Iron Valley: Transition and Evolution of Merchant Iron Producers in the Youngstown District, 1845-1967

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Abstract

The study of the merchant iron industry presents a unique representation of the growth of both the Mahoning Valley and its industrial fortitude into the twentieth century. Known as the Steel Valley throughout the 1930s to the 1970s, the region's principal industry began in the first half of the nineteenth century in the form of pig iron production to serve local pioneer life and other industries throughout Youngstown and Pittsburgh. As steel manufacture flourished at the turn of the century, extensive steel production supplanted many of these former merchant iron producers, as large-scale manufacturing centralized in Youngstown. Those former merchant iron producers and their furnaces that remained portray distinctive methods of business practice and significant development in iron making technology and work.

Relative hesitation of local industrialists to convert from iron to steel production allowed some former independent merchant iron producers to remain in operation or become part of a larger corporate entity into the twentieth century. This thesis looks at the furnaces in Hubbard, Struthers (Anna furnace) and Lowellville, Ohio (Mary furnace) and how their transition into the twentieth century presented various changes and adaptation in blast furnace technology, and how reliance on wrought iron manufacture presented a regional disadvantage as steel overtook iron production. One of the primary sources used are photographs, which allow the best look at changing technology within the industry when other documentation from these companies are relatively non-existent. Other information such as industry periodicals, newspapers, personal accounts and local histories help construct an extensive study of an industry that developed the Mahoning Valley into one of the largest iron and steel centers in the United States.

Acknowledgments

The journey I have taken during this massive project (this thesis being just a fraction of my overall study) has allowed me to meet many different people and experience many different things. For aiding in my multi year journey of searching and finding hundreds of images of the early iron and steel mills, I would like to thank Martha Bishop. You have been one of the biggest helps throughout my entire research. I would also like to thank Pamela Speis for allowing me to scour what seems to have been the entire photo collection at the Mahoning Valley Historical Society archives. I also greatly appreciate the aid and assistance of Ralph and Cecilia Cooper and the Hubbard Historical Society. I also want to thank Marian Kutlisa of the Struthers Historical Society, as well as Marsha Kamensky. Also, a special thanks goes to Rick Rowlands and Rich Rees for personally taking me to various industrial sites in the area. I also want to sincerely thank Bill Lewis for all of your help at *The Vindicator* "photo morgue."

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Introduction

"We who live in the valley are so accustomed to the sight of the dynamic glory of our great industry…but the stranger, to whom the mills and furnaces are a novelty, is apt to stand in awe at a vision which in grandeur exceeds any other of man's works, and approaches the phenomena of the Creator."[1] So noted John Struthers Stewart, descendant of iron pioneers John and Thomas Struthers, in his 1935 *History of Northeastern Ohio.* In this work, Stewart describes the great visual spectacle of steel mills permeating Ohio's Mahoning Valley, mainstays of the landscape lasting through the area's iron empire and during its transition to steelmaking at the turn of the twentieth century. Stewart makes a bold comparison of man's great mills as almost equivalent to God's creations, an assessment not entirely unwarranted. The smoke, steam, and fire emanating from the mills at night created an awesome industrial environment that seemed, to unaccustomed eyes traveling by train, as if the whole of the valley was ablaze. Journalist Clingan Jackson refers to Youngstown's fiery blast furnaces as metaphorical "gods" along the Mahoning River, which shot their fire and smoke into the sky, defying the heavens and bringing one long day to the valley.[2] This was not only a common occurrence in Youngstown proper, but was also prevalent in the towns of Warren, Niles, Girard, Struthers, and Lowellville, which stretched twenty miles along the Mahoning River. Some mills also existed in villages or towns not directly on the river but inland. Hubbard, one such town, was a small village between the iron and steel-manufacturing giants of Sharon, Pennsylvania and Youngstown, Ohio with a surprisingly unique development of

[1] John Struthers Stewart, *History of Northeastern Ohio*, vol. 1 (Indianapolis: Historical Publishing Co., 1935), 416.
[2] Clingan Jackson, "Capping of Blast Furnaces Recalled," *The Vindicator*, August 23, 1931.

its own in the coal and iron industry.

Between 1845 and 1872, twenty-one blast furnaces, a tall cylindrical steel shell lined with refractory firebrick, were constructed throughout the Mahoning Valley, which produced iron from iron ore, carbon fuel (coal or coke) and flux (limestone). Iron, not steel, dominated the Mahoning Valley's economy throughout the nineteenth century until a rapid transition from iron to steel manufacturing occurred in the region at the turn of the twentieth century. The late appearance of steel to supplant iron in Youngstown, as compared to Pittsburgh, which utilized steel production as early as the 1870s, originated partly from inexperience with steel making, the hesitant nature of local iron proprietors to see wrought iron as inferior to steel, and the barriers to entry posed by the pooling of patents for Bessemer steelmaking. While iron and steel were the prominent industries in the valley, many regional towns contained other industries, including a booming coal-mining trade, gristmills for flour production, and foundries.

The coal boom began during the 1840s in Brier Hill, a large farm on Youngstown's west side owned by the Tod family, and spread northwest to Mineral Ridge and east to the areas of Lowellville, Hubbard, and Sharon, Pennsylvania. By the mid-nineteenth century, these vast coalfields that fueled Youngstown's furnaces were only second in importance to Pennsylvania's bituminous coalfields in the Connellsville region. The vein from western Pennsylvania's massive coalfields ran under the Mahoning Valley and contained an estimated yield of twenty-seven cubic feet per ton with an overall estimate of 209,733,333,340 tons.[3] Its use in blast furnaces without coking was crucial to the development of the valley's iron industry, and both industries soon became

[3] N. J. Drohan, *History of Hubbard, Ohio: its People, Churches, Industries and Institutions – from Early Settlement in 1798 to 1907* (Hubbard: H. W. Ulrich Print Co., 1907), 18.

a staple to the region. Block coal in the Mahoning Valley was rich in carbon and was comprised of 64% coke and 36% volatile material, of which 61.5% was fixed carbon; a perfect composition for smelting iron ore in blast furnaces.[4] The establishment of the Cleveland and Mahoning Railroad by David Tod in 1856 soon opened up the Mahoning Valley coalfields to Cleveland and within a few years constructed the Hubbard Branch Railroad, which connected the coalmines throughout Hubbard and Coalburg and allowed shipment of coal to Youngstown, Cleveland and Sharon, Pennsylvania for use as both domestic and industrial fuel. After the opening of large mines on the rural properties of local residents in the valley, Youngstown industrialists capitalized on the vast coal that lay beneath their properties and soon leased or purchased the majority of these mines for their furnaces and rolling mills.

The discovery of coal commenced the creation of an industry that would sustain Youngstown and its surrounding communities for decades. The evolution of iron firms and furnaces such as Andrews & Hitchcock in Hubbard, the Mary furnace in Lowellville, and the Anna furnace in Struthers are important case studies of the merchant iron industry - that is, iron produced by independent furnace companies and sold to foundries, steel works, and rolling mills - throughout the Mahoning Valley. The development of the valley's economy from subsistence to market reflects the cultural and economic changes that pervaded the nineteenth century, particularly within an industry of such great importance to the developing Midwest. The expansion of transportation networks changed the structure of business around Youngstown, as products and raw materials could be shipped cheaper and quicker. When the Pennsylvania and Ohio Canal opened

[4] Drohan, *History of Hubbard, Ohio*, 18.

through the Mahoning Valley in 1839, iron manufacturing grew, as the artisan's product was no longer limited to the confines of the immediate area. By 1840, the Mahoning Valley still only boasted two small charcoal blast furnaces: the Mill Creek furnace in Youngstown and the Maria in Niles.[5] Initially, iron manufacturing was exclusive to the necessities of pioneer life, but after the canal opened it could be shipped to other customers, such as forges, foundries and rolling mills, particularly in the Pittsburgh area.

The Mahoning Valley's primary market was the sale of merchant pig iron on the open market. The crude pig iron, which received its name from the method of casting iron in sand beds with the resultant mold resembling pigs suckling at a mothers sow, was then refined in puddling furnaces and rolled into semi-finished wrought iron known as muck bars, then rolled into rails and other products for the developing west and reconstruction South. As the iron business grew throughout the Mahoning Valley, merchant iron diminished as larger iron and steelworks emerged. Steel dominated Youngstown's industry by the early twentieth century and new steel companies constructed massive blast furnaces in convenient locations near their Bessemer converters, open-hearth facilities, and rolling mills. Integrating blast furnaces with steel works reduced costs by transferring molten pig iron to the steel plants rather than re-melting cold pig iron in cupolas (for Bessemer practice) or open-hearths.

When localized raw materials, such as iron ore and raw coal, began to diminish in the Mahoning Valley, blast furnaces and steel plants were constructed in areas that included major railroad lines or water routes in order to import external raw materials, and as a result, a new industrial geography emerged. Vast amounts of rich iron ore mined

[5] Joseph Green Butler, *History of Youngstown and the Mahoning Valley*, *Ohio*, vol. 1 (New York: American Historical Society, 1921), 663.

in the Great Lakes was shipped via ore boat, unloaded into railroad cars, and transferred to Youngstown, Pittsburgh, and other landlocked industrial areas. The exhaustion of local coal by the 1880s led to the use of coke in local furnaces produced at the coalfields in Southwestern Pennsylvania.[6] Coke was the product of cooking bituminous coal to remove impurities, which burned hotter, faster and was also less dense than coal, a property that allowed coke to support heavier burdens in taller furnaces. Some merchant furnaces found themselves at a disadvantage, as many originally built their plants in areas adjacent to native ore or coal mines, which created a convenient source for raw materials but ultimately was an inconvenience as those materials depleted.

By the turn of the twentieth century, only three pioneer blast furnace plants and iron firms, defined as first generation blast furnaces constructed during the coal and iron ore boom in the valley from 1845 to 1872, remained in the hands of the original owners' families. These firms included the Andrews & Hitchcock Iron Company in Hubbard (one of the most-well-documented pioneer blast furnaces in the Mahoning Valley), the Brier Hill Iron and Coal Company, and the Ohio Iron and Steel Company.[7] However, the Ohio Iron and Steel Co., formed in 1880, took over the interests of the Mary furnace in Lowellville while the Brier Hill Iron and Coal Co., reorganized several times throughout the late nineteenth century, retained the same name and primary stockholders. Andrews & Hitchcock was incorporated as a joint stock company in 1892 (the Andrews & Hitchcock Iron Co.), but the stock remained in the Hitchcock and Andrews families until 1916.

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[6] Bituminous coal in the Connellsville region was not as pure as that in the Mahoning Valley. It was higher in phosphorous and sulfur, which made it ideal for coking. Direct use of Connellsville coal in a furnace resulted in a tarry substance that could destroy the stack.

[7] Butler, *History of Youngstown and the Mahoning Valley*, *Ohio*, 699.

Eventually, larger steel firms purchased all three pioneer furnaces. The Youngstown Sheet & Tube Co. purchased the Andrews & Hitchcock Iron Co. during the First World War. The Sharon Steel Hoop Co. purchased the Mary furnace in Lowellville from the Ohio Iron and Steel Co. in 1918. Lastly, the acquisition of the Brier Hill Steel Company by Youngstown Sheet & Tube was completed in March 1923. In Struthers, the Anna furnace, built in 1869, remained under the ownership of the Struthers Furnace Co., a Cleveland-based merchant iron producer.

Outside the city of Youngstown, some merchant iron production remained after the turn of the twentieth century when consolidations and the formation of new steel companies largely reduced the importance of merchant iron. The coalmining town of Hubbard, the small village of Struthers, later known as the "cradle of steel," and the borough of Lowellville, which contained the first furnace in the Mahoning Valley to successfully use raw bituminous coal as fuel, each retained a specific niche in their respective pig iron and mineral markets. In Hubbard and its nearby borough of Coalburg, coalmining was king. Prominent Youngstown industrialist Chauncey H. Andrews soon took advantage of the vast Brier Hill block coal vein that ran just north of Hubbard center and with William J. Hitchcock, a New York native, began a coalmining partnership in 1859.

By the 1860s, Hubbard contained the major components to enter the pig iron industry. C. H. Andrews and W. J. Hitchcock took full advantage of the circumstances laid before them and constructed two successful blast furnaces in 1868 and 1872 that persisted through all economic downturns, market changes and industrial centralization in Youngstown. In Lowellville, the construction of the Pennsylvania and Ohio Canal

brought revitalization to the village. Coupled with the experimentations with raw coal as blast furnace fuel by David Himrod in Mercer County, Pennsylvania, Frederick Wilkes saw the opportunity to utilize the seemingly infinite veins of block coal that ran through Youngstown and Lowellville. Wilkes' firm constructed the Mahoning furnace in 1845 – yet another stack that persisted through constant economic and market changes. At Marbletown (later renamed Struthers), Thomas Struthers constructed the famed Anna furnace on his family's farm nearly sixty years after his father's furnace at Yellow Creek went out of blast. The Anna stack resisted consolidation into big steel and remained an independent producer of merchant pig iron.

Struthers, Hubbard and Lowellville each present a unique aspect of iron making in the Mahoning Valley. As four of the twenty-one furnaces erected in the valley between 1845 and 1872, these pioneer stacks persisted unlike many others and played an important factor in the rise of the Youngstown area as a major producer of iron and steel. Each town is located outside the nineteenth century mill centers at Youngstown and Niles; however, significant capital from Youngstown industrialists endowed the furnaces with stability and modernization at a time when other firms throughout the valley failed to do so. In addition, each furnace maintained independence as merchant iron producers well into the 1900s, and in the case of the Anna furnace at Struthers, its entire existence.

Integration into larger steel companies did not always guarantee long-term survival. In Niles, at the turn of the twentieth century, the National Steel Co. (later a part of the Carnegie Steel Co., a subsidiary of U.S. Steel) purchased the blast furnace originally built by William Ward & Co. in 1870. As six large furnaces were built in groups adjacent to Carnegie Steel's Ohio Works in Youngstown, a single blast furnace in

an un-advantageous location detached from steelmaking facilities usually meant early abandonment. Although the Niles furnace survived until 1920, it remained the smallest furnace in the valley with relatively few upgrades or rebuilds after its last major overhaul in 1890. This was the case with many of the small merchant furnaces in the Valley. Relics remaining from the iron boom between 1845 and 1872 were rarely rebuilt and modernized after 1910 due to the declining market for merchant iron and steel companies' construction of their own blast furnaces to control pig iron supply. Companies believed that upgrading and modernizing these small furnaces was uneconomical because operational costs often outweighed profits, especially if the furnaces were exclusively run on merchant iron. Sheet & Tube's Hubbard furnaces were the most modern in the Youngstown district and became the only pioneer furnaces that included the majority of the modern raw material handling techniques employed at blast furnaces associated with U.S. Steel's Ohio Works and Sheet & Tube's Campbell Works.

The pioneer and merchant iron works of the Mahoning Valley cannot be put into perspective without discussing the technological evolution, or lack thereof, of blast furnaces and iron works in relation to economic factors. As technology improved the productivity of the blast furnace, smaller furnaces that lacked modernization and locational advantages were dismantled, while larger, more modern furnaces replaced the output of these outdated and isolated stacks. The integration of steel manufacture brought improved technology and larger scale operations into the valley, simultaneously ending the area's total reliance on hand puddling and rolling iron - an industry that largely relied on the product of valley merchant furnaces.

The emerging technology and intricacies of modern blast furnace practice were

integral to the developing steel industry in the Mahoning Valley. As larger mills, such as the Edgar Thompson Works near Pittsburgh, produced mass quantities of steel with the Bessemer process, demand for iron grew along with the demand for steel rails and structural steel by expanding railroads and rapidly growing cities. In 1905, Pittsburgh and its surrounding region contained forty-four blast furnaces, twenty-four of which were built after 1890. The Mahoning Valley contained fourteen furnaces with only five built after 1890, a clear indication of Youngstown's continued reliance on wrought iron manufacture.[8] The majority of Pittsburgh's blast furnaces were constructed directly adjacent to the city's Bessemer and open-hearth facilities, thereby allowing convenient locations for future modernization and rebuilding.[9] Pittsburgh's vast steel mills necessitated larger production of pig iron and many Pittsburgh-based engineers, such as James Gayley, Julian Kennedy and Marvin Neeland, who initiated the Duquesne Revolution in Pittsburgh, continued to develop blast furnace technology as steel manufacture grew and, with it, the demand for iron.

Recurring economic panics and depressions in the latter half of the nineteenth century also had a profound effect on many of the smaller iron companies throughout the Mahoning Valley. The great economic Panic of 1873 forced many less capitalized iron manufacturers in the valley to go bankrupt, sell or completely abandon their mills and caused the majority of businesses in the Mahoning Valley to cease operation. Some blast furnace men persisted and kept their stacks in operation during the depression. In the mid

[8] Data taken from the 1892, 1989, and 1904 editions of the *Directory to the Iron and Steel Works of the United States and Canada* (Philadelphia: The American Iron and Steel Association).
[9] See Kenneth Warren, *The American Steel Industry, 1850-1970: A Geographical Interpretation* (Pittsburgh: University of Pittsburgh Press, 1973).

1870s, seven of the thirteen pig iron producers in the Mahoning Valley went bankrupt.[10] Only two iron companies remained in full operation during the crash: the Girard Iron Company's furnace at Girard and Andrews & Hitchcock's two furnaces in Hubbard.[11] Both companies continued to produce pig iron, which stockpiled in their yards, but although the companies were overstocked with pig iron, operations in other mills resumed and some pig iron was sold to rolling mills, foundries, Bessemer steel plants, and puddling furnaces that continued to operate in some capacity throughout the Mahoning Valley and Pittsburgh.

Twenty years after the 1873 Panic, over-construction of railroads and financial speculation caused yet another significant economic depression that endured through the mid 1890s. In the late 1890s, industrialists looked to reduce competition from smaller firms in order to secure themselves against the instability of the market, insure personal profit, and achieve greater capacity through integration.[12] They began consolidating old mills and investing in modern steel mills, which led to the formation of large trust companies. The mergers created holding companies, such as the National Steel Co., American Tin Plate Co., and the American Sheet Steel Co., which bought out many smaller mills in order to secure their assets and have dominant control over a particular product in the iron and steel industry, thereby reducing competition with remaining independent companies. In the Mahoning Valley, these consolidations had a profound effect on the region's older iron mills and blast furnaces, particularly the wrought iron

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[10] *The Ironworks of the United States* (Philadelphia: The American Iron and Steel Association, 1876), 47-48.

[11] Jackson, "Capping of Blast Furnaces Recalled," *The Vindicator*, August 23, 1931.

[12] William T. Hogan, *Economic History of the Iron and Steel Industry in the United States* (New York: Heath Publishing, 1972), 236. Also, see Naomi Lamoreaux, *The Great Merger Movement in American Business, 1895-1904* (Cambridge: Cambridge University Press, 1985), for a more detailed look at the merger movement in the iron and steel industry.

and rolling mills, which were obsolete by the turn of the century. The majority of the pioneer furnaces and rolling mills that remained in the Mahoning Valley were consolidated into larger corporate entities in the early twentieth century, such as the A. M. Byers Co., Youngstown Sheet & Tube, Carnegie Steel, and Republic Iron and Steel.

In Youngstown, steel making was absent until the mid-1890s and puddling wrought iron, a refining process done by working pig iron in a reverberatory furnace by hand, required significantly less iron than manufacturing steel due to puddled iron's unsuitability for manufacturing on an industrial scale. The finished product in and around the Mahoning Valley did not demand the vast amounts of iron that the larger, more technologically developed steel mills in Pittsburgh required. The Mahoning Valley's hesitation in manufacturing steel allowed the Pittsburgh district to overtake Youngstown in overall iron production by the 1870s; however, this hesitation also allowed some older blast furnaces in the Mahoning Valley to persist and continue to produce iron.

Because of the late response to steel making and its correlation with wrought iron production, former merchant furnaces in and around Youngstown became outdated by the early twentieth century. As steel overtook iron, modern blast furnaces constructed in geographically advantageous areas near steel producing facilities condemned the small furnaces to extinction. Youngstown industrialists did not recognize the need for copious amounts of iron from larger furnaces until the mass production of steel occurred in Youngstown after the turn of the twentieth century.

Many Youngstown industrialists believed steel would never replace wrought iron due to its malleability and easy workability, and long-established reputation as the superior product in the nineteenth century. As steel became increasingly popular in the

1870s and 1880s, some merchant iron companies such as the Ohio Iron and Steel Co. in Lowellville often included "steel" in their company title to entice potential clients. By the early 1890s, Youngstown industrialist Henry Bonnell reluctantly concluded that steel would soon replace iron unless puddlers made a proper concession in their pay to match the low price of steel manufacture. In 1892, the Mahoning Valley contained 477 puddling furnaces, which employed 954 puddlers, 954 helpers and 236 roll hands. Together, these furnaces and their workers produced 1,050 tons of wrought iron per day.[13]

In 1893, Mahoning Valley industrialists proposed a single Bessemer steel plant that was estimated to produce 1,000 tons of Bessemer steel billets in a single day with a labor force of only 200 men. Bonnell boldly predicted that, because of new and advanced steel making technology, "one ton of steel billets or slabs can be laid down in the mills of this valley to-day at a lower price than it is possible to produce a ton of puddled iron. This being the case, the inevitable conclusion will be that unless the cost of producing puddled iron is reduced, steel will take the place of muck bar, and the puddler's occupation will be gone."[14] Bonnell's prediction ultimately came into fruition by the turn of the century, although he did not live long enough to witness its transition. Manufacturing steel not only affected the puddling industry, which received the most severe blow as steel replaced iron, but also the area's small pioneer and merchant blast furnaces, an industry that underwent a more gradual decline at the beginning of the twentieth century. Steel replaced wrought iron, but pig iron remained the essential ingredient to produce steel, and blast furnaces were primarily affected by advancement in technology to service larger capacity steel making facilities, rather than complete

[13] "H. O. Bonnell's Views On Iron," *The Vindicator*, May 30, 1892.
[14] *The Vindicator*, May 30, 1892.

abandonment.

Companies such as the Republic Iron and Steel Co. and Carnegie Steel consolidated many small furnaces throughout the valley, but strong capital, reliable product and relative isolation prevented absorption of the iron companies in Struthers, Lowellville and Hubbard. Without capital investment and modernization, geographic isolation away from the urban industrial centers usually meant early demise and abandonment. However, furnaces like the one in Hubbard retained a type of independence away from the major steel producers in Youngstown. Additional iron and steel related industries in Hubbard aided the furnaces to prosper and continue production well into the 1950s under the ownership of Youngstown Sheet & Tube. Hubbard's Valley Mould and Iron Company, an independent ingot mould manufacturer, presented the old Hubbard furnaces with constant business through the late 1950s. Valley Mould's reliance on Hubbard furnace's hot metal supply preserved long-term operations at the small furnace plant. By the 1950s, Lowellville's Mary furnace was one of two remaining hand-filled blast furnaces in the world; yet the historic site still thrived due to its association with the small open-hearth steel facility built in Lowellville in 1915. The Sharon Steel Hoop Company acquired the Mary furnace to supply hot metal for its nearby steelmaking operations, a symbiosis that greatly prolonged the viability of the world's oldest operating blast furnace. Struthers' Anna furnace lingered as a merchant stack that operated intermittently when market conditions were favorable, and as with the Hubbard furnaces, its early modernization permitted iron making well into the height of Youngstown's steel empire at mid-twentieth century.

Struthers, Hubbard and Lowellville each were Mahoning Valley pioneer blast

furnace sites that endured into the reign of steel. Although the furnaces' proprietors modernized the stacks in the early twentieth century, further remodeling halted due to old age, isolation, and limited investment, which resulted in technological stagnation. With the smallest iron-making capacity in the Youngstown district, the partially modernized furnaces eventually declined into intermittent operations, inefficiency, and limited output compounded by the lack of technological modernization. Such factors included the lack of modern blowing equipment such as turbo blowers, reliance on steam power, hand-filling, and antiquated raw material handling – components that led to the passing of the Mahoning Valley's final remnants of its bygone iron era.

The study of the iron industry, particularly one in an historic region such as Youngstown, is vital to an overall understanding of how the developing technology of iron and steel manufacturing quickly diminished the importance of the earlier iron industry and the pioneer blast furnaces that were once a dynamic economic workhorse for the Mahoning Valley. Each furnace or iron mill demonstrated an important aspect of the valley's development as a major manufacturer of iron and, later, steel. The iron industry's development as a whole is a relatively neglected field in an academic sense, partly due to the lack of sources left behind. Joseph G. Butler, Jr., Mahoning Valley iron and steel industrialist and popular historian, presented brief accounts of the region's early iron industries and mills in his narrative *History of Youngstown and the Mahoning Valley*, published in 1921.[15] Much of the information within most likely stemmed from the memory and memoirs of Butler, as the work lacks citations; however, the histories of the mills are far from complete. Other narratives and histories of the Mahoning Valley are

[15] Joseph G. Butler, Jr., *History of Youngstown and the Mahoning Valley*, vol. 1 and 2 (New York: American Historical Society, 1921).

scarce and usually fairly capricious. Further scholarship within a broader context of the early iron industry, particularly regional technological change and evolution, is limited. William T. Hogan's *Economic History of the Iron and Steel Industry in the United States* presents the transition of the industry from the 1860s until the 1970s, with factors such as changing technology and consolidation justly addressed; however, the importance of the puddling process to nineteenth century iron production is overlooked.[16] Robert Gordon's *American Iron* presents an incredibly detailed look at the development and processes in all areas of the iron industry in the United States in the nineteenth century from the perspectives of archaeometallurgy and industrial archaeology.[17] Much of Gordon's research directly pertains to technology in the Mahoning Valley in the mid-nineteenth century, but his treatment of blast furnace practice is limited largely to stone stack and charcoal furnaces rather than the subsequent development of blast furnace technology into the turn of the twentieth century. Joel Sabadasz's essay, "The Development of Modern Blast Furnace Practice: The Monongahela Valley Furnaces of the Carnegie Steel Company, 1872-1913," studies the Carnegie Steel Company and its predecessor firms as the first major developers of furnace technology that allowed Pittsburgh and the United States to take over worldwide leadership in iron production.[18] The essay presented many early developments of furnace technology that eventually spread to the Mahoning Valley by the turn of the twentieth century.

The relatively small number of micro-studies within a broader context of

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[16] William T. Hogan, *Economic History of the Iron and Steel Industry in the United States* (New York: Heath Publishing, 1972).

[17] Robert Gordon, *American Iron, 1607-1900* (Baltimore: Johns Hopkins University Press, 1996).

[18] Joel Sabadasz, "The Development of Modern Blast Furnace Practice: The Monongahela Valley Furnaces of the Carnegie Steel Company, 1872-1913," *The Journal of the Society for Industrial Archeology* 18 (1992): 94-105.

technological evolution in the iron industry inhibits a more comprehensive interpretation of Youngstown's evolution from an iron to steel manufacturing center. A great volume of work within the realm of the iron and steel industry focuses on labor studies, the rise of big steel through consolidation, or the decline of the steel industry in the 1970s and 80s, but several studies since the 1950s have emphasized the importance of individual ironworks and companies in the nineteenth century.[19] Keach Johnson's 1953 essay, "The Genesis of the Baltimore Ironworks," focused on Benjamin Tasker's ironworks, developed in the 1730s, from both a technological and social perspective.[20] Owing to a large amount of surviving sources, Charles B. Dew's *Ironmaker to the Confederacy* concentrated on all aspects of the Tredegar Ironworks in Virginia, with a major emphasis upon developing technology, its slave labor workforce, and production methods.[21] Dew portrays the ironworks almost as a living being with its own pulse and heart beat, a theme omnipresent within this present study. Bruce E. Seely's 1981 essay, "Blast Furnace Technology in the Mid-19th Century: A Case Study of the Adirondack Iron and Steel Company," examined a charcoal blast furnace and the company's response to a period of rapid technological change with both written and physical evidence through industrial archeology.[22] Within the study, Seely utilized various photos and drawings in order to better illustrate the changing technology of the company's blast furnaces. Gerald G. Eggert's 1999 narrative, *Making Iron on the Bald Eagle*, presents a distinctive study on

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[19] See David Brody, *Steelworkers in America: The Nonunion Era* (Cambridge: Harvard University Press, 1988), for a classic study of workers' experiences during the era up to the Great Depression.
[20] Keach Johnson, "The Genesis of the Baltimore Ironworks," *The Journal of Southern History* 19 (May 1953): 157-179.
[21] Charles B. Dew, *Ironmaker to the Confederacy: Joseph R. Anderson and the Tredegar Iron Works* (New Haven and London: Yale University Press, 1966).
[22] Bruce E. Seely, "Blast Furnace Technology in the Mid-19th Century: A Case Study of the Adirondack Iron and Steel Company," *The Journal for the Society for Industrial Archeology* 7 (1981): 27-54.

the evolution of Roland Curtin's Eagle Ironworks in Centre County, Pennsylvania and its effects on the adjacent community at a local level.[23]

The study of merchant iron producers in an historic industrial region such as the Mahoning Valley presents a unique composition of economic, business, labor, local, regional, industrial, and technological history. Although large-scale sources were not left behind for many of the ironworks and blast furnaces in the valley, their histories and evolution can be pieced together using local histories, period journals and publications, industrial directories, and most importantly, photographs. Because of this inherent lack of sources, photographs best dictate the technological transition and evolution of these early furnaces, such as the Anna, Mary and Hubbard furnaces. Photos ranging from the 1870s to the 1960s allow a sense of tangible scholarship and investigation to an otherwise indiscernible regional industry such as merchant iron production. Numerous images of Lowellville's Mary furnace allow an in-depth look at blast furnace technology and practice common in the 1880s and 1890s. Opportunities to study iron making labor and technology at a single furnace plant of that era are indeed rare and improbable, whereas in Lowellville, Mary furnace's technological stagnation and survival well into the twentieth century presented opportunities for photographic documentation. Combining photographic evidence with other existing sources allows for a comprehensive study unavailable to many other industrial regions, and imparts a broader perspective into the Mahoning Valley's industrial heritage.

[23] Gerald G. Eggert, *Making Iron on the Bald Eagle: Roland Curtin's Ironworks and Workers' Community* (University Park: Penn State University Press, 1999).

Chapter 1: Anna Furnace – Merchant Operation through Modernization

For nearly ninety years, Struthers' Anna furnace retained a unique dimension of iron manufacture in the Mahoning Valley. Established in 1869, the Struthers Furnace Co. became a staple in the iron industry with its abnormally large furnace that inspired the likes of Andrew Carnegie. The stack transformed the small village of Struthers into an industrial community built upon the capital of its founders. Unlike many of the furnaces and rolling mills constructed throughout the Mahoning Valley in the mid nineteenth century, the Anna furnace became a symbol of the community, one that defied most economic turns and trends, technological advances and the change from iron to steel at the turn of the twentieth century. Yet the Anna furnace quickly faded into obscurity in the twentieth century. Merchant iron production, once a dominant feature in pig iron manufacture throughout the country, was all but replaced with larger, more modern blast furnaces and steel works.

Comparable yet dissimilar to the circumstances presented by the Hubbard and Mary furnaces, Anna persisted through continual transition. Although James and Daniel Heaton's Hopewell furnace and the Struthers, Montgomery and Clendennin furnace on Yellow Creek became symbols of the Mahoning Valley's early rise to industrial power, the small stone stacks were unable to sustain significant operations that allowed substantial economic growth. Thomas Struthers's efforts to lay out the village in the 1860s and establish a gristmill in 1867 and finally a blast furnace in 1869 allowed the small community to compete in the already booming iron industry. The Anna furnace persisted. Periodically rebuilt and modernized, it provided continual employment for

Struthers' residents and continued to do so until the early 1950s. Reflecting its intermittent success during the twentieth century, the Anna boasted the title of the only remaining independently owned pioneer blast furnace in the Mahoning Valley, meaning it avoided consolidation into a larger steel company such as Carnegie Steel or Republic Steel (Youngstown Sheet & Tube briefly owned the furnace, but never operated the stack). The furnace remained a true merchant stack until Sheet & Tube dismantled Anna in the 1960s.

Anna's independence principally relied on the proprietors' refusal to sell to larger companies, technological modernization and successful operations as a provider of iron for foundries rather than steel companies. The Anna stack remained one of the last merchant blast furnaces in the United States and endured as an iconic structure in the industrial landscape of the Mahoning Valley. Eventually, the arrival of Youngstown Sheet & Tube and its nearby Struthers and Campbell Works diminished Anna's once towering stack to the shadows as steel overtook iron.

In 1806, John Struthers, father of Anna furnace founder Thomas Struthers, collaborated with Robert Montgomery and David Clendennin and constructed the Montgomery furnace, a small, cold-blast, water-powered furnace three-fourths of a mile from the Hopewell furnace along Yellow Creek in Struthers. The furnace failed due to the War of 1812 and Struthers persisted through a number of setbacks, which included losing his furnace, land, his son Alexander and two daughters as they attempted to cross the Mahoning River in a skiff. Following these family setbacks, John Struthers' remaining son, Thomas, settled in Warren, Pennsylvania where he set up his own law

practice, a profession that he soon abandoned in favor of the development of a local railroad. Struthers continued to take advantage of the wealth he accrued from his railroad enterprises and in 1865 decided to buy back the once prosperous family homestead on the south side of the Mahoning River, just west of its junction with Yellow Creek. Thomas laid out the small village known as Marbletown that would later bear his family name. He established a saw and gristmill in the late 1860s, but unlike other towns throughout the Mahoning Valley, such as Lowellville, Youngstown and Niles, the construction of the Pennsylvania and Ohio Canal through the Struthers area had little influence on the town's economic prosperity. It was not until the railroads established their rights of way through the town that Thomas was able to establish further industrial expansion.

By 1869, the iron industry in the Mahoning Valley embraced the affluence provided by the post-Civil War boom that enveloped the nation. Yet Thomas Struthers' village remained economically stagnant in comparison to the canal, coal and black-band iron ore boom of other nearby villages. The new village of Struthers contained no rolling mills, forges or bloomeries. Any economic potential that the Yellow Creek furnaces instilled in the area had sputtered out nearly sixty years before Struthers laid the foundations for his town. With a small background in iron production, Struthers decided to take advantage of the large block coal deposits and limestone quarries just down the Mahoning River at Lowellville. Together with John Stambaugh, Jr., Thomas W. Kennedy, and John Stewart, Struthers established the Struthers Iron Company in 1869. The new company accessed additional capital shortly after with the arrival of Hugh T. Stewart and Daniel B. Stambaugh into the firm. The same year, the company constructed the Anna furnace, named after Thomas Struthers' only living daughter Anna, on the site

of the old John Struthers homestead just south of the Mahoning River and west of Bridge Street.

In July 1870, Thomas Struthers, John Stambaugh, Jr., T. W. Kennedy and John Stewart incorporated the company with a capital of $400,000 of $100 shares each for "the purpose of acquiring, owning and mining mineral coal, iron ore and limestone, and manufacturing pig iron and other merchant iron."[1] On a visit to Youngstown, M. D. Raymond, a Clinton, New York journalist and editor of the *Courier,* noted that the Struthers furnace "has a stack like a young volcano, from which a molten mass of over fifty tons of iron daily runs in streams of liquid fire."[2] The Struthers Iron Co. developed both company housing and a company store along Bridge Street for its 75 employees. As is the nature of blast furnaces, the Anna furnace often went out of blast due to accidents or repairs. When this occurred, those who lived in the company's housing received free rent on both their living quarters and a small garden during down time.[3]

The Anna furnace was similar to those constructed throughout the Mahoning Valley except for its most distinctive feature: its abnormally large size. The larger capacity of contemporary English blast furnaces greatly influenced Struthers in the construction of the Anna furnace. It measured fifty-five feet high with a sixteen-foot diameter bosh and a nine-foot hearth. The size of the hearth was far in advance of the normal construction at the time, and only became common in a furnace of equal size constructed twenty years later. In comparison, the old stone stack Mary furnace located a

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[1] *Western Reserve Chronicle*, August 10, 1870.
[2] "What a Clinton, N. Y., Editor Saw in Youngstown and Wrote to His Paper About," *The Vindicator*, November 10, 1871.
[3] U.S. Department of the Interior, *Report on the Statistics of Wages in Manufacturing Industries at the Tenth Census (1880)*, Vol. XX, 1886, 121.

mile down the river only contained a five-foot hearth. It was also the first "high" furnace constructed of the cupola type, meaning no other ironclad stack reached the height equivalent of the Struthers furnace to that time.[4] Thomas Struthers built a furnace that became much talked about throughout the iron empire of Pittsburgh. The Anna furnace could produce up to 1,600 tons of iron a month on raw coal, an achievement that seemed unprecedented to iron moguls Thomas and Andrew Carnegie, whose smaller furnaces used coke as fuel.[5] In December 1871, the Anna furnace produced 1,602 tons of iron and in January 1872, 1,642 tons, both remarkable production numbers for the time.[6] The furnace's product reached 2,032 tons in March 1876. The stack utilized a single blowing engine with an air cylinder 72-inches in diameter and a 4-foot stroke, and the only change that occurred between 1871 and 1876 was the addition of a second blowing engine.[7] One of the primary reasons for Anna's large output was Thomas Kennedy's departure from the traditional practice of regulating the quantity of blast by the pressure gauge; instead the Anna furnace substituted the revolutions of the blowing engine as the method of regulation, a practice that held well into the 1890s.[8] Inspired by Anna's impressive feats, the Pittsburgh firm of Kloman, Carnegie & Co. constructed the massive, 75-foot Lucy furnace in Pittsburgh only three years after the Anna's construction and soon exceeded

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[4] Hogan, *The Economic History of the Iron and Steel Industry in the United States*, 29. Hogan notes that the Struthers Iron Co. constructed the Anna furnace in 1871, which is incorrect. Stone furnaces built in Lehigh County Pennsylvania by Thomas Iron Company in 1855 measured 60 feet in height.

[5] James Howard Bridge, *The Inside History of the Carnegie Steel Company* (New York: The Aldine Book Company, 1903), 55.

[6] James Gayley, "The Development of American Blast Furnaces with Special Reference to Large Yields," *Scientific American Supplement* (New York: November 15, 1890): 12394.

[7] Gayley, "The Development of American Blast Furnaces with Special Reference to Large Yields," p. 12394.

[8] Gayley, "The Development of American Blast Furnaces with Special Reference to Large Yields," p. 12394.

the production values set by the Anna furnace.

Struthers's furnace became an inspiration to the majority of the iron industry and was the largest, most productive furnace in the Mahoning Valley. Before its construction, the largest furnaces in the Mahoning Valley only ranged from 45-50 feet in height with 12-14 foot boshes (the lowest section of a blast furnace shaft and the widest point where a furnace is commonly measured for its diameter). Many blast furnace proprietors in the Mahoning Valley installed a bell and hopper top on their furnaces after Job Froggett's successful installation of the closed top at the Phoenix furnace in 1870. The bell and hopper was a conical cast iron bell placed over the top of the furnace to seal the stack from escaping waste gasses. The Anna remained an open top and still produced a respectable amount of iron. By the early 1870s, all other companies in the valley installed a bell and hopper on their furnaces, with the exception of the No. 1 Hubbard furnace.

Despite this, the Struthers Iron Company's stack was one of the most productive in the valley and produced up to 18,000 tons of pig iron a year.[9] The company exclusively produced merchant iron and was not associated with an integrated iron mill. At this time, only a limited number of iron companies in the Mahoning Valley were of the pure merchant pig iron type, these included the Girard Iron Co., Jonathan Warner's Ashland furnaces at Mineral Ridge, the Mahoning Iron Co.'s Ada furnace in Lowellville, William Ward's Kitty furnace in Niles, Andrews & Hitchcock's two furnaces in Hubbard and the Brier Hill Iron and Coal Co.'s Brier Hill and Grace furnaces. The Anna's high production values remained steady through the early 1870s until the 1873 Panic crippled production. Thomas Struthers continued iron manufacture until 1875 when he was forced

[9] *The Ironworks of the United States* (Philadelphia: The American Iron and Steel Association, 1876), 47.

to blow out his furnace due to financial difficulties and a distressed economy, thereby running at less than half capacity throughout the rest of the decade. Before 1875, the Anna furnace only employed four top fillers, with two to each turn of twelve hours, but in the midst of the Panic, the company employed three top fillers at turns of eight hours each, a system that was "more satisfactory to the employees."[10] Despite the strong capital investment by partners Stambaugh and Stewart, harsh economic conditions forced Struthers to sell his share in the firm. The remaining partners formed the Struthers Furnace Co., who leased the stack in 1878, with Thomas Kennedy manager and H. T. Stewart selling agent.

The reorganized partnership restarted the furnace as the Panic subsided in the late 1870s. As the supply of local block coal became limited, the firm used a combination of 5/6 block coal and 1/6 Connellsville coke and produced roughly sixty-five tons of Bessemer grade pig iron daily for the newly established Bessemer steel works of Pittsburgh, Johnstown, and Harrisburg, Pennsylvania and Troy, New York.[11] In October 1878, the furnace received a contract to produce Bessemer iron for the Edgar Thompson steelworks in Pittsburgh. *The Vindicator* acknowledged that "prospects for continuous work is good," but by 1880, the Anna furnace remained the only open top stack in the Mahoning Valley and had yet to be rebuilt or remodeled since its construction in 1869.[12] The furnace, entirely modern in its initial construction, soon became one of the most outdated in the valley, primarily due to the lack of available capital to rebuild during the lean years. Yet the furnace's initial high capacity construction and the firm's ability to

[10] Department of the Interior, *Report on the Statistics of Wages in Manufacturing Industries (1880),* 121.
[11] *The Ironworks of the United States,* 1878, 57.
[12] "Industrial Items," *The Vindicator*, October 25, 1878.

invest in upgrading its auxiliary equipment (such as blowing engines and boilers) allowed the company to compete with the larger furnaces in the valley for the time being without any association with a rolling mill or integrated ironworks.

The 1879 sale of Youngstown's Brown, Bonnell & Co. to Chicago-based industrialist Herbert C. Ayer prompted Brown-Bonnell to invest in an additional pig iron supply after a large expansion of the mill's wrought iron production in 1880. Between 1879 and 1882, Brown, Bonnell & Co. nearly tripled its annual capacity from 25,000 to 75,000 tons per year and added seventy puddling furnaces for a total of 124.[13] In Struthers, the Anna furnace remained in its 1869 configuration, but produced at high enough capacity and included additional coal, limestone and iron ore lands and mines, which made the furnace a prime target for the newly expanded Mahoning Iron Works. Thomas Kennedy and Hugh T. Stewart, lessees of the Anna furnace under the name of the Struthers Furnace Co., agreed to sell the furnace to Brown, Bonnell & Co. for an unknown amount in 1881. Immediately after the purchase, Brown, Bonnell & Co. decided to rebuild the Anna furnace and fit it with a bell and hopper top, thereby ending the era of open top furnaces in the Mahoning Valley. The furnace now measured seventy-four feet tall with a sixteen-foot diameter bosh, one of the largest in the Valley. In Youngstown, Brown-Bonnell's old Phoenix and Falcon furnaces only provided 32,000 tons of iron for the puddling and rolling mills per year.[14] The Anna furnace doubled the company's pig iron output, adding 32,000 tons a year, which equaled the combined capacity of both the Phoenix and the Falcon. Famed Brown-Bonnell blast furnace manager Job Froggett operated the Anna furnace. Froggett's critical experiments with the

[13] *Directory to the Iron and Steel Works of the United States* (Philadelphia: The American Iron and Steel Association, 1882), 137. Referred to as *Directory,* (accompanying year) throughout the rest of this study.
[14] *Directory,* 1882, 45.

bell and hopper top at the Phoenix furnace in 1870 initiated a revolution in blast furnace practice in the Mahoning Valley. Under Froggett's management, Anna ran on block coal, the company's own Connellsville coke, and Lake Superior ores.

Brown, Bonnell & Co.'s efforts to expand their pig iron production were short-lived. After the company rebuilt the Anna furnace, it only operated the stack for three years. The Anna furnace provided a crucial amount of mill and foundry iron for the company's rolling mills, but Herbert Ayer's financial failure in 1883 banked the Anna stack for two years. The furnace plant became property of the bank until 1885, when Cleveland businessman James Pickands and Youngstown industrialist Myron C. Wick leased the stack under the name of the Struthers Furnace Company. The Struthers Furnace Co. named Robert Bentley as the company's new secretary and treasurer while he simultaneously served the same position at the Ohio Iron and Steel Co.'s highly successful Mary furnace in Lowellville. Together, these men successfully operated the Anna furnace and raised its annual capacity to 40,000 tons a year.[15]

The furnace contained the usual iron hoist and two iron pipe stoves and operated with an enclosed stock house with elevated wooden trestles. Railcars loaded with stock dropped their contents in the stock house, while bottom fillers loaded barrows with the proper amount of coke, iron ore or limestone and placed the barrows on the elevator hoist's platform. The bottom fillers gave the top fillers an indication, or in some cases, rang a bell, that signaled the top fillers to operate the steam hoist that sent the barrows to the furnace top. The top fillers wheeled the barrows from the hoist, dumped the stock onto the bell and hopper, and lowered it into the furnace. The single-bell system released

[15] *Directory*, 1886, 49.

valuable waste gasses from the furnace top and exposed workers to poisonous gasses.

The Anna furnace benefitted from the vast amounts of iron ore reserves that James Pickands and partner Samuel Mather owned and developed under the Pickands, Mather & Co. In addition, the Struthers Furnace Co. recognized that the Valley's source of raw block coal was rapidly diminishing and soon transitioned to using Connellsville coke exclusively. The company consistently operated the Anna furnace throughout the late 1880s and maintained a steady production of 40,000 tons of iron per year. Unlike the Brier Hill Iron and Coal Co. and the Thomas Furnace Co. in Niles, the Struthers Furnace Company did not immediately invest in more modernized auxiliary equipment, such as firebrick hot stoves, which were tall, cylindrical steel-plated stoves lined with firebrick and operated on the regenerative rather than recuperative principle to pre-heat blast air. The company retained the old iron pipe stoves to heat the blast, which only produced a blast temperature of roughly 800 degrees, compared to the more expensive yet lower maintenance regenerative firebrick stoves' ability to reach 1,200 degrees.[16] The company did little to modernize the furnace itself and only improved the necessary auxiliary equipment, such as blowing engines, tuyeres, hoist and other practical machinery. The furnace remained in the hands of Mather and Wick until 1893 when the latest owners of the newly incorporated Brown-Bonnell Iron Company again required an additional pig iron supply to supplement the loss of their obsolete Falcon furnace.

In Youngstown, receiver Fayette Brown paid the majority of the debt accrued by the Brown, Bonnell & Co. from Herbert Ayer's financial failure in 1883. In 1892, the former Brown, Bonnell & Co. reorganized as the Brown-Bonnell Iron Company with

[16] W. C. Roberts-Austen, *An Introduction to the Study of Metallurgy* (London: Charles Griffin and Company, Ltd., 1898), 325.

Cleveland native Samuel Mather as president. The company immediately abandoned and dismantled its obsolete fifty-five foot Falcon furnace due to its old age and uneconomical operations, which left a substantial need for pig iron to supply the company's rolling mills. In Struthers, the Anna furnace maintained operation under lease by the Struthers Furnace Co., a direct consequence of Herbert Ayer's 1883 financial failure. The furnace itself maintained high capacity operations despite a span of eleven years since its last rebuild. With the lease on the Anna furnace revoked in 1893, the Brown-Bonnell Iron Co. again purchased the stack to supplement the pig iron production of the company's Phoenix furnace. Together with the old Phoenix furnace, the company now produced up to 75,000 tons of pig iron per year.[17]

The Anna furnace only remained in the hands of Brown-Bonnell for a short period with relatively little modernization or advancements in furnace practice. Furnaces such as the Thomas in Niles, Tod, Grace and Haselton No. 1 in Youngstown and the Mary in Lowellville all significantly modernized with the installation of modern firebrick stoves, thereby foregoing the use of the older, less efficient iron pipe stoves. In 1895, the Brown-Bonnell Iron Co. decided to rebuild the Anna furnace for the first time in fourteen years. The company remodeled the stack by adding three Julian-Kennedy firebrick stoves. The rebuild raised the company's pig iron production by 15,000 tons a year. With the Anna stack more or less modernized by Brown-Bonnell, it became one of the most productive and up-to-date furnaces in the Mahoning Valley and presented a noteworthy business opportunity for those willing to invest, despite the rising interest in the production of steel and the declining significance of the merchant iron trade.

[17] *Directory,* 1894, 53.

In the latter part of 1895, Cleveland businessman and industrialist W. C. Runyon and his long-time partner and Poland, Ohio native, Jabez Burton Stubbs, purchased the Anna furnace from the Brown-Bonnell Iron Co. In the late 1880s and early 1890s, Runyon and Stubbs organized a commission business in Chicago to deal pig iron under the name of Stubbs & Runyon. In 1895, Stubbs moved to Cleveland and again formed a partnership with Runyon under the name of Runyon, Stubbs & Co., which purchased the Anna furnace in the latter part of 1895. In June 1896, Runyon and Stubbs incorporated their partnership as the Struthers Furnace Company capitalized at $1,000,000 at $100 shares. The new company named W. C. Runyon, president; J. B. Stubbs, vice president and treasurer; A. Grossman, secretary and Samuel Allen Richards, son of Mahoning Valley iron pioneer William Richards, furnace manager.

Samuel Richards had previously worked under his father at the Girard furnace and was a member of the firm of William Richards & Sons that operated a furnace and rolling mill in Warren, Ohio, a short-lived enterprise that met with disaster. After the failure of the Warren furnace, Richards travelled throughout the country managing many different blast furnace plants. He finally returned to the Mahoning Valley in the early 1890s when he became associated with W. C. Runyon in the lease and operation of the Sharon furnace between Sharon and Sharpsville for eighteen months before Runyon's purchase of the Anna furnace. Richards' extensive background in blast furnace management and operations seemed the perfect fit to operate the Anna furnace successfully for many years.[18]

In 1896, Richards and the new owners continued to modernize the stack, with extensive changes made to the furnace stock house and raw materials storage. The

[18] Butler, *History of Youngstown and the Mahoning Valley*, vol. 2, 32.

company dismantled the old, wooden-framed stock house along with several of the elevated wooden ore trestles, which only left one trestle for coke storage. The company changed the furnace's product to exclusively Bessemer grade pig iron, this being the first time in the stack's long history where it produced iron for Bessemer steel facilities. Previously, the furnace produced foundry and forge pig iron for castings and rolling mills. The improvements made by the new company allowed upwards of 90,000 tons of iron produced annually and 250 daily.[19] The company sustained production relatively unhindered as small, independent ironworks and furnaces throughout the Mahoning Valley fell victim to the large steel companies that developed at the turn of the twentieth century. The Cleveland-based Struthers Furnace Co. continued to upgrade its auxiliary equipment and with the competence and expertise of its furnace manager, the Anna stack quickly became one of the most productive independently owned merchant furnaces in the valley during an era when such businesses became increasingly rare due to corporate mergers and consolidations.

As the twentieth century unfolded and steel began to replace iron production, only a handful of independent iron companies remained free from corporate consolidation. The year 1899 brought the formation of the Republic Iron and Steel Co. and the National Steel Co.; in 1900, the Youngstown Iron Sheet & Tube Co. (albeit with local capital and initially no steel or pig iron manufacture) began production; and in 1901 the United States Steel Corporation started operations.

The Struthers Furnace Co. resisted consolidation, as its capital, business and production remained positive and progressive. Only three other furnace companies

[19] *Directory*, 1898, 47.

remained independent throughout the Mahoning Valley, including the Andrews & Hitchcock Iron Co. in Hubbard, Ohio Iron and Steel Co. in Lowellville and the Brier Hill Iron and Coal Co. in Youngstown. Each company thoroughly modernized and acclimated to current market conditions while also remaining independent (an important factor as many large-scale steel companies purchased rolling mills that were often connected to a blast furnace). Under the management of S. A. Richards, the Struthers Furnace Company adhered to market conditions and product demand while modernizing according to the latest forms of blast furnace practice.

By 1900, the Anna furnace's principal product again expanded to include both Bessemer pig and forge and basic iron, the latter produced for open-hearth steel works. To produce basic pig iron for the open-hearth process, the company installed a single-strand Uehling pig casting machine – one of the first merchant furnaces in the valley to do so outside of the larger corporations. This method largely eliminated the harsh labor involved in casting pig iron on the furnace floor: breaking, carrying and loading the pigs for shipment. As open-hearth steel overtook the Bessemer process in the early 1900s, the acid-silica based pig iron cast in sand on the furnace floor was unsuited for the open-hearth process because the acid base quickly ate away the basic open open-hearth furnace's refractory brick lining. Casting in 'chills' (cast iron or steel molds) on a pig casting machine eliminated the silica base and allowed the Struthers Furnace Co. to sell basic iron on the market as steel companies constructed open-hearth steel works throughout Youngstown and its vicinity between 1910 to 1920.

At Youngstown, the Brier Hill Iron and Coal Co. also installed a Davies pig-casting machine, making the Anna furnace the second independent iron manufacturer to

employ the use of an automatic pig caster. The Struthers Furnace Co. also partially rebuilt and remodeled its raw material handling with the construction of three elevated wooden trestles that spanned the iron ore and coke yards. The company installed three bins for ore and coke on each trestle. These bins reduced much of the labor for bottom fillers due to this relatively new system. Bottom fillers placed iron ore or coke barrows under the proper bin, pulled a lever, and opened a chute to allow the iron ore, coke or limestone to fall into the barrow via gravity, thereby eliminating the laborious task of filling the barrows by hand. Workers wheeled the barrows to the hoisting platform and sent the raw materials to the top of the furnace where top fillers dumped the burden on the hopper and lowered it into the stack. Both the Mary and Hubbard furnaces utilized a similar method of raw material handling.

Throughout the early 1900s, the Struthers Furnace Co. expanded its product, which by 1905 included the production of Portland cement to utilize the large amount of slag produced as a by-product of the smelting process, the mining of coal and the production of coke for its own use and sale on the market. Shortly after the installation of the Uehling pig casting machine, the company constructed a plant for the manufacture of Portland cement from blast furnace slag with a capacity of 500 barrels a day. The plant, one of three associated with blast furnace plants in the Mahoning and Shenango Valleys, was located just southwest of the furnace along State Street and the Pennsylvania Railroad. At the furnace proper, the company installed a fourth Julian Kennedy firebrick stove and by 1904, all iron manufactured at the furnace was cast in chills at the pig-casting machine rather than on the furnace floor. The termination of casting in sand

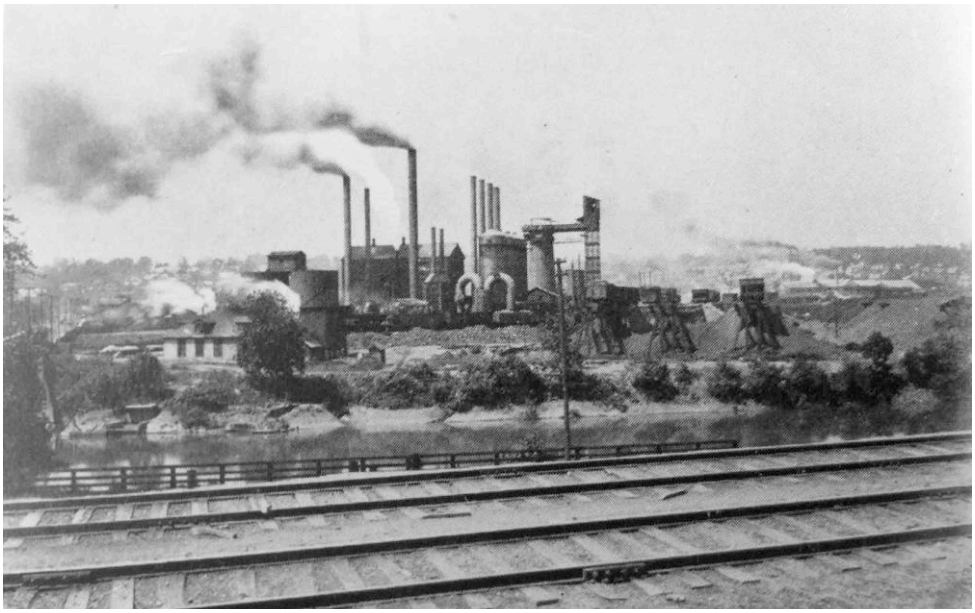

Figure 1-1: A general view of the Struthers Furnace Company's Anna furnace plant looking southwest c. 1907. Bridge Street is located just to the left with the Mahoning River in the mid-ground. Unlike modern furnaces, the plant used elevated wooden trestles in its stockyard to dump raw materials and an elevator hoist until the plant was overhauled in 1909.

From Thomas W. Sanderson, *20th Century History of Youngstown and the Mahoning Valley* (Chicago: Biographical Publishing Co., 1907), 260.

required the company to install brick-lined iron runners in the cast house, which allowed molten iron to flow into ladle cars below the cast house floor. Locomotives transferred the molten iron from the cast house to the pig-casting machine, where a crane hoisted the ladle and poured the iron into molds on an endless conveyor. This new method pushed the furnace's annual capacity to 100,000 tons and drastically reduced labor costs.[20]

In June 1905, company president W. C. Runyon incorporated the Struthers Coal & Coke Co. at a capital of $500,000 for the mining and coking of coal for use at the Struthers Furnace Co.[21] Runyon purchased coal lands in the Connellsville region in Fayette County, Pennsylvania, and erected one hundred and sixty bee-hive coke ovens.

[20] *Directory*, 1904, 307.
[21] *The Commercial & Financial Chronicle,* vol. LXXXII (New York: William B. Dana Company, March 24, 1906): 696.

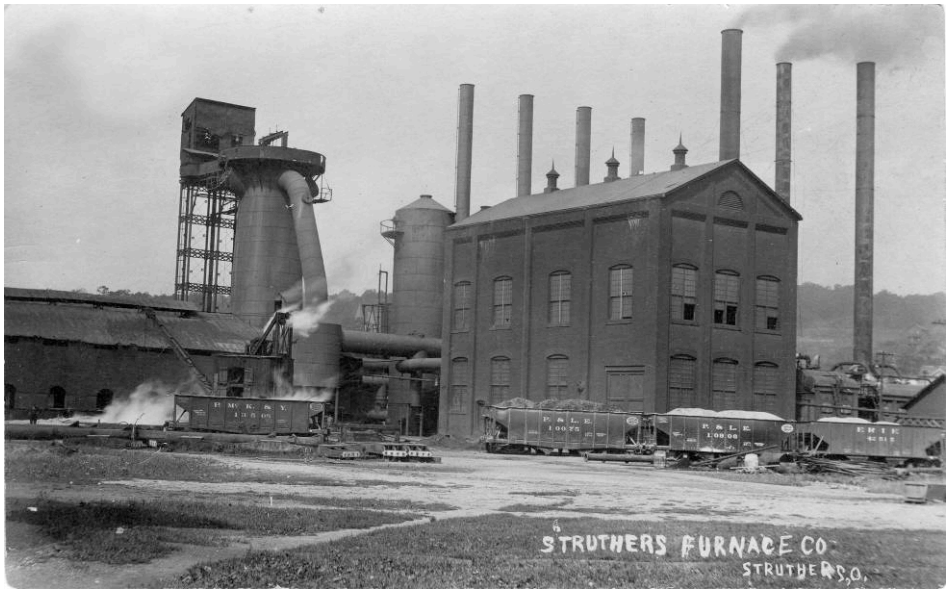

Figure 1-2: Prior to its rebuild in 1909, the Anna furnace remained a relatively old stack that retained an 1890s build. Shown from l. to r. are the furnace's cast house, elevator hoist and Anna furnace, firebrick hot stoves (behind the blowing engine house), blowing engine house, and boilers. The blowing engine house, constructed in the early 1890s, housed one Weimar and two small Cuyahoga high-pressure steam-blowing engines.

Courtesy of Struthers Historical Society

The vast bituminous coal reserves in the region allowed the company to control its own source of high carbon coke for use as blast furnace fuel. The establishment of the coke ovens made the Struthers Furnace Co. self-sufficient in fuel, but it still relied on outside sources for its iron ore. Yet, for all of the company's advances, the furnace itself remained hand-fed, as did all of the pioneer furnaces that remained in the Mahoning Valley. The Anna furnace's proprietors soon realized the advantages a proper mechanical skip hoist gave the independent iron manufacturer and S. A. Richards soon pushed for a complete overhaul of the furnace. The modernization of the Anna furnace indicated the last accomplishment in the storied and successful career of its well-travelled manager.

Between 1905 and 1909, the Anna furnace remained in steady operation with little overall additions or further modernization, and the only changes in the company's

management occurred. In 1907, former company vice president J. B. Stubbs retired. George L. Fairbank acted as his immediate replacement. Approaching 65 years of age, S. A. Richards's announced his retirement after a long and demanding career in the industry. However, Richards' retirement did not take place until the company entirely rebuilt the Anna furnace, and in June 1909, Richards ordered the stack blown out in order to completely rebuild, remodel and modernize the plant at a cost of nearly $1,000,000.[22]

The Struthers Furnace Company's rebuilt Anna furnace included an entirely new stack, foundations elevated five feet above the level of the old furnace, hand-filling equipment supplanted by a skip bridge and top with stock distributor, stock bins, cast house with its bed raised to correspond with the new furnace elevation, downcomers, dust catcher, hot blast main and valves, blowing engine, a double bell system, and additions to the electric plant. Arthur G. McKee of Cleveland, William B. Pollock Co., The Variety Iron and Steel Works Co., and the William Tod Co. of Youngstown provided all of the contract work. The furnace's size increased to a height of eighty-three feet with a twenty-one-foot bosh. Six cast iron columns raised above the level of the old furnace supported the new furnace's foundation. The firebrick lining in the bosh area averaged 27 inches in thickness with the lining at the hearth 31 inches thick. A 500,000-gallon, motor driven De Laval centrifugal pump located in the hoist engine house supplied water for the nine rows of cast-iron cooling plates. Twelve tuyeres blew the super-heated air into the furnace, and a McKee revolving distributor, manufactured by the Arthur G. McKee Co. of Cleveland, evenly distributed the raw materials at the furnace's top. A double track skip-bridge delivered the coke, limestone and iron ore to the McKee distributor that dumped the

[22] *The Chemical Engineer*, volume IX (Chicago: The Chemical Engineer Publishing Co., June 1909): 197.

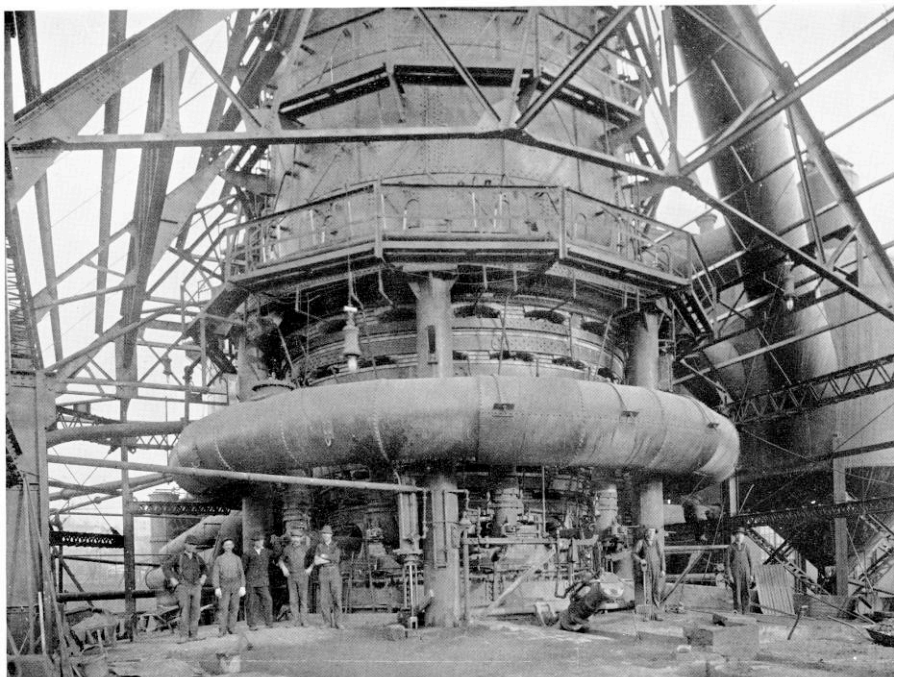

Figure 1-3: Workers pose next to the new furnace inside the unfinished cast house during the 1909 rebuild. Additional features installed at the furnace were a mud gun (bottom center), which mechanically shot fire clay into the open tap hole after iron was cast. The iron flowed through the iron runners (also shown) and poured into 25-ton hot metal ladles, which were then taken to the single strand Uehling pig-casting machine and cast in chills.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

burden upon a small bell (3'10" in diameter) that lowered and in turn dumped the burden on a sealed large bell (10 feet in diameter), which prevented much of the gas from escaping the stack. Before the installation of the double bell system, the old stack utilized a single bell and hopper, which allowed valuable furnace gasses to escape. A 12x14 inch double drum steam-hoisting engine located in the brick building at the bottom of the skip bridge operated the skip cars.[23] The furnace's bosh was also steepened to accommodate the use of Mesabi ores in the burden, which often stuck to the furnace walls and caused slips that resulted in damage to the stack.

In addition to the furnace itself, the company installed new auxiliary equipment,

[23] *The Iron Trade Review,* vol. 46 (Cleveland: The Penton Publishing Co., April 14, 1910): 723-24.

which included a new dust catcher and downcomer with mains that conveyed the gas to a Mullen type gas washer installed in 1908. The use of fine Mesabi ores in the early 1890s required the introduction of gas cleaning systems to reduce the amount of ore, or flue dust, in the gasses for proper reuse in the furnace stoves and boilers. The new cleaning system used both a dustcatcher that filtered large particles of iron ore from the gas, which was then piped to the gas washer, a turn of the century device that further cleaned the gasses with a water spray. When reused in the stoves, ore dust did not clog the checker-brick flues, which in turn allowed a larger heating surface and less frequent cleaning, thereby saving heat.

The furnace retained its four Julian-Kennedy 2-pass stoves with one being completely relined. Youngstown's William Tod Co. furnished a 96-inch and 96x60-inch vertical long crosshead low-pressure steam blowing engine to work in conjunction with the older Weimar and two Cuyahoga 42"x84"x54" engines. The furnace's new stock bins were constructed primarily out of steel and concrete rather than the old wooden trestle construction, but delays on steel deliveries prompted the company to use hardwood protected by steel sheeting. The coke bin had two doors, one that fed directly into each skip car and the other that operated through a system of levers from the operator's cage. Ten limestone and iron ore bins delivered their raw materials into an electrically driven scale car that ran over the skip pit.[24]

Unlike more modern and larger furnaces owned by steel companies, the Anna furnace only contained a semi-modernized raw material handling system and also lacked an ore bridge due to the furnace's comparatively small production levels. Hopper cars

[24] *The Iron Trade Review*, vol. 46, April 14, 1910: 725.

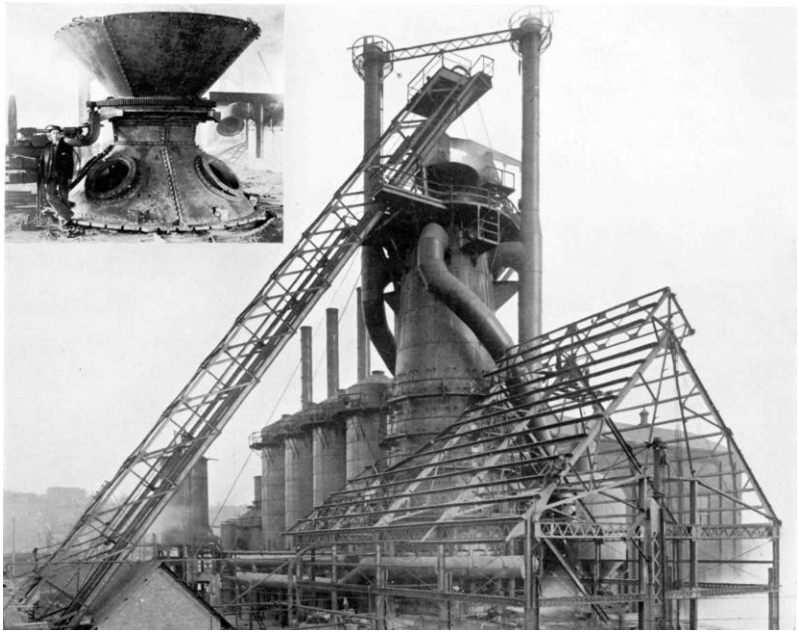

Figure 1-4: The new 400-ton Anna furnace is shown with its unfinished cast house. The hoisting engine for the skip cars was located in the small brick building seen in the bottom left corner underneath the skip incline. Unlike the Grace and Hubbard furnaces, which still cast in sand molds on the furnace floor, Anna's cast house was short, meaning the company only cast pig iron at the casting machine and did not require a longer cast house for additional sand molds.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

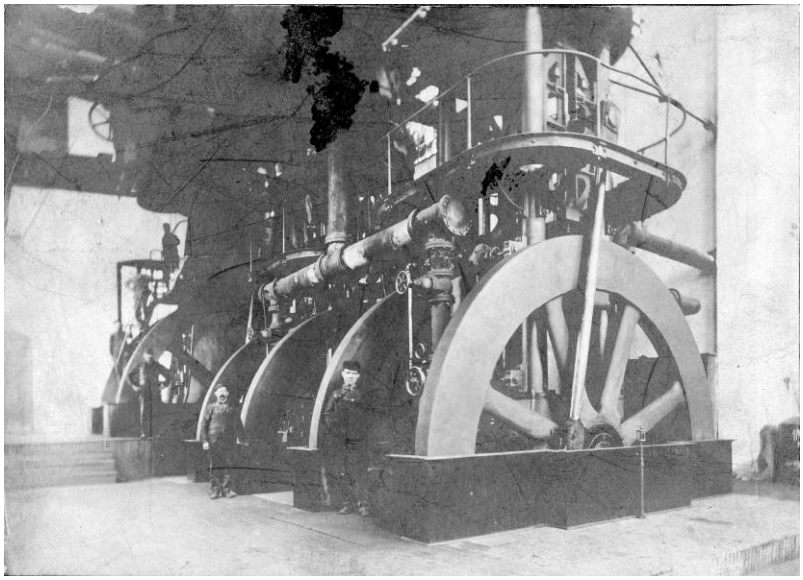

Figure 1-5: Inside the blowing engine house sat three, long cross-head vertical blowing engines: two small, Cuyahoga built low-pressure engines and one Weimar engine. The building was extended for the addition of a William Tod long cross-head vertical engine in 1909. The new engines provided higher blast pressure, which allowed increased production.

Courtesy of Struthers Historical Society

delivered raw materials and dumped them through pockets in the elevated trestles. Steam operated cranes with clam shell buckets reloaded the materials into the iron ore and limestone bins. Inside the casting house, the iron ran through iron runners into 25-ton Pollock built ladles and transferred by rail to the Uehling pig-casting machine. This complete overhaul of the Anna furnace allowed the company to stay competitive in a shrinking market for merchant iron producers. The furnace's primary product now consisted of basic iron for open-hearth steel works and malleable pig iron for foundry work, the former being an ever-shrinking market due to the construction of modern blast furnaces at many previously un-integrated steel works, rendering the purchase of iron on the open market unnecessary. The furnace now had a capacity of over 400 tons per day, on par with Brier Hill Iron and Coal Co.'s newly rebuilt Grace furnace and greater than all other independent iron manufacturers in the Mahoning Valley.

By December 1909, the Struthers Furnace Company blew in its new Anna stack. After the furnace's completion, the company lost one of its key members in Samuel Richards, who retired with his son Jules, longtime blower at the Anna furnace, on January 1, 1910 after fifty years in the iron business. The Struthers Furnace Co. replaced Richards with R. H. Wilkinson, former superintendent of the Carnegie Steel Co.'s Niles furnace.

Although the price of pig iron always played a major role in a blast furnace plants operations, the merchant market now faced increasing competition from the construction of modern blast furnaces in association with steel works. In the Mahoning Valley, the market for merchant pig iron remained high due to many companies' reliance on other sources of pig iron for steel manufacture. Pig iron prices remained stable through 1910 at

around $15 a ton and business for a small independent merchant furnace such as the Struthers Furnace Co. remained constant. By 1911 and 1912, steel companies throughout the Mahoning Valley constructed large open-hearth steelmaking facilities, with most companies initially lacking the iron production to wholly supply them. The Struthers Furnace Co. soon became an important purveyor of additional basic pig iron to steel companies as well as malleable iron for foundries. The boost in steel production combined with the pending First World War resulted in drastic increases in iron prices. This also meant good business for the Struthers Furnace Company.

In 1910, the Mahoning Valley only retained five independent merchant blast furnaces: Anna, owned by the Struthers Furnace Co.; Hubbard No. 1 and No. 2, owned by the Andrews & Hitchcock Iron Co.; Mary, owned by the Ohio Iron and Steel Co.; and Grace No. 2, owned by the Brier Hill Iron and Coal Co. Of these remaining furnaces, three modernized with an automatic skip hoist while two remained hand-fed (these two being the Hubbard No. 2 furnace and the Mary furnace. The formation of the Brier Hill Steel Co. in 1912 consolidated the former merchant furnace, Grace No. 2, into an integrated steel company that produced basic pig iron for the company's new open-hearth facility. The remaining timeworn pioneer furnaces now stood amidst furnaces built for large-scale steel production, such as the 500-800-ton stacks constructed at the Carnegie Steel Co.'s Ohio Works, Youngstown Sheet & Tube Co.'s East Youngstown Works (later Campbell Works) and Republic Iron and Steel Co.'s Haselton complex. The increased iron production from these new furnaces pushed the small, older furnaces into obscurity. Proper capital and management combined with sufficient modernization allowed the remaining merchant stacks to prosper throughout the decade, yet only the Anna furnace

Figure 1-6: This photo shows the Anna furnace in operation in 1914. The coming of the First World War shot pig iron prices up to a price not seen since the Civil War in the Mahoning Valley. The Struthers Furnace Company maintained full operation through the war years and produced both foundry and basic pig iron for open-hearth steel works.

Courtesy of Struthers Historical Society

remained an independent entity in the midst of the First World War and the concurrent high demand for any available pig iron. In the Mahoning and Shenango Valleys, basic pig iron prices remained steady between 1912 and 1916 at $12 and $17 per ton until the United States' involvement in the war boosted prices over $50 a ton by June 1917, a price not seen since the Civil War.[25]

Production at the Anna furnace remained constant with relatively little further construction after its overhaul in 1909. By 1916, the Struthers Furnace Co. had a capital stock of $1,000,000 with an outstanding debt of $525,000. The furnace itself contained four blowing engines, water supply pumps, generators, repair shops, four 18x70 and one 22x100 Cowper-Kennedy two-pass firebrick stoves, a slag-cement plant with a capacity

[25] G. F. Laughlin, *Mineral Resources of the United States 1918* (Washington: Government Printing Office, 1921), 561.

of 1,000 barrels a day all on thirty-three acres of ground.[26] The company's coke plant consisted of 200 bee-hive coke ovens and 235 acres of coal and surface lands, with 66 acres un-mined. The furnace itself rated at 500-tons per day and 170,000 tons annually, on par with several of the more modern furnaces constructed strictly for steelmaking purposes.[27] With basic pig iron prices sharply rising, the Anna furnace remained in full production, providing steel companies and foundries with much-needed iron for the war effort. To counter costs, the government, from October 1917 thru March 1918 regulated the prices of pig iron, remaining stationary at $33 per ton. Pig iron producers desired higher rates because demand exceeded supply, but the War Industries Board nullified this request and lowered prices another dollar in 1918.

The war years brought prosperous conditions to the Mahoning Valley's pig iron producers, but only the Struthers Furnace Company retained its independence. Many large steel companies required further pig iron production and purchased independent merchant iron producers during the war. In 1920, the Anna furnace was the only merchant stack that remained in the Valley. As the market subsided and pig iron prices stagnated due to both government regulation and decreased demand, the Struthers Furnace Co. accrued significant debt because of unsold inventory. By the latter half of 1919, the weakness in the basic pig iron market forced president W. C. Runyon to produce foundry iron rather than basic pig iron, the latter a grade the company produced for twenty years.[28]

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[26] *Poor's Manual of Industrials: Manufacturing, Mining and Miscellaneous Companies* (New York: Poor's Manual Company, 1916), 2219.

[27] *Directory*, 1916, 310.

[28] *The Iron Age*, vol. 104 (New York: David Williams Co., August 14, 1919): 471. The weakness in the basic pig iron market was attributed to consumers in the railroad trade that operated at less than 30% capacity. The foundry iron market was strong with much of the leading producers' stock sold for the

The first half of the 1920s brought financial distress to the company, which was unable to pay off its mortgage and outstanding debt accumulated over the years. Steel companies throughout the Mahoning Valley greatly enlarged the capacity of their modern furnaces constructed in the early 1900s, decreasing their dependence on the open market. Fluctuating market conditions in the pig iron market made it increasingly difficult to operate small, obsolete and independent blast furnaces on merchant iron. Of 119 furnaces in the United States that produced less than 8,000 tons of iron per month, over half became inoperable by 1925 with twenty-seven of these furnaces dismantled the same year.[29] The Anna furnace was rated at roughly 15,000 tons per month and considered by many in the industry as a productive unit, despite the company's accumulation of debt and the declining market for merchant pig iron.

On January 20, 1925, the Ohio state court appointed Hugh W. Grant as receiver of the Struthers Furnace Company in order to foreclose a mortgage on the company's realty and blast furnace equipment. The company was now under the supervision of the bank with intentions to manage the affairs of the company in order to discharge its accrued debt. Despite Grant's efforts, W. C. Runyon and secretary-treasurer A. Grossman filed for bankruptcy on April 18, 1927. The court forced the company to sell its properties in the latter half of the year. On November 4, 1927, the Struthers Furnace Co. officially dissolved and the Struthers Iron and Steel Company formed with William C. Holzworth, president; R. Selkirk, treasurer; and E. G. Tillotson, vice president. The new owners reconditioned the furnace's auxiliary equipment and relined the stack, which blew in on December 15, 1928. The company also added a sintering plant for the agglomeration of

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remainder of 1919.

[29] *The Iron Trade Review*, vol. 78, January 7, 1926: 63.

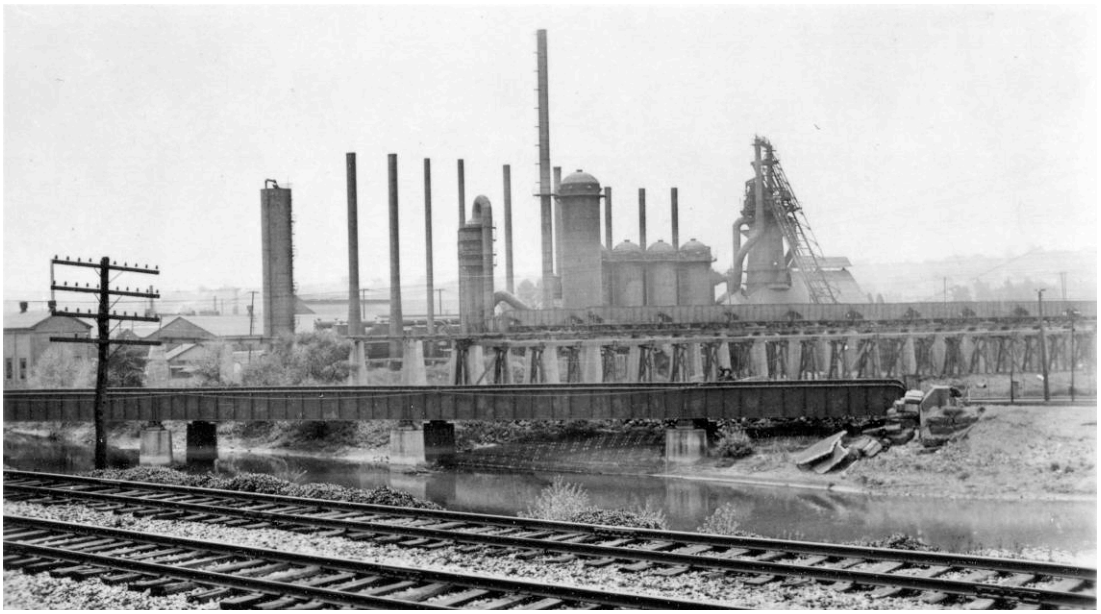

Figure 1-7: This 1933 photo shows an overall view of the Anna furnace and its ore and stock trestles looking south across the Mahoning River. As a merchant furnace, the company relied on the fluctuating nature of the pig iron market, a consequence that subjected the furnace to intermittent operations. The construction of large integrated steel mills reduced demand of merchant iron from furnaces such as Anna. The furnace's ore and stockyard was completely empty, with its last shipment made in 1933. The effects of the depression idled the furnace for four years until a loan from the Reconstruction Finance Corp. restarted operations two years later.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

flue dust in order to reuse the sinter at the furnace. The furnace now produced up to 500 tons of foundry, basic and malleable pig iron per month for purchase on the open market. Despite its name, the new company was not associated with a steel works and only operated the Anna furnace as the last single merchant stack in the Mahoning Valley.

Sustained operations of the Struthers Iron and Steel Co.'s Anna furnace proved temporary due to the effects of the Great Depression. The furnace only operated for two and a half years and produced low phosphorus pig iron, a specialty grade seldom manufactured because of the declining number of Bessemer converters.[30] The economic

[30] Low phosphorous pig iron contained less than 0.04% phosphorous and was generally used in the Bessemer process. By this time, the majority of steel works had shifted to open-hearth steelmaking and used basic pig iron, which contained 0.2 to 2.5% phosphorous.

crisis forced the company to temporarily cease operations in 1931. Along with the Anna, the Sharon Steel Hoop Company's Mary furnace at Lowellville and the Youngstown Sheet & Tube's two Hubbard furnaces were also inoperable due to the depressed economic conditions. The Anna furnace remained idled for another four years until president W. C. Holzworth successfully obtained a $350,000 loan from the Reconstruction Finance Corporation (RFC). Herbert Hoover established the RFC in 1932, which gave $2 billion in aid to state and local governments, along with loans to banks, railroads and other manufacturing businesses. The RFC expressly granted the loan for use "by the firm to further recovery in the company's own private operations."[31] Locals praised Holzworth for his efforts to obtain the loan, which put three hundred employees back to work at the furnace. At a time of financial difficulty, the city of Struthers benefitted greatly from its operation. Holzworth stated, "Most of our men live in Struthers…they will be first re-employed," an action that took several hundred families off relief.[32] The furnace remained warm over its four-year idleness, but its raw material yards remained empty with the last shipment of ore, coke or limestone made in 1933. The 500-ton furnace consumed about 15,000 tons of coke, 25,000 tons of ore and thousands of tons of limestone monthly, and the acquisition and transferal of these raw materials gave the railroads added business and further work for men working for the rail lines. The company hired R. C. Butler, former Sharon Steel Hoop blast furnace manager at Lowellville, to manage operations.

The Struthers Iron and Steel Company's Anna furnace was the first of the four remaining pioneer furnaces in the Mahoning Valley to restart operations during the

[31] "Furnace Firm Gets Big Loan," *The Vindicator*, February 15, 1935.
[32] "Furnace Firm Will Resume," *The Vindicator*, March 27, 1935.

depression. Men employed at the idle Mary furnace in Lowellville temporarily received work at the Anna furnace. On June 3, 1935, the Struthers Iron and Steel Co. lit its Anna furnace and employed 250 men while simultaneously aiding other industries, such as the railroad, foundries and mining companies. The 500-ton stack needed over 1,000 tons of ore, 500 tons of coke and about 125 tons of limestone to meet a single days capacity. The Anna furnace was still the second smallest iron producer in the Youngstown district, behind the Mary furnace in Lowellville. The company made few improvements to the furnace and its equipment since its overhaul in 1909, with the exception of general reconditioning. Even with the furnace back into production, the number of active blast furnaces in the Mahoning Valley amounted to ten out of thirty-one (this included the Shenango Valley), a statistic that shows the strong effects of the depression.[33] The Anna furnace only remained in blast for a year when the stack shut down as quickly as it started. Ultimately, the lingering economic crisis and price of pig iron during 1936 to the first quarter of 1937 forced the company to temporarily to cease operations. Throughout the depression, pig iron prices remained low and stagnant at $16-$17 a ton until 1937 when prices hit $20 per ton for the first time in a decade.[34] As the Second World War loomed in Europe, pig iron imports dropped sharply from 150,000 tons in 1936 to only 3,330 tons in 1941.[35] A decline in foreign pig iron imports combined with increased demand and production of pig iron throughout the United States signified profitable operations for remaining merchant blast furnaces. The war brought constant production for Anna as demand for pig iron grew throughout the early 1940s. Unlike the First World

[33] "Anna Furnace Lighted Today," *The Vindicator,* June 3, 1935.
[34] *Iron and Steel Statistics*, U. S. Geological Society (Last modified: December 7, 2010).
[35] *Iron and Steel Statistics*, U. S. Geological Society (Last modified: December 7, 2010).

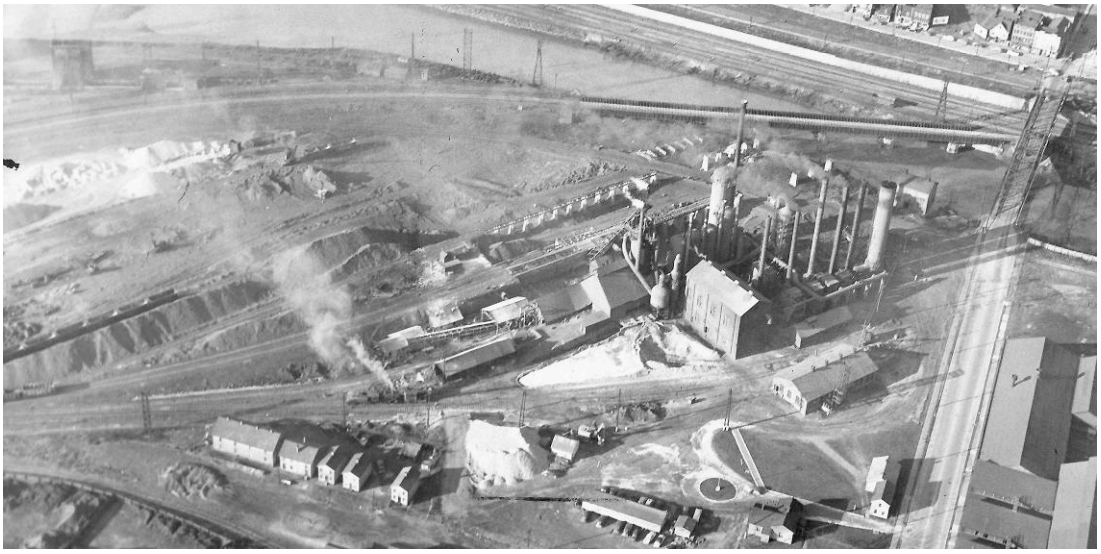

Figure 1-8: This late 1940s or early 1950s aerial view of the Anna furnace shows the plant's rather atypical layout along Bridge Street. The furnace's stockyard contained three trestles, one wooden (demolished in the photo) and two concrete. The plant did not utilize an ore bridge, but rather steam-powered cranes for raw material distribution, but it did contain stock bins similar to that of a modern furnace. Shown in the center of the photo is the furnace's Heyl & Patterson single strand pig casting machine.

Courtesy of The Vindicator

War, when pig iron prices averaged nearly $35 per ton, government regulation and price control forced the price of pig down to $21 during the 1940s, making it increasingly difficult for independent producers to operate on these prevailing prices.

Despite the price control of pig iron, the Struthers Iron and Steel Co. continued to receive orders for pig iron and production remained constant heading into the latter years of the war. It was not until November 1944 that the furnace required temporary closure when a surplus of pig iron developed and operations became unprofitable due to the Office of Price Administration's regulation of pig iron prices. The furnace was the only idled stack in the Mahoning Valley due to its sole dependence upon the price of pig iron, unlike large steel producers that benefitted from the use of both scrap and pig iron. The Anna furnace remained idle for six months until another acute pig iron shortage occurred

in the first half of 1945. Industry officials listed the Anna furnace as a "must" production unit. Company president William C. Holzworth announced that the stack would be blown in "as soon as possible" and also secured a large order from the government-controlled Metal Reserve Corporation, with further orders assured until war's end.[36] The resumption of the Anna furnace made each one of the twenty-five blast furnaces in the Youngstown district active.[37]

As the Second World War ended, the Anna furnace no longer produced iron economically and increased difficulties in plant operation prompted W. C. Holzworth to sell the furnace in October 1945. Holzworth sold the stack to the J. H. Hillman interests of Pittsburgh, who also controlled the Pittsburgh Steel Co. and the Pittsburgh Coke and Chemical Co.; however, the Anna furnace was not associated with the former company, which contained two modern blast furnaces and twelve open-hearth furnaces at Monessen, Pennsylvania. With Holzworth's resignation and controlling interest now under J. H. Hillman, the small furnace at Struthers retained the title of the Struthers Iron and Steel Co., a subsidiary of the Pittsburgh Coke and Chemical Co. headed by R. M. Marshall and T. R. Kirkpatrick. The Pittsburgh Coke and Chemical Co. was not an integrated steel company and only produced pig iron in two modern blast furnaces at Neville Island, near Pittsburgh, for foundries and the production of ingots for the steel industry. The company also manufactured by-product coke for the company's Neville Island furnaces and sale on the open market. The Neville Island furnaces had the advantage of modern operations adjacent to a large by-product coke plant, which utilized

[36] "Anna Furnace Will Resume," *The Vindicator*, April 28, 1945.

[37] These included the two furnaces of the Carnegie-Illinois Steel Corp. in Farrell (purchased by Sharon Steel after the war) and the two furnaces of the Shenango Furnace Company in Sharpsville.

gasses to power much of the equipment at the two blast furnaces (a practical and economical process whose absence motivated the Republic Iron and Steel Co. to dismantle its outlying Hannah, Hall and Atlantic furnaces). Pittsburgh Coke and Chemical suspended its significantly smaller and less efficient Anna furnace for a year until the company found a practical use for its operations by way of lease to the automobile industry.

As an independent merchant furnace, profitable start up for the Anna stack was often intermittent and the company frequently required arrangements with the federal government in order to resume production. The furnace remained idle for a year when the Hillman interests decided to restart the stack in August 1946 with government aid. Both steel companies and foundries required pig iron because of the post-war scrap shortage to meet the demands for civilian production. However, the furnace remained idle due to negotiations for the furnace's lease by outside industrialists. On August 25, 1946, Edgar F. Kaiser and his son, Henry J. Kaiser negotiated a three-year, $355,000 lease of the Struthers Iron and Steel Co.'s Anna furnace to "break the blockade of raw materials" and provide iron for the automobile company's Willow Run plant in order to regain full production of new cars.[38] The Kaiser-Frazer Corporation acquired a workforce of nearly 200 men for the long-idle plant, and one of the nation's oldest merchant blast furnaces that received its last major overhaul thirty-seven years earlier. The furnace remained nearly identical in appearance and equipment from its overhaul in 1909. It still measured eighty-three feet tall with a twenty-foot bosh, contained five two-pass stoves, three long-cross head vertical steam blowing engines with 15 pound per square inch pressure, a Heyl

[38] "Kaiser-Frazer Leases Plant," *Pittsburgh Post-Gazette*, August 26, 1946.

& Patterson double-strand pig casting machine, and a Greenawalt sintering plant with an annual capacity of 21,600 ton of sintered flue dust.[39] The furnace's daily capacity remained between 400 and 500 tons daily with an annual capacity of about 182,500 tons of basic and foundry pig iron and encompassed no further advances in raw material handling

When the Second World War ended, demand for raw materials for the steel trade skyrocketed. In order to provide a fair system, the government initiated a quota system for the purchase of steel, but for automobile companies, these purchases worked off use for models produced in 1941, an inherent problem for Kaiser-Frazer, who began operations in July 1945. In order for Kaiser-Frazer to obtain sheet steel and iron for automobile production, the company needed to buy capacity or purchase a steel mill outright. In June 1946, the company purchased 300,000 shares of the newly formed Portsmouth Steel Corporation in Portsmouth, Ohio, a company formed by Republic Steel Corp. founder Cyrus Eaton.[40] The old Portsmouth mill contained a by-product coke plant, ten open-hearth steel-making furnaces and a near 800-ton per day modern blast furnace. The purchase of 300,000 shares in the company guaranteed Kaiser-Frazer at least 33% of the company's output of steel rolled at Wheeling Steel's sheet mill in Steubenville, Ohio, despite high market prices. The deal put Kaiser-Frazer automobiles on the road but the company paid a premium price for the sheet steel rolled at Wheeling Steel.

In order to supply Kaiser-Frazer's need for iron castings for their automobiles, the company incorporated a subsidiary known as the Kaiser-Frazer Parts Corporation in 1946 to operate the Anna furnace. The stack provided pig iron to the subsidiary's foundries to

[39] *Directory*, 1948, 217.
[40] *Kaiser-Frazer Iron & Steel Plants*, June 1946-January 1950.

make castings for the parent company, which had trouble meeting production schedules due to the iron and scrap shortage. The Anna furnace provided the company with 14,000 tons of pig iron for castings and engine blocks; a number that Edgar Kaiser stated was "better than money."[41] Kaiser's frantic search for steel and raw materials resulted in the purchase of pieces for his automobiles from over 3,400 different firms, but the Anna furnace was one of the few that provided the Kaiser-Frazer Corporation with the entirety of its output.

Many officials throughout the automobile and steel industries considered the Anna furnace an "angel" for Edgar Kaiser and his automobile plant. The lease on the Anna furnace remained until May 1949, but in 1948, the company leased a war surplus blast furnace built by the Defense Plant Corporation for the Republic Steel Corp. in Cleveland. The company's situation continued to deteriorate and soon resulted in discontinuation of its remaining steel and pig iron operations, all being heavy financial burdens. In May 1949, Kaiser-Frazer revoked the lease on the Anna furnace and full ownership returned to the Pittsburgh Coke and Chemical Co. The furnace's age and relatively small output did not attract potential customers and P.C.&C. had no reason to operate the stack due to the sufficient output of the company's Neville Island furnaces. A boom in the pig iron market prompted owner R. M. Marshall to spend nearly $500,000 to reline and recondition the Anna furnace. The average price for pig iron jumped dramatically from $27 per ton in 1946 to $46 per ton in 1949 due to the post-war scrap shortage, which provoked the company to ready the stack for eventual production as soon as the demand for iron appropriately improved.[42] In the meantime, Marshall entered into

[41] "Old Struthers Blast Furnace Is "Angel" for Edgar Kaiser," *The Vindicator*, May 28, 1947.
[42] *Iron and Steel Statistics, U. S. Geological Society* (Last modified: December 7, 2010).

a five-year contract to furnish pig iron and by-product coke for the General Motors Corporation. A temporary slump in the pig iron market allowed P.C.&C. to furnish orders for the contract with operations at only one of the company's Neville Island furnaces, which produced 295,700 tons of iron annually while Anna only produced 188,150.[43] P.C.&.C. also saved $2.50 a ton on coke shipments from Neville Island to Struthers, and in addition economically utilized the blast furnace gasses at its adjacent coke plant while the Anna furnace wasted the gasses due to stack's relative isolation.

By August 1949, the demand for iron improved enough for P.C.&C. to put the Anna furnace back into production. The stack took over the duties of the Neville Island furnaces, which supplied nearly 150 customers in the Pittsburgh area, with coke shipped to the Anna furnace from the company's own by-product ovens. The Anna furnace remained under contract to supply its entire output to General Motors for castings until August 31, 1954, but uneconomical operations and high cost prompted General Motors to shut down the Anna furnace in the first week of April 1953. The shut down threw over 125 men out of work and any future restorations of operations at the old furnace became grim. Owner R. M. Marshall stated that the furnace remained on reserve until the expiration of the contract, but General Motors had already sold the stack's stock of 70,000 tons of iron ore to the Youngstown Sheet & Tube Co.; a decision that indicated no immediate plans for start up.[44] P.C.&C.'s two Neville Island furnaces provided enough pig iron capacity to take care of the needs of General Motors and the rest of its customers without production from the Anna furnace. Marshall stated that "We've no plans for the furnace…We didn't like the idea of shutting it down, but we can't operate it

[43] "Anna Furnace Being Repaired For $500,000," *The Vindicator*, June 25, 1949.
[44] "Anna Furnace in Struthers May Be Near End of Line," *The Vindicator*, April 12, 1953.

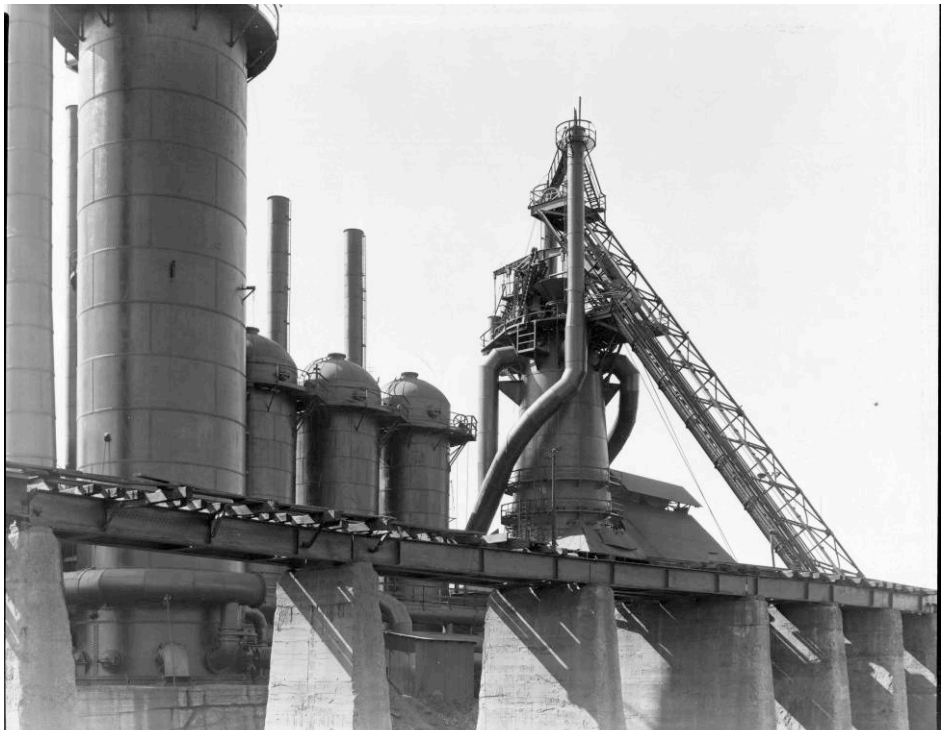

Figure 1-9: This late 1950s or early 1960s photo of the Anna furnace shows its elevated concrete stock trestles, hot stoves and the furnace with its skip hoist. The 83-foot tall furnace was the largest of the three remaining pioneer furnaces in the Mahoning Valley, but still only produced up to 500 tons of iron per day, second to Sheet & Tube's Hubbard blast furnace, which produced 550 tons per day. Sharon Steel's Mary furnace in Lowellville had the smallest daily capacity at 400 tons.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

economically for the present. I don't know what the future holds for it. There have been a lot of rumors in the past about dismantling it – but it always seems to have made a comeback."[45] The most prominent rumor for the furnace involved tearing it down with the real estate used for additional industrial use, which included the possibility of the site as a terminal for a Youngstown-Ohio River coal pipeline.

P.C.&C. retained ownership of the idle Anna furnace for several years without any intentions of operating the outdated stack. In 1956, company president Henry Hillman announced that Pittsburgh Coke and Chemical formed a subsidiary intended

[45] "Anna Furnace in Struthers May Be Near End of Line," *The Vindicator*, April 12, 1953.

Figure 1-10: J. D. Fowler officials stand amongst the remains of the Anna furnace's boiler plant. The constant neglect and dilapidation over a period of thirteen years left shattered windows about the blowing engine house and plants sprouting around the furnace grounds. The dismantling of the Anna furnace left only the Hubbard stack as the last extant pioneer blast furnace in the Mahoning Valley.

Courtesy of The Vindicator

manufacture and sell ferro-alloys, which included ferromanganese. The initial hope was for P.C.&C. to manufacture these ferro-alloys at the Anna furnace, thereby supplementing the production of the Neville Island furnaces. However, the company never restarted its Struthers furnace and the Neville Island furnaces constituted the company's ferro-alloy production, leaving the Anna stack in a precarious situation. Although P.C.&C. did not dismantle the furnace, it sat idle for another five years until it the company sold the old furnace to a prominent Youngstown steel-maker.

In June 1961, the Youngstown Sheet & Tube Co. severed its ties with the Mahoning Valley's once prominent iron producing past with the sale of its Hubbard blast

furnace to the Valley Mould & Iron Co. Only three months later, the company purchased the Anna furnace from the Pittsburgh Coke and Chemical Co. Despite the purchase, Sheet & Tube did not acquire the Anna stack with the intent to resume operations, but for its land and strategic position adjacent to the company's Campbell Works. President Albert S. Glossbrenner stated that the furnace, along with its 32 acres of land, provided Sheet & Tube with space for growth, but the company made no immediate plans for expansion. The furnace remained idle since 1953 and additional production of iron for Sheet & Tube's steel-making purposes proved unnecessary, as the company operated four modern furnaces at its Campbell Works, each capable of producing over 1,000 tons of iron per day. In April 1962, Sheet & Tube razed several of the smaller auxiliary buildings around the Anna furnace, but the stack itself remained extant for another four years. On May 4 1966, Sheet & Tube dismantled the ninety-seven year old landmark, an event that marked the demise of the Mahoning Valley's last merchant iron furnace. Only the furnace's cast iron plaque survived the demolition. Sheet & Tube never expanded operations onto the old Anna furnace property and it was not until the 1990s when the city utilized the former furnace grounds for construction of the Bob Cene baseball field complex and the city of Struthers' wastewater treatment plant.

Chapter 2: Mary Furnace – Endurance through Consolidation

As many of the early pioneer blast furnaces and iron works in the Mahoning Valley gradually dissipated from lack of modernity, consolidations and mass production of steel that transpired after 1900, iron production at Lowellville defied many of those obstacles and sustained profitable operations well into the twentieth century. In a 1949 article written for the industrial trade journal *Steel*, John D. Knox spoke of Lowellville's Mary furnace as a "landmark of the early days of the iron industry that has all but disappeared...a thing of the past" and "a reminder of the days when the ironmaster was the jack of all trades."[1] By 1900, the Mary furnace was the oldest operating iron manufacturer in the Mahoning Valley and by 1955, the world. Only a select few pioneer furnace plants in the Mahoning Valley prolonged operations after 1920 with success, but Mary furnace maintained a specific manner of operations that defied the odds in the industry, this being hand-fed filling. The pioneer furnaces that still functioned in the Valley, such as the Anna and Hubbard furnace, relied on the automatic skip hoist, but by 1950, the Mary furnace remained hand-fed and continued processes similar to those used in the 1880s and 1890s.

Although the furnace remained manually filled, slight modernizations transformed the laborious work of filling the furnace into a more manageable process in times of high demand for steel and iron. Like the Hubbard furnaces and Grace furnace at Brier Hill, the purchase of the Mary furnace by a larger integrated steel company allowed the old stack to remain in production. The Mary furnace provided sufficient amounts of

[1] John D. Knox, "Mary Blast Furnace: Last of Hand-Filled Stacks In America," *Steel,* vol. 125 (October 10, 1949): 133.

molten iron for the Sharon Steel Corp.'s small open-hearth plant located just a quarter mile from the old stack, which presented little need for the company to build larger and more modern furnaces. This was partly due of the topography of the land, the relatively small production of steel at the adjacent open hearth plant and the inherent high cost of blast furnace construction when the company required large amounts of iron after the Second World War.

Before 1845, the small village of Lowell (later renamed Lowellville) appeared similar to many of the other small villages throughout the Mahoning Valley: largely agricultural. The construction of the Pennsylvania and Ohio Canal in 1839 allowed some industry to arise in Lowell in the forms of grist and sawmills, but industry on a larger scale did not appear until several years later. The construction of a blast furnace similar to the charcoal stacks on Mill Creek in Youngstown and the Maria in Niles was uneconomical at the time due to the inherent cost of shipping and producing charcoal. Wood for coaling soon dissipated and the productivity of local charcoal furnaces waned. After the old charcoal blast furnaces in the Mahoning Valley faltered through lack of fuel, transportation, isolation, obsolescence or transformation into raw coal furnaces, a new era of smelting iron with low sulphur block coal arrived.

The first blast furnace constructed in the post-charcoal era in the Mahoning Valley was the Mahoning furnace, built along the Pennsylvania and Ohio Canal and the Mahoning River by the Wilkes, Wilkinson & Co. of Pittsburgh in the small village of Lowell, Ohio. The new stack, designed by William McNair, utilized quarried stone for its construction and used native coal and ores from the Lowell neighborhood, primarily from

Figure 2-1: Built in 1845, Lowellville's Mary furnace was the first in the United States constructed to intentionally utilize raw coal as fuel. By the mid-twentieth century, it was the oldest active furnace in both the Mahoning Valley and the world, and retained a unique aspect of old blast furnace practice for its entire lifetime: hand-fed charging rather than automatic skip charging. This 1932 image shows the furnace, its elevator hoist and old wooden stock house at right.

Courtesy of the Hagley Museum & Library, 1986268_0370

the Sharon seam, a block coal of similar composition to the Brier Hill block coal found by David Tod in the early 1840s. Proprietor Frederick Wilkes first put the Mahoning stack into blast August 8, 1846 under furnace manager John Crowther, an experienced blast furnace man who previously operated a furnace at Brady's Bend, Pennsylvania and seven furnaces in Staffordshire, England before immigrating to America in the early 1840s. On August 26, 1846, the *Mahoning Index* reported, "The Mahoning Iron Works are of the largest capacity and of the most perfect construction - They are provided with powerful machinery, and embrace all the modern improvements in use in Scotland and at the furnaces of Staffordshire."[2] On the first day of operation, the furnace produced 100 pigs of No. 1 grey foundry iron, which resembled "the Scotch pig iron held in such high

[2] *Mahoning Index*, August 26, 1846, 2.

estimation in the Eastern cities for fine castings, being soft and close grained."[3]

The small firm utilized a hundred and fifty acres of land in one lot and forty in another. Initially, newspaper reporters and industrial journalists deemed the furnace the first to utilize raw coal as fuel, when, on August 15, 1846, *The Trumbull Democrat* of Warren, Ohio stated, "to these gentlemen [Wilkeson, Wilkes & Co.] belongs the honor of being the first persons in the United States who have succeeded in putting a furnace in blast with raw bituminous coal."[4] However, recent evidence suggests otherwise. In 1845, the Clay furnace in Mercer County, Pennsylvania, just east of Hermitage, also experimented with raw coal as fuel after workers at the furnace's charcoal producing plant called a strike due to low wages. In desperate need of another fuel, Clay furnace proprietors David Himrod and Bethnel B. Vincent were compelled to use raw coal rather than charcoal, but only produced a "fair quality of metal."[5] For years, disagreements arose amongst the owners of the Clay and Mahoning stacks for the honor of first using raw coal as fuel. In 1975, Archaeologist John White of Youngstown State University found evidence of raw coal used as fuel in the Hopewell furnace in Struthers before 1812, which disproved Vincent and Himrod's argument.[6] Those in the industry noted the Mahoning furnace as the first blast furnace in the United States to *intentionally* use raw coal as fuel. The 1891 issue of *The Popular Science Monthly* stated, "The successful blowing in of the furnace at Lowell may be fairly regarded as the commencement of the

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[3] *Mahoning Index*, August 26, 1846, 2.

[4] James Moore Swank, *History of the Manufacture of Iron in All Ages* (Philadelphia: The American Iron and Steel Association, 1892), 373.

[5] Gordon, *American Iron*, 160.

[6] For additional information on Dr. John White's analysis, see: John R. White, "Archaeological and Chemical Evidence for the Earliest American Use of Raw Coal as a Fuel in Ironmaking," *Journal of Archaeological Science* 5 (1978): 391-393.

use of raw bituminous coal as a blast-furnace fuel in the United States."[7]

The Mahoning furnace's primary source of coal came from both the Sharon seam on the state borders and Mount Nebo coal mines, the area located between Struthers and Lowellville where the Heaton's quarried much of their limestone for the Hopewell furnace. Mount Nebo also provided a source of native ores along with additional iron ore mines from local farms. Rolling mills in New Castle, Pennsylvania provided the Mahoning furnace with its primary market, where iron shipped on the canal reached its final destination at New Castle's puddling and rolling mills. Frederick Wilkes recalled that the furnace "was a great success, but a financial failure; I there lost eight years of the best of my life and nearly $3,000," and in the summer of 1853, Wilkes sold the Mahoning stack to the Alexander Crawford & Co. out of New Castle, Pennsylvania to directly supply the company's rolling mills.[8] The Crawfords hired Benjamin Crowther to manage the furnace, who trained under the guidance of his father John at the Mahoning furnace under the proprietorship of Frederick Wilkes. Benjamin's knowledge allowed sufficient production from the stack, which in the early 1850s produced up to 10.2 tons of iron per day using a lower coal measure carbonate ore mixed with rolling mill cinder.[9] Crawford constructed a two-mile long railroad from the furnace to his mines to decrease the cost of coal for the furnace. The stack only operated a month utilizing its old equipment installed by the Wilkes ownership. After insufficient operation, Crawford blew out the stack and commenced several improvements. One of these consisted of

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[7] William F. Durfee, "The Development of American Industries Since Columbus: Iron Smelting by Modern Methods," *The Popular Science Monthly*, February 1891, 458-459.
[8] "The First Furnace in This Valley in Which Bituminous Coal was Used Erected by William Wilkes," *The Vindicator*, January 25, 1900.
[9] Knox, "Mary Blast Furnace: Last of Hand-Filled Stacks In America," *Steel,* vol. 125 (October 10, 1949): 133.

Figure 2-2: By 1900, the small village of Lowellville presented little heavy industry with the exception of the blast furnace. This c. 1912 view from Bedford Hill shows the Mary furnace in the distance, then owned by the Ohio Iron and Steel Co., which formed in 1880. Although the company's name included the word "steel," it only produced pig iron from the Mary furnace to sell to foundries and steel mills, largely located in Pennsylvania and New York.

Courtesy of Mahoning Valley Historical Society

bringing the gas down from the tunnel head in order to utilize the gas in the boilers and hot blast. Crawford placed both the boilers and hot blast on the ground rather than at the tunnel head, which saved him thirty dollars a day and simultaneously made the Mahoning stack one of the first furnaces in the United States to successfully adopt this practice.[10] These additions and improvements greatly increased the furnace's production from 35 to 85 tons of iron per week while using the same quantity of hot blast used before Crawford's enhancements.[11]

[10] *Encyclopedia of Contemporary Biography of Pennsylvania*, vol. 2 (Bethlehem: Historical Society of Pennsylvania, 1868), 154.

[11] *Encyclopedia of Contemporary Biography of Pennsylvania*, vol. 2, 154.

The Alexander, Crawford & Co., a firm composed of practical iron men who established the first rolling mills in New Castle, utilized the Mahoning furnace's high production rate and experienced furnacemen to their advantage. James D. White, with the assistance of Joseph H. Brown, the latter becoming so critical in the establishment of Youngstown's early iron manufacture, developed New Castle's first rolling mill in 1839. After White's death, Brown pulled out of the mill and by 1850, A. L. Crawford and his brother James purchased the primary shares and established the Cosalo Iron Company to produce nails, bar iron and rails for the nation's developing railroads. In the early 1850s, the Crawford Brothers and the Cosalo Iron Co. entered into a contract with the Cleveland & Columbus Railroad to produce 10,000 tons of iron rails from pig iron produced at their furnace in Lowellville and the company's Tremont furnace near New Wilmington, PA.[12] Barring any disturbances in production, such as relining, strikes and accidents, the furnace needed to produce 10 tons of iron per day over a period of two and a half years to fulfill its contractual obligations. In 1853-54, the Cosalo Iron Co. manufactured over 4,000 tons of iron rail from pig iron manufactured at the Mahoning furnace, and by supplying Crawford's rail mill in New Castle, the furnace developed a staunch reputation in the North as a purveyor of pig iron which continually built the region's early transportation networks.[13] Confederate forces did not overlook the Mahoning furnace's considerable production of pig iron for military armaments and railroad iron for the Union during the Civil War. Because of its high production, the furnace was supposedly a

[12] Aaron L. Hazen, *20th Century History of New Castle and Lawrence County Pennsylvania* (Chicago: Richmond-Arnold Publishing Co., 1908), 120.
[13] J. P. Lesley, *The Iron Manufacturer's Guide to the Furnaces, Forges and Rolling Mills of the United States* (New York: John Wiley, Publisher, 1859), 253.

target of Confederate General John Hunt Morgan during his Northern raid in 1863.[14] Union forces defeated Morgan's army at Salineville, Ohio only forty-five miles from Lowellville, thereby leaving the furnace intact.

Crawford's improvements on the Mahoning furnace allowed him to sell the stack at a premium price during the height of the Civil War. In May 1864, Alexander Crawford & Co. sold the furnace and one hundred and fifty-six acres of land to the Hitchcock, McCreary & Co. for $100,000. The furnace produced at high capacity throughout the remainder of the war and afterwards became essential to the country's rebuilding program, yet the new company did little to improve the furnace and its auxiliary equipment and subsequent unsuccessful business operations led to the sale of the stack to the Mahoning Iron Company in 1871. By 1872, twenty-one furnaces were spread around the Mahoning Valley from Warren to Lowellville and Hubbard. Each furnace in the Valley was modernized and constructed with an ironclad frame rather than a stone stack, while the Mahoning furnace remained the only stone furnace in the Valley. Prolonged operations at Lowellville meant a complete overhaul of the Mahoning furnace due to the increased competition and production from other Valley furnaces. With the stack aged and quickly becoming obsolete, the company soon decided to completely rebuild it to remain competitive in the pig iron market.

In 1872, the Mahoning Iron Co. rebuilt the furnace with an ironclad shell lined with firebrick, enlarged it to a height of fifty-six feet with a bosh diameter of fifteen feet and installed modern auxiliary equipment. The company also changed the name of the furnace from Mahoning to "Ada" and constructed it for the utilization of both

[14] "Century-Old Furnace Reaches End of Line," *The Vindicator*, September 16, 1962.

Connellsville coke and raw coal, which pushed production up to 8,000 tons of iron annually.[15] With the overhaul of the furnace from a stone stack to a larger, ironclad furnace, the company removed the charging bridge from the hillside and added a wooden framed water-balance elevator hoist. Despite the overhaul of the Ada furnace, the Mahoning Iron Co. succumbed to the 1873 Panic and sold its furnace to the estate of Thomas Bell, William McCreary and J. S. Dillworth, who only operated the stack intermittently during the depression years.

In 1879, prominent Youngstown businessman and iron industrialist Henry Wick, son of banker Hugh Bryson Wick, examined both the property and furnace owned by McCreary & Bell. Shortly after Wick deemed the furnace and its lands profitable, he placed an option on the property and purchased the furnace on February 11 of the following year. In March 1880, Wick organized the new company under the name of the Ohio Iron and Steel Co. with a capital of $35,000. Although the new company included the word "steel," it only produced pig iron for sale on the open market. Officials of the new company included Thomas H. Wells, president; Henry Wick, vice president and Robert Bentley secretary and treasurer, the former two men being essential in Youngstown's transition to steel manufacture in 1890 with involvement in the Ohio Steel Co. and Union Iron and Steel Co. in Youngstown.

Before the formation of the Ohio Iron and Steel Co., Henry Wick had experience in the iron business as secretary and treasurer of the Youngstown Rolling Mill Company, a puddling and rolling mill on Youngstown's west side. Together, the three new proprietors of the Lowellville furnace owned vast amounts of limestone deposits within a

[15] Knox, "Mary Blast Furnace," 134.

few miles of the stack in Hillsville, Pennsylvania, which allowed the furnace to prosper and simultaneously initiate the revival of the village of Lowellville. When Wells and Wick purchased the Ada furnace, it contained seven tuyeres, two cast-iron pipe stoves of the Hamilton pattern preheated the air, a small blowing engine that measured 66 in. by 4 ft. 6 in. provided the hot blast pressure, which was a mere 3-3.5 pounds per square inch. It did not implement fast driving or higher blast pressures available from modern blowing engines.[16] The cast house consisted entirely of a wooden-framed building and the hoisting elevator operated as a water-powered, gravity driven wooden-framed device similar to the hoisting system used at the old and outdated Eagle furnace in Youngstown. The first change to the stack was not technological modernization, but the furnace's name, which changed from Ada to Mary after Robert Bentley's mother, Mary McCurdy.[17]

With the exhaustion of local bituminous coal throughout the area, Wick and Bentley completely overhauled and remodeled the Mary furnace to utilize Connellsville coke as fuel in 1883. The company enlarged the furnace to a height of seventy-five feet with a bosh diameter of sixteen feet and produced up to 41,000 tons of iron per year.[18] New equipment at the furnace included a Pollock-type hot blast stove that contained 60 cast-iron pipes, a new blowing engine house built in 1882 that housed a Weimar blowing engine, which measured 84 in. by 4 ft., a new stockhouse, two new boilers and a new iron framed hoist to replace the old wooden framed device.[19] Throughout the 1880s, iron loaders and carriers performed extremely laborious and difficult tasks. Only a single

[16] *Report of the Geological Survey of Ohio,* vol. V (Columbus: G. J. Brand & Co., 1884), 535-536.
[17] George R. Reiss, "Fad of Naming Furnaces After Women Dies in Iron Industry," *The Vindicator*, December 21, 1941.
[18] *Directory*, 1884, 58.
[19] Knox, "Mary Blast Furnace," 134.

railroad siding ran along the stockhouse to deliver coke, limestone and iron ore, while the mainline Pittsburgh, Fort Wayne & Chicago Railway, a division of the Pennsylvania Railroad, ran about 300-400 feet from the northernmost edge of the casthouse. Iron loaders had the arduous task of carrying one hundred pound pigs from the casting house to a long, brick shed that sat parallel to the mainline railroad, where workers placed the pig iron in storage until delivery.

As steel production loomed over the Mahoning Valley's iron industry, Ohio Iron and Steel Co. vice president Henry Wick left operations at Lowellville and organized the Ohio Steel Company in Youngstown. John C. Wick filled the vacancy while the other officers of the Ohio Iron and Steel Co. remained intact. This small reorganization of officers had little effect on the successful operations of the company. After Wick purchased and remodeled the furnace, it experienced constant success and always maintained some of the highest and most prosperous production of any furnace in the Mahoning Valley. An 1892 company report described one of the keys to the furnace's continuous success, "Experience taught the greatest care in the manufacture of our product by the association of daily analysis. We are able to preserve uniformity that sustains its demand."[20] The company installed its own chemical laboratory in the early 1890s, which allowed uniformity in the company's product, something that customers always looked for their pig iron needs. To remain competitive in an aggressive market, the company decided to remodel the stack and improve its auxiliary equipment in 1894.

The most significant additions were the installation of three Cowper-Kennedy two-pass firebrick stoves, which significantly improved the hot blast and the furnace's

[20] Knox, "Mary Blast Furnace," 134.

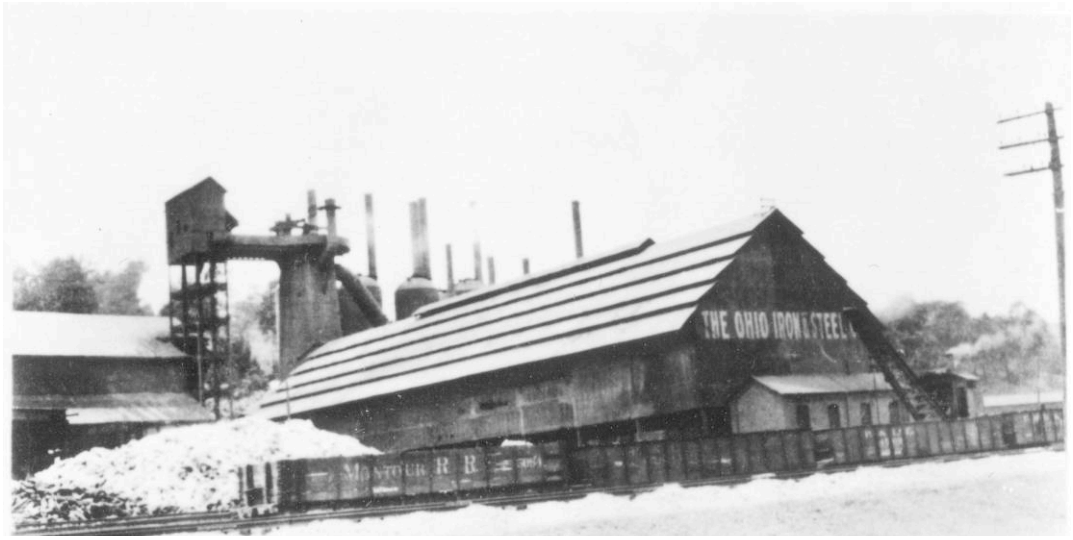

Figure 2-3: The Ohio Iron and Steel Company's Mary furnace is pictured here around the turn of the twentieth century. Shown from left to right is the furnace stock house, elevator hoist, furnace and its long cast house with hot stoves in the background. The extended cast house accommodated the enlarged capacity of the furnace after its enlargement in 1898.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

production.[21] The company did not enlarge the furnace itself for another four years. On July 1, 1898, the Ohio Iron and Steel Co. commenced its most extensive rebuild of the Mary furnace since its overhaul in 1883. The company shut down the Mary furnace and invested $100,000 in repairs to the plant, which consisted of a practically new furnace that measured eighty-five feet tall with an eighteen-foot bosh, an additional 2-pass side-combustion Cowper-Kennedy hot blast stove along with new boilers and three long-crosshead vertical Tod steam blowing engines for the hot blast.[22] In addition, the company improved the stock house, trestles and hoist, "making the furnace one of the finest in the country...and most complete and largest in the Mahoning Valley."[23] The

[21] In 1894, the Mary furnace had an annual capacity of 58,000 tons. Constant improvements to the furnace and its auxiliary equipment throughout the next four years raised its annual output to over 100,000 tons by 1900.

[22] "Finished are the Repairs at the Lowellville Blast Furnace," *The Vindicator*, November 28, 1898. The Tod blowing engines served the furnace until it was dismantled.

[23] *The Vindicator*, November 28, 1898.

Figure 2-4: The image above shows a view inside the cast house of Lowellville's Mary furnace c. 1908-10. The furnace is shown in the background with employees using trowels to direct the flow of the iron on the sand bed-casting floor. Workers directed the iron into molds, which cooled and formed hardened pig iron. Men wielding sledgehammers broke the iron and loaded it onto railroad cars for shipment. By 1910, the Hubbard furnaces and Mary furnace were the last in the Mahoning Valley to exclusively cast pig iron with this outdated and laborious method.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

furnace's increased tonnage required the company to extensively remodel and extend the cast house in order to accommodate larger amounts of pig iron cast on the furnace floor. This extensive overhaul resulted in making the Mary furnace one of the tallest and most modern merchant furnaces in the Mahoning Valley. It would be the last time the Ohio Iron and Steel Co. or the furnace's successor would undertake such a large overhaul.

Financially, the company was one of the most prosperous in the Mahoning Valley and continued further modernization, particularly in auxiliary equipment and operations outside the furnace itself. One step in further modernization was the installation of an improved method of handling furnace slag by the Browning Engineering Company of

Cleveland in 1902. The slag was now granulated into a pit and transferred by crane and grab bucket to gondola cars for shipment to a slag processing plant or concrete manufacturer. This new process eliminated thirteen men a turn, whereas prior to its installment, the slag was flushed into a yard, broken up by hand and hauled away in a mule-drawn, two-wheel dump cart. At the turn of the century, the furnace's cast house was replaced with an elongated, all iron building that terminated directly adjacent to the mainline Pennsylvania Railroad. Additional railroad sidings were installed near the cast house with a track that ran directly through its northern most point, thereby mostly eliminating the harsh labor that many iron loaders and carriers endured as pig iron was now placed upon railcars at the cast house rather than carried or carted 300 feet to the brick storage shed. In 1905, the company installed another Tod long cross head vertical blowing engine at the furnace. This particular engine measured 84 in. by 64 in. and operated at 50 revolutions per minute with a maximum air pressure of 25 pounds per square inch. It also incorporated a specific design where the steam gear was of the usual Corliss type and the air gear was positively operated. The Ohio Steel Co. first used this type of engine for their blast furnaces at Youngstown in 1898 and patented shortly thereafter.[24]

Around 1907, Ohio Iron and Steel Co. installed a mechanical pig breaker in the Mary furnace's cast house. This device, also installed in the Hubbard furnaces, broke the pig iron from the comb by a machine rather than men wielding sledgehammers, which eliminated eighteen jobs at the furnace. Once the iron was cast on the furnace floor, an overheard crane lifted the "comb" of pig iron and moved it to the pig breaker, where it

[24] *The Iron Age*, vol. 76, November 2, 1905: 1139.

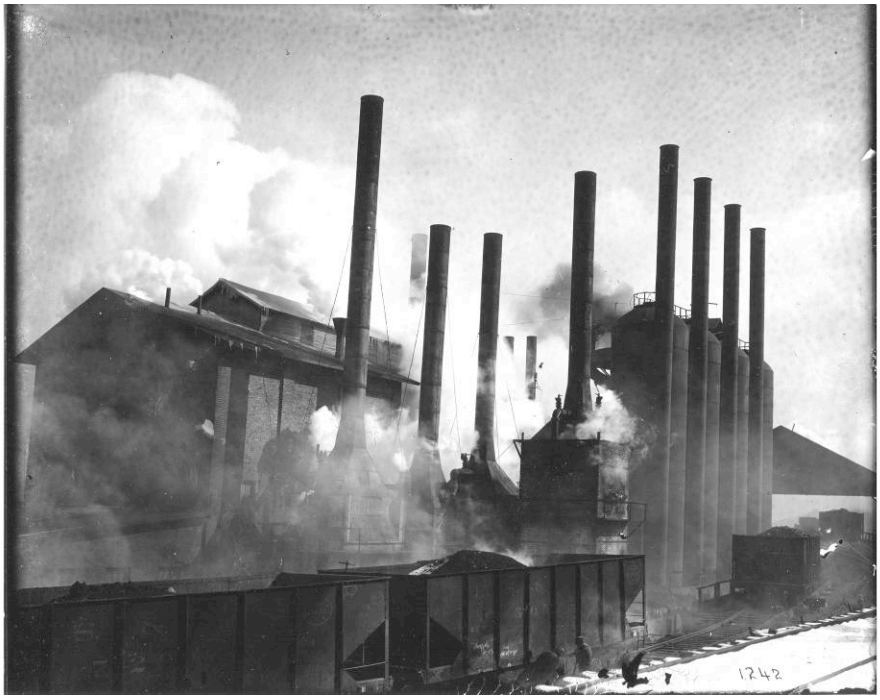

Figure 2-5: This c. 1908 photo of the Ohio Iron and Steel Company's Mary furnace shows the plant's auxiliary equipment. To the extreme right in the background is the stockhouse where hopper cars dumped iron ore, limestone and coke into the appropriate bins. The coal-loaded hopper cars in the foreground dumped their contents into coal bins placed directly behind the stoves and boilers. Both the coal and furnace waste gasses fueled the boilers, which produced steam to power the three Tod vertical long-cross-head steam blowing engines housed in the brick blowing engine house shown to the left.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

laid the pig iron down upon a table of rollers that fed them up to a hydraulic plunger working up and down, which broke them into short sections. The company also added an additional 2-pass Cowper-Kennedy hot blast stove around 1912, which allowed for a larger heating surface and production. Although the furnace utilized a dustcatcher to partially clean the furnace gasses of dust, the lack of a gas washer to better cleanse the gasses resulted in particles frequently clogging the checker-brick heating surface within the stoves. A fifth stove lessened the down time in pre-heating blast air when cleaning the stoves of dust and other particles. Like many other merchant furnaces in the Mahoning Valley, the company installed a single-strand Uehling pig casting machine around 1912,

which eliminated the majority of casting operations on the furnace floor and allowed production of basic pig iron used for open-hearth steelmaking.

After the death of eccentric industrialist Thomas H. Wells in 1905, the company chose Robert Bentley as Wells' successor; John C. Wick as vice president and David Davis as secretary and treasurer. Despite constant success from the firm, the furnace itself had an unavoidable setback that resulted in the loss of two lives. In March 1907, the stack exploded from a slip of stock inside the furnace because of the use of Mesabi ores.[25] The explosion was so severe that it blew out the bell and injured an additional six men. The company immediately reconditioned and rebuilt the damaged portion of the stack to its previous arrangements and operations continued only a day later.[26] The company halted any further enlargement and remodeling of the furnace until 1916 when the Mary stack underwent only slight modifications. The company actually shortened the furnace four feet and its bosh enlarged by one foot, thus allowing for a slightly shorter smelting period along with slightly higher production per cast. Because of these modifications, the stack produced 11,000 tons of basic pig iron in October 1916, an average of over 350 tons of iron per day.[27] The furnace produced 480,000 tons of iron between 1913 and 1916, a substantial output for any merchant blast furnace in that period. Despite the furnace's age, it averaged well over 330 tons of iron per day since the company relined it in 1913. The stack remained in full production throughout the First World War when pig iron prices skyrocketed to a price not seen since the Civil War, and provided many steel works with basic iron, which included the Youngstown Sheet & Tube Co., whose basic pig iron

[25] Slips occurred frequently after the introduction of finer Mesabi Range ores in 1892, which often stuck to the furnace walls and created a void in the furnace hearth below. The stock fell into this void, which caused a rush of gasses to expel from the top of the furnace.
[26] "Furnace Explosions Kill and Injure," *Oakland Tribune*, March 30, 1907.
[27] "Mary Furnace Makes Fine Record," *New Castle News*, November 9, 1916.

production could not fully supply its open-hearth furnaces. This period was characterized by the sale of many independent iron manufacturers to previously un-integrated steel works for a source of pig iron. The need to manufacture steel for the war meant the acquisition or construction of blast furnaces by steel companies, but due to the demand for steel and raw materials by the government and the war effort, it was often more economical for companies to purchase individual furnaces from independent owners rather than construct entirely new stacks.

The Mary furnace maintained highly successful operations as an independent merchant stack until January 1918, when the Sharon Steel Hoop Co. of Sharon, Pennsylvania negotiated a deal with the Ohio Iron and Steel Co. to purchase the Mary furnace. Incorporated in 1900, Sharon Steel Hoop was not an integrated steel company. It was one of the largest producers of steel hoops and bands for barrels and the cotton industry. The company produced its own steel in open-hearth furnaces at its Sharon Works, but acquired all of its pig iron from the nearby Farrell Works of the Carnegie Steel Co. In March 1917, Sharon Steel Hoop acquired a recently constructed open-hearth steel plant and primary rolling mills in Lowellville owned by the Youngstown Iron and Steel Co., located less than one mile from the Mary furnace. Sharon Steel Hoop also acquired the Youngstown Iron and Steel Co.'s sheet mill in Youngstown, where the company sent sheet bars from its open-hearth and blooming mill in Lowellville. The open-hearth plant consisted of three 75-ton basic open-hearth furnaces, two 4-hole soaking pits to uniformly heat steel ingots and a 36-inch slabbing mill and 30-inch sheet bar mill with molten metal provided under contract by the Ohio Iron and Steel Co.'s Mary furnace. The plant manufactured over 185,000 tons of steel ingots and 185,000 tons

of slabs and sheet bars annually.[28] Coupled with about three hundred tons of scrap used in the open-hearth, the 400-ton Mary furnace was just enough to supply the immediate need of roughly 750 tons for successful operations at Sharon Steel Hoop's steel-making facility.[29]

The acquisition of the nearby Mary furnace gave Sharon Steel Hoop complete control over both its molten iron requirements and chemical structure within the iron at a period when steel was in high demand. Sharon Steel Hoop paid the Ohio Iron and Steel Co. in stock, and confident in their ability to make a profit, increased its capital from $10 million to $15 million. The transaction only included the physical property of the Ohio Iron and Steel Co. and did not include its ore, coke, coal and limestone interests. Ohio Iron and Steel president Robert Bentley stated, "As the Sharon Steel Hoop Co. has planned by next June 1, to take approximately all of the output of the Mary furnace, the transfer of the property was the logical outcome of the progressive industrial expansion of this larger corporation."[30] Before Sharon Steel Hoop's purchase of the Mary furnace, the stack was often a potential source for non-integrated steel companies and companies with less than sufficient pig iron production, such as Youngstown Sheet & Tube. Sheet & Tube proposed a deal with Ohio Iron and Steel to construct a belt line railroad to transport molten iron from Mary furnace directly to Sheet & Tube's Bessemer facility.[31] The deal fell through and talk of Sheet & Tube outright purchasing the Mary furnace for its own use in 1913 also went by the wayside.[32]

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[28] *Directory*, 1916, 362.
[29] *The Iron Trade Review*, vol. 46, February 3, 1910: 247.
[30] "Sharon Steel Hoop Co. Buys Mary Furnace," *The Vindicator*, January 31, 1918.
[31] "May Mean a New Railroad," *The Vindicator*, November 10, 1909.
[32] *The Iron Age*, vol. 92, July 17, 1913: 157.

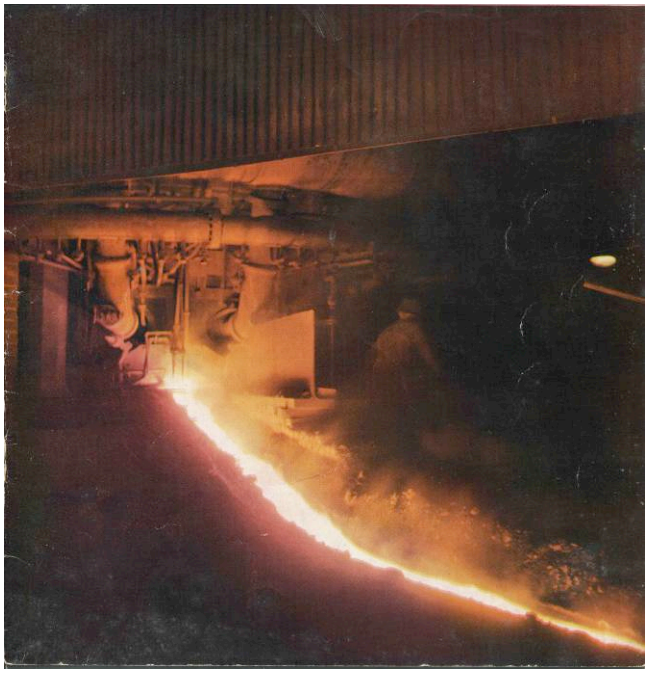

Figure 2-6: After Sharon Steel Hoop purchased the Mary furnace in 1918, all iron was cast through runners and into ladles for transport to the company's nearby open-hearth steel plant. The company used the casting machine primarily on Sundays when the steel works closed. This photo shows molten slag running through troughs on its way to the slag pit at Mary furnace in the early to mid 1940s. The slag, or cinder notch, was located slightly above the iron notch because molten slag floated on top of the iron within the hearth.

From *Sharon Steel Record* (Sharon: Sharon Steel Corp., June 1944), front cover.

The acquisition of the Mary furnace by Sharon Steel Hoop allowed the company complete control over its molten iron requirements rather than relying on the open market. As a self-sustaining steel company, Sharon Steel Hoop produced over 130,000 tons of pig iron annually for its steel-making purposes.[33] Forty-ton hot metal ladles transported molten iron over a private railroad track to the charging floor of the open-hearths, where, in addition to cold scrap, the molten iron was poured into the 75-ton open-hearth furnaces. By 1919, Sharon Steel Hoop completed two additional 75-ton open-hearth furnaces at the Lowellville property and shortly after dismantled the six-furnace open-hearth facility constructed at its Sharon Works in 1902-03. Sharon Steel Hoop also had joint ownership in ore properties with only a portion of the requirements for the Mary furnace supplied, whereas the open market provided the remaining balance of iron ore needed for the furnace. Hopper cars delivered the iron ore over the elevated

[33] *Directory*, 1926, 316.

stockyard trestles, dropped the ore through pockets in the trestles, where it was reloaded by steam crane and clamshell bucket into the stock bins. Bottom fillers pulled a lever that opened a small door in the bin, which allowed iron ore to fall by gravity into their barrows. The company purchased all of its coke from the open market, which was delivered by hopper cars and loaded into gravity driven bins within the stock house.

In the 1920s, the Mary furnace was one of the oldest and smallest stacks in the Mahoning Valley. While many other pioneer furnaces became obsolete and were either rebuilt or dismantled, Mary furnace endured as one of the few hand-filled blast furnaces in operation in the 1920s, yet its new integration with a steel mill drastically prolonged the furnace's operation and profitability. The small size of the furnace allowed for the continuation of practical manual filling, unlike larger furnaces whose larger capacity did not allow top fillers to keep up with operations. Like all furnaces, smooth production relied upon the skill and knowledge of the men who operated it, and Mary furnace soon became associated with an individual who considered 'Old' Mary part of his genetic make-up. On June 7, 1920, a former railroad construction worker and North Carolina native named John Stewart came to Lowellville's Mary furnace looking to settle down after asking for his fiancée's hand in marriage. Stewart possessed many of the qualities of a hard-working individual, who learned the tricks of the iron trade quickly; he soon moved through the ranks at Sharon Steel Hoop and was named Mary blast furnace superintendent by the mid 1920s, a position he retained for thirty years. Those associated with Stewart recognized him as "the best furnace operator in the steel business."[34]

Mary furnace supplied adequate pig iron quantities for Sharon Steel Hoop's

[34] *Sharon Steel Record* (Sharon: Sharon Steel Corp., April 1955), 16.

Figure 2-7: An aerial view of Sharon Steel's Mary furnace in the 1940s shows the configuration of the small blast furnace plant. The Mary furnace still maintained blast furnace operations similar to those used in the 1890s. The furnace's ore trestles and slag house are on the right side of the image, and the ladle house and pig casting machine are seen at the top left.

Courtesy of The Vindicator

Lowellville Works; however, the small furnace soon showed its age. Stewart continued to provide Mary with regular maintenance and always checked the furnace proper and auxiliary equipment two or three times a day. Proper relining, updated equipment and stoves and all other forms of maintenance remained constant, yet the furnace still relied on employees for hand-charging, a feature that by the late 1920s represented a fairly significant handicap due to increased tonnage of the company's steel-making furnaces. An additional disadvantage of a single furnace plant was the necessity to purchase pig iron from the open market when the Mary furnace was down for repairs. Before the Mary furnace's relighting in July 1921, Sharon Steel Hoop purchased supplemental pig iron for its open-hearth facility from the Youngstown Sheet & Tube Co.[35] Even at full production, the Mary furnace could not completely provide the Sharon Steel Hoop's open-hearth

[35] "Lowellville Furnace to Be Re-Lighted," *New Castle News*, July 28, 1921.

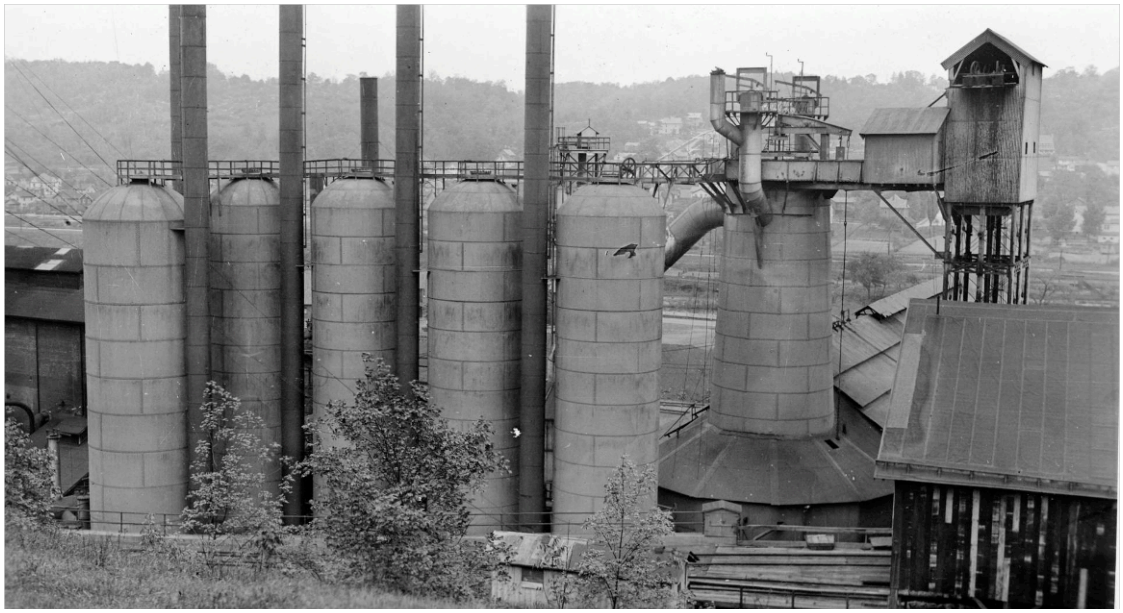

Figure 2-8: This 1932 view looking north shows the idle Mary furnace with the Mahoning River in the background. By this period, many smaller, independently owned furnaces throughout the country succumbed to the harsh economic conditions and obsolete operations. Large, integrated steel producers with substantial capital outlasted these smaller, merchant iron producers. Sharon Steel Hoop's ownership and reliance of the Mary furnace prevented its dismantling during this precarious period, which allowed the small stack to remain in operation as the last hand-fed furnace in the United States.

Courtesy of the Hagley Museum & Library, 1986268_0371

facility with sufficient iron for capacity steel production.

Sharon Steel Hoop attempted to remodel the furnace to achieve higher production rates, and in 1930, the company partially reconditioned the Mary furnace, but the dimensions of the stack remained as they were at eighty-one feet tall with a nineteen-foot bosh. The company thickened the brick lining in the furnace, which ranged from two feet, three inches to three feet in thickness in order to prevent additional downtime for relining. New cooling plates were added throughout the bosh section to prevent the lining from burning through the steel shell.[36] Unlike modernized furnaces in the Mahoning Valley, the Mary furnace still only contained a single-bell system that measured 10-foot

[36] T. J. Ess, "Sharon Steel Corporation," *Yearly Proceedings for the Association of Iron and Steel Engineers* (Philadelphia: Association of Iron and Steel Engineers, 1941), 208.

in diameter, whereas the older Anna and Hubbard furnaces utilized the more efficient double-bell system.

The Lowellville Works remained a rather small operation in the Mahoning Valley as compared to Sheet & Tube's massive Campbell and Brier Hill Works or the Ohio Works of the Carnegie Steel Co. By 1930, Sharon Steel Hoop added an additional open-hearth furnace for a total of six, all being 100-ton capacity. Sharon Steel Hoop's Lowellville facility now produced over 450,000 annual tons of steel ingots and 362,000 tons of semi-finished rolled products annually.[37] Comparatively, Sheet & Tube's Campbell Works had twelve 100-ton basic open-hearth furnaces and two, 15-ton Bessemer converters that collectively produced 1,560,000 tons of steel ingots annually (720,000 tons Bessemer; 840,000 tons open-hearth) and 2,550,000 tons of semi-finished hot rolled products.[38] However, the depression idled many of the small furnaces throughout the Mahoning Valley and on November 19, 1931, the Mary furnace shut down because of the economic crisis. The furnace sat idle for six years - the longest period in the stack's history since the Panic of 1873. With their own source of pig iron idled, Sharon Steel purchased pig iron off the market for their open-hearth facility as the Mary furnace "could not be operated economically under the conditions which prevailed during the depression years."[39] In 1935, the Anna furnace in Struthers went back into operation with men formerly employed at the Mary furnace, an event where local reporters treated the furnaces with human personifications and allegorical headlines such

[37] *Directory*, 1930, 301.
[38] *Directory*, 1930, 387.
[39] Stanley S. Miller, *Manufacturing Policy: A Casebook of Major Production Problems in Six Selected Industries* (Homewood: Richard D. Irwin, Inc., 1957), 605.

as "Old Mary sheds tears as Anna steals her men."[40] Only a year after the Anna furnace began operations again did it shut down; however, Sharon Steel reconditioned the Mary furnace at a cost of $150,000 and put the stack back into operation in 1937.[41]

In the mid 1930s, Sharon Steel Hoop opted for a change in the company's name. With increased competition in the Mahoning Valley and the focus on steel as the primary product, Sharon Steel Hoop Co. diversified their product and changed their name to the Sharon Steel Corporation in 1936, thereby removing the word 'hoop,' a once important product at the turn of the twentieth century and now only a small part of the total production of the firm. The year 1930 marked the company's transition from primarily steel hoop production to stainless strip steels and alloy steels. Under severe market conditions, the Sharon Steel Hoop Co. suffered terrible operating losses and many observers in the industry believed the company would fold. The election of Henry Roemer as president in 1931 allowed the company to experience a sort of renaissance with the expansion of the company's finishing capabilities balanced with that of its steel production, as well as the installation of new, modern equipment that enlarged its hot and cold rolling capacity, thereby increasing the production of stainless steel. Despite these improvements, Roemer still eyed the large steel mill of the Carnegie-Illinois Steel Co., which sat directly adjacent to Sharon Steel's finishing mills in Sharon.

In 1938, Roemer began negotiations for the Farrell Works with U. S. Steel president Benjamin Fairless, who had previously mentioned that the Farrell Works "did not fit particularly well into the long run plans which the United States Steel Corporation

[40] "Old Mary Sheds Tears as Anna Steals Her Men," *The Vindicator*, June 6, 1935.
[41] Miller, *Manufacturing Policy*, 605.

Figure 2-9: This photo shows the now Sharon Steel Corporation's Mary furnace in 1939, active again after the depression. The railroad line at left was once part of the Pittsburgh & Lake Erie Lowellville division and gradually climbed uphill to the vast limestone quarries just across the Ohio and Pennsylvania border in Hillsville, PA where both Sharon Steel and Youngstown Sheet & Tube owned rights to limestone quarries.

Courtesy of The Vindicator

was developing for the consolidation of its properties."[42] Out of necessity during the war years, Carnegie-Illinois Steel Co. continued o6peration of the Farrell Works by request of the federal government. Meanwhile, Sharon Steel executives became anxious for the plant's acquisition because they realized that the old Mary furnace would pass out of operation in the near future, leaving the company without a supply of pig iron. Sharon Steel faced two options: build a new blast furnace or purchase pig iron from the market. Neither option was viable due to the highly inflated building costs involved in the construction of a brand new blast furnace, and purchasing pig iron on the open market exposed the company's uncertainties in supply when pig iron was unavailable. However, after the war, Roemer and the United States Steel Corp. resumed negotiations for the acquisition of the Farrell Works. During the war, the Mary furnace countered all low expectations by breaking its previous daily outputs. In May 1942, the Mary furnace

[42] Miller, *Manufacturing Policy*, 606.

shattered all of its previous 24-hour output records and produced 515 tons of pig iron, over one hundred tons its average rated capacity.[43] The furnace's previous record was 507 tons ten years earlier. Although five-hundred plus tons of iron in a 24-hour period was still a small amount compared to the giant furnaces throughout the valley, it still matched the more modernized pioneer stacks in Hubbard and the Anna in Struthers that utilized automatic skip hoists.

Despite higher than normal production values from the Mary furnace, Sharon Steel still required higher outputs for steelmaking. In 1945, one of the largest business deals in the Youngstown district's industrial history transpired between Sharon Steel and the Carnegie-Illinois Steel Co. After months of negotiations, Roemer finally approved the purchase of the Carnegie-Illinois Steel Company's massive Farrell Works, which contained two modern, 900-ton blast furnaces positioned directly adjacent to Sharon Steel's finishing mills, a deal that many officials in the steel industry described as the perfect alliance. Prior to the purchase, the Carnegie-Illinois Steel Co.'s Farrell Works lost the majority of its finishing capacity after its government sanctioned ordnance plant closed - a finishing mill for production of products such as helmet steel, flak curtain, and aircraft armor steels for various divisions of the military for the War effort. In addition, U. S. Steel dismantled the mill's sheet, tin and wire mills during the 1930s. This lack of finishing at Farrell made the mill's future dim, and although the facility ranked as a 'low-cost plant,' Carnegie-Illinois only operated it on standby status when the finishing departments at the company's other mills obtained more orders than they could handle.[44] However, with Sharon Steel's finishing mills located directly adjacent to Carnegie-

[43] "Old Mary Furnace Breaks Output Record," *The Vindicator*, May 9, 1942.
[44] George R. Reiss, "Sharon Steel Buys Farrell Works," *The Vindicator*, November 10, 1945.

Illinois' steel plant combined with the former company's need for steel and iron production, the combination seemed a perfect fit. Roemer hailed the purchase as "the most important step Sharon Steel has taken in its long history."[45]

The purchase of the large steel works in nearby Farrell, Pennsylvania put the small Lowellville Works in a bind. With the acquisition, Sharon Steel gained an additional 500,000 tons of pig iron and 750,000 tons of steel capacity per year.[46] To justify the purchase, Roemer contended that the "company no longer was in a good competitive place, depending on Lowellville for its semi-finished steel. While the Lowellville plant was a 'low cost unit,' its blast furnace was inadequate and freight charges for moving steel from Lowellville to Sharon are becoming prohibitive."[47] "Sharon's Lowellville Works - including historic "Mary" blast furnace and its open hearth and electric furnace plant - will be disposed of before Jan. 1 [1946].[48] However, this did not take effect. Despite Roemer's efforts to market and negotiate the sale of the Lowellville facility to four steel finishing companies, the negotiations failed and Sharon Steel maintained operations of both the Mary furnace and the steel works.

The purchase of the Farrell Works allowed Sharon Steel to save $250,000 on freight annually, but with the surplus of funds obtained from the new plant at Farrell, along with a post-war boom in product demand, the company decided to concentrate stainless and alloy steel production at its Lowellville Works.[49] By 1948, the small plant at Lowellville contained five basic, 150-ton open-hearth furnaces (one being dismantled in

[45] "Sharon Steel Buys Farrell Works," *The Vindicator*, November 10, 1945.
[46] *The Vindicator*, November 10, 1945.
[47] *The Vindicator*, November 10, 1945.
[48] *The Vindicator*, November 10, 1945.
[49] "Grandma of Blast Furnaces Retires - After 100 Years," *The Vindicator*, November 26, 1945.

the 1930s) and two 26-ton electric arc steel-making furnaces installed in 1940.[50] The facility's open-hearth plant produced about 41,000 tons of steel ingots per month while the Mary furnace only produced 12,000 tons of pig iron per month.[51] These lopsided production values meant that one of the open-hearth furnaces only used 30% of the Mary furnace's pig iron with the rest being scrap. The company purchased additional pig iron from the open market; however, this was highly unfavorable for Sharon Steel officials, as the average ratio of pig iron to scrap was 60/40. The lower iron to scrap ratio meant the cold scrap and pig iron took longer to melt, therefore increasing the time per heat and removing too much carbon from the metal.

Despite the acquisition of the Farrell Works and the low production of the company's Mary furnace, additions and enlargements to the steel-making facilities at Lowellville persisted, although the Mary furnace continued to show its age. Sharon Steel relined the old furnace in 1942, but the 1898 rebuild and small remodeling in 1916 was the last overall modernization for the furnace itself, despite the company maintaining proper condition of the furnace's auxiliary equipment. Still, company officials attempted to reduce labor and increase production at the furnace without completely remodeling the facility. The company introduced gasoline operated lift trucks, or forklifts, within the stock house. In the early 1900s, the furnace's stock house required 217 men per turn to wheel the empty barrows from the hoist, pull them to the ore piles, load them by hand with over 1,000 pounds of iron ore or limestone, wheel the barrow back to the hoist, weigh it on a scale and finally push it onto the hoist. The bottom fillers who performed these chores were often 'husky fellows' and required brute force and strength to carry out

[50] *Directory*, 1948, 319.
[51] Miller, *Manufacturing Policy*, 608.

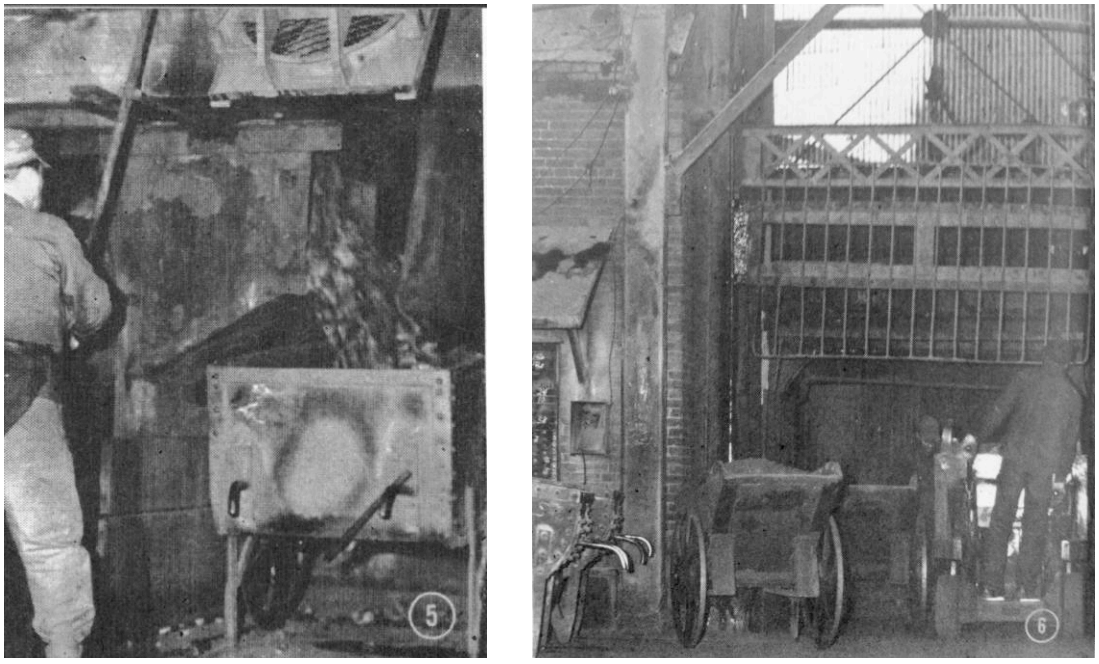

Figure 2-10: Left - to combat the laborious conditions that bottom fillers endured and to increase production, coke and ore bins, opened by way of lever, dumped the appropriate amount of stock needed into the barrow, which was then wheeled to the bottom of the hoist by gas-operated lifting trucks rather than manpower. Right - a bottom filler places a barrow full of coke, limestone or iron ore onto the bottom of the elevator hoist platform via forklift. After the bottom fillers loaded the barrows, they gave signal to the top fillers, who operated the steam-lifting hoist that raised the barrows to the top of the furnace.

From John D. Knox, "Mary Blast Furnace: Last of Hand-Filled Stacks in America," *Steel*, vol. 125 (New York: Penton Publishing Co., 1949): 134.

their jobs 365 days a year. By the 1930s and 1940s, the stock house turn required only fifteen men. Hopper cars dropped iron ore from the trestle and into a bin system that discharged through doors and into the barrows, where, instead of bottom fillers pulling the barrows, the gas-operated forklifts handled the thousand pound barrows, which ran from the ore and coke bins to the hoist and back again. This method eliminated many of the harsh working conditions and labor once performed by bottom fillers. Despite these modernized features, the furnace remained one of the smallest stacks in the Youngstown district, measuring only eighty-one feet tall with a nineteen-foot bosh, and produced

Figure 2-11: A top filler removes a barrow full of coke from the unloading platform at the furnace's top in the late 1940s. Although gas-operated forklifts removed much of the labor for the bottom fillers, the top fillers still had to handle 700-1,000 pound barrows of both iron ore and coke and dump the materials evenly on the furnace's hopper.

From John D. Knox, "Mary Blast Furnace: Last of Hand-Filled Stacks in America," *Steel*, vol. 125 (New York: Penton Publishing Co., 1949): 140.

148,600 tons of iron annually. The two modern furnaces at Farrell measured ninety-three feet tall with twenty-five foot bosh and produced annually over 280,500 tons of iron each.[52] Many furnaces in the district manufactured over 1,500 tons of iron per day, while Mary only produced a modest 400 tons.[53]

By the 1950s, production of steel at the Lowellville Works actually increased, as steel ingots rose to 593,000 net tons annually by 1956. Despite the rise in steel production, the small Mary furnace still provided the majority of the hot metal for the company's open-hearth facility, yet was often banked or out of blast for repairs. Stocks of pig iron produced at Mary's pig caster usually provided for iron in the open-hearth, or in the case of depletion while the furnace was out of blast, the company purchased

[52] Miller, *Manufacturing Policy*, 608.

[53] "Century-Old Furnace Reaches End of Line," *The Vindicator,* September 16, 1962.

Figure 2-12: This 1957 photograph shows a top filler dumping coke onto the Mary furnace's hopper, which was then lowered into the stack. The rigging system on the furnace's top is shown here with a water spray system to moisten the burden and steel bars that prevented the barrow from accidently falling on the bell and hopper. The furnace's ladle house is shown in the background.

Courtesy of Mahoning Valley Historical Society

supplemental pig iron on the market. Sharon Steel made all necessary repairs on the furnace, which included a relining in 1953, a procedure that took forty-six days and required over a million refractory bricks.[54] Long-time Mary furnace superintendent John Stewart, who assured perennial success and highest possible output in the operation of the oldest furnace in the United States, retired in 1955 with Dave Rearick acting as his replacement. Due to low demand for carbon and alloy semi-finished products by October 1954, Sharon Steel decided to yet again shut down the Mary furnace and the Lowellville steel plant, which initially threw over 1,000 employees out of work, with some transferring to Farrell.[55] As the market for stainless steel rebounded and scrap prices rose, Sharon Steel put Mary furnace back into production in December 1955, which simultaneously employed an additional 180 men and allowed shorter heats in the open-hearth by using direct molten iron rather than only cold pig iron and scrap.[56] But in the

[54] "Mary Furnace is Back in Production," *Sharon Steel Record*, September 1953, 9.
[55] George R. Reiss, "Lowellville Plant Will Shut Down," *The Vindicator*, March 25, 1960.
[56] "Blast Furnace Lighted," *Greeneville Record*, December 2, 1955.

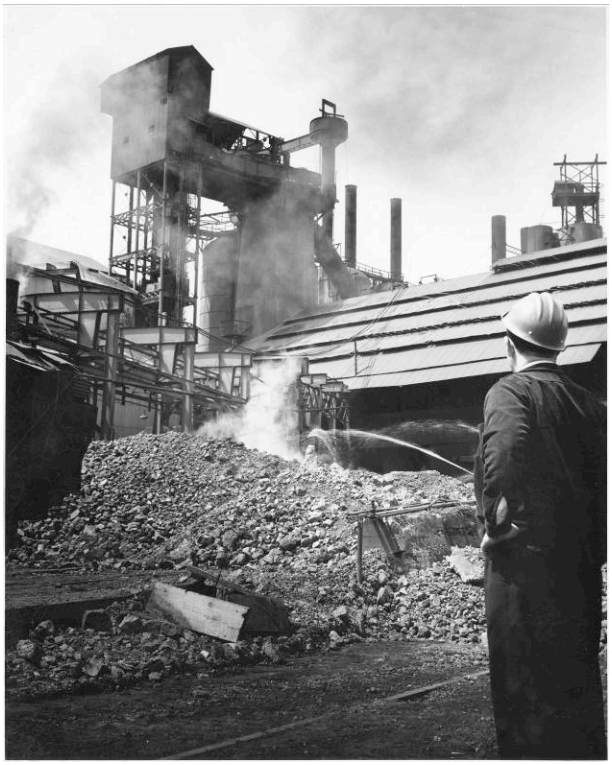

Figure 2-13: Despite being the oldest blast furnace in the United States and one of two remaining hand-fed furnaces in the world, Mary still operated and produced iron for the Sharon Steel Corporation's Lowellville Works throughout the 1950s. Shown in the midground of this 1957 photo are water sprays cooling and granulating slag as the elevator hoist lifts barrows to the top of the stack. Dave Rearick, who replaced long-time Mary furnace superintendent John Stewart in 1955, stands in the foreground.

Courtesy of Mahoning Valley Historical Society

midst of the 1956 steel strike, Sharon Steel idled its Lowellville Works, yet the growth in demand for semi-finished steel during the strike required Sharon Steel to re-open its Lowellville Works nearly two years later, albeit temporarily. In November 1957, Sharon Steel again banked the Mary furnace because the company already had a substantial inventory of pig iron built up, which rendered Mary's operation unnecessary.[57] At the time, the plant increased steel production and added an additional open-hearth and boosted its electric steel output. In 1959, the company once again put Mary furnace into blast as the Lowellville steel plant used up its inventory of pig iron, but operations soon halted as quickly as they began.

In March 1960, Sharon Steel announced "the demand for carbon and alloy semi-finished products for rerolling has declined to the point where it is now possible to meet

[57] "Bank Furnace at Lowellville," *The Vindicator*, November 4, 1957.

Figure 2-14: This c. 1960-61 photo shows the Mary furnace shortly before its abandonment. At left are the furnace's stock house, wooden ore trestles and iron ore pockets. Unlike most pioneer and merchant furnaces in the valley, Mary furnace still retained old wooden trestles, a method that other furnaces abandoned by the 1920s. The furnace also still utilized wooden ore pockets, a system of iron ore distribution that allowed workers to pull a lever, thereby opening a door and allowing iron ore to fall into their barrows via gravity, the same method used at Hubbard furnace from 1900-1920.

Courtesy of The Vindicator

current demand with shipments from the Roemer [Farrell] Works," and again idled the Mary furnace and the open-hearth plant at Lowellville.[58] Old age and obsolescence enveloped both the Mary furnace and its accompanying steel plant. By 1962, Sharon Steel officials deemed the plant a "high-cost iron and steel producing facility, and there was no possibility that it ever could compete successfully with newer steelmaking facilities," a reversal of fortunes from seventeen years earlier when Roemer proclaimed his Lowellville Works a 'low cost unit.'[59] By the mid 1950s and early 1960s, a new, more

[58] "Lowellville Plant Will Shut Down," *The Vindicator*, March 25, 1960.

[59] "Lowellville Steel Mill Abandoned," *The Vindicator,* September 6, 1962.

Figure 2-15: This poignant September 1962 photo captures the Mary furnace's descent into neglect. Workers' shoes and hard hat lie unused as a poplar tree sprouts from the furnace grounds. The furnace and its downcomer are seen in the background and its blowing engine house appears on the right. Sharon Steel's decision to shut down the Lowellville Works in 1960 and completely abandon the facility in 1962 left the oldest furnace in the world dilapidated with its iron ore stockyard empty, the slag tramway torn away and pieces of scrap metal spread throughout the now barren grounds.

Courtesy of The Vindicator

modern steelmaking process developed in Europe revolutionized steel-making in the United States and truly branded the Lowellville Works, as well as other older steel-making facilities, as "high-cost." Sharon Steel installed two 150-ton basic oxygen furnaces at its Farrell Works in 1962. The basic oxygen furnace, or B.O.F., is a rapid steelmaking process where pure oxygen is injected at high pressure into hot metal and cold scrap, which burns carbon and other impurities in the pig iron. This new method of creating steel drastically increased production and efficiency in Sharon Steels steelmaking capabilities and eventually replaced the company's open-hearth furnaces (the only other steel plant in the Shenango and Mahoning Valley's to install a B.O.F. facility was Republic Steel at its Warren plant in 1965). The $17,000,000 B.O.F facilities increased Sharon Steel's steel production by 1,000,000 tons and doubled the capacity

once produced by the old Lowellville Works, which cut costs sharply and presented the company with more versatility.[60]

The introduction of oxygen steelmaking at Farrell was the final nail in the coffin for the company's Lowellville Works. The idling of the mill in 1960 was the end of operations at Lowellville and in 1962, Sharon Steel decided to completely abandon the facility. In August 1963, Sharon Steel sold both the Lowellville plant and the old Mary furnace to the River Road Company, a subsidiary of the Wilshire-Charleston Corp. On November 21, 1963, workmen of the River Road Corp. demolished several of the Mary furnace's auxiliary buildings with the furnace itself dynamited ten days later, marking the demise of the oldest blast furnace in the world.[61] River Road Corp. retained the open-hearth buildings in the hope that another industry could utilize them, however, the company already scrapped the majority of the furnaces and machinery. The River Road Corp. demolished and auctioned off the remaining buildings in 1964. Mary was the first of the last three remaining pioneer furnaces dismantled in the Mahoning Valley. With the Anna furnace in Struthers dismantled in 1966, only the long-idle Hubbard furnace still stood as a symbol of the Mahoning Valley's once rich and independent iron producing past.

[60] "New Units at Sharon Use Oxygen," *The Vindicator*, August 18, 1962.
[61] "Lowellville Seeks Industry to Use Sharon Steel Site," *The Vindicator*, November 21, 1963.

Chapter 3: Hubbard Furnace – Growth and Prosperity, 1868-1916

Like the Anna and Mary furnaces in Struthers and Lowellville, the Hubbard blast furnaces were only two of four pioneer stacks that maintained operations throughout the majority of the first half of the twentieth century. Yet unlike Anna, Mary and many of the other furnaces constructed throughout the valley, the Hubbard furnaces became the only stacks constructed outside of the immediate vicinity of the Mahoning River Valley. Located roughly five miles northeast of Youngstown on the Ohio-Pennsylvania border, Hubbard soon transformed into a small industrial town of its own, with many other iron and steel related industries growing around the already established iron furnaces. The heart of Hubbard and Coalburg, its neighboring hamlet just to its north, was the vast mining of block coal and black-band iron ore, one of the principle industries of the village from the late 1850s until their exhaustion in the 1880s and 90s. The town suffered from the enervation of the mines, particularly Coalburg, a once booming village that found its 1,000 plus residents quickly moving from the area in order to find other work.

As the importance of coal mining diminished in the late nineteenth century, the two blast furnaces built by the partnership of Youngstown industrialists C. H. Andrews and W. J. Hitchcock maintained extremely prosperous operations and soon became one of the only furnace firms to retain independent ownership by its original proprietors and their families into the twentieth century. As a merchant iron firm, the Andrews & Hitchcock furnaces constantly upgraded and improved their equipment to conform to ever-changing market conditions and technology. The success of the company attracted other industry related mills around the blast furnaces, which included the first sintering

plant in the world. By the beginning of the twentieth century, the Hubbard furnaces consistently operated as one of the largest and most productive merchant furnace plants in the Mahoning Valley. The strong capital of its owners led to persistent modernization and rebuilding of the furnaces with the installation of modern skip hoists rather than elevator hoists in 1910 and 1915. In the midst of the First World War, the Hubbard furnaces were amongst the largest and most modern merchant iron furnaces in the Mahoning Valley and the state of Ohio, an appealing quality for integrated steel producers that lacked sufficient pig iron production for the war effort.

Before the establishment of the Hubbard furnaces, the small village of Hubbard still searched for an identity such as that found in the greater Mahoning River Valley. In Youngstown and Niles, James Ward, Joseph H. Brown, William Bonnell, Charles T. Howard and David Tod were all essential in the development of the vast Brier Hill block coalfields and iron smelting furnaces such as the Brier Hill, Eagle, Phoenix and Falcon. With the Hubbard Branch Railroad in place by the late 1850s, local industrialist Chauncey H. Andrews took advantage of the booming coal mining industry in the Valley. He had already made a small fortune with the purchase of the Thorn Hill mine at Baldwin's farm on Youngstown's east side and continued to open mines and buy already prosperous coalmining operations from their original proprietors. In 1859, Andrews partnered with William James Hitchcock to form the coalmining firm of Andrews & Hitchcock. Hitchcock was born in Granville, New York in 1829 and grew up on the family farm where he remained until his teens when he decided to move west to Cleveland to attend school. He gained experience as a machinist in Detroit and soon

returned east to Pittsburgh where he found employment as a bookkeeper for the Mackintosh, Hemphill & Co., foundry men and machinists, who sent Hitchcock to an iron mill in New Castle, Pennsylvania as a receiver's agent. Hitchcock decided to capitalize on the vast block coal mines in the nearby Mahoning Valley and soon established a business connection with Andrews. Together they purchased interests in the Westerman Iron Co. at Sharon, operated the Thorn Hill mine and purchased several others along the Hubbard Branch of the Cleveland and Mahoning Railroad.

One of the most prominent mines near Hubbard in the early 1860s belonged to Jesse Veach, one of Hubbard's pioneer citizens. David Tod, John Stambaugh and Myron Arms leased the large coalfield under Veach's property in the early 1860s for use at the Grace furnaces of the Brier Hill Iron and Coal Co. Together with the Himrod Furnace Co., Brown, Bonnell & Co. owned the Mahoning Coal Company, which consisted of four large mines along the Hubbard Branch. These included the Lowe, Long, Mayer and Drake coal banks, all located within two miles of Hubbard with an annual capacity of over 125,000 tons for the companies' furnaces in Youngstown.[1] In 1863, Edmund P. Burnett opened Hubbard's largest coal mine, yet by the mid to late 1860s, the firm of Andrews & Hitchcock purchased the Burnett mine along with many of the other large coalmining operations in the vicinity of Hubbard and Coalburg. By 1868, the Youngstown firm owned three large mines in the Hubbard area, which included the Andrews & Hitchcock mine with a daily capacity of 200 tons; the Burnett Coal Co., with a capacity of 250 tons per day, and the Hubbard Coal Co. Works, the smallest mine that

[1] Joseph Wiggins, *Directory of Beaver, Shenango and Mahoning Valleys, For 1869*, (Pittsburgh: Bakewell and Marthens, 1872), 224.

only had a capacity of 100 tons per day.[2] Together, Andrews & Hitchcock's mines employed 550 men and established Hubbard and its vicinity as one of the largest suppliers of coal in the Mahoning Valley.

C. H. Andrews' capitalization of the coal boom in Hubbard and the Mahoning Valley, along with his various interests in the development of local rail lines allowed him to accumulate enough capital to enter into the pig iron trade with the construction of two blast furnaces at Haselton in 1867 and 1868. In Hubbard, both Andrews and Hitchcock capitalized on the firm's coal mines throughout Hubbard and in 1867 construction commenced on a single blast furnace built by the William B. Pollock Co. of Youngstown along Little Yankee Creek on Hubbard's north side.[3] Andrews & Hitchcock put its No. 1 Hubbard furnace into blast in the first quarter of 1868 with several coal line branch railroads connected to its stock house. The rights of way of the Cleveland and Mahoning Railroad, now leased by the Atlantic and Great Western, ran directly adjacent to the furnace with several spur lines linking the company's furnaces and its coalmines. The furnace's height and bosh diameter are unknown; however, it is probable that it was between 45-50 feet in height due to the Anna furnace's distinction as the first "high" furnace built of iron. The stack utilized an iron hoist for charging barrows of coal, iron ore and limestone and also incorporated basic iron pipe hot stoves to pre-heat the blast. Like all valley furnaces built before 1870, the Hubbard furnace was also an open-top that allowed the furnace gasses to escape into the atmosphere. The furnace's source of limestone was the quarries near Lowellville and local black-band iron ore mined from the

[2] Wiggins, *Directory of Beaver, Shenango and Mahoning Valleys*, 225.
[3] Little Yankee Creek is a tributary of the nearby Shenango River and was the main water source for the Hubbard furnaces. Canals were never present in Hubbard.

Leyde Ore Mines in Hubbard, which produced about thirty tons a day.[4] The furnace rated as a 50-ton stack and together with the similarly constructed furnaces at Haselton, was amongst the largest and most productive in the Valley. The Hubbard furnace produced up to fifty tons per day and 12,000 tons per year, a figure that represented roughly 15% of the total annual capacity of pig iron produced in the Mahoning Valley.[5] The furnace most likely employed the use of a walking beam style horizontal blowing engine to force the super-heated air into the furnace at high pressure.

The construction of the Hubbard furnace transformed the small community into one of the vast pig iron manufacturing centers of the Mahoning and Shenango Valleys. Although the firm's coal mines were not directly adjacent to the furnace, such as was the case with many of the furnaces built in the 1840s and 50s, the company constructed additional coal mine railroads where needed and those that existed made transportation of the fuel both convenient and affordable. Extensive need for pig iron from exuberant railroad construction throughout the nation in 1871-72 resulted in pig iron rising to its highest price since the Civil War. Both Andrews and Hitchcock capitalized on further potential for profits in the pig iron trade, and combined with the firm's ongoing development of local coal lands, the company constructed its No. 2 furnace for further utilization of block coal and production of pig iron. The William B. Pollock Co. built the second furnace directly adjacent to the No. 1 stack; however, significant advancements in blast furnace practice and technology resulted in the remodeling and enlarging of the No. 1 stack. After Andrews' No. 1 furnace at Haselton exploded in 1871, the Andrews Bros. Co. rebuilt both Haselton furnaces larger with their open-tops replaced with a bell and

[4] *Western Reserve Chronicle*, June 29, 1870.
[5] Drohan, *History of Hubbard, Ohio*, 18.

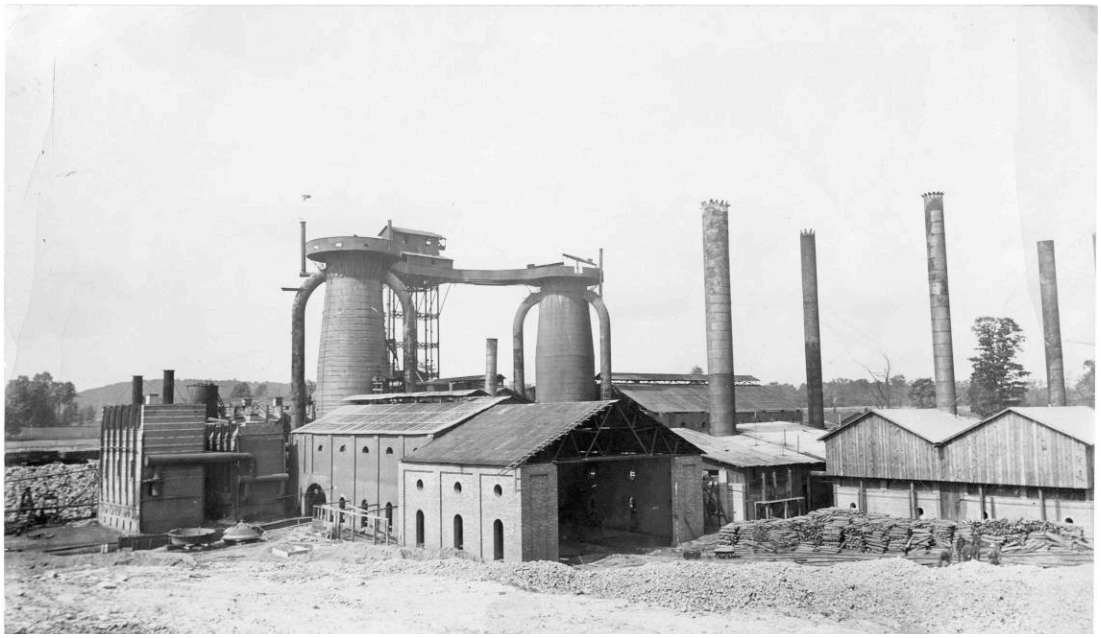

Figure 3-1: Andrews & Hitchcock's Hubbard furnaces looking northeast in the mid-1870s. After the construction of the No. 2 stack (right), the No. 1 was remodeled to meet the height equivalent of the new furnace in order to share the elevator hoist. The No. 2 furnace is also shown with a bell and hopper while the No. 1 remained an open-top. The iron hot blast stoves are seen to the left, the blowing engine house sits directly in between the furnaces (not visible) and the boilers are shown to the right with cords of pig iron in front of the boilers awaiting shipment.

Courtesy of Mahoning Valley Historical Society

hopper. As construction progressed at the Hubbard furnaces, Andrews & Hitchcock adopted the new features of the Haselton furnaces at Hubbard. The company added an additional ten to fifteen feet to the No. 1 furnace in order to match the height of the new No. 2 furnace, thereby accommodating a shared iron elevator hoist. The Pollock Co. finished the second stack in the first quarter of 1872 and the stack was in blast by May 1872.

The new furnace contained a closed top, while the No. 1 stack remained an open top. Each furnace featured two pockets, or small downcomers, that collected gasses as they travelled up through the furnace. The majority of the gasses were wasted on the open-top stack with only small amounts collected in the pockets and used as fuel in the

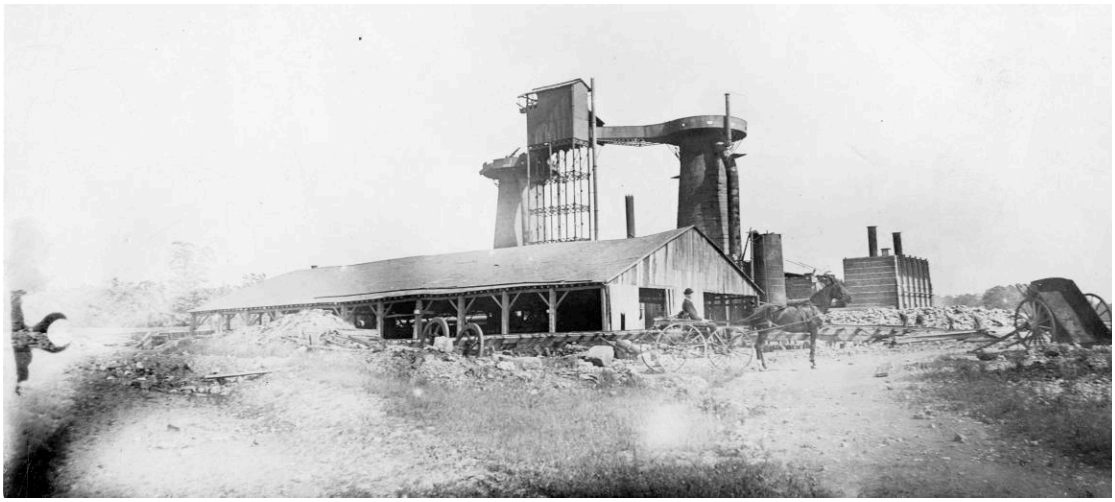

Figure 3-2: A view looking southeast of the Hubbard furnaces in the mid 1870s. The large, wooden-framed stock house held the raw materials delivered by train from the company's adjacent coalmines, which were then shoveled into barrows and hoisted to the top of the furnace. Shown at the far right is a two-wheel dump cart. This was most likely used to haul slag from the furnace with a mule and dump the contents at a slag pit.

Courtesy of Mahoning Valley Historical Society

iron pipe stoves to produce heat for the hot blast, however, the closed top stack utilized nearly all of the gasses by forcing the rising gasses down the pockets where they were re-used in both the boilers and hot blasts. The furnaces' stock house consisted of a covered, elongated wooden-framed structure at the foot of the furnaces that contained railroad spurs linking Andrews and Hitchcock's coal line railroads. The company transferred coal from their mines directly to the stock house where it was dumped or shoveled by workers from the rail cars. The same was true for iron ore and limestone. Each furnace measured sixty feet in height with sixteen-foot diameter bosh. The addition of the second stack more than doubled Andrews and Hitchcock's capacity from 12,000 to 25,000 tons annually.[6]

The Hubbard furnaces far exceeded all other pig iron producers in the Mahoning

[6] "What Protection Has Done for the Mahoning Valley," *American Working People*, April 1872, 16.

Valley in terms of production, and the size of the company's stacks were second only to James Ward & Co.'s Elizabeth furnace in Niles and Brown, Bonnell & Co.'s Phoenix furnace in Youngstown. Despite the size and production rates of the Hubbard furnaces, the company still only produced merchant iron and was not associated with any puddling or rolling mills. Yet Hubbard retained a type of isolation from the vast ironworks spread throughout the Mahoning River Valley, and although the majority of Hubbard's product went to the rolling mills in Pittsburgh, the company's relatively close proximity to the rolling mills of the Shenango Valley allowed for a further expansion of its marketability.

With a strong customer base and seemingly inexhaustible coalmines maintained by Andrews & Hitchcock throughout the immediate vicinity of Coalburg and Hubbard, the Hubbard furnaces seemed destined for profitable and long-term operations. The coalmine boom not only brought the blast furnaces, but it also encouraged Jesse Hall and other industrialists in the construction of the Hubbard Rolling Mill in between the Lake Shore & Michigan Southern and New York, Pennsylvania & Ohio Railroads in 1872. Only four years after Hubbard became incorporated as a village it contained a vast coalmining industry, two mainline railroads, two large blast furnaces and a puddling and rolling mill. Yet despite the heralded success of the industries in Hubbard, the Panic of 1873 crippled the majority of the industrial progress in the town, like in all villages throughout the Mahoning Valley. Coal mining slowed and the Hubbard Rolling Mill folded and temporarily ceased operations. However due to the strong capital and business sense of C. H. Andrews and W. J. Hitchcock, the Hubbard furnaces continued to operate through the depressed economic situation. According to Edwin Froggett, son of long-time Brown, Bonnell & Co. blast furnace manager Job Froggett, the Girard Iron Co. and

Andrews & Hitchcock's Hubbard furnaces were the only stacks that did not shut down due to economic reasons during the 1870s and continued to produce, "piling up acres upon acres of pig iron."[7] The business reasoning behind the continued production of pig iron lay behind both strong capital and the immediate need of pig iron from rolling mills once the economic depression subsided and rolling mills and foundries commenced their fires once again. In the short run, Andrews & Hitchcock piled up pig iron and temporarily lost both money and capital, but as other companies banked their furnaces throughout the depression, rolling mills found an immediate and plentiful source of pig iron from Hubbard for their puddling furnaces as economic conditions improved.

As the Panic waned in the late 1870s, business and industry experienced progress throughout the village of Hubbard and Coalburg. The Mahoning Coal Co. opened slope No. 4 near Coalburg in July 1877, which gave employment to over one hundred men and shipped over seven hundred tons of coal per day.[8] The furnaces continued prosperous operations and soon found a plethora of clients, as was predicted by its owners. W. J. Hitchcock had long been a admirer of the use of Connellsville coke since his initiation into the iron industry, calling it "the best in the world;" however, fuel provided by block coal from his adjacent mines was still clearly the best economic choice.[9] By 1878, Hitchcock augmented the use of block coal with a mixture of Connellsville coke, which at this time was purchased from various coking companies in Fayette County, Pennsylvania. Andrews & Hitchcock used a combination of one-fifth Connellsville coke and four-fifths local block coal with an ore combination of three-fourths local Trumbull

[7] Clingan Jackson, "Capping of Blast Furnaces Recalled," *The Vindicator*, August 23, 1931.
[8] *The Vindicator*, August 3, 1877.
[9] *The Vindicator*, March 19, 1892.

County black-band and one-fourth Lake Superior ores.[10] This combined to create "Hubbard Scotch," a soft foundry iron that resembled the chemical structure of the famed Scotch iron made from black-band ores in Scotland. The company also produced "Hubbard Strong Foundry," which utilized a combination Lake Superior specular and magnetic ores.

By 1880, the Hubbard furnaces were still sixty feet tall with a sixteen-foot bosh and a combined annual capacity of 32,000 tons. The company out produced all other furnaces in the Mahoning Valley. Yet one of the considerable problems that presented itself in the early part of the decade was the near exhaustion of the local block coal supply. The 1872 estimate of over 200 billion tons of coal was grossly overestimated and Andrews & Hitchcock soon began to supplement their fuel with additional amounts of coke. By 1882, the company started to use a lower ratio of block coal to coke and soon invested in coal lands in the Connellsville region and purchased two hundred acres of iron ore lands, although it is unknown as to the location and the year they were purchased (at least prior to 1887). The investment in supplemental coal lands led to the company's decision to rebuild their No. 2 furnace to a height of seventy-five feet with a sixteen-foot bosh. In addition to the enlargement of the furnace, along with the No. 1 furnace (which was not enlarged at this time), it was also able to use coke as fuel. The enlargement of the No. 2 stack and the exclusive use of coke pushed the annual combined production of the furnaces to an extraordinary 62,000 tons.[11] The company still produced foundry iron along with "Hubbard Scotch" from local black band ores primarily mined in Mineral

[10] *Ironworks of the United States,* 1878, 56-57.
[11] *Directory*, 1884, 58.

Ridge.[12]

Technologically, the Hubbard furnaces remained on par with the other prominent pig iron firms in the Mahoning Valley. Andrews & Hitchcock retained the use of iron pipe stoves, pneumatic iron elevator hoists and the closed top, single bell system. One of the most important advances in technology was the company's utilization of the latest vertical steam blowing engines, which provided a sharp increase in production. Robert Allen's essay on the productivity history of American blast furnaces from 1840-1913 provides a possible explanation for the dramatic jump in production from the Hubbard furnaces in 1880s. A relatively new method for higher production was the process of fast driving, which increased the rate and pressure of the air blown into the base of the furnace to smelt the raw materials into molten iron.[13] Allen argues that this practice did not become widespread until coke-fired stacks replaced coal-fired furnaces in the late 1870s and 1880s, which coincided with Hubbard's dramatically increased production values, however, no record of the pressure exerted by Andrews & Hitchcock's blowing engines exist prior to 1896. The 1884 *Report of the Geological Survey of Ohio* noted that the Brier Hill Iron and Coal Company's vertical blowing engines produced a blast pressure between 8 and 9 pounds per square inch (a slow driven furnace had a pressure of about 4 pounds and fast driven from 7.5-17.5 pounds per square inch).[14] The Geological Survey also noted that Andrews & Hitchcock's furnace contained three blowing engines, one being smaller with a 30-inch steam cylinder, and the other two identical in size to

[12] C. H. Andrews also produced "American Scotch" at his furnaces in Haselton from Mineral Ridge black-band ores.

[13] Robert C. Allen, "The Peculiar Productivity History of American Blast Furnaces, 1840-1913," *The Journal of Economic History* 37 (Sept. 1977): 615.

[14] *Report of the Geological Survey of Ohio,* vol. V (Columbus: G. J. Brand & Co., 1884), 536.

Brier Hill's, at 84 in. by 8.5 feet with a 36-inch steam cylinder that ran at 30-40 revolutions per minute.[15] It is then plausible that Hubbard's blowing engines produced a blast pressure of nearly 8-9 pounds per square inch, which greatly contributed to the increased production.

In addition to fast driving and updated blowing engines, Andrews & Hitchcock rebuilt its No. 1 furnace in 1886 to a height of seventy-seven feet with a seventeen-foot bosh, which again dramatically pushed the company's production to over 73,000 tons per year.[16] By 1887, Andrews & Hitchcock had occupied "a prominent position" in the production of pig iron, "both on account of the extent of their facilities and the high standard of their productions."[17] Foundries celebrated Andrews & Hitchcock for its "Hubbard Scotch," which received attention for great strength, while also unrivaled for its softness, non-shrinkage and fluidity.[18] The company owned iron ore mines in both Lake Superior and Tuscarawas County, Ohio, with additional coal lands in Western Pennsylvania and had a capital of $500,000 in 1887 with $1,000,000 in sales of pig iron and coal in 1886. By the late 1880s, the aged C. H. Andrews had left the majority of the operations of the company in the hands of W. J. Hitchcock and his sons Frank and William Jr. Andrews had primary interests in many other industries. These included the Haselton furnaces and ironworks, the Pittsburgh, Cleveland and Toledo Railroad, the William Anson Wood Mower and Reaper Co., and the Commercial National Bank, of which the latter three companies he was president. As both founding members

[15] *Report of the Geological Survey of Ohio,* vol. V, 536.
[16] *Directory*, 1886, 51.
[17] *Leading Manufacturers and Merchants of Ohio Valley* (New York: International Publishing Company, 1887), 126.
[18] *Leading Manufacturers and Merchants of Ohio Valley*, 126.

approached their final years, the Andrews & Hitchcock furnaces remained a prominent and respectable business that had the privilege of remaining in the hands of competent businessmen and iron industrialists well after the passing of its founders.

For thirty-three years, Andrews & Hitchcock remained a partnership and never incorporated as a business under the laws of Ohio. In January 1892, C. H. Andrews and William Hitchcock incorporated the firm as a stock company with a capital of $400,000 under the title of the Andrews & Hitchcock Iron Company, with all of the stock remaining in the hands of the families of C. H. Andrews and W. J. Hitchcock.[19] With Andrews quickly succumbing to illness, the company named W. J. Hitchcock president with his son, Frank Hitchcock secretary and treasurer. John A Logan, son-in-law of C. H. Andrews (Logan married Andrews's daughter Edith in 1887) represented Andrews in the company as vice president. Despite the company's progress, overproduction of both pig and bar iron saturated the iron industry in the early 1890s. A headline in an interview with W. J. Hitchcock from the March 19, 1892 edition of *The Vindicator* read: "Iron the King, Depressed and His Kingdom Unsettled. The Cause is Overproduction." Hitchcock stated, "I suppose the pig iron business might be worse but not much. We have one furnace in blast and do not intend at present to suspend operations or bank the furnace. We have about 4,000 tons of iron in the yard and are selling enough to keep going." On February 1, 1892, the stock of pig iron in the Mahoning Valley was 41,808 tons, and on March 1, this stock increased to 52,600, a gain of 11,000 tons in only a month's time.[20]

Hitchcock's reserve on the state of the pig iron industry was not to be overlooked. The following year brought yet another severe economic depression caused in part by

[19] "The Andrews & Hitchcock Iron Company Being Formed," *The Vindicator*, January 27, 1892.
[20] *The Vindicator*, March 19, 1892.

under consumption as well as other factors present since the Civil War, which included a long debate over the silver and gold standard. 1893 also brought the death of C. H. Andrews, however, the company continued to persevere and retained operations despite a 25% decline of pig iron consumption since 1889.[21] The company named the wife of the late C. H. Andrews, Louisa Baldwin Andrews, vice president. The nomination of the wives of iron barons as company presidents was unusual but not exclusive. Many inherited their husbands' estate and assets, which often allowed them control of their spouses former businesses and capital. This also occurred in Niles when the iron firm of James Ward & Co. failed in 1873, which resulted in Ward's wife, Elizabeth, daughter of Pittsburgh millionaire William H. Brown, to take over operations with capital obtained from her father's estate.

Despite the depressed economic conditions, the Andrews & Hitchcock decided to rebuild its No. 2 furnace in 1894. The new No. 2 furnace measured seventy-six feet in height with a seventeen-foot bosh, but despite its overall modernization, it still retained iron pipe stoves. Unlike several other furnace companies in the Mahoning Valley, the Andrews & Hitchcock Iron Co. was relatively late in applying the more modernized and efficient firebrick stoves to their furnaces. But along with the No. 2 furnace rebuild, the company also installed four Cowper-Kennedy two-pass firebrick stoves at the older No. 1 stack, each with individual chimneystacks for waste gasses. In addition to the technological improvements, the company also diversified their pig iron product, which had long been dominated by foundry iron. Like the Brier Hill Iron and Coal Co., Hubbard now produced Bessemer grade iron for the growing number of Bessemer steel facilities

[21] *The Statist, A Weekly Journal for Economists and Men of Business* (London: Published at "The Statist" Office, February 10, 1894): 181.

throughout the Ohio River Valley and Pittsburgh regions, as well as the newly established Ohio Steel Company in Youngstown.

After the incorporation of the company, the Andrews & Hitchcock Iron Co. became one of the major pig iron producers in the Mahoning Valley, with their product shipped throughout the country, despite the worst economic crisis since the 1870s. Only the Brier Hill Iron and Coal Co. equaled the importance of the Hubbard furnaces in quality, size and production values. After a small modernization campaign in the early 1890s with the rebuilding of the No. 2 stack and the replacement of the less-efficient iron pipe stoves with Englishman Edward Cowper's two-pass firebrick stoves, the company continued to advance in both production and technical innovation. In 1896, the company erected a new blowing engine house to house two new, 120-ton vertical steam blowing engines built by the William Tod Co. of Youngstown. These new engines furnished a blast pressure of 18 pounds per square inch, nearly double the pressure supplied from the company's engines ten years before.[22] The application of the new stoves, modernized furnace and new blowing engines pushed the company's production to 130,000 tons a year.[23]After these major changes, vast modernization did not occur until after the turn of the twentieth century.

As the large-scale mergers and consolidations affected the Mahoning Valley at the turn of the century, considerable change transpired within the hierarchy of Andrews & Hitchcock's company officers. The company remained independent despite C. H. Andrews's other local concern, the Andrews Bros. Co. in Haselton, consolidation with

[22] *Engineering News and American Railway Journal*, (New York: The Engineering News Publishing, July-Dec. 1896), 33.
[23] *Directory*, 1896, 47.

the Republic Iron and Steel Co. Andrews & Hitchcock named Henry W. Heedy secretary and treasurer of the Andrews & Hitchcock Iron Co. in 1901, a man long-associated with the Andrews Bros. mill as its bookkeeper and later secretary. Former Andrews & Hitchcock company officer John A. Logan departed the firm to serve the country in the Spanish-American War, where he was struck down by a sniper's bullet in 1899. The greatest loss came with the death of company founder William J. Hitchcock in 1899. As a result, a large-scale reorganization of company officers took place: Hitchcock's sons Frank and William Jr. were named president and vice-president, respectively. The wives and relatives of C. H. Andrews and John A. Logan remained principle shareholders in the company.

The passing of both founders did not inhibit the progress of the company and further modernization immediately continued in order to stay competitive as large-scale steel production penetrated the Mahoning Valley, thereby leaving the remaining independent merchant iron companies in a precarious situation. The Andrews & Hitchcock Iron Co., like the Brier Hill Iron and Coal Co., became renowned for its great reputation and high quality product, which always commanded the highest prices. Andrews & Hitchcock's relative isolation in between manufacturing giants Youngstown and Sharon placed the furnaces at a slight advantage. Those independent iron companies in Youngstown, such as Brown-Bonnell, Mahoning Valley Iron Co. and Andrews Bros., presented ideal sites for expansion of steel production within a relatively consolidated and centralized area. At Hubbard, the furnaces allowed little room for expansion of a large steel works, as there were no other iron or steel works within a 5-10 mile radius. The principal reason for Andrews & Hitchcock Iron Co.'s continued independence was

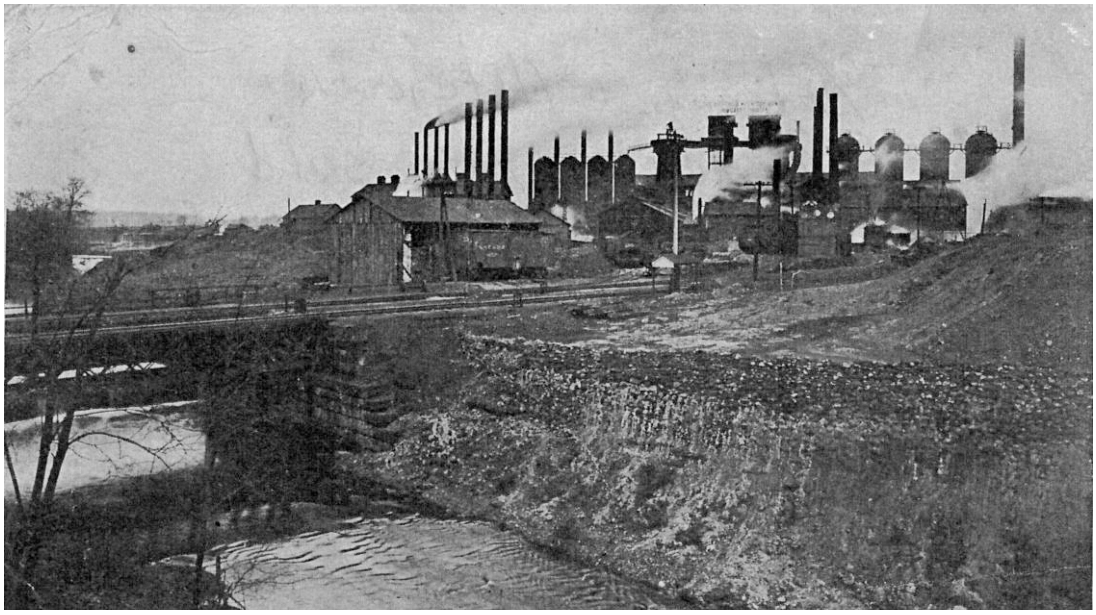

Figure 3-3: The Andrews & Hitchcock Iron Co. looking northwest across Little Yankee Run c. 1905. The No. 1 furnace appears on the left while the No. 2 furnace (partly obstructed by steam) is to the right with the elevator hoist in the middle. By this time, the furnaces utilized Cowper-Kennedy firebrick stoves and produced upwards of 220,000 tons of both foundry and Bessemer grade pig iron.

Courtesy of Hubbard Historical Society

the company's stockholders' unwillingness to sell due to sustained profitability and established customers at a time when merchant iron still remained marketable.

The Andrews & Hitchcock Iron Co. embarked on another modernization campaign in the 1900s, and in 1903 rebuilt its No. 2 furnace for a third time. *The Vindicator* deemed the expansion as the potential for the company to have "one of the biggest furnaces in either of the two valleys," a consequence that simultaneously doubled the company's already extensive capacity.[24] Andrews & Hitchcock removed the furnace's old iron pipe stoves and installed three Cowper-Kennedy two-pass firebrick stoves, and enlarged the blowing engine house for the installation of Tod vertical steam

[24] "Will Double the Capacity of the Works of the Andrews-Hitchcock Iron Co.," *The Vindicator*, October 9, 1902.

blowing engines.[25] Although the No. 2 furnace was not enlarged in any way, its new stoves were considerably larger than those installed on the No. 1 stack, and along with more powerful blowing engines, the company's combined output improved to 220,000 tons per year, a number significantly higher than any other merchant or pioneer furnace in the Mahoning Valley. In 1904, the company installed a battery of four, 400 horsepower Sterling boilers, which greatly improved the company's steam capacity.[26] The improvements allowed the company to remain competitive amongst the large-scale merger movement in the iron and steel industry.

The increased productivity of the Hubbard furnaces, as well as those throughout the Mahoning and Shenango Valley, attracted further companies to Hubbard that looked to take advantage of the furnace's by-products, particularly flue dust. Men in the iron industry searched for a use for this wasteful by-product of the combustion process that contained fine particles of iron ore. In 1905, the Hoover & Mason Company out of Chicago developed a method to conglomerate flue dust into sinter, an agglomeration of heated flue dust and coke dust reused in blast furnaces as part of the burden. Hoover & Mason chose Hubbard for its new subsidiary, the American Sintering Co., due to the area's large number of blast furnaces and Hubbard's geographic location in the middle of both the Mahoning and Shenango Valleys. The company constructed its plant – the first of its kind in the world - a quarter-mile east of the Hubbard furnaces along the Erie Railroad. The American Sintering Co. approved contracts to sinter flue dust from the Mabel, Claire and Alice furnaces in Sharpsville; the Ella furnace at West Middlesex; the

[25] *The Iron Age*, vol. 70, October 23, 1902: 33.
[26] *The Iron Age*, vol. 74, July 28, 1904: 31.

Stewart furnace at Sharon and the two Hubbard furnaces.[27] The American Sintering Co. reduced over 600 tons of flue dust for the Andrews & Hitchcock Iron Co. per day, which reduced costs of shipping iron ore from Cleveland.[28]

The construction of the American Sintering Co. greatly increased industrial productivity, employment, railroad traffic and further profitability for the Hubbard furnaces. The successful agglomeration of flue dust allowed other companies to construct similar devices for other furnaces, a cause that greatly affected blast furnace operations in the future. But as the Andrews & Hitchcock Iron Co. indirectly benefitted from this new technology, their own furnaces became outdated. By 1909, the No. 1 furnace still retained its 1886 configuration while the furnaces of the Brier Hill Iron and Coal Co. and the Struthers Furnace Co. were completely overhauled and modernized with mechanical skip hoists and all other matters of efficient equipment. To maintain competitive operations in the local merchant trade, the Andrews & Hitchcock Iron Co. rebuilt its No. 1 furnace for the first time in nearly a quarter century. For the furnace's overall design, the company hired famed blast furnace engineer Julian Kennedy while the William B. Pollock Co. fabricated the plate work. Construction commenced in late 1909 and all remnants of the old No. 1 furnace were torn out, with the foundations of the new furnace raised fourteen feet above the old stack's level.

One of the primary features of the furnace was the installation of a modern mechanical skip hoist and the removal of the elevator hoist and hand filling, making it the fourth of the five older merchant furnaces in the Mahoning Valley to adopt a skip hoist. A double Otis steam-hoisting engine located in the hoist house, a small shanty directly

[27] *The Iron Trade Review*, vol. 36, April 6: 1905.
[28] *The Iron Age*, vol. 101, Jan. 24, 1918: 259.

Figure 3-4: This 1910 view shows the construction of the new No. 1 furnace along with the older, hand-fed No. 2 furnace at right. The dust collector shown on the No. 2 furnace acted only as a primary gas cleaning facility, as a gas washer to more thoroughly clean the waste gas was not installed on that particular stack until 1915. The covered stock house for the furnaces can be seen directly behind the elevator shafts.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

over the skip incline at the level of the coke bins, powered the skip cars. In addition to the skip hoist, the furnace received a Kennedy revolving top designed by Julian Kennedy to evenly distribute the coke, ore and limestone.[29] The Kennedy top was similar to the McKee top used at the Anna furnace; however, it rotated by a wire rope that passed around the hopper and down to the ground level, where it was moved by an Otis engine, whereas a McKee top utilized a small ball bearing that allowed the small bell to rotate without any interference from the operating mechanism above.[30] The furnace also contained a double-bell system, which allowed further utilization and conservation of

[29] "The New Andrews & Hitchcock Furnace," *The Iron Age*, vol. 85, March 3, 1910: 539.
[30] J. E. Johnson, Jr., *Blast-Furnace Construction in America* (New York: McGraw Hill Book Co., Inc., 1915), 76-77.

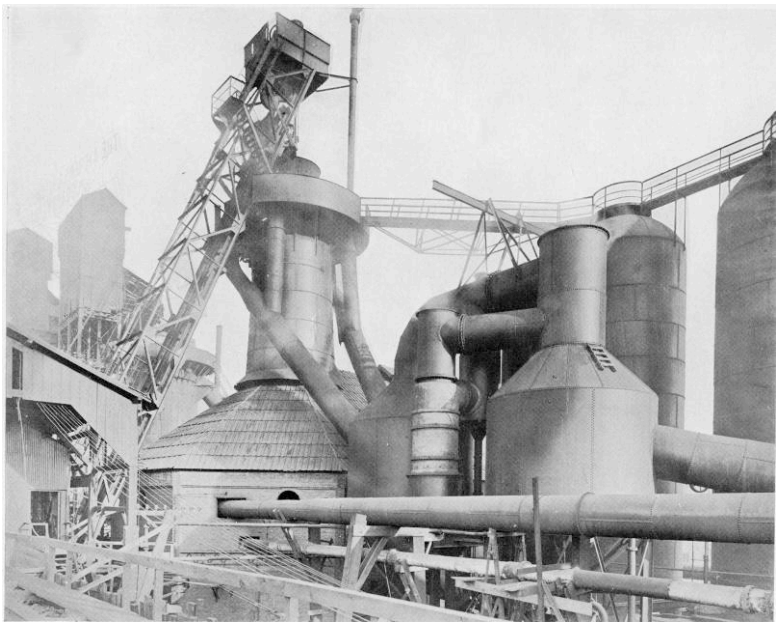

Figure 3-5: When finished in 1910, the 80-foot tall Hubbard No. 1 furnace contained nearly all aspects of modern blast furnace practice: a mechanical, 2-car skip hoist, a dust collector and gas washer, and modernized firebrick stoves. Shown in the background at left are the old elevator shafts and No. 2 furnace. The hoisting house is seen on the left (partially cut off).

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

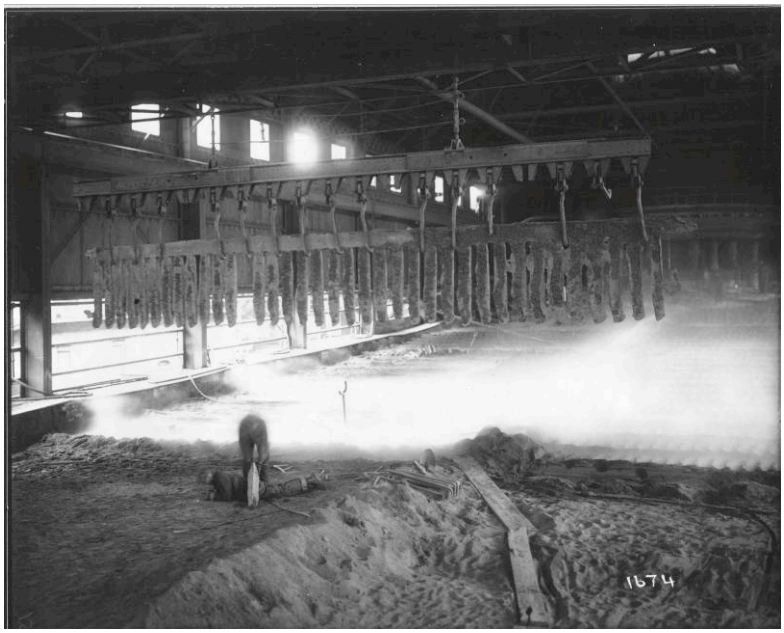

Figure 3-6: Inside the cast house, iron was still cast in sand molds on the furnace floor. The image above shows a comb of hardened pig iron being carried to the pig breaker, where they were mechanically broken, rather than the old method of laborers manually breaking the iron with sledgehammers.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

Figure 3-7: Youngstown's William Tod Co. furnished all of Andrews & Hitchcock's blowing engines from 1896 to 1910 (and possibly prior to 1896, however, no records exist). In 1910, the company utilized six vertical blowing engines to furnish the blast air for the two furnaces. The installation of two Mesta horizontal engines in 1915 resulted in the removal of several of the older vertical engines.

Courtesy of Mahoning Valley Historical Society

furnace waste gasses.

In addition to the five Tod vertical engines already in use at the furnace, the company installed a supplementary Tod low pressure long cross head 96 x 96 x 60 vertical steam blowing engine. Other equipment installed included an entirely new all iron cast house that measured 65 x 200 feet, and within it the company installed a pig breaker and crane built by the Brown Hoisting Machine Co. By this time, the Hubbard furnaces still required a long cast house to accommodate the higher output of the furnace due to the lack of a pig casting machine and the continuation of casting in sand molds on the furnace floor. Once the iron was cast on the furnace floor, an overheard crane lifted the "comb" of pig iron and moved it to the pig breaker, where the pig iron was laid down upon a table of rollers that fed them up to a hydraulic plunger working up and down, which broke them into short sections. This new machine made the old method of

breaking iron manually with sledgehammers obsolete and simultaneously allowed the company to save both time and money on labor. Because the size of the furnace was drastically increased to eighty feet in height with a nineteen-foot bosh, the company removed its old hot stoves and replaced them with modernized two-pass stoves with a larger heating surface. Along with new stoves, the furnace also received a dust collector and gas washer to purify blast furnace gas for reuse as fuel for the stoves and boilers. The new furnace now produced up to 500 tons of iron per day and acknowledged in the April 1910 issue of *Metallurgical and Chemical Engineering* as one of premiere units in the district, stating that "The furnace, stoves, and connections make one of the best and most complete blast-furnaces in the Mahoning Valley."[31]

Although the new Hubbard No. 1 furnace was modern in all aspects of merchant blast furnace practice, it still lacked current raw material handling that characterized many of the other large furnaces in the Mahoning Valley, such as Youngstown Sheet & Tube and Carnegie Steel's Ohio Works. Prior to the furnace's rebuilding, its capacity per day was roughly 250-275 tons and did not necessitate the vast expanses of raw material handling that larger furnaces required. Despite the furnace's 500-ton capacity, the old methods of raw material handling remained due to one furnace retaining its elevator hoist and hand charging, while the other utilized a new automatic skip hoist. Hubbard's raw material handling remained similar to the methods applied in the late nineteenth century with the exception of handling coke. Hopper cars loaded with iron ore and limestone ran across three, 20-foot elevated wooden trestles and dumped its contents into the ore storage yard, and any ore that remained stuck in the cars was shoveled out by employees.

[31] *Metallurgical and Chemical Engineering*, vol. VIII (New York: McGraw-Hill Company, April 1910): 215.

Figure 3-8: Raw material handling still remained fairly antiquated despite the modernizations to the furnace in 1910. This image shows iron ore piled underneath the 20-foot elevated wooden railroad trestles. Bottom fillers still had the laborious task of loading ore barrows with 500-700 pounds of iron ore and dumping them into the skip buckets.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

The iron ore and limestone sat in large heaps in the furnace ore storage grounds underneath the trestles, with the majority confined in the covered stock house that protected most of the raw materials from the elements. Antiquated raw material handling remained due to the company's comparatively low output, which did not yet necessitate the use of entirely modernized raw material handling, such as stock bins, ore bridge and larry cars.

Despite these rather antiquated raw material handling procedures, the company continued to produce high quality iron in the years prior to the First World War. In 1913, the Youngstown Sheet & Tube Co. purchased 12,500 tons of Bessemer iron from Andrews & Hitchcock due to insufficient output from Sheet & Tube's furnaces at East Youngstown (later Campbell).[32] Andrews & Hitchcock's product continued to demand

[32] *The Iron Age*, vol. 91, January 2, 1913: 112.

the highest prices ruling and rumor soon spread of the company expanding its furnace operations with the construction of an additional blast furnace. However, this was not the case. In April 1913, the company purchased 28 acres of land adjoining their two blast furnaces and company officials soon discussed the idea of constructing an open-hearth steel plant comparable to the decision made by the Brier Hill Steel Co. in 1912 to integrate their merchant furnaces into a vast open-hearth steel-making and steel finishing plant. Such a decision by Andrews & Hitchcock Iron Co. would have all but removed the company from the merchant iron business.[33] The idea lulled for a year's time before *The Mahoning Dispatch* reported, "the Andrews-Hitchcock Iron Co. will erect a big open-hearth steel plant at Hubbard in connection with its furnaces there. This will be a big boom for that town."[34] Despite the talk of a steel plant, the proposition fell through for unknown reasons and the company remained in the merchant iron business; however, the company soon overhauled its older, hand-fed No. 2 stack to the extent of the improvements made to the No. 1 stack in 1910.

The rebuilding of the No. 2 stack commenced in March 1914 when the Mesta Machine Company in Pittsburgh received an order from Andrews & Hitchcock for two horizontal cross compound steam blowing engines with high pressure steam cylinders 48 in. in diameter, low pressure 84 in., air cylinders 84 in., and stroke 60 in.[35] Horizontal engines required the largest and most expensive foundations of any type of steam blowing engine and also necessitated a large building with sufficient ground area, but it did not require a building of great height. The large foundations also acted as a huge anvil

[33] *The Iron Age*, vol. 91, May 1, 1913: 1089.
[34] *The Mahoning Dispatch*, June 26, 1914.
[35] *The Iron Age*, vol. 93, March 19, 1914: 751.

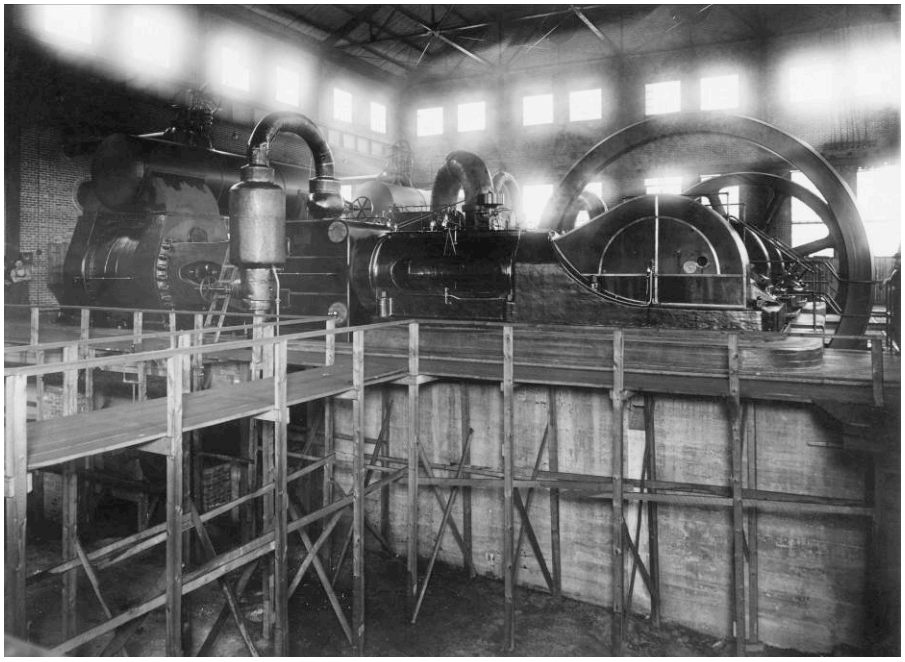

Figure 3-9: The reconstruction of the No. 2 furnace in 1915 brought further modernization of the company's auxiliary equipment. The addition of the two horizontal blowing engines necessitated a second blowing engine house. The large building also contained the water feed pumps and power equipment. The two Mesta, horizontal cross compound steam blowing engines specifically built for the new No. 2 furnace. The engines contained 48-inch steam cylinders and produced a blast pressure up to 25 pounds per square inch. The engines served the furnace until it shut down in 1960.

Courtesy of Mahoning Valley Historical Society

that absorbed inertia stresses and unbalanced centrifugal effects of counterbalance, which cut down the overall vibration of the unit.[36] The engines ran at a speed best adapted to produce the highest economy and went far to offset the disadvantages of total cost. In order to house the new horizontal engines, the company constructed a large blowing engine house along Little Yankee Run that also accommodated the hydraulic and boiler feed pumps and DC motor generators and AC turbine. In addition to a new blowing engine house, the company also constructed a new boiler house with six, 600 horsepower Sterling boilers for maximum steam capacity. Andrews & Hitchcock completed the new

[36] Johnson, Jr., *Blast-Furnace Construction in America*, 147.

No. 2 furnace in 1915, which measured eighty feet in height with a nineteen-foot bosh. The furnace, again under the supervision of Julian Kennedy with all plate work furnished by the William B. Pollock Co., contained all the modern aspects installed on the No. 1 furnace five years earlier, which included an automatic, two-car skip hoist, dust catcher and Mullen gas washer, identical cast house with pig breaker, Kennedy revolving top and five Cowper-Kennedy two-pass stoves rather than the No. 1 stack's four. The installation of the skip hoist marked the last pioneer furnace in the Mahoning Valley overhauled with automatic charging. Due to both furnaces' utilization of the skip hoist, Andrews & Hitchcock removed the sheltered stock house and constructed additional elevated trestles to accommodate further ore, coke and limestone storage capacity for two 500-ton furnaces.

The additional capacity of the furnaces meant that the company required a sufficiently large and constant supply of water for successful operations. Water was one of the most essential elements of the blast furnace plant. It prevented the furnace from overheating and the molten iron from burning through the lining, and also provided water for the boilers, where it was filtered and softened for use at the plant. In 1868, the small volume of water provided by Little Yankee Run was sufficient enough to provide for the needs of the small hand-fed furnaces. As the company's furnaces grew in size and production, the small river became insufficient, and unlike those furnaces along the larger Mahoning River, the Hubbard plant desperately necessitated a constant and reliable water supply. A mile northwest of the furnaces in Coalburg, the company constructed a dam along Little Yankee Run in order to collect rainwater and run off from Old Route 82. The resultant Coalburg Lake provided a constant water supply for both the furnaces and the

New York Central Railroad. At times of drought, the drain valve at the dam opened, which allowed water accumulated in the lake to flow naturally down the river to the furnace plant, where, in 1915, the company constructed an additional reservoir to hold a further water supply. The Yankee Run dam contained two reservoirs, an upper and lower. The upper primarily served the furnaces while the lower served both the N.Y.C. Railroad and the sintering plant. According to Clifford Harmon, long-time Hubbard furnace employee, the valve at Coalburg Lake contained a special handle that the company locked away at the furnace plant while guards patrolled the dam around the clock during times of war to prevent sabotage.[37]

The overhaul of the No. 2 furnace and the additional construction of further modernized auxiliary equipment transformed the Andrews & Hitchcock Iron Co. into one of the premiere blast furnace plants in the Mahoning Valley outside of the large steel works in Youngstown. The company was self-sufficient in raw materials and operated mines in both the Menominee and Mesabi iron ore ranges in the Great Lakes region, and was also interested in limestone quarries at Hillsville, Pennsylvania, which ultimately did not transpire. Simultaneously with the rebuilding and modernization of the plant in 1915, the New York Central Railroad and Andrews & Hitchcock negotiated a right of way through the furnace property to service the new Hubbard plant of the Standard Slag Company. The by-product slag that rose to the top of the molten iron was run into granulated slag pits adjacent to the furnace cast house (granulated slag was combined with water in order for it to be converted into a usable product). The furnaces produced over 85,000 tons of slag per year with the majority now sent to the Standard Slag Co. to

[37] Clifford Harmon, *Hubbard Blast Furnace*, February 22, 1990, Hubbard Historical Society.

be crushed and formed into concrete aggregate, road and roofing materials.[38] The thorough modernization of the Hubbard furnaces combined with the supplementary industrial services of the nearby American Sintering Co. and Standard Slag Co. allowed maximum profitability for the Andrews & Hitchcock Iron Co. The company was nearly self-sufficient in raw materials and produced over 270,000 tons of Bessemer and foundry iron per year.[39] All of these factors combined for a highly successful iron plant, which sparked a vested interest from the Youngstown Sheet & Tube Company, whose blast furnaces, although modernized and of substantial size and production, could not fully supplement their expanding steel production. But Sheet & Tube's primary concern lay in the acquisition of Andrews & Hitchcock's interest in iron ore mines in the Mesabi district in the Great Lakes, as well as other ore, limestone and coal reserves.

[38] *Directory*, 1916, 36.
[39] *Directory*, 1916, 36.

Chapter 4: Hubbard Furnace – Stagnation and Decline, 1917-1960

The Andrews & Hitchcock Iron Company's modernization of their Hubbard furnaces between 1910 and 1915, accumulation of coal and ore reserves, and large capital designated the merchant iron firm as one of the most successful in the Mahoning Valley. No merchant furnaces produced more iron than Hubbard did, and the coming war presented yet another opportunity for capacity production and strong sales. The early twentieth century presented both advancement and decline for the Hubbard furnaces, and integrated steel companies around the Mahoning Valley looked to supplement their own pig iron production by building new furnaces, or, for a temporary resolution, purchase small, merchant furnaces that remained independent. Regardless of the Hubbard furnaces' isolation away from the centralized steel producing area of Youngstown and Campbell, Hubbard persisted as an operation of their own under the guise of Youngstown Sheet & Tube. Sheet & Tube's remodeling and enlargement of their furnaces in Campbell eventually rendered Hubbard redundant, but the construction of an ingot mold foundry by the Valley Mould & Iron Co. adjacent to the Hubbard stacks in 1927 inadvertently preserved operations at Hubbard for another thirty-three years, until technological stagnation pushed the once prosperous merchant furnaces into decline.

By the late nineteenth century, many of the smaller iron firms in the Mahoning Valley did not have the initial experience, capital or expertise to convert from iron to steel production. For many independent iron manufacturers, the production of pig iron or puddled wrought iron was the extent of their knowledge in the industry, and in the

Mahoning Valley, where many industrialists continued to rely on iron production, the need to convert to steel manufacture was inevitable. But as the consolidations and mergers took place at the turn of the century, George D. Wick and James A. Campbell, president and vice president of the newly formed Youngstown Iron Sheet & Tube Co., initially believed that the lasting qualities of iron were greater than that of steel and focused their new mill in the production of wrought iron sheets and pipe.

Wick and Campbell's new company was not self-sufficient in pig iron production and purchased all of its iron off the open market. To combat this handicap, Iron Sheet & Tube purchased the small Alice furnace in Sharpsville, Pennsylvania in 1903 for its own supply of pig iron. The old Alice furnace appropriated enough surplus of capital to allow Sheet & Tube to expand their mill, and in 1905, the company installed a Bessemer steel facility to augment their wrought iron production. For increased iron production, the company constructed four modernized blast furnaces between 1908 and 1912, all complete with stock bins, ore bridge, ore yard, skip hoists and firebrick stoves. The modern furnaces meant the production from the old Alice furnace was unnecessary, and it was subsequently sold to the Valley Mould & Iron Corp. in Sharpsville. Sheet & Tube's steel production continued to expand with open-hearth facilities, which led to a need for additional pig iron production, particularly during the First World War. In 1916, the company planned to add a fifth furnace with identical capacities and size to increase its additional steel production, but the recently modernized blast furnaces and iron ore holdings of the Andrews & Hitchcock Iron Co. seemed a more formidable, long-term investment and the plan of a fifth furnace fell through.

The expense spared from building a fifth blast furnace from the ground up

allowed the company to negotiate with Andrews & Hitchcock Iron Co. president Frank Hitchcock and his brother and vice president William J. Hitchcock, Jr. Like the Republic Iron and Steel Co., which rebuilt their Haselton furnaces to higher capacity in the 1920s, thereby eliminating any reliance on their older, outlying furnaces, Sheet & Tube did not embark on a similar blast furnace modernization campaign until the same period, with the exception of the necessary relining procedures. With the Hubbard furnaces, Sheet & Tube added an additional 300,000 tons of pig iron per year, a number, when combined with the production of the four Campbell furnaces, reached well over a million tons per year, which eliminated the dependency of purchasing pig iron off the open market.

Negotiations for the two Hubbard furnaces were successful and on April 12, 1916, the Youngstown Sheet & Tube Co. acquired all of the capital stock of the Andrews & Hitchcock Iron Co. for $2.5 million.[1] According to *The Hubbard Enterprise*, the deal involved a total value of $7 million and was a transaction "stupendous in its importance and in the property value involved making it the largest transfer of industrial interests and assets ever negotiated in the history of Youngstown…" and also hailed by *The Vindicator* as "the greatest deal ever recorded in industrial circles of the Mahoning and Shenango district."[2] Other than the newly rebuilt furnaces, Sheet & Tube obtained 1,123 acres of virgin coal land in Greene County, Pennsylvania, with one half interest in 973 acres of surface land, 250 acres of land in Hubbard and Brookfield townships, and interests in steamship companies in the Great Lakes region. One of the most important assets secured

[1] *Moody's Manual of Railroads and Corporation Securities,* vol. II (New York: Poor's Publishing Company, 1921), 839.
[2] "Local Furnaces are Sold to Youngstown Sheet & Tube Comp'y," *The Hubbard Enterprise*, April 13, 1916. "Stupendous Deal of Industrial Interests," *The Vindicator*, April 12, 1916.

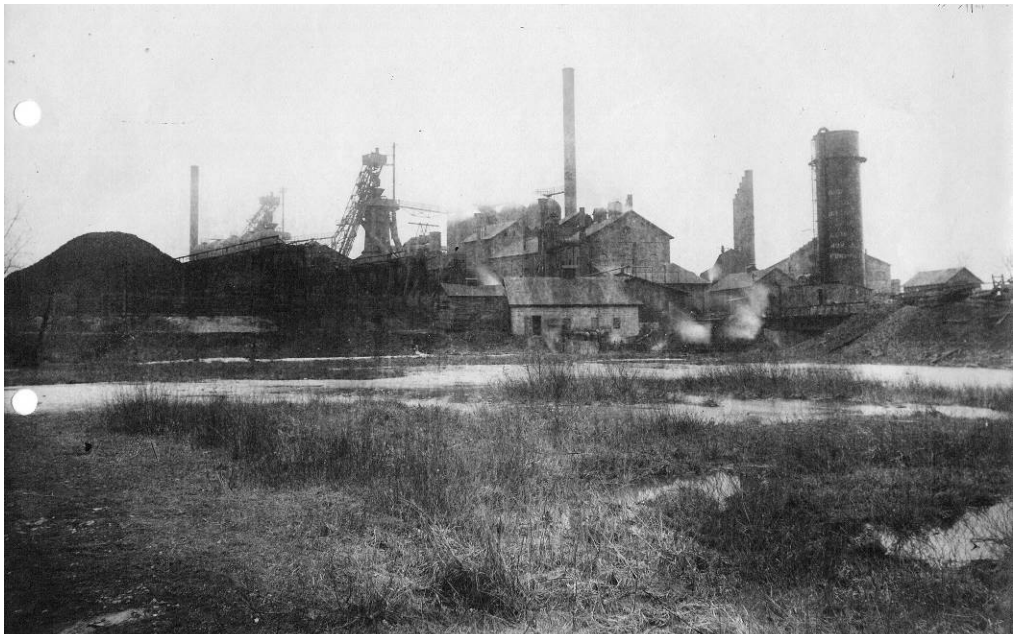

Figure 4-1: After the completion of the new No. 2 furnace, the Andrews & Hitchcock Iron Co. was one of the most productive merchant iron businesses in both the Mahoning Valley and the state. This 1916 photo shows the extent of the plant with the ore storage yards at left, the two modernized furnaces (No. 1 shown in the foreground), the old blowing engine house in the center and the boilers, new blowing engine house and water stand pipe shown at right. Raw material handling still remained inefficient.

Courtesy of Rick Rowlands

by Sheet & Tube was the ore rights in a 12% interest in the Mahoning Ore Co. in the Mesabi Range in Minnesota, which was one of the largest mines in the district with an estimated deposit of 100,000,000 tons of ore.[3] The purchase of this interest secured Sheet & Tube at least 10,000,000 tons of ore.[4]

The purchase of the Andrews & Hitchcock Iron Co. marked the passing of the furnaces from the merchant iron trade, which it had been an important factor for nearly fifty years. It also marked the passing of the company as an independent firm and left only the Ohio Iron and Steel Co. in Lowellville and the Struthers Furnace Co. as the last

[3] The other owners of the stock in the Mahoning Ore Co. were the Cambria Steel Co., 50%; Carnegie Steel Co., 20%; Hanna interests, 12%; and the Republic Iron and Steel Co., 6%.
[4] "Local Furnaces are Sold to Youngstown Sheet & Tube Comp'y," *The Hubbard Enterprise*, April 13, 1916.

independent merchant iron companies in the Mahoning Valley. The Hubbard furnaces remained under the title of the Andrews & Hitchcock Iron Co. with James A. Campbell president until its merger with Youngstown Sheet & Tube in March 1917. At the time of its sale, the Hubbard furnaces still filled orders through the end of 1916 and operated one furnace as a merchant stack on foundry iron while the other was operated for Sheet & Tube's use at its East Youngstown plant.[5] Although the furnaces themselves were each modernized within the past six years, the handling of raw materials remained relatively antiquated, particularly for the moderately large size and production rates of each furnace. The plant still maintained elevated wooden trestles in their iron ore stockyard and relied upon employees to transfer raw materials via wheelbarrow. The company constructed several extensions and additions to the wooden ore trestles to accommodate an increased supply of iron ore in the stockyard to supplement a growth in production and restrict any shortage of ore during the winter seasons as the lakes froze. The furnace's bin systems still consisted of the gravity-operated lever technique and only accommodated coke, although some may have utilized ore, and unlike other former and pioneer merchant furnaces, iron was cast in sand molds on the furnace floor rather than in a casting machine.

Hubbard furnace was still far less technologically modern than the company's furnaces at Campbell, which utilized all manner of the latest blast furnace practice; however, in June 1916, James Campbell appropriated $100,000 for additions at the Hubbard plant, which included modernized pumping and power equipment along with a steam-powered ore bridge.[6] The ore bridge, a massive traveling crane that moved across

[5] "Buys Andrews & Hitchcock Interests," *The Iron Trade Review*, vol. 58, April 13, 1916: 803.
[6] *The Iron Age*, vol. 97, June 8, 1916: 1420.

Figure 4-2: Prior to the installation of modernized stock bins in 1919, these make-shift, wooden-clad coke bins necessitated bottom fillers to pull a lever, which allowed coke to drop from the chutes via gravity into coke barrows. The barrows were then wheeled into the overhang seen at center left, where they were dumped into the skip buckets.

Courtesy of Mahoning Valley Historical Society

the iron ore stockyard handling ore in large quantities and transferring the iron ore from dump piles to stock piles via a large, clam-shell bucket, was only utilized at furnace plants associated with a large steel works due to the high capacity of the more modern furnaces. The Hubbard furnaces were the first and only pioneer furnace in the Mahoning Valley to utilize an ore bridge (it was also the first of two ex-merchant furnaces to use an ore bridge, the second being the Grace furnace of the Brier Hill Steel Co., which constructed an ore bridge in 1918 for use at both Grace and the new Jeannette furnace).

The installation of the ore bridge marked the largest addition to the plant in 1916, but after its merger into the Youngstown Sheet & Tube Co. in 1917, the company invested over one million dollars at their Hubbard plant in order to maximize production during the height of the First World War.[7] One of these investments included a $48,000 relining of the No. 2 furnace.[8] One of the final and principal investments in the Hubbard

[7] "Hubbard Works Property Ledgers, 1924-1942," *Youngstown Sheet & Tube Co. Records Collection, Accounting Division: Container 25* (Ohio Historical Society: Youngstown Historical Center of Industry and Labor Archives, Youngstown), 24.

[8] "The Youngstown Sheet and Tube Company and Subsidiary Companies Report and Accounts, December

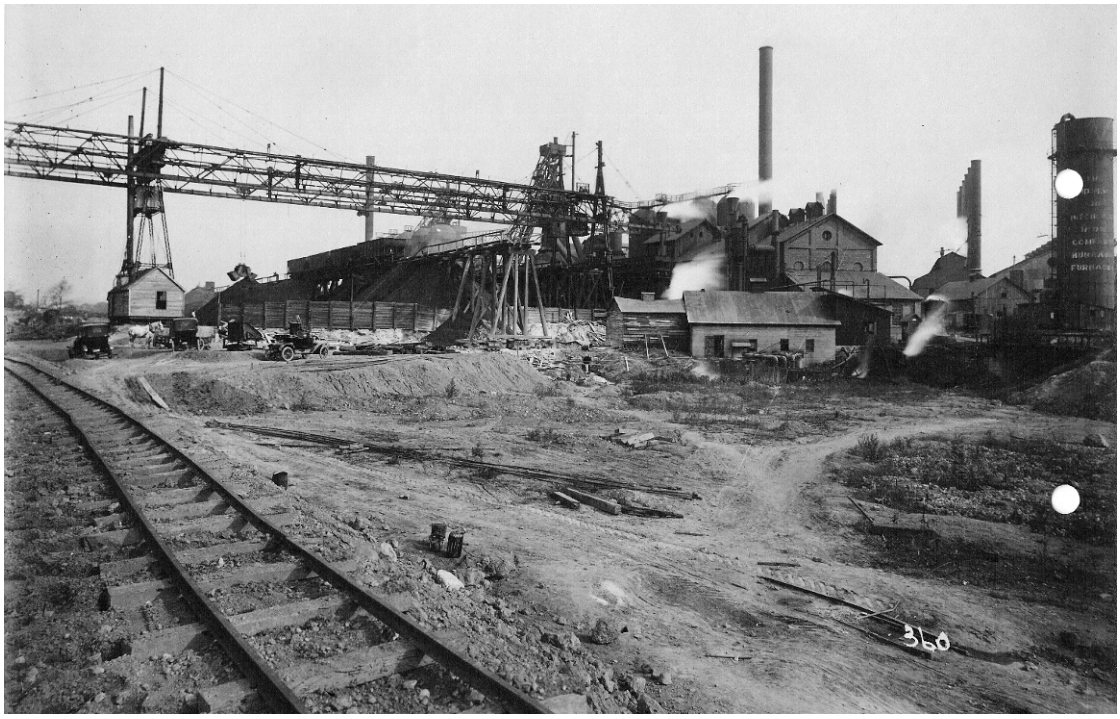

Figure 4-3: After the purchase of the Hubbard furnaces by Sheet & Tube, one of the first major additions was the installation of a steam-powered ore bridge in 1916. The ore bridge spanned the iron ore stock yard and transferred large dump piles of iron ore from the elevated trestles into more manageable stock piles. Hubbard were the only pioneer furnaces in the Mahoning Valley to utilize an ore bridge.

Courtesy of Rick Rowlands

plant occurred in 1919-1920 when the company expended $548,267 on the additions of modernized Hoover & Mason type stock bins and a pig casting plant.[9] Modernized stock bins and a pig-casting machine meant a fairly long-term investment and reliance on the plant as an essential aspect to the company. The Hubbard Works was now the only pioneer furnace plant to contain nearly all aspects of modernized raw material handling. Other furnaces from the Mahoning Valley's iron era still relied on hand-filling with little to no aspects of modernized raw material handling due to their small production rates and

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31, 1917," *Y. S. & T. Records Collection, Accounting Division Oversize Files: Container 150, Statements of Investments in Properties, 1910-1934* (Y.H.C.I.L. Archives, Youngstown).

[9] "The Youngstown Sheet and Tube Company and Subsidiary Companies Report and Accounts, December 31, 1917," *Y. S. & T. Records Collection, Accounting Division Oversize Files: Container 150*.

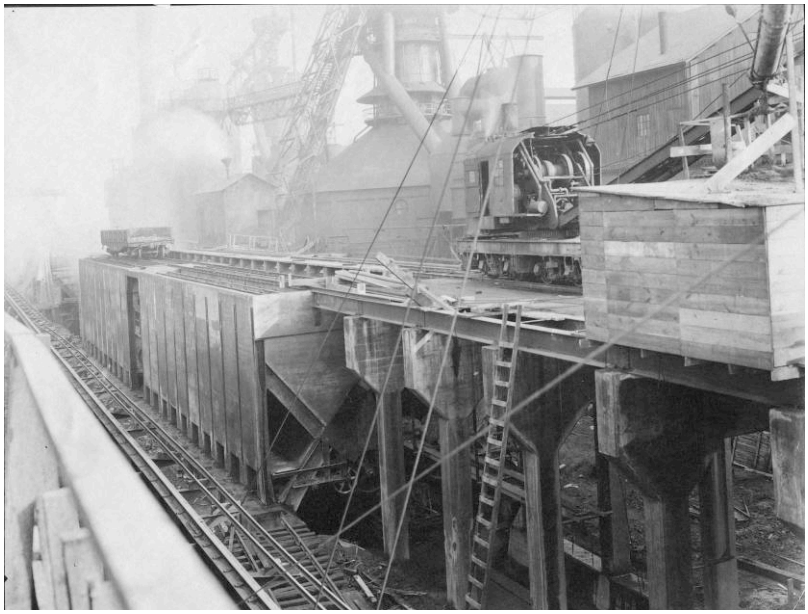

Figure 4-4: Construction of both the trestles (right) and bins (midground) are seen in this 1919 photo. Shown on top of the trestles are two railroad tracks, the left for iron ore and the right for coke, limestone and other aggregate. There were ten bins total for each furnace: three coke, two limestone and five ore.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

those companies' unwillingness to invest in further modernization.

The first of Sheet & Tube's additions and modernizations to their Hubbard furnaces occurred in the latter half of 1919 despite a nationwide steel strike. As Hubbard modernized, many unskilled jobs were lost due to mechanization, yet the plant still employed 400 men, with several semi-skilled labor positions introduced after the installation of the ore bridge and skip hoists. Sheet & Tube president James Campbell continued with the construction of the new equipment at Hubbard regardless of the inconveniences from the 1919 steel strike, and further automated the facility. The installation of the $315,351.38 Hoover & Mason type stock bins meant the end of hand-filling operations at Hubbard and the gravity-operated coke bins, and marked the plant's entrance into modernized blast furnace practice. Transfer of iron ore and other raw materials by hand and barrow consumed both time and labor. The new bins, constructed of steel and reinforced concrete directly adjacent to the furnaces and their skip hoists, were elevated in similar fashion as the wooden trestles; however, on the top laid two

railroad tracks that ran over the bins. Like the openings in the wooden trestles that allowed gondola cars to dump iron ore onto the stockyard grounds, railcars containing coke and limestone ran across the top of the trestle and dumped their contents into the specific steel bins below. On the other track ran an ore transfer car, which received ore from the ore bridge's clam shell bucket and dispensed it into the proper ore bins. Underneath the bins ran a single rail that contained two Hoover and Mason electric scale cars, which removed the proper contents from the bins, weighed the burden and dumped it into the skip buckets that sat underneath the scale car track. The skip operator then hoisted the skip cars and dumped their contents into the furnace. The company invested in two 5-ton larry cars for $12,052.29 and two Hoover and Mason scale cars for $116,200.00.[10] The new stock house and bins saved Sheet & Tube time, money, labor and held a vast advantage over the old method of hand filling from the furnace yards.

Despite the extensive modernization process Sheet & Tube engaged in at their Hubbard furnaces, the plant still cast in sand on the furnace floor, a highly outdated method used primarily at the small charcoal furnaces that remained in Southern Ohio and Pennsylvania. In order to produce basic iron for the open-hearth process, pig iron needed to be cast in chills, or in special circumstances, a magnesia-based sand, due to the acidic properties of regular silica-based sand. At Hubbard, the lack of a pig-casting machine necessitated the special magnesia based casting floor to produce basic iron for Sheet & Tube's open-hearth furnaces. The American Casting Machine Company authorized the use of Edward A. Uehling's pig casting machine for use at Sheet & Tube's Hubbard

[10] "The Youngstown Sheet and Tube Company and Subsidiary Companies Report and Accounts with Relative Exhibits, December 31, 1919," *Y. S. & T. Records Collection, Accounting Division Oversize Files: Container 150*.

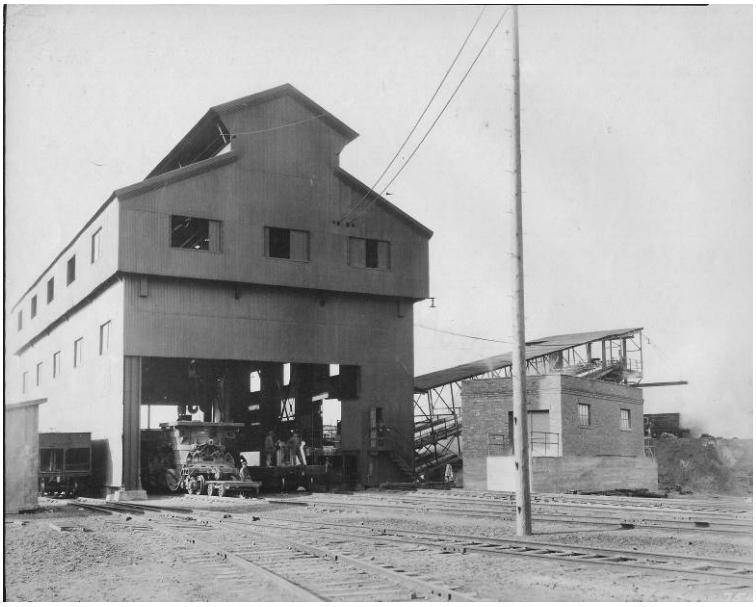

Figure 4-5: In order to transfer molten iron from the furnace to the pouring shed, the company purchased four 40-ton hot metal ladle cars constructed by the William B. Pollock Co. of Youngstown. One such ladle is shown in the pig-pouring shed. A 40-ton stationary tilting hoist transferred the molten iron from the ladle to the molds. The small brick shanty on the right contained lime used as a non-stick substance for the molds.

Courtesy of Rick Rowlands

furnaces in 1920 and construction began on the Uehling double-strand pig casting machine along the west side of the plant adjacent to Little Yankee Run the same summer. The machine contained a large covered steel-framed, ironclad pig iron pouring shed, which encompassed an Alliance, 75-ton crane and a 40-ton stationary crane that handled the pouring of the molten pig iron from a 40-ton Pollock hot metal ladle car. After tapping the iron from the furnace, it ran through brick-lined iron runners and into the hot metal ladle car, which was then transferred to the pouring shed. The iron was poured into molds on an endless conveyor belt up a slight incline, where both air movement and water sprays cooled it. The 50-100 pound hardened pigs were dropped into waiting rail cars for shipment. Four 40-ton hot metal cars and ladles were purchased for the pig caster at a cost of $26,986.00.[11] Like the Anna furnace in Struthers, which relied on basic iron production via the pig-casting machine, the Hubbard furnaces no longer necessitated the

[11] "The Youngstown Sheet and Tube Company and Subsidiary Companies Report and Accounts with Relative Exhibits, December 31, 1919," *Y. S. & T. Records Collection, Accounting Division Oversize Files: Container 150*.

old method of casting in sand on the furnace floor. To accommodate the pig caster, the company constructed a 23-foot high, 36-foot long skew arch concrete railroad bridge across Little Yankee Run. The bridge acted as both access to a slag dump and an elevated platform to accommodate the pig caster where the rail cars waited for the finished iron to drop from the molds.

The addition of new stock bins, an ore bridge, and pig-casting machine increased the annual capacity of the Hubbard furnaces to over 300,000 tons, however, the company made little improvements to the plant following its four-year modernization campaign.[12] Regardless, the Hubbard furnaces were now the most modernized pioneer stacks in the Mahoning Valley at a time when many were near their last cast of iron. At Hubbard, Sheet & Tube's investment stalled and dropped off considerably after 1921. A relative lack of investment became a trend throughout the 1920s, although a small revival occurred in 1927 with the construction of Valley Mould and Iron Co.'s Hubbard plant. Several events occurred in the 1920s that severely lessened Sheet & Tube's reliance on their older Hubbard furnaces, the first being the purchase of the local Brier Hill Steel Co. and the newer Indiana Harbor Works of the Steel & Tube Co. of America in East Chicago, Indiana in 1923.

At the time of the sale, the Brier Hill Steel Co. was one of the premiere steel plants in the Mahoning Valley and contained three blast furnaces, the ex-merchant Grace and Tod stacks and the newly constructed Jeannette furnace. The company also utilized its own by-product coke plant adjacent to their furnaces and encompassed an open-hearth plant that contained 12, 90-ton open-hearth furnaces that produced up to 700,000 tons of

[12] *Directory*, 1920, 394.

slabs, blooms, billets and sheet bars per year.[13] The company's Indiana Harbor plant comprised one modern blast furnace built in 1917-18, with an additional ninety-five foot furnace built by Sheet & Tube in 1924-25, a by-product coke plant, a Bessemer steel department built in 1916-17, and an open-hearth plant constructed in 1918. In South Chicago, Illinois, Sheet & Tube also acquired five blast furnaces and another by-product coke plant. The Indiana Harbor plant, while also more modern, held the distinct advantage of location along the lakefront, whereas the Campbell, Brier Hill and Hubbard plants were landlocked and subjected to high railroad freight rates for raw material and product shipment.

In Campbell, Sheet & Tube thoroughly rebuilt and enlarged their four blast furnaces in order to accommodate further steel production. Sheet & Tube rebuilt their A furnace in 1927; B in 1926; C in 1924, and their D in 1923. At Brier Hill, the company rebuilt the Jeannette furnace in 1924. The rebuilding program increased the output of these five furnaces to nearly 1.3 million tons while Hubbard only produced 310,000 tons. The Hubbard furnaces quickly became a product of neglect with the last modernizations made in 1910 and 1915; however, the plant's raw material handling received an additional upgrade. In 1924, the Hubbard furnaces' elevated wooden ore trestles were torn out and the company installed a modernized Heyl & Patterson 10-ton ore bridge. The new ore bridge spanned 225 feet across the 210-foot wide and 610-foot long ore yard and transferred the ore from the stockpile to a 50-ton Atlas electric driven larry car, which distributed the ore to the stock bins.

The company constructed concrete trestles and piers directly adjacent to the stock

[13] *Directory*, 1926, 404.

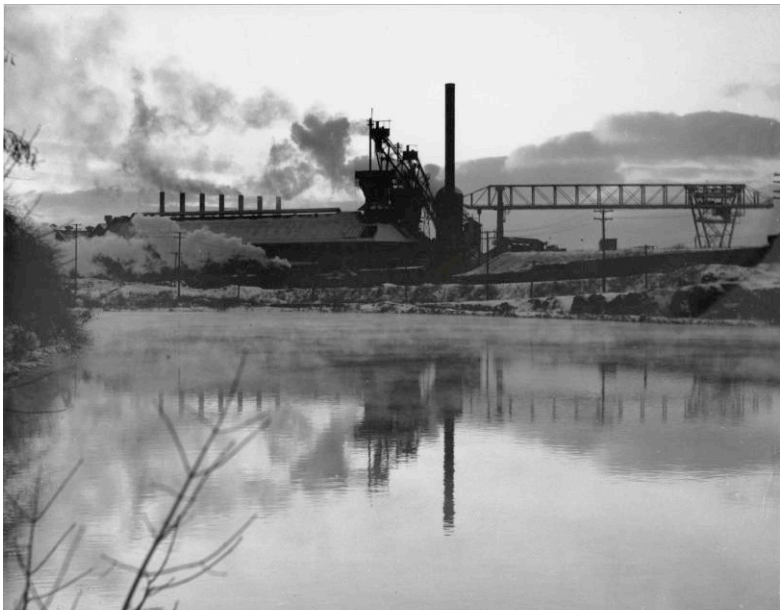

Figure 4-6: A c. 1930 view looking west along the Yankee Run reservoir of the two Hubbard furnaces and the new 10-ton Heyl & Patterson ore bridge to the right. The new Hubbard plant of the Valley Mould and Iron Co. is located to the right of the photographer. The new ore bridge and iron ore distribution eliminated much of the small labor positions at the furnace.

Courtesy of Hubbard Historical Society

bins to replace the method of stock distribution used with the wooden trestles throughout the yard. The new ore bridge ran on a track along the trestle while a single railroad line spanned the trestle directly parallel with the stock bins. Gondola cars carrying ore dumped their contents through pockets underneath the trestle, where it cascaded into the ore yard via a declined grade and was distributed into stockpiles by the ore bridge and its 10-ton capacity bucket. This modernized method of raw material handling was a vast improvement over the former method of wooden ore trestles and greatly increased efficiency and decreased labor. The total investment at Hubbard for 1924 was just over $212,000.[14] In addition to the ore bridge, the company installed a cross-compound William Tod Co. DC engine for further electric power, which was original to the DC

[14] "Youngstown Sheet & Tube Company Ledgers, 1923-1937," *Y. S. & T. Records Collection, Accounting Division Oversize Files: Container 149*. According to the ledgers, the company spent $14,618.86 for the installation of iron runners, but it is uncertain if it was for the No. 1 or No. 2 furnace. After the construction of the pig caster in 1920, it seems only one furnace received iron runners for running the iron directly into hot metal ladle cars rather than into sand molds. Due to its closer proximity to the pig caster, the No. 1 furnace may have had iron runners while the No. 2 furnace continued casting on the furnace floor until 1924, when both were fitted with iron runners.

powerhouse at Campbell but moved to Hubbard in 1924.[15] Between 1923 and 1937, Sheet & Tube spent a total of $989,154.05 on its Hubbard Works – less than the entire investment for 1917.[16]

Despite the new ore bridge, investment at Hubbard continued to decline with only the necessary funds afforded to the plant for motor generators, power lines, railroad tracks, and other basic equipment for proper functionality. With the majority of Hubbard's output not needed, Sheet & Tube designated the furnaces foundry and basic iron production for both the company's own use and sale on the open market, while its malleable iron production was strictly for sale on the market. By 1925-26, many of the smaller, older and outlying furnaces throughout the Mahoning Valley were dismantled due to uneconomical operations and the enlargement of the more modern furnaces in the district. Hubbard seemed destined to follow in the footsteps of the old Haselton No. 1, Hannah, Niles and the plethora of other smaller furnaces throughout Ohio that suspended operations in the face of obsolescence. In Sharpsville, Pennsylvania, the Valley Mould & Iron Co.'s old Alice furnace, formerly owned by Sheet & Tube, still maintained operations but its reliance on iron pipe stoves and hand-filling limited the small furnace to less than 300 tons of iron per day, an inadequate output for Valley Mould's requirements. Valley Mould banked old Alice and entered into a molten iron contract with the adjacent Shenango Furnace Co.; however, the Erie Railroad's freight rates for transferring molten iron across their lines were unacceptable. In Hubbard, Sheet & Tube owned nearly 30 acres of unused land directly adjacent to their two furnaces and the New

[15] Harmon, *Hubbard Blast Furnace.*
[16] "Youngstown Sheet & Tube Company Ledgers, 1923-1937," *Y. S. & T. Records Collection, Accounting Division Oversize Files: Container 149.*

York Central Railroad, a seemingly perfect situation for Valley Mould's freight and molten iron problems. In 1925, Valley Mould entered into negotiations to construct a new ingot mould foundry adjacent to Sheet & Tube's Hubbard furnaces. Negotiations were successful and in 1926 Valley Mould instantaneously dismantled their Alice furnace and abandoned its Sharpsville foundry in favor for immediate construction of their new plant in Hubbard.

Both the Valley Mould and Iron Co. and Sheet & Tube's Hubbard furnaces benefitted greatly from the construction of the ingot mould foundry at Hubbard. The neglected Hubbard furnaces found new life when the companies entered into a ten-year hot metal agreement, and Valley Mould benefitted from a sure supply of molten iron that was nearly unobtainable and uneconomical in Sharpsville. The hot metal agreement assured that Valley Mould purchased all of the Hubbard furnaces' output, unless it exceeded their requirement of 10-15,000 tons of hot metal per month.[17] Valley Mould's one million dollar Hubbard plant opened on June 22, 1927 and it simultaneously became the largest independent producer of ingot moulds in the world.[18] The new plant concurrently transformed the Hubbard furnaces into a strictly merchant operation, despite their ownership by one of the largest steel companies in the world. As a result of the new contract, Sheet & Tube re-invested in the furnaces and expended over $300,000 for the enlargement of the No. 1 furnace's hearth, relining the No. 1 furnace, new hot blast connections, tracks and power lines to Valley Mould, an 800 horsepower Heine boiler

[17] "Contract Between Youngstown Sheet & Tube and the Valley Mould and Iron Co., December 22, 1954," *Y.S.&T. Records Collection, Real Estate Division: Container 25* (Youngstown Historical Center of Industry and Labor Archives, Youngstown), 1.

[18] *Fifty Years of Valley Mould at Hubbard, Ohio* (Hubbard: Valley Mould & Iron Co., 1977), 3.

Figure 4-7: This 1932 photo shows the Hubbard furnaces idled due to the depression. In Lowellville and Struthers, both the Mary and Anna furnaces were also idled until conditions improved enough for the aged furnaces to be profitable. The Hubbard No. 2 furnace (foreground) was dismantled in September 1937.

Courtesy of Ohio Historical Society

and the dredging of Yankee Run.[19]

The Hubbard furnaces were now a vital source for the newly established Valley Mould and Iron Corp. In 1929, the combined production of the two Hubbard furnaces was 273,430 tons, a daily capacity of 750 tons per day.[20] The monthly total of just over 22,000 tons greatly exceeded Valley Mould's needs of 10-15,000 tons of iron per month, and all excess iron was sold on the open market. The furnaces' 1929 production rates even exceeded that of the Grace furnace at Brier Hill, which only totaled 144,584 tons, despite Grace being rated as a 600-ton stack. The Hubbard plant operated at 88.5% capacity in 1929, but the stock market crash drastically drove that number down each

[19] "Youngstown Sheet & Tube Company Ledgers, 1923-1937," *Y. S. & T. Records Collection, Accounting Division Oversize Files: Container 149*.
[20] Frank Purnell, *Plant Visitations by the Board of Directors, Executive Officers and Plant Managers* (Youngstown: Youngstown Sheet & Tube Co., May 31, 1934), 195.

year. Nineteen thirty saw Hubbard's capacity operation drop to 44.3%; 1931 to 36.2%; 1932 to 9.4%, and despite a slight raise to 18.6% in 1933, the plant was completely idled at the end of the year due to the economic conditions.[21] Investments ceased at Hubbard as they did at all of Sheet & Tube's facilities while only the Campbell Works operated at slightly less than half capacity throughout the early 1930s. Valley Mould continued production through the depression, although not a full capacity, and in 1933, the company required another source of iron due to the idling of the Hubbard furnaces. Valley Mould president William H. Ramage convinced the New York Central and Erie Railroads to carry molten iron in bottle cars across their lines from Sheet & Tube's Campbell furnaces to Valley Mould's Hubbard plant. The molten iron contract stated that if the Hubbard furnaces did not provide Valley Mould with its monthly requirement, Sheet & Tube could ship hot metal via bottle cars from its Brier Hill or Campbell furnaces.[22] Sheet & Tube also transported hot metal from Brier Hill or Campbell if the Hubbard furnaces were idle due to repairs or depressed economic periods; however, Sheet & Tube's supply obligation did not exceed 250 tons a day.[23] Valley Mould also required a special type of iron that contained 1.25-2.25% silicon, less than .05% sulphur, less than .16% phosphorous and .5-1.75% manganese.[24] Due to this special requirement, Valley Mould had the right to keep an inspector on the furnace property at all times to examine each batch of iron. The inspector could reject the iron if it was not to Valley Mould's requirements. The Hubbard furnaces also had a chemical laboratory to test each batch of iron before it was shipped. After inspection, the ladle car was weighed on railroad scales

[21] Purnell, *Plant Visitations by the Board of Directors, Executive Officers and Plant Managers*, 195.
[22] *Contract Between Sheet & Tube and Valley Mould*, December 22, 1954, 1.
[23] *Contract Between Sheet & Tube and Valley Mould*, December 22, 1954, 2.
[24] *Contract Between Sheet & Tube and Valley Mould,* December 22, 1954, 4.

and sent to Valley Mould. Sheet & Tube also required a superintendent at Valley Mould to examine iron returned to the furnaces, which was used in the pig-casting machine. Another stipulation in the contract between Sheet & Tube and Valley Mould was if Valley Mould's requirements were less than 325 tons a day, Sheet & Tube shipped iron from the Youngstown district, a common occurrence throughout the 1930s.

From 1933 to 1936, the Hubbard furnaces temporarily shut down. Although the No. 1 furnace resumed operations, the No.2 furnace remained idle because of Valley Mould's reduced requirements of molten iron during the depression. On February 20, 1936, Sheet & Tube officials reported to the *Hubbard News* that in sixteen days, the Hubbard No. 2 furnace would close permanently because its stock of iron ore was depleted.[25] The reason of ore depletion seemed highly unlikely due to Sheet & Tube's vast iron ore mine's throughout the Great Lakes and was most likely a scapegoat for the company losing funds for the operation of two old furnaces when only one stack was necessary to fulfill Valley Mould's needs, while any additional iron was transported from Youngstown. Sheet & Tube officials promised to take care of the 120 men who worked the furnace and would be sent to Brier Hill or Campbell, but the furnace did not permanently close down. After inspections by Sheet & Tube officials, the furnace's condition only required a relining and the company planned to re-open the furnace in three months time when the lake-shipping season began.[26] Despite the promises, the No. 2 furnace did not open in three months time and remained inactive until October 1936, which marked the ninth month of idle operations at the stack. Relining of the furnace

[25] "Furnace Will Not Close This Week," *The Hubbard News*, February 20, 1936.
[26] "Furnace May Open in Three Months," *The Hubbard News*, March 19, 1936.

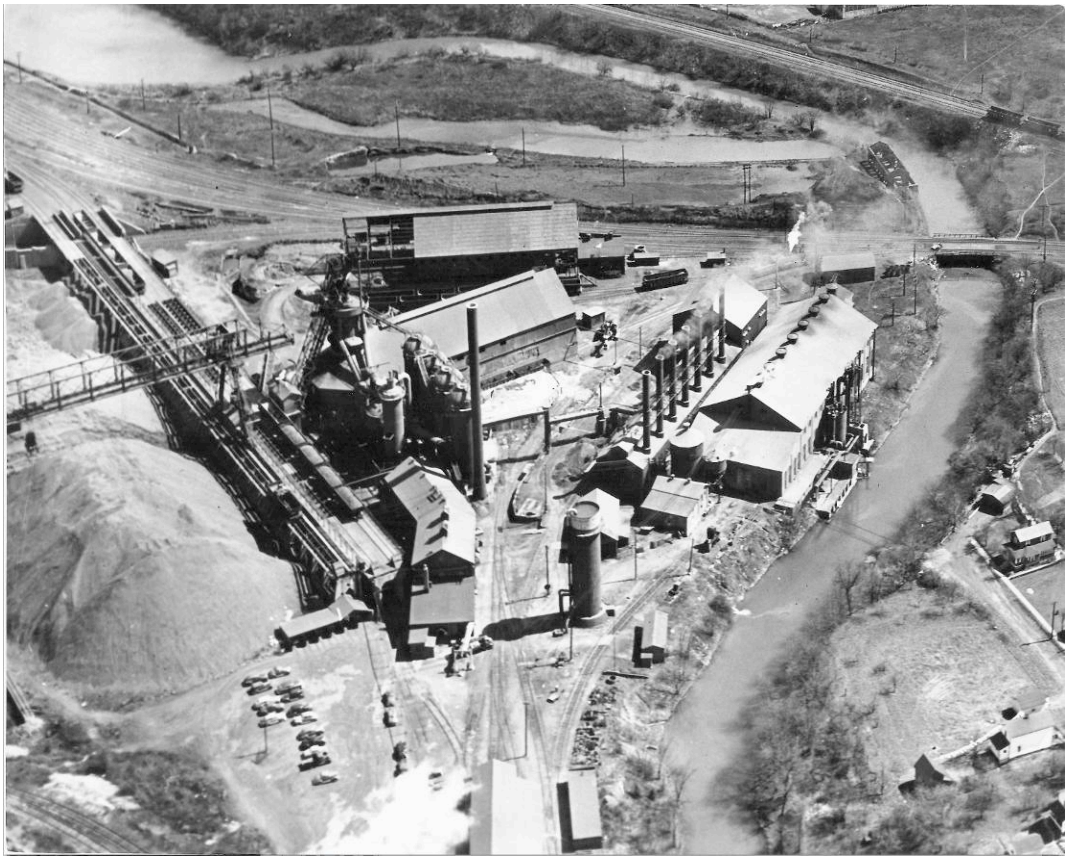

Figure 4-8: This c. 1952 aerial photo shows the Hubbard furnace's method of raw material handling. The stock bins, shown in between the ore yard and furnace, utilized three tracks for raw material distribution. The first track nearest to the ore yard contained pockets underneath the trestle that allowed hopper cars to dump iron ore into the stock yard, where it was then moved to stock piles by the ore bridge. The middle track contained the iron ore stock bins. The ore bridge used a clam shell bucket to distribute iron ore to the scale cars, which distributed the ore equally into the proper bins underneath the track. The third line, nearest to the furnace, contained the limestone and coke bins. Both materials were directly dropped into their appropriate bins from incoming rail cars.

Courtesy of The Vindicator

began on October 1 and operations resumed on January 21, 1937.[27] The furnace remained active for a short time and provided 150 men with jobs, but by September 1937, the company permanently shut down and dismantled Hubbard's No. 2 furnace. Prior to the furnace's closing, it produced 181,400 net tons of iron per year.[28] The exact cause of its

[27] "150 On Job As Hubbard Stack Is Lighted," *The Hubbard News*, January 21, 1937.

[28] *Yearbook of the American Iron and Steel Institute* (Philadelphia: The American Iron and Steel Association, 1947), 54.

dismantling is not known, however, Sheet & Tube saved additional funds by only operating one old stack at Hubbard, which alone provided Valley Mould's molten iron requirements. It was also more economical to ship iron from Youngstown when the Hubbard furnace was shut down for repairs than to continually operate and restart a second old and fairly uneconomical furnace, while also receiving a tax write off for its dismantling.[29] Only the furnace's stock house and cast house remained as storage until the early 1950s.

The 1930s was an arduous period for the Hubbard furnaces. Limited operations and the dismantling of the No. 2 stack was a serious blow to the city of Hubbard, but 1937 conveyed yet another brief shut down in the form of the Little Steel Strike. On May 26, 1937, the S.W.O.C. (Steel Workers Organizing Committee) called a strike on the Little Steel companies, which included Bethlehem Steel, Republic Steel, Inland Steel and Youngstown Sheet & Tube, due to low wages and poor working conditions after Myron Taylor, president of industrial steel giant U.S. Steel, agreed to terms with the S. W. O. C. in 1937. Workers in the Mahoning Valley organized picket strikes at the Republic and Sheet & Tube plants, which simultaneously crippled production throughout the Valley. The Hubbard furnaces were quiet compared to the riots that occurred throughout Youngstown district. On June 10, 1937, *The Hubbard News* reported, "Without the fact that about 300 employees are out of work at the Hubbard furnace and that there is no black smoke billowing from its stacks, no one would know that there has been a strike here for two weeks."[30] Picketing employees deserted the Hubbard furnace for fields of

[29] Sheet & Tube expended $11,377.64 to dismantle the No. 2 furnace although it is not known how much the company received in taxes. In Leetonia, the dismantling of the Cherry Valley furnace in 1935 brought $14,700 in taxes for the Kulka Iron & Metal Co. (*The Iron Trade Review*, October 28, 1935.)
[30] "Pickets Desert Hub Furnace," *The Hubbard News*, June 10, 1937.

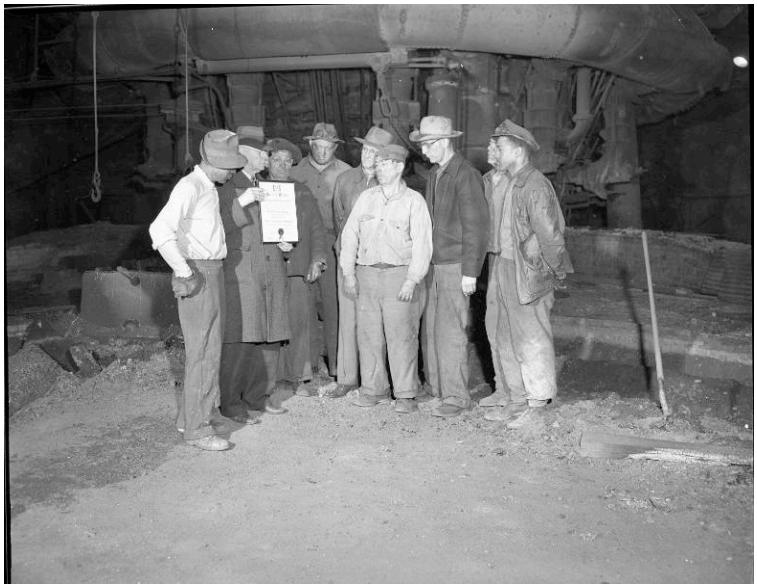

Figure 4-9: Over the years, the Hubbard furnace crew earned several safety awards. In this 1951 photo, Hubbard men receive a safety award inside the Hubbard furnace's cast house. Iron runners appear on the furnace floor at both the left and right side of the image. These allowed molten iron to run through the brick-lined troughs into a hot metal ladle car, which was then sent to the pig caster or directly to Valley Mould.

Courtesy of Mahoning Valley Historical Society

greater activity in Youngstown, Niles and Warren. Only a small force of watchmen remained at the furnaces during the strike.

On June 30, 1937, Sheet & Tube re-lit its No. 1 Hubbard furnace and as a result, Ohio governor Martin Davey sent the state militia to guard the gate with six troopers along with railroad detectives to ensure safe passage of workers and materials.[31] Although the strike was peaceful at Hubbard, workers were without pay and local businesses suffered. Standard Slag and Valley Mould idled business during the strike due to the cessation of both the Hubbard and Campbell furnaces, but Valley Mould resumed operation when molten iron became ready from the Hubbard furnace. As the Second World War approached, the remaining Hubbard furnace and Valley Mould operated at 100% capacity. However, little changes occurred to further modernize the furnace with the exception of a new McKee gas washer installed in 1943 – one of the last major investments in auxiliary equipment for the plant. With the dismantling of the No. 2

[31] "Hubbard Furnace in Operation," *The Hubbard News*, July 1, 1937.

furnace, the company removed the old Tod vertical steam blowing engines, which left only the two Mesta horizontal engines installed in 1915. The old blowing engine house transformed into an electric, machine and pipe shop and an employee wash room.

As the war ended in Europe, industries throughout Youngstown returned to peacetime operations and the post-war economic boom allowed prosperity for the middle class, consumerism and the growing strength of labor unions. Yet as other mills throughout the Mahoning Valley enjoyed this highly welcomed affluence, the Hubbard furnace continued to age and was amongst the three oldest and smallest furnaces in the Youngstown district. Only the Anna and Mary furnaces produced less iron per day than Hubbard, but like Sharon Steel's Mary furnace in Lowellville, Hubbard had a guaranteed market for its pig iron unlike the Anna furnace's constant reliance upon the irresolute pig iron market. The Hubbard furnace's last rebuild occurred in 1910, its steam-blowing engines installed in 1915, boilers in 1915 (the Heine boiler constructed in 1928 was abandoned shortly after its installation for unknown reasons), the pig caster and stock bins in 1919 and 1920 and its last reline in July 1943. Sheet & Tube neglected the furnace due to its age and the unfavorable economics involved with modernizing the plant. Despite its neglect, the company continued use of the furnace until operations were no longer plausible.

Throughout the 1950s, Sheet & Tube subjected the Hubbard furnace to intermittent shutdowns due to both frequent repairs and inefficient operation, as it was often more cost effective to transport Valley Mould's molten iron requirements from Campbell or Brier Hill. On January 20, 1954, the furnace shut down due to a necessary relining, which resulted in the Company's Campbell furnaces providing all of Valley

Figure 4-10: In January 1955, Sheet & Tube invested one final relining of the Hubbard furnace. This rare look inside the Hubbard furnace shows Sheet & Tube personnel relining the stack at the level of the tuyeres just below the bustle pipe in the furnace's hearth. The bricks used in the reline averaged seven to fifty pounds. The 1955 reline was Sheet & Tube's last major investment at its Hubbard stack and operations only continued for another five years.

Courtesy of Ohio Historical Society: Youngstown Historical Center of Industry and Labor

Mould's iron. Sheet & Tube sent Hubbard's 130 employees to the blast furnace departments at Brier Hill and Campbell, where they labored until January 1955, when Sheet & Tube invested in a final relining of the old Hubbard furnace. The company sent twenty-four carloads of firebrick ranging from seven to fifty pounds to Hubbard while over one hundred Sheet & Tube maintenance personnel worked eight-hour days on the project and installed seven, 18-inch layers of brick.[32] Between its last reline in 1943 and its shutdown in January 1954, the furnace produced 1,660,950 tons of iron, an average of just over 400 tons per day despite its 500-ton rated capacity.[33] Sheet & Tube put the furnace into operation in April 1955 and primarily used it as a standby facility subjected

[32] "Hubbard Furnace Relining To Be Completed March 17," *The Hubbard News*, February 24, 1955.
[33] *The Hubbard News*, February 24, 1955.

to intermittent operations.

No further investment in the furnace occurred between 1955 and 1960 with the exception of two 70-ton hopper cars in 1959, while the pig-casting machine was only used for off analysis casts unsuitable for Valley Mould.[34] Sheet & Tube only utilized the furnace when there was enough demand to absorb the capacity production from the Campbell furnaces, which exposed Hubbard to continual decay. On the morning of April 9, 1960, the operating and maintenance forces received orders to blow out the furnace permanently and not bank it for start up at a later date. Long-time Hubbard employee Clifford Harmon remembered that that somber morning "was the last day for the whistle to blow for change of shifts and see the glow of the hot slag lighting up the evening sky. There was something in the air that said this was the end of an era."[35]

The furnace remained stagnant for over a year and in June 1961, Valley Mould president William Ramage announced the purchase of the Hubbard blast furnace from Sheet & Tube, which included the furnace, all of its shops, machinery and 88 acres of land. It did not include Coalburg Lake, which remained a picnic area for Sheet & Tube employees.[36] Between 1916 and 1960, the Hubbard furnaces produced a total of 5,904,726 tons of iron, an average of roughly 360 tons per day with higher production rates after the improvements of the early 1920s.[37] All of the raw materials in the stockyard remained Sheet & Tube's property and were loaded into 2,500 railroad cars and shipped to the company's Campbell and Brier Hill furnaces.[38] Sheet & Tube had no

[34] Harmon, *Hubbard Blast Furnace.*
[35] Harmon, *Hubbard Blast Furnace.*
[36] Edward Salt, "Company Sells Hubbard Blast Furnace," *The Youngstown Sheet and Tube Company Bulletin* (Youngstown: Youngstown Sheet & Tube Co., July 1961): 16.
[37] Salt, "Company Sells Hubbard Blast Furnace," 16.
[38] Harmon, *Hubbard Blast Furnace.*

Figure 4-11: The sale of the Hubbard furnace to Valley Mould in June 1961 marked the end of a nearly 100-year iron-making campaign at Hubbard. The furnace is shown sitting idle with its ore yard empty and covered with snow in January 1962. Valley Mould retained the furnace until November 1967 when it was dismantled. Much of the equipment and buildings shown in this photo was 45 and 60 years old.

Courtesy of The Vindicator

experience with selling a portion of the company's physical operations to another operator without provision for taking over the operation of the furnace, and whether or not the company dispensed severance pay in such circumstances. The company looked to Bethlehem Steel and U. S. Steel for any advice on the situation; however, neither company had any experience in the case of such an event. Sheet & Tube decided that among the 117 employees assigned to the Hubbard furnace at the time of its closure, 45 were entitled to make an election between accepting jobs offered by Sheet & Tube or be terminated from company service and receive severance pay, while the others were given severance pay based upon their years with the company.

As presumed by Sheet & Tube, Valley Mould had no plans for the furnace after its purchase and only maintained the facilities on a standby basis for its hot metal requirements, but Hubbard's new owners never produced iron at the plant. To supplement the company's hot metal needs, Sheet & Tube shipped 300 to 400 tons of iron from its

Campbell furnaces, a significantly more economical option.[39] Prior to the purchase of the furnace, Valley Mould planned on expanding its facilities and purchased a large tract of land on the former New York Central railroad yard just west of the furnace where another the company proposed another ingot mould plant; however, the company became inhibited by the Hubbard furnace's low quantity of hot metal.[40] The new plant never came into fruition, but Valley Mould expanded its facilities at Hubbard and further needs for hot metal required a new contract with the Republic Steel Corporation signed on July 1, 1961. Republic agreed to ship molten iron via hot metal bottle cars from its Haselton furnaces at Center Street in Youngstown to Hubbard, which rendered the Hubbard furnace useless.

The now decrepit Hubbard furnace sat idle for another six years when Valley Mould hired the J. D. Fowler Co. of Youngstown to dismantle the old stack. J. D. Fowler had twenty men at work and attempted to salvage what material seemed practical, but the old age and neglect of the furnace became evident in a strong statement by Fowler to *The Vindicator* in November 1967, "Relatively little of the equipment has much resale value except perhaps in South America where a few old furnaces still exist."[41] The dismantling of the Hubbard furnace marked the end of any remnants of the Mahoning Valley's pioneer iron industry, and with the Mary and Anna furnaces dismantled in 1963 and 1966, all connections with the Valley's historic iron making past were severed. Hubbard's demise dropped the total number of blast furnaces in both the Mahoning and Shenango Valleys to twenty-one, which equaled the number of furnaces that existed in

[39] "Valley Mould Acquires S&T's Hubbard Plant," *The Vindicator*, June 15, 1961.
[40] *The Vindicator*, June 15, 1961.
[41] "Old Hubbard Furnace Passing Into History," *The Vindicator*, November 29, 1967.

the Mahoning Valley alone in 1872. Those that remained consisted of four at Sheet & Tube's Campbell Works; two at its Brier Hill Works; five at U. S. Steel's Ohio Works; five at Republic Steel's Youngstown Works; one at its Warren Works; two at Sharon Steel's Farrell Works; and two at the Shenango Furnace Co. in Sharpsville, Pennsylvania.[42] By 1968, only the large, modernized blast furnaces connected with the steel mills of Youngstown Sheet & Tube, Republic Steel and U. S. Steel remained standing and in operation in Youngstown.

[42] Of the named furnaces, Sheet & Tube's Grace furnace was banked in 1961, Shenango Furnace Co.'s No. 1 furnace was banked in 1962 and its No. 3 furnace in 1968. The latter two furnaces were not associated with a steel company and produced iron for the company's adjacent ingot mould foundry, a similar situation to Hubbard furnace and Valley Mould's business relationship.

Conclusion: From Iron to Steel

As the Mahoning Valley transitioned into steel production, many procedures within the traditional methods of making pig and wrought iron fell to new technology, mass production, and work and labor within the area's furnaces and rolling mills. Although the Hubbard, Mary and Anna furnaces comprised only four of twenty-one blast furnaces constructed in the Mahoning Valley over a twenty-seven year period in the mid to late nineteenth century, their persistence and constant acclimation to fluctuating market trends and technological change present a unique aspect of integration that rarely occurred in other industrial areas throughout the United States. Unlike Pittsburgh, which began its transition to steel production in the 1870s, Youngstown was an iron valley rather than a steel valley. The Mahoning Valley's rapid transition to steel making between 1895 and 1920 caused significant regression to the pioneer iron mills built in the valley during the mid nineteenth century, but it also allowed many older merchant furnaces to remain in operation as a legacy of the area's industrial past once steel displaced iron as the superior product.

The Mahoning Valley's long-time reliance on wrought iron and merchant iron production did not require larger, more modern furnaces like those constructed in Pittsburgh to feed their massive steel mills and foundries. Furnaces such as the Falcon and Phoenix, constructed by Lemuel Crawford and Charles Howard in 1850 and 1854 on the current site of the Covelli Center in downtown Youngstown, became landmarks amongst iron industrialists in both the United States and England. Little investment and modernization throughout the nineteenth century caused their destruction in the wake of

Republic Iron and Steel's merger movement in 1899, which saw the conversion from wrought iron to steel production and the simultaneous dismantling of old and outdated relics of the once prosperous iron era. Old furnaces such as these were common throughout the Mahoning Valley, as reliance on merchant iron production did not require large-scale output of pig iron, which left many furnaces small, old, and obsolete at the turn of the century. Larger steel companies consolidated many of these former merchant furnaces, but their isolated locations away from the centralization of steel manufacture in Youngstown presented difficulties in production, as steel companies looked to mass produce steel at the cheapest price possible. Small, detached furnace plants cost money, particularly in the waste of furnace gasses for fuel, transferal of product by rail, obsolete operations and the re-melting of pig iron in cupola furnaces rather than the direct method of transporting molten iron from the furnace to a company's Bessemer or open-hearth plant.

The strong capital of local industrialists allowed continuous modernization amongst the merchant iron trade in the Mahoning Valley. Large-scale overhauls at Hubbard, Struthers and Lowellville at the turn of the century preserved market niches amongst the burgeoning steel industry that enveloped Youngstown. The formation of the Ohio Steel Co. in 1895 offered another strong outlet for merchant furnaces in the area, which provided low phosphorous pig iron to the company's Bessemer converters. While many old furnaces in the Mahoning Valley passed into history, the construction of large steel mills in Youngstown created an additional market for the more prosperous merchant iron producers in the area. In 1900, the newly formed Youngstown Iron Sheet & Tube Co. required pig iron for the production of wrought iron sheets and skelp, and later to

supply their Bessemer converters; Republic Iron and Steel needed additional pig iron to supplement their small, aged furnaces located in Youngstown, Sharon, and New Castle, Pennsylvania, which could not produce enough for the company's needs. The Mary furnace, Hubbard furnaces and Anna furnace gained yet another market when steel producers in Youngstown constructed open-hearth steel plants in the 1910s. This additional steel capacity called for more pig iron to be provided by those remaining merchant iron companies in the valley. The need for a constant supply of pig iron at the height of the First World War prompted many steel companies to purchase old merchant furnaces, as construction of brand new blast furnaces was often uneconomical and slow during the period due to materials shortage. This prompted the purchase of the Hubbard furnaces by Youngstown Sheet & Tube and the Mary furnace by the Sharon Steel Hoop Co.

The need for a constant supply of pig iron impelled the major steel producers in Youngstown to construct their own modern blast furnaces. This allowed for uniformity within the chemical structure of the iron and decreased reliance of purchasing pig iron from the open market. Constant modernization and enlargement of these modern furnaces reduced the needs for steel producers to purchase merchant iron, which left stacks such as the Anna furnace to produce specialty iron, particularly low-phosphorous and foundry grades. The decreased reliance of purchasing iron on the market combined with the ever-fluctuating nature of iron prices forced many individual merchant companies into bankruptcy in the 1920s and 1930s.

The furnaces at Hubbard, Struthers and Lowellville managed to survive both the mergers and the inherent disadvantages former merchant furnaces faced after the

Mahoning Valley transitioned to steel making. Each furnace plant presented separate circumstances in the twentieth century that allowed continued production. In Struthers, the Anna furnace remained independent and became an impoverished artifact of its relative isolation and location, a situation which many merchant stacks suffered from in the early half of the twentieth century. "Old Annie" was affectionately known to old time iron men in the Mahoning Valley as an important link to Youngstown's industrial past, a reminder of the day when small, merchant blast furnaces once thrived up and down the Mahoning River. The furnace became a landmark for the village of Struthers, as well as an inspiration for larger and more productive blast furnace practice in the Mahoning and Monongahela Valleys. The stack remained under the constant management of competent businessmen and blast furnace engineers, including Henry Roemer, who, before becoming the chairman of the Sharon Steel Corporation, was the Anna furnace's superintendent at the age of twenty-one. The experienced management of Samuel A. Richards, one of the Mahoning Valley's most prominent blast furnace men, allowed the Anna furnace to prosper as an independent merchant stack when larger corporations absorbed other small furnaces. As the pig iron market declined and stagnated after the First World War, many independent and small furnaces became outdated and unnecessary to supply steel works and foundries with their product. The Anna furnace persisted and its 1909 overhaul allowed the stack to stay competitive amongst the larger furnaces built by steel companies. The installation of the mechanical skip hoist eliminated labor and uneconomical time consumption in an unstable and competitive market, thereby allowing the furnace to maintain operations, albeit intermittently and often sporadically after 1927 and into fluctuating economic conditions throughout the

1930s and 40s.

The pig iron and scrap shortage after the Second World War was a redeeming quality for the Anna furnace, and its association with the automobile industry proved vital for continued operations. One of the primary faults of the Anna furnace was its old equipment and relatively small output, each consequence acting as a burden upon the Pittsburgh Coke and Chemical Co.'s operations. Unlike modern furnaces, the stack did not utilize an ore yard, more modern turbo blowers for the blast, secondary gas cleaning equipment such as electrostatic precipitators, and small stoves, which resulted in a small heating surface. Merchant iron production did not require the immense amounts of pig iron needed from steel companies, a concern that prevented many merchant blast furnace operators from enlarging and modernizing their stacks under constantly fluctuating market conditions. The Anna stack's isolation away from the company's by-product coke plant proved uneconomical, both in wasteful blast furnace gasses and freight rates for shipment of coke from Pittsburgh to Struthers. Ultimately, the Anna furnace suffered from more cost-effective operations of larger and more modern blast furnaces, a consequence similar to those faced by other pioneer furnaces in the Mahoning Valley in the early twentieth century; however, its separation from a large steel company paradoxically allowed its survival into the 1960s, a particularly rare incident. The Anna furnace's 1909 modernization helped push the old plant through constant market changes and fluctuations almost solely based upon the price of pig iron and its subsequent demand, but the other pioneer furnaces that remained in Lowellville and Hubbard experienced a different set of circumstances.

Lowellville's Mary furnace was ultimately a victim of advanced technology,

modernization and increased production throughout the steel industry. Under the ownership of the Wick brothers, the local bankers who continuously accumulated the capital for proper modernization and business techniques, the Mary furnace prospered until its acquisition by Sharon Steel Hoop Co., which put little into its modernization unlike other steel plants that constantly rebuilt and enlarged their iron manufacturing facilities. Neither the Ohio Iron and Steel Co. nor Sharon Steel fitted the stack with a modern skip hoist, secondary gas cleaning equipment, or turbo blowers to replace the old steam-powered blowing engines, the latter being unnecessary for such a small capacity furnace. Although the stack remained hand-filled until its dismantling, it succeeded in avoiding one of the primary downfalls that other pioneer furnaces in the Mahoning Valley fell victim to: its relative lack of a close and convenient location near the company's steelmaking facilities. Many early iron masters located their furnaces in an advantageous area adjacent to a fuel and ore supply, but these advantages diminished as their raw materials disappeared. Location inhibited many old stacks like the Mary furnace, which carried over into the era of steel. Yet, because the Youngstown Iron and Steel Co. constructed its open-hearth plant less than a mile from Mary furnace, the stack prospered rather than becoming a hindrance to the company.

Until the increased demand during the Second World War and the post-War economic boom, the Mary furnace provided an adequate amount of pig iron for the Lowellville Works' rather small steel operation, which rendered additional, larger and more modern blast furnaces unnecessary. The addition of two electric arc furnaces, which allows high carbon alloy steels to be made from 100% scrap rather than both pig iron and scrap, helped minimalize the amount of pig iron needed from the old furnace, an already

burdensome problem for the limited pig iron available for the company's open-hearth furnaces after the war. The small production values and costly operations of auxiliary equipment of both the furnace and steel works throughout the late 1940s and 50s prompted Sharon Steel to focus all operations at Farrell. The closure of Lowellville marked the end of a 115-year production run for Mary furnace.

Despite the Lowellville Works' small capacity, higher steel demand during and after the Second World War required greater iron and steel production, a need seemingly met with the purchase of the Carnegie-Illinois Steel Company's Farrell Works. Continued production of specialty alloy and stainless steels at Lowellville gave Sharon Steel the status of the eighth largest steel producer in the United States, but the primary focus on the company's larger Farrell Works initiated a slow decline for the Mary furnace and its nearby steel plant. Unlike other companies, such as the Valley Mould and Iron Co. in Hubbard, that transported hot metal nearly ten miles from Republic Steel's blast furnaces in Youngstown for its needs rather than operating the old, uneconomical blast furnace at Hubbard, Sharon Steel continued production of pig iron at its Mary furnace, despite higher cost and lower production values.

The long life of the Mary furnace was atypical for a former, un-modernized merchant stack. The stack was one of only three stacks in both the Mahoning and Shenango Valleys built in the 1840s that survived operation into the twentieth century, the other two being the Sharon furnace in Sharon, Pennsylvania, built 1845, and the Sharpsville furnace in Sharpsville, Pennsylvania, built 1847. Many other merchant and pioneer blast furnaces in the Mahoning Valley fell victim to geographic isolation and old

age rather quickly, often resulting in expensive operation, which simultaneously produced considerably less iron than modern furnaces.

Although not as iconic or symbolic in nature as the hand-filled Mary furnace in Lowellville or "Old Annie" in Struthers, the Hubbard furnace retained its imagery and association with the Mahoning Valley's iron producing past and persevered in an era when the old furnaces fell to the development of steel and constant economic change. Like many of the nineteenth century iron companies in the Mahoning Valley, Hubbard became a town based on its strong coalmining and ongoing industrial aptitude. The construction of Andrews & Hitchcock's furnaces in 1868 and 1872 carried Hubbard into the age of iron that already strongly permeated throughout the Mahoning River Valley and continued well into the twentieth century. The Hubbard furnaces persistently conveyed the latest in blast furnace practice and were constantly among the highest producers of pig iron in the Youngstown district. As one of two Mahoning Valley companies that remained independent within the first twenty years of the twentieth century, the Andrews & Hitchcock Iron Co. found themselves at a distinct advantage with modernized blast furnaces and a strong product that also enjoyed a wide reputation, particularly amongst foundries.

The sale of the furnaces to Sheet & Tube in 1916 marked an era of both advancement and decline. Sheet & Tube's need for iron and Hubbard's relatively high output and iron ore holdings procured an initial upswing in investment for the already semi-modernized merchant stacks. Sheet & Tube invested millions in modernized raw material handling within the first eight years of the company's ownership, but the purchase of the Brier Hill Works in Youngstown and Indiana Harbor Works in East

Chicago marked a slow and steady decline for the un-integrated and isolated blast furnace plant. With steel production centralized in Youngstown and supplemental pig iron provided by the Grace, Jeannette and the rebuilt and revamped Campbell furnaces, Hubbard's significance waned and the stacks soon fell into disrepair. The construction of Valley Mould's ingot mould factory in 1927 averted the stacks from a fate comparable to similar furnaces in Youngstown.

Although major steel producer Youngstown Sheet & Tube owned the Hubbard furnace, it still retained merchant operations and provided Valley Mould's hot metal requirements, but as Valley Mould continued to grow in operations, the Hubbard furnace simultaneously continued to be a product of neglect, a particularly volatile combination in business relations. The closing of the Hubbard furnace marked the end of 92 years of iron production, the second longest stretch behind the Mary furnace's 115-year run. The Hubbard furnaces provided an unparalleled glimpse into blast furnace practice and technology, and presented unique characteristics that the Anna and Mary furnaces never encompassed. As the furnaces grew and continued to produce iron, so did the town and its industrial integrity. The plant seemingly defied many of the odds that condemned the other small, isolated furnaces throughout the Mahoning Valley, which included detached plants, uneconomical operations, low production, little to no investment and the inability to operate as a merchant stack. Unlike the Anna furnace, Sheet & Tube's control of Hubbard allowed the plant to operate through many economic crises and not entirely depend upon the pig iron market, a circumstance that ultimately permitted Hubbard to remain operational despite its total reliance upon a single client after the construction of Valley Mould's Hubbard plant in 1927.

The special circumstances that surrounded these former merchant iron furnaces allowed an unparalleled look into the both the changing technology and work within the industry. While the Mary furnace operated for 115 years, Hubbard 92 years, and Anna 84 years, their transition through constant technological transformation shows the unceasing need for adjustment in an ever-changing industry and market. Technological stagnation resulted in the demise of many of the independent iron enterprises in the nineteenth century, but continuous change in furnace practice, raw material handling and auxiliary equipment allowed for persistent iron production in Hubbard, Struthers and Lowellville. However, each furnace succumbed to technological stagnation after their last major overhauls in 1898, 1909, 1910, and 1915, which resulted in a slow and gradual decay into obsolescence. The need to acclimate to an aspect of steel production rendered these furnaces useful for their respective companies, but uneconomical operations pushed these old stacks into obscurity, and they quickly fell into the shadows as the steel industry continued to modernize and grow amidst a developing globalized economy.

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