in June and was told by Agent McGrew, "You can't work for Cambria any more, better look for something outside." Mr. Yart protested that he had worked there for forty years, that he is now 54 years of age and can't work very well on the out-

side and the only reply he got was "You can't work here any more—you are an agitator and a disturbance maker in the car department." Mr. Yart denied this charge and protested that he never spoke to anyone there about his union affiliations, but no attention was paid to his protest. Mr. Yart has been unable to find another job ever since and has been out of work now for the past eight months, as every place he goes to his age handicaps him in securing a job. Mr. Yart was born and lived all his life in Johnstown and was one of the first employees that helped to organize the Cambria Employees' Beneficial Association. One of Mr. Yart's sons was in the army of occupation, and Mr. Yart now complains: "My son went to fight for democracy and I am thrown out on the streets without any means of livelihood."

(Signed) Joseph Yart.

Charles Bacha, 911 Virginia Ave., Johnstown, was employed by the Cambria Steel Company for seven years and never discharged before. On April 1st he participated in the miners' parade, and although he was not a member of the union at that time, he was discharged on the 2nd of April by Superintendent Donk May. The foreman, May, gave him no explanation for his dismissal. He tried to find further employment with the Cambria and when he saw Mr. Lumpkin, the General Superintendent, he was told, "My boy, if you want union work, go down to a union town and get it—no work for you here."

Mr. Bacha applied again four times, but was refused work continuously. Mr. Bacha is a U. S. citizen and has been out of a job now for eight months, as he could not find another job.

(Signed) Charles Bacha.

William Barnhart, 50 Messenger St., Johnstown. On October 24, 1918, he was hired by Telford & Jones Coal Company and started to work, when the foreman came over and said, "I'm sorry, I'll have to take you off—they telephoned me from the main office to take you off." He asked the foreman whether this was because he belonged to the union, to which the foreman replied, "I have nothing against the union, but I got to be on the other side." Mr. Barnhart is a U. S. citizen.

(Signed) William Barnhart.

Bernard Heeney, 336 Honnan Ave., Johnstown, worked for the Cambria Steel Company for seven years and was never discharged before. He joined the union on March 24, 1919, and was discharged on June 6th by Assistant Superintendent F. W. Bryan. When he asked the Assistant Superintendent why he was laid off and explained to him that he was in charge of about twelve men and was the oldest employee in the department, Bryan said, "I don't know—we have orders here to take you off." When he asked him where these orders came from he said, "They may have come from New York, Philadelphia or Chicago." Mr. Heeney is a native of the U. S.

(Signed) Bernard Heeney.

Joe Mandorgotz, 1320 Virginia Ave., Johnstown. Worked for the Cambria Steel Company on and off for about twenty years. He joined the union about March, 1919, and took part in the miners' parade on April 1st. About April 7th, Davie Malcomb, foreman, asked him whether he belonged to a union. He admitted he did and was discharged two days later. Mr. Mandorgotz is a U. S. citizen, lived in Johnstown for twenty-seven years and has a wife and three children to support. He could not find another job for four months.

(Signed) Joe Mandorgotz.

Theodore Salitski, 206 Broad Ave., Johnstown, Pa., worked for Cambria seven years—never discharged before. Was discharged by foreman, Donk May. Joined the union March 17th and was discharged April 7th. Took part in parade held April 1, 1919. When asked for reason, told him "Because you stayed

home April 1st." Applied again and was told by May that "There is no work for a Bolshevist." Out of work six weeks. Married man—wife and one child. Lived in Johnstown eight years.

(Signed) Theodore Salitski.

I, the undersigned, do hereby testify that I have been employed by the Cambria Steel Company for almost eight (8) years in the capacity of unloading steel.

I have at all times been an efficient and reliable employee.

W. H. Walter, the Foreman of the stockyard Department called me into his office this morning and then he asked me if I belonged to the Union. I answered "Yes." He then asked why I joined the Union. I told him the men were joining and I thought I should belong. Mr. Walters then asked "If the men jumped into the furnace would you follow them?" I answered "Yes, if they would I would." I did not believe it was any of his business, as I believe I have a right to join a labor organization for my protection.

I asked Mr. Walters why he discharged me. He answered "Because you joined the Union."

The foregoing occurred the forenoon of February 22nd, 1919.

his
(Signed) Nick (X) Poppovich.
mark

Witness to mark: Thos. A. Daley.

State of Pennsylvania, } ss.:
County of Cambria, }

Before me, a Notary Public, in and for said County personally came Nick Poppovich, who being by me duly sworn according to law deposed and said that the foregoing statement is true and correct.

his
(Signed) Nick (X) Poppovich.
mark

Witness to mark: Thos. A. Daley (Signed).

Sworn and subscribed, before me
this 22nd day of February, 1919.
Ray Patton Smith (Signed),
Notary Public (Seal).
My commission expires March 12, 1921.
Paper not drafted by Notary.

State of Pennsylvania, }
County of Cambria, } ss.:

Personally appeared before me, Myrtle R. Johnston, a Notary Public in and for said County and State, John Kubanda, personally known to me, who being by me first duly sworn deposes and says:

That I worked for the Cambria Steel Company for nine (9) years, the 1st two (2) years in the blast furnace department, always was a steady and dependable man. On Thrusday, February 13th, 1919, Peter Riley, Foreman, sent a man to tell me to come and get my time. I went in to the office and asked him why I was laid off. He said "I got my orders from the office." I told him I don't belong to the Union. He said, "What were you doing at the meeting?" I said, "Anyone can go over to the meeting." He said "go down to the general office and fix it up with them."

I verily believe that it was through Union affiliations that I was discharged.

(Signed) John Kubanda (Seal).

Sworn and subscribed, before me
this 24th day of February, A. D. 1919.
(Signed) Myrtle R. Johnston,
Notary Public (Seal).
My commission expires February 27th, 1921.

APPENDIX 44

Employees Register, 1920s

Source: Employees Register, Mcol IV, Box IX, Cambria Steel Company, JFM.

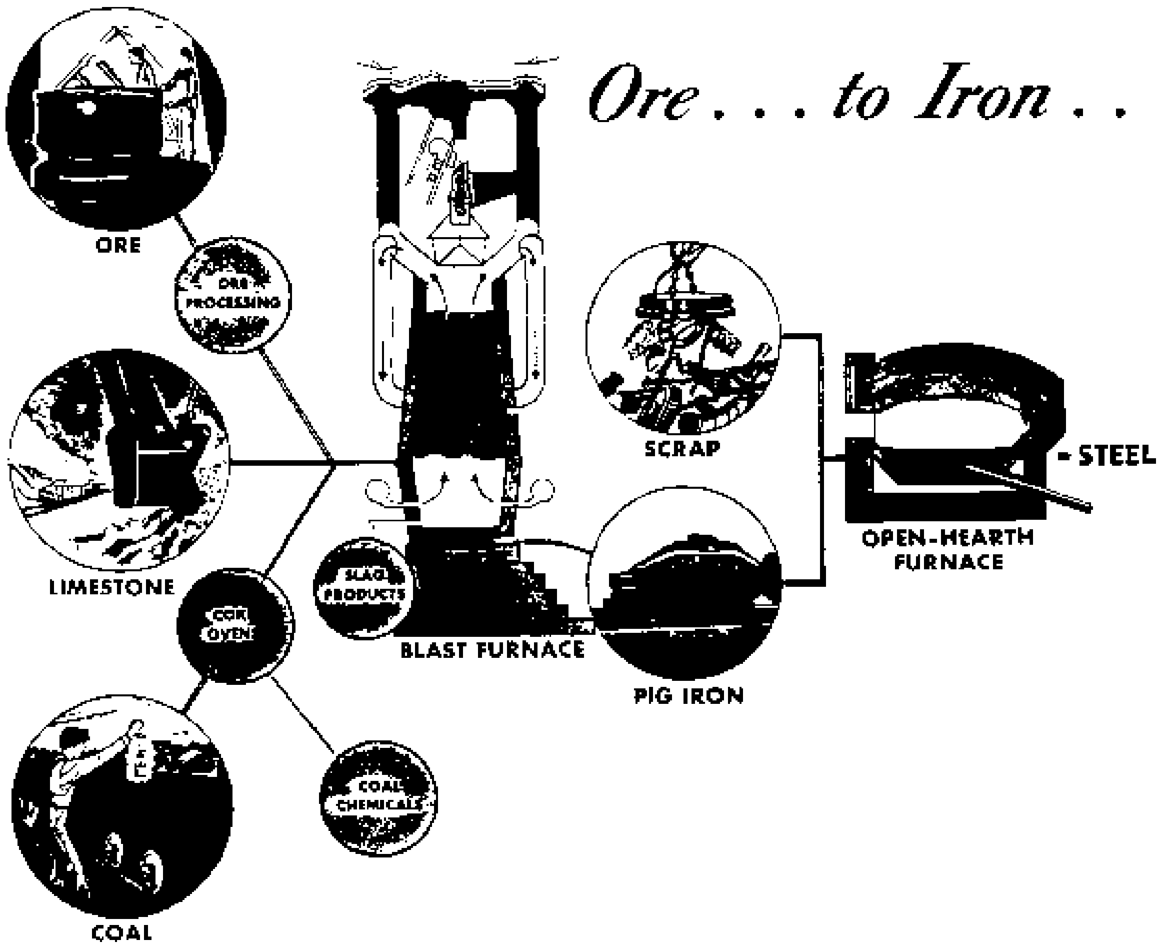
Chgd Spec Treat	Ex'd	Check No	Name	Address	Age	Class
	Bj	431	Leonard Casher	112 Manor Place	17	
1	Bj	432	~~Samuel Smith~~	316 Strayer St	17	
2		432	Wm Hridan			
		432	Ernest Dolk	131 Strayer St ~~24 Walnut St~~	22	
✓	Bj	433	Raffaele Solfi	129 Dolite alley	19	
	Bj	433	Samuel Pollak	244 Cooper Ave	19	
✓	Bj	434	Bert Clevenger	188 Collins St	21	
	Bj	435	Walter Dowling Sr	120 Emery St ~~507 Broad St~~	66	
	Bj	436	Steve Orabenye	103 Fulton St	~~54~~ 55	896 X
	Bj	437	James Finnegan	251 Cypress Ave	54	
	Bj	438	John Quinn	158 Chiral St	69	
✓	Bj	434	Geo Bierman	173 14th Cemetery St	19	
✓		439	Frank Skowpan			
	Bj	440	Steve Kovacs	104 Virginia Ave	47	5557-B

Date started	Children under 16	Single or Married	Position	Date Leaving	Cause for Leaving	Date on Rail	Foreman
3-15-23		Single	1st year app	6-16-24	Laid Off	5-1-23	[illegible]
3-21-23		Single	1st year app Vise Hd	7-7-23	Pneumonia [illegible] Started	5-16-23	Larson
7-15-24 4-15-24			[illegible]	Notice	3-27-25		[illegible]
8-25-22		Single	Drill Press		Notice		Meester
8-15-23		Single	M H Helper				Spangler
2-23-23		Single	Vise Hand	5-25-23	Quit		Meester
2-1-17		Married	Electrician				McAvoy
-1918		Married					Kimmel
8-1916		Married	Laborer	1-8-24	Laid Off		Kimmel
4-30-19		Single	Laborer				Kimmel
6 1 23		Single	M H Helper Vise Hd	[illegible]	[illegible]		Ryan
-1920	3	Married		[illegible] 24	Stopped		Kimmel

Illustration 1: Ore to Iron to Finished Steel

Source: "Johnstown Plant Bethlehem Steel Company," booklet 303, 1951, pamphlet, pp. 6-7, folder: Plants-Johnstown box: Plants-Danville-Johnstown Acc 1699, Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

Ore . . . to Iron . .



PIG IRON for steelmaking is produced in the blast furnace. Iron ore, coke and limestone are fed into the furnace and subjected to preheated air. As the coke burns, gases are formed that reduce the iron ore to metallic iron. Lime from the limestone combines with the impurities and forms slag. Five blast furnaces at Johnstown are used for making pig iron, two others are used for producing ferromanganese.

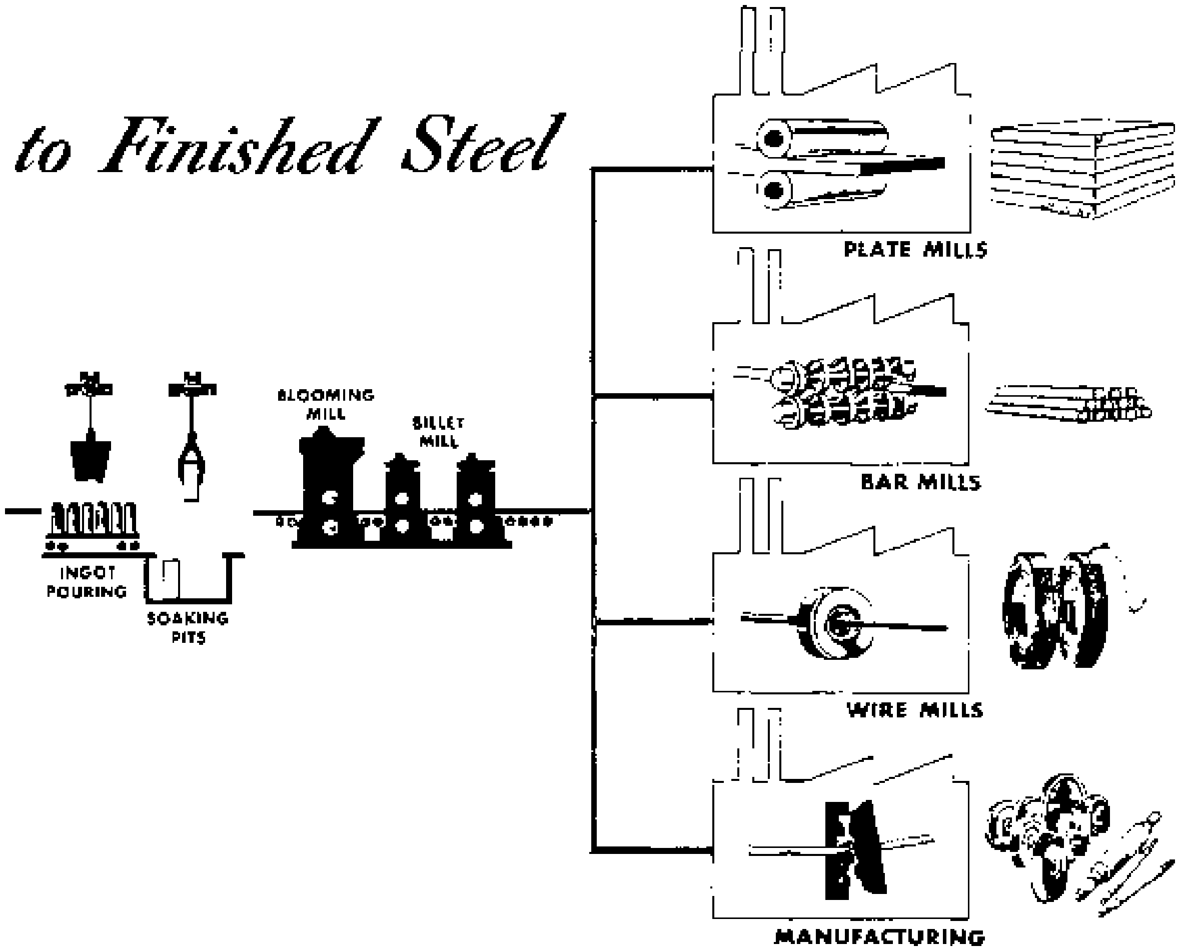
OPEN-HEARTH FURNACES produce all of the steel made at Johnstown. The open-hearth furnace is charged principally with molten pig iron from the blast furnace, and cold ferrous scrap along with a quantity of ferro-manganese. Flames from the combustion of oil or gas, and preheated air sweep down across the shallow hearth to melt the charge and to provide necessary heat for refining the steel. Johnstown is equipped with 21 open-hearth furnaces.

AFTER TAPPING of the open-hearth furnaces, the molten steel is poured into cast-iron ingot molds where it cools and solidifies.

INGOTS are stripped from the molds and reheated in furnaces called soaking pits. Here heat is applied until the ingots are at uniform temperature throughout, ready for rolling.

THE BLOOMING OR SLABBING MILL is the first mill through which the ingots pass. Consisting of large reversing rolls, this mill rolls the ingots down to blooms or slabs for further processing in other mills.

to Finished Steel



BLOOMS go to the billet mills where they are elongated and reduced in cross-section. Some of the resulting billets are further reduced on rod and bar mills while some are forged and formed into other shapes.

PLATES are rolled on large single-stand mills. Heated slabs pass between the rolls until they are reduced to the proper thickness. Some plates are then sheared to width, and others are rolled to width by means of vertical rolls.

BARS are rolled from billets in any one of several bar mills. Each roll stand elongates and further reduces the bars in cross-section. The shape of the bar is developed by grooves in the surface of the rolls. The finished bars are then cooled prior to other processing.

WIRE is made from coiled rod produced on high-speed continuous mills. The rod is drawn through a series of dies of gradually diminishing size, to produce wire of the required gage. Some wire is furnished plain and some is zinc-coated, either by the hot-dip or the bethanizing (electrolytic) process.

FORGED PRODUCTS such as axles and locomotive parts are shaped from billets by means of large steam hammers. Railway wheels, gear blanks and other rolled-and-forged circular products are made from billets of circular section, and are formed into shape by a combination of rolling and forging on special machines.

Illustration 2: Original Cambria Furnace, Cambria Co., Pa 1936

Source: AISI Collection, Courtesy of Hagley Museum and Library

Illustration 3: Plan of Cambria Iron Works Near Johnstown, Pa. Drawn by Edgar Clark Engineer Sept. 4th, 1853.

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

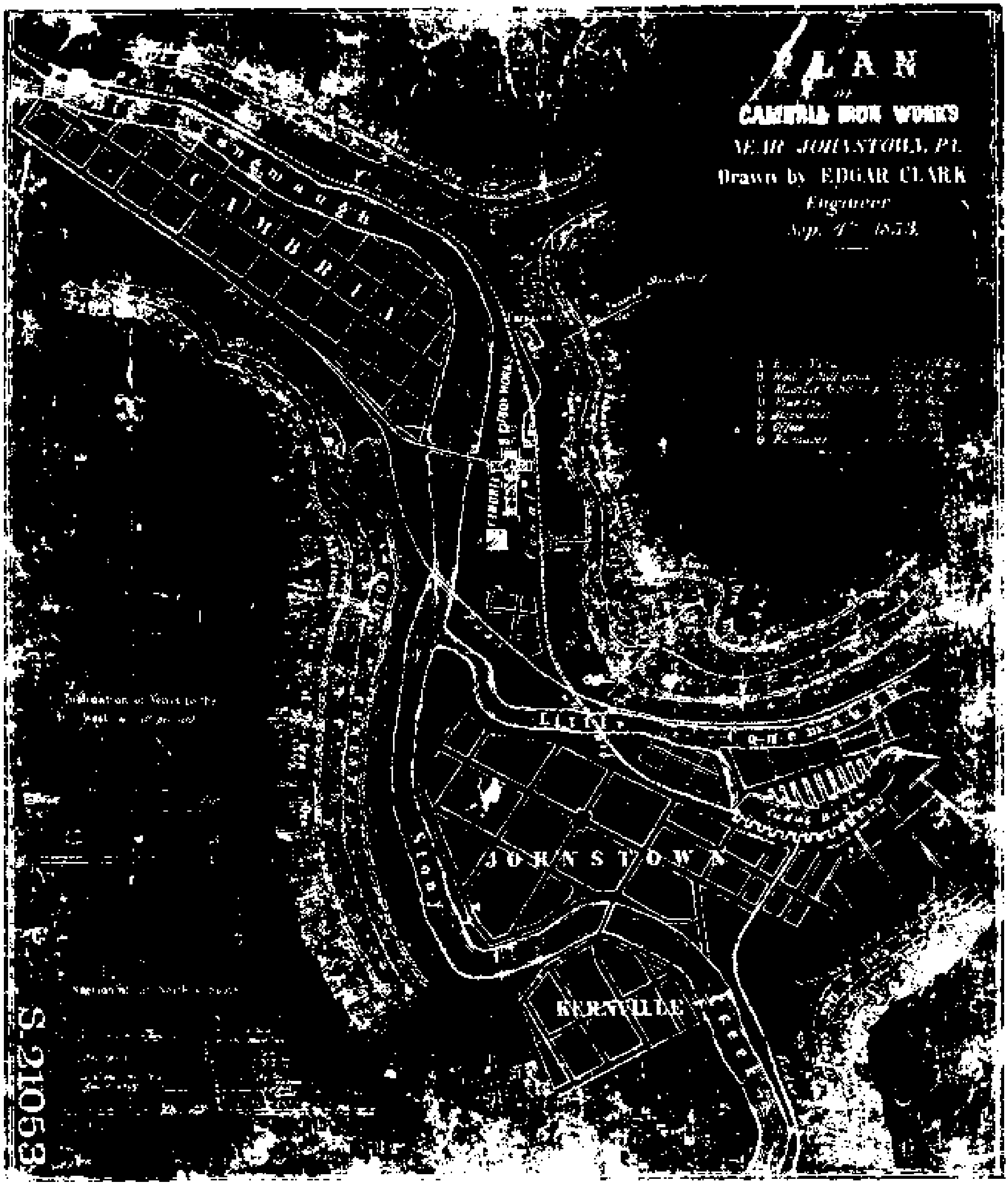

PLAN
CAMBRIA IRON WORKS
Drawn by EDGAR CLARK
CAMBRIA
JOHNSTOWN
S 21053

Illustration 4: Wood, Morrell & Co., 1854

Source: AISI Collection, Courtesy of Hagley Museum and Library

WOOD, MORRELL & CO., LESSEES OF THE CAMBRIA IRON WORKS, JOHNS

Illustration 5: Wood, Morrell & Co., 1856

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

WOOD, MORRELL & CO.,

LESSEES OF THE CAMBRIA IRON WORKS, JOHNSTOWN, PA.

Are now prepared to manufacture

400 Tons per Week

of

Railroad Bars

Of a superior quality of

IRON,

And of any required Weight or Pattern.

Manufacturing all our Iron from the Ore, and doing all our work and repairs in our own shops, we are enabled to produce

RAILS

UNIFORM QUALITY,

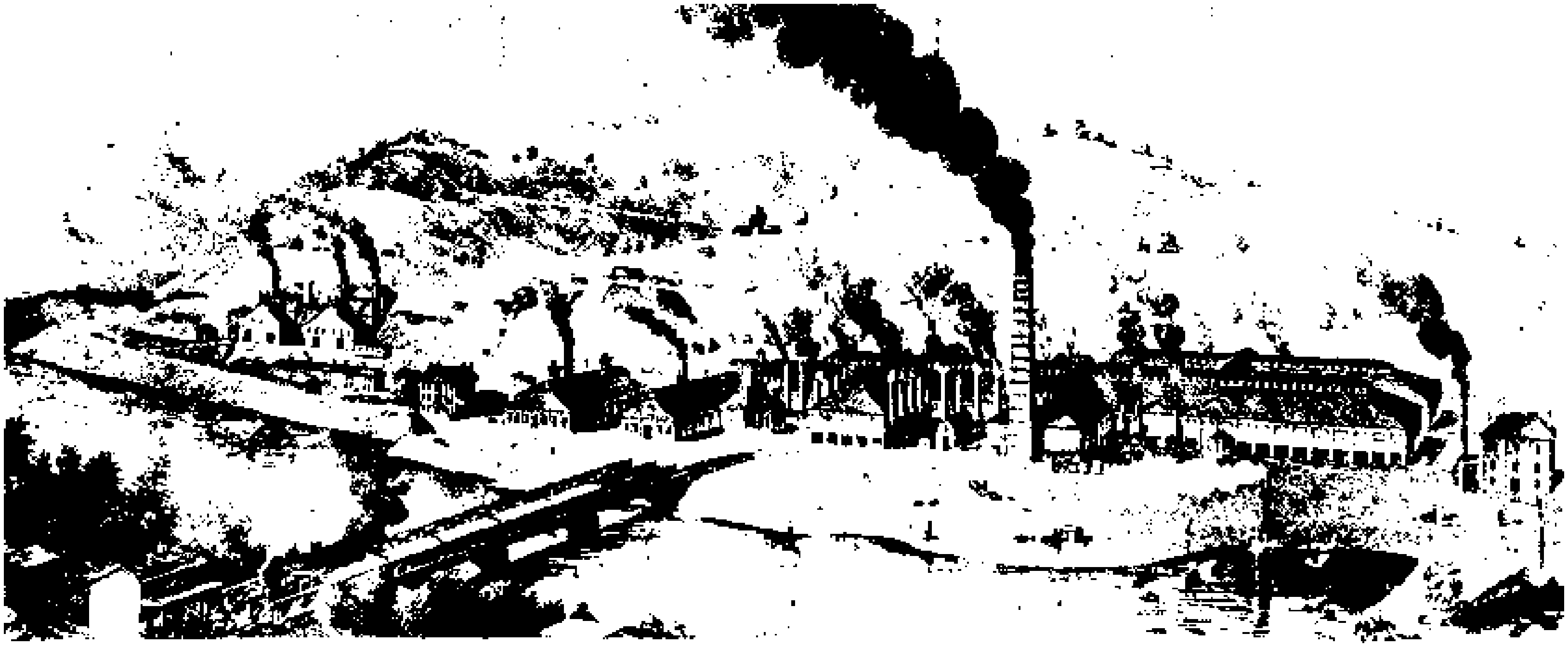
OFFICE IN PHILADELPHIA

No. 123 WALNUT STREET,

"1856"

Illustration 6: Cambria Iron Works, Johnstown, Pa., 1863

Source: AISI Collection, Courtesy of Hagley Museum and Library



CAMBRIA IRON WORKS, JOHNSTOWN, PA.

Illustration 7: Cambria Iron Works May 1876. "Nip and Break" test of Steel Rails

Source: Johnstown Flood Museum (JFM)

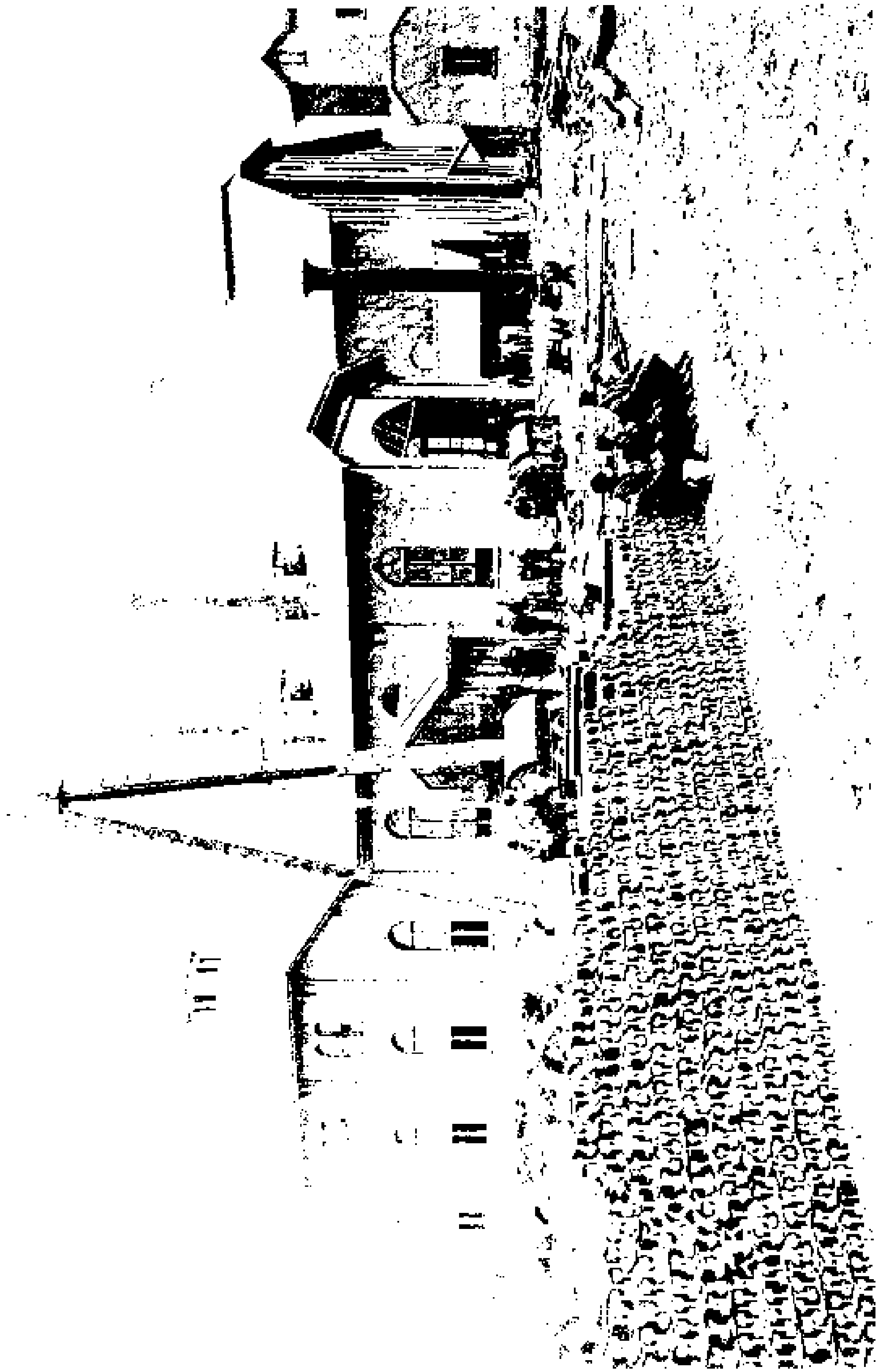


Illustration 8: Cambria Iron and Steel Works, 1874

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

CAMBRIA IRON AND STEEL WORKS
1874

Illustration 9: Cambria Iron Co., Cast Houses for Blast Furnaces Nos. 1, 2, 3 and 4, May 1876

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

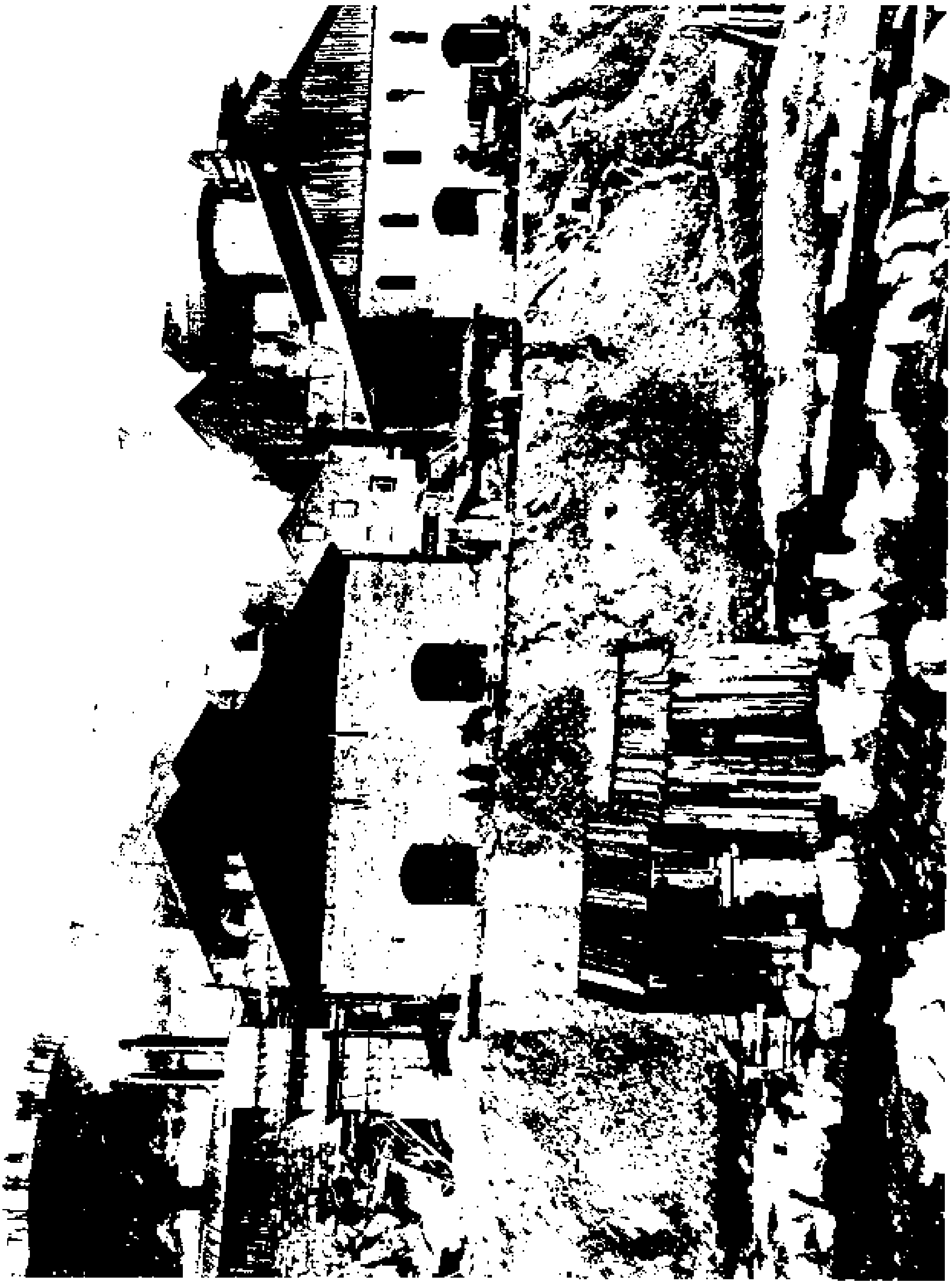


Illustration 10: The Cambria Iron and Steel Works, c. 1876

Source: Cambria Iron Co., *Sections af Steel and Iron Rails*, c. 1876, Courtesy of Hagley Museum and Library

THE CAMBRIA IRON AND STEEL WORKS

AT

JOHNSTOWN, PENNA.

Upwards of **ONE MILLION TONS OF IRON AND STEEL RAILS** have been made at these works during the past 20 years for the Rail Road Companies named within and to whom reference is confidently made as to the quality and durability of

CAMBRIA RAILS.

Illustration 11: Cambria Lower Works

Source: Hugh Moore Historical Park and Museums, Center for Canal History and Technology (CCHT)

Illustration 12: Cambria Lower Works

Source: CCHT

THE MILL.

The Rolling Mill, when completed in 1853, was a balloon frame structure, one hundred and fifty by six hundred feet, with two wings. The ring marked "a" was the stack, which was torn down only a few years ago; "b," the four heating furnaces, and the thirty puddling furnaces were along the dotted lines in the northerly end of the mill:

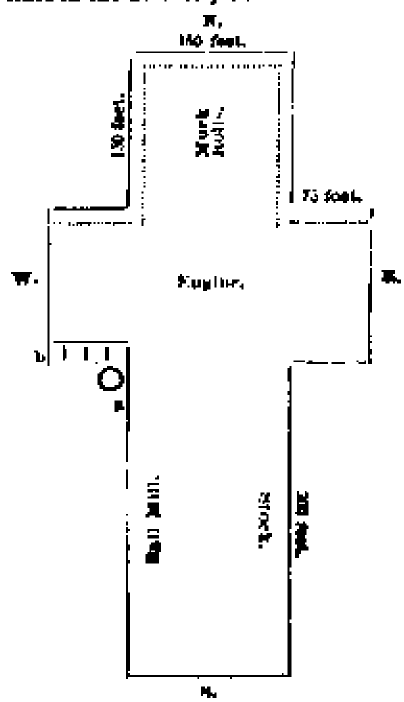
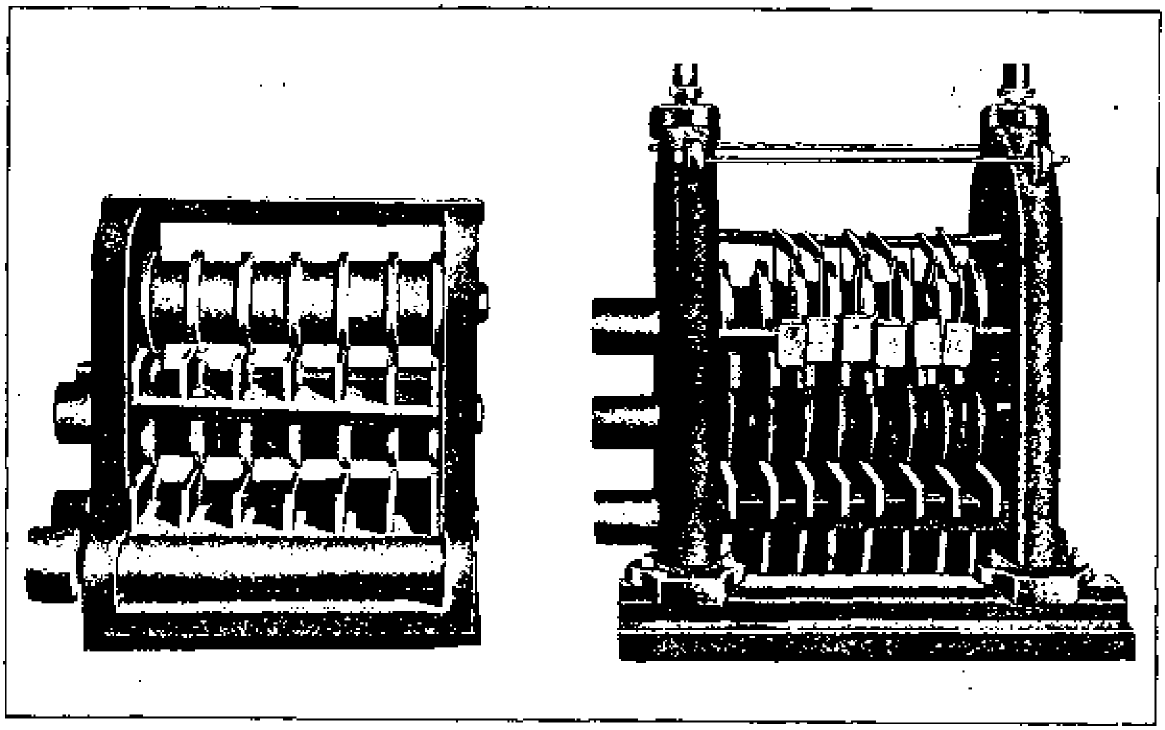


Illustration 13: Rolling Mill, 1853

Source: *The Daily Tribune*, Johnstown, June 23, 1897



Original Models of the Fritz Three-High Mill, Developed at Cambria Works. Now in Mr. Stackhouse's Office

Illustration 14; Model of Fritz Three-High Mill

Source: B.S. Stephenson, "Powell Stackhouse," *Iron Trade Review*, May 14, 1908, pp. 2-8

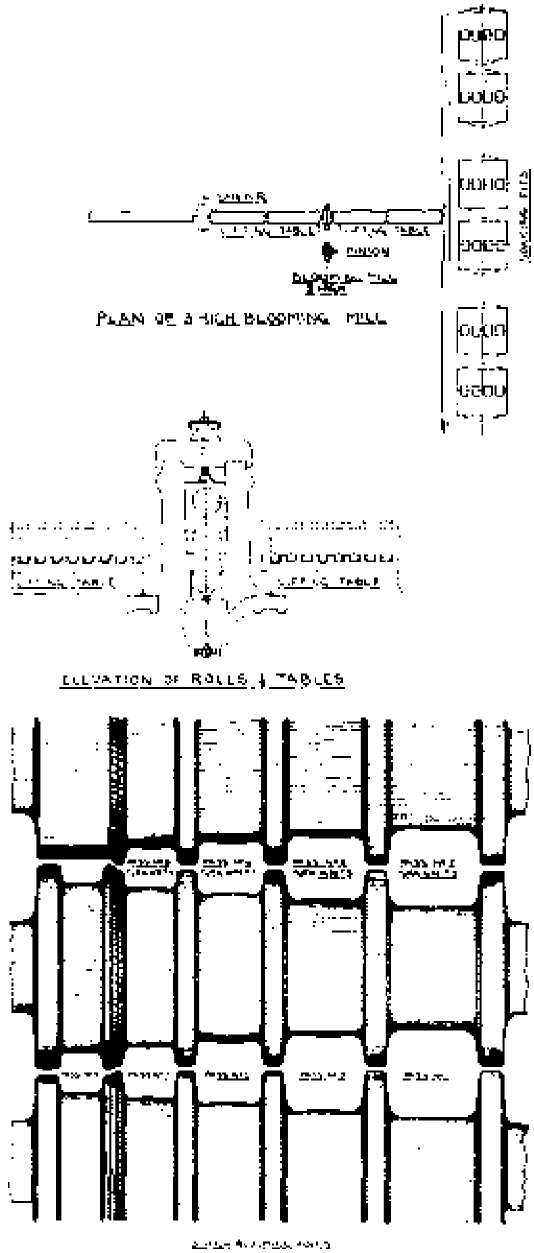


Figure 4-5. Three-High Mill with Lifting Tables. (Courtesy Association of Iron and Steel Engineers.)

Illustration 15: Three-high mill with lifting tables

Source: William T. Hogan, *Economic History of the Iron and Steel Industry int he United States* 5 vols. (Lexington, Massachusetts: Lexington Books, 1971) 1:43.

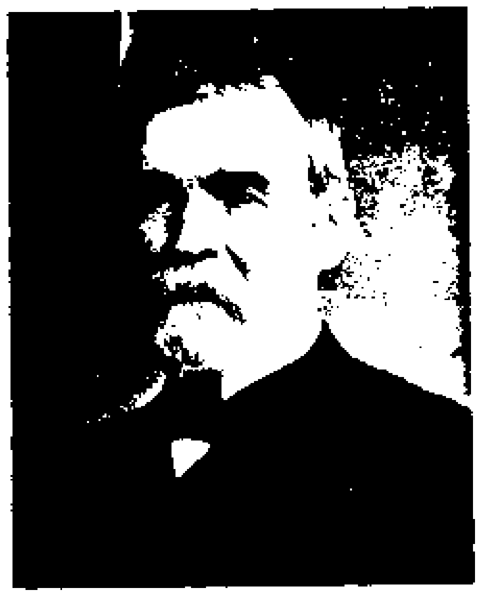
Illustration 16: Portraits of George S. King, William Kelly, William R. Jones, Daniel J. Morrell, John Fritz, Alexander Holley

Sources: Jeanne McHugh, *Alexander Holley and the Makers of Steel*, Baltimore: The Johns Hopkins University Press, 1980, pp. 225, 240

John Newton Boucher, *William Kelly: A True History of the So-Called Bessemer Process*. Greensburg, Pennsylvania: By the Author, 1924, n.p.

J.J. McLauren, *The Story of Johnstown: Its Early Settlement, Rise and Progress, Industrial Growth, and Appalling Flood on May 31st, 1889*. Harrisburg: Hames M. Place, Publisher, 1890, p. 42

GEORGE S. KING.



John Fritz

Alexander Lyman Holley about 1869.

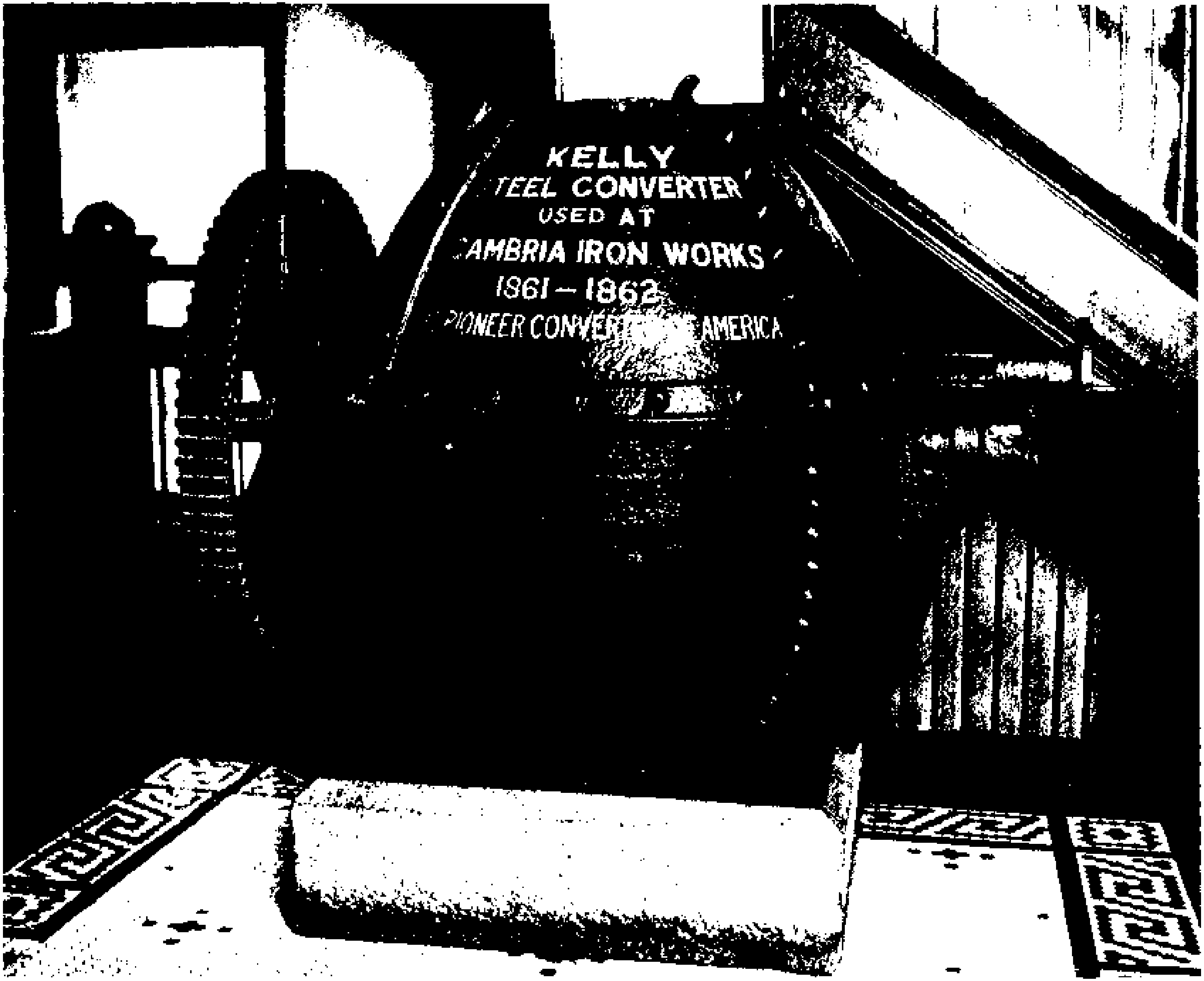
William Kelly

DANIEL J. MORRELL

WILLIAM R. JONES

Illustration 17: Kelly Converter, Main Office, Cambria Steel Co. , February 24, 1922

Source: Photo by G.A. Richardson, Courtesy of Hagley Museum and Library


KELLY
TEEL CONVERTER
USED AT
AMBRIA IRON WORKS
1861 — 1862
PIONEER CONVERT
AMERICA

THE PNEUMATIC
Or BESSEMER PROCESS.

To Manufacturers of Iron and Steel.

[illegible]

[illegible]

[illegible]

[illegible] for the management of this department of their business, and that all communications respecting Licenses, and inquiries concerning the Process and cost of the apparatus therefor, &c. &c., should be addressed to him as above.

JOHN F. WINSLOW, Troy, N. Y.
JOHN A. GRISWOLD, " "
DANIEL J. MORRELL, Johnstown, Pa. } Trustees.

Illustration 18: Notice of "The Pneumatic or Bessemer Process," 1867

Source: AISA Bulletin No. 25, (February 27, 1867)

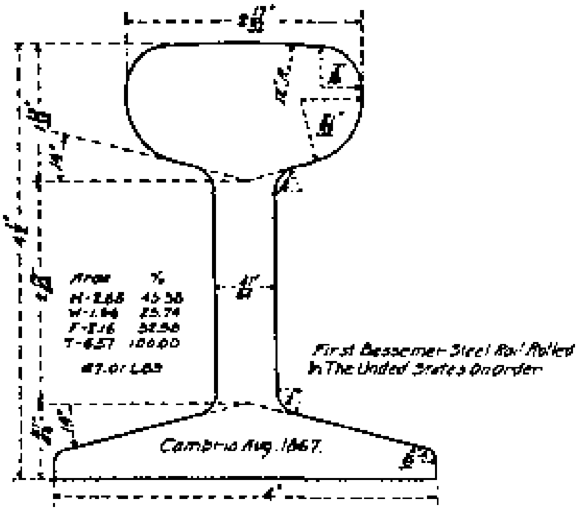


Fig. 1

Illustration 19: First Bessemer steel rail rolled upon order in America, August 1867, by Cambria Iron Company

Source: G.T. Raidabaugh, "History of the Rolling of Rails," *The Blast Furnace and Steel Plant* (April 1927): 184

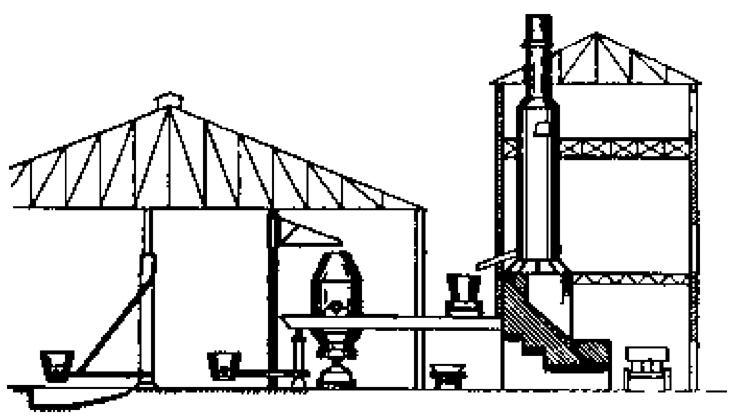


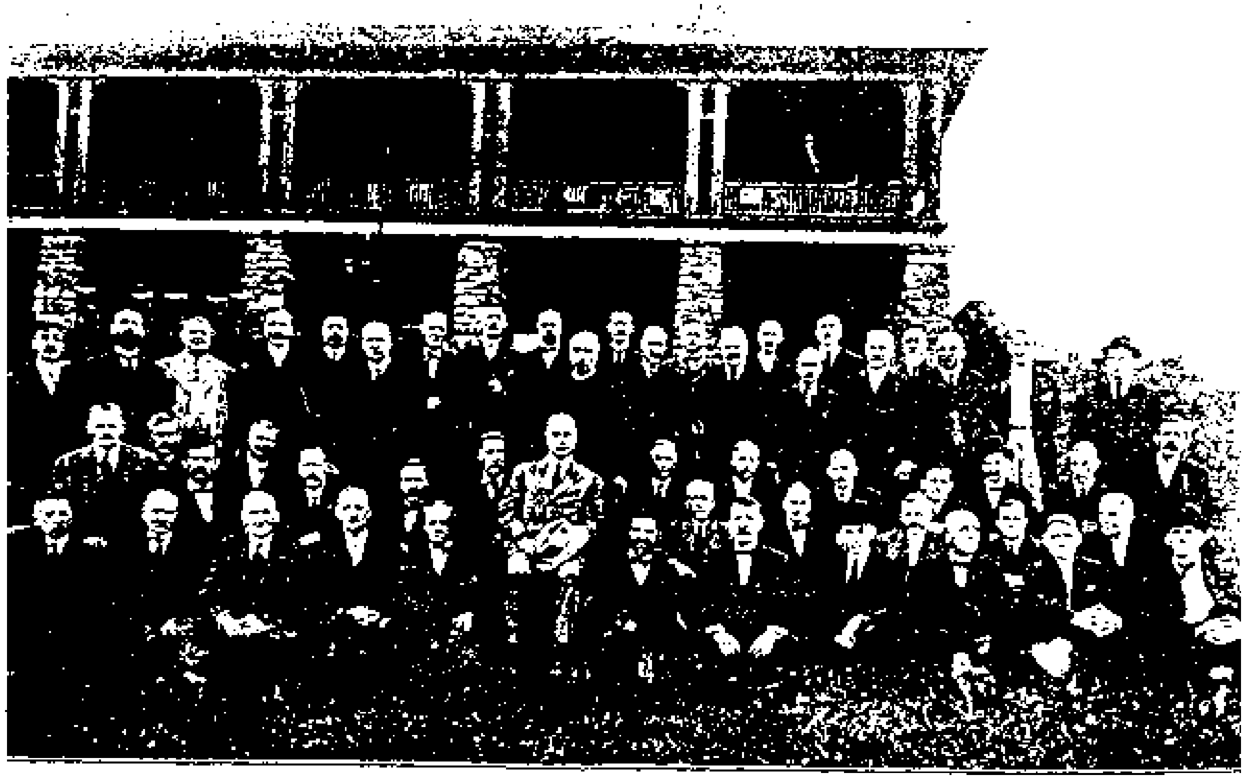
Fig 17—Arrangement of bessemer plant, Cambria Iron Works, 1890.

Illustration 20: Arrangement of bessemer plant, Cambria Iron Works, 1890

Source: C.D. King, *Seventy-five Years of Progress in Iron and Steel*. (New York: American Institute of Mining and Metallurgical Engineers, 1948), p. 100.

Illustration 21: Fortieth Anniversary of Cambria Bessemer Blow

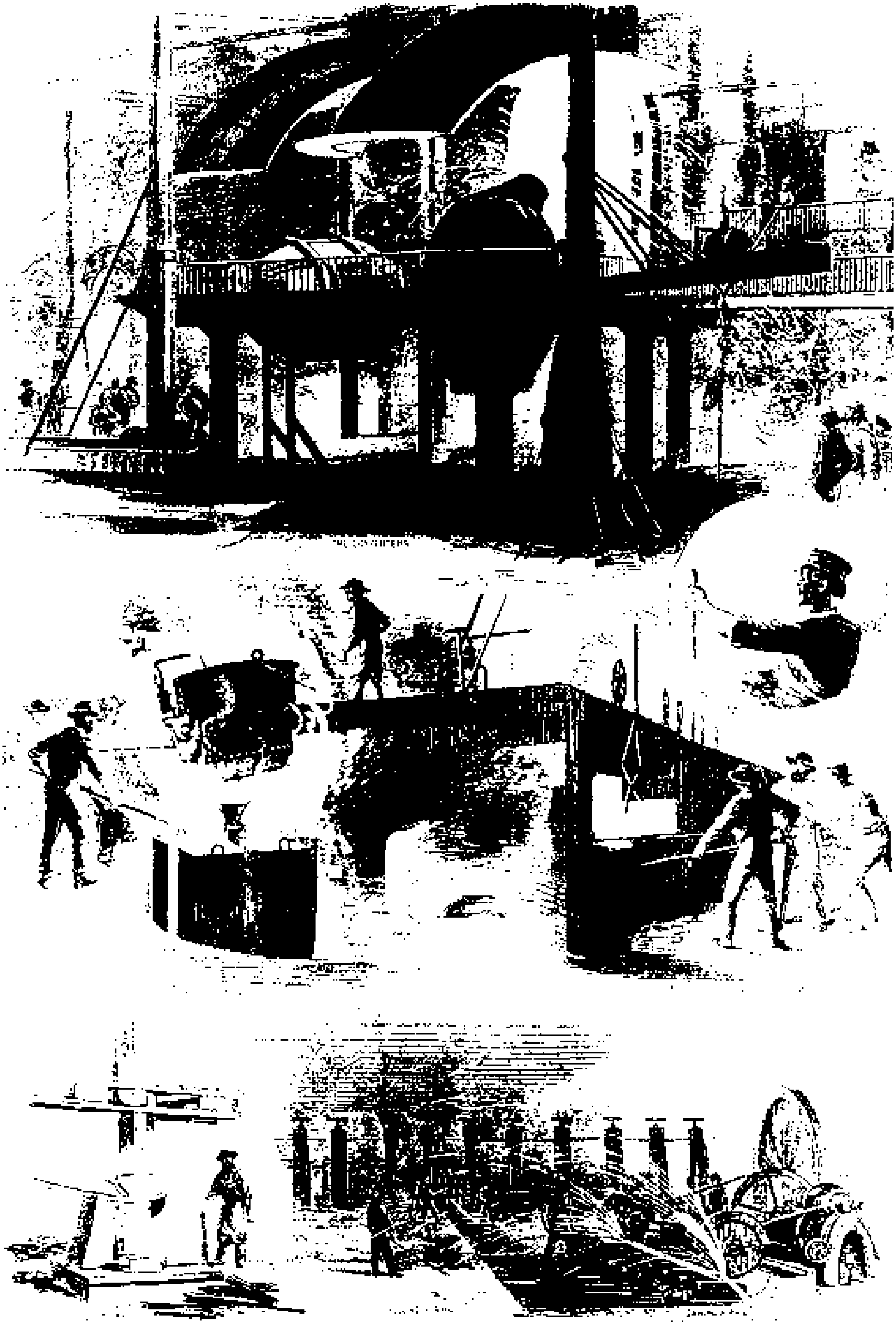
Source: "Cambria Steelworkers' Reunion," *The Iron Age* 88 no. 14 (October 5, 1911): 740



The Cambria Steel Workers of Forty Years Ago, Grouped at the Country Club, Johnstown, Pa., September 29, 1911

Illustration 22: Manufacture of Rails from Bessemer Steel

Source: "A Century of Progress in Steelmaking," American Iron and Steel Institute, New York, 1957, n.p.



MANUFACTURE OF RAILS FROM BESSEMER STEEL.

Illustration 23: Bessemer Converter Blowing, Bethlehem Steel Co., Cambria Plant

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

Illustration 24: Cambria Steel Rails, 1896

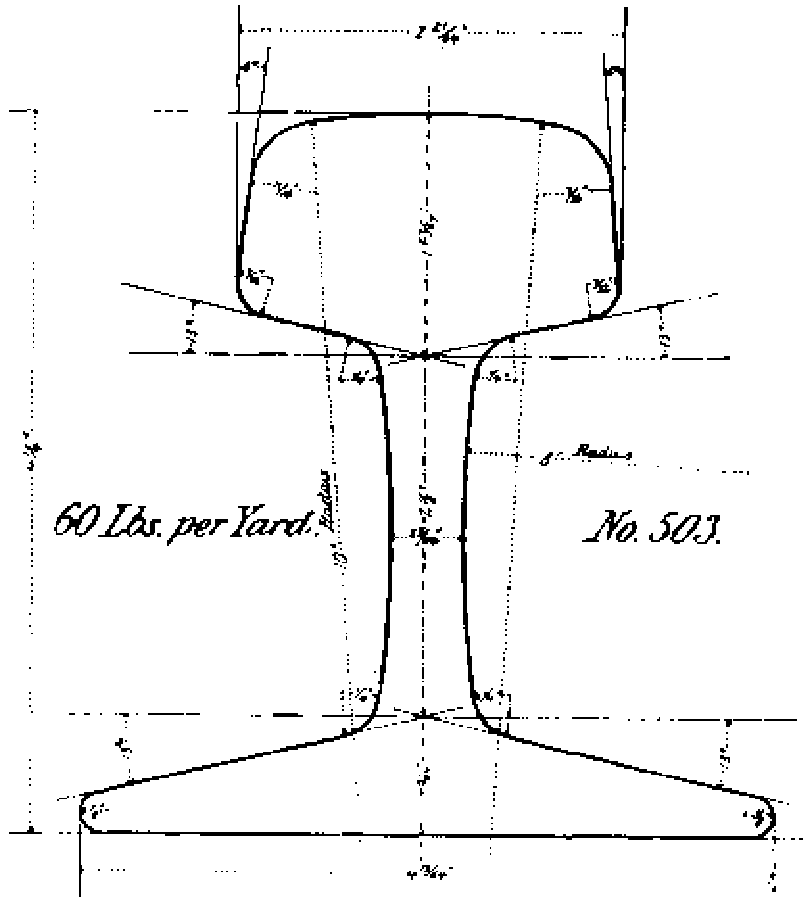
Source: Cambria Iron Co., *Cambria Steel Rails*, 1896, Courtesy of Hagley Museum and Library

CAMBRIA STEEL.

Address, Cambria Iron Company, Philadelphia, Pa.
(Works at Johnstown, Pa.)

Wt. 60
No. 503

Ohio and Mississippi R R, 1881--84
Campbell's Creek Coal Co., 1884
Allegheny Valley R R, 1879
Cleveland and Pittsburgh R R, 1877
Northern Central Ry. (Penna.) 1877
Bellefonte and Snow Shoe R R, 1880
Erie and Pittsburgh R R., 1878
Summit Branch R. R., 1876
Philadelphia and Erie R R., 1879
Toledo and Woodville R. R., 1877
West Jersey R R, 1880.
Illinois Central R R, 1877.
Springfield Southern R R., 1881.
Baltimore and Potomac R.R., 1876
Iron Railway Co., 1884.
Midland Const'n Co., 1883—84.
Delaware River R. R., 1882—83
Pennsylvania Co., 1883
Western Maryland R. R., 1882
Cincinnati Southern Ry., 1882
Kentucky Central Ry., 1881.
Bowers, Brown & Co., 1882
New York, Philadelphia and Norfolk R. R., 1884
Pennsylvania R. R., 1881 83—84
Pittsburgh, Ft Wayne and Chicago R R, 1881 Also 67, No 55
Pittsburgh, Cincinnati and St. Louis R R, 1881-- 82.
Terre Haute and Indianapolis R R, 1878—83
Louisville, Paducah and Southwestern R R, 1875
Dunleith and Dubuque Bridge Co. 1880- 84
St. Louis, Alton and Terre Haute R R, 1879--84
Huntingdon and Broad Top R R, 1879 -82
Cumberland and Penna R. R. 1880- 84 Also 56, No. 73
St. Louis, Iron Mountain and Southern R R., 1880 -81
Baltimore and Ohio R. R 1881 -82 -83—91 Also 67, No 55
Rochester and Pittsburgh R R, 1881--84
Cincinnati Northwestern R R, 1884
Cincinnati, Jackson and Mackinaw R. R. Co
Roaring Creek and Charleston R R Co
Ashland Coal and Iron Railway Co Ashland, Ky
Atlantic Mining Co
Terminal R R Association
Wisconsin Central R R
Tuckerton R R Co
Lehigh Valley Coal Co
Quincy Mining Co
Charleston Mining and Mfg Co
Monongahela Connecting R R Co
National Storage Co
Claus Viehs



60 Lbs. per Yard.

No. 503.

$94\frac{640}{2240}$ Gross Tons to the Mile.

Illustration 25: Bessemer steelmaking, Lower Cambria Works, 1952

Source: JFM

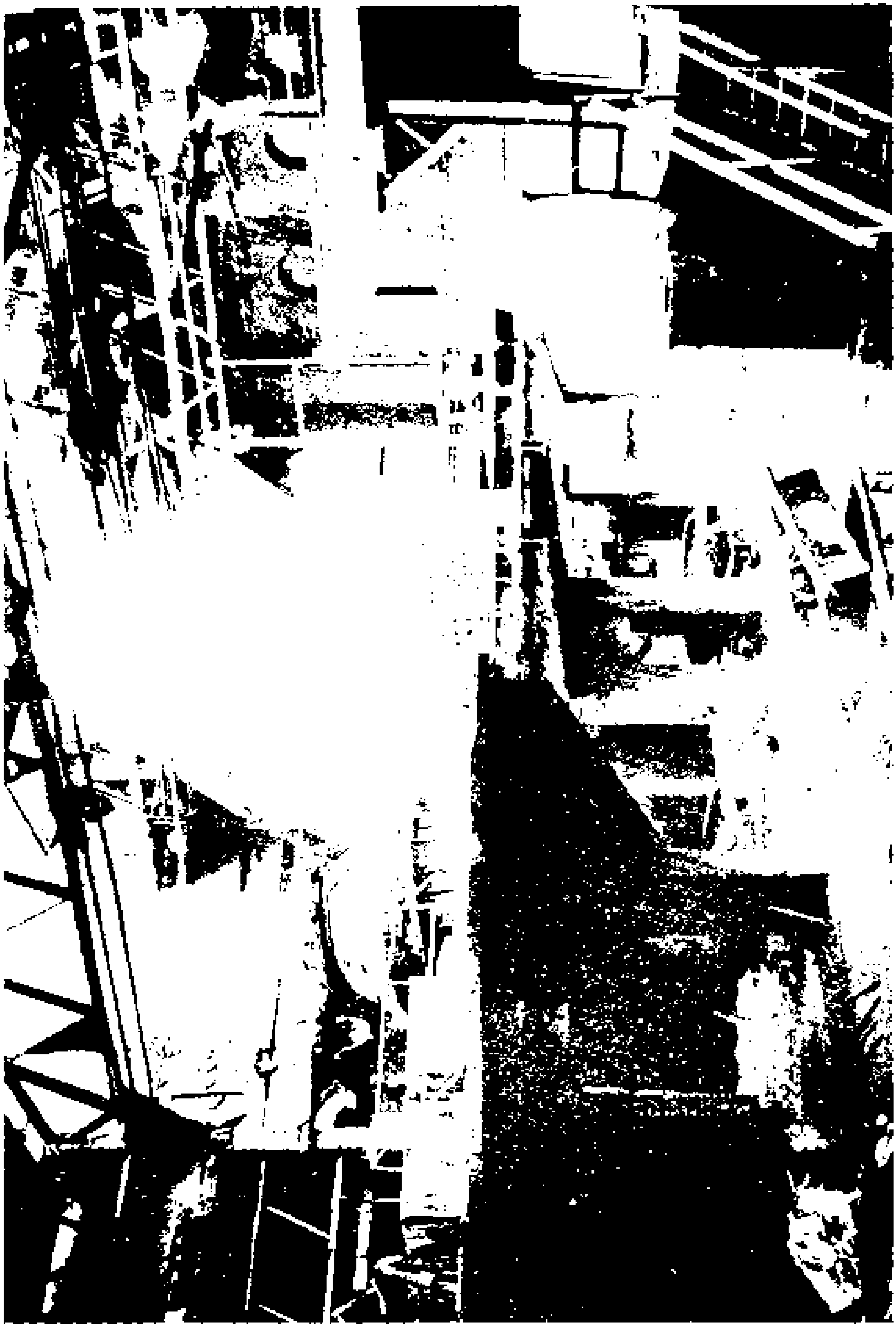


Illustration 26: Cambria Iron Company, 1881

Source: Cambria Iron Co., *Sections of Steel and Iron Rails*, Courtesy of Hagley Museum and Library

Cambria Iron Company.

INCORPORATED 1852.

ANNUAL CAPACITY OF WORKS

Pig Metal	[illegible] Tons	[illegible]	[illegible]
Coke	[illegible] Tons	[illegible]	[illegible]
Steel Ingots	[illegible] Tons	[illegible]	[illegible] Tons

Total Number of Employes

10,000.

ANNUAL CAPACITY OF MINES.

Iron Ore	[illegible] Tons
Coal	[illegible] Tons
Limestone	[illegible] Tons
Total	[illegible] Tons

Illustration 27: Cambria Mills, 1888

Source: LCUS262-88068, Prints and Photographs Division, Library of Congress


Copyright 1888.
by G.M. Greene.

Illustration 28: Johnstown, Pennsylvania Flood 1889, General View of Debris

Source: American Red Cross photo


JOHNSTOWN FLOOD No 15.
GENERAL VIEW OF DEBRIS.

Illustration 29: Wreckage and Debris at the Mill, Johnstown Flood, May 31st, 1889, Johnstown, Pa.

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

Wreckage and Debris at The Mill, Johnstown Flood, May [illegible]

Illustration 30: View of Cambria Iron Works, after the Flood, May 31st, 1889, Johnstown, Pa.

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

[illegible] Iron Works after the Flood, May 31st, 1889, Johnstown, Pa.

Illustration 31: Office of the Cambria Iron Co., Johnstown Flood, May 31st, 1889, Johnstown, Pa.

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

[illegible] Iron Co., Johnstown Flood, May [illegible]

Company [illegible]

Illustration 32: An Integrated Steel Company

Source: "Headlines of Progress Issue," *Bethlehem Review* 55 (February 1949): 3, box: Bethlehem Vertical File Material, Acc 1699, Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

An Integrated Steel Company Offers Lower Costs to Consumer

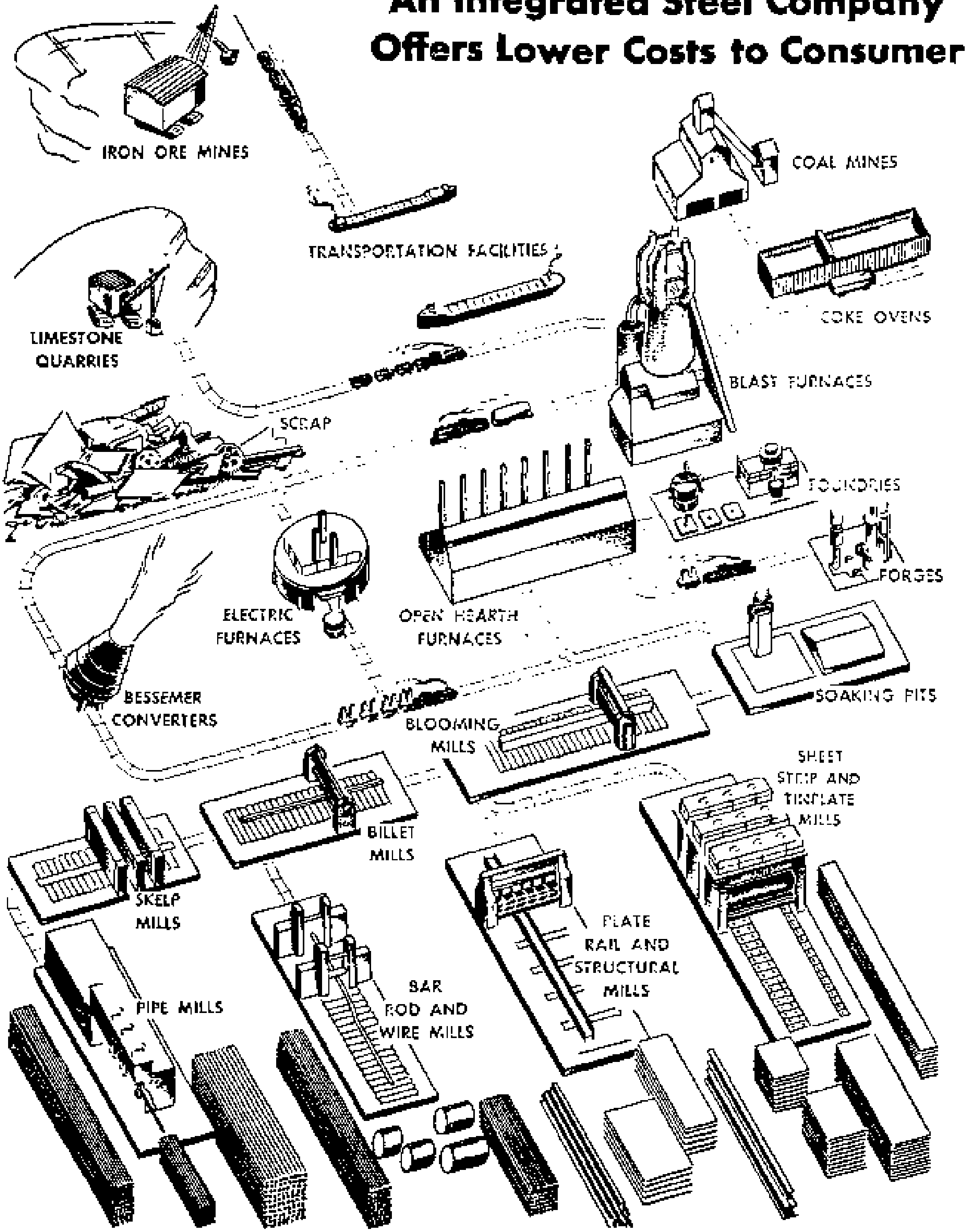


Illustration 33: Contour Map of Johnstown & Vicinity Showing Mines of Cambria Iron Co., Johnstown, Pa., 1890

Source: Local Reception Committee, "The Iron, Steel and Allied Industries of Johnstown, Penn'a For The Information of the Visiting Members of the Foreign and American Technical Societies," October 1890, n.p.

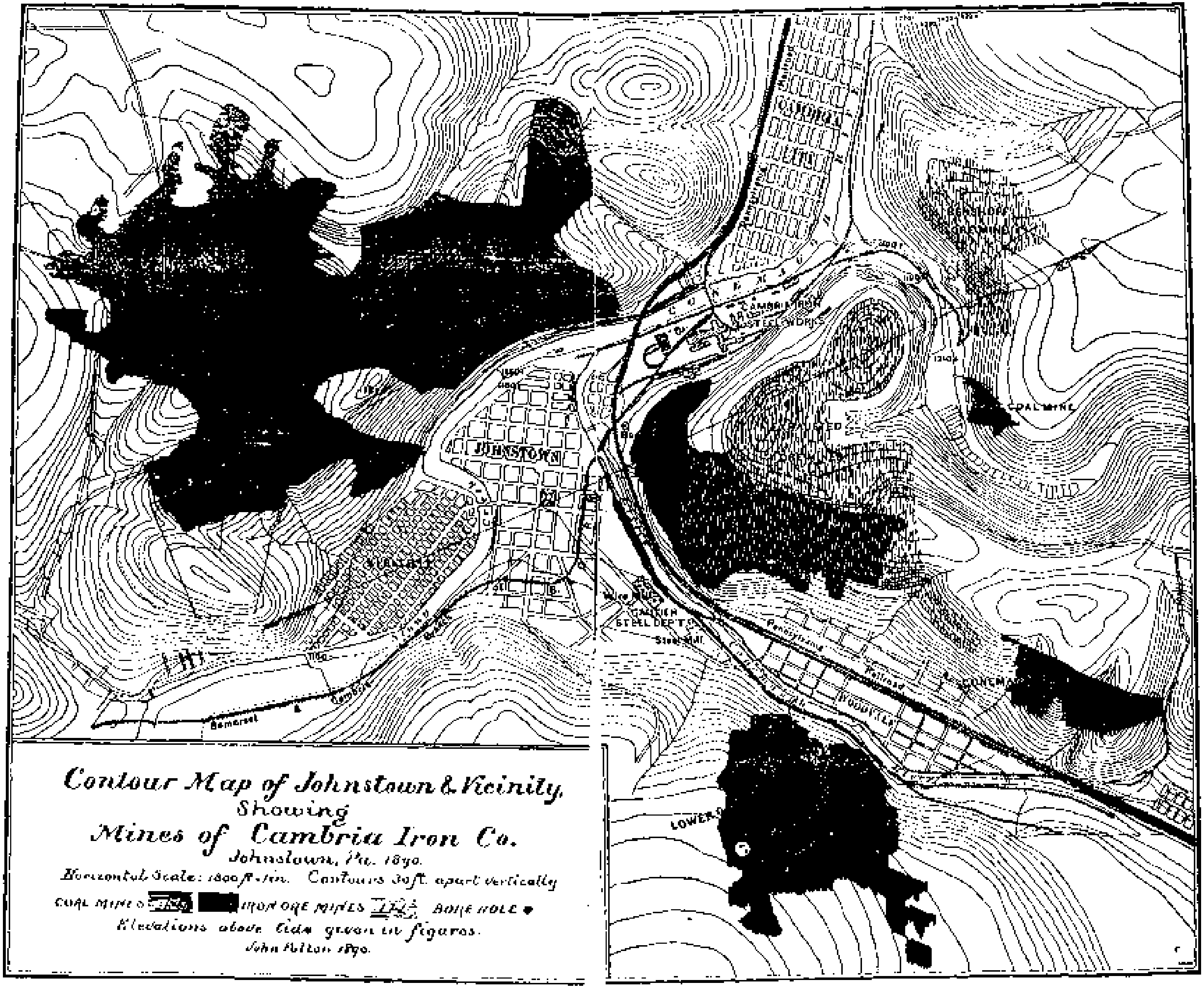

Contour Map of Johnstown & Vicinity,
Showing
Mines of Cambria Iron Co.
Johnstown, Pa. 1890.
Horizontal Scale: 1800 ft.=1in. Contours 30ft. apart vertically
COAL MINES IRON ORE MINES BORE HOLE
Elevations above tide given in figures.
John Fulton 1890.
JOHNSTOWN
CAMBRIA CITY
CAMBRIA IRON & STEEL WORKS
COAL MINE
STEEL DEP'T
Steel Mill
Pennsylvania Railroad
WOODVALE
Somerset & Cambria

Illustration 34: Cambria Car Shop, 1922

Source: Photo by G.A. Richardson, Courtesy of Hagley Museum and Library

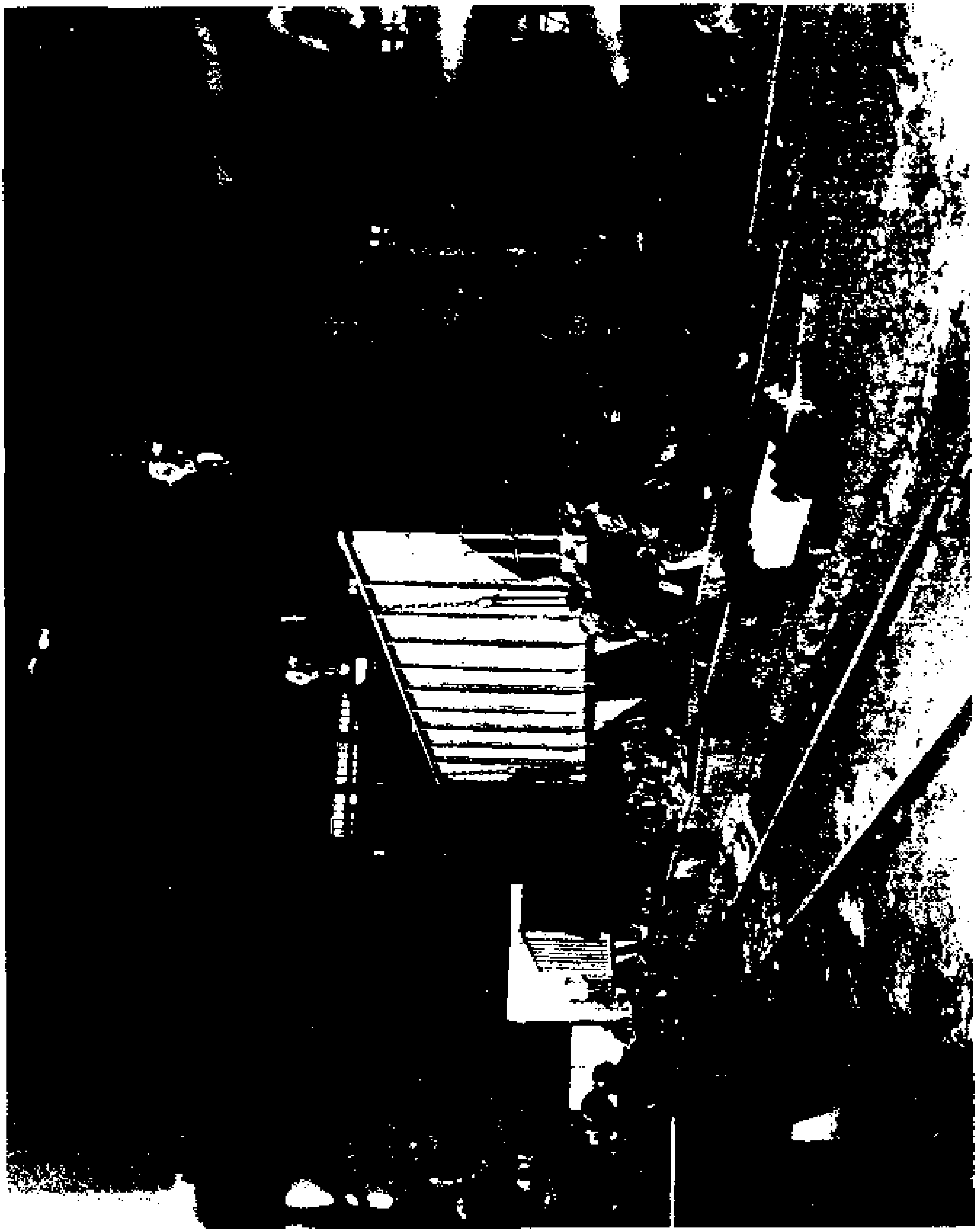


Illustration 35: High Water in Conemaugh at Stone Bridge 6/7/1906

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

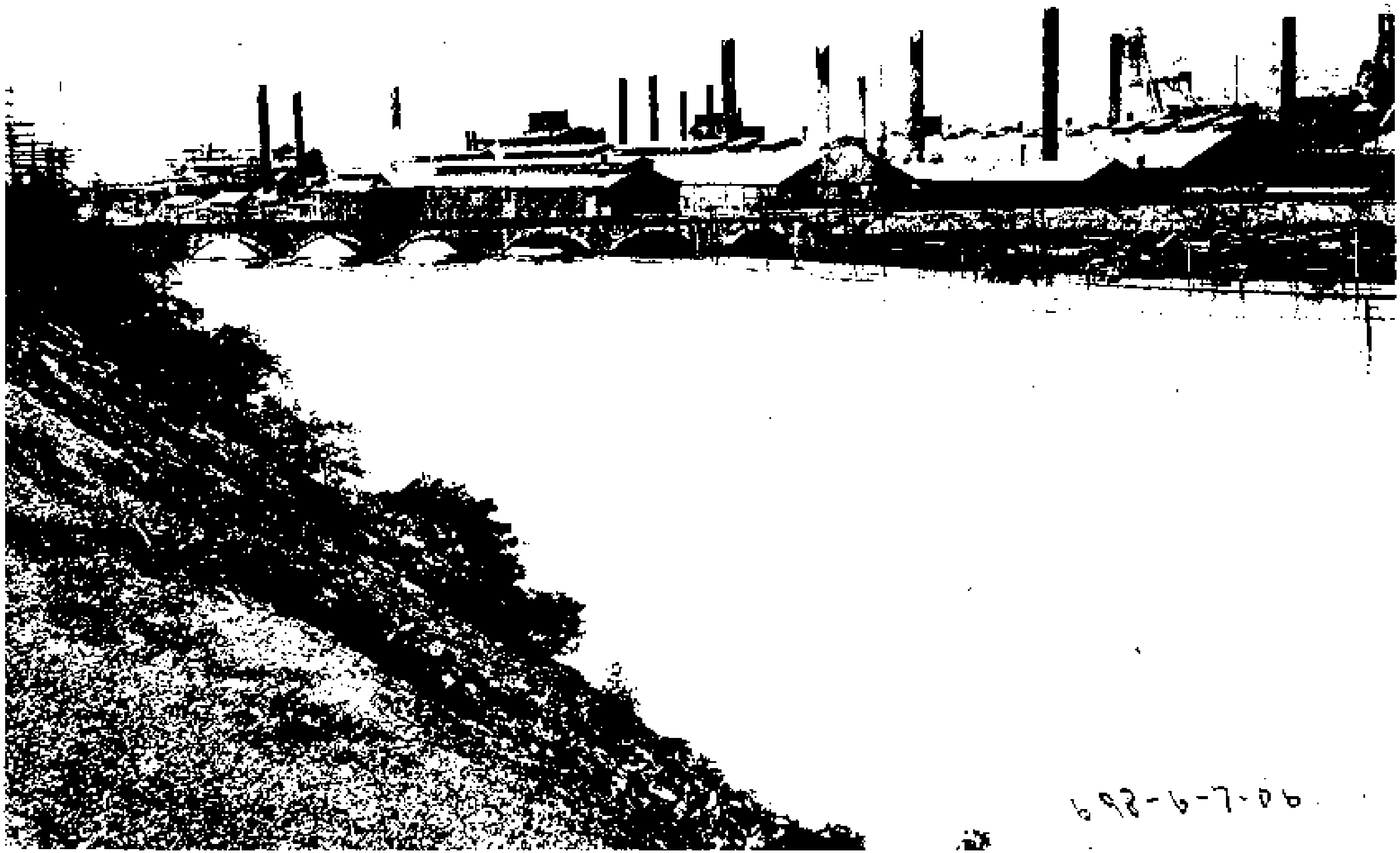


Illustration 36: Cambria Bessemer Plant 7/18/1908

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

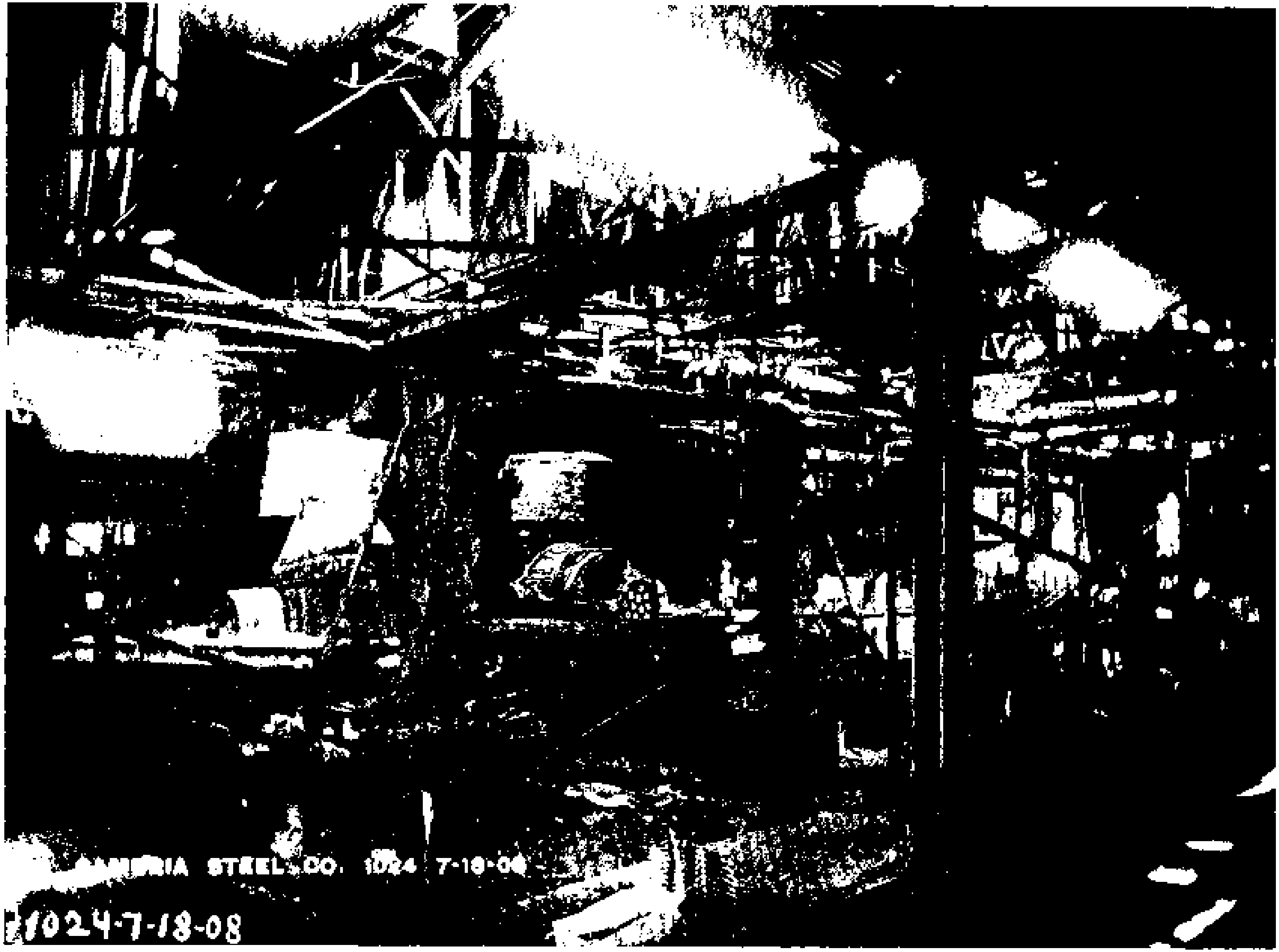

STEEL CO. 1024
1024-7-18-08

Illustration 37: Cambria Plant Blast Furnaces 1-4, ca. 1933

Source: AISI Collection, Courtesy of Hagley Museum and Library

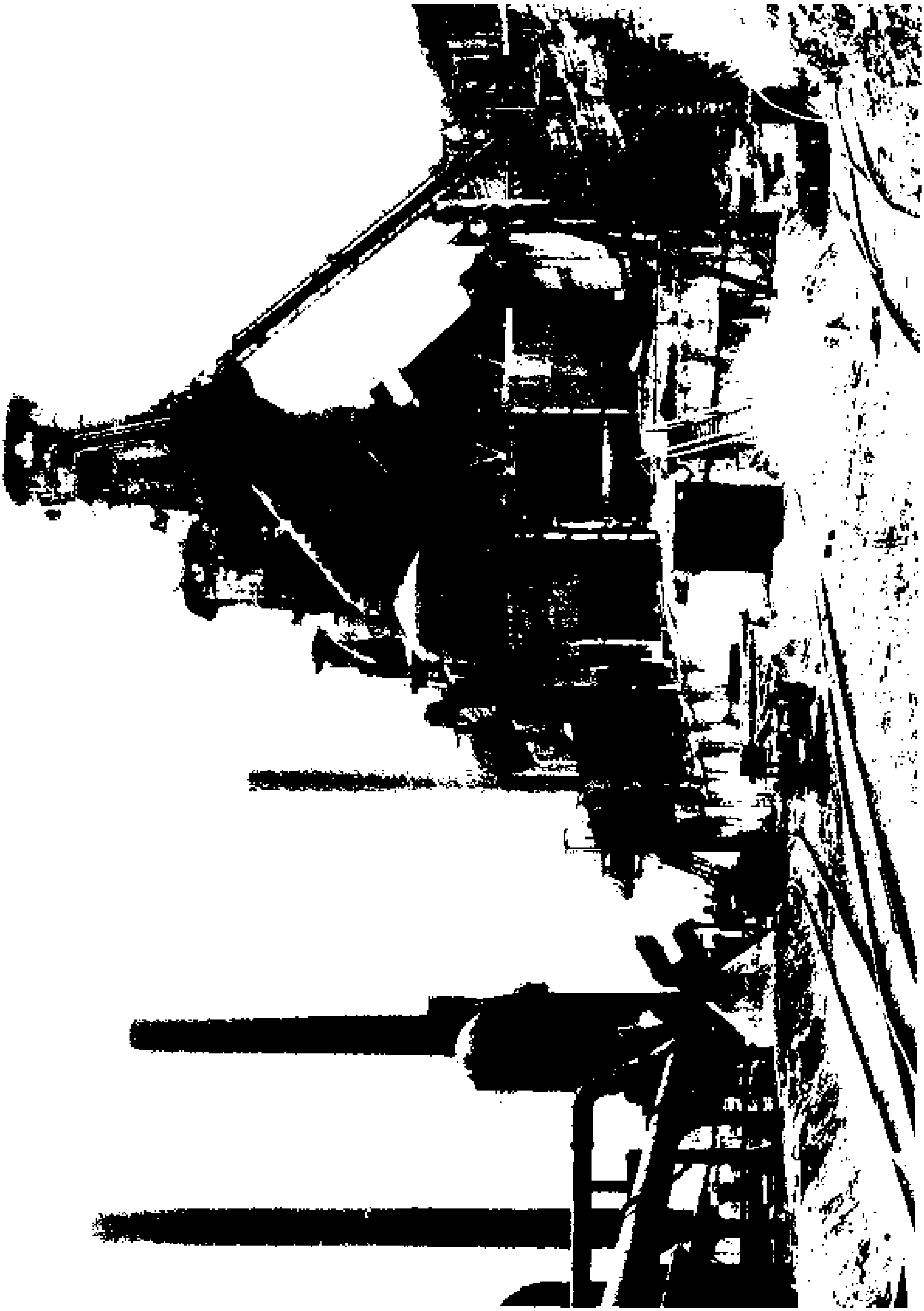


Illustration 38: Cambria Plant Blast Furnaces 1-4, ca. 1933

Source: AISI Collection, Courtesy of Hagley Museum and Library


13

Illustration 39: Cambria Plant Blast Furnaces 1-4, ca. 1933

Source: AISI Collection, Courtesy of Hagley Museum and Library

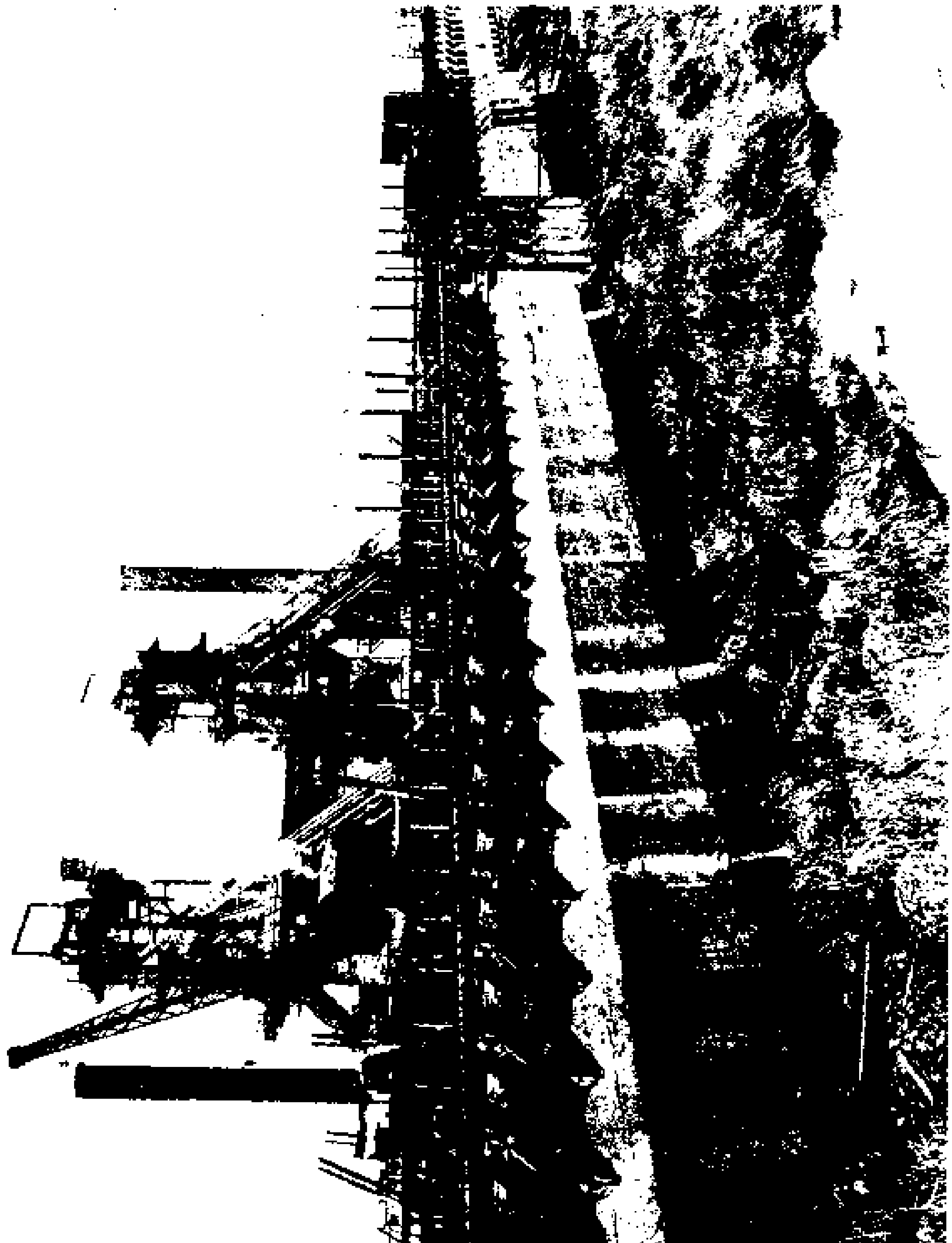


Illustration 40: Cambria Iron Works Blast Furnaces 5 & 6 June 1886

Source: AISI Collection, Courtesy of Hagley Museum and Library

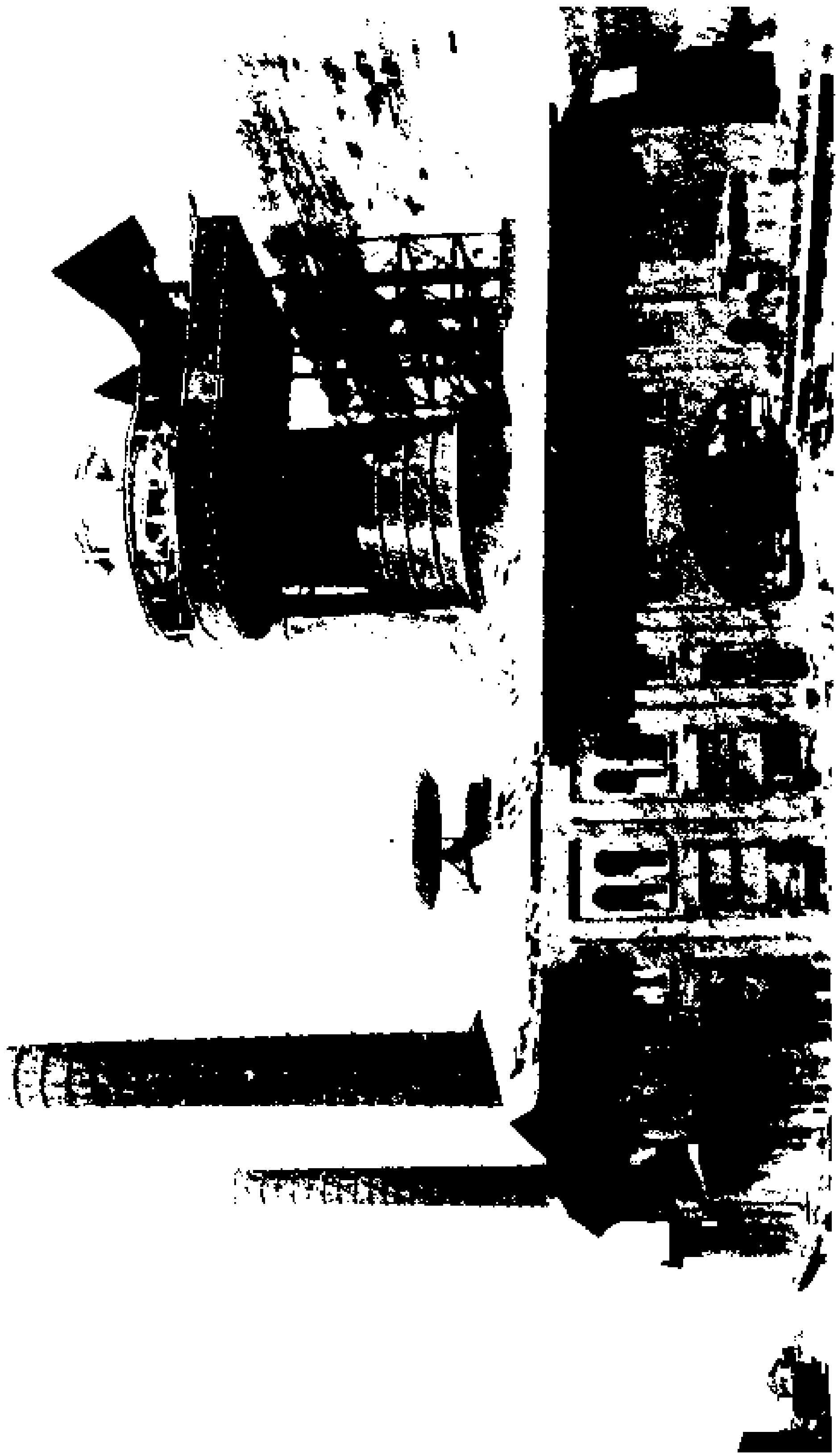


Illustration 41: Cambria Car Shops, Axle Turning Shop 2/14/1925

Source: Photo by G.A. Richardson, Courtesy of Hagley Museum and Library

Illustration 42: Cambria Steel Co. Dwelling Houses 2185 1911

Source: JFM

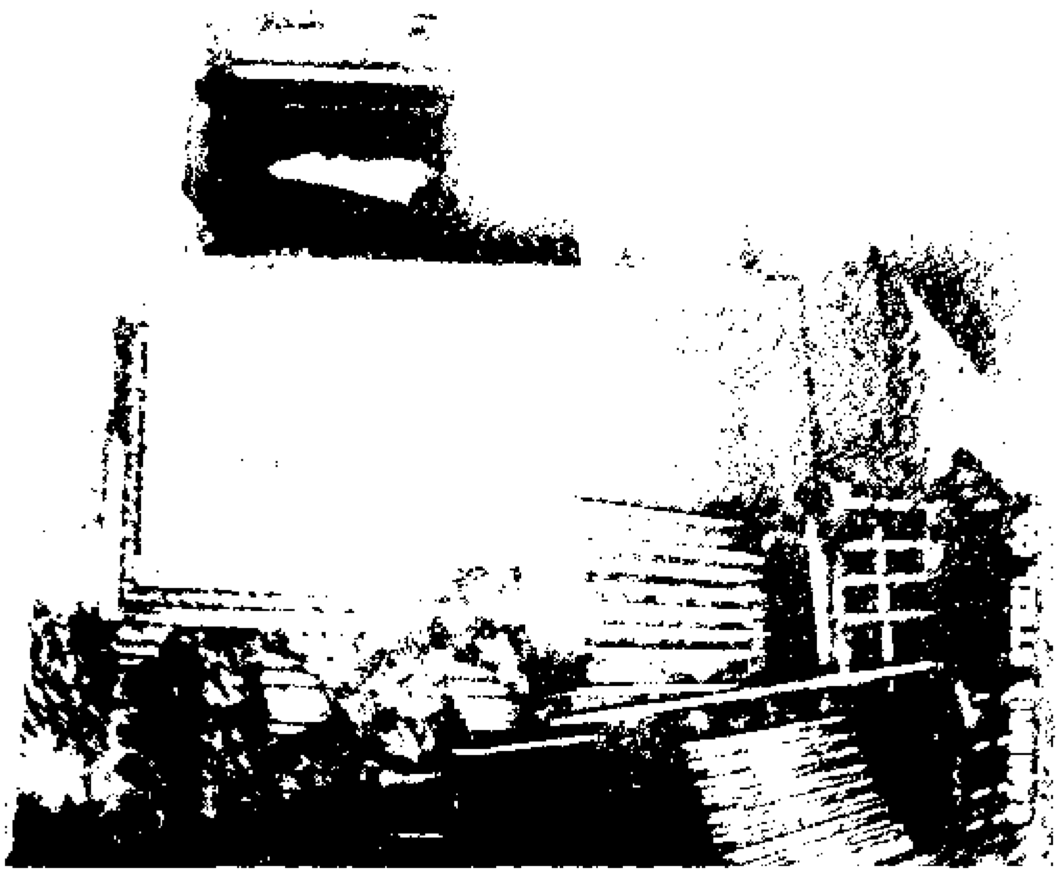
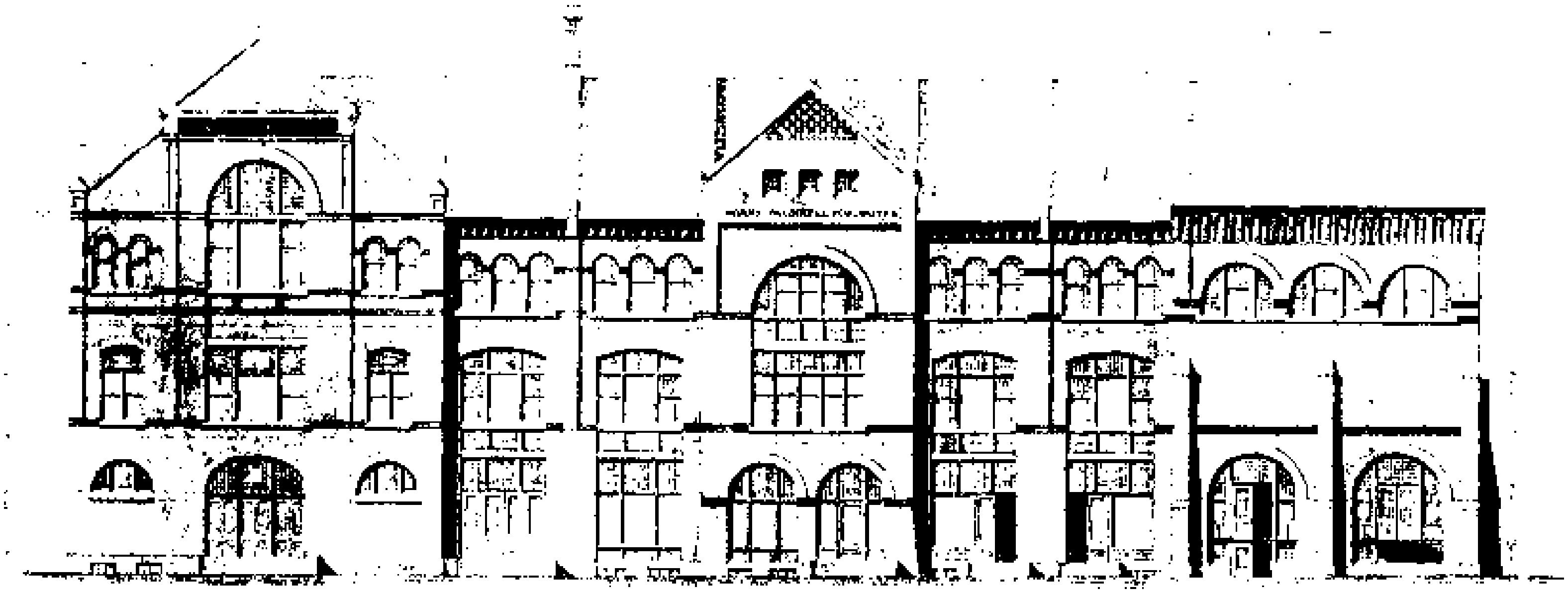


Illustration 43: Wood, Morrell & Co Limited

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library



Washington St. Front

Illustration 44: Offices of the Cambria Iron Company

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

OFFICES OF THE

CAMBRIA IRON COMPANY

JOHNSTOWN

PA.

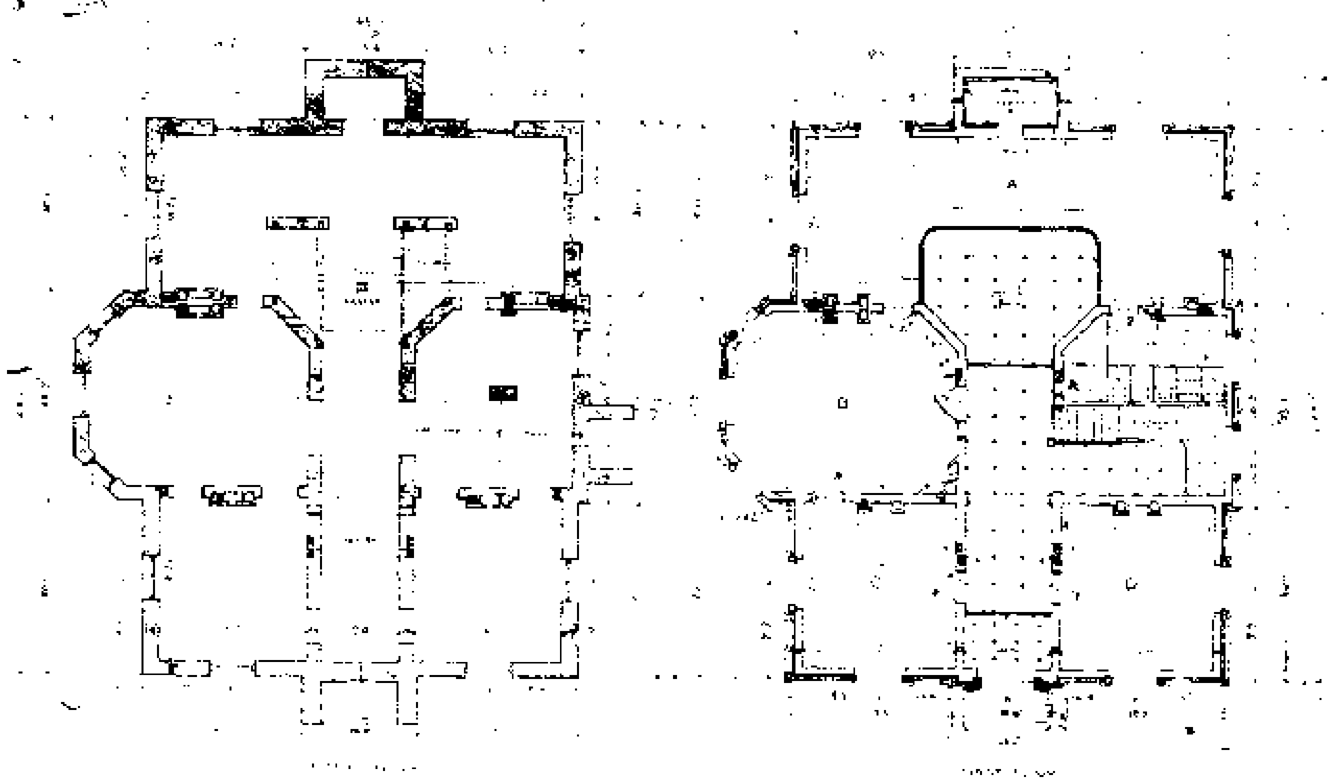
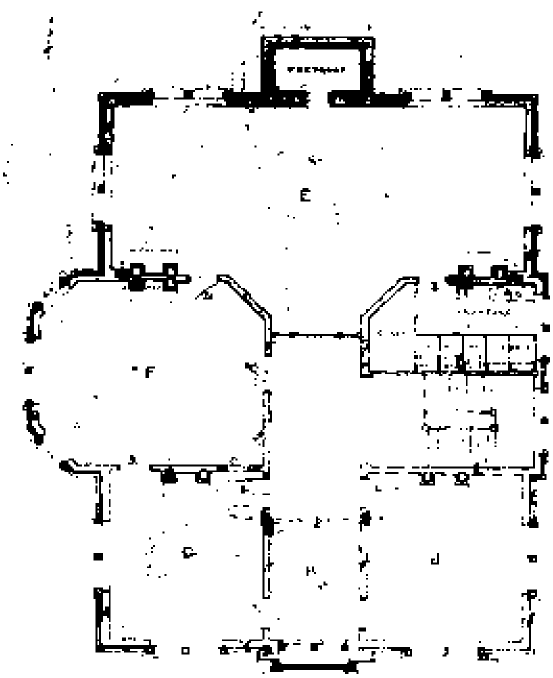


Illustration 45: Offices of the Cambria Iron Company

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library



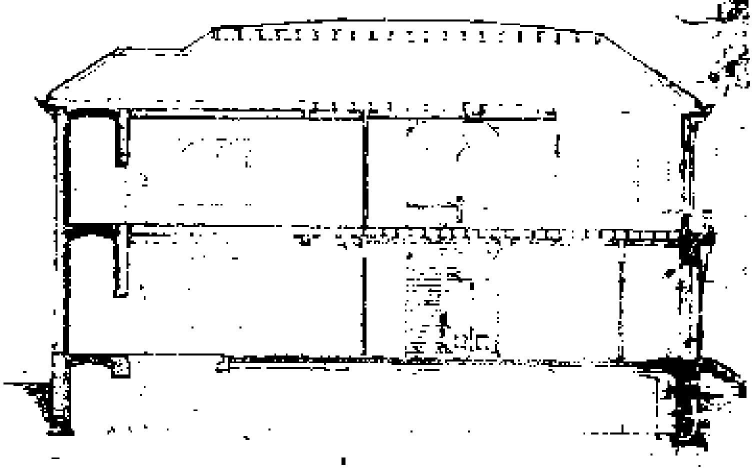


Illustration 46: Cambria Iron Co., General Office Additions, December 5, 1884

Source: Bethlehem Steel Corporation Collection, Courtesy of Hagley Museum and Library

Cambria Iron Co.
General Office Additions

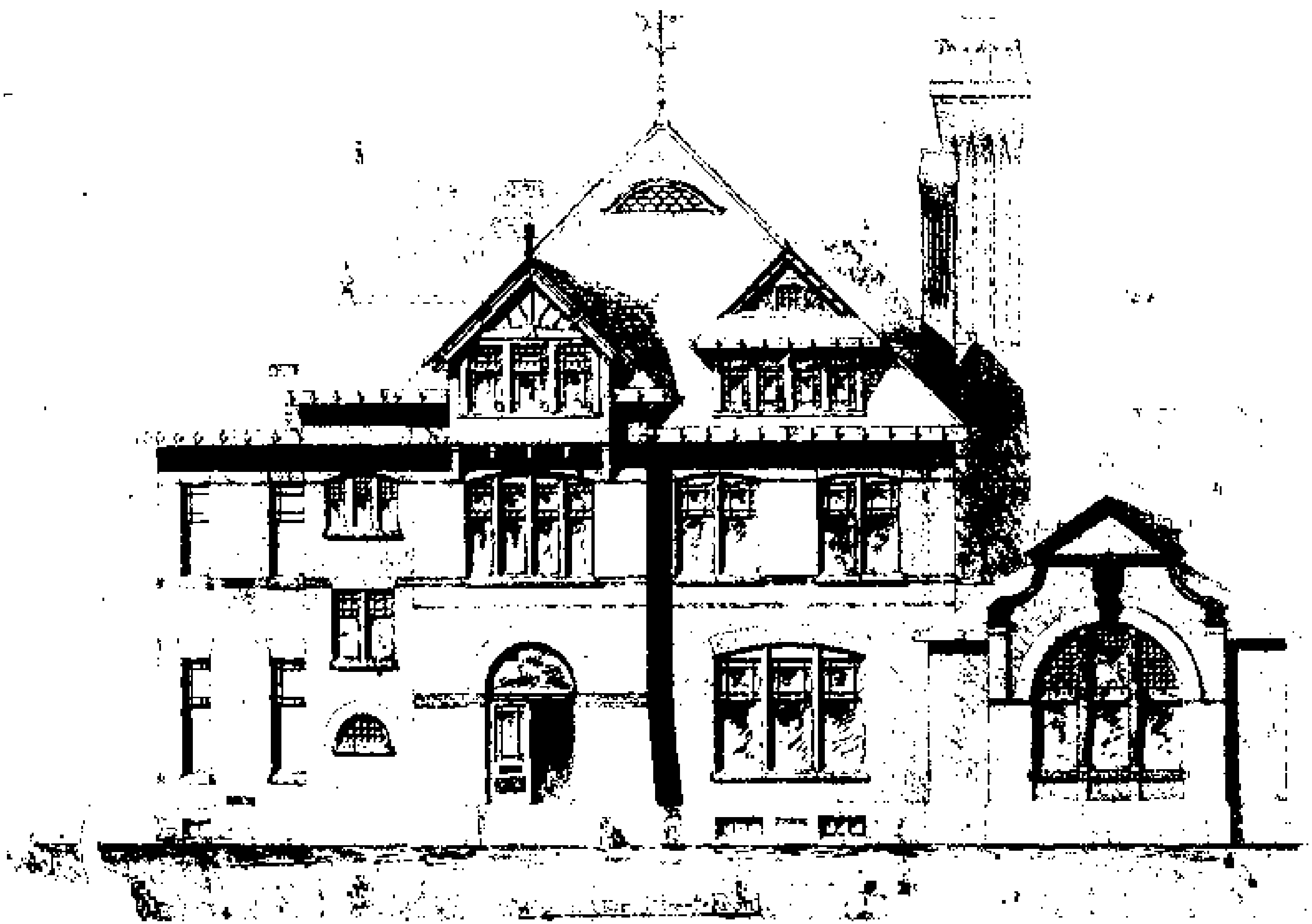


Illustration 47: Cambria Steel Company Method of Paying 1911, Locust Street Office

Source: JFM


CAMBRIA STEEL CO.

Illustration 48: C.I. Co. 3555 Stockers & Chargers 4 clock

Source: JFM

Illustration 49: C.I. Co 3549 "Bessemer" 4 oclock

Source: JFM

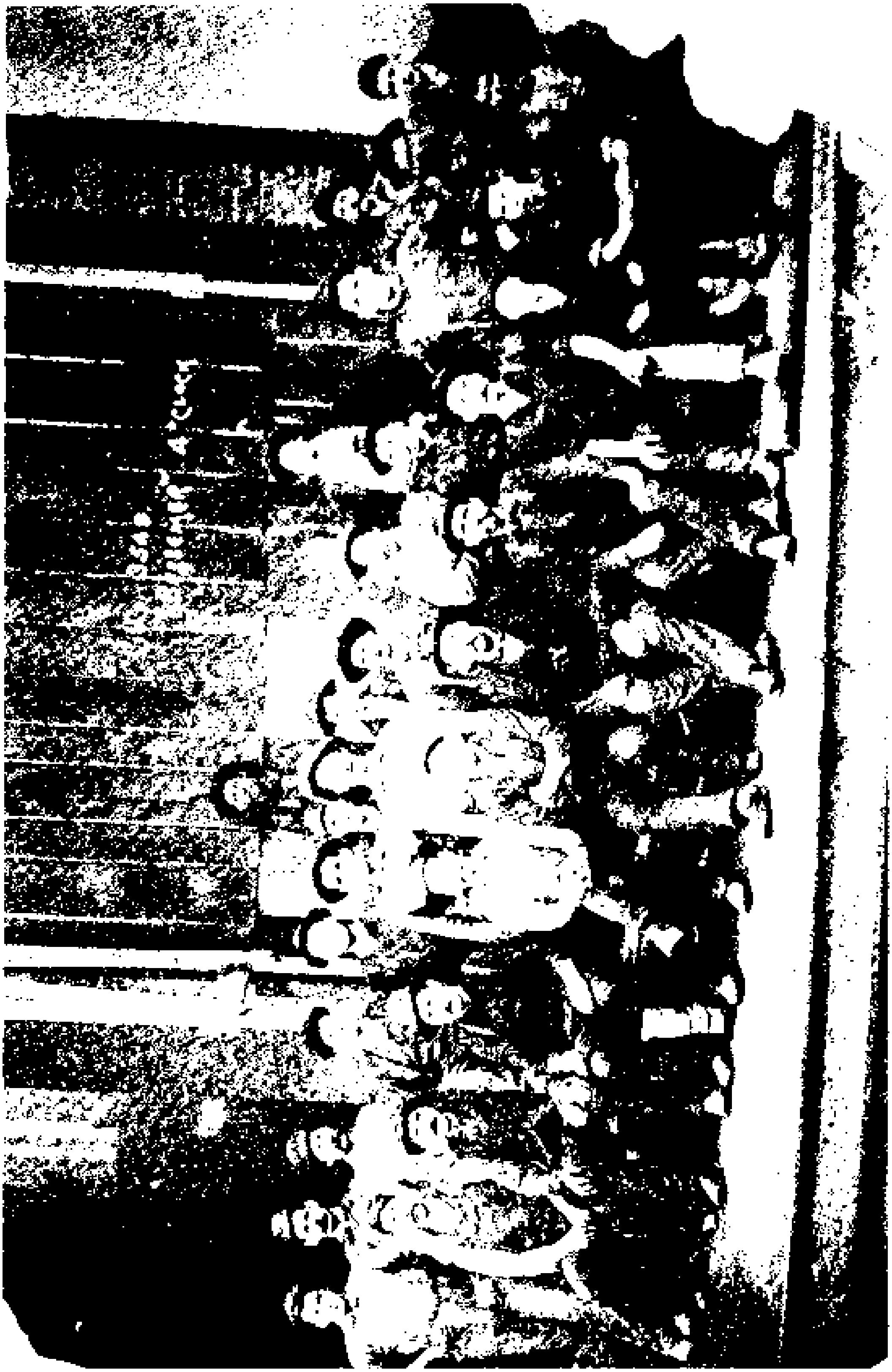


Illustration 50: Cambria Iron Works, group of men holding tongs

Source: JFM

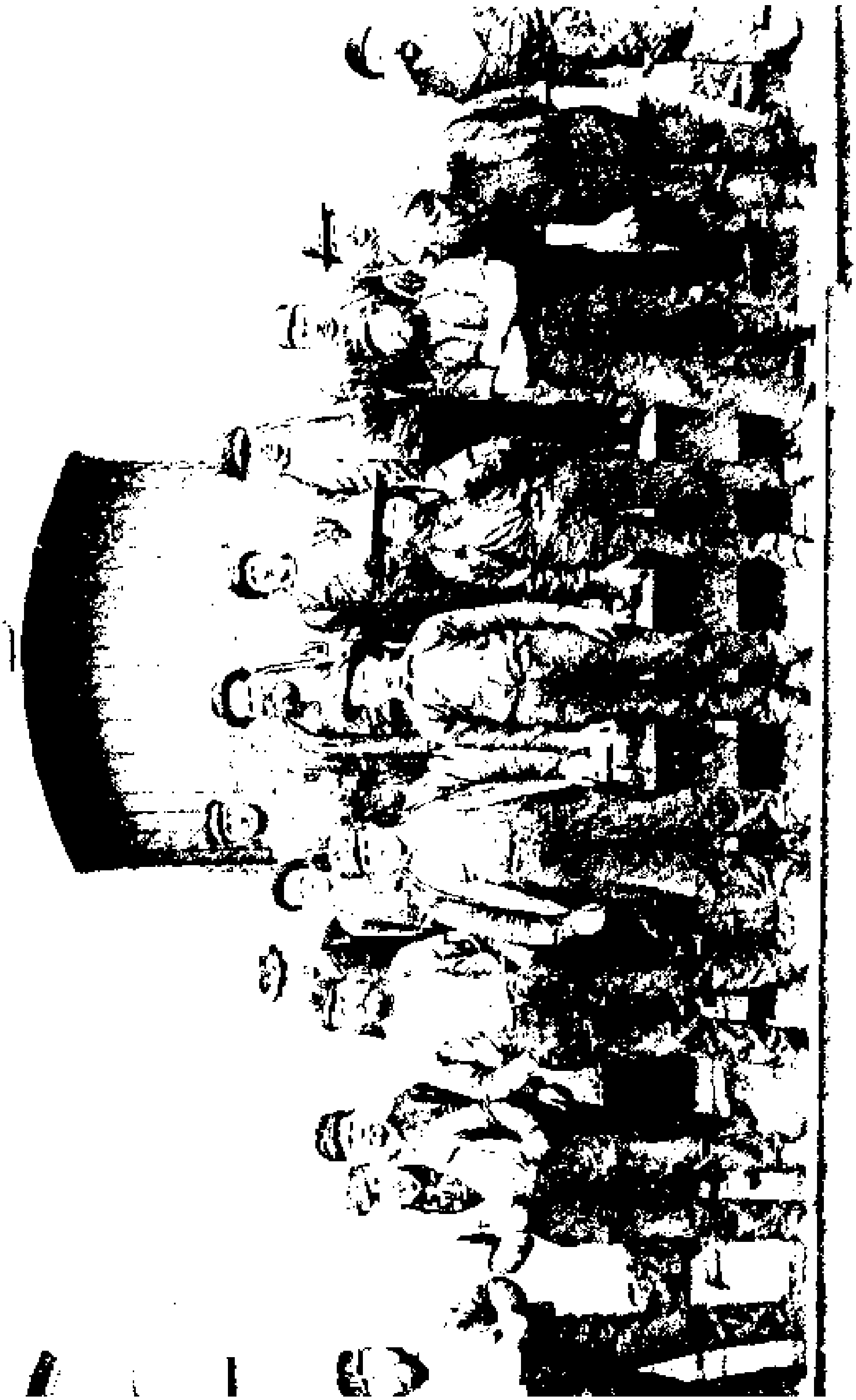


Illustration 51: Forge Plant, Cambria Iron Company, August 25, 1888

Source: JFM

Illustration 52: Armistice Day parade, Franklin Street bridge

Source: JFM

PERSONS CONSULTED DURING RESEARCH

Richard Burkert, Johnstown Flood Museum, Johnstown, Pennsylvania
G. Gray Fitzsimons, Historic American Engineering Record, National Park Service, Washington, D.C.
Lance Metz, Center for Canal History and Technology, Hugh Moore Historical Park and Museum Incorporated
Robert Vogel, National Museum of American History, Smithsonian Institution

REPOSITORIES VISITED DURING RESEARCH

Lakewood, Colorado

Rocky Mountain Regional Office Library

Wilmington, Delaware

Hagley Museum and Library
- Imprints Department
- Manuscripts and Archives Department
- Pictorial Collections

Washington, District of Columbia

American Red Cross, National Headquarters
Library of Congress
- Geography and Map Division
- Prints and Photographs Division
- Social Science Division
  - Business and Economics

Smithsonian Institution
- National Museum of American History

Easton, Pennsylvania

Center for Canal History and Technology, Hugh Moore Historical Park and Museum Incorporated

Ebensburg, Pennsylvania

Cambria County Historical Society

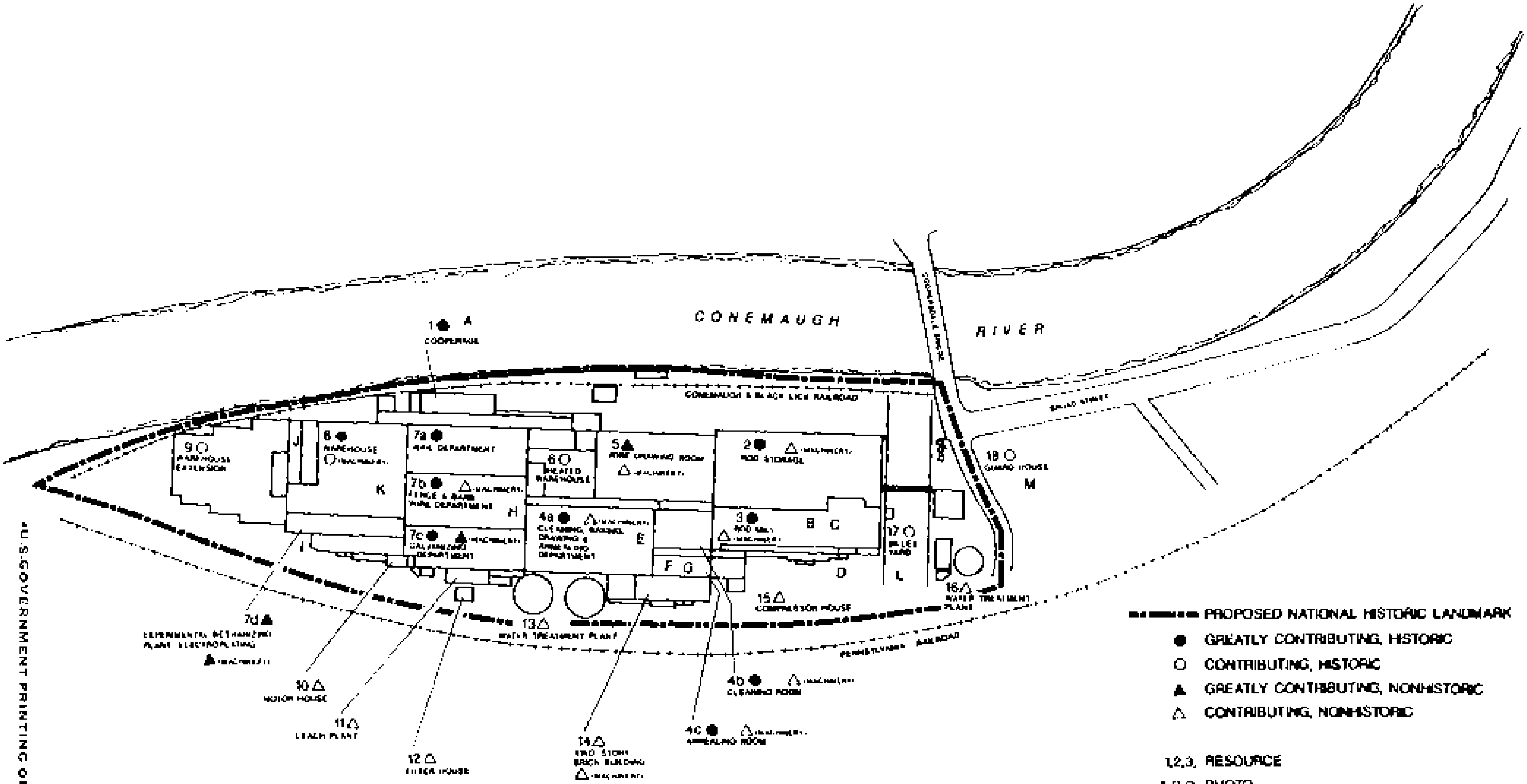
Johnstown, Pennsylvania

Cambria County Library
- Pennsylvania Room

Johnstown Flood Museum
- Library

Philadelphia, Pennsylvania

Historical Society of Pennsylvania
- Library
- Manuscripts



PROPOSED NATIONAL HISTORIC LANDMARK

● GREATLY CONTRIBUTING, HISTORIC

○ CONTRIBUTING, HISTORIC

▲ GREATLY CONTRIBUTING, NONHISTORIC

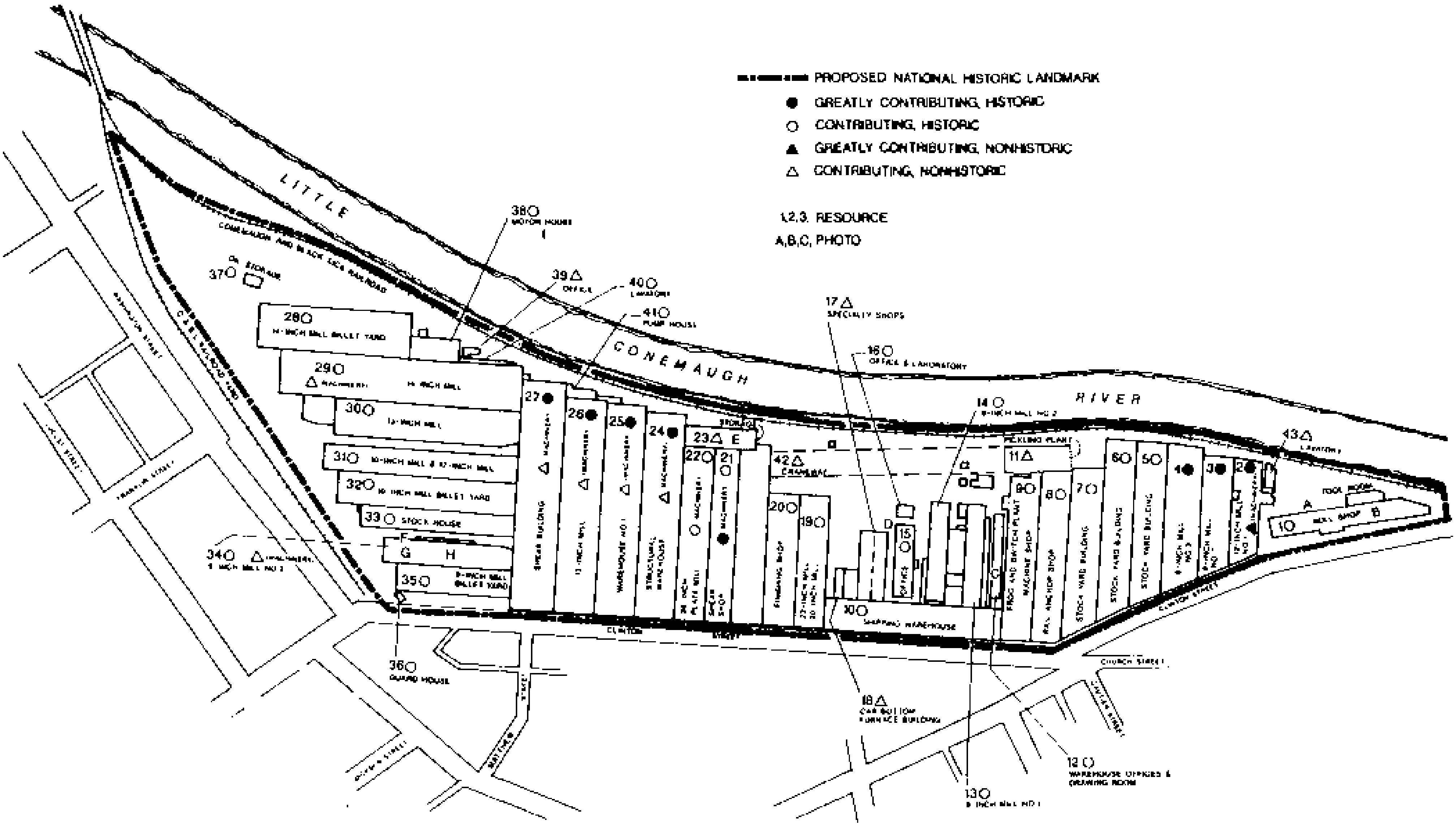
△ CONTRIBUTING, NONHISTORIC

1,2,3, RESOURCE

A,B,C, PHOTO

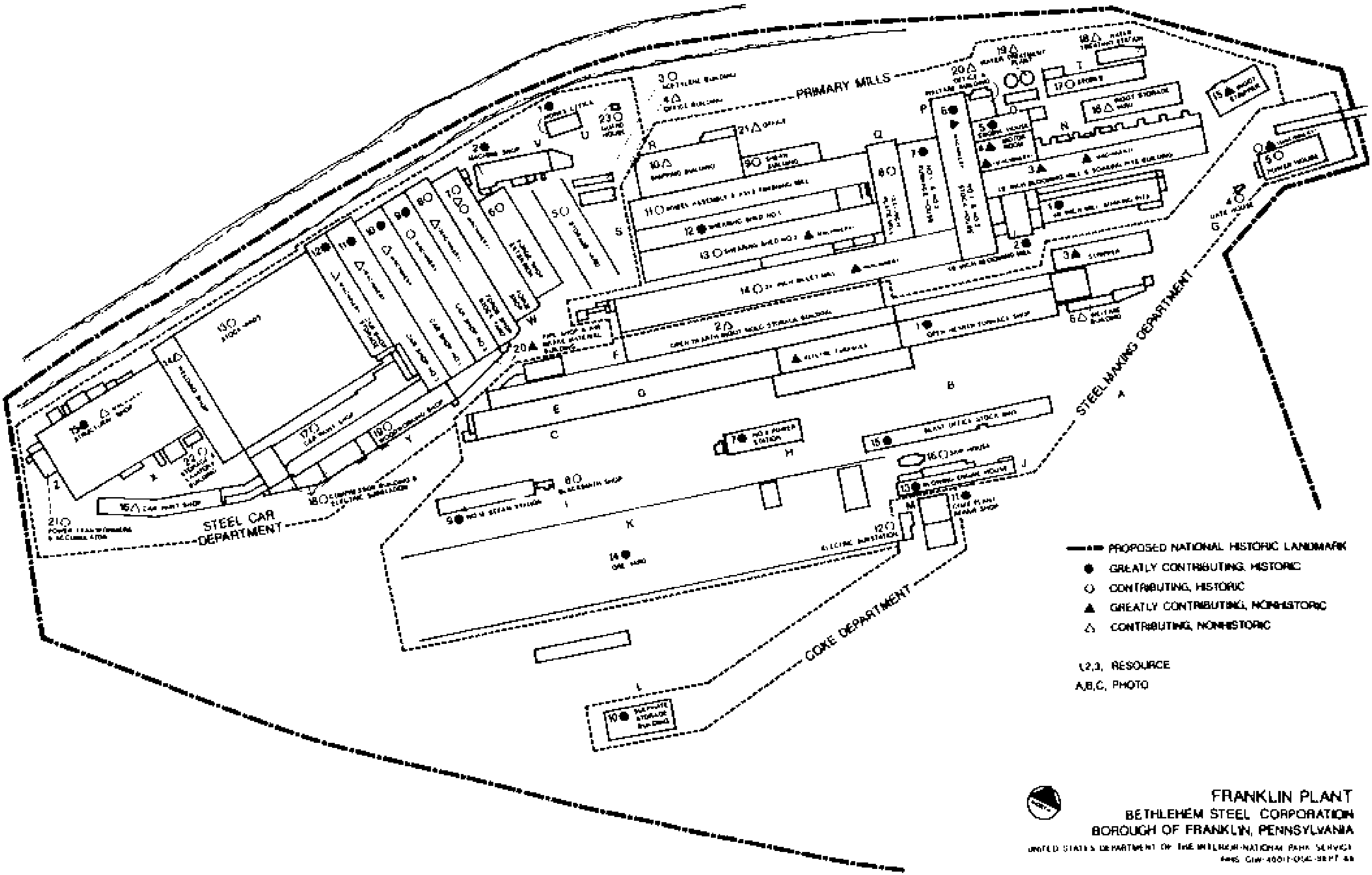
ROD AND WIRE PLANT
BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PENNSYLVANIA

ON MICROFILM



GAUTIER PLANT
BETHLEHEM STEEL CORPORATION
JOHNSTOWN, PENNSYLVANIA

ON MICROFILM

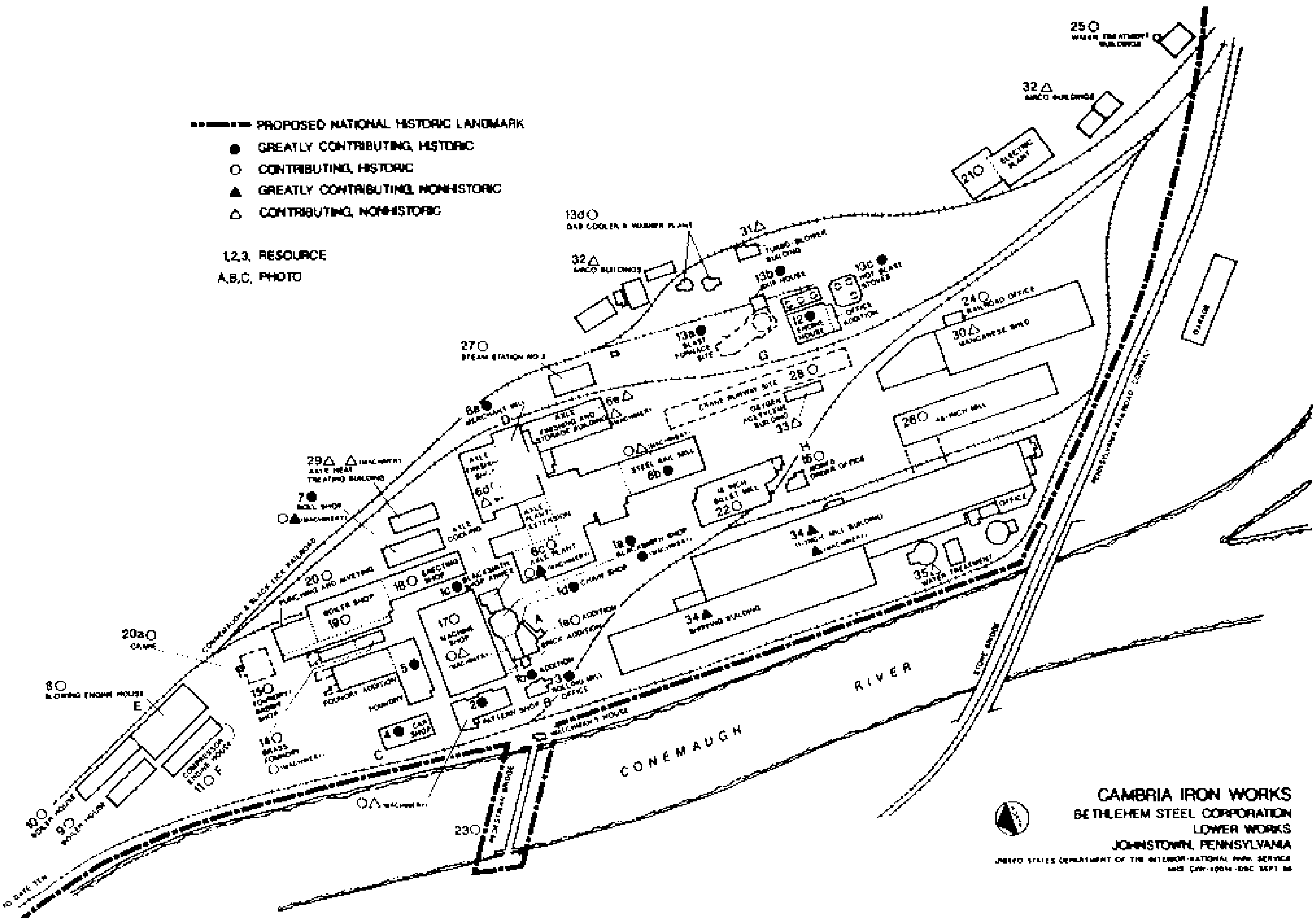


PROPOSED NATIONAL HISTORIC LANDMARK
● GREATLY CONTRIBUTING, HISTORIC
○ CONTRIBUTING, HISTORIC
▲ GREATLY CONTRIBUTING, NONHISTORIC
△ CONTRIBUTING, NONHISTORIC

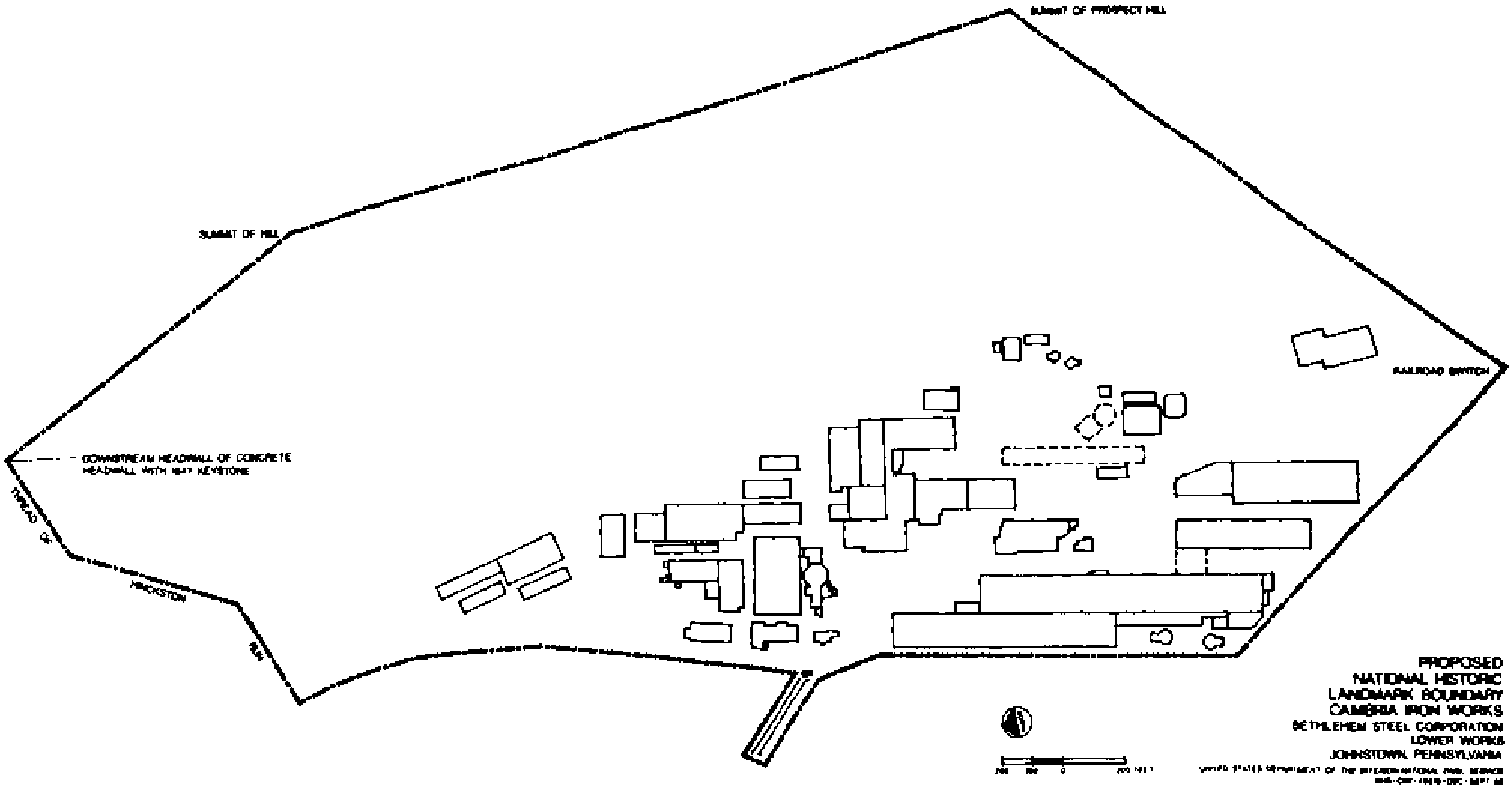
1,2,3, RESOURCE
A,B,C, PHOTO

FRANKLIN PLANT
BETHLEHEM STEEL CORPORATION
BOROUGH OF FRANKLIN, PENNSYLVANIA

ON MICROFILM



ON MICROFILM



ON MICROFILM

9. Major Bibliographical References

[x] See continuation sheet

Previous documentation on file (NPS):

- [ ] preliminary determination of individual listing (36 CFR 67) has been requested
- [ ] previously listed in the National Register
- [ ] previously determined eligible by the National Register
- [ ] designated a National Historic Landmark
- [ ] recorded by Historic American Buildings Survey # ____
- [x] recorded by Historic American Engineering Record # PA-109

Primary location of additional data:

- [ ] State historic preservation office
- [ ] Other State agency
- [ ] Federal agency
- [ ] Local government
- [ ] University
- [x] Other

Specify repository:
Hagley Museum and Library, Wilmington, Delaware

10. Geographical Data

Acreage of property See continuation sheet

UTM References See continuation sheet

	Zone	Easting	Northing		Zone	Easting	Northing
A				B			
C				D			

[x] See continuation sheet

Verbal Boundary Description

[x] See continuation sheet

Boundary Justification

[x] See continuation sheet

11. Form Prepared By

name/title Sharon A. Brown Historian
organization Denver Service Center, National Park Service date January 26, 1989
street & number 12795 W. Alameda Parkway telephone (303) 969-2419
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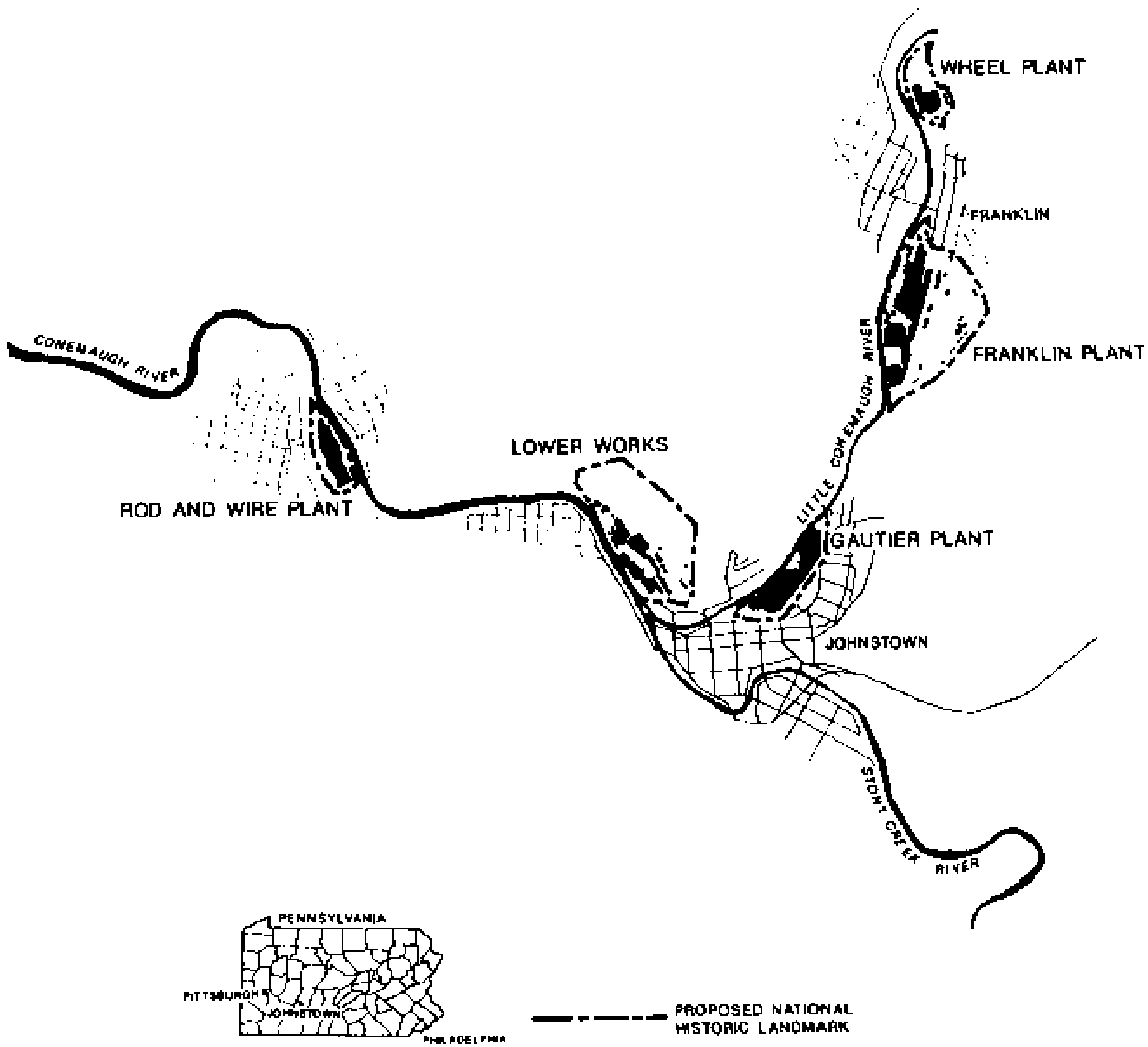

VICINITY
CAMBRIA IRON WORKS
BETHLEHEM STEEL CORPORATION

ON MICROFILM

The Gautier Plant is included within the boundary because of its associations with historic and present-day steel product manufacturing. The buildings are a physical manifestation of the Cambria Steel Company's decision to reenter these trades immediately after the 1889 Johnstown Flood. Included are the intact buildings, built together to be a single unit, and supporting services buildings and structures.

The Franklin Plant is included within the boundary because of its associations with historic and present-day steel car manufacturing, and steelmaking. This plant was built as a result of the Cambria Steel Company's decision to expand their operation in Johnstown, rather than move the entire complex. The site of the former coke and by-product operation and the blast furnace operation are included for their potential archeological value.

The Rod and Wire Plant is included within the boundary due to its historic and present-day associations with wire drawing. The boundary includes the entire complex, including intact buildings, and support services buildings and structures.

The Wheel Plant is included within the boundary because of its historic association with the manufacture of wheels and circular products. The entire complex is included, with intact buildings, and support services buildings and structures.

8. Statement of Significance

Certifying official has considered the significance of this property in relation to other properties: See continuation sheet

[X] nationally [ ] statewide [ ] locally

Applicable National Register Criteria [ ] A [ ] B [ ] C [ ] D

Applicable National Historic Landmark Criteria 1 2 4

Criteria Considerations (Exceptions) [ ] A [ ] B [ ] C [ ] D [ ] E [ ] F [ ] G

Areas of Significance (enter categories from instructions)
Industry
Architecture
Engineering
Ethnic Heritage European

Period of Significance
1852-present

Significant Dates
1857 Fritz mill
1857-62 Kelly experiments
1867 Bessemer rails rolled

Cultural Affiliation
N/A

Significant Person
Fritz, John

Architect/Builder
Cambria Iron Company, Cambria Steel Company, Midvale Steel and Ordnance Company, Bethlehem Steel Company

State significance of property, and justify criteria, criteria considerations, and areas and periods of significance noted above.

Significance

Founded in 1852, the Cambria Iron Company was considered one of the greatest of the early modern iron and steel works. In the 1850s, 1860s, and 1870s, Johnstown attracted some of the best engineers, innovators, and managers in the industry and was the technological leader in the manufacture of iron and steel rail. Iron and steel technology was advanced through invention and industrial design at the Lower Works in Johnstown, innovations which were widely copied by other iron and steel companies throughout the country. These contributions included experimentation with the Kelly converter from 1857-1862; first use of the three high roll mill to produce iron railroad rails in 1857; development of the first blooming mill for breaking down ingots, the first hydraulic manipulator for turning over and moving ingots, and the first mechanical driving of rollers in the mill tables; early conversion to the Bessemer steel process in 1871; and first U. S. commercial production of steel railroad rails in 1867. Throughout the years of the steel industry's growth and dominance, Cambria remained a large independent company (third largest in 1904, fifth largest in 1916), becoming the Cambria Steel Company in 1898 during an age of steel consolidation. In 1916 it was purchased by the Midvale Steel and Ordnance Company. In 1923 the Bethlehem Steel Company purchased the entire Johnstown plant, thereby making it a component of the second largest steel company in the United States. Under Bethlehem's stewardship the plant was modernized, it participated in the World War mobilization of industry, it accepted organized labor, and it changed from war to peacetime operations to contribute to U. S. dominance in steel after 1945. Responses to postwar challenges to that dominance can be seen in the remaining machinery and the steelmaking and manufacturing processes presently occurring on site. The Johnstown plant's significance lies in its growth, from an integrated company specializing in iron and steel rail, to an expansive plant offering a diversity of steel products; a continuum reflecting the evolution of the industry nationwide.

The Cambria Iron Company's production of iron and steel rail helped end America's reliance on English-produced rails and allowed the momentous expansion of the nation's railroad network in the nineteenth century. Cambria trained a generation of iron and steel innovators and was the

[X] See continuation sheet

National Register of Historic Places Continuation Sheet

Rod and Wire Plant
A Zone 17 Easting 674 920 Northing 4469 060
B Zone 17 Easting 674 870 Northing 4468 360
C Zone 17 Easting 674 740 Northing 4468 380

Wheel Plant
A Zone 17 Easting 680 140 Northing 4468 300
B Zone 17 Easting 680 020 Northing 4468 460
C Zone 17 Easting 680 200 Northing 4468 860
D Zone 17 Easting 680 360 Northing 4468 880
E Zone 17 Easting 680 240 Northing 4468 380

Verbal Boundary Description

Lower Works

Starting at the downstream headwall of a concrete headwall with a 1947 keystone, the boundary follows Hinckston Run to the southwest, intersecting with the Conemaugh & Black Lick Railroad line and the Conemaugh River. The boundary proceeds south along the river and tracks, taking in the pedestrian bridge, turning southeast at a railroad switch, turning northeast past another railroad switch, to the summit of Prospect Hill. It then proceeds north to the summit of another hill to the north, before returning northwest to the point of origin.

Gautier Plant

The nominated boundary begins at the western end of the plant at the railroad switch of the Conemaugh & Black Lick Railroad. It follows the railroad line and the Little Conemaugh River to the eastern end of the plant at the eastern end of the roll shop. It then proceeds southwest along Clinton Street, to the corner of Clinton and Washington Street. The boundary then proceeds northwest along Washington and the Conemaugh & Black Lick Railroad line to the point of origin.

United States Department of the Interior
National Park Service

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Franklin Plant

The nominated boundary begins at the southwestern corner of the plant near the power transformers and the Conemaugh River, at the Franklin Borough Line, and follows the Conemaugh River northeast to Locust Street. It follows Locust Street south to Main Street, then west to Bridge Street. It follows Bridge Street southeast, turning west along the Franklin Borough Line, taking in the face of the hill formerly containing the coke operation. At the western end of the plant the boundary cuts northwest, taking in the power transformers, to the point of origin.

Rod and Wire Plant

The nominated boundary begins at the northern end of the plant, moving south along the Conemaugh River and Conemaugh & Black Lick Railroad to the Coopersdale Bridge. Moving southwest, it follows Laurel Avenue to the Pennsylvania Railroad right-of-way, then follows the right-of-way north to the point of origin.

Wheel Plant

The nominated boundary starts at the southwest corner of the wheel finishing shop and shipping building, following the Conemaugh & Black Lick Railroad and the Little Conemaugh River north, around the north end of the site, to the northern end of Pershing Avenue where it meets the tracks. It then proceeds south along Pershing, detouring to include the warehouse building, before following gravel entrance roads around and including the wheel plant office, to the point of origin.

Boundary Justification

Lower Works

The Lower Works of the Cambria Iron Company are included in the boundary because of its association with advancements in iron and steelmaking technology, and because it was the site where iron and steel rails were manufactured in the mid-nineteenth century to early twentieth century, and where axles were produced until recently. Prospect Hill facing the Lower Works was included because of the historic relationship between the iron ore and coal mining operations conducted there by the Cambria Iron Company and the production of iron and steel. The employee entrance gate and pedestrian bridge were included because of the historic relationship between the works and the neighboring communities, home to employees of the Cambria Iron Company.

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

Section number 9 Page 6

U. S. Department of the Interior, National Park Service, Denver Service Center, "Historic Resource Study, Cambria Iron Company, America's Industrial Heritage Project, Johnstown, Pennsylvania," by Sharon A. Brown, Draft, September 1987. Copy available from Denver Service Center.

Surveys

U. S. Department of the Interior, National Park Service, Historic American Engineering Record, "Survey of Historic Structures in Blair and Cambria Counties, Pennsylvania Cambria Iron Works, Historic Overview for Cambria Iron Works, Inventory Cards of Structures," Draft, 1987. Copy available from HAER.

U. S. Department of the Interior, National Park Service, Historic American Engineering Record, "Survey of Nationally Significant Iron and Steel Works" prepared by Gray Fitzsimons, Draft, September 1988. Copy available from HAER.

10. Geographical Data

Acreage
Lower Works approximately 165 acres
Gautier Plant approximately 41 acres
Franklin Plant approximately 211 acres
Rod and Wire Plant approximately 26 acres
Wheel Plant approximately 39 acres

UTM References

Lower Works
A Zone 17 Easting 676 370 Northing 4467 540
B Zone 17 Easting 676 710 Northing 4467 440
C Zone 17 Easting 676 990 Northing 4466 710
D Zone 17 Easting 676 560 Northing 4466 260
E Zone 17 Easting 676 260 Northing 4466 500
F Zone 17 Easting 676 300 Northing 4466 880
G Zone 17 Easting 676 180 Northing 4466 980
H Zone 17 Easting 676 280 Northing 4466 960
I Zone 17 Easting 676 240 Northing 4467 420

Gautier Plant
A Zone 17 Easting 676 820 Northing 4466 000
B Zone 17 Easting 677 780 Northing 4466 300
C Zone 17 Easting 677 580 Northing 4466 060
D Zone 17 Easting 677 100 Northing 4465 840

Franklin Plant
A Zone 17 Easting 678 620 Northing 4466 700
B Zone 17 Easting 679 000 Northing 4467 420
C Zone 17 Easting 679 600 Northing 4467 740
D Zone 17 Easting 679 640 Northing 4466 920

Books

Bernstein, Irving. Turbulent Years A History of the American Worker 1933-1941 (Boston: Houghton Mifflin Company, 1971).

Boucher, John Newton. The Cambria Iron Company. Harrisburg: Meyers Printing and Publishing House, 1888.

____. William Kelly: A True History of the So-Called Bessemer Process. Greensburg, Pennsylvania: By the Author, 1924.

Casson, Herbert N. The Romance of Steel The Story of a Thousand Millionaires. New York: A.S. Barnes & Company, 1907.

Degan, Paula and Degan, Carl. The Johnstown Flood of 1889 The Tragedy of the Conemaugh. n.p.: Eastern Acorn Press, 1984.

Lewis, W. David. Iron and Steel in America. Greenville, Delaware: The Hagley Museum, 1976.

McHugh, Jeanne. Alexander Holley and the Makers of Steel. Baltimore: The Johns Hopkins University Press, 1980.

Morawska, Ewa. For Bread with Butter The Life-worlds of East Central Europeans in Johnstown, Pennsylvania, 1890-1940. Cambridge: Cambridge University Press, 1985.

Morison, Elting E. Men, Machines, and Modern Times. Cambridge: The M.I.T. Press, 1966.

Storey, Henry Wilson. History of Cambria County Pennsylvania. 3 vols. New York: The Lewis Publishing Company, 1907.

Strohmeyer, John. Crisis in Bethlehem Big Steel's Struggle to Survive. Bethesda, Maryland: Adler & Adler, 1986.

Swank, James M. Cambria County Pioneers. Philadelphia: Allen, Lane & Scott, 1910.

_____. History of the Manufacture of Iron in All Ages, and Particularly in the United States from Colonial Times to 1891. Philadelphia: The American Iron and Steel Association, 1892.

_____. Notes and Comments on Industrial, Economic, Political, and Historical Subjects. Philadelphia: The American Iron and Steel Association, 1897.

Temin, Peter. Iron and Steel in Nineteenth-Century America: An Economic Inquiry. Cambridge: The M.I.T Press, 1964.

Warne, Colston E., ed. The Steel Strike of 1919. Lexington, Massachusetts:D. C. Heath and Company, 1963.

Williams, Bruce Y. and Yates, Michael D. Upward Struggle A Bicentennial Tribute to Labor in Cambria and Somerset Counties. n. p.: n. p.

Dissertations

Bennett, John William. "Iron Workers in Woods Run and Johnstown. The Union Era 1865-1895." Ph.D. dissertation, University of Pittsburgh, 1977.

Shappee, Nathan Daniel. "A History of Johnstown and The Great Flood of 1889: A Study of Disaster and Rehabilitation." Ph.D. dissertation, University of Pittsburgh, 1940.

Unpublished Reports

Engineering Department, "History of the Evolution of the Johnstown Plant Bethlehem Steel Company 1852-1935" (Revised to 1958), January 10, 1935, Revised August 1958.

U. S. Department of the Interior, National Park Service, Applied Archeology Center, Rockville, Maryland and American University, Washington, D.C. "An Archeological Planning Overview of the Cambria Iron Company, Lower Works Johnstown Pennsylvania," by Paula A. Zitzler, August 1987. Copy available from Allegheny Portage Railroad National Historic Site, Cresson, Pennsylvania.

_____. "American Iron and Steel Works Works of the Cambria Iron Company." London Engineering XXV (June 21, 1878):485-487.

_____. "American Iron and Steel Works Works of the Cambria Iron Company ." London Engineering XXVI (July 12, 1878):21-24.

_____. "American Iron and Steel Works Works of the Cambria Iron Company ." London Engineering XXVI (July 19, 1878):41-43.

_____. "American Iron and Steel Works Works of the Cambria Iron Company ." London Engineering XXVI (August 23, 1878):152-153.

_____. "American Iron and Steel Works Works of the Cambria Iron Company ." London Engineering XXVI (September 20, 1878):233.

Hunt, Robert W. "A History of the Bessemer Manufacture in America." Transactions of the American Institute of Mining Engineers. V (May 1876 to February 1877):201-216.

_____. "Steel Rails and Specifications for Their Manufacture." Transactions of the American Institute of Mining Engineers XVII (May 1888 to February 1889):226-248.

Books

Fritz, John. The Autobiography of John Fritz. New York: John Wiley & Sons, 1912.

McCormick, S. B. A Sketch of Johnstown and Suburbs, and the Cambria Iron Works. Pittsburgh: Barr & Myers, 1868.

McLaurin, J. J. The Story of Johnstown: Its Early Settlement, Rise and Progress, Industrial Growth, and Appalling Flood on May 31st, 1889. Harrisburg: James M. Place, Publisher, 1890.

Catalog

Cambria Iron Company, Manufacturer of Iron and Steel Railway Bars, Johnstown, Cambria County, Penn'a. Centennial Exhibition 1876, 1876.

Documents

Shoenberger, Peter. Cambria Iron Company of Johnstown, Pa. New York: George F. Nesbitt and Co., Printers, 1853.

Secondary Sources
Articles

Burkert, Richard A. "Iron and Steelmaking in the Conemaugh Valley." In Johnstown: The Story of a Unique Valley, pp. 254-315. Edited by Karl Berger. Johnstown: Johnstown Flood Museum, 1984.

"Helping the Workingmen to Help Themselves." The Iron Trade Review, June 6, 1912, pp. 1213-1219.

McPherson, Donald S. "The "Little Steel" Strike of 1937 in Johnstown, Pennsylvania." Pennsylvania History 39 (April 1972):219-238.

Sherman, Richard B. "Johnstown v. The Negro: Southern Migrants and the Exodus of 1923." Pennsylvania History 30 (October 1930):454-455.

Raidabaugh, G. T. "History of the Rolling of Rails." The Blast Furnace and Steel Plant (April 1927):183-185, 197.

Swank, James M. "The Manufacture of Iron and Steel Rails in Western Pennsylvania." The Pennsylvania Magazine of History and Biography XXVIII, no. 1 (1904):1-11.

13. St. Louis Ore and Steel Company, St. Louis, Missouri. Two seven-ton converters were added to an iron rail mill, and the first blow was on September 1, 1876. There do not appear to be any remaining structures.

Properties comparable to the Cambria Steel Company after the turn of the century, with the expansion into Gautier, Franklin, the Wheel Plant, and the Rod and Wire Plant; and with the entire complex after it was absorbed by the Midvale Steel and Ordnance Company and the Bethlehem Steel Company, need to be considered. Such a study is beyond the scope of this nomination, but the companies are listed here for further consideration. In the early 1950s, at the height of the American steel industry's strength, the 12 largest companies were: United States Steel Corporation, Bethlehem Steel Corporation, Republic Steel Corporation, Jones and Laughlin Steel Corporation, National Steel Corporation, Youngstown Sheet and Tube Company, Inland Steel Company, Armco Steel Corporation, Wheeling Steel Corporation, Crucible Steel Company of America, Pittsburgh Steel Company, and Sharon Steel Corporation. Each of these companies operated more than one plant.

National Register of Historic Places Continuation Sheet

9. Major Bibliographical References

Primary Sources
Manuscript Sources

Center for Canal History and Technology
Hugh Moore Historical Park and Museum Incorporated
Easton, Pennsylvania
Bethlehem Steel Corporation Collection
Engineering Department "History of the Evolution of the Cambria Plant Bethlehem Steel Company 1852-1935," January 10, 1935, typed manuscript

John Fritz Collection

Hagley Museum and Library
Wilmington, Delaware
Manuscripts and Archives Department
Bethlehem Steel Corporation Papers Acc 1699
George E. Thackray, "Brief History of Cambria Plant, Johnstown, Penna." In "History of Cambria and Coatesville Plants, B.S. Co.," 1925, typed manuscript, box: Plants-Danville-Johnstown

Johnstown Flood Museum
Miscellaneous Collection IV

Articles

Fritz, John. "The Development of Iron Manufacture in the United States Seventy-Five Years of Progress." Cassiers 17, November-April, 1900, pp. 459-471.

_____. "The First Three-High Roll Train." Cassiers 7, no. 6, April 1895, pp. 468-472.

Holley, Alexander L., and Smith, Lenox. "American Iron and Steel Works The Cambria Iron and Steel Works," London Engineering XXV, (May 31, 1878):422-423.

at the Franklin Plant in Johnstown. Jones & Laughlin had a rail mill, dated later than Cambria's. The Jones & Laughlin plant was also an independent mill, as was Cambria, and had raw materials, furnaces, and production facilities all on one site. It is the only plant which has a similar history to Cambria's, although it is not as historically significant in terms of industrial and engineering achievements occurring there.

Other early Bessemer plants (1864-1876) need to be compared against the resources at Cambria. All of these plants were affected in some way by the Pneumatic Steel Association, owners of the American Bessemer steel patents, and were influential in establishing an American steel industry. They are listed here in order of their establishment.[48]

1. Kelly Pneumatic Process Company, Wyandotte, Wayne County, Michigan. This company began experiments on a Bessemer-like process in 1862 and the first blow on the two-and-one-half-ton experimental converter was in the fall of 1864. However, the experiments were not commercially successful and the operations were abandoned in 1869. There had been a rolling mill at this site since 1855, and a second mill was built in 1872. This company eventually became the Eureka Iron and Steel Company. The only indicator of the importance of this site to the development of America's steel industry is a historical marker; there are no remaining structures.

2. Albany and Rensselaer Iron and Steel Company, Troy, New York. This experimental Bessemer plant had one two-and-one-half-ton converter which first blew on February 15, 1865. The Bessemer plant was added to an iron rail mill. There are no remaining structures.

3. Pennsylvania Steel Works, Pennsylvania Steel Company, Steelton, Dauphin County, Pennsylvania. This was an entirely new works with two seven-ton converters. The first blow was in June 1867. Remains include only a three-story stone Bessemer building, probably dating from 1881.

4. Freedom Iron and Steel Works, Lewistown, Mifflin County, Pennsylvania. Two five-ton converters were added to the works of the Freedom Iron Company, and the first blow was on May 1, 1868. These works failed in 1869 and most of the Bessemer machinery was moved to Joliet, Illinois. Although there are probably no remains, HAER will investigate this site.

48. Swank, *History*, pp. 411-412.

5. Cleveland Rolling Mill Company, Cleveland, Ohio. Two six-and-one-fourth-ton converters were added to an iron rail mill. The first blow was on October 15, 1868. There are no remaining structures at this site.

6. Cambria Iron Works, Cambria Iron Company, Johnstown Pennsylvania. Two six-ton converters were added to an iron mill, and the first blow was on July 10, 1871.

7. Union Steel Company, Chicago, Illinois. Two six-ton converters were added to an iron rail mill, and the first blow was on July 26, 1871. There are no remaining structures.

8. North Chicago Rolling Mill Company, Chicago, Illinois. Two six-ton converters were added to an iron rail mill. The first blow was on April 10, 1872. There are no remaining structures.

9. Joliet Steel Works, Joliet Steel Company, Joliet, Illinois. This was an entirely new plant, with two eight-ton converters. The first blow was on January 26, 1873, and the first steel rail rolled on March 15, 1873. There are several buildings remaining from the time period, but none directly relating to the steelmaking process.

10. Bethlehem Iron Company, Bethlehem, Pennsylvania. Two seven-ton converters were added to an iron rail mill. The first blow was on October 4, 1873, and the first steel rail rolled on October 18, 1873. Buildings built by John Fritz in 1862 remain, and are threatened with demolition.

11. Edgar Thomson Steel Works, Carnegie Brothers & Co., Limited, Bessemer Station, Braddock, Pennsylvania. These were entirely new works with two seven-ton converters. The first blow was on August 25, 1875, and the first steel rail rolled September 1, 1875. USX Corporation has not yet granted permission to pursue any field survey at this plant, thus the extent of any remaining structures is not known.

12. Lackawanna Iron and Steel Works, Lackawanna Iron and Coal Company, Scranton, Lackawanna County, Pennsylvania. Two five-ton converters were added to an iron rail mill. The first blow was on October 23, 1875, and the first steel rail made December 29, 1875. These works were dismantled and the machinery moved to Lackawanna, New York, in the 1890s. At this time it appears that the only remaining structures at Scranton may be some remnants of stone iron furnaces and blast furnaces.

Manufacturing Company built by Abram Hewitt. Remaining historical structures include: (7) the 1853 machine shop, (8) 1853 foundry, and (9) the 1853 pattern shop.

Besides these important sites, there are several other companies that were important 19th century rail producers. The rolling mill operations of the Renssalaer Iron Works was begun in 1853, and a rail mill built in 1866 rolled steel rails from the newly completed Bessemer steel converter. Unfortunately, it burned in October 1969. During the summer of 1969 this brick rail mill was documented by HAER.

The Joliet Iron and Steel Company was formed in 1873 to roll steel rails using Bessemer steel. It was part of the 1889 merger which created Illinois Steel, the first of the major steel company mergers. The mill was dismantled in 1905, but several significant structures remain, including (1) an impressive 1873 limestone office building, (2) a ca. 1872 machine shop, (3) a ca. 1872 boiler house, (4) a ca. 1872 pattern shop, (5) a ca. 1886 storage building and (6) an 1888 roll shop.

The Pennsylvania Steel Company, in Steelton, Pennsylvania, was started in 1866, and rolled rails for the Pennsylvania Railroad Company. The steel came from a Bessemer steel converter which began operations in May 1867. The rail mill was completed in May 1868. The first Bessemer plant was built in 1867 and housed two five-ton converters. In 1881, the second Bessemer plant was built, containing three eight-ton converters. Structures remaining from this early period include (1) a three-story, stone Bessemer building, probably ca. 1881, (2) an 1892 roll shop, and (3) an 1899 machine shop. Many other buildings remain at this site although they date from the early 20th century.

The Cleveland Rolling Mill, Newburgh, Ohio, was built in 1858 for rerolling iron rails. The company began rolling steel rails in 1868 after the installation of a Bessemer converter, and in 1889, was part of the merger which formed Illinois Steel. There do not appear to be any remaining structures at this site.

The Union Rolling Mill was built in 1863 at South Chicago, or Bridgeport, Illinois, and was owned by Cleveland Rolling Mill. It first rolled iron rails and then in 1871, steel rails after the installation of a Bessemer converter. In 1889 it became part of the Illinois Steel Company. The works were dismantled in 1902, and there are no remaining structures.

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The North Chicago Rolling Mill was built in 1857 on the North Branch of the Chicago River. The original rail mill was for rerolling iron rails. Another rail mill was built in 1864, and, by 1878, it was used to roll steel rail after a Bessemer converter was built in 1871. There are no surviving structures at the North Chicago Works.

In 1880, the South Chicago works were built on Lake Michigan and became the nucleus of the operations. In fact, the North Chicago works were later abandoned. In 1889, North Chicago (including the South Chicago Works), combined with Joliet Iron and Steel, Cleveland Rolling Mill, and Union Rolling Mill to form Illinois Steel. North Chicago held 54 percent of the stock and was the dominating interest in this merger. Illinois Steel later became part of Federal Steel, and then, in 1901, was part of the United States Steel Corporation merger. South Chicago does have remaining machinery.

The Johnstown Plant can also be compared with remaining iron and steel works in nearby Pittsburgh, Pennsylvania, also known for its iron and steel heritage. In 1987 the Pittsburgh History & Landmarks Foundation rated six mills to have potential for listing on the National Register of Historic Places. These are: (1) USX Corporation's Clairton Works, founded in 1900, occupying 238 acres, is partially demolished and was at one time the world's largest coke-producing operation; (2) USX Corporation's Duquesne Works, dating from 1886 and occupying 200 acres, were part of Carnegie mills. They are threatened with demolition. Older buildings are intact and modified blast furnaces date from the 1880s; (3) USX Corporation's Homestead Works date from 1881, occupy 410 acres and are threatened with demolition. This plant was the site of the famous 1892 strike; (4) USX Corporation's Edgar Thomson Works, dating from 1875 and located on 176 acres, is currently in use. This was Andrew Carnegie's first steel mill, and contains much old equipment; and (5) Jones & Laughlin Steel's South Side plant dating from 1852, is on 230 acres. It is partially used and partially demolished. It is a large diversified steel mill, and was an impetus for Pittsburgh's growth and attracted East European immigration into the city. It has no remaining furnaces, but has an open hearth furnace shed and an old Bessemer building. A sixth plant was identified by Pittsburgh History & Landmarks Foundation, the CCX Braeburn Alloy Plant in Lower Burrell, Westmoreland County, but it is a specialty steel plant and is of a much smaller scale than the Johnstown Plant.

Only the Jones & Laughlin plant in Pittsburgh is as old as the Cambria Iron Company's Lower Works. It contains historic buildings which have been significantly altered, and contains no remnants of Bessemer furnaces, open hearth furnaces, or blast furnaces, although it does have remnants of a Bessemer building. It does contain electric arc furnaces, as does Bethlehem Steel by the Steel Workers Organizing Committee to sign contracts with other steel companies led to the Little Steel Strike of 1937. Johnstown was Bethlehem Steel Corporation's only plant to strike. Pickets rallied for days in front of plant gates, and some violence occurred at Franklin. This strike failed, and not until after World War II brought government controls would steel management accept the SWOC as a bargaining agent. The Johnstown Plant was soon organized by the United Steelworkers of America, in 1941.[47]

The possibility for survival of the American steel industry is currently debated, and the ramifications of its loss in terms of American strength is not known. Seen in a continuum of history, the significance of the Cambria Iron Company and its successive managements remains in its contributing and representative role not only in the development of an industry, but in the larger context of American world dominance and strength as well.

Comparable Properties

In 1988, the Historic American Engineering Record (HAER) conducted a nationwide survey of important iron and steel works, specifically those that were established in the 1840s through the 1860s, and rose to prominence in the mid- to late-nineteenth century. The purpose of the survey was to determine the extent to which these important iron and steel works retained historic buildings, structures, and machinery. Through a literature search, followed by the research of primary and secondary sources, HAER developed a list of significant iron and steel works founded in the three decades between 1840 and 1870.

During the course of the fieldwork HAER determined that no single site exists that can be considered a complete and unaltered "showpiece" of mid- to late-nineteenth century steelmaking and manufacturing technology. Simply put, there does not exist in the steel industry any site which is perfectly preserved. This finding is not surprising in light of the periodic modernization that the nation's major steel works experienced over the course of their history. Nonetheless, HAER found that certain steel works contained a greater number of extant historic structures than others; however, in each case these historic structures had undergone at least some structural or

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47. Morawska, *Bread With Butter*, p. 87; Shappee, "History of Johnstown, pp. 73-82; Irving Bernstein, *Turbulent Years A History of the American Worker 1933-1941* (Boston: Houghton Mifflin Company, 1971), pp. 490-494; Bruce Y. Williams and Michael D. Yates, *Upward Struggle A Bicentennial Tribute to Labor in Cambria and Somerset Counties* (n. p.:n. p.), n. p.; Colston E. Warne, ed., *The Steel Strike of 1919* (Lexington, Massachusetts: D. C. Heath and Company, 1963), pp. v, ix; Donald S. McPherson, "The "Little Steel" Strike of 1937 in Johnstown, Pennsylvania," *Pennsylvania History* 39 (April 1972):219, 237.

architectural alterations. As for historic machinery and equipment dating from the mid- to late-nineteenth century, HAER found that very few of these resources survive in situ.

Thus, with these findings serving as a framework, HAER concluded that among the historically important iron and steel works identified in the research, there are three sites that contain a relatively large number of historic structures and thereby provide the best physical evidence of an early prominent iron and steel works. The three include: the Cambria Iron Company in Johnstown, Pennsylvania; the Trenton Iron Company in Trenton, New Jersey; and the Bethlehem Iron Company in South Bethlehem, Pennsylvania. In each case several structures survive from the mid-nineteenth century. Importantly, the Bethlehem Steel Corporation presently operates the works in Johnstown and South Bethlehem, whereas the works in Trenton, last operated by the American Steel and Wire Company, are now abandoned.

Bethlehem Iron Company was organized in 1857 as the Saucon Valley Iron Company. Its name was changed in 1859 to the Bethlehem Rolling Mills and Iron Company and then in 1861 to Bethlehem Iron Company. The company was a major producer of iron and then steel rails throughout the latter part of the 19th century. Several buildings associated with this period remain at Bethlehem, now the Bethlehem Steel Corporation, including structures built by John Fritz. Extant resources include: (1) ca. 1860 Iron Rail Mill and Puddling Furnace Building, now threatened with demolition; (2) ca. 1870-1872 Bessemer Building and Rail Mill, greatly altered; (3) ca. 1862 Pattern Shop; (4) five blast furnaces, ca. 1860-1870s, all rebuilt; (5) ca. 1870s Blowing Engine House; (6) ca. 1888 "High House"; (7) ca. 1888 Machine Shop; and (8) ca. 1888 Press Forge Shop.

The Trenton Iron Company was formed in 1845 by Peter Cooper and Abram Hewitt as the Smith Trenton Iron Company, and in 1847 its name was changed to the Trenton Iron Company. The original works consisted of a rod and wire mill and facilities for rolling iron rails. The company adapted to meet changes in the iron market and in the early 1850s began rolling iron structural beams when rail prices began decreasing. In 1865 Trenton Iron completed one of the earliest open hearth facilities in America. However, the process did not prove commercially viable at this time and the process was abandoned in 1869. In 1866, Trenton began rolling a combination iron and steel rail ("steel-topped") which served as a transition from iron to the all-steel rails that followed in the 1870s. Structures remaining from this period include: (1) the Trenton Iron Company Office, ca. 1879; (2) an 1872 Boiler House; (3) an 1880 Engine House; (4) the 1871 Wire Mill No. 1; (5) the ca. 1850s Wire Mill No. 3; (6) and the 1885 Blacksmith Shop. Adjacent to these buildings is the site of the Trenton Locomotive and Machine

National Register of Historic Places Continuation Sheet

In 1916 Cambria became a subsidiary of the Midvale Steel and Ordnance Company of Philadelphia and was taken over again in 1923 by the Bethlehem Steel Company.[41]

The American steel industry underwent dramatic changes in the second half of the twentieth century. Dominant worldwide during World War I, and surviving the Great Depression to become even larger during World War II, the industry produced more than 90 million tons of steel ingots in 1946, an amount far above any other nation in the world. In America approximately 85 percent of all manufactured goods contained steel, and 40 percent of employed workers were tied to the steel industry directly or indirectly. By the early 1950s the Johnstown plant employed approximately 18,000 workers, and produced 2.28 million tons of steel ingots annually.[42]

By the mid-1980s the steel industry's economic health had deteriorated. More than 250,000 jobs were lost, entire steel facilities were closed and are currently being scrapped, and 30 million tons of capacity disappeared. Foreign steel suppliers gained one-fourth of the domestic steel market, and the American industry lost $7.25 billion between 1981 and 1986. This fall has signalled drastic changes in several areas, including the evident scale-down of large integrated plants, the emergence of mini-mills, and the use of concessionary bargaining as a union attempt to save jobs by keeping plants open.[43] The continuing evolution of steelmaking regarding machinery and products is visible when the Johnstown Plant of the Bethlehem Steel Corporation is viewed in the context of its continuing history. The extant buildings, structures, and machinery either abandoned or still in use on the site are the result of decisions made in the interest of economics, competitiveness, and capacity in the reality of a modern world steel market. The Johnstown Plant, heir to the Cambria Iron Company, still survives and remains open with reduced operations, even though other plants have closed. This is due to several factors, the primary ones being the cooperation and sacrifices of the workforce and the support of the community.[44]

The social history of the Cambria Iron Works is intertwined with the surrounding community regarding ethnicity and the growth of labor unions. Labor for the Cambria mills came from

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41. Burkert, "Iron and Steelmaking," pp. 296, 303-304.

42. John Strohmeyer, *Crisis in Bethlehem Big Steel's Struggle to Survive* (Bethesda, Maryland: Adler & Adler, 1986), pp. 11-12, 196.

43. Ibid., pp. 12-15.

44. Ibid., p. 195.

several different sources. Farm labor and German and Welsh migrations in the 1830s, 1840s, and 1850s supplied the initial manpower. South European and Slavic immigration came in waves after the 1870s. Southern black migrants arrived after World War I. More than 70 percent of the male blue-collar force in Johnstown was employed at Cambria mills and coal mines, and there were very few opportunities for women's employment in Johnstown. The Cambria Iron Company was the main attraction for this immigration into Johnstown, and thus shaped the city's cultural and ethnic heritage.[45]

The Cambria Iron Company engaged in a paternalistic form of welfare capitalism, assuming responsibility for worker welfare and civic improvements. In 1887 the company built the first industrial hospital in America. After 1870 it funded and then built a public library, after 1889 it funded the public library built by Andrew Carnegie after the 1889 Johnstown Flood. The company built an opera house and club house, operated a company store, and ran a night school offering free classes for employees. The Cambria Iron Company was also the largest landlord in Johnstown, owning houses which it either rented or offered for sale to workers.[46]

According to historian Ewa Morawska, the Cambria Iron Company's influence affected not only Johnstown's economic sphere, but its social, political, and cultural worlds as well. The major newspaper "traditionally" supported company policy, and company managers held high public offices in town, forming "a tightly knit sociopolitical elite in the city." From the very beginning the company's managers actively opposed labor organizations and successfully suppressed several strikes by miners and mill workers between 1866 and 1919. Organizational efforts by various trade unions and the Knights of Labor through the years were either short-lived or failed altogether. Workers at the Johnstown Plant participated in the Great Steel Strike of September 1919, and thousands were rewarded by the Midvale Steel and Ordnance Company management with outright dismissal. This strike crippled the iron and steel industry when industry leadership fought against craft unions affiliated with the American Federation of Labor. The strike was a total defeat for the unions. John L. Lewis formed the Committee for Industrial Organization with other labor leaders in 1935. In 1937 discussions between Lewis and U. S. Steel ended in a collective bargaining agreement between the company and a CIO local. Efforts

45. Shappee, "History of Johnstown," p. 72; Ewa Morawska, *For Bread with Butter. The Life-worlds of East Central Europeans in Johnstown, Pennsylvania, 1890-1940* (Cambridge: Cambridge University Press, 1985), p. 85; Richard B. Sherman, "Johnstown v. The Negro: Southern Migrants and the Exodus of 1923," *Pennsylvania History* 30 (October 1930):454-455.

46. Shappee, "History of Johnstown," p. 97; Holley and Smith, "Cambria Iron and Steel Works," XXV:422; Morawska, *Bread With Butter*, p. 87; "Helping the Workingmen to Help Themselves," *The Iron Trade Review*, June 6, 1912, pp. 1213-1219.

the association designed and built a plant in 1867 at Steelton, outside Harrisburg, Pennsylvania, followed by continued influence on the development of American steel plants until 1875.[36]

In 1867 the Cambria rolling mill produced the first Bessemer rails on commercial order in the United States, made from ingots forged at the Steelton plant. At the time Cambria was the largest iron rail producer in the country. By 1871 Alexander Holley had designed and installed Bessemer converters at Cambria. This was the sixth Bessemer furnace in America, and by 1876 commercial rail production at Johnstown reached 103,743 tons; 47,643 tons of iron rail and 56,100 tons of steel rail. Beginning with 10,000 tons of iron rails produced in 1855, the Cambria Iron Company's capacity in 1878 was 100,000 tons of iron and steel rails, bar iron, steel wire, bolts, nuts, and other products. This production exceeded that of any other steel plant and totaled 10 percent of all American rail manufacturing. The company produced iron and steel rail for more than 50 years.[37]

Cambria continued to contribute to the American steel industry well past the formative years of the industry. Technological innovation was advanced through the introduction of the Otto-Hoffman by-product coke ovens in 1895-1896 at Franklin, the first by-product oven plant in the United States to be operated in conjunction with a blast furnace. Cambria employee John Coffin invented the Coffin heat treating process used in the manufacture of car axles; the first use in the industry of heat treatment for axles. Not only did Robert W. Hunt set up the first analytical laboratory, but he and John E. Fry patented the principle of filling an ingot mold from the bottom. In 1902 the first Steel Plant Metallurgical Department in the country was established at Cambria. In 1917-1918 the Slick Wheel mill was developed by Edwin E. Slick.[38]

The Cambria Iron Company owned several subsidiary industries, principally the Gautier Works, established in 1878 and specializing in wire, specialty steel, and agricultural implements. The Johnstown Mechanical Works specialized in fancy iron work and wood-turned products. The Johnstown Manufacturing Company in Woodvale made bricks. Also affiliated were the Woodvale

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36. Swank, *History*, pp. 409-412; Morison, *Men, Machines*, pp. 139-144; McHugh, *Alexander Holley*, pp. 199-200, 211-212; Robert W. Hunt, "A History of the Bessemer Manufacture in America," *Transactions of the American Institute of Mining Engineers* V (May 1876 to February 1877):15.

37. Burkert, "Iron and Steelmaking," pp. 281; Swank, *History of the Manufacture*, pp. 413; Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company," London *Engineering* XXVI (September 20, 1878):233.

38. Engineering Department, "History of the Evolution," 1958, pp. 5, 77.

Flouring Mill and Woodvale Woolen Mills. The company possessed coal and iron ore veins in the adjacent hills and counties, and operated its own mines. The local iron ore was used until the 1870s, when purer iron ore from the Lake Superior region was needed for making steel but regional coal mining has continued to the present day. Efficient rail communication running east and west helped transform both Cambria into a major iron and steel producer and Johnstown into a thriving city.[39]

The Cambria Iron Company and its subsidiaries were the principal employers and the reason for the area's extraordinary growth. The company was the major factor in Johnstown's development for more than 100 years. Johnstown grew from a single borough of 1,300 people in 1850 to the focus for boroughs inhabited by 15,000 people in 1880. Conemaugh Borough was the location of Cambria's Gautier Works. Most of Prospect Hill's residents rented houses from the company. The main rolling mills, foundries, machine shops, and blast furnaces were located in Millville. The majority of Cambria City's population was employed by Cambria. Woodvale had a Cambria Iron Company chemical works, woolen mill, tannery, flouring mill, and brick works. East Conemaugh was built around the railroad yards. Other boroughs and villages, Kernville, Morrellville, Franklin, Coopersdale, and Moxham, were all connected economically to the Cambria Iron Company.[40]

Continuing growth of the company's production was reflected in the expansion of the plant along the Little Conemaugh River. Increased competition and costs forced many independent steel companies to merge or reorganize, and in 1898 the Cambria Iron Company leased its properties to the Cambria Steel Company. Thought was given to moving the plant from Johnstown to nearer the Great Lakes, but the decision was made to extend the facilities. The Franklin Plant was built, and the construction of new waterworks assured the plant's growth. Johnstown's proximity to the Connellsville, Pennsylvania coal region and the good railroad access also factored in the decision. In later years Johnstown's industrial advantage was reduced as increasing competition in transportation put the steel plant at a disadvantage. Isolated to an extent from the Great Lakes and the eastern seaboard, Johnstown's traditional role as a supplier to distant markets was diminished. The steel industry grew only slowly after World War I, and Cambria was not spared.

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39. Alexander L. Holley and Lenox Smith. "American Iron and Steel Works The Cambria Iron and Steel Works," London *Engineering* XXV (May 31, 1878):422-423.

40. McLaurin, *The Story of Johnstown*, pp. 39-40; Paula Degen and Carl Degen. *The Johnstown Flood of 1889 The Tragedy of the Conemaugh* (n.p.: Eastern Acorn Press, 1984), p. 8.

of making Bessemer steel to the American industry, together with his brother George Fritz, Robert W. Hunt, William R. Jones, and Alexander L. Holley.[29]

George Fritz was a mechanical genius like his brother. He participated in the trials of the three high mill, helping with its development, and served as general superintendent of the plant. He invented the first blooming mill for breaking down ingots, adopted by steel works at Troy, North Chicago, Joliet, and Bethlehem; in addition to a hydraulic manipulator for turning and moving ingots, and the mechanical driving of rollers in mill tables. George Fritz's mechanical skill was evident in the design and efficiency of the mill machinery, furnaces, and supporting services. George Fritz also worked with Alexander Holley to roll the first steel rails at Cambria, using ingots from the Pennsylvania Steel Company plant in Steelton.[30]

Other early experiments centered on the work of William Kelly. Cambria's general manager, Daniel J. Morrell, brought Kelly to Johnstown in 1857 where he experimented with the pneumatic process at the same time that Henry Bessemer was perfecting the hot blast in England. Kelly had worked with small converters since 1851, and he produced enough steel to ask for a U. S. patent, which he obtained in 1857. At Cambria, Kelly invented a tiltable converter and experimented with it before leaving Johnstown in 1862.[31]

William R. Jones began work at Johnstown in 1859 as a machinist. He served in the Civil War and returned to Cambria, where he became assistant to George Fritz. He arrived in Cambria just in time to become part of the circle of iron and steel experts who were combining their knowledge to promote the making of Bessemer steel. He left Cambria after 16 years to become a master mechanic for Andrew Carnegie at the Edgar Thomson Steel Company, where he patented many processes and machinery to improve the making of steel.[32]

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29. Jeanne McHugh, *Alexander Holley and the Makers of Steel* (Baltimore: The Johns Hopkins University Press, 1980), pp. 234-239; John Fritz, *The Autobiography of John Fritz* (New York: John Wiley & Sons, 1912), pp. 91, 108-115.

30. McHugh, *Alexander Holley*, pp. 213-214, 217-218, 228; Engineering Department, "History of the Evolution," 1958, p. 4.

31. John Newton Boucher, *William Kelly: A True History of the So-called Bessemer Process* (Greensburg, Pennsylvania: By the Author, 1924), pp. 80-82; Swank, *History of the Manufacture*, pp. 396-400.

32. McHugh, *Alexander Holley*, pp. 220, 251.

Daniel Morrell hired Robert W. Hunt to establish the first chemical laboratory as part of an iron company at Cambria in 1860. After the Civil War he took part in early testing of the Bessemer process, took charge of rolling the first steel rails on commercial order at Cambria, and assisted John Fritz and Alexander L. Holley in designing and building Cambria's Bessemer plant. He took charge of this plant upon its completion in 1871. He left Johnstown in 1873 to work at the Troy Iron & Steel Company, and later established an engineering consulting firm.[33]

Alexander L. Holley's career was closely associated with establishing the Bessemer steel process in America. He rebuilt, designed, or served as a consultant in starting most of the early Bessemer steel plants, including consulting on Cambria's Bessemer plant in 1871, and supervising the first Bessemer blow in 1873. He was the most renowned steel plant designer and engineer in America. He worked with George Fritz and Robert W. Hunt to roll the first steel rails at Cambria.[34]

By the early 1860s the process for steelmaking was understood chemically, but its commercial use was still hindered because of inadequate machinery, inadequate control over the process, and because suitable pig iron was hard to find. Lake Superior ores eventually became the source of supply. Ten years passed between Kelly's and Bessemer's discoveries and the full commercial use of steel because of the legal, technical, and financial problems involved.[35]

Daniel Morrell with others obtained control of the Kelly patents, organizing the Kelly Pneumatic Process Company. In October 1864 the Kelly process was combined with Robert F. Mushet's patent for recarburizing pneumatic steel. In England Henry Bessemer patented his process and sold his American control to Alexander Holley and Associates of Troy, New York. Thus, the Kelly Company controlled the pneumatic principle and the Mushet patent while the Troy Company controlled the Bessemer patent. Alexander Holley brought together the two groups and formed the Pneumatic Steel Association. The U.S. patent office recognized the Bessemer patent in 1866, and all the patents for the process and required machinery were consolidated. The combination of these patents, bringing together the various technological, mechanical, and chemical aspects of the process, resulted in the establishment of the American steel industry. Members of

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33. Ibid., pp. 214-215, 252, 376-377.

34. Ibid., pp. 213-214, 228-229.

35. Temin, *Iron and Steel*, p. 127; Morison, *Men, Machines*, p. 141.

cooling, the ingots were reheated in furnaces, and moved to the blooming mill where they were hammered or rolled into blooms. These were then passed through the rail mills.[24]

The expansion of the railroad system was a commercial boon to the American iron and steel industry. At the end of 1860 there were 30,626 miles of steam railroad in use, but by 1895 this figure grew to 181,021 miles. The first steel rails were rolled at the North Chicago Rolling Mill in May 1864, from Bessemer steel ingots forged at a small experimental works at Wyandotte, Michigan. The first steel rails rolled in America on commercial order were run at the Cambria Iron Works in August 1867, for the Pennsylvania Railroad Company. After 1867 American Bessemer steel rails began replacing iron rails. The highest tonnage of iron rails made was 808,866 tons in 1872, but by 1877 iron rails fell behind steel rails in the amount produced. In 1876 Cambria's rail production exceeded that of any other plant; totalling 10 percent of all American rail output. In that year 103,743 net tons of rail were rolled; 47,643 tons were iron rails and 56,100 tous were steel rails. In 1880 iron rails totaled 70.9 percent of the nation's railroad track; by 1895, 87.8 percent of track was laid with steel rail. In 1902 the nation produced 2,935,392 tons of Bessemer steel rails. Western Pennsylvania contributed 950,266 tons of this amount, or one-third of the total. This tonnage came almost entirely from the Edgar Thomson Steel Works at Braddock, Pennsylvania, operated by Andrew Carnegie, and the Cambria Iron Works. Steel rails had replaced iron rails by 1907.[25]

The site for the Cambria Iron Company was chosen because of the abundant coal and iron ore deposits, and available water in and around Johnstown. Early iron forges in the area used these local resources, and relied on Johnstown's geographic location to ship goods to far markets. Johnstown was the western terminus of the Allegheny Portage Railroad where passengers and freight were transferred onto canal boats for transport west on the Pennsylvania Mainline Canal, part of which flowed through the eastern section of the iron works. Location and raw resources dictated the early success of iron producing ventures.[26]

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24. Morison, *Men, Machines*, pp. 166-167.

25. Swank, *Notes*, p. 147; James M. Swank, "The Manufacture of Iron and Steel Rails in Western Pennsylvania," *The Pennsylvania Magazine of History and Biography* XXVIII, no. 1 (1904):7; G. T. Raidabaugh, "History of the Rolling of Rails," *The Blast Furnace and Steel Plant* (April 1927):183; Shappee, "History of Johnstown," p. 93; Richard A. Burkert, "Iron and Steelmaking in the Conemaugh Valley," in *Johnstown: The Story of a Unique Valley*, ed. Karl Berger (Johnstown: Johnstown Flood Museum, 1984) p. 281.

26. J. J. McLaurin, *The Story of Johnstown: Its Early Settlement, Rise and Progress, Industrial Growth, and Appalling Flood on May 31st, 1889* (Harrisburg: James M. Place, Publisher, 1890), p. 41.

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

The Cambria Iron Company had several predecessors, dating to early local efforts at producing iron. Local iron forges took advantage of the ore deposits and water transportation, and in the 1840s George Shryock King and a partner, Dr. Peter Shoenberger, operated four iron furnaces in the area. The two associates owned more than 25,000 acres of land in Cambria and Somerset counties, including the ore in Prospect Hill overlooking Johnstown, which was mined from the 1840s until the 1880s. When the Pennsylvania Railroad entered the Conemaugh Valley, George King recognized the potential of producing iron railroad rails. Construction of a rolling mill and four coke furnaces began in March 1853, after articles of association establishing the Cambria Iron Company were signed August 21, 1852. The location chosen for the new plant was the Millville bottom, bounded by the railroad, canal, Prospect Hill, and the Conemaugh River.[27]

Monetary problems resulted in the company's transfer from local and New York hands to those of Philadelphia businessmen. Wood, Morrell and Company leased the Cambria Iron Company for five years, starting May 21, 1855. In 1862 the company took over the plant through default.[28]

Technical innovation was Cambria's early claim to fame. All of the significant persons associated with the Cambria Iron Company contributed to the nation's development through their contributions to the American iron and steel industry. John Fritz was considered the most innovative engineer of his day, a mechanical genius, and many iron and steel employees who worked with him were called "Uncle John's boys." He arrived at Cambria in 1854, and designed the three high roll mill and other machinery. On July 29, 1857, iron railroad rails were first rolled on John Fritz's mill which economized on both labor and heat by allowing hot rails to be passed alternately through the rollers in both directions without removal. He left Cambria in 1860 after honing a competent labor force, and after influencing the commercial success of the iron rail industry. Fritz subsequently became closely associated with the Bethlehem Iron Company, in Bethlehem, Pennsylvania. He was one of a group of men who applied the process

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27. Henry Wilson Storey, *History of Cambria County Pennsylvania* (New York: The Lewis Publishing Company, 1907) 1:400-405; James M. Swank, *Cambria County Pioneers* (Philadelphia: Allen, Lane & Scott, 1910), pp. 66-68; Thackray, "Brief History," pp. 1-2.

28. Storey, *History of Cambria*, 1:413-414, 416-417; Nathan Daniel Shappee, "A History of Johnstown and The Great Flood of 1889: A Study of Disaster and Rehabilitation," Ph.D. dissertation, University of Pittsburgh, 1940, pp. 65-66.

The Cambria Iron Works was an early producer of iron rail, the sixth plant to produce Bessemer steel, the first to roll steel rail on commercial order, and an early producer of steel rail. In 1876 the plant rolled the largest aggregate of rails rolled in one year by one mill in the country. Thus, the Cambria Iron Company's story is more than an examination of the nationally significant technological advances made there in the conversion from iron to steelmaking. The continuing history of the steel business in America can also be seen in Cambria's continuing physical evolution up to the present day. The plant's history is a contextual look at the human, social, economic and political responses to industrialism, in which Cambria played a significant, yet representative role.

The Cambria Iron Works' physical location in western Pennsylvania was a crucial factor in its success during its early years. During colonial times Pennsylvania was the most important iron manufacturing colony. It had abundant resources of raw materials and water. Philadelphia merchants financed the ironmaking establishments, and by the end of the colonial era the industry was located west of the Susquehanna River in York County, the Cumberland Valley, and in the Juniata Valley. By the time of the Revolutionary War iron production commenced in the western part of Pennsylvania. Eastern manufacturers had great difficulty sending heavy iron goods over the Allegheny mountains, thus providing western ironmasters with some protection from competition. Blast furnaces and forges were established close to ore, charcoal and water sources, and the wrought iron and pig iron was shipped by animal or boat to Pittsburgh, where they were finished. Pittsburgh was an iron processor, but not yet an iron manufacturer.[20]

The high cost of British rails eased competition and spurred American production. By the mid-1850s new American rail mills were built, primarily west of the Allegheny Mountains, including the Cambria Iron Company. Western Pennsylvania became a leader in the production of iron and steel rails. This was due in part to the liberal supply of raw materials, but also because of protective legislation. Liberal grants of public lands to railroad companies, protective tariff policy, and the homestead policy all spurred the construction of thousands of miles of railroads. With the building of these roads, the consumption of iron increased along with the population.

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20. David Lewis, *Iron and Steel in America* (Greenville, Delaware: The Hagley Museum, 1976), pp. 20, 29.

The opening of farms and ranches in the Midwest and West expanded the market for iron products.[21]

Railroads were important to American growth from 1850 to 1890. Railroads were the first dominant business, and railroad expansion sparked many changes in the nation's social and technological fabric. The railroads created the demand for iron, then steel rail, and the railroaders were the biggest supporters of the fledgling Bessemer industry. Of the first 11 Bessemer plants, all but one were organized for the rail business. Steel plants were established across the United States, and from 1870 to 1907, Bessemer steel comprised half of national production. Almost all of this steel went to the production of rails. American production of Bessemer steel rails surpassed that of Great Britain in 1879; by 1886 the United States was the largest steel maker in the world, with an output of more than 2,500,000 tons.[22]

The Bessemer process consisted of forcing cold air under pressure into a converter partially filled with melted cast iron. The air's oxygen combined with the iron's carbon and silicon and eliminated it through combustion. The silicon, manganese, and carbon joined with the oxygen to form combustible gases which burned off, leaving pure iron. However, some carbon was needed to make steel, so it was added back to the iron in the form of manganiferous pig iron (spiegeleisen), composed of carbon, manganese, and iron. The product was liquid Bessemer steel, produced in large quantities, which could then be poured into ingots. The commercial success of Bessemer steel laid in the control of the recarburization step of the process.[23]

In a Bessemer steel plant the pig iron was brought in by railroad cars. A ton was dumped into the cupola where it was melted and run off into ladles. The melted iron was tipped into spouts which filled the converters. Fans were started to blow air into the tuyeres and through the metal. This began the blow, after which the molten steel was tipped into ingot molds. After

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21. Peter Temin, *Iron and Steel in Nineteenth-Century America An Economic Inquiry* (Cambridge: The M. I. T. Press, 1964), pp. 21-22; James M. Swank, "The Manufacture of Iron and Steel Rails in Western Pennsylvania," *The Pennsylvania Magazine of History and Biography* XXVIII, no. 1 (1904):1-2.

22. Elting E. Morison, *Men, Machines, and Modern Times* (Cambridge: The M. I. T. Press, 1966), pp. 170-171; James M. Swank, *Notes and Comments on Industrial, Economic, Political, and Historical Subjects* (Philadelphia: The American Iron and Steel Association, 1897), pp. 155-156.

23. James M. Swank, *History of the Manufacture of Iron in All Ages, and Particularly in the United States from Colonial Times to 1891* (Philadelphia: The American Iron and Steel Association, 1892), p. 395; Morison, *Men, Machines*, pp. 126-127.

most productive iron and steel company of the mid- to late-nineteenth century. It represents the evolution of the iron and steel industry, from scattered furnaces, forges, and rolling mills, to fully integrated plants. The earliest surviving buildings reflect a vernacular style of industrial construction, including heavy timber and iron framing and ornate brickwork. Iron ore, coke, and coal supplying the mills came first from local and regional sources; Cambria being one of the larger coal and coke producers in the area. Raw materials came from Prospect Hill and the Rolling Mill Mine locally, as well as from mines in Fayette, Cambria, Blair, and Bedford, and Westmoreland counties. Iron ore was later obtained from the Great Lakes region, a trend reflective of the industry as a whole. This control of raw resources was crucial to the iron and steelmaking operation. Much of the labor in the Cambria mills was supplied initially by American-born workers and subsequently by western and southern European workers. This diversified workforce accounted for Johnstown's rich ethnic heritage. Through the decades, the expanding plant in Johnstown diversified its product line to offer steel needed for an industrializing America. In addition to steel trackwork for mine and industrial railroads, at various times in its history, the plant manufactured structural steel products, wheels, axles and forgings, merchant bar and agricultural steels, spring steels, concrete bars, wire rods and wire products, steel freight and mine cars, coke and by-products, and Bessemer and open hearth plates.

The Lower Works convey a sense of historic and architectural cohesiveness through its design, setting, materials, and association. The buildings are made of brick, timber, iron and steel, and were functional for specific industrial processes. The plant's evolution was dictated by changing technology and the need to upgrade facilities for cheaper and more efficient steel production. The plant's layout was based on the most efficient use of space within an area defined by natural features--the river and looming hillside. The spacing of older brick buildings among newer corrugated tin ones shows the relationship between the historic iron and steelmaking processes and newer ones. The uses and functions of older facilities changed, yet they continued to contribute to the on-going process of steel fabrication.

By 1900 the Cambria Steel Company consisted of the original plant, the Lower Works, as well as two other plants, Gautier and Franklin. The company also owned various support and supply operations such as water works, coal mines, and coke ovens. The Gautier Plant's significance lies in the integrity of its buildings and in the visible evolution of mill machinery. Constructed by the Cambria Steel Company in the late 1890s and after, the buildings remain virtually unchanged. The remaining active mills reflect both modern milling practices, and the evolution of mill industry. The 12-inch Mill is a direct descendant of the type of three high mill invented by John Fritz at Cambria.

The building of the Franklin Plant was a result of the Cambria Steel Company's decision to expand in Johnstown rather than move the entire operation to an interior port. The building of this plant allowed Cambria to diversify, expand in the steel market, stay competitive, and remain one of the largest steel producers in the nation. The most intact parts of the Franklin Plant include the Steel Car Department, followed by the Primary Mills and the Steelmaking Department. Railroad cars are still made in buildings built for that purpose, and remaining machinery reflects the evolution of car building from hand methods to modern automation. The buildings at the Primary Mills are largely unchanged and still house the same functions (production has been reduced, a reflection of the current steel market). Remaining mill machinery dating from the post-war modernization of the plant, ca. 1950s, is still active. The shell of the open hearth building is a remnant of the Cambria Steel Company's capacity for steelmaking which enabled the company to be a national leader in steel production. The modern electric furnaces located within this building are the latest in steelmaking technology.

The Rod and Wire Plant's significance lies in its integrity, both of the buildings and the evolution of its machinery. The Cambria Steel Company decided to reenter the wire trade and built the plant in 1910-1911. Some functions have changed; the plant no longer produces nails or barb wire. The drawing of wire does still occur in buildings constructed for that purpose on machinery dating from the 1950s. Experimentation with the Bethanizing treatment of wire began here in the 1930s, followed by general acceptance of this type of electric plating process.

Midvale Steel and Ordnance Company built the Wheel Plant in 1917-1918 to manufacture steel wheels. Vice-president and General Manager Edwin E. Slick invented the Slick Wheel Mill which produced stronger wheels capable of handling increased wheel loads and speeds. Remnants of this significant mill remain in the Wheel Plant buildings.

The Cambria Iron Company's significance can be placed in the context of both the late nineteenth and the twentieth century industrialism of the United States. Domestic production of iron and steel changed the look of America, contributed to western expansion and the growth of modern cities, fostered the growth of transportation systems, and was a factor in America's becoming a world power. The iron and steel industry also radically affected human lives. The discipline of the mills imposed long work days and work weeks, intensive labor and for many mill jobs, low pay. American born and immigrant workers alike were often powerless to control their lives and working conditions, and became the most vocal in demanding reforms and a higher standard of living. Several eventful strikes failed before labor was organized in the mills.

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History and Prehistory in the National Park System and the National Historic Landmarks Program 1987 Themes and Subthemes

XII. Business
A. Extractive or Mining Industries
1. Iron and Ferro Alloys
3. Other Metal and Minerals (Coal)

B. Manufacturing Organizations
4. Fabricated Metal and Glass Products

XVI. Architecture
X. Vernacular Architecture (Industrial)

XVIII. Technology (Engineering and Invention)
D. Tools and Machines
F. Extraction and Conversion of Industrial Raw Materials
G. Industrial Production Processes

XXXI. Social and Humanitarian Mevements
H. Labor Organizations

Significant Dates

1852 Cambria Iron Company founded
1871 First blow from Bessemer furnace; Cambria Iron Works sixth Bessemer plant in United States
1876 Cambria Iron Works largest U. S. rail producer
1878 Open hearth furnace installed in Lower Works
1881 Gautier becomes subsidiary of Cambria
1889 Johnstown Flood
1890s Gautier Plant rebuilt
1895 Otto-Hoffman coke by-product plant built
1898-1902 Franklin Plant built
1910-1911 Rod and Wire Plant built
1916-1917 Wheel Plant built
1916 Takeover by Midvale Steel and Ordnance Company
1919 Great Steel Strike
1923 Takeover by Bethlehem Steel Company
1937 Little Steel Strike
1941 Labor organized in Johnstown Plant
1952 Bessemer process discontinued and machinery demolished
1982 Electric furnaces installed at Franklin

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Significant Person

Morrell, Daniel Johnson
Holley, Alexander Lyman
Kelly, William
Fritz, George
Hunt, Robert Woolston
Jones, William Richard

5. Wheel Finishing Shop and Shipping Building, historic and present name (1917-18). Two-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel roof-trusses with monitors, corrugated metal roofing. Interior of the Finishing Shop includes six King tracer lathes (ca. 1950s), two 50" Niles-Bement (ca. 1918) vertical-car wheel machines, one Bullard tracer lathe (ca. 1950s), Snyder boring mill (ca. 1950s), Wheelabrator and inspection station (ca. 1960s). Interior of the Shipping Area includes two lines of railroad tracks. Miscellaneous scrap is now stored in this building. Two-and-one-half-story addition, ca. 1960s, containing a steel frame, corrugated metal siding, steel roof-trusses, and concrete foundation, extends off the north facade. (Level 2, Machinery Levels 3, 4) (PHOTOS E, F, G)

6. Die Machine Shop, historic and present name (ca. 1920s). Two-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel roof-trusses, gable roof covered with corrugated metal and containing metal vent stacks. Interior includes overhead crane (ca. 1920s) and miscellaneous debris. (Level 2)

Contributing associated buildings and structures attached or adjacent to the Wheel Plant include:

7. Accumulator Building, historic and present name (ca. 1918). Partially demolished, brick, houses two ca. 1918 accumulators for operating hydraulic machinery. (Level 2)

8. Electrical Substation Building, historic and present name (ca. 1918 with later additions). Four-story, brick and corrugated metal, glass windows and translucent fiberglass. Still an active substation. (Level 2)

9. and 10. Two lavatory and office buildings, historic and present name (ca. 1920s, 1950s). Brick lavatories, currently abandoned. (Levels 2, 4)

11. Office and Welfare Building, present name (ca. 1950s). One-story, brick, flat roof, glass windows. Currently abandoned. (Level 4)

12. Locomotive Repair Shop, historic and present name (ca. 1920s). One-and-one-half story, brick, flat roof, glass windows. A small repair facility, now abandoned. (Level 2)

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13. Warehouse Building, historic and present name (ca. 1920). One-and-one-half story, brick veneer, steel frame building with concrete foundation. Storage facility served by the Conemaugh & Black Lick Railroad. (Level 2)

14. Craneways, historic and present name (ca. 1918 and ca. 1960s). Two cranes on steel frames located north of the Wheel Plant are still in service.
(Levels 2, 4)

15. Heat Treating Building, present name (ca. 1960s). Two-story, steel frame, corrugated metal. Addition to the south facade of Wheel Mill No. 1, contains ca. 1960s rotary furnace. (Level 4, machinery Level 4)

16. Wheel Plant Office, present name (1955). One-story, brick, with flat roof. Currently abandoned.

Railroad track enters the north end of the building. A one-story brick lavatory is located inside; the building is used for storage. (Level 2)

Contributing associated buildings and structures attached or adjacent to the Rod and Wire Plant include:

10. Motor House, present name (ca. 1950s). Two-story, brick. (Level 4)

11. Leach Plant, present name (ca. 1960s). Three-story, brick building, with translucent fiberglass over the windows. (Level 4)

12. Filter House, present name (ca. 1970s). Three-story, clad with corrugated metal. (Level 4)

13. Water Treatment plant, present name (ca. 1970s). Two steel water tanks. (Level 4)

14. Two-story brick building, present name (ca. 1940s). Concrete foundation, containing pipe storage, electric repair shop, and machine shop with several ca. 1960s lathes and shapers. (Level 4, machinery Level 4)

15. Compressor House, present name (ca. 1940s). One-and-one-half story, brick, with extant Ingersoll-Rand compressors. (Level 4)

16. Water Treatment Plant, present name (ca. 1970s). Pond and water tank. (Level 4)

17. Billet Yard, historic and present name (1930s). Contains two overhead cranes. (Level 2) (PHOTO L)

18. Guard House, historic and present name (ca. 1920s). One-story, brick, flat-roof. (Level 2) (PHOTO M)

<u>Wheel Plant</u>
Contributing Resources

The Wheel Plant, mostly abandoned or used for storage, contains the following buildings and structures:

1. Steel Receiving and Preparation Building, historic and present name (1917-18). Two-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel roof-trusses with monitors, corrugated metal roofing. Interior includes railroad spur line for receiving round blooms and wheel blocks, charging machine (ca. 1950s), parts of three Heller saws (ca. 1950s), billet breaker plate (ca. 1950s), forging press No. 1 (ca. 1918), and overhead crane (ca. 1918). This building, now used for storage, also contains coiled rods and pieces of scrapped machinery from the wheel plant. (Level 2, machinery Level 4) (PHOTOS A, B)

2. Circular Products Rolling Mill No. 1, historic and present name (1917-18). Two-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel roof-trusses with monitors, corrugated metal roofing. Interior includes piercing press (ca. 1950), finish shear, and hub punch (ca. 1950). This building, part of which is now used for coal storage, contains miscellaneous scrap and debris. The original No. 1 mill was developed by Edwin E. Slick to produce sections formed by circular rolling to manufacture railroad car wheels. A combined rolling and pressing action occurred between two revolving dies which formed the wheel. The tread was rolled in a tread rolling mill to produce a harder wearing surface. These wheels were found to be structurally weak and wheel manufacture was afterwards carried out on the No. 2 mill. (Level 2, machinery Level 3)

3. Circular Products Rolling Mill No. 2, historic and present name (1917-18). Two-and-one-half story, steel frame, brick curtain walls, concrete foundation, steel roof-trusses with monitors, corrugated metal roofing. Interior includes rotary reheating furnace (ca. 1918) and parts of Morgan wheel rolling mill (ca. 1918). This building is now used for roll storage and miscellaneous scrap storage. (Level 2, machinery Level 2)

4. Heat Treating Buildings, historic and present name (1917-18). Two buildings, the first is a one-and-one-half story, steel frame with brick curtain walls, concrete foundation, steel Fink roof-trusses, gable roof with one-story monitor, corrugated metal roofing. Interior includes rotary furnace (ca. 1932). The second building is two-and-one-half story, steel frame, brick curtain walls, concrete foundation, steel Fink roof-trusses, gable roof with full-length monitor, corrugated metal roofing. Interior includes charging machine (ca. 1950s), rotary-type drawing furnace (ca. 1932, now partially demolished), pusher-type drawing furnace, pusher-type heating furnace, and a Treadwell quenching tank. (Level 2, machinery Level 3) (PHOTOS C, D)

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Rod and Wire Plant
Contributing Resources

The Rod and Wire Plant contains several buildings and structures associated with the current manufacture of rods and wire:

1. Cooperage, historic name; Office, present name (ca. 1911). Two-story, brick with concrete foundation. Formerly used as cooperage, presently used as offices for the mill, having moved there in 1957. (Level 1) (PHOTO A)

2. Rod Storage, historic and present name (ca. 1911, ca. 1940s). Two-and-one-half story brick, steel frame, steel roof-trusses with monitors, and concrete foundation. A "Loopro Line," consisting of ca. 1950s machinery for drawing, cleaning, coating, and heat-treating steel wire, stands in the 1940s addition, and is still in use. The eastern half of the building is presently used as storage area. (Level 1, machinery Level 4)

3. Rod Mill, historic and present name (ca. 1911). Two-and-one-half story, brick curtain walls, steel frame, steel roof-trusses with monitors, concrete foundation. The original continuous Rod Mill was installed in 1911, and completely removed and replaced in 1955 by a 23 stand Morgan Rod Mill, still in use. Other machinery includes an Olson Furnace (ca. 1950s), and a hook conveyor (1951), used to cool rod coils. (Level 1, machinery Level 4) (PHOTOS B, C, D)

4A. Cleaning, Baking, Drawing, and Annealing Department, historic name; Wire Drawing Mill, present name (ca. 1911). Two-and-one-half story, brick curtain walls, steel frame, steel roof-trusses with monitor, concrete foundation. Ten Vaughn wire drawing machines (ca. 1950s) still stand. Brick infill-offices are adjacent. 4B. Cleaning House, historic and present name; (ca. 1911, 1933). Original cleaning house was rebuilt in 1933. Acid wash and lime tubs are arranged in two parallel sections. 4C. Annealing Room, historic and present name; (ca. 1911). Contains two parallel lines of annealing pots. (Level 1, machinery Level 4) (PHOTOS E, F, G)

5. Wire Drawing Room, historic and present name (ca. 1940s). Two-and-one-half story, brick curtain walls, steel frame, steel roof trusses with sawtooth monitors, concrete foundation. Contains

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wire-drawing equipment (ca. 1950s) and a Patent Furnace, which heat-treats the wire with salt. Part of the building is used for storage. (Level 3, machinery Level 4)

6. Heated Warehouse, historic and present name (ca. 1920s). Two-and-one-half story, brick curtain walls, steel frame, steel roof trusses with sawtooth monitor, concrete foundation. Currently used for storage. (Level 2)

7. Several departments in one building: Two-and-one-half story, brick curtain walls, steel frame, steel roof trusses with monitors, and concrete foundation. 7A. Nail Department, historic name, Bundling Room, present name (ca. 1911). There is no remaining nail making machinery, and the building currently serves as wire storage. (Level 1) 7B. Fence and Barb Wire Department, historic name; Surface Furnace, present name (ca. 1911). No fence or barb wire machinery remains; the building now contains a ca. 1970s Surface Combustion Co., Toledo, Ohio, annealing furnace and wire storage. (Level 1, machinery Level 4) (PHOTO H) 7C. Galvanizing Department, historic name; Galvanizing Plant and Bethanizing Plant, present name (ca. 1911). The original mill, in 1911, included two galvanizing lines, a process consisting of coating steel wire with zinc; a smaller line was added in 1924. In 1935 the No. 2 galvanizing line, coating steel wire with zinc, was removed to make room for Bethanizing units No. 1 and No. 2. Bethanizing was an electric-plating process for zinc-coating on steel wire, and was based on patents by Dr. V. C. Tainton. The active plant contains aluminizing and Bethanizing heat treatments. (Level 1, machinery Level 3) 7D. Experimental Bethanizing Plant, Electroplating, historic name; No. 3 and No. 4 Bethanizing, present name (1944). An experimental work was established in 1944, and placed into commercial production in 1951, having two parallel lines each treating six strands of wires. Extant machinery is still operating with GE spoolers. (Level 3, machinery Level 3) (PHOTO I)

8. Warehouse, historic and present name (ca. 1911). Two-and-one-half story, brick curtain walls, steel frame, steel roof-trusses with monitors, and concrete foundation. Building is still used for wire storage and contains two brick-infill sections. The northernmost section contains Ajax-Hough (Cleveland) straightening and shearing machines, and bar straighteners; and three Lewis Machine Company (Cleveland), No. 8F, Travel-Cut machines, along with other spooling and shearing machinery, all dating from 1910s-1930s. (Level 1, machinery Level 2) (PHOTOS J, K)

9. Warehouse Extension, historic and present name (1936-1937). Two-and-one-half story, brick curtain walls with corrugated metal, steel frame, steel roof-trusses with monitors, and concrete foundation. Windows are covered with translucent fiberglass. A Conemaugh & Black Lick

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foundation. Used for assembly of rail cars and contains ca. 1920s hand-operated riveting machines termed Bull riveters. (Level 1, machinery Level 2)

10. Car Shop No. 1, historic and present name (1901-1906). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete foundation. Used for assembly line for steel cars with associated machinery including ca. 1970s automated cold riveters and overhead cranes. (Level 1, machinery Level 4)

11. Car Shop No. 3, historic and present name (1901-1906). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with gable roof, concrete foundation. Contains associated machinery for steel car assembly, including angle punch. Also serves as piece storage for steel car assembly. (Level 1, machinery Level 4)

12. Car Shop Storage, historic name; Car Preparation Shop, present name (ca. 1902). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor and steel vent stacks, concrete foundation. Contains piece storage and associated fabrication machinery, including a 1960s Beatty punch and angle punch. (Level 1, machinery Level 4)

13. Stockyards, historic and present name (ca. 1900). Active, open stockyards with traveling cranes and runways serve the Steel Car Department. Overhead cranes include two Morgan 20-ton, an Alliance 20-ton, Bethlehem 20-ton, and Sellars 20-ton cranes. (Level 1)

14. Welding Shop, present name (1960). Two-story, steel frame, corrugated metal siding, steel roof-trusses, concrete foundation. Corrugated tin building used for welding shop, shipping, and storage. (Level 4)

15. Structural Shop, historic name; Tank Car Shop, present name (ca. 1898, 1922, ca. 1940s). One-and-one-half story, steel frame, brick nogging, riveted Warren steel roof-trusses, concrete foundation. A structural fabricating shop which was used until 1922; the adjoining Steel Tank Car shop was built in 1922. Another addition was made in the 1940s. Active shop contains overhead cranes, welding machinery, 250-ton press, and other smaller machinery used to fabricate steel hopper cars. (Levels 1, 2, machinery Level 4) (PHOTO X)

16. Car Paint Shop, present name (1960s). Two-story, steel frame, corrugated metal siding, concrete foundation. Building burned and was rebuilt in the 1960s. Contains Conemaugh & Black Lick Railroad track and equipment used for painting steel cars. (Level 4)

17. Car Paint Shop, historic and present name (ca. 1920s). Steel frame building. Contains east and west car transfer for transporting assembled steel cars into shot blasting facility, a part of the car painting process. (Level 2)

Other contributing buildings associated with the Steel Car Department include:

18. Compressor Building and Electric Substation, historic and present name (ca. 1910). Two-story, steel frame, brick cladding, concrete foundation. The substation contains four Westinghouse generators. Attached are a Pump House (ca. 1920s), one-story brick building, and a Pipe Shop (ca. 1920s), one-story, brick. (Level 2)

19. Woodworking Shop, historic and present name (ca. 1920s). Two-story, steel frame, brick veneer, concrete foundation. Attached is one-story brick pipe shop. (Level 2) (PHOTO Y)

20. Pipe Shop and Air Brake Material Building, historic name; Bolt Repair and Chain Shop, present name (ca. 1920s). One-story, brick, contains weld test area, hydraulic repair, electric reamer, and basic tool repair. Attached is a one-story office. (Level 2)

21. Power Transformers and Accumulator, historic and present name (ca. 1920s). Five-story, steel frame, brick cladding, concrete foundation. Houses pressure vessel for hydraulically operated machinery. (Level 2) (PHOTO Z)

22. Storage and Lavatory Building, historic and present name (ca. 1910s). Two-story and two-and-one-half story, steel frame, brick cladding lavatory building extends off the north facade of the storage building which contains a gable roof. The lavatory building has a flat roof. (Level 2)

23. Guard House, historic and present name (ca. 1920s). One-story, brick, flat roof. Currently in use. (Level 2)

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13. Shearing Shed No. 2, historic name; 21-inch Billet Mill, present name (ca. 1920s). Two-and-one-half story, steel frame, brick-cladding, steel roof-trusses with monitor, concrete foundation. Presently houses 21-inch Billet Mill roll stands. (Level 2, machinery Level 3)

14. 34-inch Billet Mill, historic and present name (1923). Two-and-one-half story, steel frame, steel roof-trusses with monitor, concrete foundation. Attached to north is active No. 2 Shear Shed; attached to south is scarfing and steel preparation facility. The 34-inch Billet Mill is still active. (Level 2, machinery Level 3)

Other contributing buildings and structures associated with the primary mills include:

15. Ingot Stripper, present name (1960s). Steel frame, steel roof-trusses, corrugated roofing, open on all sides. Active facility. (Level 3)

16. Ingot Storage Yard, present name (1960s). Steel frame, steel roof-trusses, corrugated roofing, open on all sides. Active facility. (Level 4)

17. Stores, historic and present name (ca. 1930s). Three-story, steel frame, corrugated metal siding, concrete foundation. (Level 2) (PHOTO T)

18. Water Treating Station, present name (ca. 1970s). One-story, brick, currently used for maintenance. (Level 4)

19. Water Treatment Plant, present name (ca. 1970s). Two steel water tanks, open steel frame, water treatment area. Currently used. (Level 4)

20. Office and Welfare Building, present name (ca. 1950). Two-story, steel frame, brick cladding, concrete foundation. Currently used. (Level 4)

21. Office, present name (ca. 1950). Two-story, steel frame, brick cladding, flat roof, concrete foundation. Currently used. (Level 4)

The Steel Car Department contains several buildings and structures where steel freight cars are fabricated, assembled, and painted:

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1. Works Office, historic and present name (ca. 1900). Two-story, brick, flat roof, stone foundation. Currently in use. (Level 1) (PHOTO U)

2. Machine Shop, historic and present name (ca. 1900). One-and-one-half story, steel frame, brick curtain walls, steel roof-trusses with full-length monitor. Contains lathes, milling machine, and drill presses. Currently in use. Attached is the former oxygen storage building, now a clock station. (Level 1) (PHOTO V)

3. Acetylene Building, historic and present name (ca. 1910s). One-story brick building with flat roof, now serves as labor office. (Level 2)

4. Office Building, historic and present name (ca. 1940s). Two-story, brick with flat roof, concrete foundation. Currently serves as welfare building. (Level 4)

5. Storage Yard, historic and present name (ca. 1910). Open stockyard containing craneways, with 10-ton crane and 20-ton Alliance crane. (Level 2)

6. Forge Shop Extension, historic and present name (ca. 1920s). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete foundation. Contains overhead crane, presses and shears, including two hydraulically operated Verson Presses ca. 1950s. (Level 2)

7. Forge Shop, historic and present name (ca. 1910). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete foundation. Contains overhead crane, a ca. 1951-1952 800-ton Verson Press, two ca. 1890s steam drop hammers, a continuous gas-fired Rust furnace, a Bethlehem steam press, three small Acme presses, and a Williams & White press. (Level 2, machinery Levels 2, 4) (PHOTO W)

8. Forge Shop Stock Yard, historic and present name (ca. 1920s). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete foundation. Contains machinery associated with steel car fabrication, including overhead crane, shears, and ca. 1970s Bliss press. (Level 2, machinery Level 4)

9. Car Shop No. 2, historic and present name (1901-1906). Two-and-one-half story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with full-length monitor, concrete

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Almost all of the former coke operation at the Franklin Plant has been demolished. This area is considered a site. Remnants of coke batteries remain, as well as the following:

10. Sulphate Storage Building, historic and present name (ca. 1900). Two-and-one-half story structure containing steel frame, brick veneer, steel truss roof, concrete foundation, and parts of the by-product coke ovens, almost completely demolished. (Level 1) (PHOTO L)

11. Coke Plant Repair Shop, historic name; Mechanical Department, present name (ca. 1900). Two-and-one-half story, steel frame, brick nogging, steel Fink roof-trusses, concrete foundation. Currently used as a rigger shop. (Level 1)

12. Electric Substation, historic and present name (ca. 1920s). Two-story, steel frame, brick veneer, steel Pratt roof-trusses, concrete foundation. Currently in operation. (Level 2) (PHOTO M)

The Primary Mills have several buildings and structures associated with steelmaking:

1. 40-inch Mill Soaking Pits, historic and present name (ca. 1900). Steel frame, corrugated metal siding, steel roof-trusses, concrete foundation. The soaking pits were filled in 1976. Currently used for storage. (Level 1)

2. 40-inch Blooming Mill (ca. 1900). Two-and-one-half story, steel frame, corrugated metal siding, steel roof-trusses, concrete foundation. Currently houses electric generators for 34-inch Billet Mill. (Level 1)

3. 46-inch Blooming Mill and Soaking Pits Building, historic and present name (ca. 1950-1951). Two-and-one-half story, steel frame, corrugated metal siding, steel roof-trusses, concrete foundation. Contains soaking pits and active machinery, including ca. 1950-1951 46-inch high lift mill with manipulators. (Level 3, machinery Level 3) (PHOTO N)

4. Motor Room, historic and present name (ca. 1950-1951). Two-story, steel frame, steel roof-trusses, brick, concrete foundation. Contains Worthington & Aldrich pumps, used for hydraulic shears for 46-inch bloom mill. (Level 3, machinery Level 3)

5. Engine House, historic name; Storage Building, present name (ca. 1902). Two-story, steel frame, brick nogging, steel roof-trusses, concrete foundation. Although slightly altered, several original arched windows survive. Presently used for storage. (Level 1) (PHOTO O)

6. No. 1 Stock House and No. 2 Stock House, historic name; 46-inch Mill Transfers, present name (ca. 1900). Two-and-one-half story, steel frame, brick nogging, steel roof-trusses, concrete foundation. The two buildings were joined together in 1950-1951. Contains active slab shear and bloom shear ca. 1950-1951, and 30-ton overhead crane. (Level 1, machinery Level 3) (PHOTO P)

7. No. 1 Furnace House and No. 2 Furnace House, historic name; Storage Building, present name (ca. 1902). Two-story, steel frame, steel roof-trusses with monitor, brick and corrugated metal. Currently used for storage. (Level 1)

8. 134-inch Plate Mill, historic and present name (1917). Two-story, steel frame, brick nogging and corrugated metal siding, steel roof-trusses with monitor; original arched windows bricked in. The plate mill was removed in 1976. (Level 2) (PHOTO Q)

9. Shear Building, historic name; Storage Building, present name (ca. 1920s). One-and-one-half story, steel frame, brick cladding, gable roof, concrete foundation. Contains hand-operated crane. (Level 2)

10. Shipping Building, historic and present name (ca. 1950s). Two-and-one-half story, steel frame, steel roof-trusses with monitor, brick cladding and corrugated metal siding, concrete foundation. Currently used for billet storage and shipping. (Level 4) (PHOTO R)

11. Wheel Assembly & Axle Finishing Mill, historic name; Steel Preparation Building, present name (ca. 1920s). Steel frame, steel roof-trusses with monitor, brick, concrete foundation. Currently active as grinder line for steel preparation. (Level 2) (PHOTO S)

12. Shearing Shed No. 1, historic name; Scarfing and Shipping Building, present name (ca. 1902). Two-and-one-half story, steel frame, steel roof-trusses with monitor, brick cladding, concrete foundation. Currently used for scarfing and shipping. (Level 1) (PHOTO S)

Franklin Plant
Contributing Resources

The Steelmaking Department has several buildings and structures associated with steelmaking:

1. Open Hearth Furnace Shop, historic name; Electric Furnace Melting Shop Area, present name (ca. 1901-1950s). Steel frame, steel roof-trusses, Cambria-made structural steel, concrete foundation. Construction began in 1901, and by 1902 seven 75-ton open hearth furnaces were in operation. By 1916, the open hearth shop measured 131 ft. by 1730 ft., and 22 furnaces were in operation. Improvements to the boiler works were carried out in the 1930s, extensive improvements beginning in 1949 included the reconstruction of the operating 21 furnaces. In 1977 work on the installation of a continuous caster commenced, however, only the structural steel work was completed. In 1982 the open hearth shop was replaced with two electric furnaces. Remnants of the open hearth operation are located in the western half of the building and include some checkers, and the base of the furnaces and furnace pans, along with some panel boards and boiler work. The pit level is unchanged. Modern improvements include several structures associated with the electric furnace shop: a large steel-frame conveyor system, a two-story office building with corrugated metal siding, and a steel frame storage bin and hopper. (Level 1, machinery Level 3) (PHOTOS A, B, C, D, E)

2. Open Hearth Ingot Mold Storage Building, historic name; Ingot Storage Yard, present name (1901, 1950s). Partly covered and partly open shed area dating from the 1950s, steel frame, used for storing ingot molds, with 5-15-ton overhead crane. Currently in use. (Level 4) (PHOTO F)

3. Stripper, historic and present name (ca. 1960s). Open yard, steel frame, two overhead cranes. Used for removing ingots from ingot molds. Currently in use. (Level 4)

Other contributing buildings and structures associated with the former open hearth shop operation:

4. Gate House, historic and present name (ca. 1920s). One-story, brick, with flat roof. Currently in use. (Level 2) (PHOTO G)

5. No. 3 Power House, historic and present name (ca. 1930). Five-story, steel frame, brick veneer, flat roof, concrete foundation, with four-story brick addition (ca. 1942). Contains two 15

megawatt General Electric turbine-generator units (ca. 1930) and one Westinghouse 25 megawatt turbine-generator unit (ca. 1942). (Level 2, machinery Levels 2, 3) (PHOTO G)

6. Welfare Building, historic and present name (ca. 1940s). Westernmost section of building is one story, brick; easternmost section is two-story, brick, flat roof, concrete foundation. (Level 4)

7. No. 2 Power Station, historic name; No. 14 Substation, present name (ca. 1902). Steel frame, brick, gable roof. Contains ca. 1920s Allis-Chalmers Turbine generator units. Currently used as substation with frequency changer. (Level 1) (PHOTO H)

8. Blacksmith Shop, historic and present name (ca. 1920s). One-story, brick, flat roof with vent. Currently abandoned. (Level 2)

9. Steam Station, historic name; Brick Storage Building, present name (ca. 1902). One-and-one-half story, steel frame, brick nogging, steel roof-trusses with full-length monitor, concrete foundation. Currently abandoned. (Level 1) (PHOTO I)

Almost all of the former blast furnace operation at the Franklin Plant has been demolished. This area is considered a site. Remnants include:

13. Blowing Engine House, historic name; Storage Building, present name (ca. 1900). Four-story, steel frame, brick nogging, steel roof-trusses, concrete foundation. Blowing engines have been removed. Two overhead cranes remain in place. Currently used for storage. (Level 1) (PHOTO J)

14. Ore Yard, historic and present name (ca. 1900). Yard measures 250 ft. by 1500 ft. Traveling ore crane removed; concrete retaining wall remains. (Level 1) (PHOTO K)

15. Blast Office Stock Bins, historic and present name (ca. 1900). Only remnants are left of this concrete viaduct, which contained hopper bins for transport of ore to skip hoist. (Level 1)

16. Skip House, historic and present name (ca. 1920s). One-story, steel frame, brick veneer, gable roof. The skip house is elevated on a steel frame, now abandoned. (Level 2)

27. Shear Building, historic name; Finishing & Shipping, present name (ca. 1893-1899). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Contains 10-ton Morgan overhead crane, truck and railroad car loading areas, and hot bed for the operating 14-inch Mill. (Level 1, machinery Level 4)

28. 14-inch Mill Billet Yard, historic and present name (ca. 1924). Three-and-one-half story, steel frame, steel roof-truss with full-length monitor, brick nogging, and concrete foundation. Currently used as 14-inch Mill Billet Yard. (Level 2)

29. 14-inch Mill, historic and present name (ca. 1924). Three-and-one-half story, steel frame, steel roof-truss with full-length monitor and vent stacks, steel chimney stacks, brick nogging, and concrete foundation. Contains active 14-inch Mill with roll stands dating from ca. 1950s, manufactured by Continental Roll and Steel Foundry Company (Pittsburgh) and Blaw-Knox Company (Pittsburgh). (Level 2, machinery Level 4)

30. 13-inch Mill, historic name; Mechanical Storage, present name (ca. 1924). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Formerly contained 13-inch Mill, which stopped operation in 1977; currently vacant. (Level 2)

31. 10-inch and 12-inch Mill, historic name; Fuel Depot and Storage, present name (ca. 1924). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Currently used for storage. (Level 2)

32. 10-inch Mill Billet Yard, historic name; Storage Building, present name (ca. 1924-1928). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Currently used for storage. (Level 2)

33. Stock House, Bar Bending, historic name; Shipping Building, present name (ca. 1924-1928). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Currently used for storage. (Level 2) (PHOTO F)

34. 9-inch Mill No. 2, historic and present name (ca. 1924-1928). Three-and-one-half story, steel frame, steel truss-roof, brick nogging, with concrete foundation. Currently houses operating 9-inch No. 2 Mill with associated machinery, including a gas-fired furnace, 1950s Continental or Blaw-Knox roll stands, transfer bed, and shear. (Level 2, machinery Level 4) (PHOTOS G, H)

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35. 9-inch Mill Billet Yard, historic and present name (ca. 1924-1928). Three-and-one-half story, steel frame, steel truss-roof, brick nogging, with concrete foundation. Billets for 9-inch Mill currently stored here. (Level 2)

Other contributing structures and buildings associated with the Gautier Plant operations:

36. Guard House, historic and present name (ca. 1920s). One-story, brick, flat roof. Currently in use. (Level 2)

37. Oil Storage, historic and present name (ca. 1920s). One-story, brick, concrete foundation. Currently in use. (Level 2)

38. Motor House, historic and present name (ca. 1920s). Two-and-one-half story, steel frame, brick veneer, glass-block masonry, concrete foundation. Currently in use. (Level 2) (PHOTO I)

39. Office, historic and present name (ca. 1940s). One-story, brick, concrete foundation. Currently in use. (Level 4)

40. Lavatory, historic and present name (ca. 1920s). One-story, brick, flat roof, concrete foundation. Currently used. (Level 2)

41. Pump House, historic and present name (ca. 1920s). One-story, steel frame, brick veneer, shed roof, concrete foundation. Contains three Ingersoll-Rand compressors, ca. 1920s. (Level 2)

42. Craneway, historic and present name (ca. 1940s). Used for open storage, with 10-ton Alliance crane. Currently used. (Level 4)

43. Lavatory, historic and present name (ca. 1940s). One-story, brick, flat roof, concrete foundation. Currently used. (Level 4)

12. Warehouse Offices and Drawing Room, historic name; Office Building, present name (ca. 1924-1928). One-story brick, intersecting gable, roof steel frame, concrete foundation. Eastern end of the building contains a washroom; western end is currently vacant. (Level 2) (PHOTO C)

13. 8-inch Mill No. 1, historic name; Mechanical Storage, present name (ca. 1924). Two-story, steel frame, brick nogging, steel roof-truss with monitor, concrete foundation. The original 8-inch Mill No. 1 was relocated here in 1924. The building is currently used for mechanical storage. (Level 2)

14. 8-inch Mill No. 2, historic name; Mechanical Storage, present name (ca. 1924). Two-story, steel frame, brick nogging, steel roof-truss with nogging, concrete foundation. The original 8-inch Mill No. 2 was relocated here in 1924. The building currently used for mechanical storage. (Level 2)

15. Office, historic and present name (1928). Two-story, brick, steel frame, concrete foundation, with gable roof. Currently used as office. (Level 2) (PHOTO D)

16. Office and Laboratory, historic and present name (1928). One-story, brick, steel frame, concrete foundation, with hipped roof. Currently used as office. (Level 2)

17. Specialty Shops, historic name; Storage Building, present name (ca. 1930s). Two-story, brick veneer, steel frame, concrete foundation. (Level 4)

18. Car Bottom Furnace Building, historic and present name (ca. 1940s). Two-story, brick veneer, gable roof. (Level 4)

19. 22-inch and 20-inch Mills, historic name; Wire Goods, present name (ca. 1906). Two-story, steel frame, brick nogging, steel roof-truss with monitor, stone foundation. Currently used for storage. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

20. Finishing Shop, historic name; Storage Building, present name (ca. 1906). Two-story, steel frame, brick nogging, steel roof-truss with monitor, stone foundation. Currently houses a welding shop. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

21. Shear Shop, historic name; Storage Building, present name (ca. 1906). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full length monitor, concrete foundation. Building is vacant or used for storage. Contains a 36-inch x 36-inch three-cylinder, horizontal reversing engine, dating from 1905 and manufactured by Southwark Foundry and Machine Company (Philadelphia). It was used to power the 36-inch Universal Plate Mill. (Level 2, machinery Level 1)

22. 36-inch Plate Mill, historic name; Storage Building, present name (ca. 1906). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full length monitor, concrete foundation. Building is currently vacant with the exception of motor house containing an 1800 kva General Electric Induction Motor. (Level 2, machinery Level 2)

23. Storage Building, historic name; Stores, present name (ca. 1930s). Two-story, brick veneer, gable roof, concrete foundation. Used for storage. (Level 4) (PHOTO E)

24. Structural Warehouse, historic name; Structural Warehouse No. 3, present name (ca. 1893-1899). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, concrete foundation. Contains Morgan shear for the operating 14-inch Mill, truck and railroad car loading areas, and a Conemaugh & Black Lick Railroad spur which extends through the building. (Level 1, machinery Level 4)

25. Warehouse No. 1, historic name; Shipping Warehouse No. 1, present name (ca. 1893-1899). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Contains transfer beds for the operating 14-inch Mill, one 10-ton Morgan overhead crane, and truck and railroad car loading areas. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1, machinery Level 4)

26. 13-inch Mill, historic name; Shipping Warehouse No. 2, present name (ca. 1893-1899). Three-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor, and concrete foundation. Formerly contained 13-inch Mill; presently contains transfer beds for the operating 14-inch Mill, one 10-ton Morgan overhead crane, and truck and railroad car loading areas. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1, machinery Level 4)

Johnstown. The Lower Works were not registered in the Pennsylvania state site inventory as of July 1987. The earliest structures on site, consisting of the Pennsylvania Mainline Canal and furnaces, can no longer be seen, and must be discovered archeologically. The discovery of prehistoric and historic cultural resources will be affected by the extent of historic and modern impacts to the site. There is high probability of discovering buried historic cultural resources at the Lower Works. Testing in archeological study units at approximate locations of former structures and features should provide data about such structures as housing, Pennsylvania Mainline Canal, inclined railway, early furnaces, brickyard, and railroad grades.[19]

<u>Gautier Plant</u>
Contributing Resources

1. Roll Shop, historic and present name (1924). Two-story, steel frame, brick curtain wall, steel roof-truss, with wood block floor, houses active roll shop. Extant machinery includes ca. 1920s Lewis Foundry and Machine Company (Pittsburgh) roll lathes used to cut rolls, and ca. 1970s Pangborn shot blaster. A one-story brick addition serves as a tool room. A roll storage yard and overhead craneway are adjacent. (Level 2) (Photos A, B)

2. 12-inch Mill No. 1, historic and present name (ca. 1893). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor. Contains active mill machinery, including two-high and three-high, ca. 1920s, Blaw-Knox roll stands, 15-ton Cleveland overhead crane, 1903 gas fired furnace, and a straightener and shear. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1, machinery 3)

3. 9-inch Mill No. 1, historic name; Storage, present name (ca. 1893). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full-length monitor. Once housed the 9-inch Mill No. 1; currently serves as roll storage for the 12-inch Mill No. 1. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1)

4. 9-inch Mill No. 3, historic name; Storage, present name (ca. 1893). Two-and-one-half story, steel frame, brick nogging, stone foundation, steel roof-truss with full length monitor. Once

19. U. S. Department of the Interior, National Park Service, Applied Archeology Center, Rockville, Maryland, and American University, Washington, D. C. "An Archeological Planning Overview of the Cambria Iron Company, Lower Works Johnstown Pennsylvania," by Paula A. Zitzler, August 1987, pp. 10-11, 15-18.

housed the 9-inch Mill No. 3, currently used for storage. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 1)

5. Stock Yard Building, historic name; 12-inch Billet Yard, present name (ca. 1924). Two-and-one-half story, steel frame, brick nogging, stone foundation, steel roof-truss. Serves as billet storage for the 12-inch mill, and contains an overhead crane. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

6. Stock Yard Building, historic name; Storage Building, present name (ca. 1900). Two-and-one-half story, steel frame, brick nogging, stone foundation, steel roof-truss with full length monitor. Currently vacant, it contains overhead crane. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

7. Stock Yard Building, historic name; Storage Building, present name (ca. 1900). Two-and-one-half story, steel frame, brick nogging, steel roof-truss with full length monitor, stone foundation. Currently vacant, it contains overhead crane. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

8. Rail Anchor Shop, Fence Post Shop, Smith Shop, historic name; Storage Building, present name (ca. 1900). Two-story, steel frame, brick nogging, steel roof-truss with monitor, stone foundation. Currently vacant. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

9. Frog & Switch Plant and Machine Shop, historic name; Machine Shop, present name (ca. 1924). Two-story, steel frame, brick nogging, steel roof-truss with monitor. Currently contains small machine shop at western end of building, and remainder is used for storage. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

10. Shipping Warehouse, historic and present name (ca. 1924). Two-story brick nogging, steel frame, steel roof-truss, concrete foundation. Currently used for shipping. Four ca. 1956 annealing furnaces remain in the southern end of the building. A Conemaugh & Black Lick Railroad spur extends along the easternmost section of the building. (Level 2)

11. Pickling Plant, historic and present name (ca. 1911). Two-story, corrugated metal, steel frame, steel roof-trusses; largely rebuilt ca. 1950s. Currently used for storage, and contains a Manning, Maxwell & Moore (Muskegon, Michigan) 10-ton overhead crane. (Level 4)

24. Railroad Office, historic name; Blast Furnace Office, present name (ca. 1924). Two-story brick building with wood frame and wood rafters was used as offices for rail operations by Bethlehem Steel. By the 1960s the building was an office for the blast furnaces operations, and by the 1970s, an office for the car repair No. 4 shop. The office was vacated in 1980. (Level 2)

25. Water Treatment Building, historic and present name (late 1920s). Two-story brick building was built by Bethlehem Steel to treat water for use in the Lower Works and Gautier. The building is virtually unchanged. (Level 2)

26. 48-inch Mill Soaking Pits Building, historic name; Car Repair Shop, present name (ca. 1930). Four-and-one-half story, brick and corrugated metal, steel frame building contained six furnaces for a blooming mill operation. Each furnace contained four soaking pits, and blast furnace or coke gas fired the furnaces. Soaking pits have been filled in, and the overhead cranes survive. Building is currently used for repair shop and steel fabrication work. (Level 2)

27. Steam Station No. 3, historic name; No. 1 Steam Station, present name (1930). Six-story brick and steel frame building contained two Babcock & Wilcox Stirling boilers which produced steam for the power house, Lower Works, and nearby Gautier. The building, used only sporadically, remains largely unaltered from 1930s appearance, and original boilers remain. (Level 2, machinery Level 2)

28. Crane Runway, historic name; No. 9 Yard, present name (ca. 1930). This steel frame shed has no walls, and originally served as a scarfing building. It is currently used as a junk/storage yard. (Level 2)

29. Axle Heat Treating Building, historic name; Storage Building, present name (ca. 1950). One-and-one-half story corrugated metal, steel frame building with steel and Fink truss roof system was built as an axle heat treating facility. It stands on the original site of the wire mill, demolished in the 1930s. Currently used for storage, one 1950s heat treating furnace remains. (Level 4, machinery Level 4)

30. Manganese Shed, historic name; No. 4 Car Shop, present name (ca. 1960). Steel frame building housed manganese slabs brought from blast furnaces by rail. Workers in the shed broke the manganese with sledge hammers, and it was loaded onto metal pans, then onto rail cars and shipped. Manganese was produced until early 1970s, and building used as a car shop until recently. Building currently vacant. (Level 4)

31. Turbo-Blower Building, historic name; Steam Station #7, present name (1961). General Electric turbo-blowers installed in this four-story, steel-frame, brick veneer building in 1961. Used in conjunction with Blast Furnace "E" until 1977. Taken off line in 1977; in 1982 it was converted to a steam plant with gas-fired boilers. (Level 4)

32. Airco Buildings, present name (1960s). Steel and metal corrugated sided buildings built in the 1960s provide compressed air for the plant. (Level 4)

33. Oxygen Acetylene Building, present name (late 1950s). Two-story brick building was built by Bethlehem Steel in the late 1950s to provide the Lower Works with oxygen and acetylene. (Level 4)

34. 11-inch Mill & Shipping Building, historic name; 11-inch Mill & Shipping Building, present name (1959-1961). Five-story steel frame structure with metal siding built on site of original Bessemer steel plant and open hearth building contains series of automated rolls and shears. Steel bars from the 11-inch mill are processed through forging, machining, and cold drawing. Parallel to the mill is a steel-frame building used to ship mill products. The mill is still in operation with crew of 20-30 men and is center of activity in Lower Works, along with Blacksmith Shop, Carpenter Shop, Tin Shop, and Roll Shop. (Level 3, machinery Level 3)

35. Water Treatment Plant, present name (1960s). This plant was built solely to furnish water for the 11-inch Mill. (Level 4)

All spur rail lines within the Lower Works belong to the Conemaugh & Black Lick Railroad, a captive railroad belonging to Bethlehem Steel Corporation. The spur lines hook into the CSX system outside the works by the Penn Railroad Station, and into the Conrail system in Conemaugh by the Franklin Works.

A visual survey of Prospect Hill facing the works did not reveal any visible extant remains of historic coal or iron ore mines. Several rail or road beds cross the hill's face.

Concerning archeology, no recording of prehistoric cultural resources has occurred at the Lower Works, although several prehistoric and one historic Indian site were recorded in

National Register of Historic Places Continuation Sheet

14. Brass Foundry, historic name; Brass Foundry, Building #514, present name (1896). Two-and-one-half story brick and steel frame building has a steel and Fink truss roof system. It housed a brass foundry which furnished brass fittings and parts for the company. Abandoned in 1983, the building retains much of its historical appearance, and machinery from the early 1900s foundry operation is still extant, including weighing scales, ovens, moulds, and overhead crane. (Level 1, machinery Level 2)

15. Foundry, historic name; Babbit Shop, present name (ca. 1898). One-and-one-half story brick and steel frame building has wrought-iron and Fink truss roof system. The building has been modified with various additions since 1900. The 1890s roof trusses contrast with the 1920s or 1930s brick walls. A one-story corrugated metal shed, ca. 1950 was added on the north end. The Babbit Shop is connected to the Brass Foundry, and was shut down in 1983. (Level 2)

16. Works Order Office, historic name; Works Order Office, present name (ca. 1897). Six-story brick and steel frame building with wood rafters contained a laboratory for testing grades of Cambria steel. Lower floors contained offices for the mill operations. The Bessemer and open hearth plants once nearby have been demolished. The building is currently abandoned. (Level 2) (PHOTO H)

17. Machine Shop, historic name; Machine Shop, present name (1906). Five-story brick and steel frame building built on size of original machine shop. From 1906 to 1970s, 400 men worked a single shift. Machinery still in place consists of ca. 1906 William Sellers 76" vertical boring stand, ca. 1950s American Pacemaker metal cutting lathes, and ca. 1960s Morton universal mills. Much of the machinery has been systematically removed in 1987-1988, including lathes, shapers, grinders, drills, and drill presses. Abandoned in 1984. (Level 2, machinery Levels 2, 4)

18. Erecting Shop, historic name; Structural Shop, present name (ca. 1900). Three-and-one-half story brick and steel frame building with steel and Fink truss roof system. Built as an erecting shop to provide structural steel products, it was linked in 1910 to a boiler shop to the north. The building was abandoned in the late 1970s and contains no machinery except for an overhead crane. (Level 2)

19. Boiler Shop, historic name; Structural Shop #511, present name (ca. 1910). Three-and-one-half story brick and steel frame building with steel and Fink truss roof system served as a boiler shop where pipe for the company's water system was manufactured. It replaced an earlier shop, built in 1880. A steel frame building was built next to the boiler shop as a dipping plant, housing

dipping tanks. After the 1920s the boiler shop was used to fabricate structural steel products, and a one-story welding shop was built alongside, adjacent to the dipping plant. Abandoned in the 1970s, no machinery remains except for overhead cranes. (Level 2)

20. Punching and Riveting Shop, historic name; Structural Shop, present name (ca. 1910). Two-and-one-half story brick and steel frame building with steel and Fink truss roof system was built as a punching and riveting shop connecting with the boiler shop to the south. Steel plate arrived in the shop by rail and went through several operations, including punching, countersinking, and scarfing. The plates were then formed into pipe for the plant's water system. Abandoned in the late 1970s, the building is currently leased. (Level 2)

20A. Crane historic and present name (ca. 1909). Open crane yard which serviced the punching and riveting shop yards. (Level 2)

21. Electric Light and Power Plant, historic name; No. 1 Power House, present name (1907-1908). Two-story brick building housed generators used for electricity in the Lower Works. The use of electricity eliminated need for overhead belts and line shafts needed for previous steam power. Used until all electricity was purchased from public utility by 1980, then converted to machine shop. No historic generating machinery remains. (Level 2)

22. 18-inch Billet Mill, historic name; Storage Building, present name (1908). Building originally housed 18-inch continuous billet mill and other mills until 1952. None of the original machinery survives, and building is currently made of corrugated metal. Only the steel frame of the 1908 billet mill remains. (Level 2)

23. Employee Entrance Gate and Footbridge, historic name; Gate #9 and Footbridge, present name (ca. 1930). A bridge spanning the Conemaugh River has existed at or near this location since the 1850s. By the 1870s an iron railroad bridge was located here, carrying a spur line across the river into the Lower Works. By the early 1890s a wagon bridge stood just south of the existing footbridge. Workers living in Cambria City and other towns north and west of the Lower Works used this bridge to enter the mills. By about 1930 a riveted steel Warren truss bridge, containing two spans, was built as a pedestrian bridge. The 1977 flood destroyed the westernmost span, however, the second ca. 1930 span remains in place. Bethlehem Steel also built a one-story brick building ca. 1930 which served as a gate house. This extant employee entrance gate was the scene of picketing during the Little Steel Strike of 1937. (Level 2)

mill, and has been abandoned since 1982. Contains 1970s HEID finishing lathe from Austria. (Level 4, machinery Level 4)

7. Roll Shop, historic name; Roll Shop, present name (1895). Three-and-one-half story brick and steel frame building with steel and Pratt trusses roof system. Shop was used to service rolls for the various mills. New rolls were produced and old ones were reconditioned on large metal-cutting lathes. Building retains original function and much of its original appearance. An overhead crane remains in place, and a 1900 metal-cutting lathe is still used. A 1958 hydraulic lathe built by Youngstown Foundry & Machine Co. of Youngstown, Ohio, is still used. A crew of 8-10 men presently work in the shop. (Level 1, machinery Level 2, 3)

8. Blowing Engine House, historic name; Storage Building #509, present name (ca. 1890). Three and-one-half story steel frame, brick building housed blowing engines for the four coke-fired blast furnaces. The building contained Southwark vertical blowers which pushed air through the furnaces and hot-blast stoves. Three Mesta blowing engines were installed in 1914, and General Electric Company turbo blowers in 1918. After blast furnace functions ceased the building was converted into storage, and is still in use. (Level 2) (PHOTO E)

9. Boiler House (east), historic name; Pattern Storage Building #507, present name (ca. 1898). Two-and-one-half story brick and steel frame building originally housed sixteen small boilers, used in conjunction with a nearby powerhouse. After four blast furnaces were demolished in the 1920s the building was converted into a pattern storage facility. (Level 2)

10. Boiler House (west), historic name; Pattern Storage Building #506, present name (ca. 1898). Two-and-one-half story steel frame brick building honsed twelve boilers for firing steam engines in the connecting engine house building. The building was converted to a pattern storage facility in the 1920s. (Level 2)

11. Compressor Engine House, historic name; Tin Shop, present name (ca. 1898). One-and-one-half story brick and steel frame building with a full basement. By the late 19th century compressed air served many functions in the steel mill. Compressed air lines extended into the blast furnace operation, various shops, and the rolling mills. This building served as an engine house, producing compressed air for more than 30 years. No original compressor machinery survives. Around 1935 the building was used as a tin shop, and recently as a plumbing shop. (Level 2) (PHOTO F)

12. Hot Blast Engine House, historic name; "E" & "F" Blast Furnace Engine House, present name (ca. 1873). Two-and-one-half story brick steel frame building housed the original blowing engines for the #5 and #6 blast furnaces. Equipment included three vertical blowing engines with blowing cylinders and steam cylinders. A northern addition was built in 1898; a southern one-story office addition was built in 1910. The machinery was upgraded in 1918 with the replacement of the original blowing engines with six Mesta horizontal engines. The southern half of the engine house is largely unaltered from its ca. 1873 appearance. The blowing engines have been removed. (Level 1) (PHOTO G)

Blast Furnace Complex
13A. Blast Furnace No. 5 and cast house, historic name; Manganese Blast Furnace "E" (1876, 1900, 1925). Blast Furnace construction began 1873, put into blast in 1876, and measured 75 feet in height with 20 feet diameter bosh and 8 foot hearth. The furnace was manually charged and produced 600 tons of Bessemer steel per week. In 1901-1903 steam driven skip hoists were installed, ending the manual charging. In 1924-1925 the skip house and blast furnace were demolished and rebuilt. The furnace was improved over the years with the addition of electrical skip hoists, new stock bins in 1930, gas cleaning plant in 1930-1931, and highly efficient hot blast stoves in 1930-1934. By the 1950s, blast furnace No. 5 was used for smelting manganese. Abandoned in the early 1970s, the blast furnace and cast house were torn down in 1986. The site contributes because the furnace foundation survives, in addition to associated structures. (Level 1-site)

13B. Skip House and Stock Bins, historic name; Skip House and Stock Bins, present name (ca. 1900). Brick-clad skip house added to blast furnaces, No. 5 and No. 6 along with steam driven hoist. Hoist was electrified in 1925, but skip house was unaltered. Stock bins were installed ca. 1931, and remain in place. (Level 1)

13C. Hot Blast Stoves, historic name; Hot Blast Stoves, present name (1930-1934). These stoves were improvements to the blast furnace. (Level 1)

13D. Gas Cooler and Washer Plant, historic name; Gas Cooler and Washer Plant, present name. (1930-1931). Gas cleaning facility at blast furnaces No. 5 and No. 6, abandoned in the late 1970s but remains in place. Consists of three primary spray towers and four disintegrators, used for cleaning blast furnace gas. (Level 2)

3. Rolling Mill Office, historic name; Mechanical Department Building, present name (ca. 1874). Two-and-one-half story building served as an office for the rolling mill operations. It originally featured an intersecting gable roof of slate, gothic brick arched windows, and a wrought-iron spiral staircase covered by a wooden cupola. The floor and ceilings are made of vaulted brick arches spanning wrought-iron rails. Several alterations have occurred, including a three-story addition to the south side in ca. 1900, and removal of the cupola. The building served as an office until recently, and contains no historic machinery. (Level 1) (PHOTO B)

4. Car Shop, historic name; Paint Shop, present name (ca. 1881). Two-story building with heavy timber-framing and infilled brick walls served as a car shop for railroad and possibly mining rolling stock. A foundry was located on the first floor and a carpenter shop on the second floor. Carpentry became the main funcoon by the 1930s, with a paint shop and mechanical office in place by the 1950s. The building retains much of its original appearance, including a clipped gable roof, and serves as storage. It is possibly one of the few heavy timber-framed structures containing brick nogging and clipped gable roof existing in a steel mill setting. It contains no historic machinery. (Level 1) (PHOTO C)

5. Foundry and Foundry Addioon, historic name; Foundry, present name (1865, 1880). One-and-one-half story brick building originally had a mansard, slate-covered roof, and housed foundry support services. In 1880 a two-and-a-half story wing was added, with stone foundation, brick pilasters and wrought-iron roof trusses. As recently as the 1930s much of the original 1870s machinery was intact, and the foundry was used until 1983. An overhead crane is in the foundry addition, and no machinery remains in the foundry. A sand shot tower and a 1950s sand conveyor are on the north side of the foundry addition. The foundry addition is almost unaltered except for covering the windows with translucent fiberglass. Ornate brick work remains in the foundry, but extensive changes were made to the original foundry roof. (Level 1)

Rolling Mill/Axle Plant Complex
6A. Merchant Mill, historic name; Axle Finishing Shop, present name (ca. 1872). Three-story brick structure had wrought-iron roof with Pratt trusses. The first rolling mill at Cambria was built in 1853-1854 and destroyed by fire in 1857. The rebuilt mill burned again in 1872, and the 1857 structure was reconstructed and expanded to the north and east. The expansion included building a merchant mill on the northeastern wing of the rolling mill. The merchant mill contained heating furnaces and a rolling train bar mill. Part of the original merchant mill is extant, forming part of

the axle plant finishing shop which was utilized until 1982. No machinery remains from the original merchant mill. (Level 1) (PHOTO D)

6B. Steel Rail Mill, historic name; Steel Car Truck Assembly Shop, present name (ca. 1867). Brick three-story building with a wrought-iron roof is a remnant of Cambria's original steel rail mill thought to have survived the 1872 mill fire. The mill contained presses, drills, heating furnaces, and a 21-inch three-high roll train, now all gone. This section of the complex was, by 1900, used for manufacturing structural shapes; by the 1930s it was a scarfing operation. After 1951 the steel rail mill remnants were used as a car truck assembly shop, and finally abandoned in 1982. Extant machinery is from the car truck assembly operation, and includes one 1920s Niles boring mill, one 1950s and one 1968 Snyder boring mill, a 1930s wheel press, and a 1977 bearing press. (Level 1, machinery Levels 2, 4)

6C. Axle Plant, historic name; Axle Plant, present name (ca. 1924). Three-and-a-half story steel frame, brick structure housed the manufacture of axles for railroad rolling stock. In the 1880s an axle plant expanded into the southwest section of the building, rendering the rolling mill almost unrecognizable. After Bethlehem Steel Company purchased Cambria the axle plant was expanded ca. 1924-1938, and improved through the takeover of the northern half of the old rolling mill. In 1938 an axle finishing shop was installed (See 6D), and in 1944-1945 the axle plant was modified when a rotating furnace was installed. The plant was upgraded again in the 1950s. Manufacture of axles ended in 1982, and remaining machinery includes a 1944 continuous rotary hearth furnace, a ca. 1890s 10,000 lb. Erie hammer, a ca. 1890s 15,000 lb. Erie steam hammer, and conveyors. Additional extant machinery includes axle cut-off machines, grinders, roughing lathes, straighteners, and two ca. 1960s West German GFF forging hammers. (Level 2, machinery Levels 2, 3)

6D. Axle Finishing Shop, historic name; Axle Finishing Shop, present name (1938). One-and-a-half story brick building was built to expand the axle manufacturing capabilities at Cambria. The finishing shop was built along the north side of the original merchant mill wing. Workers used grinders and boring mills to remove defects in the surface of steel axles. Axle manufacturing ceased in 1982. Surviving machinery includes an axle heating furnace, ca. 1950s Morey lathes, ca. 1950s Snyder journal lathes, and ca. 1950s-1960s shapers. (Level 2, machinery Level 4)

6E. Axle Finishing & Storage Building, historic name; Axle Finishing & Storage Building, present name (ca 1960). Two-story steel frame and corrugated metal structure was erected to finish and store axles produced in the axle plant. It extends from the south side of the original merchant

National Register of Historic Places Continuation Sheet

Level 2--Contributing, Historic (pre-1940)

Buildings

a. Buildings erected between 1890 and 1940 that exhibit outstanding architecture or structural engineering design, or are representative of steel mill building technology and design, and remain relatively intact.

b. Buildings that meet the above (2a) criteria and housed an important steelmaking process or important machinery for the manufacture of iron and steel products, or was an important support-service building associated with the steel mill.

Machinery

c. Pre-1940 machinery that is still commonly found in the nation's steel works but, over the next several decades, may become increasingly rare.

Level 3--Greatly Contributing, Nonhistoric (post-1940)

Buildings

a. Buildings built after 1940 that represent major technological innovations in structural engineering design or major works of architecture.

Machinery

b. Machinery manufacrured after 1940 that when installed and in operation represented a major innovation in steelmaking or the manufacture of steel products.

Level 4--Contributing, Nonhistoric (post-1940)

Buildings

a. Buildings erected after 1940 that exhibit outstanding architecture or structural engineering design, or are representative of steel mill building technology and design, and remain relatively intact.

Machinery

b. Machinery representing minor improvements in materials and design, and is commonly found in the nation's steel mills.

Cambria Iron Company
Lower Works
Contributing Resources

1A. Blacksmith Shop, historic name; Blacksmith Shop, present name (ca. 1864). The shop is an octagonal brick structure topped by a wooden cupola and an iron and wood roof system which served the iron and steel works by producing a variety of metal works. Contained steam-powered hammers, coal-fired forges and many tools, including grinders, anvils, vises, and hammers. As many as 200 workers toiled in the blacksmith shop. (Level 1)

1B. During the 1870s a two-story addition was made to the west of the original octagon. (Level I)

1C. Around 1884-1885 a two-story annex with paired windows was built to the east of the shop. This addition held a ca. 1880s steam-powered five-ton Sellers hammer and an overhead crane, still in place. (Level I)

1D. About 1900 a one-story brick building, the chain shop, was built along the southwest side of the shop, containing forges and an overhead crane. A small office was built on the west side at the same time. (Level 1)

1E. In the 1920s a two-story brick structure was built as a locker room and lavatory. (Level 2) The Blacksmith Shop currently retains its original function. The main hammers, four Chambersburg hammers ca. 1920s, two of which are operational, are operated with compressed air. The hammers and gas-fired forges employ a handful of workers. (machinery Level 1) (PHOTO A)

2. Pattern Shop, historic name; Carpenters Shop, present name (ca. 1870). Two-story brick, wood post, and beam shop originally measured 51 ft. by 103 ft., and was topped by a mansard roof covered with slate. Inside machinery included saws, planers, and sanders. The patterns were used for foundry castings. Major additions to the pattern shop include a two-story, gable-roofed addition and a three-story brick fire-hose tower in 1890. The pattern shop is currently used for carpentry work and contains ca. 1950s, 1960s electric-powered machinery and one ca. 1900 pattern marker's lathe. (Level 1, machinery Levels 2, 4) (PHOTO B)

By 1958 the mill manufactured rods; hard drawn, annealed, bright, patented, spheroidized, normalized, galvanized, Bethanized wire and fine wire; barb wire and fence staples; woven wire fence; common, special and roofing nails; straight and cut wire rods; welding wire rods; twisted wire; clothesline and more. The making of nails, barb wire, and woven fence ceased in 1958. Current products include specialized wire and rod orders.[17]

Wheel Plant

The Wheel Plant was built in 1917-1918, and was composed of two units: No. 1 Mill and No. 2 Mill. Edwin E. Slick of Midvale Steel & Ordnance Company, directed the construction and development of the No. 1 Mill, which produced sections formed by circular rolling. The mill manufactured industrial wheels, gear blanks, motor flywheels, brake drums, shaft couplings, pipe flanges, turbine wheels, tire moulds, and other products. Midvale then transferred wheel rolling equipment from its Nicetown, Pennsylvania, plant to form most of No. 2 Mill, which produced railroad car wheels. The plant also contained finishing, shipping, storage and inspection facilities, as well as fuel, power, and hydraulic equipment.[18]

Description of Resources

Rating System for Historic Structures and Machinery Associated with the Nation's Historic Steel Works

Of the many historic steel mills in the United States, very few retain buildings and machinery dating from the 1850s through the 1880s, a period that witnessed the rise of the modern steelmaking and manufacturing complex. This lack of historic resources is not surprising in light of the modernization and expansion that occurred in the nation's steel works after the turn of the century and continues today. Of the few historic resources that survive from this early period, most are buildings or structures that housed steelmaking or manufacturing machinery; there is a marked paucity of surviving historic machinery. Most of the historic buildings that remain, have been, to varying degrees, physically altered. While many of the present guidelines developed by the National Park Service work extremely well for a wide range of architectural resources--

17. HAER, "Survey, Blair and Cambria Counties," n.p.; Engineering Department, "History of the Evolution," 1958, p. 67.

18. Engineering Department, "History of the Evolution," 1958, pp. 77-82.

residential, commercial, and institutional buildings--they are lacking in their applicability for resources relating to the nation's heavy industry.

It is with the idea that new parameters are needed to establish guidelines for evaluating America's historic iron and steel works that the Historic American Engineering Record and the Denver Service Center developed a rating system specifically for evaluating the rich historic resources of the Cambria Iron Works in Johnstown, Pennsylvania. It is hoped that this rating system will be the starting point from which other resources related to the nation's important iron and steel works may be evaluated. Clearly, other work is needed in this area.

Levels of Significance

Level I--Greatly Contributing, Historic (pre-1940)

Buildings

a. Early (pre-1890) buildings that are associated with the historic steel and rail production at Cambria. It was during the years from 1860 to 1890, that Cambria either led the nation or was one of the leaders in rail production and the technology of manufacturing iron and steel rail.

b. Buildings built prior to 1940 that exhibit outstanding architecture or structural engineering, or a high degree of craftsmanship in the use of building materials, and remain largely intact.

c. Buildings that meet the above (1b) criteria and housed an important steelmaking process or important machinery used in the manufacture of iron or steel products, or important support-service buildings associated with the iron and steel works.

Machinery

d. Pre-1940 machinery that was important in the technological advancement of steelmaking or in the manufacture of steel products.

e. Pre-1940 machinery that when installed was commonly found in the nation's steel works, but is now among the few remaining of its kind.

National Register of Historic Places Continuation Sheet

Mill; all bar mills, in addition to the 36-inch Universal Plate Mill, rake shop, machine shop, disc shop, and cold rolling and drawing shop.[10]

Bethlehem installed four modern electric driven mills in 1924, and several mills were scrapped and others moved to make room. The four new mills included: a 14-inch structural mill, 13-inch bar mill, 10-inch bar mill, and the 9-inch No. 2 mill. Operations at Gautier have been greatly reduced within the last 10 years due to a decrease in demand for domestic steel, and the age of the facility. The 1977 Johnstown Flood did considerable damage at Gautier, and the losses included the 13-inch mill and the 36-inch plate mill.[11]

Franklin Plant

As the twentieth century approached, the demand for Cambria Iron Company products increased but there was no room for expansion at the Lower Works or Gautier because of physical limitations. Approximately 160 acres of land in Franklin borough was purchased and work began on a new integrated mill. As built, Franklin had coal mines, by-product coke ovens, blast furnaces for pig iron, open hearth furnaces for steel, rolling mills, and rail car shops. Coal mines were on either side of the river with tramways carrying coal into the plant, which was serviced by the captive Conemaugh & Black Lick Railroad. The mills supplied blooms and billets to the other Cambria plants in Johnstown for manufacturing into finished goods.[12]

In 1895 four batteries of Otto-Hoffman by-product ovens were built at Franklin--an industry first. Before this time, all of the company's coke was supplied by coke ovens located in Connellsville, Pennsylvania. In 1901 work began on the open hearth furnaces, consisting of six 75-ton furnaces. Additions to the furnaces were made in 1902, 1903, 1904, 1905, 1907, 1912, and 1916. By 1917, 22 open hearth furnaces were in operation. Mills by 1923 included a 40-inch Blooming Mill, 32-inch Round Mill, 34-inch Billet Mill, 34-inch Universal Slab Mill and 134-inch Plate Mill.[13]

10. Engineering Department, "History of the Evolution," 1958, pp. 54-55.

11. U. S. Department of the Interior, National Park Service, Historic American Engineering Record, "Survey of Historic Structures in Blair and Cambria Counties Pennsylvania 1987," Draft, March 23, 1988, n.p.

12. Ibid.

13. Engineering Department, "History of the Evolution," 1958, pp. 31, 61-62.

Construction of two blast furnaces began at Franklin in 1903, and was completed in 1906 and 1907. The furnaces were served by hot stoves, stock handling systems, and an ore field with ore bridges and traveling car dumpers. The blowing equipment consisted of steam driven vertical blowing engines and tandem horizontal gas driven blowing engines. Two additional blast furnaces were built in 1917 due to increased wartime demands. The last of these furnaces was demolished in 1986.[14]

The Franklin Plant contributed to the production of steel during World War II, and women were first hired there in 1942. After the war Bethlehem Steel Corporation modernized the plant to expand its capacity. All of the open hearth furnaces were rebuilt, the last completed in 1953. During the 1970s construction began on a Basic Oxygen Furnace, but this effort was discontinued after questions were raised about the process' suitability at Franklin, and after the 1977 Johnstown Flood. A continuous caster, capable of producing bar, rod, and wire products, was 90 percent installed at Franklin, but the decision was made to forgo the project after a $10 million investment because of the plant's physical unsuitability. In 1981-1982 two electric furnaces were installed.[15]

Construction of the Franklin Car Shops began in 1898. By 1922 the facility was building 40 steel hopper railroad cars per day. In 1939 the two car assembly lines were revamped, and improvements over the next 10 years consisted of only relocation or addition of equipment. A third car line was added in 1954 to make welded car sides and sills. By 1958 the shop was equipped to produce hopper cars, gondola cars, ore cars, box cars, and mine cars. Adaptions have been made to the facility, but it remains largely intact and the historic function of making railroad cars continues to this day.[16]

Rod and Wire Division

The Cambria Steel Company did not manufacture wire after Gautier's destruction in 1889 until a new wire plant was built in 1910-1911. Built by the Morgan Construction Company of Worcester, Massachusetts, and completed in February 1911, the Rod and Wire Plant originally was composed of a rod mill, wire drawing department, nail machines, and a cooperage department.

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14. Ibid., p. 2.

15. HAER, "Survey, Blair and Cambria Counties," n.p.; John Strohmeyer, *Crisis in Bethlehem: Big Steel's Struggle to Survive* (Bethesda, Maryland: Adler & Adler, Publishers, Inc., 1986), p. 61.

16. HAER, "Survey, Blair and Cambria Counties," n.p.; Engineering Department, "History of the Evolution," 1958, p. 95.

steel construction contained seven basic and one acid open hearth furnaces. A stock yard and refractory bins were nearby.[5]

In 1923 the Lower Works still contained a variety of mills: one 40-inch and one 48-inch two high mills with necessary support machinery produced blooms, blanks, and slabs. The beam, billet and slab mills produced slabs, billets, beams, channels, and tie plates. Billet mills produced billets and sheet bars. The rail mill contained two stands of 28-inch three high roughing and one stand of 28-inch three high finishing mills with two engines, five regenerative heating furnaces, two cooling beds, and saws. The rail mill building was supported by a continuous preheating furnace. The rail finishing department was in a steel building with drill presses, straighteners, saws, and other equipment. The rails produced ranged from 30 lbs. to 130 lbs. The No. 4 Mill produced angles, beams, channels, ship channels, crane rails, crane tees, and rounds.[6]

The axle plant and shop which eventually replaced the rail mills contained trolleys, six furnaces and cranes, four steam hammers of different sizes, axle and crank pin finishing machines, and tables. The plant produced railroad freight car axles, street car axles, crank pins, piston rods, forgings, armature shafts, and mine car axles.[7]

Shops consisted of the smith shop, pattern shop and carpenter shop, storage houses for the pattern shop, two foundry buildings, machine shop with storage yard and erecting shop, boiler shop, structural shop, and roll shop. Also on-site were an air compressor plant, electric power plant, electric repair shop, and two stations with six boilers, one for each blast furnace, and four more stations for the rail mill, Bessemer plant, blooming mills, and electric plant. A three-story brick warehouse was used for warehouse and emergency hospital needs; a six-story brick and steel office building contained the general mill offices and chemical and physical laboratories. A two-story brick general labor building was on-site along with stables, wagon and smith shops, lumber yard, saw mill, weight scales and mill offices.[8]

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5. George E. Thackray, "Brief History of Cambria Plant, Johnstown, Penna." In "History of Cambria and Coatesville Plants, B. S. Co.," typed manuscript, 1925, box: Plants-Danville-Johnstown, Acc. 1699, Bethlehem Steel Corporation Papers, Manuscripts and Archives Department, Hagley Museum and Library, Wilmington, Delaware, pp. 37-41.

6. Ibid., pp. 38-40.

7. Ibid., p. 40.

8. Ibid., pp. 40-43.

National Register of Historic Places Continuation Sheet

The Cambria Iron Company's earliest history is represented by buildings and structures surviving in the Lower Works from the 1860s-1880s. These ancillary buildings and structures were primarily involved with providing support services for the production of iron and steel rail on-site. No key buildings or structures used for iron and steelmaking and rail rolling have survived in their entirety, yet the extant buildings and structures are original to the site, contributed services as smithing, pattern-making and administrative support, and were critical to the overall iron and steelmaking operation. The Lower Works was built to supply rail; the evolution from railmaking to axle making in the 1920s can be seen in the extant axle plant and remaining machinery.

In the years after Bethlehem Steel Company's takeover, many changes occurred in the Lower Works. The company's "long range plan" sought the concentration of all steel ingot production and conversion to be located at the Franklin Plant. As a result several mills were demolished or moved, the open hearth furnaces were demolished and the last Bessemer steel was made in 1952. The Lower Works continued producing axles, manufactured mine cars briefly in the 1950s, and became home to the mechanical maintenance shops. An 11-inch Mill was added in 1959-1961, and axle manufacturing ended in 1982.[9]

Gautier Division

In 1877 the Gautier Mills of Jersey City, New Jersey, moved to Johnstown and became partners with the Cambria Iron Company, forming the Gautier Steel Company, Ltd. These mills were built on the site of the former Pennsylvania Mainline Canal basin and they manufactured plow steel and other merchant bar and wire products. In 1881 the company became a subsidiary of the Cambria Iron Company. After their destruction in the 1889 Johnstown Flood (in which rolls of barb wire entangled debris and victims in a huge mass lodged against the Stone Bridge) the mills were rebuilt after 1892 with the exception of wire facilities. Expansion occurred in several phases, dating from the initial rebuilding phase, followed by 1906-1911 mill additions and 1920s mill additions. Machinery in 1923, the year of Bethlehem Steel Company's takeover, included the 12-inch Mill No. 1, 9-inch Mill No. 1, 9-inch Mill No. 3, 8-inch Mill No. 1, 8-inch Mill No. 3, 14-inch Mill, 10-inch--18-inch mill, 10-inch Mill No. 1, 13-inch Mill, and 20-inch

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9. Engineering Department, "History of the Evolution of the Johnstown Plant Bethlehem Steel Company 1852-1935 (Revised to 1958)," January 10, 1935, Revised August 1958, pp. 49-53.

Cambria Iron Company's Development

Lower Works

The Cambria Iron Company built its first furnaces and mills in an area located close to the Allegheny Portage Railroad terminus and the Pennsylvania Mainline Canal. Transportation was readily available for the company's iron products, but more important was the abundance of nearby coal and iron ore deposits. Located at the junction of two rivers, Johnstown was in a natural amphitheater formed of hills containing iron ore and coal beds, which could be opened above water level and mined at minimal cost. Quantities of mineral resources were thus available for the production of iron and steel, the closest source being Prospect Hill, first mined in 1853. The large amounts of iron ore and coal owned by the Cambria Iron Company allowed it to control and regulate supplies, to manufacture its products cheaply, to combine varieties of ores and coal to produce different products, and offered the company some independence of the general iron and steel market's fluctuations.[1]

After the Cambria Iron Company was established in 1852 its owners purchased more than 25,000 acres of land and built four charcoal fuel furnaces. By December 1853 four coke blast furnaces were being built to smelt iron ore, and a large rolling mill, 600 ft. by 350 ft., was being finished. The rolling mill was of a cruciform shape and contained 60 puddling furnaces, 12 heating furnaces, and 4 scrap furnaces. Five engines were used to turn the machinery. A large machine shop, foundry, and blacksmith shop were finished and in operation. The company made all of its own brick in brickyards on-site.[2]

By the late 1860s Cambria's rail mill was one of the largest in the United States and produced 75,000 tons of rails each year. A second wing was added to the side of the main building for the boilers and a stack reached 150 feet high. Another addition was built, extending along the building's east side, 300 ft. long and 100 ft. wide. This wing contained a double set of three high rolls and 12 heating furnaces with squeezers, shears, saws, straightening hammers, and punches. A third mill was built, an extension shaped as another cross, the main building being 300 ft. long and 75 ft. across. This building included a set of three high bar rolls, 14 puddling furnaces, and a vertical engine. A fourth mill was soon built east of the second rolling mill, to

1. Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company," London *Engineering* XXV (June 21, 1878):485-487.

2. Peter Shoenberger, *Cambria Iron Company of Johnstown, Pa.* (New York: George F. Nesbitt and Co., Printers, 1853), pp. 3-54.

roll Bessemer steel rails. All of the mills were built of brick with slate roofs. The plant also contained a machine shop, foundry, smith shop, pattern making shop, boiler house, metal house, iron house, office building, grist mill, stables, wagon makers and carpenter shops, metal sheds, saddler shops, and other buildings. Approximately 40 rods from the works were four furnaces, connected by railroad, and above them was a coke yard. Around Prospect Hill was a railroad connecting the main ore drift mines.[3]

By 1878 the rolling mills expanded over seven acres in a complex covering 60 acres. At its height of technological influence and rail output, the Cambria Iron Works consisted of 77 buildings and structures. The coal washing and coking apparatus and stock houses for blast furnaces Nos. 1-4 were located on a high bank on Prospect Hill, while the rest of the works were located on level ground. Coking coal was drawn up an incline from the mines under the works. The arrangement of the different departments was convenient, the yard spaces were large, and railways, both standard gauge and narrow, wound throughout the works. With only a few exceptions all of the structures were brick. Most of the roofs covering the rolling mills had iron trusses and slate coverings. All of the roof trusses were rolled and put together at Cambria. By 1878 the company owned in fee simple, 51,962 acres of mineral lands in six Pennsylvania counties: Cambria County, 23,914 acres; Somerset County, 6,211 acres; Indiana County, 1,768 acres; Blair County, 7,392 acres; Bedford County, 10,577 acres; and Huntingdon County, 2,100 acres.[4]

By 1923 the Lower Works (so named because the company had grown to include other plants along the Little Conemaugh River) had expanded with new products being manufactured in addition to rail. The production of axles was undertaken, and the Lower Works still produced Bessemer and open hearth steel. There were six blast furnaces with capacities of 500 tons each. Near the furnaces were a pig casting plant, car dumper, and a sintering plant. The four Bessemer converters were accompanied by all the necessary support equipment, including seven cupolas and blowers, cranes, pumps, and hot metal receivers. The main open hearth building, of brick and

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3. S. B. McCormick, *A Sketch of Johnstown and Suburbs, and the Cambria Iron Works* (Pittsburgh: Barr & Myers, 1868), pp. 11-15.

4. Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company," London *Engineering* XXV (June 21, 1878):485-487; Alexander L. Holley and Lenox Smith, "American Iron and Steel Works Works of the Cambria Iron Company," London *Engineering* XXVI (July 12, 1878):21.

offering other services, being representative of changes occurring in the steel industry as a whole. Steel industry related buildings from the mid-twentieth century are included within the Lower Works site, but do not significantly detract from the overall look and association of the historic property. There are no active coal or iron ore mines in the west side of Prospect Hill facing the district as there were during the formative years of Cambria's history, yet the hill's size and mass has not been altered and provides the same physical backdrop to the works. The Stone Bridge crossing the Conemaugh River south of the historic works contributes to the historic scene.

Gautier Plant

The Gautier Plant, rebuilt after its destruction in the 1889 Johnstown Flood, is located on the south bank of the Little Conemaugh River, to the southeast of the Lower Works. It was built on the site of the former canal basin of the Pennsylvania Mainline Canal. The integrity of the Gautier Plant is high, as the buildings stand as built after the 1890s with few major alterations. The plant physically dominates sections of Johnstown, being visible at the end of several streets leading toward the river. Sections of the plant are in active use, although many large mill buildings stand empty or are used for storage. Buildings closely identified with steel manufacturing and fabrication processes stand intact. Much of the historic machinery has been demolished through the years as products and the marketplace changed; however, three bar mills are active inside the historic buildings, including the 12-inch Mill No. 1, 14-inch Mill, and 9-inch Mill No. 2.

Franklin Plant

The Franklin Plant is located about one-and-one-half miles east of Johnstown in the borough of Franklin, along the south side of the Little Conemaugh River. Franklin is an active works, containing primary mills, an intact steel car department dating from the 1890s, and modern steelmaking department with electric furnaces. It also contains numerous associated buildings, such as offices and shops offering support services. Much historic machinery and structures has been removed, including the open hearth furnaces, by-product coke plant, and the blast furnaces. These have been replaced with active, modern steelmaking equipment which is representative of the continuing evolution of industrial processes associated with the steel industry. The Rosedale Coke Plant, a site associated with the Franklin coke operation, but located near the Lower Works, was built in 1918 and contained batteries of by-product coke ovens. It has been demolished.

National Register of Historic Places Continuation Sheet

Rod and Wire Plant

The Rod and Wire Plant is located approximately three miles northwest of the Lower Works, on the south side of the Conemaugh River. It is an active site with rod and wire drawing occurring to meet current market demand. The buildings look essentially the same as they did when built in 1910-1911; machinery immediately connected to wire drawing has been replaced with 1950s vintage equipment, but other historic machinery remains.

Wheel Plant

The Wheel Plant is located on Main Street north of the Franklin Works, on the south side of the Conemaugh River. The facility was built in 1911 on farmland, and it produced forged railroad car wheels and other circular products. The wheel plant section of the operations closed in 1978, and the remainder of the operations closed in the early 1980s. The entire complex is currently abandoned, with trash and scrap storage strewn throughout. There is presently a scrap metal operation at the rear of the plant. Much historic machinery remains in place, although some has been scrapped.

Evidence of planning for efficiency and increased productivity can be seen in the general physical relationship of buildings to each other throughout the entire Johnstown Plant, as evolved from the Cambria Iron Works. The buildings are situated for easy access to transportation facilities, principally railroad tracks. The general character of the entire plant is industrial, and the building types were designed with function being the primary concern. Ease of hauling in raw resources, transporting products between buildings for processing, efficiency in processing, and ease in moving products to local and distant markets were all considerations in the building designs. Many remnants of the industrial process are visible on-site and add significantly to the look and feel of the historic scene, including tools, machinery, slag piles, waste, storage, grime, dirt, and other products generated by steelmaking. The general condition of the historic contributing buildings is good; there are currently no restoration or rehabilitation activities being conducted on site by the present owner, Bethlehem Steel Corporation. The historic Pennsylvania Mainline Canal, located between Prospect Hill and the plant alongside the Conemaugh and Little Conemaugh rivers, has been filled. The rivers are in a steep gorge with a narrow, 1,500 ft. wide floodplain. The river courses flow in essentially the same configuration as they did throughout the Cambria Iron Company's existence, but the riverbed has been substantially changed; natural earth banks have been channelized with concrete in an effort to control frequent flooding.

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

Section number 1 Page 1

Midvale Steel and Ordnance Company; Bethlehem Steel Corporation, Johnstown Plant

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

Section number 3 Page 1

Number of Resources within Property
Contributing Noncontributing

LOWER WORKS

32	buildings
1	sites
6	structures
39	Total

GAUTIER PLANT

39	buildings
4	sites
43	Total

FRANKLIN PLANT

52	buildings
2	sites
8	structures
62	Total

ROD AND WIRE PLANT

15	buildings
3	structures
18	Total

WHEEL PLANT

16	buildings
2	structures
18	Total

United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations of eligibility for individual properties or districts. See instructions in *Guidelines for Completing National Register Forms* (National Register Bulletin 16). Complete each item by marking "x" in the appropriate box or by entering the requested information. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, styles, materials, and areas of significance, enter only the categories and subcategories listed in the instructions. For additional space use continuation sheets (Form 10-900a). Type all entries.

1. Name of Property

historic name Cambria Iron Company

other names/site number Cambria Iron Works; Lower Works, Gautier Plant, Franklin Plant, Wheel Plant, Rod and Wire Plant, all of Cambria Steel Company; See continuation sheet

2. Location

street & number N/A ☐ not for publication

city, town Johnstown ☐ vicinity

state Pennsylvania code PA county Cambria code PA 021 zip code 15907

3. Classification

Ownership of Property
- [x] private
- [ ] public-local
- [ ] public-State
- [ ] public-Federal

Category of Property
- [ ] building(s)
- [x] district
- [ ] site
- [ ] structure
- [ ] object

Number of Resources within Property

Contributing	Noncontributing	
		buildings
See continuation sheet		sites
		structures
		objects
		Total

Name of related multiple property listing: N/A

Number of contributing resources previously listed in the National Register None

4. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this ☐ nomination ☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ☐ meets ☐ does not meet the National Register criteria. ☐ See continuation sheet.

Signature of certifying official   Date

State or Federal agency and bureau

In my opinion, the property ☐ meets ☐ does not meet the National Register criteria. ☐ See continuation sheet.

Signature of commenting or other official   Date

State or Federal agency and bureau

5. National Park Service Certification

I, hereby, certify that this property is:

- ☐ entered in the National Register.
  ☐ See continuation sheet.
- ☐ determined eligible for the National Register. ☐ See continuation sheet.
- ☐ determined not eligible for the National Register.
- ☐ removed from the National Register.
- ☐ other, (explain:)

Signature of the Keeper   Date of Action

6. Function or Use

Historic Functions (enter categories from instructions)

INDUSTRY/manufacturing facility

Current Functions (enter categories from instructions)

INDUSTRY/manufacturing facility

7. Description

Architectural Classification
(enter categories from instructions)

Other: Vernacular Industrial

Materials (enter categories from instructions)

foundation stone
walls brick, tin
roof wood, wrought iron, steel
other steel, tin

Describe present and historic physical appearance.

Description of Property

The Cambria Iron Company, founded in 1852 in Johnstown, Pennsylvania, was established to supply iron rails for the burgeoning railroad network. Construction of four coke blast furnaces and a rolling mill began, and local and regional sources of water, coal, timber, and iron ore were utilized to feed the ironmaking process. The plant grew, adopted the Bessemer and open hearth steelmaking processes, and became the largest works in the United States by the 1870s. The capacity to produce manufactured rods, parts for agricultural implements, and wire drawing was added in 1878 with the building of the Gautier Works. The formation of the Cambria Steel Company in 1898 signalled massive growth, with the construction of several plants. A new facility for wire products was built in 1911 after Gautier's destruction in the 1889 Johnstown Flood. Initial construction of the Franklin Plant began in 1898 and continued throughout several decades. This plant contained large rolling mills, a by-product coke plant, blast furnaces, open hearth furnaces, and a steel car manufacturing facility. More building occurred when the Midvale Steel and Ordnance Company assumed control of the plant in 1916. The manufacture of rolled freight car wheels and other circular products began with the Wheel Plant's construction in 1917-1918. In 1923 Bethlehem Steel Company acquired the entire Johnstown Plant and embarked upon a major modernization plan which turned the facilities into a modern and coordinated steel mill. The Johnstown Plant, as it has evolved from the initial Cambria Iron Works, presently extends for approximately 12 miles along the Conemaugh and Little Conemaugh rivers.

Lower Works

The oldest section of the former Cambria Iron Company is the Lower Works, located on river bottom land nestled between the west face of Prospect Hill and the east side of the Conemaugh River just north of the confluence of the Little Conemaugh River and Stonycreek River in Johnstown, Pennsylvania. The integrity of the site regarding location, design, setting, materials, feeling, and association is good. The property retains the look and feel of an industrial plant, and finishing of steel products still occurs in several areas. The evolution of the iron and steelmaking process is visible in the changes of the buildings and structures themselves. Several buildings associated with iron and steelmaking remain, these being identified primarily with auxiliary or support services. Structures in the Lower Works closely identified with the iron and steelmaking process have been demolished, including blast furnaces, Bessemer furnaces, open hearth furnaces, and various mills associated with rolling rail. These were replaced with buildings

[x] See continuation sheet

BIBLIOGRAPHY

PRIMARY SOURCES

Manuscripts

Center for Canal History and Technology, Hugh Moore Historical Park and Museum Incorporated
- Bethlehem Steel Corporation Papers
- John Fritz Collection
- Robert H. Sayre Collection

Hagley Museum and Library
- Manuscripts and Archives Department
  - American Iron and Steel Institute Papers
  - Bethlehem Steel Corporation Papers

Historical Society of Pennsylvania
- Library
- Manuscripts Division
  - Edward Carey Gardner Collection
  - Henry C. Carey Papers

Johnstown Flood Museum
- Miscellaneous Collection IV

Articles

Fritz, John. "The Development of Iron Manufacture in the United States Seventy-Five Years of Progress." *Cassiers Magazine* 17, April 1900, pp. 459-471.

________. "Early Days of the Iron Manufacture." *Transactions of the American Institute of Mining Engineers* 24 (1895): 594-609.

________. "The First Three-High Roll Train." *Cassiers Magazine* 7, no. 6, April 1895, pp. 468-472.

Holley, A. L. "The Bethlehem Iron and Steel Works." London *Engineering* XXXII (October 28, 1881): 427-429.

Holley, Alexander L., and Smith, Lenox. "American Iron and Steel Works The Cambria Iron and Steel Works," London *Engineering* XXV, (May 31, 1878): 422-423.

________. "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXV (June 21, 1878): 485-487.

________. "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXVI (July 21, 1878): 21-24.

________. "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXVI (July 19, 1878): 43-43.

________. "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXVI (August 23, 1878): 152-153.

________. "American Iron and Steel Works Works of the Cambria Iron Company." London *Engineering* XXVI (September 20, 1878): 233.

Hunt, Robert W. "A History of the Bessemer Manufacture in America." *Transactions of the American Institute of Mining Engineers* V (May 1876 to February 1877): 201-216.

________. "Steel Rails and Specifications for Their Manufacture. *Transactions of the American Institute of Mining Engineers* XVII (May 1888 to February 1889): 226-248.

Books

Bowen, Eli. *The Pictorial Sketch-Book of Pennsylvania or its Scenery, Internal Improvements, Resources, and Agriculture.* Philadelphia: Willis P. Hazard, 1852.

Fritz, John. *The Autobiography of John Fritz.* New York: John Wiley & Sons, 1912.

McCormick, S.B. *A Sketch of Johnstown and Suburbs, and The Cambria Iron Works.* Pittsburgh: Barr & Myers, 1868.

Catalogs

Cambria Iron Company, Manufacturer of Iron and Steel Railway Bars, Johnstown, Cambria County, Penn'a. *Centennial Exhibition 1876,* 1876.

Cambria Iron Company; Gautier Steel Department, *Gautier Steel Development of Cambria Iron Co., manufacturers of merchant steel of every description: springs, rake teeth, finger bars, knife backs, harrow teeth, plow steel, finished plowshares, and wire of all kinds. Works and general office, Johnstown, Pa.* [Johnstown, Pa.]: Cambria Iron Co., 1883.

Cambria Steel Company. *Bolts, Nuts, Rivets and Small Forgings.* [Philadelphia]: Cambria Steel Co., May 1904.

Cambria Steel Company. *Cambria Fence.* [Philadelphia]: March 1, 1916.

Cambria Steel Company. *Cambria Steel Cars Built by Cambria Steel Company General Office Philadelphia, Pa. Works at Johnstown, Pa.* [New York: Chasmer-Winchell, ca. 1905].

Directories

Clark, Charles B. *Johnstown Directory and Citizens' Register.* May 1889. Republished September 1st, 1889 with notations showing the work of the great flood. Altoona: N.C. Barclay & Sons, 1889.

Costa, Isaac, compiler. *Gopsill's Philadelphia City Directory for 1876.* Philadelphia: James Gopsill, 1876.

McElroy's Philadelphia Directory for 1855. Philadelphia: Edward C. & John Biddle, 1855.

Hite, A.J. "The Handbook of Johnstown for 1856." Typed manuscript, copy available at Cambria County Library.

Swank, Geo. T. *Geo. T. Swank's General and Business Directory of Johnstown.* Johnstown: Geo. T. Swank, Book and Job Printer, 1869.

Webb's Johnstown Directory, 1884. New York: W.S. Webb & Company, Publishers, 1884.

Documents and Reports

Documents Relating to the Manufacture of Iron in Pennsylvania Published on behalf of the Convention of Ironmasters. Philadelphia: General Committee, 1850.

Shoenberger, Peter. *Cambria Iron Company of Johnstown, Pa.* New York: George F. Nesbitt and Co., Printers, 1853.

Tenth Annual Report of the Directors of the Pennsylvania Railroad Co. to the Stockholders, February 2, 1857. Philadelphia: Crissy & Markley, Printers, 1857.

Maps and Atlases

Illustrated Historical Combination Atlas Cambria County Pennsylvania From Actual Surveys by & under the directions of J. A. Caldwell. Philadelphia: Atlas Publishing Company, 1890.

Sanborn Map, February 1886.

Sanborn Map, August 1891.

Newspapers

Bethlehem *The Globe*, 1912
Bethlehem *Globe-Times*, 1942
Johnstown *Daily Tribune*, 1897
Johnstown *Tribune-Democrat*, 1952, 1953, 1956
Johnstown *Tribune*, 1928
New York *American*, 1922
New York *Herald Tribune*, 1974
New York *Times*, 1937
Workingman's Advocate, 1874

Pamphlets

Fritz, John. "Early Days of the Iron Manufacture. Presidential Address at the Bridgeport Meeting of the American Institute of Mining Engineers, October 1894." Author's Edition, 1894.

Local Reception Committee. "The Iron, Steel and Allied Industries of Johnstown, Penn'a for the Information of the Visiting Members of the Foreign and American Technical Societies." October 1890.

Rupp, I. Daniel. "1848 History of Cambria County Pennsylvania," pp. 574-595, reprint ed. from The History and Topography of Dauphin, Cumberland, Franklin, Bedford, Adams, Perry, Somerset, Cambria and Indiana Counties. Southwest Pennsylvania Genealogical Service, Laughlintown, Pennsylvania, pp. 574-595, n.y.

"Sixteenth Annual Report of Cambria Steel Company, December 31st, 1916," 1916.

"A Visit to the Cambria Plant of Bethlehem Steel Company in connection with the 18th Annual Convention, Dept. of Pennsylvania, American Legion, at Johnstown, August 20, 21 and 22, 1936," 1936.

SECONDARY SOURCES

Articles

Anderson, Paul Y. "Fascism – American Style." *The Nation* 146, March 26, 1938, pp. 347-348.

Asher, Robert. "Painful Memories: The Historical Consciousness of Steelworkers and the Steel Strike of 1919." *Pennsylvania History* 45, no. 1 (1978): 61-68.

Benhart, John E. "Location Factors and Location Theory Influencing the Iron and Steel Industry." *The Pennsylvania Geographer* X, no. 4 (December 1972): 3-11.

"Bethlehem Embarks on Major Modernization Program at Johnstown Plant." *Iron and Steel Engineer,* July 1950, pp. 132-134.

"Bethlehem's Johnstown Plant a century of pioneering." *Iron and Steel Engineer,* April 1953, pp. J2-J20.

Bining, Arthur Cecil. "The Rise of Iron Manufacture in Western Pennsylvania." *The Western Pennsylvania Historical Magazine* 16, no. 4 (November 1933): 235-256.

"Blast Furnace Completed in 57 Days." *The Iron Age* (July 12, 1917): 111.

"Cambria's New Record." *The Iron Age* (July 26, 1917): 189.

"Cambria Steel Company's New Bar Mill." *The Iron Age* (May 6, 1915): 1002-1004.

"Cambria Steel Company Improvements in 1914." *The Iron Age* (February 18, 1915): 429.

"The Cambria Steel Company's New Wire Plant." *The Iron Age* (March 23, 1911): 730-734.

"The Cambria Steel Company's New Works." *The Iron Age* (February 6, 1902): 10-15.

"The Cambria Steel Company's Presidency." *The Iron Age* (November 25, 1909): 1630-1631.

"The Cambria Steel Company to Enter the Wire Trade." *The Iron Age* (December 30, 1909): 1955.

"Cambria Steel Workers' Reunion." *The Iron Age* 88, no. 14 (October 5, 1911): 740-743.

"The Cambria Steel Works." *Railway Age Gazette* 49, no. 8 (August 19, 1910): 316-320.

"Case Hardening at the Cambria Works." *The Iron Age* (April 17, 1913): 943.

Chandler, Alfred D. Jr. "The Structure of American Industry in the Twentieth Century: A Historical Overview." *Business History Review* XLIII, no. 3 (Autumn 1969): 255-298.

"A Complete Blast Furnace in 85 Days." *The Iron Age* (June 15, 1916): 1441-1444.

Cooper, Eileen Mountjoy. "To Organize the Unorganized." *Pennsylvania Heritage* 15, no. 1 (Winter 1989): 32-37.

Fink, Frances. "Scabs and Scars." *Literary Digest* 124, August 7, 1937, pp. 13-16.

Graziosi, Andrea. "Common Laborers, Unskilled Workers: 1880-1915." *Labor History* 22, no. 4 (1981): 512-544.

Gutman, Herbert G. "Two Lockouts in Pennsylvania 1873-1874." *The Pennsylvania Magazine of History and Biography* LXXXIII, no. 3 (July 1959): 307-326.

Harbeson, William. "Mediaeval Philadelphia." *The Pennsylvania Magazine of History and Biography.* LXVII, no. 3 (July 1943): 227-253.

"Helping the Workingmen to Help Themselves." *The Iron Trade Review,* June 6, 1912, pp. 1213-1219.

Hill, Charles. "Fighting the Twelve-Hour Day in the American Steel Industry." *Labor History* 15, no. 1 (1974): 19-35.

"A Historic Converter." *The Iron Age* (August 5, 1915): 313.

Hughes, George W. "The Pioneer Iron Industry in Western Pennsylvania." *Western Pennsylvania Historical Magazine* 14 (1931): 207-224.

"Improvements at Cambria and Gautier." *The Iron Age* (December 17, 1891): 1062-1063.

"J. Leonard Replogle and Others Buy Large Cambria Steel Company Holdings." *The Iron Age* (November 18, 1915): 1192.

Jaques, W.H. Lieutenant. "The Establishment of Steel Gun Factories in the United States." *Proceedings of the United States Naval Institute* X, no. 4 (1884): 800-813.

"Johnstown on Trial." *Business Week* March 5, 1938, pp. 18, 20, 22.

Kleinberg, Susan J. "Technology and Women's Work: The Lives of Working Class Women in Pittsburgh, 1870-1900." *Labor History* (Winter, 1976): 58-72.

Krause, Corinne Azen. "Urbanization Without Breakdown Italian, Jewish, and Slavic Immigrant Women in Pittsburgh, 1900 to 1945." *Journal of Urban History* (May 1978): 291-306.

"Labor: Mr. Roosevelt Helps a Friend, as Strike Goes on Its 'American Way.'" *Newsweek* IX, no. 26, June 26, 1937, pp. 13-17.

McClymer, John F. "The Pittsburgh Survey, 1907-1914: Forging an Ideology in the Steel District. *Pennsylvania History* 41 (April 1974): 169-186.

McPherson, Donald S. "The 'Little Steel' Strike of 1937 in Johnstown, Pennsylvania." *Pennsylvania History* 39 (April 1972): 219-238.

"The Midvale Acquisition of Cambria." *The Iron Age* (February 17, 1916): 441.

"Midvale Merged with Bethlehem." *The Iron Trade Review* November 30, 1922, pp. 1468-1469.

"Midvale Plan of Employee Representation." *The Iron Age* 102, no. 13 (September 26, 1918): 763.

"Midvale Plan of Employee Representation." *The Iron Age* 102 (October 3, 1918): 834-835.

"Midvale Plan of Representation Tested." *The Iron Age* 105 (March 18, 1920): 815.

Moye, William T. "The End of the 12-Hour Day in the Steel Industry." *Monthly Labor Review* 100, no. 9 (1977): 21-26.

Murray, Robert K. "Communism and the Great Steel Strike of 1919." *The Mississippi Valley Historical Review* 38 (December 1951): 445-466.

"Open Hearth Steel Soon to Pass Bessemer." *The Iron Age* (April 18, 1907): 1206.

Pendleton, O.A. "Poor Relief in Philadelphia 1790-1840." *The Pennsylvania Magazine of History and Biography* LXX, no. 2 (April 1946): 161-172.

Raidabaugh, G.T. "History of the Rolling of Rails." *The Blast Furnace and Steel Plant* (April 1927): 183-185, 197.

Renshaw, D.E. "Transporting Hot Ingots at Cambria Works." *The Iron Age* (December 29, 1932): 992-993.

Richardson, George A. "Cambria Steel Co. Drops Coal Down Well, Loads It at Bottom and Hauls It to Ovens." *Coal Age* 22, no. 9 (August 31, 1922): 313-317.

________. Cambria Steel Co. Finds that Good Housing Increases Output." *Coal Age* 23, no. 20 (May 17, 1923): 812-818.

________. "Improvements in the Johnstown Car Shops." *Railway Review*. (June 7, 1924): n.p. Reprint issued by Bethlehem Steel Company.

Sayenga, Donald. "Canals, Converters, and Cheap Steel." *Canal History and Technology Proceedings* VIII (March 18, 1989): 74-103.

Schiefer, H.V. "Sintering Flue Dust with Minimum Labor." *The Iron Age* (November 3, 1921): 1141-1146.

Shappee, Nathan D. "Spoilation and Encroachment in the Conemaugh Valley before the Johnstown Flood of 1889." *The Western Pennsylvania Historical Magazine* 23, no. 1 (March 1940): 25-48.

Sherman, Richard B. "Johnstown v. The Negro: Southern Migrants and the Exodus of 1923." *Pennsylvania History* 30 (October 1963): 454-464.

"The Slick Wheel Mill." *The Iron Age* (August 29, 1918): 491-498.

"Steel-Mill Power Plant Has Many Unusual Features." *Power* 64, no. 22 (November 30, 1926): 798-801.

Stephenson, B.S. "Powell Stackhouse." *Iron Trade Review* May 14, 1908, pp. 2-8.

Stone, Katherine. "The Origins of Job Structures in the Steel Industry." *Radical America* 7, no. 6 (November-December 1973): 19-64.

Swank, James M. "The Manufacture of Iron and Steel Rails in Western Pennsylvania." The *Pennsylvania Magazine of History and Biography* XXVIII, no. 1 (1904): 1-11.

Swetnam, George. "Labor-Management Relations in Pennsylvania's Steel Industry, 1800-1959." *Western Pennsylvania History Magazine* 62, no. 4 (1979): 321-332.

Talman, Charles Fitzhugh. "The Story of Iron and Steel." *The Mentor* 7, no. 3 (March 15, 1919, serial no. 175): 1-12.

Thackray, G.E. "Notes on the History of Iron and Steel." *Transactions of the American Society for Steel Treating* (October 1924): 443-490.

Williams, C.F. "Inventor, Engineer, Executive The Story of the Rise of One of the Most Successful of the Younger Generation of Steel Works Executives." *Iron Trade Review* January 21, 1915, pp. 184-185.

Wilson, Edward. "The Organization of an Open Shop Under the Midvale Plan." *Annals of the American Academy of Political and Social Science* 85 (September 1919): 214-219.

Books

Backert, A.O., ed. *The ABC of Iron and Steel.* Cleveland: The Penton Publishing Company, 1925.

Berger, Karl, ed. *Johnstown: The Story of a Unique Valley*. Johnstown: Johnstown Flood Museum, 1984.

Bernstein, Irving. *Turbulent Years A History of the American Worker 1933-1941*. Boston: Houghton Miffin Company, 1971.

Bethlehem of Pennsylvania The Golden Years. Bethlehem, Pennsylvania: Bethlehem Book Committee, 1976.

Bining, Arthur Cecil. *Pennsylvania Iron Manufacture in the Eighteenth Century*. Harrisburg: Pennsylvania Historical and Museum Commission, 1973.

Biographical Directory of the American Iron and Steel Institute. New York: American Iron and Steel Institute, 1911.

Bishop, Philip W. *The Beginnings of Cheap Steel.* United States National Museum Bulletin 218. Washington, D.C.: Smithsonian Institution, 1959.

Blankenhorn, Heber. *The Strike for Union.* New York: The H.W. Wilson Company, 1924.

Bodnar, John. *Immigration and Industrialization Ethnicity in an American Mill Town, 1870-1940.* Pittsburgh: University of Pittsburgh Press, 1977.

_______. Simon, Roger; and Weber, Michael. *Lives of Their Own Blacks, Italians, and Poles in Pittsburgh, 1900-1960.* Urbana: University of Illinois Press, 1982.

Boucher, John Newton. *The Cambria Iron Company.* Harrisburg: Meyers Printing and Publishing House, 1888.

_______. *William Kelly: A True History of the So-Called Bessemer Process.* Greensburg, Pennsylvania: Published by the Author, 1924.

Brody, David. *Labor in Crisis The Steel Strike of 1919.* Philadelphia: J.B. Lippincott Company, 1965.

_______. *Steelworkers in America The Nonunion Era.* New York: Harper Torchbooks, 1960.

Brooks, Robert R.R. *As Steel Goes, . . . Unionism in a Basic Industry.* New Haven: Yale University Press, 1940.

Brophy, John. *A Miner's Life.* Madison: The University of Wisconsin Press, 1964.

Butler, Elizabeth Beardsley. *Women and the Trades Pittsburgh, 1907-1908.* New York: Charities Publication Committee, 1911.

Byington, Margaret. *Homestead The Households of a Mill Town.* [New York] : The Russell Sage Foundation, 1910; reprint ed. , Pittsburgh: University of Pittsburgh, 1974.

Casson, Herbert N. *The Romance of Steel The Story of a Thousand Millionaires.* New York: A.S. Barnes & Company, 1907.

Chard, Jack. *Making Iron & Steel The Historic Processes: 1700-1900.* Bogota, New Jersey: Roebling Chapter of the Society for Industrial Archaeology, 1986.

Clark, Victor S. *History of Manufactures in the United States.* 3 vols. New York: Carnegie Institution of Washington, 1929; reprint ed., New York: Peter Smith, 1949.

Cochran, Thomas C. *Pennsylvania A Bicentennial History.* New York: W.W. Norton & Company, Inc., 1978.

Commemorating the Sesquicentennial of Cambria County 1804-1954. Ebensburg, Pennsylvania: The Cambria County Historical Society, 1954.

Cooling, Benjamin Franklin. *Gray Steel and Blue Water Navy The Formative Years of America's Military-Industrial Complex 1881-1917.* Hamden, Connecticut: Archon Books, 1979.

Degen, Paula and Degen, Carl. *The Johnstown Flood of 1889 The Tragedy of the Conemaugh.* n.p.: Eastern Acorn Press, 1984.

Dubofsky, Melvyn. *Industrialism and the American Worker, 1865-1920.* New York: Thomas Y. Crowell Company, 1975.

Dunaway, Wayland F. *A History of Pennsylvania.* New York: Prentice-Hall, Inc. , 1948.

Eggert, Gerald G. *Steelmasters and Labor Reform, 1886-1923.* Pittsburgh: University of Pittsburgh Press, 1981.

Espenshade, A. Howry. *Pennsylvania Place Names*. State College: The Pennsylvania State College, 1925.

Fitch, John A. *The Steel Workers*. New York: Charities Publication Committee, 1911; reprint ed., New York: Arno & The New York Times, 1969.

Foster, William Z. *The Great Steel Strike and Its Lessons*. New York: B.W. Huebsch, Inc., 1920.

Gable, John E. *History of Cambria County Pennsylvania*. 2 vols. Topeka: Historical Publishing Company, 1926.

Hareven, Tamara K. *Family Time and Industrial Time The Relationship Between the Family and Work in a New England Industrial Community*. Cambridge: Cambridge University Press, 1982.

Hays, Samuel P. *The Response to Industrialism 1885-1914*. Chicago: The University of Chicago Press, 1957.

Hazlett, Dr. T. Lyle, and Hummel, William W. *Industrial Medicine in Western Pennsylvania 1850-1950*. Pittsburgh: University of Pittsburgh Press, 1957.

Hessen, Robert. *Steel Titan The Life of Charles M. Schwab*. New York: Oxford University Press, 1975.

Hetrick, Calvin W. *The Iron King The Story of Dr. Peter Shoenberger, Early Ironmaster of Central Pennsylvania - His Industrial Empire, His Family, His Times*. Martinsburg, Pennsyvania: Morrisons Cove Herald, 1961.

Hoerr, John P. *And the Wolf Finally Came The Decline of the American Steel Industry*. Pittsburgh: University of Pittsburgh Press, 1988.

Hogan, William T. *Economic History of the Iron and Steel Industry in the United States*. 5 vols. Lexington, Massachusetts: Lexington Books, 1971.

Interchurch World Movement. *Public Opinion and the Steel Strike*. New York: Harcourt, Brace and Company, 1921; reprint ed., New York: DaCapo Press, 1970.

Interchurch World Movement of North America, Commission of Inquiry. *Report on the Steel Strike of 1919*. New York: Harcourt, Brace and Howe, 1920; reprint ed., New York: DaCapo Press, 1971.

Kellogg, Paul U., ed. *The Pittsburgh Survey*. 6 vols. New York: Charities Publication Committee, then Survey Associates, Inc. 1910-1914.

Kindl, F.H. *The Rolling Mill Industry*. Cleveland: Penton Publishing Company, 1913.

King, C.D. *Seventy-five Years of Progress in Iron and Steel*. New York: American Institute of Mining and Metallurgical Engineers, 1948.

Livesay, Harold. *Andrew Carnegie and the Rise of Big Business*. Boston: Little, Brown and Company, 1975.

________. *Samuel Gompers and Organized Labor in America*. Boston: Little, Brown and Company, 1978.

Lens, Sidney. *The Labor Wars From the Molly Maguires to the Sitdowns*. Garden City, New York: Anchor Books, 1974.

Lesley, J.P., secretary. *American Iron Association Bulletin 1856*. Philadelphia: American Iron Association, 1856, corrected to 1858.

________. *The Iron Manufacturer's Guide to the Furnaces, Forges and Rolling Mills of the United States with Discussions of Iron as a Chemical Element, an American Ore, and a Manufactured Article, in Commerce and in Industry*. New York: John Wiley Publisher, 1859.

Lewis, W. David. *Iron and Steel in America*. Greenville, Delaware: The Hagley Museum, 1976.

MacFarlane, James. *The Coal Regions of America: Their Topography, Geology, and Development.* New York: D. Appleton and Company, 1873.

McCormick, S.B. *Sketch of Johnstown and Suburbs and the Cambria Iron Works.* Pittsburgh: Barr & Myers, 1868.

McHugh, Jeanne. *Alexander Holley and the Makers of Steel.* Baltimore: The Johns Hopkins University Press, 1980.

McLaurin, J.J. *The Story of Johnstown: Its Early Settlement, Rise and Progress, Industrial Growth, and Appalling Flood on 31st, 1889.* Harrisburg: James M. Place, Publisher, 1890.

The Manufactories and Manufacturers of Pennsylvania of the Nineteenth Century. Philadelphia: Galaxy Publishing Company, 1875.

Morawska, Ewa. *For Bread with Butter The Life-Worlds of East Central Europeans in Johnstown, Pennsylvania, 1890-1940.* Cambridge: Cambridge University Press, 1985.

Morison, Elting E. *From Know How to Nowhere The Development of American Technology.* New York: Mentor Book, 1974.

________. *Men, Machines, and Modern Times.* Cambridge: The M.I.T. Press, 1966.

Mulkearn, Lois, and Pugh, Edwin V. *A Traveler's Guide to Historic Western Pennsylvania.* Pittsburgh: University of Pittsburgh Press, 1954.

Nalle, Richard T. *Midvale - and its Pioneers.* New York: The Newcomen Society of England, 1948.

Pearse, John B. *A Concise History of the Iron Manufacture of the American Colonies Up to the Revolution and of Pennsylvania Until the Present Time.* Philadelphia: Allen, Lane & Scott, Publishers and Printers, 1876.

Perlman, Selig. *A Theory of the Labor Movement.* New York: The Macmillan Company, 1928; reprint ed., New York: Augustus M. Kelley Publishers, 1970.

One Hundred Years of Steel Making in Johnstown 1857-1957. n.p.: Bethlehem Steel Co., [1957].

Peters Jr., Richard. *Two Centuries of Iron Smelting in Pennsylvania.* [Chester, Pennsylvania]: n.p., 1921.

Pinkowski, Edward. *John Siney The Miners' Martyr A Biography.* Philadelphia: Sunshine Press, 1963.

Sharp, Myron B., and Thomas, William H. *A Guide to the Old Stone Blast Furnaces in Western Pennsylvania.* Pittsburgh: The Historical Society of Western Pennsylvania, 1966.

Schroeder, Gertrude G. *The Growth of Major Steel Companies, 1900-1950.* Baltimore: The Johns Hopkins Press, 1953.

Stevens, Sylvester K. *Pennsylvania Titan of Industry.* 3 vols. New York: Lewis Historical Publishing Co., Inc., 1948.

Storey, Henry Wilson. *History of Cambria County Pennsylvania.* 3 vols. New York: The Lewis Publishing Company, 1907.

Strohmeyer, John. *Crisis in Bethlehem Big Steel's Struggle to Survive.* Bethesda, Maryland: Adler & Adler, 1986.

Swank, James M. *Cambria County Pioneers.* Philadelphia: Allen, Lane and Scott, 1910.

________. *History of the Manufacture of Iron in All Ages, and Particularly in the United States from Colonial Times to 1891.* Philadelphia: The American Iron and Steel Association, 1892.

________. *Notes and Comments on Industrial, Economic, Political, and Historical Subjects.* Philadelphia: The American Iron and Steel Association, 1897.

Taft, Philip. *Organized Labor in American History.* New York: Harper & Row, Publishers, 1964.

Temin, Peter. *Iron and Steel in Nineteenth-Century America An Economic Inquiry.* Cambridge, Massachusetts: The M.I.T. Press, 1964.

United Steelworkers of America, Education Department, compilers. *Then & Now: The Road Between The Story of the United Steelworkers of America.* n.p.: n.p., 1974.

Urofsky, Melvin I. *Big Steel and the Wilson Administration A Study in Business-Government Relations.* Columbus, Ohio: Ohio State University Press, 1969.

Vorse, Mary Heaton. *Men and Steel.* New York: Boni & Liveright, Inc., 1920.

Warne, Colston E., ed. *The Steel Strike of 1919.* Lexington, Massachusetts: D.C. Heath and Company, 1963.

Warren, Kenneth. *The American Steel Industry 1850-1970 A Geographical Interpretation.* Oxford: Clarendon Press, 1973.

Wall, Joseph Frazier. *Andrew Carnegie.* New York: Oxford University Press, 1970.

Weitzman, David. *Traces of the Past A Field Guide to Industrial Archaeology.* New York: Charles Scribner's Sons, 1980.

Williams, Bruce T., and Yates, Michael D. *Upward Struggle A Bicentennial Tribute to Labor in Cambria and Somerset Counties.* n.p.: n.p., [1976].

Wolff, Leon. *Lockout The Story of the Homestead Strike of 1892: A Story of Violence, Unionism, and the Carnegie Steel Empire.* New York: Harper & Row, Publishers, 1965.

Writers' Program of the Work Projects Administration, compilers. *Pennsylvania A Guide to the Keystone State.* New York: Oxford University Press, 1940.

Yellen, Samuel. *American Labor Struggles.* New York: Harcourt, Bruce and Company, 1936.

Correspondence

Sayenga, Donald to Sharon Brown, n.d.

Dictionary

Dictionary of American Biography, 1930 ed. S.v. "Carnegie, Andrew," by Buton Jesse Hendrick.

________, 1932 ed. S.v. "Fritz, John," by Philip B. McDonald.

________, 1933 ed S.v. "Holley, Alexander Lyman," by Carl W. Mitman.

________, 1933 ed S.v. "Hunt, Robert Woolston," by Robert C. Canby.

________, 1933 ed S.v. "Jones, William Richard," by Asher Isaacs.

Directory

Biographical Directory of the American Iron and Steel Institute. New York: American Iron and Steel Institute, 1911.

Dissertations

Bennett, John William. "Iron Workers in Woods Run and Johnstown: The Union Era 1865-1895." Ph.D. dissertation, University of Pittsburgh, 1977.

Kelley, Dennis P. "The Contrasting Structures of Johnstown, PA, Binghamton, N.Y., 1850-1880." Ph.D. dissertation, University of Pittsburgh, 1977.

Reitell, Charles. "Machinery and Its Benefits to Labor in the Crude Iron & Steel Industries." Ph.D. dissertation, University of Pennsylvania, 1917.

Shappee, Nathan Daniel. "A History of Johnstown and The Great Flood of 1889: A Study of Disaster and Rehabilitation. Ph. D. dissertation, University of Pittsburgh, 1940.

Documents

Commonwealth of Pennsylvania, Department of Internal Affairs, *Monthly Bulletin* 20, no. 6, "A Brief History of Bethlehem Steel Company." May 1952.

Commonwealth of Pennsylvania. Department of Internal Affairs, *Report of Bureau of Mines*. Part V, "The Great Catastrophe at the Rolling Mill Mine, Johnstown, Pa., by an Explosion of Gas Which Caused the Loss of 112 Lives." [Harrisburg]: 1902, pp. 53-72.

U.S. Congress, *Report on the Conditions of Women and Child Wage Earners in the United States*. vol. 9: *History of Women in Industry in the United States*. 61st Cong. 2nd sess., Sen. Doc. 645, Washington: Government Printing Office, 1910.

U.S. Department of the Interior. Census Office. Tenth Census of the United States 1880. Vol. 10 Special Reports on Petroleum, Coke and Building Stones. "The Manufacture of Coke" by Joseph D. Weeks. Washington: Government Printing Office, 1884.

Pamphlets

Brown, Gilbert and Joyce, Stanley J. compilers. "Souvenir History of Johnstown Pennsylvania 1800-1939." May 1939.

"A Century of Progress in Steelmaking." American Iron and Steel Institute, New York, 1957.

"1867-1942 The Seventy-Fifth Anniversary of the Midvale Company Steel." The Midvale Company, 1942.

Metz, Lance D. "John Fritz 1822-1913 His Role in the Development of the American Iron and Steel Industry and His Legacy to the Bethlehem Community." 1987.

"Sesquicentennial Cambria County 1804-1954," n.p. [1954].

"Steel's Centennial - 1957 The First 100 Years of the Steel Age." American Iron and Steel Institute, New York, April 1975.

Swank, James M. "Early Iron Enterprises in Cambria, Somerset, Westmoreland, and Indiana Counties." In "Johnstown Centennial 1800-1900," 1900.

Theses

Craig, Harold M. "The Iron Industry in Cambria County From Founding to 1885." Thesis, Gettysburg College, 1932.

Hunter, Robert John. "Biography of Daniel J. Morrell, Ironmaster." M.A. thesis, University of Pittsburgh, 1954.

Unpublished Sources

Alexander, James R. "The Johnson Company: Its Role in the Industrial Heritage of Johnstown Pennsylvania." Typed manuscript, July 1987.

"Bethlehem Steel Company, Johnstown Plant, A Brief History of Johnstown Coke Plants." Typed manuscript, n.y.

Burkert, Richard A., and Cooper, Eileen Mountjoy. "Uphill All the Way: The Story of Johnstown's Incline Plane." Typed manuscript, 1984.

Metz, Lance E. and Sayenga, Donald. "The Role of John Fritz in the Development of the Three-High Rail Mill, 1855-1863." Typed manuscript, n.y.

ANNOTATIONS FOR BIBLIOGRAPHY

The manuscript collections consulted for this resource study of the Cambria Iron Company were the most useful in finding data on the evolution of the Cambria plant. The Manuscripts and Archives Department at the Hagley Museum and Library contained much material obtained from Bethlehem Steel Company's Schwab Library, formerly in Bethlehem. The Bethlehem Steel Corporation Papers were not in final catalogued form in 1987, but were organized and accessible. Most of the data on Cambria's early years were copies of secondary sources, while much primary source material was available for the years after 1900, including annual reports and correspondence. Trade catalogs providing a view of the wide variety of Cambria products were located in the Hagley Imprints Department. The Hagley Pictorial Collections contained many Cambria photographs in the George Atwell Richardson Collection, Bethlehem Steel Corporation Collection, and American Iron and Steel Institute Collection. There were six boxes of photograph albums located in the Bethlehem Steel Corporation Collection containing photographs of Cambria, primarily taken after 1900. The American Iron and Steel Institute Papers contained data on iron and steelmaking. Both the Johnstown Flood Museum and the Center for Canal History and Technology contained some primary source material on Cambria. The museum held what has survived the years of flooding, consisting of several ledgers, scrapbooks and directories. The John Fritz correspondence at the canal center focused on his years at Bethlehem, with items pertaining to Cambria. The former Schwab holdings at the canal center were mostly secondary imprints about the iron and steel industry. The Manuscripts Division at the Historical Society of Pennsylvania contained limited correspondence of Daniel J. Morrell. Secondary data was found in the Library.

All of the primary articles, written by participants in the early Bessemer experimentation at Cambria, were invaluable. The Alexander Holley articles in London *Engineering* provided information detailed drawings on Cambria machinery not found anywhere else. Copies of London *Engineering* were found at the National Museum of American History, Smithsonian Institution. John Fritz's autobiography should be consulted for any discussion of the three-high roll mill.

The city directories, along with the McLaurin and McCormick texts, offered descriptions of Cambria at different years of its development. Dr. Peter Shoenberger's account of building the Cambria Iron Company works was invaluable. The Sanborn maps and atlas were found in the Geography and Map Division of the Library of Congress. Anniversary histories of Cambria were found in the Johnstown *Daily Tribune* in 1897 and in the *Tribune-Democrat* in 1953.

The Iron Age articles contained a wealth of data concerning the Cambria plant's growth, machinery and management. A thorough search of this journal should be undertaken to find all the available information on Cambria. George A. Richardson's articles in *Coal Age* and *Railway Review* also provided data on Cambria's machinery. Excellent analysis of the labor struggles at Cambria were found in the Asher, Gutman, Hill, McClymer, McPherson, Moye, and Murray articles. The *Literary Digest*, *Nation*, *Newsweek* and *Business Week* articles provided a feel for the conditions in Johnstown during the 1937 strike. The Sherman article on black residents of Johnstown was the only scholarly piece found on that topic.

All of the secondary texts provided data on some aspect of the iron and steel industry generally, or on Cambria, Midvale and Bethlehem companies specifically. The Berger collection of articles on Johnstown was a good starting point. Background data on the iron and steel industry was found in the Backert, Bining, Bishop, Casson, Chard, Clark, Cooling, Eggert, Hessen, Hogan, Hoerr, King, Livesay, Lewis, McHugh, Schroeder, Strohmeyer, Temin, Urofsky, Warren, and Weitzman texts. Both the Lewis and Temin texts should be consulted for good overviews of the industry. McHugh's work on Alexander Holley and the Casson text contained many references to Cambria personnel and the first attempts at making steel. There was a wealth of information on the early years of labor struggles in the iron and steel industry, including Bernstein, Blankenhorn, Brody, Brooks, Fitch, Interchurch World Movement reports, Kellogg, Lens, Perlman, Taft, Warne, Williams and Yates, Wolff, and Yellen texts. The Brody work on steelworkers was very necessary reading. The Fitch, Kellogg, and Interchurch World Movement reports provided crucial information on the various efforts to reform injustices within the steel industry. James Swank's work on Cambria pioneers and the Boucher text on Cambria contained valuable data on early Cambria development, as did Henry Wilson Storey's county history. Data on the lives of Johnstown immigrants was found in Morawska and the Bennett dissertation. The Hays, Dubofsky, and two Morison texts provided analysis of the basic industrialism and technological issues involved with the changeover from iron to steel.

The *Dictionary of American Biography* identified nationally significant people associated with the Cambria Iron Company. The Bennett and Shappee dissertations proved indispensible in providing details about Cambria workers and housing, ethnicity, and the company's community programs and worker welfare.

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