THE ROMANTIC DAYS OF JUNIATA CHARCOAL IRON

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Greenwood Furnace State Park

ABSTRACT: In the annals of Pennsylvania history, few industries had as significant an impact as iron and steel. From its beginnings in the southeast, the industry headed westward after the American Revolution, until firmly landing in Pittsburgh in the mid-nineteenth century. Historian Arthur C. Bining documented the origins of ironmaking in the state, and numerous authors wrote of the later steelmaking centers in the Lehigh Valley and western Pennsylvania. Sandwiched in between is the Juniata Valley, which has been and is a major transportation corridor, with trails, the turnpike, canal, railroad, and modern highway successively following the Juniata River through central Pennsylvania. It seems a backwater today, but centered in the nineteenth century, the iron and steel industry briefly stopped here and sent the name "Juniata" around the world. In 136 years, around 150 charcoal-fueled furnaces and forges produced iron regarded as among the finest in the world. During its peak, the Juniata produced nearly half of all iron in Pennsylvania, and a fifth of the national output. With the rise of big steel, the Juniata Valley became a mere footnote in history. Few today know of the incredible legacy of Juniata iron. This article brings to life the story of Juniata iron, its rise, prominence, and fall, and sheds light on the veracity of its reputation.
KEYWORDS: Juniata River, Pennsylvania iron industry

> *Wild Roamed an Indian Girl, bright Alfarata, where sweeps the waters of the Blue Juniata.*
>
> — Marion Dix Sullivan, "Blue Juniata" (1841)

INTRODUCTION

Driving through the Commonwealth today, one is struck by the beauty of the Juniata Valley of central Pennsylvania. It is here that the Juniata River wends its way through and around mountain after mountain in the state's

ridge-and-valley geographic region. Small towns dot the landscape. It is a side road in modern times, a place to pass through while heading east or west.

To some, echoes of the song "Blue Juniata" come to mind. Written by Marion Dix Sullivan around 1841 while traveling by canal through the valley, she was moved to create what became the first hit song composed by a woman in America, and a popular tune in its day. Author and humorist Samuel Clemens, better known as "Mark Twain," commented on the song. Laura Ingalls Wilder wrote about her pa playing it on his fiddle in one of her books. Sherman's troops sang it while marching through Georgia, and several groups have recorded it, including the Sons of the Pioneers and Riders in the Sky.[1]

The word itself is melodic, flowing off the tongue as easy as a lullaby. It is not of Hispanic origin, as some from afar often pronounce it as "Juanita." It is one of many local place names derived from the language of the original inhabitants of the valley. In its earliest form it is described as "Ona Utta Haga," the "peoples of the Standing Stone." Early settlers pronounced it "Choniata" among others, before it morphed into its current form.[2]

Mixed with the scenic beauty of the Juniata, one often encounters along the highway overgrown crumbling flat-topped stone pyramids, or perhaps they drive through a town or village with the word "furnace" in its name. Some of these structures are preserved in state or local parks. When were they erected? What happened here? To what exactly does the "furnace" in the town name refer? These stones are silent sentinels of an underappreciated and understudied era in Pennsylvania history, when the valley was not merely passed through, where charcoal iron ruled supreme, and the name "Juniata" was known around the world (see fig. 1).

One industry above others has laid the infrastructure of America today, and it certainly can be stated that the iron and subsequent steel industry of Pennsylvania played a major role. Modern histories of her great iron- and steel-making centers such as Bethlehem and Pittsburgh have been published. One region stands out as conspicuously neglected in these studies, yet during much of the nineteenth century was synonymous with high-quality iron and provided a significant share of the wealth enabling Pittsburgh to become the Steel City. This article is an attempt to rectify this neglect, though is merely an introduction to a far larger history awaiting further exploration.

The Juniata Iron District, located in central and south-central Pennsylvania, comprises all or parts of the present counties of Perry, Juniata, Mifflin, Centre, Huntingdon, Blair, and Bedford.[3] During most of the

FIGURE 1 Remains of Huntingdon Furnace, one of many of the crumbling "pyramids" found throughout the Juniata Valley and Pennsylvania. Photo by the author.

nineteenth century, high-quality ores smelted with charcoal made from local hardwood forests were turned into iron that would travel around the world and put the Juniata Valley on the industrial map. This was a time, in the westward progress of iron and steel manufactories, when the industry briefly stopped here.

Iron production began in the valley in 1786 and ended in 1922. Between those years, there were seventy-three furnaces and sixty-two forges fueled by charcoal in the valley. It should be noted that a good number of these works were later converted to coal or coke. Several additional works were present, fueled only by anthracite coal or coke, but are not included here because the reputation of the Juniata district was built on iron produced with charcoal as fuel. Out of the many, many ironworks, only a few are featured in this article.[4]

So great was the reputation of "Juniata Charcoal Iron" that contemporary works often considered that reputation to be universally known and gave little documentation to back up the claims. What exactly was this reputation? Why did this valley become so well known in iron production, and why was

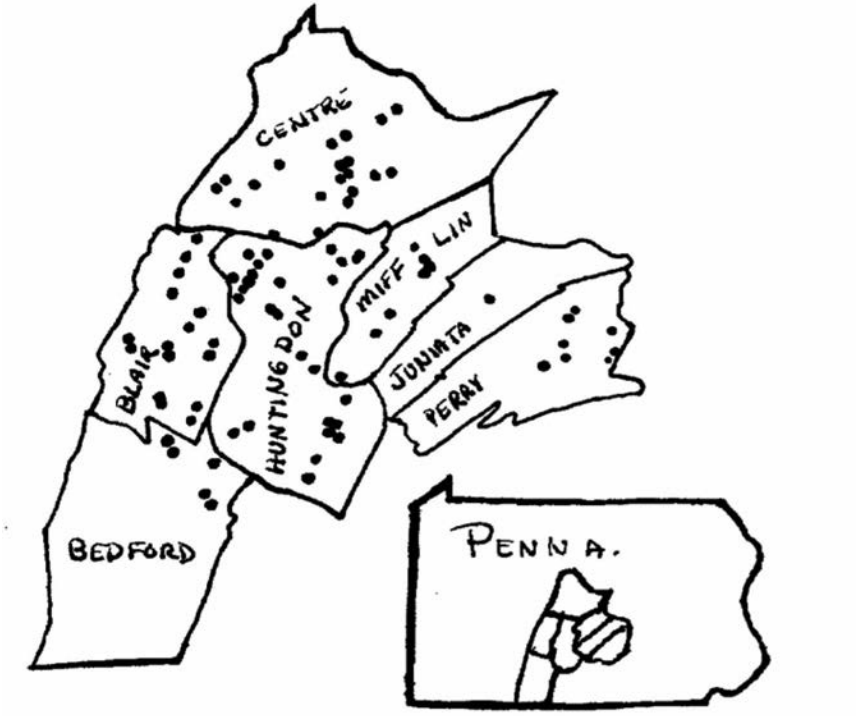

FIGURE 2 Map of the Juniata Iron District, showing general distribution of ironworks. Illustration by the author.

the word "Juniata" synonymous with high-quality iron? In order to answer these questions, it is necessary to examine the valley, its ironworks, and what special forces and resources combined here to grow and bear fruit. In many instances, the names and borders of towns, townships, and counties have changed over the years. Locations given in this paper are the modern names, for the benefit of the reader (see fig. 2).

IN THE BEGINNING

Iron was first made in the Jamestown colony of Virginia around 1622, but was not a success. Twenty-four years later, the Saugus Ironworks outside of Boston became the first commercially successful iron works in the New World. Pennsylvania would not make its first iron until 1716, nearly

a century later. By the American Revolution, Pennsylvania was the leading iron-producing colony. The Hopewell Iron Works (1771) in Berks County and Cornwall Iron Furnace (1742) in Lebanon County are outstanding examples of iron works east of the Susquehanna.

The British government had little intention of producing finished iron and steel in the colonies. While some local production was tolerated, England wanted pig and bar iron to be shipped back to the mother country. British policy viewed the colonies as the supplier of raw materials and the consumer of finished products. Manufacture was to be in England, to keep the wealth of the New World in Britain.

American colonists thought differently. Why not manufacture iron here? If this was the policy of the Crown, then, where better then to build ironworks than in the wilderness, far from royal detection? Pine Grove Furnace, built in 1770 in Cumberland County, was one of many "bootleg" furnaces in this time period, far enough in the backcountry to escape British attention, but still civilized enough for permanent towns. Production slowly crept westward over the Susquehanna River, but did not jump far beyond it just yet.[5]

Before 1754 most of the Juniata River watershed was territory under the control of the Iroquois Confederation, who complained to the provincial government about intrusions by European American settlers. The Penn family tried to keep settlers away, even resorting to forced evacuation at such places as Burnt Cabins in 1750, largely to no avail. At the Treaty of Albany in 1754, the Pennsylvania delegation successfully negotiated the purchase of the Juniata region in what became known as the Albany Purchase. Settlers legally moved in, only to be attacked and driven eastward during the French and Indian War.

Following the war, the Juniata region became a bit less wild, as settlers made permanent homes and Native Americans moved further west. By the 1760s, numerous unconfirmed accounts of rich iron ores found by traders and settlers in the Juniata Valley had traveled east and piqued the interest of colonial and British entrepreneurs alike. In 1767 a group of British capitalists under the direction of Joseph Jacobs from eastern Pennsylvania organized themselves as "The Juniata Iron Company" to explore the valley and hopefully confirm these accounts. Explorers descended upon the region, and indeed copious quantities of ore were found and samples sent east to be worked in furnaces and forges; the iron content was confirmed to be excellent.[6]

Even more important, good quality limestone for fluxing furnaces along with dense hardwood forests for charcoal manufacture were found in abundance and would provide the necessary ingredients for successful iron production. Before the British were able to utilize these ores, the colonies broke their bonds from King George III, and it would be many years before the first iron was made in the valley.

THE STAGE IS SET

Freed from British rule, eastern ironmasters and industrialists looked favorably to the Juniata watershed as a place of untapped wealth. The fledgling nation needed iron as the Industrial Revolution took hold. One thing that impeded industrial expansion into the region was the lack of well-established transportation routes. Unlike the network of good quality turnpike roads already developed in southeastern Pennsylvania, the area was still wild, with little more than crude trails and untouched waterways. This began changing as more people entered the valley, and trails became early roads widened for pack-mule teams. Two main roads heading westward from the Juniata were the Forbes Road, completed in 1758, and the more northern Frankstown Road, developed from the Frankstown Path, completed around 1764.[7] Navigable rivers and creeks were designated as public highways by the legislature to spur expansion and growth. Towns were being established, and counties laid out to bring government closer. Farmers, including Amish and Mennonites, were clearing valleys for agriculture, and timber was plentiful. The stage was set, and the curtain would soon rise. The last fifteen years of the eighteenth century would witness the birth of the iron industry in the Juniata Valley.[8]

FIRST IRONWORKS

In 1786 Baltimore industrialists George Ashman, Thomas Cromwell, Tempest Tucker, and Charles Ridgely formed the Bedford Company to erect the first furnace in the valley, named for Bedford County, a "mother" county for much of the Juniata Valley. It was located in what is now downtown Orbisonia, Huntingdon County. Ashman had recently moved to the valley with several of his freed slaves. They set about building Bedford Furnace, described as small, probably fifteen to seventeen feet high, with a five-foot bosh, with a daily output of about one and a half

to two tons per day. Accounts say that the stack was constructed mostly of wood, with a stone lining and base to contain the intense heat. The ingots were cast into U-shaped bars, for shipment by pack-mule teams to local forges.

By 1791 Bedford Forge was built nearby. Pig iron was now processed into bar iron for blacksmiths locally or was cast into Franklin stoves right at the furnace. Shortly after 1800 surplus iron was being shipped overland to Pittsburgh, where new forges were being built. Iron was also sent in arks down the Juniata River to eventual markets in Philadelphia and Baltimore. The furnace and forge appear to have closed around 1816, possibly victims of the depression following the War of 1812.[9]

In what is now Juniata County, Thomas Beale and William Sterrett established Freedom Forge (circa 1790) on the banks of Licking Creek in Milford Township. It was located in the deep forest, and again there were only pack-mule trails to the forge. The owners petitioned the Mifflin County court for a road numerous times; however, this court repeatedly ruled the taxpayers should not shoulder the cost of a road that would only benefit the forge. The road was not built until years after the forge ceased operation and the area further settled. Iron for the forge originally came from furnaces in Lancaster County and later Centre County. Some also came from Bedford Furnace. This Freedom Forge was never a real success, and the difficulty in transporting iron to and from the forge led to its shutdown in 1795. The forge may have operated sporadically for the next decade. In 1806 the county sheriff sold the forge to its creditors. It sat idle for another two years, when it was accidentally set on fire and never rebuilt, but would be relocated fifteen miles away near Lewistown, where it had a ready market. Today its descendant, Standard Steel, is still in business in Burnham.[10]

For much of the valley at this time, the Juniata River and its many tributaries were improved for navigation by removing rock barriers from the main waterway. Similarly improved trails allowed iron to be carried overland by pack mule westward, or brought the iron to the river to be loaded onto log arks and sent downriver to eastern cities. After the iron reached its market, the arks were torn apart and the logs were sold. The raftsmen then walked back upstream.

Centre County

By the mid-1790s ironworks had been established all over the Juniata Valley. Most were in Huntingdon and Centre counties, both leading the watershed

in the number of ironworks throughout the ironmaking era. Several entrepreneurs were attracted by reports of excellent ore in the Nittany Valley. Colonels Samuel Miles and John Patton began operation of Centre Furnace in 1792 at the headwaters of Spring Creek. With the success of iron making elsewhere in the region, Centre Furnace quickly faced stiff competition.[11] General Phillip Benner established his extensive ironworks operation beginning in 1793. Collectively known as the Rock Ironworks, the firm ultimately consisted of two forges, two furnaces, a rolling and slitting mill, and a nail factory, and would continue successfully for many years. Following the general's death in 1832, his heirs carried on some of the works until it passed out of existence in 1852. The Rockview State Penitentiary occupies the general location of Benner's iron works today.

The Bellefonte and Milesburg areas became another center of iron production prior to 1800. There several ironmasters got together and built Harmony Forge just north of Bellefonte to process iron from their local furnaces. The works eventually became Milesburg Ironworks and consisted of a forge and rolling mill. These works would continue for nearly a century. Another large company was the Bellefonte Iron Works, which consisted of several forges and a furnace. An interesting bill of lading surviving (at least until the 1870s) from the forge gave an indication of the costs of iron at the time. The iron was sold by James Lindsay, on the account of John Dunlop and signed by Lowrey, to William Irvin. Amounting to 1,010 pounds of bar iron, it was sold at $5.60 per hundred pounds, and amounts to $56.50 for the total order.[12]

In the northern part of the county, Henry and James Phillips built Cold Stream Furnace near Phillipsburg in 1797. Twenty years later, Hardman Phillips built a forge, rolling mill, and a screw factory. This screw factory, built in 1823, is claimed to be the first in the United States. It operated until the 1850s.[13]

Huntingdon County

Several extensive ironworks were established in Huntingdon County in those final years of the century. About 1796 Greenberry P. Dorsey and Edward Bartholomew built Barree Forge near Alexandria along the banks of the Little Juniata Branch. The iron soon gained a good reputation among blacksmiths and iron mills as an excellent-quality iron. The first iron processed at Barree Forge was purchased from Centre Furnace. This shipment was thirty tons of

pig priced at eighteen pounds per ton, or 540 pounds, translating to 2,700 silver dollars.

With Dorsey's sudden death in 1807, his widow Elizabeth took over ownership and management of the works as the estate was in financial distress and in danger of ruin. Her courageous management of the works made it profitable again, and allowed it to remain in the family for decades after her death in 1834. Later her son Henry joined her and took over active management of the forge.[14]

The works prospered though the heyday of Juniata iron and expanded with Barree Furnace in 1864 (see fig. 3). Following the Civil War, it passed to Abraham Mumper and the Dorsey name faded in the winds of time. The Barree Ironworks would continue to operate until 1883. The mansion and stack, the latter in poor condition, remains on the site today, now the Green Hills United Methodist Camp.

A history of the Juniata Charcoal Iron District in Huntingdon County would not be complete without biographies of noted ironmasters. George Anshutz and William McDermott are two of the most prominent.

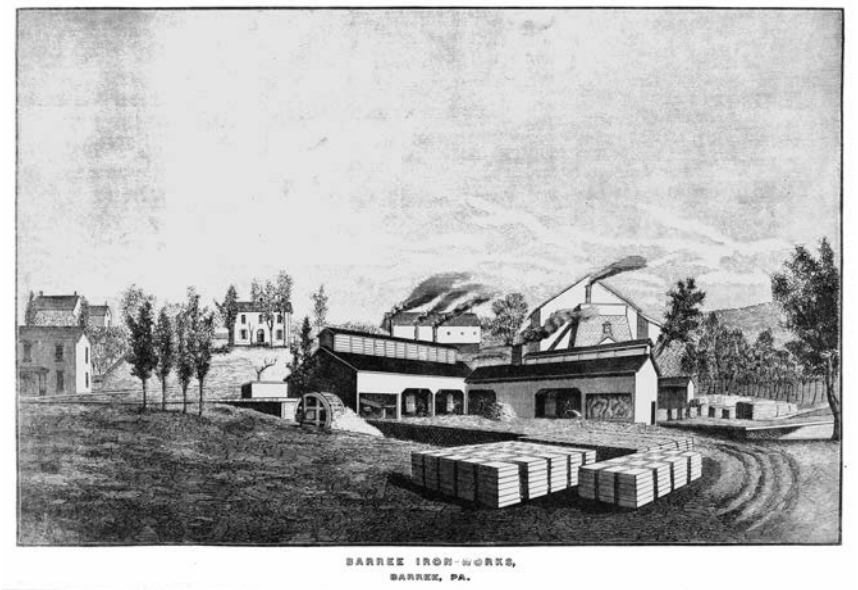

FIGURE 3 A drawing of the Barree Ironworks, as it appeared after 1864. From Africa's *History of Huntingdon and Blair Counties*, opposite 424.

Pioneer Ironmaster George Anshutz. George Anshutz will forever be tied to the history of Huntingdon Furnace. This man's career includes deeds virtually forgotten, yet he can rightly hold the claim as establishing the first ironworks in the Pittsburgh area, planting the seed for that city's rise as an industrial power.[15]

Born November 28, 1753, in Alsace, France, the ethnically German Anshutz grew up in the iron business, and in 1789 immigrated to the United States and made his way to Pittsburgh. Here he built Shadyside Furnace, in operation by 1792 and likely the first ironworks within that city.' It is not known how large the furnace was, or how much iron it produced, but it is known to have made primarily ten-plate stoves, fire grates, and other castings for local consumption. The ores in the vicinity that looked promising turned out to be of an inferior grade, and the expense of transporting ore from a distance was considered too cost prohibitive. Anshutz abandoned this furnace in 1794 and moved to Westmoreland County, where he managed another furnace for John Gloninger for a short time.

In 1796 Anshutz came to Huntingdon County and, finding that the ores of Franklin and Warrior's Mark townships were of excellent quality with good running streams and great stands of forests, he chose a place to build a furnace. Lacking capital himself, Anshutz recruited local landowner Mordecai Massey, John Gloninger (the owner at Westmoreland Furnace), and Philadelphia businessman Martin Dubbs to enter into a partnership under the name "John Gloninger & Co.," with Anshutz as manager. They built Huntingdon Furnace on Warrior's Mark Run. In these early days, much iron was cast into stoves, and bore the familiar legend "Huntingdon Furnace." In 1800 the company leased nearby Spring Forge, and George Shoenberger joined the company.[16]

In 1805 a larger stack was erected two miles downstream and, under the practical direction of Anshutz, it quickly became a success and through his care and thrift made profits for all the owners. Anshutz was rewarded with a partnership in the firm. In 1835 all of the partners except Shoenberger sold their interests in all of their Huntingdon County holdings to their business rivals Shorb, Stewart and Company, who owned Pennsylvania Furnace a few miles away. A few years later Dr. Peter Shoenberger became the sole owner of Huntingdon Furnace. Following Peter's death in 1854, his sons George and John H. operated it until 1870, when it closed for good. Although located entirely on private property, the stone stack and other surviving structures, still standing today, make it one of the best-preserved furnace sites in Huntingdon County.

William McDermott and His Steel-Making Process. In the annals of Juniata iron, William McDermott must be mentioned.[17] He had apparently developed a process of making steel described as unique, but details of his method have never been found. Two centuries ago, steel was still decades away from the Bessemer process and the modern steelmaking era. Steelmaking was still an artisan craft, handed down for nearly 4,000 years. In the late eighteenth century new processes were developed that allowed steel to be made in greater quantities, but production was still greatly limited.

McDermott (spelling varies) was born in Glasgow, Scotland, and became interested in iron manufacturing at an early age. Experimentation in this field led him to create a unique process of steel manufacturing. He decided the ores of Pennsylvania were better suited for processing in his method, and came to the lower Juniata Valley. Here he built Caledonia Forge and Steel Furnace and within a few years was successfully manufacturing steel using his special method. Disaster soon struck, as a friend he lent money to defaulted, resulting in the county sheriff seizing his steel works. No one understood his process, and the works were left to ruin; the machinery was carried away and converted for other uses.

About 1811 McDermott moved his family to the Upper Sligo Forge on Spruce Creek in Huntingdon County, and built Millington Steel Works. McDermott again made steel in his own way and soon regained a part of his earlier fortune. The trade of his steel grew through the War of 1812, but then financial ruin again intervened. This was a period where many industries suffered tremendous losses, and for McDermott it was too much; he died soon thereafter. His son-in-law, Pennsylvania governor David Rittenhouse Porter, frequently spoke of McDermott's accomplishments and lamented that he never made his steel-making technique known for others to follow. It was Porter's firm belief that the loss of this method not only retarded steel production, but also prevented the industry from being revolutionized by the quality of the old Scotsman's steel.

Mifflin County

In addition to Freedom Forge already mentioned, General William Lewis of Berks County put into blast Hope Furnace on Strode's Run in 1798. Stove plates and other castings were made there in early days. In 1830 David W. Hulings purchased the furnace and made Franklin-type stoves carrying the name "Hulings Hope Furnace." In 1846 Hulings leased the furnace to A. B. Long and Brothers, who made "chair castings" for the construction of

the Pennsylvania Railroad. These were used to support the rail on top of the wooden ties. Several other lessees operated it between 1849 and 1860, when the furnace was abandoned for good. Despite its favorable location, Hope Furnace seems to never have been a profitable enterprise.[18]

THE EARLY NINETEENTH CENTURY

By 1800 twenty-four ironworks had been built, about half of them furnaces. In the years to follow, the number of ironworks in the Juniata grew even more rapidly, as word of the quality of the iron quickly spread. Forgers used to working the best Russian and Swedish iron found Juniata iron to be equal or better in quality, even rivaling the Salisbury iron of Connecticut.[19] It was during this time, that reputation would span the globe, and the number of ironworks in the Juniata Valley exploded. Much of this was due to the high profitability of Juniata iron, bolstered by its well-deserved reputation.[20]

As transportation routes improved and expanded, the Juniata River Valley became the major east-west transportation corridor, with a succession of at least seven forms of travel: footpath, pack-mule trail, navigable river, turnpike, canal, railroad, and modern highway. As one new form replaced the other, greater opportunities existed for shipping iron and other goods. This was especially true for shipping west. In eastern markets prices were depressed because of competition with cheaper imported British iron. But if shipping west, prices were better, as less British iron made its way west due to the high costs of shipping overland that far.

First to be improved were the pack-mule trails that were now becoming turnpikes. These were roads built by the Commonwealth or chartered by county courts as private companies to build and maintain roads, paid for by revenue generated by collecting tolls about every seven miles. Villages grew up around the toll houses, and amenities for travelers were established. Taverns served as early restaurants and motels, and had places to feed, water, and rest the draft animals that pulled the stagecoaches and the great Conestoga wagons. Daily travel by this method was about twenty-eight miles, so larger towns grew around the overnight stops. In the 1830s canals would steal away the bread-and-butter revenue of heavy freight traffic from the turnpikes, which in turn was captured by the railroads a decade later. Today, modern US and state highways, especially US Route 22, still follow early turnpike routes.[21]

The valley became an important ironmaking center, and by 1816 it was considered the principal iron-producing district of the United States.[22] The rich iron ores provided much wealth and was a substantial portion of the economic base for the region. The Juniata District was a powerhouse of iron production, producing tons upon tons of the celebrated Juniata charcoal iron. At the peak of production in 1828, almost half of all iron made in Pennsylvania came from the Juniata Valley, which equated to 20 percent of the national output.[23]

Acclaim for Juniata iron came from many corners, and one notable example is from Eli Whitney. Though known for the invention of the cotton gin, he has a more lasting legacy as an early adopter of concepts of interchangeable parts and assembly line production.[24] Whitney bought iron from different locales to make his muskets and was well aware of the quality of Salisbury iron, as he often used it. On a trip to Pennsylvania he purchased some iron produced in the Juniata Valley. Years later, in 1819, he would tell a friend of the quality of the metal he had purchased, stating,

> About ten or twelve years ago I purchased at Columbia, Pennsylvania, about 15 tons of the common Juniata Iron, made by Phillip Benner, which was wrought in my manufactory, into various parts of muskets. I am satisfied that the Juniata Metal, in its native state, is some of the best in the world & that if it is carefully & skillfully manufactured, it will answer an excellent purpose for Musket Barrels or any other use.[25]

In the 1840 US manufacturing census, Huntingdon County (including Blair County at the time) led the state in tons of cast or pig iron produced and was second in tons of bar iron.[26] However, the valley was not immune to the economic ups and downs of the national economy, and many ironworks would experience failure due to periodic downturns in the business. Presidential administrations alternated between free trade and high tariff protectionism, further affecting the health of the iron industry. The Tariff of 1842, coupled with the rise of iron made with mineral fuel, wrested the crown from the Juniata Valley as the industry shifted to the Lehigh Valley and later Pittsburgh.[27]

Turnpike-Era Expansion of the Iron Industry

The Industrial Revolution was growing, and iron was increasing in demand. As the War of 1812 began, there was a spike in new ironworks in the valley.

FIGURE 4 The Stone Arch Bridge at Lewistown, 2013. Photo by Nathaniel Thierwechter, Mifflin County Historical Society.

Much of the ironworks development was spurred by the improvements to the cross-state roads, especially to what was known as the Harrisburg, Lewistown, Huntingdon, and Pittsburgh Turnpike Road, chartered in 1807, and completed ten years later. It followed sections of the old Forbes and Frankstown roads. Today, US Highway 22 generally follows the course of this original road (see fig. 4).[28] Other turnpikes funneled iron to this road, most notably from Bellefonte and Tyrone to Water Street, for shipment westward. Pittsburgh was becoming a focal point for pig and bar iron, where it was processed into products for local consumption or shipment further west. Turnpike roads reduced shipping time and costs, and brought greater prosperity to the Juniata Valley.

The Curtin Family

One of the most significant iron families of the Juniata, and spanning several generations over 112 years, the Curtin family was prominent in Centre and surrounding counties. Although best known for their Eagle Iron Works furnace and forge (at Curtin Village) near Milesburg, the family was involved in several ironworks throughout the Juniata Valley, including Martha Furnace in Huston Township, Centre County, and Rebecca Forge and Furnace at Jackson's Corner in northern Huntingdon County. Roland Curtin

was one of Centre County's true pioneer ironmasters. His son, Andrew Gregg Curtin, eventually took over control of his father's iron interests and was Pennsylvania's governor during the Civil War.

In 1810 Miles Boggs and Roland Curtin erected the Eagle Forge along the banks of Bald Eagle Creek. Though the Bald Eagle flows into the West Branch of the Susquehanna, not the Juniata, these iron works were considered as part of the Juniata Iron District. Iron produced at the forge was shipped to Pittsburgh. Boggs's association with the forge was short-lived, for he retired in 1815. In 1818 Curtin erected Eagle Furnace at the forge. In 1830 he added a rolling mill and built Martha Furnace several miles away. By 1836 the old Eagle Furnace was abandoned, and the Curtins later built a new furnace on the site of the old one. It continued under the family's management until the end of operations, one of the very few long-lived furnaces to remain in the same family for its entire existence. In May of 1921 the furnace caught fire and burned to the ground. The forge continued to operate for a short time after the furnace ceased, going out of business in 1922. The ironworks complex is now a historical site owned by the Pennsylvania Historical and Museum Commission and operated by the Roland Curtin Foundation. The furnace has been reconstructed, and displayed today in front of the casting shed is the last charcoal iron made in the Commonwealth of Pennsylvania.[29]

Spruce Creek Valley

In Huntingdon County, Spruce Creek Valley had perhaps the greatest concentration of ironworks in the entire Juniata District. In a distance of about fifteen miles, there were three furnaces and fifteen forges due to the presence of large amounts of good iron ore. Three of the works were among the wealthiest: Huntingdon Furnace, Pennsylvania Furnace, and Colerain Forges. Shipment by water and road was relatively easy, as the Little Juniata River was navigable as far north as Birmingham. Also, Centre County ironmasters further east helped fund the building of a highway through Spruce Creek Valley and the heart of its ironworks, to ship their iron westward or to connect with the Juniata River. Tons of iron also came into the Little Juniata from the Tyrone area.

Located on the Huntingdon/Centre County line, Pennsylvania Furnace was perhaps the most profitable ironworks in the valley. Erected in 1813 by the partnership of John Lyon, Jacob Haldeman, and William Wallace, it replaced nearby Tussey Furnace, built three years earlier. In 1835, under the firm name of Shorb, Stewart and Company, the partners acquired the

controlling interest in Huntingdon Furnace and the Tyrone Forges. Most of the iron produced in the furnace was turned into blooms at local forges and then sent west to Pittsburgh where the Sligo Ironworks manufactured it into rolled bars. By 1881 wood for charcoal was getting scarce, so the furnace was converted to run on coke but by this time was no longer profitable. It was idle by 1888 and was never fired again. In its final years, Andrew Carnegie owned it. In conjunction with ownership of Tyrone Forges and Bald Eagle Furnace, Shorb, Stewart & Co. was among several Juniata iron companies to utilize the mineral wealth of the Juniata to provide resources for Pittsburgh.[30] The elegant twenty-eight-room mansion built by the Lyon family in 1834 remains.

Blair County and Dr. Peter Shoenberger

Several important Huntingdon County ironworks became listed in Blair County when it was formed in 1846. There were several families prominent here in the iron business, including the Spang, Royer, Baker, and Shoenberger families.

In 1808 Canan, Stewart and Moore erected Mount Etna Furnace near Williamsburg and soon added a forge to the works. It prospered well up to the War of 1812, but like many hit hard times during the postwar depression. In 1823 Henry S. Spang of Berks County purchased the ironworks. The prosperity brought by the canal and later railroad, both of which passed near the works, allowed increased production but it was blown out in 1877.

Robert Allison and Andrew Henderson erected Allegheny Furnace in 1811 in what is now Altoona. The furnace ran about seven years and failed around 1818. During this time, the partners may have experimented with using coke to fuel the furnace. It came back to life in 1836 under new owner Elias Baker, who took advantage of the canal and later railroad. His son operated it until 1884. Today the furnace stack, several associated buildings, and the Baker Mansion remain in the City of Altoona.[31]

Dr. Peter Shoenberger, the "Iron King," was one of the most active industrialists in the Juniata Valley and early Pittsburgh. He once owned so much land that he bragged he could walk from his ancestral home in Petersburg in Huntingdon County to the Ohio Valley without getting off his land. As prominent a citizen as he was, very little was recorded of his remarkable life and career in iron manufacturing. Yet, the vestiges of his activity are found throughout the Juniata Iron District and beyond. It seems the consensus of historians is that the title "ironmaster" did not fit the doctor,

for his iron enterprise was so much more extensive. The title "Iron King" seems more appropriate to this remarkable, and sometimes cunning, man.

Peter Shoenberger trained as a medical doctor and for a while practiced in Pittsburgh, until poor health forced him to retire. In the meantime, he inherited his first ironworks from his father, who died in 1815. Samuel Fahnestock and George Shoenberger erected Juniata Forge about 1798 along Shaver's Creek, at Petersburg, where it emptied into the Little Juniata. From the beginning, iron from this forge was considered excellent by local blacksmiths, and as the iron reached far-flung markets, its reputation grew. Revenues derived from the sale of this iron laid the foundation of the great Shoenberger family wealth in the nineteenth century.

Peter built his first furnace, Rebecca, in 1817, in Blair County, and aggressively sought a steady market for his iron. A savvy businessman, he became the sole supplier of iron to the gun works at Harper's Ferry, West Virginia. However, allegations of paying off workers and supplying inferior-grade iron led to the canceling of his contracts in the late 1820s.[32]

To expand his enterprise, he erected the Juniata Rolling Mill in Pittsburgh in 1826. He ultimately owned numerous ironworks, from Philadelphia to Marietta Furnace in Lancaster County, through the Juniata Valley, and was one of the founders of the Cambria Ironworks at Johnstown. He had operations in Pittsburgh, Wheeling, Cincinnati, and into Illinois. His works in the Juniata Valley included several named for his daughters. Most of these, in Blair County, included Rebecca Furnace (1817–82), Elizabeth Furnace (1827–42), Sarah Furnace (1832–82), Bloomfield Furnace in Bedford County (1846–88), and the three Maria Forges (1828, 1830, and 1832–18??).

At his death on June 18, 1854, his vast iron empire was valued at over $5 million, a remarkable sum in his day, equating to nearly $130 billion today. His works were divided among his ten children and their families. Few of them had their father's business acumen, and most of these works failed within a few years. His death notice referred to him as "The King Ironmaster."[33] This position was never challenged, and steel magnate Andrew Carnegie acknowledged the title, considering the doctor the only person worthy to be his predecessor. He recognized Shoenberger as the "Iron King," in reference to his own position as the "Steel King." Much of Pittsburgh's later success in steel manufacture can certainly be grounded in Shoenbergers's Juniata Rolling Mill and his extensive enterprise, and it would become a cornerstone of the US Steel Corporation many years later.[34]

Bedford County

The original boundaries of Bedford County contained the first ironworks in the Juniata Valley, and as its size was reduced with the erection of several new counties, it remained a prominent area for iron production in the early nineteenth century. Turnpike roads allowed transport of its iron to distant markets, but the county would not benefit from the Main Line Canal as did the rest of the valley.

William Lane came to Bedford County and built Hopewell Forge, finished by 1802, and in 1808 built Lemnos Forge. Hopewell Furnace ceased operation about 1820, in part due to Lane's financial problems and his sudden death. The forges, however, were kept in operation by a number of managers. About 1831 the Hopewell was back in production. After a succession of owners, it was rented in 1840 to David Puderbaugh, who operated the furnace and forge until 1847. While he was renting the ironworks, he began experimenting with the use of coke in ironmaking. He did not use it in the blast furnace, but rather built a crude furnace to convert pig iron into what was then called "pig metal." Just what "pig metal" referred to is not certain, but it may have been a reference to a type of steel, possibly similar to cast steel, and appears to be a crude forerunner of the open hearth furnace, still years in the future. By 1850 Hopewell Furnace and Forge passed to new owners, but apparently never operated after Puderbaugh's experiments failed. By 1855–56, during construction of the Huntingdon and Broad Top Mountain Railroad, all of the buildings were demolished except for the furnace stack.

Perry County

Perry County did not get into the iron manufacturing business until the early days of the nineteenth century. The county's mountainous surface and lean ores discouraged much investment in ironworks. Only where sufficient waterpower and good roads for transportation existed were ironworks built. Mount Vernon Forge (a.k.a. Lewis Forge) was built in 1804 near Millerstown. General William Lewis, owner of the Hope Furnace in Mifflin County, owned and operated them in conjunction with each other. Metal for the forge came from Hope Furnace in the early days and later pig iron was obtained from the Juniata Furnace, located in the same county. Free African Americans workers operated it. After several changes in owners, it was sold in 1808 to William P. Elliott of Lewistown and William Powers of Perry County. The forge was then abandoned around 1817. In 1873 one of the old hammers, broken through the eye, still remained on the site.[35]

In 1808 William Powers and David Watts built a Juniata Furnace on a small stream in Centre Township. For ten years beginning in 1824 the furnace was leased to John Everhart of Chester County. He erected a forge and put the furnace back in blast in 1825. In 1838 James McGowan acquired the property and erected a second furnace farther upstream. The new furnace was named the same—Juniata Furnace—and from this point, the earlier one called Old Juniata Furnace, which was soon abandoned. Around 1849 the latter furnace was abandoned and the gristmill was sold to William R. Shoaff. A tornado destroyed the furnace complex and office in 1855. The restored gristmill is a showpiece of Little Buffalo State Park.

CANAL FEVER

While improved turnpikes greatly aided commerce, canal fever swept the state and the nation. By 1825 the Erie Canal connected New York City to the burgeoning interior and the Great Lakes. The Chesapeake and Ohio (C&O) Canal in Maryland likewise would connect Baltimore with the west. Pennsylvania needed its own canal. But unlike the Erie and C&O, which were water routes over their entire length, the Commonwealth had some formidable geologic obstacles. First, there were no rivers connecting the Delaware to the Susquehanna, and a miles-wide wall of mountains stretched diagonally across the state's middle.

The Pennsylvania government therefore authorized the Pennsylvania Main Line of Public Works, an ingenious and complex combination of canal and railroads, requiring dozens of locks, along with tunnels, aqueducts, and related systems, to link east and west. Finally, ironmasters had a transportation system that could easily haul tons of bulk freight. No longer were ironmasters restricted to the pack mule trains, limited to 250 pounds per animal, or the six- to eight-ton limits of the Conestoga wagons that traversed the turnpikes. Shipping would also be faster. It took about twenty-three days to travel between Philadelphia and Pittsburgh by turnpike. The canal would cut that time down to just four days.

To conquer the formidable Allegheny Front, the state built the Allegheny Portage Railroad, where the boats had to be carried overland for thirty-six miles. It was an engineering marvel in its day, and played a crucial role in the expansion of the west to commerce and settlement. Famous author Charles Dickens traveled on the Portage in 1842 and wrote about it in his *American Notes*.[36]

Construction of the system began in 1826, and was completed in 1834, with the Juniata Division built between 1827 and 1829. Private and state-owned feeder canals and waterways furthered the system's reach. Centre County operations shipped iron eastward via a connection to the North Branch of the Main Line, and westward from the Little Juniata feeder canal. While it can be argued that the Main Line brought new prosperity to the towns and industries along its route, it was a financial disaster for the state, which never profited from it. When it was sold to the Pennsylvania Railroad in 1857, it was for only a fraction of what it cost the Commonwealth to build, maintain, and operate.[37]

The largest expansion of ironworks in the valley occurred between 1830 and 1845, largely due to the availability of the Main Line Canal. All but Bedford County ironworks benefitted from them. During this time, Juniata Valley ironworks were supplying as much as 40 percent of the iron processed in Pittsburgh.

The route of the canal specifically along the Frankstown Branch of the Juniata brought prosperity to several ironworks within reach of it. Mount Etna furnace, already mentioned, was conveniently right along the line. Elias Baker revived the abandoned Allegheny Furnace in Altoona in 1836, also taking advantage of the canal as it passed through nearby Hollidaysburg.

Henry S. Spang built the conical-shaped Canoe Furnace near Williamsburg in 1837, located at the base of Short Mountain, and handy to the canal. This furnace was more commonly called the "Soapfat Furnace," as local lore relates a story of a load of bacon that arrived at the furnace so rancid that the furnace workers claimed it was unfit to eat and was only good for rendering soapfat. The furnace operated only about ten years, then fell to ruin. Today, the partially collapsed stack remains the only known surviving example of a conical-shaped furnace (see fig. 5).

West of Tyrone in what is now Bellwood, Edward Bell built Mary Ann Forge in 1830 and Elizabeth Furnace two years later, which he quickly passed to his son Martin. In 1836 Martin Bell developed a system of capturing and utilizing the waste gases to create steam, for which he was granted a patent in 1840. Although the invention came into practical use, he derived little or no profit from it. Additionally, Martin was devoutly religious and did not like working the furnace on Sundays. He devised a method to bank the furnace's fire from Saturday night through Monday morning. From this practice, the furnace and village came to be known as "Sabbath Rest Furnace." In 1880 new owner John Whitehead refitted the furnace to use coke, operating them until 1884. Edward Bell's son John operated the forge until 1872.

FIGURE 5 A Historic American Engineering Record image of Canoe Furnace (HAER PA-316) sometime after 1968. Courtesy of the Library of Congress, https://www.loc.gov/item/pa3039.

The Royer Family

The Royers were one of the more prominent families in the region in iron production. Patriarch Samuel Royer, a commissary in the federal army during the American Revolution, also commanded a company during the Battle of Brandywine. Samuel may have been involved in ironworks in Franklin County, possibly as an owner or investor. Several of his sons, including John and Daniel, would enter the iron business.

John Royer left Franklin County in 1808 and went to Centre County, where he partnered with Andrew Boggs. Under the firm name Boggs and Royer, they rented the Logan Furnace in Bellefonte for two years. Royer left that business and came to the Williamsburg area, where he erected Cove Forge in 1810. He manufactured bar iron and shipped it west to Pittsburgh at a cost from $20–$40 per ton. As rolling mills became established locally and in Pittsburgh, iron was then made into blooms. The forge employed

from twenty-five to thirty men, and produced about 400 tons of bar iron or blooms per annum. It operated until 1880 when production halted, the last forge to close in Blair County.

In 1815 brothers Daniel and John Royer erected Springfield Furnace five miles south of Williamsburg on Piney Creek. The furnace's output of pig iron was fabricated into blooms at their Cove Forge. Later, the company made ten-plate stoves. The furnace operated until 1885, when it shut down permanently. The Royer family owned it for its entire existence, and it was one of the last charcoal-fueled furnaces to go out of blast in the county. Finally, Samuel Royer built Franklin Forge in 1830, employing about twenty-five men. It was demolished in 1861.

John Gloninger

One of the major owners of several local ironworks in the Tyrone and Spruce Creek areas was John Gloninger, already a well-established ironmaster. He was owner of Westmoreland Furnace, where he met George Anshutz. When Anshutz came to the area to build his Huntingdon Furnace, Gloninger was one of the partners. Impressed with the quality ores and reputation of the Juniata iron, Gloninger expanded his local holdings. He built the (Lower) Tyrone Forge in 1805, near Ironville, and two years later added a rolling mill and nail factory. The Upper Forge was erected in 1813 at the mouth of Plummer's Hollow. Both forges and the associated mills operated for many years, and later became part of Lyon, Shorb and Company, who owned Huntingdon and Pennsylvania furnaces, along with the Colerain Forges. The last of these forges operated until 1874, when operations were suspended.

Gloninger built Bald Eagle Furnace in 1824 east of Tyrone, in the Bald Eagle Valley, and about 1835 it became part of Lyon, Shorb and Company. Pig iron was forged into bar iron and blooms at the nearby Tyrone Forges. The furnace could produce in excess of 2,200 tons of metal per annum. It closed in 1865. Gloninger's empire utilized the Little Juniata feeder canal to funnel iron to the Pennsylvania Main Line Canal and onto their rolling mills in Pittsburgh.

Black Log and Trough Creek Valleys

There were several ironworks scattered through southern Huntingdon County. These works were able to ship on the canal via a long-forgotten feeder up the Raystown Branch of the Juniata, which went as far as the Great

Trough Creek. Despite favorable ores, however, only one of the works was truly successful, the coke-fueled Rockhill Furnaces no. 2, which did not rely on the canal, but rather shipped by rail via the East Broad Top Railroad.

In 1829 Berks County ironmaster Reuben Trexler erected Trough Creek Furnace[38] and Eagle Foundry in Trough Creek Valley. In 1833 John Savage of Philadelphia leased the furnace and forge, who renamed it the Mary Ann Furnace; the forge was known as Savage Forge. Shortly after production began in 1834, he suddenly died. The works remained in the Savage family for only a few years.

In 1835 William Firmstone of Shropshire, England, came to the furnace and utilized his knowledge of using coke as a fuel to experiment with local semi-bituminous coal from Broad Top, in southern Huntingdon County. Instead of kilns or beehive ovens, it is said that the coal was piled in heaps and burned into coke in a process much like traditional charcoal making. Firmstone claimed to have made a good grade of forge iron for a one-month period in that year. Some evidence also suggests that he was among the first ironworkers in America to utilize the hot blast system for furnaces. Although his experiments seemed to have produced good iron, they were short-lived.

On a final note, in 1835 the Franklin Institute in Philadelphia offered the prize of a gold medal to anyone who could manufacture good iron during a three-month period using only anthracite coal. Firmstone, if he did meet the requirements (which is unknown), never came forward to put in a claim for the prize. After managing furnaces in the Hanging Rock region of Ohio, where he introduced the hot blast system to that area, he eventually ended up in Easton, where he owned the Glendon Ironworks.[39]

Reuben Trexler regained ownership of Mary Ann Furnace in 1841, and operated it through his death in 1846. He changed the name to Paradise Furnace. The furnace operated sporadically until 1852, when it again went out of production. In 1858 Rueben's son Horatio put the furnace again into blast. It continued until 1867, when it was put out of blast for the last time. The forge operated into the late 1850s. The stacks' remains can be seen today in Trough Creek State Park.

Thomas T. Cromwell

Cromwell was one of the most notable figures in iron production in the Orbisonia area, and his father was a partner in the erection of Bedford Furnace. In 1821 Cromwell built a large gristmill in the Black Log Creek Narrows, and in 1831 began construction on Rockhill Furnace, just east of

the gristmill. Before it was finished, he sold it to Thomas Diven and William Morrison, who put it into blast in 1832. Cromwell then erected Winchester Furnace just west of the gristmill. He operated it for only a few years, then leased it to several parties until 1856, when it was abandoned.

In 1849 the firm of Isett, Wigton and Company bought Rockhill Furnace and operated it until 1857, when production ceased. In 1864 Lorenz and Leamer purchased the furnace, and then sold it in 1868 to Lewis Royer and Percival P. Dewees, who were in the process of acquiring properties, which also included the abandoned Winchester Furnace for the recently formed Rockhill Iron and Coal Company. They operated the furnace for a short time until construction was completed on the New Rockhill Furnaces no. 2, fueled by coke made from Broad Top coal. These furnaces operated until 1907 and were the last blast furnaces to operate in Huntingdon County. The crumbling stone remains of Cromwell's grist mill along with Winchester and (Old) Rockhill furnaces remained in the narrows south of Orbisonia until a few years ago, when they were removed due to highway improvements.[40]

Greenwood Furnace

In the northeastern corner of Huntingdon County, Greenwood Furnace went into blast on June 5, 1834, under the ownership of Norris, Rawle, and Company, who also owned Freedom Iron Works near Lewistown. The stack had an annual capacity of 1,200 gross tons of iron. The furnace passed to John A. Wright and Company in 1847, then became part of the Freedom Iron Company in 1856. The iron produced here was used to make various products for railroads, principally locomotive tires. The iron from Greenwood Furnace was shown to be the best in the world for this product, as no other iron could match it in quality and durability.[41] A second furnace was constructed in 1864, making this the only known site within Pennsylvania where two charcoal furnaces operated simultaneously side by side. The firm became Logan Iron and Steel Company in 1871. By 1882 the older furnace was shut down. The number 2 furnace was extensively remodeled in 1889, and again in 1902, increasing its height to fifty feet with an eleven-foot bosh. This made it one of the largest charcoal furnaces ever built. However, trees for charcoal were getting scarce, and the economics were shifting toward larger, urban-centered furnaces. The furnace's remote location in mountainous terrain hindered the addition of a rail line. The final day came December 7, 1904. In 1906 the Commonwealth purchased the property and established the Greenwood Forest Tree Nursery and in 1924 created Greenwood Furnace

State Park. Greenwood Furnace is the best-preserved charcoal iron furnace open to the public in the Juniata Valley.

Perry County

The Duncannon Iron Works was located south of the mouth of the Juniata River in Duncannon. The first forge, built in 1827, was destroyed by fire in 1829 and quickly rebuilt. In 1837 a rolling mill was built on the site of the old forge. This factory was small and crude, and could only produce 5,000 tons of bar iron per year. Two years later, a nail factory was added that could make over 25,000 kegs of nails per year. A flood damaged the plant in 1846 but was rebuilt, and by 1853 a twenty-ton-per-day furnace with a twenty-ton-per-day capacity was added to the works. Disaster struck yet again, when the nail factory burned in 1860. Again, it was rebuilt and increased in size, making 100,000 kegs of nails annually.

On February 1, 1861, the facility reorganized as the Duncannon Iron Company. The old partnership of Fisher, Morgan, and Company retained stock in the new company, and the firm came under the management of James Wister. Over the next two decades, the plant would suffer, then recover several times from fires. The furnace was remodeled in 1880 to make 15,000 tons of iron per year and continued to operate until 1900. The nail mill, which made cut nails, was becoming obsolete as wire nails were becoming common. Rather than modernizing the plant, the owners closed it in 1908. The remaining factory was sold to the Lebanon Iron and Steel Company, which operated it sporadically for several years.

John Wister stands out as a great iron manufacturer in Perry County. For over fifty years, he was connected with the Duncannon Iron Works, starting as an errand boy and working his way up to the president and general manager of the company. When his employment started, the plant was still operated by water power. He was instrumental in introducing steam power, making the company one of the most important in the state.[42]

THE COMING OF THE RAILROADS

No sooner than the Pennsylvania Main Line Canal had gone into operation, railroads came of age, and towns and industrialists were clamoring for a rail link. Canals were costly to build and maintain, did not operate in the winter, and could not go everywhere. Railroads not only solved these problems, they were faster and more efficient. Even the Main Line utilized railroads as part of its system.

In the 1830s the Pennsylvania legislature authorized the surveying of cross-state rail lines. Noted railroad surveyor Col. Charles L. Schlatter was chosen to make many of these surveys for new rail lines. Two of these survey excursions passed through the Juniata Valley. One was known as the Central Route. It would start at Columbia, on the Susquehanna River, at the western end of the Philadelphia and Columbia Railroad, which was a part of the canal system. From here, the line would follow the Susquehanna upstream to the Juniata River, and then continue along the Juniata to the Hollidaysburg area. Crossing the same mountains that were an obstacle for the canal, the line would go to Johnstown, and then on to Pittsburgh. Numerous alternate routes were proposed. Ultimately, the route chosen followed the Juniata River and was constructed beginning in the late 1840s. While this route added more mileage than some of the alternates, a big reason for its choice was conservation of fuel and less expense to build along the river.[43]

During the surveys, some of the alternate routes were favorably regarded, to the extent that ironworks were built in anticipation of the rail lines passing through their area. One good example was the Stone Valley option, in northern Huntingdon County, which would have diverged from the Juniata at Lewistown, proceeded to Kishacoquillas Valley, then tunneled through Stone Mountain and diagonally cross Stone Valley to the Little Juniata Branch. Along this route, the Freedom Iron Works in Burnham would have been favorably located, as was its Greenwood Furnace, which would have been near the proposed Stone Mountain tunnel. Both of these were well established before the surveys. Just down valley from Greenwood, three new furnaces were built, but when the route was abandoned as too expensive to build, two of these furnaces quickly met their demise.[44]

When construction began on the Pennsylvania Railroad (PRR), the track had to be built on the opposite side of the river from the canal, as it was considered direct competition. This is why rail stations in the lower Juniata Valley are on the opposite side of the river from the major towns, such as at Lewistown (see fig. 6).[45] But as the canal lost money for the state, and by the time the PRR reached Huntingdon, it had purchased the canal from the Commonwealth.

As rail lines proceeded westward, they did not follow the canal route up the Frankstown Branch, but rather followed the Little Juniata Branch to Tyrone, before turning west. This alignment sent the PRR through the very heart of the Juniata Iron District. Reaching the mountains, they established the city of Altoona north of Hollidaysburg. Crossing the same mountains as the Allegheny Portage Railroad, the line conquered the barrier with the

FIGURE 6 The Pennsylvania Railroad station at Lewistown, circa 1860. Courtesy: Forest Fisher, Mifflin County Historical Society.

famous Horseshoe Curve, completed in 1854. A spur line would service the Frankstown Branch.

The second route surveyed was the "Southern Route" by Hother Hage in 1839, and worked its way through the state and mountains south of the Central Route. This survey would years later become the infamous South Penn Railroad, a collaboration between New York Central Railroad president William H. Vanderbilt and steel magnate Andrew Carnegie in direct competition with the PRR. Construction started on grading the right-of-way, digging several tunnels, and beginning bridges such as one over the Susquehanna at Harrisburg. Financier J. P. Morgan realized this only meant superfluity and disaster, and brought the two sides together, and forced them to agree to cease activity. Vanderbilt abandoned the South Penn. It was never built and became known as "Vanderbilt's Folly." In the 1930s some of the grading and tunnels were used for the route of the Pennsylvania Turnpike.[46]

The railroads did not at first bring expansion of ironworks as expected. Economic conditions were not as favorable as in earlier times. Between 1837 and 1850, fully three-quarters of Pennsylvania's ironworks had either failed or were sold at sheriff sales.[47] The Wildcat Panic of 1837 caused economic hardships, as the departing Andrew Jackson administration recalled the bank notes that many bought on speculation, drying up credit. In the late 1840s conditions worsened with the lowering of tariffs on iron imported mainly from Britain.[48]

This situation continued through the 1850s, reaching its lowest point about 1856–57. Ironmasters like General James Irvin suffered, being severely crippled financially. His Centre Furnace was blown out in 1858, never to operate again, but it did have a later life as a lime kiln. Always a charitable man, Irvin's lasting legacy was his involvement in the establishment of a state "Farmer's High School" on the lands of Centre Furnace, which opened in 1856 and is now the main campus of the Pennsylvania State University.

Freedom Iron Works

Shortly after the demise of the original Freedom Forge in Juniata County, Miller, Martin and Company around 1810 erected and put into production a new Freedom Forge about a mile north of Lewistown, on Kishacoquillas Creek.[49] Although the connection between this forge and the earlier one is tenuous, there does appear to be some evidence of a relationship. This forge consisted of two fires, three waterwheels, and one hammer. The ore came from the Greenwood ore banks near Belleville. In 1812 Freedom Furnace had been added to the works, and had an output of about six tons a week. The firm would change hands many times over the years as partners came and went. Products included bar iron, small forgings, and domestic wares, such as andirons, skillets, tools, and Franklin-type ten-plate stoves.[50]

In 1825 the old stack, abandoned five years earlier, was torn down and a larger furnace erected. Weekly output was ten to twelve tons of iron. Freedom Iron Works again went through a major change of ownership in 1833, when Norris, Rawle and Company took over. The forge was completely rebuilt, with one chafery and six refining fires.[51] Annual capacity increased to 800 tons of blooms. The firm also took out a lease on Rebecca Forge, just down the valley, and used it to process some iron from their Greenwood Furnace for local consumption. The old Freedom Furnace was permanently abandoned.

The Freedom and Greenwood Works were sold at sheriff sale in late 1847. John A. Wright and his family purchased both plants, and he soon gained a reputation as one of Pennsylvania's foremost ironmasters. John was born in Philadelphia in 1820 and was fascinated by railroads as a child. He became a civil engineer and a noted railroad surveyor. He first assisted Hother Hage in his surveys in 1839, and later surveyed a section of the Central Railroad of Georgia, where he met J. Edgar Thomson, the "father of the Pennsylvania Railroad." The two became life-long friends. Wright was a founding member of the PRR board of directors, and was instrumental in the establishment

of Altoona as its rail city. During the Civil War, he served as one of two aide-de-camps to Governor Andrew Gregg Curtin.

Wright began to manufacture spring wire blooms, which were quickly celebrated as a superior product. The demand for quality iron products for the growing railroads allowed the company to grow and prosper.

Wright decided to enlarge the works to manufacture a whole new range of products, especially locomotive tires, wheels, and other parts. In order to better capitalize this expansion, he incorporated the ironworks as the Freedom Iron Company in 1856 and became its president. The firm added a new hammer shop, rolling mill, and tire shop. The company became the first manufacturer in the United States to produce a locomotive tire that was not only equal, but superior to any foreign manufactured tire. This was the testimony of the superintendents and master mechanics of the leading railroad companies of America. The plant could produce two thousand tires per year.[52]

IRON IN THE WAR

Juniata's ironworks cranked out much iron for the war effort, including munitions. Some iron went into the ironclad ships, while some went into the famous Rodman guns. The Juniata Valley and its ironworks and railroads were potential targets of Lee's armies during his invasion of Pennsylvania in the summer of 1863. An interesting story from this time tells of a charcoal pit exploding near Greenwood Furnace in northern Huntingdon County, and the people going into a panic, fearing it was Confederate cannon fire. Altoona was days away from Confederate occupation when Lee had the invaders turn east to meet Meade at Gettysburg.[53]

In 1864 several new furnaces were built in the Juniata Valley. This would be the last major expansion of charcoal iron in the district. Following the war, most of the new furnaces were built to use coal or coke, while others were converted to mineral fuels. The last charcoal furnace in the Juniata Valley, Laura Furnace, was built in 1873, near Millerstown, Perry County.

THE AGE OF STEEL

Beginning in the late 1700s, new manufacturing processes were developed for making steel. While steel had been around since ancient times, it was difficult and expensive to make, thereby limiting its use. Crucible steel became an

interim method that allowed modest increases in production volumes. In 1855 Englishman Henry Bessemer introduced his process that would revolutionize the iron industry, and bring rise to the modern steel age. At the same time in America, Kentucky ironmaster William Kelly experimented with blowing air through iron to make steel, independently developing a process much like Bessemer's. Another process under development at the time was commonly known as "open hearth" and would supplant Bessemer's process and dominate the industry through World War II.

Less known, but more important in some ways, were processes and improvements in manufacturing, largely driven by railroads. New demands for quality iron for locomotives, rails, bridges, and the like led to many companies investing in plants to manufacture these products. The Juniata Valley would not be outdone in this new expansion. Many ironworks expanded into car wheels, locomotive tires, axles, and boilerplates for locomotives. Charcoal iron was particularly suited to these products, so production remained strong in the valley. But iron made with anthracite coal or coke was overtaking charcoal iron, and the ironmaking center of Pennsylvania shifted from the Juniata to the Lehigh Valley before settling in Pittsburgh by the 1870s.[54]

Freedom Iron and Steel Company

During this period, Andrew Carnegie became involved with the company and in 1860 was its major stockholder. This association with the Freedom plant would be Carnegie's first tentative steps into the production of steel. The Bessemer process was not yet available to American manufacturers, so Carnegie was one of a handful of manufacturers trying to utilize other ways to make steel rails, but found no success.[55]

At the close of the Civil War, John Wright became interested in the Bessemer process. Carnegie later claimed it was he who talked Wright into obtaining the rights to the process for the plant. Wright went to England to study the Bessemer technology and purchased all of the equipment necessary. The plant consisted of two five-ton converters and a new tire mill. Iron would come from the company's furnaces.

The Freedom Bessemer plant was the fourth in the nation and the second one in Pennsylvania.[56] The first steel was made on May 1, 1868, and used for steel tires and boilerplates, and, finally, rails. Unfortunately, the steel was of poor quality. A chemist from Yale University determined the problem to be small amounts of phosphorus in the local ores, which makes iron and steel

brittle. Phosphorus could not be removed during the manufacturing process in those days, requiring the use of phosphorus-free ores.

This revelation came too late, for creditors seized the plants and foreclosed on the mortgages. The Bessemer converters were sold to the Joliet Steel Company in Illinois, while the rest of the works went for sale. Carnegie later lamented on the failure of the plant and his friend, saying,

> My friend, John A. Wright, president of the Freedom Iron Works at Lewisto[w]n, Pennsylvania, had visited England purposely to investigate the new process. He was one of our best and most experienced manufacturers, and his decision was so strongly in its favor that he induced his company to erect Bessemer Works. He was quite right, but a little ahead of his time. The capital required was greater than he estimated. More than this, it was not to be expected that a process which was even then in somewhat of an experimental stage in Britain could be transplanted to the new country successfully from the start. The experiment was certain to be long and costly, and for this my friend had not made sufficient allowance.[57]

It is interesting to contemplate the significance of the Freedom Bessemer plant and Carnegie's involvement. Previous local histories have addressed the Bessemer works with but a few sentences, and none mention Carnegie's involvement. As the foregoing shows, this was a major and bold step by Wright and the company. What if the plant had been a success? It is quite possible that the Juniata Valley could have been the "Pittsburgh" of the steel industry. For John A. Wright, it was the disastrous end of an otherwise illustrious career as one of the Commonwealth's foremost iron manufacturers. During the Bessemer fiasco, his health failed, forcing his retirement. He died in 1891, yet his legacy lived on. His ironworks refused to die, and was given not one, but two new leases on life: Logan Iron and Steel Company, and Standard Steel.

Logan Iron and Steel Company

This company purchased the defunct Freedom plant on March 30, 1871, and included both Greenwood and Monroe furnaces. Monroe Furnace was abandoned. The Greenwood Furnaces and Emma Furnace remained in production. The plant consisted of the now very old 1810 water-powered forge, the puddling mill, and the plate/rail mill. The product included

hammered and rolled bar iron and blooms. The product line expanded to include bar iron in the following shapes: flat, round, oval, square, half-oval, half-round, band iron, bevel edge, wagon and buggy tires in round or square edge, and special small shapes. The plant operated through World War II and by its end the equipment was worn out. The plant closed for good during the National Steel strikes of 1946. It was one of the last puddled wrought iron companies remaining in America.

William Butcher and Company

Around 1865 William Butcher Jr. came to America. He was the son and nephew (respectively) of famous English steelmakers Samuel and William Butcher. In England William Jr. was a well-known manufacturer of cast steel locomotive tires, using crucible steel. His intention was to introduce the process on a mass scale to America, as this country was still years behind England in steel production. He first designed a new steel plant being built in 1865 at present-day Steelton, near Harrisburg. He soon left and went to Philadelphia, where he was one of the founders of the William Butcher Steel Works, which became Midvale Steel Company.

He left that firm in 1871 and came to Burnham, bringing forty English steelworkers with him, and founded William Butcher and Company. He leased the old tire mill, hammer shop, and empty Bessemer buildings, and began again to manufacture cast steel locomotive tires and axles from crucible steel. Butcher was a good steelmaker, but seems to have had no head for business. By late summer of 1872 he was in financial trouble, and creditors soon seized the plant, assuming control. They operated it for three years as the Crucible Steel Works. It is possible Butcher's financial troubles were tied to the deaths of his father and uncle in 1869 and 1870 respectively, when the family fortune was tied up in the estate settlements.[58] He disappears from the historical record, and details of his life after this are unknown.

Standard Steel

In 1875 principal creditor Baldwin Locomotive Works took full control of the Crucible Steel Works in Burnham and renamed it Standard Steel Works. Baldwin operated the plant as a separate entity until its demise in the 1960s. The initial product line included crucible cast steel locomotive tires, car wheels, car and carriage axles, forgings, and other castings. In 1892 Standard began to manufacture its first steel-tired wheels, and set about solidifying its position as a quality steel maker. The first of many open-hearth furnaces began production in 1895. Standard Steel began experimenting with improving the

quality and durability of wheels for freight and passenger railroad cars. Many of these became the "standard" of the industry. Today they are the major leading domestic producer of forged steel railroad wheels and axles.

Standard Steel is the oldest continuously operating iron and steel forging company in the country.[59] Starting as the first forge in the valley about 1790, the company grew, expanded, experienced setbacks, and managed to come out of all adversity to remain a strong leader in steel products. While the steel used in the plant is no longer made from the celebrated Juniata charcoal iron, it still is a sense of pride for the residents of Mifflin County and surrounding area, in producing a product so good in quality, and with few if any rivals (see fig. 7).

Though Standard would never achieve the scale of Carnegie's vast steel empire, or even match Bethlehem Steel, it was part of a fundamental change in the industry, as steel eclipsed iron as the dominant form in the late nineteenth century. With steel came specialization, consolidation, requiring scientific management of the chemistry and production of the metal. Gone were the days where the skill of the founder and worker, with his keen senses, adjusted and worked each batch of iron according to "secret recipes."

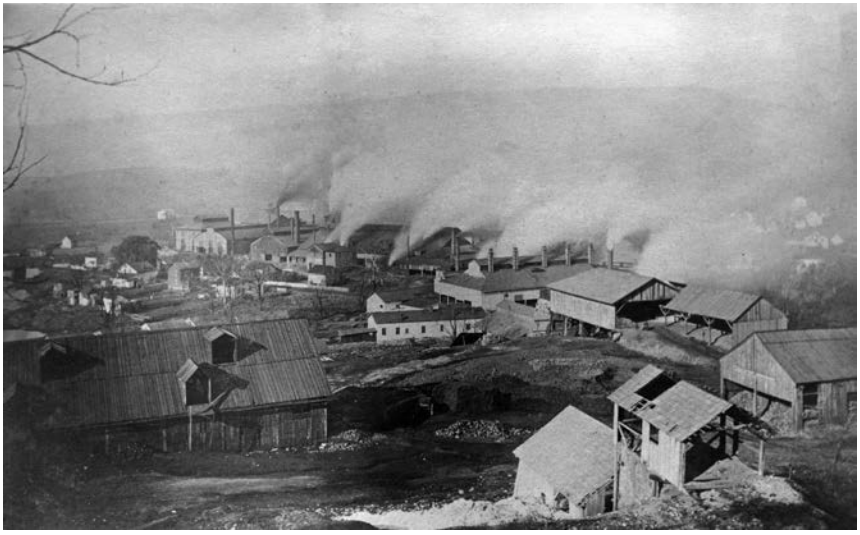

FIGURE 7 Overview image of Standard Steel and Logan Iron and Steel, circa 1880. Standard occupied the two stone buildings to left of center at this time. These were originally built for the Bessemer plant in 1868. Next was the hammer shop, rolling mill, tire mill, and forges (with the five chimneys in a row) of Logan Iron. In the bottom right and foreground are the structures associated with Emma Furnace. Courtesy of the author's collection.

As the amount of steel used increased exponentially, the small charcoal furnace producing a few tons a day couldn't keep up. Coke-fueled furnaces could produce as much in a day as the old charcoal stacks did in a year. Most of the Juniata charcoal iron furnaces succumbed to the inevitable. A few were converted to run on anthracite coal or coke fuel.

By the twentieth century, only very few furnaces still smelted iron with charcoal in Pennsylvania, all but one in the Juniata Valley. The end of the Juniata iron industry came in 1921 with the burning and closure of the Eagle Furnace at Curtin, Centre County. The associated forge used up the remaining iron and closed in 1922. Laying in front of the cosmetically rebuilt furnace today is the last charcoal iron made in Pennsylvania, and the very last run of Juniata iron. All told, there were seventy-three furnaces and sixty-two forges fueled by charcoal in the valley between 1786 and 1922.

THE REPUTATION OF JUNIATA IRON

From the early days of iron production in the Juniata, ironmasters touted the quality of their iron. Many of these works claimed to make the famous "Juniata iron," but Phillip Benner in Centre County seems to have first used this title as a product label. Freedom Forge in Burnham was also an early user of the title. Was this reliance on the brand name by the various works just hyperbole for their product, or was it demonstrated that Juniata iron was, in fact, a superior grade of iron?

Iron historian John Pearse wrote in the 1870s that "the reputation of Juniata iron was well deserved. . . . The iron from this district of Centre, Mifflin, and Huntingdon Counties had been always used for best bar iron, and when puddled iron displaced the hammered bars, about 1840, the product of the district was used almost exclusively for the best boiler plates."[60]

Likewise, in 1849 Juniata ironmaster John A. Wright wrote a letter to the Convention of Iron Masters in Philadelphia. In it he speaks eloquently of the state of the iron industry in the Commonwealth, and provides stunning evidence of the economic force an iron furnace was in a local community. He states:

> There are probably few counties in the State richer in valuable ores than Mifflin, Huntingdon, and Centre. The ores are generally the richest hydrates, making the Iron so long and favorably known throughout the country as the Juniata Iron—equaled by some rare banks but unequalled in extent of ore in the United States. . . .

> For the manufacture of Charcoal Iron these counties are admirably situated. . . . You will particularly bear in mind, that this is the state of things at the places where the iron made is exclusively of the best character, superior to any iron imported from England or Scotland, and fully equal to the best from Russia, Sweden, or Norway.[61]

Such was the reputation of Juniata charcoal iron. Its "romantic" days were long in the past. For much of the first half of the nineteenth century, "Juniata iron" was a household word. But as the Industrial Revolution pressed on, the charcoal iron industry found itself outproduced and outcompeted at nearly every level. Only a few products remained in the market for charcoal iron. The last was for railroad passenger car wheels. Even though charcoal-iron production remained small but strong after 1900, the industry was all but gone in Pennsylvania. The last bastion of charcoal iron in Pennsylvania was the Juniata Valley. Nationally, charcoal iron production ended in the late 1920s, around the same time as the dawn of the Great Depression (see fig. 8).

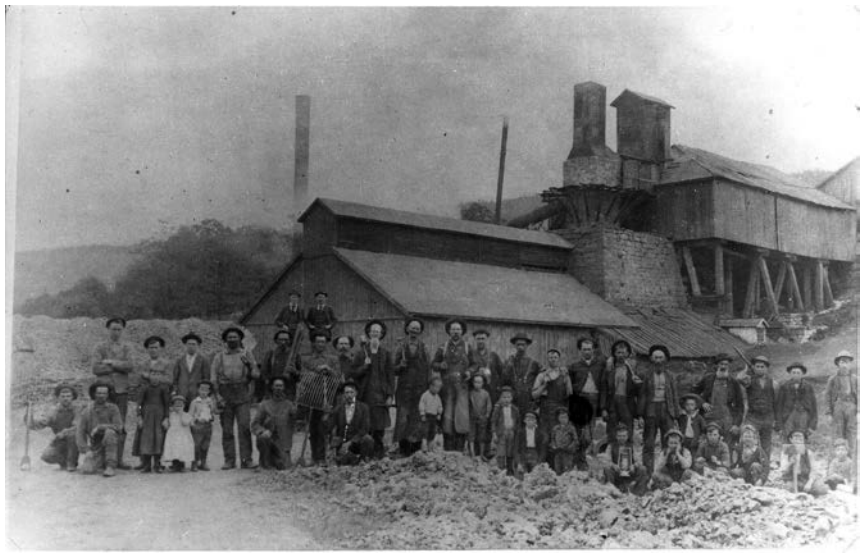

FIGURE 8 Greenwood Furnace, ca. 1890. It is fitting to remember all of the workmen of the many ironworks of the Juniata Valley. They put the valley on the map, and for a time when Juniata iron was regarded as the finest, their labors helped to forge a nation and make the products used in the westward expansion of America. Courtesy R. Franks, Greenwood Furnace State Park.

Today, few know of the incredible legacy of this beautiful valley. Much of the capital used to establish the ironworks came from southeastern Pennsylvania. In turn, the Juniata Iron District laid the foundation and supplied iron for Pittsburgh and propelled that city to the forefront of national steel production. Vestiges of former ironworks in the valley are disappearing as the years go by. Much research still needs to be done to preserve the rich legacy of Juniata charcoal iron and of the industries that manufactured some of the best iron in the world.

Fleeting years have borne away, the voice of Alfarata; still sweeps the river on —Blue Juniata!

— Marion Dix Sullivan, "Blue Juniata" (1841)

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NOTES

This work is an intermediate publication that draws upon thirty years of continuing research by the author into the Juniata Iron District. An earlier version entitled, "The Romantic Days of Juniata Iron: A Preliminary Report," was presented at the sixth annual Ironmasters Conference – Lehigh Valley, held in Bethlehem, Pa. on April 27–29, 2001, and published in the conference booklet along with the other presentations. The conference, a mix of amateur and professional presentations, was sponsored by the National Canal Museum in Easton, Pa. and Bethlehem Steel Corporation.

1. Complete lyrics can be found at http://www.songofamerica.net/song/blue-juniata. While some have speculated that "bright Alfarata" was a real "Indian girl," historians have generally held that the name is an invention of Sullivan as she needed a world to rhyme with "Juniata." Its appearance in the song is always opposite "Juniata." Interestingly, there are a couple of communities, Alfarata in Mifflin County, Pennsylvania, and Alpharetta in Georgia, named for her. Original sheet music for the song can be found in the Keffer Collection at the University of Pennsylvania.

2. For a well-written account of the pre-European settlement era of the Juniata Valley, see Dennis P. McIlnay, *Juniata, River of Sorrows: One Man's Journey Into a River's Tragic Past* (Hollidaysburg, PA: Seven Oaks Press, 2003).
3. The seven counties listed are generally considered to comprise the Juniata Iron District. Of them, Centre County is not geographically within the Juniata River watershed; rather, it is in the Upper Susquehanna watershed. While a few references list its ironworks with the latter, most place it in the Juniata, which was consistent with the Centre County ironmasters considering themselves part of the Juniata as well.
4. Finding information on these ironworks is often challenging, as many came and went prior to the Civil War, or were short-lived. There have also been instances of, say, a forge in the 1820s, mentioned only once in a brief newspaper passage, and no other information has been discovered on it. By the time of the voluminous county histories of the 1870s and 1880s, many of these ironworks were distant memories, and were given only a few lines if any. Surviving company records are even more elusive. While a few scattered record books have ended up in various archives around the state, the vast majority are lost forever. The remaining information comes from contemporary books, governmental records, periodicals, and newspapers, requiring years of searching to collect. A perusal of the endnotes to this article only hints at the number of sources used to help complete the picture of Juniata Iron.
5. Specifically, the Iron Act, passed by the British Parliament in 1750, intended to allow colonial ironworks to only produce pig or bar iron, which was to be shipped to Britain for manufacture into finished products. The act also restricted new rolling and slitting mills, plate mills, and steel works. As many of those in government power in the colonies also had interests in ironmaking, they did not enforce the act, and often located new ironworks in areas where there was little or no British presence. For more information, see Arthur C. Bining, *British Regulation of the Colonial Iron Industry* (Philadelphia: University of Pennsylvania Press, 1933; reprint, Clifton, NJ: Augustus M. Kelley, 1973); and Paul F. Paskoff, *Industrial Evolution: Organization, Structure, and Growth of the Pennsylvania Iron Industry, 1750–1860* (Baltimore: Johns Hopkins University Press, 1983).
6. Evidence for this venture comes from James M. Swank, *History of the Manufacture of Iron in All Ages, and Particularly in the United States for Three Hundred Years, from 1585 to 1885* (Philadelphia: Self-published, 1884), 156, and Arthur C. Bining, *Pennsylvania Iron Manufacture in the Eighteenth Century*, 2nd ed. (Harrisburg, PA: Pennsylvania Historical and Museum Commission, 1987), 50. It should be noted that neither offers a source for his information, and Bining likely used Swank as his source. The result is that what little there is has been continuously recycled time and again by numerous authors. In the *Bulletin of the American Iron and Steel Association*

19, no. 24 (1885): 186, author "A. N. H" adds details to Swank's account, stating that there was a Joseph Jacobs, who "was treasurer of Cumberland County between 1767 and 1789," and that he was a large landholder in the Juniata Valley. He then links this Jacobs to a Jacobs family who were iron-makers in Lancaster County. He proffers this as "proof" of the Juniata Iron Company, but makes no attempt to provide documentation to definitively show that this and the other Joseph Jacobs were one and the same person. He also fails to show that any of the lands this Jacobs owned had any ore on them, or became seats of iron production. In fact, he states that is impossible to ascertain what lands he actually owned. Finally, there is a collection of "Jacobs Family Papers, 1681–1838," in the manuscript collections of the Historical Society of Pennsylvania, in Philadelphia, that reportedly contains a ledger from this venture. This Jacobs family was based in Chester County, outside Philadelphia.

7. The Forbes Road was a military road built by British general John Forbes to advance troops toward Fort Duquesne, then later developed for commerce. A local entry point was at Fort Bedford on the Raystown path. See Wayland F. Dunaway, *A History of Pennsylvania* (New York: Prentice-Hall, 1948), 246. Conversely, the Frankstown Road was built for commerce and travel. See Charles A. Hanna, *The Wilderness Trail* (New York: G. P. Putman's Sons, 1911), 247–51, 291.
8. There are few good sources of early history of the Juniata Valley. Much of what has been published is anecdotal in its source. Accuracy varies widely, even within the same volumes, as sections were written by different people. See as examples, J. Simpson Africa, *History of Huntingdon and Blair Counties* (Philadelphia: Louis H. Everts, 1883); John Blair Linn, *History of Centre and Clinton Counties* (Philadelphia: Louis H. Everts, 1883); J. Franklin Ellis and Austin N. Hungerford, *History of that Part of the Susquehanna and Juniata Valleys, embraced in the counties of Mifflin, Juniata, Perry, Union and Snyder, in the Commonwealth of Pennsylvania* (Philadelphia: Everts, Peck and Richards, 1886), in two volumes.
9. Two detailed histories of Bedford Furnace can be found in Africa, *History of Huntingdon and Blair Counties*, 34 and Swank, *History of the Manufacture of Iron*, 204.
10. Historical works, such as Ellis and Hungerford, *History of That Part of the Susquehanna and Juniata Valleys*, call this forge "Licking Creek Forge," "Beale's Forge," or simply, the "Forge on Licking Creek." Mifflin County court records (Juniata County was not yet erected) clearly show that the forge was called "Freedom Forge." A detailed correct history can be found in Paul T. Fagley, "Forging Iron, Forging Steel, Forging Freedom: The Story of the Iron and Steel Industry at Burnham, Pa. From Freedom Forge to Standard Steel," *Canal History and Technology Proceedings* 14 (1995): 33–37.

11. Linn's *History of Centre and Clinton Counties* gives excellent accounts of the county's better-known ironworks, though they are scattered throughout the chapters on the townships.
12. Linn, *History of Centre and Clinton Counties*, 32.
13. It is reported in numerous local histories, and in a state historical marker at the site, that this was the first screw factory in America. The earliest source to cite this statement appears to be Linn, *History of Centre and Clinton Counties*, 384. A quick check on the Internet reveals an earlier screw factory in Rhode Island in 1810, though all references found are recent publications.
14. Africa, *History of Huntingdon and Blair Counties*, 425; and Albert Rung, "'Viators' Journey in 1833," *Daily News* (Huntingdon, PA), December 28, 1946, 6. It is interesting to note that her life paralleled that of Rebecca Lukens, who is considered the first female industrialist in America, except that Elizabeth accomplished her feat twenty years earlier, and ran her ironworks for twenty-seven years, five more than Rebecca. Yet Elizabeth is unknown.
15. In addition to information in Africa, *History of Huntingdon and Blair Counties*, 495 (addenda), a good biography of Anshutz can be found in John Newton Boucher, *A Century and a Half of Pittsburgh and Her People*, vol. 2 (Pittsburgh: Lewis Publishing Co., 1908), 13–14.
16. This George is the father of Dr. Peter Shoenberger, and grandfather of the George Shoenberger of Pittsburgh fame.
17. The best account of William McDermott is in James Moore Swank, *History of Ironmaking and Coal Mining in Pennsylvania* (Philadelphia: Published by the author, 1878), 42–44.
18. David Watts Hulings was a grandson of Marcus Hulings, an early settler near Clark's Ferry. See *Commemorative Biographical Encyclopedia of Dauphin County, Pennsylvania* (Chambersburg, PA: Runk, 1896), 121.
19. There was an important iron district centered on Salisbury, Connecticut, that lasted from about 1734 to 1920. While the ore was average in quality, it was high in manganese, a mineral that improved the melting and corrosion resistance of iron, and is a critical alloy in steelmaking. The ore was worked with great labor into a high-quality iron that was as "celebrated" in New England as Juniata iron was on a larger scale. There are many instances of the two being compared to each other.
20. As stated, this reputation of the "celebrated" Juniata iron is unequivocally stated in numerous sources, including those by noted iron historians like John B. Pearse, J. Peter Lesley, and James M. Swank, yet little if any documentation to back up these claims was ever offered, and seems to be more anecdotally derived. In 1964 American University graduate student Harold Edwin Stine wrote a master's thesis exploring this reputation, using surviving nineteenth-century statistical data to attempt to discover solid evidence to back up the claims. While he acknowledged the data was limited and incomplete, there was

enough to demonstrate that Juniata iron was held in high esteem by "downstream" manufactures and consumers. Harold E. Stine, "The Story of Juniata Iron," master's thesis, American University, Washington, DC, 1964. This thesis is the only good history of the valley written to this point, yet nearly a century after the authors cited.

21. In addition to US Route 22, which follows the route of the Harrisburg-to-Pittsburgh Turnpike, and US 322, which locally follows the old Kishacoquillas Turnpike from Lewistown to Boalsburg. State Route 45 through Spruce Creek Valley in Centre and Huntingdon counties follows the main route of Centre County iron westward.
22. For instance, Swank, in his *Introduction to a History of Ironmaking and Coal Mining*, on page 44 makes a statement to this affect, yet provides little beyond anecdotal evidence for this statement. Surprisingly, surviving reputable documents from the time do support the idea that the Juniata Iron District was a principal ironmaking district, based on available production figures.
23. These statistics are compiled in Stine, "Story of Juniata Iron," 32–42. In this study, while Stine rejects the numbers cited by Pease and others as relying too heavily on a single source that itself notes was grossly incomplete, he instead uses other, more reliable data, and is able to very closely match the statistics stated by these authors. These statistics bear out the percentages stated.
24. Historically, mechanical items were made one at a time by hand, which took considerable time. No two items were alike, creating problems when parts broke. Whitney's radical idea was to use new precision machining technology to mass-manufacture parts, where an operator concentrates on the making of only one part, and then assemble the items from these parts along a line of workers, essentially popularizing the modern concepts of "parts standardization" and the "assembly line." In Whitney's case, it was muskets for the federal army.
25. Eli Whitney, letter to Henry Grubb, Esq., dated June 12, 1819, as quoted in "Rung's Chronicles." These were a series of historical newspaper articles printed in the *Huntingdon Daily News*. Later, the best columns were compiled in book form. See Albert M. Rung, *Rung's Chronicles of Pennsylvania History* (Huntingdon, PA: Huntingdon County Historical Society, 1977), 275.
26. These figures are from the 1840 US Census of Manufacturers. Compilers at the time noted the possible inaccuracies in the results, but produced a chart showing production. Huntingdon County had twenty furnaces, producing 13,855 tons of cast (pig) iron. No other county, including Allegheny with twenty-eight furnaces, exceeded the 8,220 tons made in only eleven furnaces in Berks Co. Similarly, Huntingdon County had twenty-seven forges, second only to Berks County with thirty-six. Huntingdon produced 14,093 tons of bar iron, second to Allegheny at 28,100 tons. See page 17 of Cephas G. Childs, ed., *Coal and Iron Trade: Embracing Statistics of Pennsylvania* (Philadelphia: C. G. Childs, 1847).

27. See, for instance, Swank, *Introduction to a History of Ironmaking and Coal Mining*, 44.
28. One of the few surviving visible remains of this road is the Old Stone Arch Bridge at Lewistown. It was built in 1813 and is considered the oldest surviving bridge of its type in central Pennsylvania. Its single arch is unusual, more of a parabolic shape than Roman, and is rather large for the size of the bridge, giving the bridge a decidedly delicate appearance. The bridge is also a rare surviving example of a stone arch bridge built without a keystone. It is listed on the National Register of Historic Places, and was last restored in 2006.
29. See Gerald G. Eggert, *Making Iron on the Bald Eagle: Roland Curtin's Ironworks and the Worker's Community* (University Park: Pennsylvania State University Press and the Centre County Historical Society, 1999).
30. Despite the extensiveness of this ironworks, no contemporary history of it exists, beyond brief mentions. It is barely mentioned in the two most important works of the period while it was still active, Linn's *History of Centre County*, and Africa's *History of Huntingdon and Blair Counties*, though the latter states that a requested history was never received. Most of this paragraph is pieced together from numerous contemporary newspaper clippings, industrial records, county tax rolls, and deeds.
31. See Africa, *History of Huntingdon and Blair Counties*, 55.
32. Nancy S. Shedd, *Huntingdon County, Pennsylvania. An Inventory of Historic Engineering and Industrial Sites* (Washington, DC: HABS/HAER Record, National Park Service, 1991), 3–5, which in turn largely quoted from Merritt Roe Smith, *Harper's Ferry Armory and the New Technology* (Ithaca, NY: Cornell University Press, 1977), 166–68, 170, 179.
33. Syndicated announcement, published in numerous newspapers around the country, on or about July 13, 1854, "Death of a Millionaire. —The *Columbian* (PA) *Spy* says Dr. Peter Shoenberger, one of the wealthiest men of the State, died at the residence of his son, in Marietta, on the 18th of June, in the seventy-second year of his age. He has been long known as 'the king' iron master, and his property is estimated to be worth over five millions."
34. Little biographical information can be found on Shoenberger. The best reference, rather uncritical, is, Calvin W. Hetrick, *The Iron King: The Story of Dr. Peter Shoenberger* (Martinsburg, PA: Morrison's Cove Herald, 1961).
35. See Harry H. Hain, *History of Perry County, Pennsylvania, Including Descriptions of Indians and Pioneer Life from the Time of Earliest Settlement* (Harrisburg, PA: Hain-Moore, 1922), 271.
36. Charles Dickens, *American Notes* (London, 1842), chapter 10. An online version is available at: http://www.online-literature.com/dickens/americannotes/11/.
37. There are many detailed histories of the Pennsylvania Main Line Canal; however, a good somewhat recent summary of its impact can be found in Joseph A.

Strausbaugh, "The Influence of the Pennsylvania Mainline of Public Works," *Gettysburg Historical Journal* 5 (Fall 2006): 18–31.

38. All later histories call this operation "Paradise Furnace." Some do barely mention the "Mary Ann Furnace" name associated with Savage. The "Trough Creek Furnace" name was totally unknown and long forgotten. This author discovered two independently verifiable sources for the original name: (1) a public notice, published in the *Huntingdon* (PA) *Gazette*, November 10, 1830, et al.; and (2) an article of agreement, dated April 16, 1833, between lessor Reuben Trexler and lessee John Savage, of Trough Creek Furnace and other lands, found in Huntingdon County Deed Book X-1, page 361.
39. While others conducted experiments in using coke in the early years of the nineteenth century, William Firmstone is generally regarded to be the first person to successfully make iron using coke in America, at Paradise Furnace in Huntingdon County. Swank gives a decent account of Firmstone at Paradise Furnace in his *History of the Manufacture of Iron* (1892 edition), 367–68.
40. Several metal parts removed from Winchester and (Old) Rockhill Furnaces are today displayed at Greenwood Furnace State Park. Many of the furnace lintels are marked "TTC," Cromwell's initials.
41. Company-produced sales booklet, *Freedom Iron Company, Manufacturer of Locomotive Tyre, Pump and Piston Rods, Engine & Car Axles, Bar of All Sizes, and All Forgings for Railroad Machinery, Lewistown, Mifflin County, Pennsylvania* (Philadelphia, Crissy and Markley, 1863. Obviously this is a biased source, but comparing the mileages given in the booklet, it can be seen that it was a very high quality. Note: "tyre" is the contemporary British spelling of "tire," that was also used in America mid-nineteenth century.
42. A good source for Perry County ironworks is Hain, *History of Perry County*.
43. Reports of these surveys are well detailed in Charles L. Schlatter, *Second Report of Charles L. Schlatter, Principal Engineer in the Service of the State of Pennsylvania: To the Canal Commissioners, Relative to the Continuous Railroad From Harrisburg to Pittsburgh* (Harrisburg: James S. Wallace, 1841).
44. No action by the state was taken on these alternate surveys. No grading took place, and no tunnels begun. While it is technically speculation that these three furnaces were built as a result of the proposed line, they were built when this particular survey was forefront in the local news. The three furnaces mentioned were the Little Furnace, built in 1841 outside McAlevy's Fort, Rebecca Furnace, built in 1843 near Jackson's Corner, and Monroe Furnace, built in 1845 near Masseyburg. Of the three, nothing was left of Little Furnace by 1876, and Rebecca Furnace survived until about twenty-five years ago. The stack of Monroe is still visible along PA Route 26 and Charter Oak Road at the base of Tussey Mountain.
45. The railroad station at Lewistown Junction, listed on the National Register of Historic Places, has been restored to its 1890s appearance. It is the oldest

existing station along the mainline of the former Pennsylvania Railroad, and may be the oldest station in continuous use in the United States. It was built in 1849 as a freight depot, when Lewistown was the western terminus of the line, and converted to a passenger station in 1868. It is also the oldest surviving building known to have been built by the PRR. The station is still serviced by two Amtrak trains daily, though there are no ticketing or baggage services. The Pennsylvania Railroad Technical and Historical Society has its headquarters and archives in the building.

46. For a good complete history of the Southern Pennsylvania Railroad, see William H. Shank, *Vanderbilt's Folly: A History of the Pennsylvania Turnpike* (York, PA: American Canal and Transportation Center, 1993).
47. Gleaned from the indices of the ironworks of Pennsylvania, found in *Documents Relating to the Manufacture of Iron in Pennsylvania* (Philadelphia: General Committee of the Convention of Iron Masters, 1850).
48. Much information on the financial hardships of this period on the iron industry of Pennsylvania can be found in ibid.
49. It should be noted here that many histories state the founding date of what is now Standard Steel was 1795. This date comes from Ellis and Hungerford, *History of that Part of the Susquehanna and Juniata Valleys*. Recent researchers have proven this date to be incorrect. Unfortunately, many other works used Ellis and Hungerford as a prime source, compounding the original error. In fact, Ellis and Hungerford give the source for the date, namely a road petition in the Mifflin County Courthouse. When examined, this petition clearly shows that it is referring to the Freedom Forge on Licking Creek. Prior to Ellis and Hungerford, the company clearly considered its founding date to be 1810. However, this author believes that there is a connection to the Licking Creek Freedom Forge and is tied to the company, which would place its founding circa 1790. See Fagley, "Forging Iron, Forging Steel, Forging Freedom."
50. One stove made circa 1816 at the Burnham plant survives and is on display in the entrance lobby of Standard Steel in Burnham.
51. A "chafery" was a type of hearth for reheating blooms (blocks) of iron while being drawn under a hammer into wrought iron.
52. Company-produced sales booklet, *Freedom Iron Company*, 1863.
53. The story of this invasion is not well known, even locally. The men that were recruited locally are part of the "Pennsylvania Emergency Troops of 1863." They were not enrolled or mustered in any regiment, therefore were not trained or provisioned. Instead, they foraged for food, and took to raiding barns and chicken coops, giving them the nickname "The Chicken Raiders." Despite the connotation of the name, they were in fact brave men who built fortifications and were prepared to fight to save their region. When the emergency passed, they went home. A more complete account of this invasion can

be found in Milton V. Burgess, *Minute Men of Pennsylvania* (Blair County PA: Morrison's Cove Herald, 1962).

54. Swank, *Introduction to a History of Ironmaking and Coal Mining*, 44.
55. The story of how the Bessemer process came to America is a complicated one, but its delay of a decade after its introduction in England is largely the result of patent disputes between Bessemer, Kelly, and Robert Mushet, each of whom controlled only some of the many patents needed in America. After the Civil War, a group of ironmakers in Troy, New York, led by Alexander Holley, was able to obtain all the necessary patents and bring it to the American iron industry, using only Bessemer's name. A good source for this story is Jeanne McHugh, *Alexander Holley and the Makers of Steel* (Baltimore: Johns Hopkins University Press, 1980)
56. The first Bessemer works in the United States were Wyandotte, Michigan (a hybrid Kelly-Bessemer Works technically using the process unlicensed), 1864; Bessemer Steel Works, Troy, NY (John A. Griswold and Company), 1864; Pennsylvania Steel Works, Steelton, PA 1867; and the Freedom Iron and Steel Company, Burnham PA, 1868. Cambria Iron Works' Bessemer Plant was not until 1871 (using the same license as the others), though William Kelly experimented there with his process years earlier. A "Kelly Converter" vessel from these experiments is today housed in the Smithsonian.
57. Andrew Carnegie, *Autobiography of Andrew Carnegie* (Cambridge, MA: Houghton Mifflin, 1920), 185.
58. Much research remains to be done on William Butcher Jr. Dr. Charles Wrege (historian and archivist at the Academy of Management, Briarcliff, NY) and Ronald Greenwood (author) did much early research, and this author had many pleasant conversations with Wrege before his passing a few years ago.
59. There is another long-lived company in the Juniata Valley. McLanahan Corporation in Hollidaysburg, Blair County, has been in business since 1835, beginning as a forge.
60. John B. Pearse, *A Concise History of the Iron Manufacture of the American Colonies Up to the Revolution, and of Pennsylvania Until the Present Time* (Philadelphia: Allen, Lane, and Scott, 1876), 175–76.
61. Quoted in part from "Extract from a Letter from John A. Wright, Esq.," *Documents Relating to the Manufacture of Iron in Pennsylvania*, 47–53.