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INDUSTRIAL ARCHAEOLOGY IN THE BLACKLOG NARROWS

A Story of the Juniata Valley Iron Industry

Pennsylvania Department of Transportation

Scott D. Heberling

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Heberling Associates, Inc.

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for the Pennsylvania Department of Transportation

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Rediscovering an Industrial Past

Today, the small community of Orbisonia, located in the mountains of southeastern Huntingdon County, Pennsylvania, is best known as the home of the historic East Broad Top Railroad. Few people realize that Orbisonia was once an important industrial center at a time when the Juniata River Valley of central Pennsylvania was world famous for its iron products. In fact Bedford Furnace, one of the first ironworks west of the Susquehanna River, was built there at the end of the 18th century when the region was still a wilderness. A little later two charcoal-fueled blast furnaces and a large stone mill operated along Blacklog Creek in the "Blacklog Narrows" just southeast of town. Still later an even larger coke-fueled iron furnace complex was built on the opposite side of the creek. These industries were surrounded by ore mines, charcoal-making platforms, stone quarries, haul roads, and workers' houses. All are now long-abandoned, their sites reclaimed by nature.

Recently, a highway improvement project provided an opportunity to rediscover the historic industries in the Blacklog Narrows. From 1997 to 2003 the Federal Highway Administration and the Pennsylvania Department of Transportation sponsored extensive archaeological excavations at the Winchester and Rockhill Furnace sites and the Cromwell Grist Mill site, all to be impacted by highway construction. The results of these studies are presented in the following pages.

Cromwell Mill and miller's house in the early 1900s
(contemporary postcard)

Orbisonia lies on the edge of the "Juniata Iron District," the most important iron-producing region in the United States during the first half of the 19th century. "Juniata Iron" owed its reputation for excellence to the high quality of local iron ores. Although the district included seven counties, most ironworks were concentrated along the Juniata River and its tributaries in Huntingdon and Blair Counties and along Bald Eagle Creek and its branches in Centre County.

In early America iron products were critically important and highly valued. Items such as iron nails, hardware, implements, and weapons were essential to many everyday activities, including building construction and maintenance, industry, transportation, hunting, farming, and animal husbandry. The need for iron increased as time went on because of growing population and greater industrialization. Beginning almost with the first settlement, colonists established blast furnaces and forges to provide themselves with the iron products that they needed, often in defiance of government policies aimed at requiring them to import all finished iron goods from England. By 1800 the iron industry was well established in the United States, with its center in southeastern Pennsylvania.

The Juniata Iron District

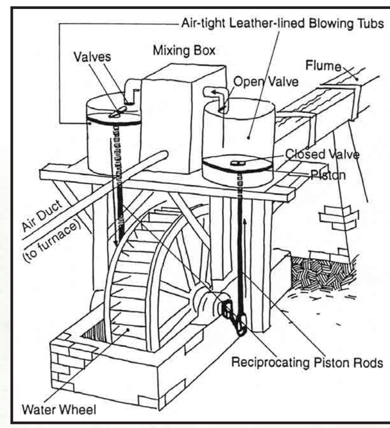
As settlers poured into central Pennsylvania after the Revolution, enterprising ironmasters found that the region's vast tracts of virgin timber, abundant deposits of high grade iron ore and limestone, and swift mountain streams were ideal for the production of iron. Since the finished products of forges and blast furnaces were less bulky and easier to transport than the raw materials, it was more practical to establish the industries in the countryside near good sources of raw materials rather than near their urban markets. Ironmasters attempted to place their furnaces near a variety of resources, but access to good ore probably was most important.

These ironworks used a standard technology that had evolved in Europe and America over hundreds of years. Although there had been a few improvements—for example, the use of blowing cylinders instead of leather bellows to generate the blast—most furnaces continued to be small water-powered operations using charcoal for fuel. However, over the next fifty years, sweeping technological changes would revolutionize the industry and make small rural charcoal-fueled ironworks like Rockhill and Winchester obsolete. In 1830 the Pennsylvania iron industry stood on the brink of a new era.

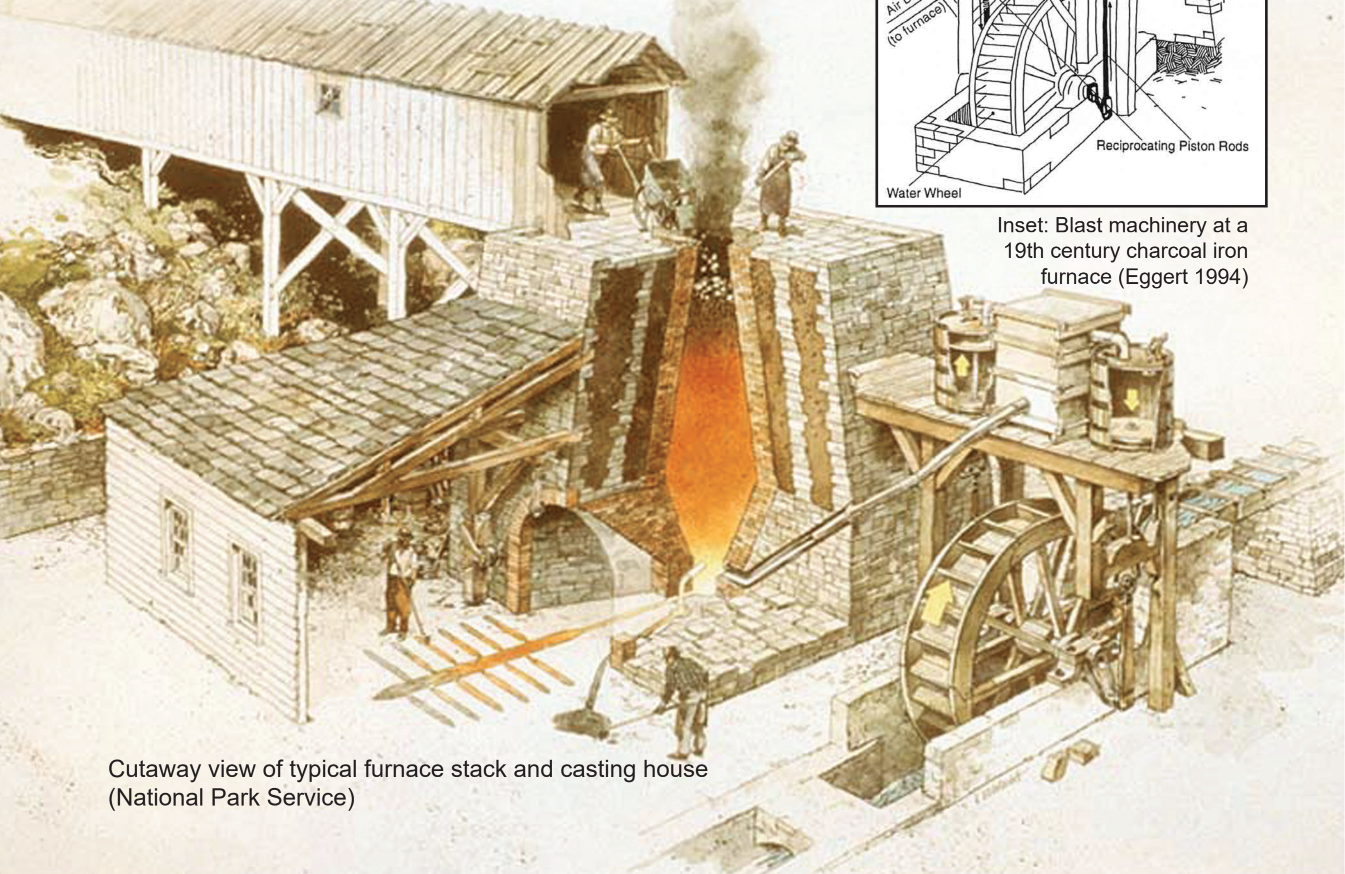
The basic process of smelting iron in a blast furnace was fairly simple. The goal was to remove impurities from the raw iron ore by applying intense heat under controlled conditions, producing a purer and more workable product that could be further refined and shaped at a forge. The massive stone structures in which the smelting process occurred were called *blast furnaces.* Combustion of carbon fuel (charcoal, anthracite coal, or coke), driven by a pressurized blast of air, provided the required high temperatures. The blast was generated by a water-powered wheel or by steam. Workers dumped alternate charges of processed iron ore, fuel, and a fluxing material (usually limestone) into the top of the blast furnace. If the heat was sufficient, the impurities were drawn off by the flux and floated to the top of the mixture as liquid slag; the iron sank to the bottom and was poured out of the furnace into sand molds. The resulting ingots were known as *pig iron* because of their resemblance to a nursing sow and piglets.

The simplicity of the basic process does not mean that it was an easy thing to smelt iron. Ironmasters needed specialized knowledge, sharp business skills, and more than a little luck. They needed to build their ironworks near sources of high-quality iron ore, limestone, and timber. In the era before steam, it was essential to have a reliable source of water power. An ironmaster had to be familiar with the chemical makeup of his ores and fluxes and with the blast process itself. He had to possess good managerial and marketing skills and enough capital to buy land and build structures. Market conditions had to be favorable. Under these circumstances, it is no wonder that failure was typical and success the exception.

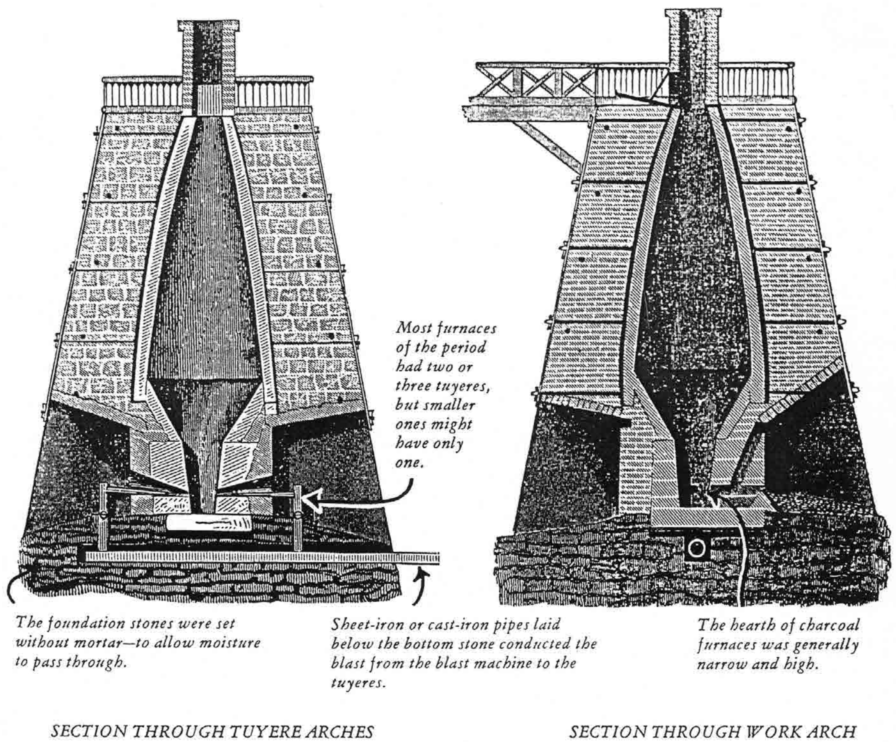
There were several key structures at every ironworks. The largest of these was the *stack*, a hollow stone pyramid about 25-35 feet high, housing a brick flue (*bosh*), where the actual smelting occurred. Several sides of the stack contained arches: the *casting arch* usually was at the front of the stack, and was large enough to allow workmen to observe the smelting process and tap the molten iron. One or more *tuyere arches* contained pipes that carried the blast of pressurized air into the stack to make combustion possible. The *casting shed* was a large shed extending from the stack and covering the casting arch and sand molds. If the furnace made stoveplate and other castings, they would be finished in a corner of the casting house or in an adjacent *cleaning shed*. The *blast shed* was located at one side of the stack and covered the machinery that generated the blast. At early furnaces large leather bellows produced the blast but by the 19th century these had been replaced by more efficient blowing tubs or cylinders.



Inset: Blast machinery at a 19th century charcoal iron furnace (Eggert 1994)



Cutaway view of typical furnace stack and casting house (National Park Service)

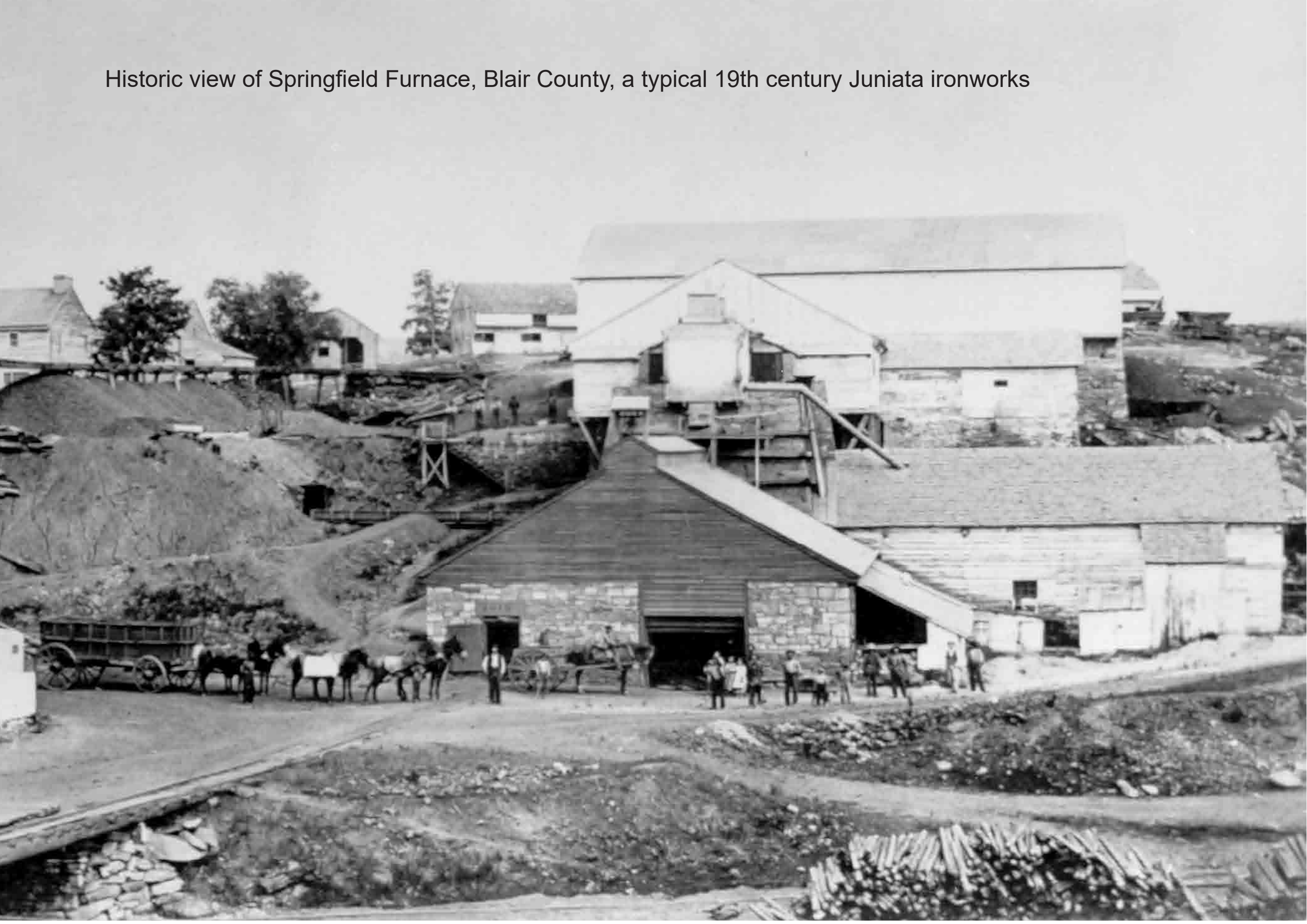


Cross-section of a 19th century blast furnace (Weitzman 1980)

A good site for the blast furnace was critical. When selecting a site, the ironmaster looked for a location at the base of a hill to make it easier to load the raw materials into the top of the stack. A *charging bridge* spanned the open space between the hill and the stack. On the hill near the charging bridge were a *charcoal shed*, *cooling shed*, and other buildings to store the charcoal, limestone and iron ore that were put into the furnace. A nearby stream would be dammed and water brought by a race system to turn a waterwheel which powered the blast machinery. When good water power was not available, many 19th century furnaces used steam as a power source.

Other structures included an office, a company store, shops for making and repairing tools, stables for the mules, and houses for the workers. Stockpiles of casting sand and huge slag dumps were typical landscape features. Nearby were ore pits and charcoal-burning platforms that produced the raw materials. A rural ironworks was the center of a self-contained industrial village complete with church, cemetery, school, and agricultural buildings.

Historic view of Springfield Furnace, Blair County, a typical 19th century Juniata ironworks

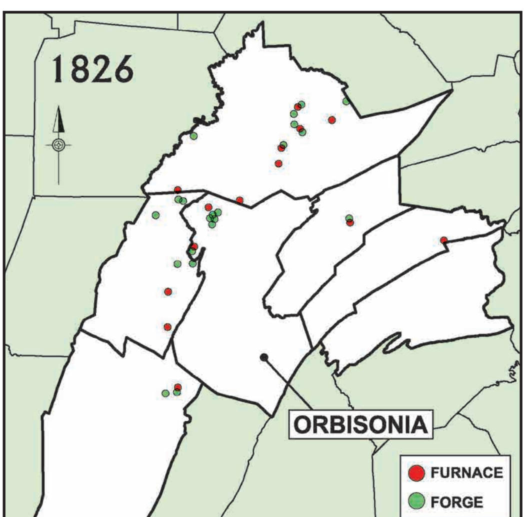


Most charcoal ironworks employed 75 to 100 full-time workers and an equal number of part-time workers. The relatively few of them who were directly involved in smelting iron worked on two 12-hour shifts because when a furnace was in blast it had to be operated 24 hours a day. The rest worked at obtaining fuel, mining ore, driving teams, and doing other essential tasks.

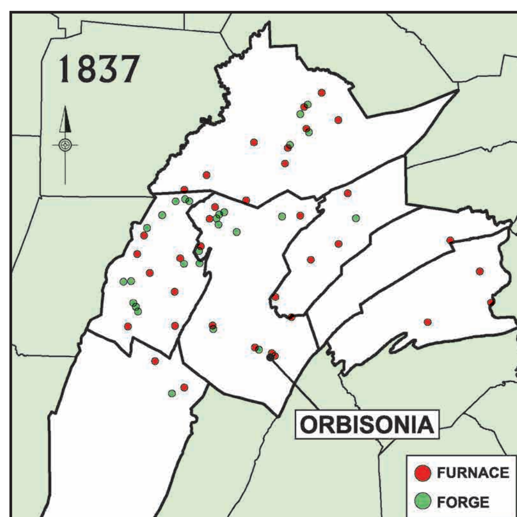
Though there were periods of depression, in general the local iron industry prospered until the 1840s. In 1828 the Juniata District contained 24 blast furnaces, 25 forges, and 4 rolling mills, producing 25,500 tons of cast and pig iron, and 12,000 tons of bar iron. Much of this was shipped overland to Pittsburgh, with smaller amounts sent down the Juniata and Susquehanna rivers to eastern markets. Since high iron prices in Pittsburgh compensated for the expense of hauling iron across the mountains most Juniata producers found this more profitable than sending iron east, where it faced greater competition and lower prices. In 1830 the completion of the Pennsylvania Canal system through the Juniata Valley greatly improved market access and reduced shipping costs.

The most successful Juniata ironworks were "vertically-integrated" operations, which included different stages of iron manufacture under unified management: a blast furnace smelted the ore, a refinery forge converted the furnace's pig iron into *blooms*, and a rolling mill produced an easily marketable product. This gave them a significant advantage over their competitors. The owner of a blast furnace who lacked a forge and rolling mill was forced to market his pig iron as best he could, by himself or through an agent.

In 1840 the Juniata Iron District had more ironworks than ever before, but there were signs of trouble ahead. From the 1830s on, local iron producers faced new competition from the Allegheny, Shenango, and Mahoning valleys of western Pennsylvania and eastern Ohio, as well as farther west. At the same time new technology was making the old refinery forges in the Juniata District obsolete. The use of cheap anthracite coal to fuel blast furnaces in eastern Pennsylvania was yet another threat. With the loss of their market for both blooms and castings, the continued survival of Juniata ironmakers depended on their ability to adapt to changing conditions and to enhance the efficiency of their operations. By the 1840s many furnaces were being adapted to hot-blast technology, where the hot waste gases rising from the top of the stack were captured and used to heat the blast, reducing the amount of fuel that was needed. Some ironmasters began using the superheated waste gases to produce steam for powering the blast machinery, resulting in even greater efficiency.



Juniata District ironworks in 1826, before completion of Pennsylvania Main Line Canal



Juniata District ironworks in 1837, after completion of Pennsylvania Main Line Canal

After 1850 the center of the Juniata iron industry moved from Huntingdon and Centre counties west to Blair County, mainly because of its better access to rail transportation and coal deposits. The changing face of the Juniata iron industry reflected the revolutionary technological changes that transformed the industry as a whole after 1850. Four developments were particularly crucial: the increasing use of coked bituminous coal as fuel; the discovery of new sources of high-quality iron ore in the upper midwest; the adoption of new open-hearth processes for making steel; and the construction of an extensive railroad network. These changes resulted in a shift of iron production to the midwest and led to the ultimate collapse of the already-troubled Juniata iron industry.

Because of a continuing niche market for high-quality charcoal iron, a few of the better-managed, better-situated, and better capitalized Juniata charcoal iron producers were able to survive into the 20th century. But eventually, they too disappeared one by one. By 1908 the Juniata District contained only two charcoal furnaces (and 10 coke furnaces), producing only 4,200 tons of iron. Although there was still a market for their products, most of the best local ore deposits had been exhausted, and local ironmakers were importing ore from the upper midwest or Virginia. Within a few more years, the iron-making era in the Juniata Valley was over.

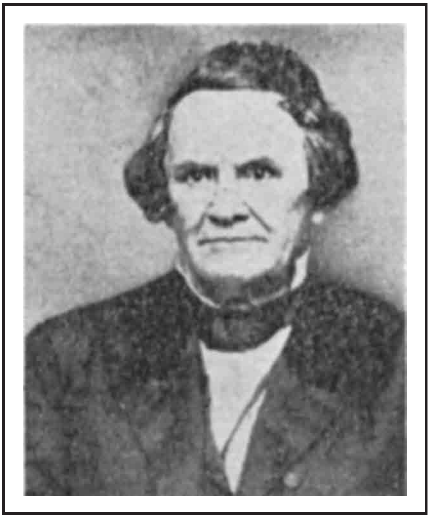
Blacklog Creek

Winchester and Rockhill furnaces were among the scores of ironworks that were established throughout the Juniata River Valley between 1800 and 1850, the height of the region's iron-making period. Although they were neither large nor particularly successful, these two operations, together with the earlier Bedford Furnace (1785-1795) and the later Rockhill Iron Works (1876-1908), both located nearby, are typical of others in the region and illustrate the evolution of American iron-making over the course of the 19th century.

The western end of the Blacklog Narrows offered a location satisfying all of the needs of early industry. Blacklog Creek provided water power for both iron furnaces and the adjacent mill. There was abundant timber on the nearby mountain slopes, which also yielded enough ore to supply not only Winchester and Rockhill furnaces, but several other contemporary furnaces and the later Rockhill Iron Works. The one thing lacking was decent transportation; this resulted in the failure of Bedford Furnace in 1795 and discouraged the construction of any new ironworks at Orbisonia until the Pennsylvania Canal was completed in 1830. After that, iron could be hauled 10 miles north to Mount Union, where it was loaded onto canal boats for transport to eastern and western markets. Because of improved transportation, five new ironworks were built near Orbisonia during the 1830s and 1840s, including Winchester and Rockhill.

Thomas T. Cromwell's stone flour mill (1826) was the first enterprise to be built in the Blacklog Narrows, powered by the same dam and race that later supplied Winchester and Rockhill Furnaces. In 1830 Cromwell sold 19 acres of land in the Narrows to Thomas Diven, together with houses, lumber, and the right to mine ore and cut timber. Diven then purchased thousands of additional acres of timber and ore lands and built Rockhill Furnace in 1831. Diven provided the technical expertise, while his partner William Morrison fronted most of the required capital. In 1832 Thomas Cromwell constructed Winchester Furnace on an adjacent tract, putting it in blast in 1834. Although it was the ore deposits that made iron smelting possible at Orbisonia, water power was the critical factor in siting the furnaces. No other potential locations offered the same combination of a stream and a high bank for loading the stack.

Very little is known about the day-to-day operation of Winchester Furnace at any time during its history, but its career seems to have been remarkably undistinguished. It was leased and operated unsuccessfully and sporadically by a series of individuals for two decades, but it was frequently out of blast and never had a large product. It was plagued by problems with ore, water power, transportation, and a low wet site. By 1850 it had been abandoned.

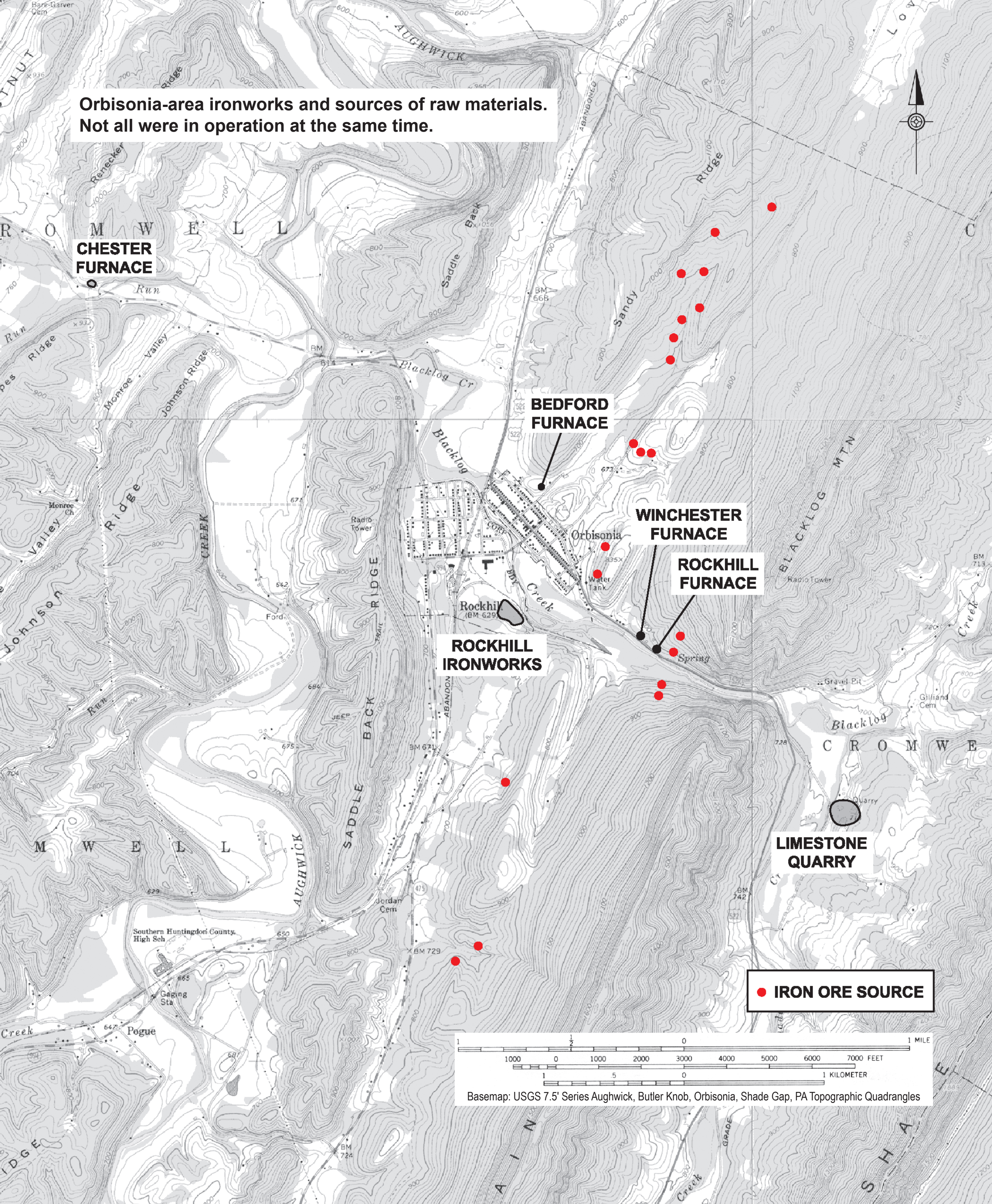


James Martin Bell

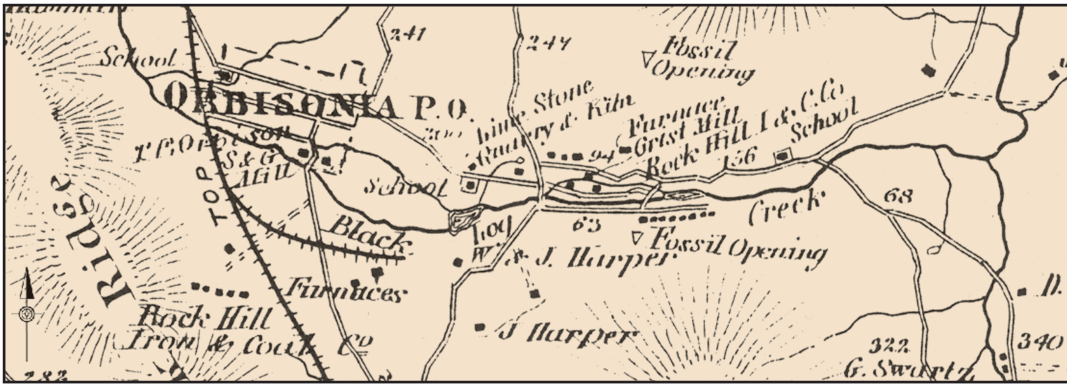
Rockhill Furnace lasted longer and was more successful, although it too experienced many problems. The partnership between Diven and Morrison ended in 1833 and the ironworks was acquired by James Martin Bell, up-and-coming Huntingdon attorney and a member of one of the most prominent ironmaking families in the Juniata Valley. Diven stayed on as manager for a time, but was succeeded by John R. Hunter in 1836. Although chronically short on operating capital Rockhill remained in fairly constant operation under Bell's ownership until 1846. Its main product was pig iron, which was sold to refinery forges throughout the Juniata District and beyond. Between 1832 and 1846, 59 different forges between Philadelphia and Pittsburgh were listed as customers in the company records. In the mid-1830s much of Rockhill's pig iron was processed into blooms at nearby Aughwick Forge, owned by William Pollack, who later was a partner at Winchester Furnace.

In addition to pig iron, Rockhill Furnace produced castings, especially stoveplate and hollow ware (pots and kettles). Many of its stoves were sold locally, usually on consignment. However, the market for Rockhill stoves extended over a huge area which included Cincinnati, Baltimore, Albany, New York City, and Boston. Some wholesalers purchased large lots. Bell made occasional trips to Philadelphia, New York, and Pittsburgh to market his iron, but like most Juniata ironmasters, he relied mainly on agents and commission merchants to sell his pig iron and castings in the cities. Bell was at a competitive disadvantage because he did not have a vertically-integrated operation with a blast furnace, refinery forge, and rolling mill.

Rockhill's castings and pig iron had a mixed reputation for quality, and Bell received many complaints about defective work, short weights, and slow delivery. Some of the ore used at the furnace was inferior and it tended to produce poor castings and blooms. While James Martin Bell was an able attorney and came from a family of well-known ironmasters, he seems to have had little technical or managerial ability. For him, ironmaking was only a sideline. Because of continuing financial and technical difficulties he began to shop the ironworks to prospective buyers as early as 1835. His appointment as a state senator in 1838 ended most of his active involvement with the business, although he remained the owner until 1846.



Orbisonia-area ironworks and sources of raw materials.
Not all were in operation at the same time.
CHESTER FURNACE
BEDFORD FURNACE
WINCHESTER FURNACE
ROCKHILL FURNACE
ROCKHILL IRONWORKS
LIMESTONE QUARRY
IRON ORE SOURCE
Orbisonia
Rockhill
Basemap: USGS 7.5' Series Aughwick, Butler Knob, Orbisonia, Shade Gap, PA Topographic Quadrangles



Orbisonia area in the 1870s (Pomeroy & Co. 1873)

Bell leased Rockhill Furnace to John R. Hunter and Andrew J. Wigton. When Hunter dropped out a few years later, Wigton brought his brothers into the business, and they operated it with fair success. In January 1846 a disaster occurred at the furnace when part of the stack collapsed during a blast. This resulted in a "breakout," one of the most serious situations that could face an ironmaster. The stack was repaired by adding a new outer layer of stone around the original stack, which made it stronger and wider. Archaeological excavation of the stack revealed evidence of this major repair. This may have been the last straw for Bell, who had been trying to sell the ironworks for over ten years. In October 1846 he finally did so, conveying it to the firm of Isett, Wigton & Company for $5,500.

Isett, Wigton & Company included members of two well-known ironmaking families from northwestern Huntingdon County. One of them, John S. Isett, had married Mary Ann Bell, James Martin Bell's sister. The Isetts and Wigtons were experienced iron men who had the ability to make a success of Rockhill Furnace if anybody could. One of the first things they did was to lease Winchester Furnace—the first attempt by any individual or firm to operate both Winchester and Rockhill together (they also were leasing Cromwell Mill at that time). One of their next moves was to rebuild both furnaces and convert them for use with the new hot-blast technology, improving their efficiency. Despite their expertise, the partners could not make a go of Winchester Furnace, and they abandoned it for good in 1850.

An 1850 survey of Pennsylvania ironworks lists Winchester and Rockhill as water-powered hot-blast charcoal furnaces employing 40 men each. Yet they differed considerably in their use of ore and their marketing strategies, with Rockhill sending its product east and Winchester west. Their annual capacity was quite small (850 tons at

Rockhill, 500 tons at Winchester), compared to other hot-blast furnaces in the Juniata region. In the same year, 19 of the other 21 hot-blast furnaces in the core of the Juniata District had larger capacities than Rockhill. Rockhill Furnace operated more or less continuously through the 1850s, under the ownership of Isett, Wigton & Company, but was out of blast by 1860. It was put back into operation during the Civil War to meet the wartime demand for iron, but at the end of the war it was abandoned again.


Percival P. Dewees

In 1867 Rockhill and Winchester furnaces and all associated property were acquired by Percival P. Dewees and Dr. Lewis Royer, both experienced iron men. Despite the checkered past of the local ironworks, Dewees was convinced that the Orbisonia area was rich in high-quality iron ore, and he was determined to find it. He no doubt was encouraged by plans to finally commence construction of the East Broad Top Railroad, which would alleviate the chronic transportation problems that had always plagued local industries. Dewees rehabilitated Rockhill Furnace and put it back in blast. He also bought and modernized the old Cromwell Mill, increasing its efficiency by adding turbines and supplemental steam power. He systematically looked for new ore sources, which he found in 1869. With a reliable source of good ore, Dewees moved ahead with his plans to build a modern coke-fueled ironworks on the opposite side of Blacklog Creek.

The old furnace remained in blast for another few years, but was finally blown out for the last time in 1872. Ground was broken for the new furnaces the next year, and the brand new Rockhill Iron Works was put into blast for the first time on New Years Day 1876. It was the beginning of a new era of ironmaking in the Blacklog Narrows, one that was very different from everything that had gone before. Dramatically different in scale and technology from the earlier charcoal furnaces that made the region nationally prominent, it was an ambitious attempt to keep Juniata Iron competitive in an industry that had moved far beyond the Juniata Valley in every way. But that was not to be. Despite a strong start and high hopes, the new facilities of the Rockhill Iron and Coal Company truly marked the last gasp of the Juniata iron industry. During the business depression of 1908-1909 operations were discontinued, and in 1915 the furnaces were dismantled and moved to Tennessee. Iron was never made at Orbisonia again.

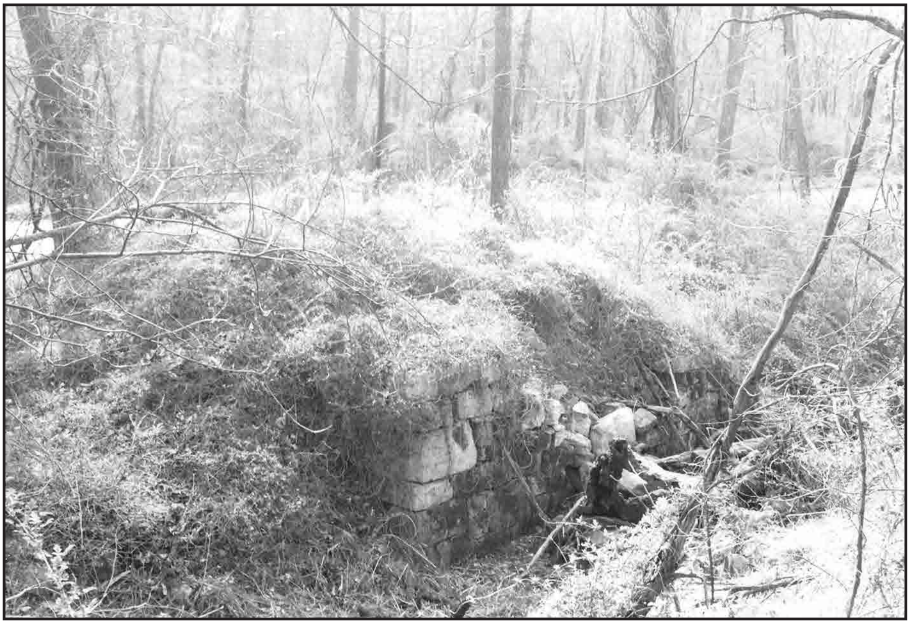
The archaeological studies focused on the remains of Winchester and Rockhill furnaces and the Cromwell Mill, but they also included documentation of many related features, including the dam and race system, ore pits and shafts, a stone quarry, and connecting roads. Other features, such as workers' houses, charcoal-making platforms, and the ruins of Bedford Furnace (1785-1795) and the Rockhill Iron Works (1876-1908) lie outside the area to be affected by highway improvements and were not studied in detail; they survive intact for future investigation.

At the Cromwell Mill, archaeological excavation revealed well-preserved remains of the turbines, headrace and tailrace, as well as the boiler shed and the massive interior walls that supported the mill machinery and millstones. The historical and archaeological evidence demonstrated that the operators of the mill—especially Percival P. Dewees—were quite willing to adopt new technology like turbines and supplemental steam power that would improve efficiency and make their enterprise more competitive and profitable, even though they continued to rely on water as the principal power source. Though many people think of rural water-powered mills as "quaint," this study and others suggest that millers often were on the cutting edge of technological innovation. They used whatever technology worked best for their specific situation.

Ruins of Cromwell Mill, 1990s

Interior of Cromwell Mill after excavation, showing intact turbine housing and tailrace

Although the ruins of the Cromwell Mill were a well-known local landmark, there was little surface evidence of the two iron furnaces, except for two overgrown mounds that marked the stack locations and a ditch that represented the race. Nature had completely reclaimed the sites, and few local residents had any idea that blast furnaces had once stood there. Many were fascinated to learn about the history that lay just beneath their feet.



Ruins of Winchester Furnace stack, before excavation

Ruins of Winchester Furnace stack from same perspective, after excavation

Winchester Furnace was located at the lower end of the race, a few hundred feet west of the mill. Because it was the last of the three industries to be established, it was relegated to the poorest site, only a few feet above stream level. Though it had the requisite water power and adjacent hill, the low ground was usually wet and subject to frequent flooding. Historical sources emphasize that wet conditions were disastrous for smelting iron. Archaeology confirmed that the area had been filled extensively before the stack was constructed. The furnace site was very constrained, squeezed between the steep hillside and the road and creek, so the buildings attached to the stack were quite small.

A level bench on the hillside above the furnace—once the site of the charcoal shed, weigh scales, and stockpiles of raw materials—was now a private lawn and unavailable for study, so the archaeologists focused on the stack and adjacent industrial buildings. The stack was intact to a height of only 3-5 feet, suggesting that the upper 23 feet of stonework had been dismantled after the furnace's abandonment and reused elsewhere. Still, portions of the casting arch and tuyere arch were intact. The stonework above the tuyere arch was supported by two cast iron lintels bearing the stamp "T.T.C. 1833," referring to owner Thomas T. Cromwell. The stack's *crucible*, where the iron was smelted, contained a solid mass of iron and slag, a remnant of the furnace's last blast.

Remains of tuyere arch at Winchester Furnace

There were stone foundations on three sides of the stack. At the front was the casting shed, marked by two parallel stone foundations which would have supported a frame superstructure. The front of the shed, adjacent to the road, was open for easy access and good ventilation (an important consideration due to the high temperatures of iron smelting), with the roof supported by a row of stone piers. The floor of the building was intact, visible as a layer of sooty hard-packed soil.

While the furnace was in blast, the area near the casting arch contained a sand bed. During each tapping of the furnace the molten iron ran into pre-formed molds pressed into the sand. Archaeology revealed intact casting sand beds with a very clear impression of a mold in the sand. Nearby on the work floor were an iron pig and a mound of congealed cinder and slag, a striking reminder of the last blast at Winchester Furnace. The mound was formed from cinder skimmed from the crucible prior to tapping the furnace for the last time; normally, the cinder waste would cool, then would be broken up and hauled away when the casting floor was prepared for another tapping. In this case it was simply left in place since there would not be another blast at this ironworks. It seemed as if the workers had just walked away from the furnace after the last cast and never looked back. The capture of such an historical moment archaeologically is rare indeed.

A building on the west side of the stack contained two rooms: a casting sand storage shed and a foundry/cleaning shed. While it was in blast, an ironworks required a steady supply of clean, dry sand to replenish the casting bed after each blast. At Winchester Furnace, fresh sand was stored in a separate room next to the stack. In the adjacent foundry/cleaning room, pig iron was remelted in a smaller furnace to produce stoveplate and other castings, which were then cleaned and smoothed by workers known as molders. Scraps of stoveplate and hollow ware littered the floor.

The well-preserved remains of the blast shed were found east of the stack. The most important archaeological feature in this room was a 9-foot by 16-foot dry-laid stone platform that supported the blast machinery. Although the machinery was gone, it probably consisted of a pair of blowing cylinders or tubs and a mixing box, powered by a shaft from a vertical undershot water wheel in the adjacent race. As in the other rooms, the work floor in the blast shed was almost completely intact.

Artifacts from the site mainly consisted of building materials such as nails and bolts, furnace products such as pig iron and fragmentary castings, and waste materials from the smelting and casting processes. A few tools were found, including a broken shovel, a sledgehammer head, and several smaller objects (pry bar, file, punch).

Excavation of east room at Winchester Furnace

East room at Winchester Furnace after excavation, showing surface of historic work floor. View is from top of stack.

Winchester Furnace: stone platform for blast machinery

Rockhill Furnace was located about 500 feet east of Cromwell Mill, in a slightly higher position on the same low terrace of Blacklog Creek. Though only six feet higher than Winchester Furnace, the site was much dryer and less prone to flooding, both important factors for achieving success in ironmaking. Its location upstream from Winchester Furnace and the mill gave it another big advantage: its elevated tailrace was over 15 feet higher than the tailrace at those sites, so that its undershot water wheel would not have been stopped by backwater from every minor flood as was the case for the other industries. During low water conditions, Rockhill's proximity to the dam would have helped to maintain its water supply, although it still had problems in that regard. Of the three industries that shared the dam and race system, Rockhill Furnace had the best site and the most reliable water power.

The main part of the furnace site was even smaller than at Winchester. The stack and buildings had to be squeezed between the high race embankment to the north and the stream and road to the south. This had several important consequences. Since there was little room for large buildings around the stack, the casting shed and foundry were very small, and the blast machinery was not placed next to the stack as at Winchester, but rather on a timber framework above the water wheel. Also, when the highway was widened in the 1920s, it destroyed much of the site, including the entire casting shed. Though the casting shed could not be investigated as it was at Winchester, the archaeologists did have access to one important area which was unavailable at the other ironworks: the bench in the hillside above the furnace stack which contained the remains of the charcoal house, charging bridge, and raw material stockpiles.

Ruins of Rockhill Furnace stack after excavation

Rockhill's stack was slightly more intact than Winchester's, though little remained of the portion nearest the road. It was obvious that at some point the stack had been enlarged by application of an outer layer of stone on all four sides, resulting in a visible seam; this most likely occurred during the repairs that followed the collapse of the stack in January 1846.

All three arches were intact. The front face contained the casting arch, with its cast iron lintel and fire brick lining still in excellent condition, despite being only a few feet from the highway. Part of the casting floor and sand beds had survived, as they had at Winchester. But unlike the other furnace, each tuyere arch contained a cast iron blast pipe that supplied air to the crucible, and in the west arch there was even a section of the "downcomer pipe", a crucial part of the hot blast system that recirculated superheated air from the top of the stack. Near the downcomer, three large cast iron plates lay amid the rubble on the work floor. These were the plates that framed the opening in the top of the stack, and they lay where they were thrown when the stack was dismantled, along with brick rubble from the chimney. Archaeology also revealed the remains of a system of underground pipes that brought water to cool the tuyere nozzles, which were exposed to intense heat during the blast. Since water-cooling was not adopted in Britain until 1834, and took a little longer to reach America, this could not have been part of the original construction.

Tuyere arch at Rockhill Furnace after excavation, showing intact "downcomer pipe"

The interior of the stack was lined with slag-coated fire bricks which were marked "J.M. & Sons Sandy Ridge." Research revealed that the bricks were manufactured at a Clearfield County brickworks operated by James Miller, which began operation in 1866. The brick lining must have been installed in the furnace sometime between 1868, when it was rehabilitated by Dewees and Royer, and 1872, the year of the final blast.

Excavation revealed the foundations of two small wooden sheds that had been attached to east and west sides of the stack. These were too small to contain blast machinery or a foundry and probably served mainly as shelter for the tuyere arches and blast pipes and to keep water away from the stack.

On the man-made bench in the hillside above the furnace and race was the stone foundation of the charcoal shed, a large barn-like structure. This building was necessary because charcoal was a very fragile material and had to be protected from the weather. It was built into the side of the hill so that charcoal could be unloaded from an elevated road directly into the structure's upper level. The front of the building was open to allow easy access. When the furnace was in blast, workers hauled charcoal from the shed and dumped it into the top of the furnace at regular intervals, together with measured amounts of iron ore and limestone. Nearby concentrations of ore and limestone on the surface of the ground marked the locations of stockpiles of these raw materials. The remains of the charging bridge consisted of a partly-collapsed stone abutment on the hillside and a row of stone piers on top of the race embankment below.

West room at Rockhill Furnace after excavation. Brick rubble (center) and curved iron plates (left) were thrown from top of stack when furnace was dismantled about 1876. Stone rubble (right) was deposited when site was filled and leveled before furnace was built.

East room at Rockhill Furnace after excavation. Iron artifacts are scattered across the surface of the intact work floor.

Several ore pits and collapsed shafts were found near the bench in the hillside above the stack, connected by a series of abandoned roads. These openings provided some of the iron ore used at Rockhill, although the rest was brought from a greater distance. The limestone came from a quarry at the east end of the Narrows.

Fewer artifacts were found at Rockhill than at Winchester, no doubt because the former casting shed and foundry now lie under the highway and could not be excavated. Most artifacts were related to the construction and repair of the buildings at the site, although there were a few tools and iron products as well. Analysis of charcoal samples from both ironworks revealed that most of the trees used for making charcoal were softwood species such as pine and hemlock that were 10-40 years old when cut. Although American ironmasters preferred fine-grained hardwoods such as oak and hickory, which produced a dense, high-quality charcoal, they were willing to use whatever species were available. Clearly this was the case at Winchester and Rockhill Furnaces. Their managers apparently practiced efficient forest management, since there is no historical or archaeological evidence to suggest that lack of fuel was responsible for the ultimate failure of either industry. Both ironworks owned enough timberland to sustain charcoal production almost indefinitely if tracts were cut on a 20 or 30-year rotation system.

Conclusion

The Blacklog Narrows investigations were the most intensive studies of any Juniata District ironworks to date. The project provided a rare chance to examine two contemporary and adjacent ironworks that operated independently while sharing the same environmental setting, sources of raw materials, labor pool, and even the same dam and race system for their water power. Despite the similarities, Rockhill Furnace (1831-1872) was moderately successful and lasted over forty years, while Winchester Furnace (1832-1850) was a chronically troubled operation that ran sporadically for less than two decades.

What accounted for their varied fortunes? The two ironworks shared many of the same difficulties, including unreliable water power, poor market access, lack of vertical integration, and ores of variable quality. But Winchester had special problems that ultimately proved fatal: a poorly-drained site at the lower end of the race, where backwater from every minor flood must have stopped its water wheel; insufficient capital; and a lack of technical and/or managerial skill on the part of its owners and managers. In such a competitive iron-making business environment, where the margin between success and failure was razor-thin, a problem in only one area could make a difference. Despite its adoption of hot-blast technology in an effort to increase efficiency, Winchester Furnace was unable to survive the business depression of 1849-1851.

The story of these long-abandoned and forgotten industrial sites provides a glimpse of an extinct industry that played a crucial role in the early development of the Juniata Valley and central Pennsylvania. Throughout their existence, both ironworks struggled — often unsuccessfully— to produce a quality product and to remain competitive within an industry that was always at the mercy of external forces. Along the way, they experienced frequent changes in ownership and management, experimented with different sources of raw materials, and adopted new technology as it became available. Ultimately they failed. But in an industry where failure was the norm and success the exception, Winchester and Rockhill furnaces were far more typical than the few Juniata ironworks that managed to prosper and survive until late in the century, long after the center of American iron production had moved west.

A vanished way of life (Greenwood Furnace State Park)

Glossary

Blast furnace: An industrial facility in which processed iron ore is converted to cast iron by applying intense heat under controlled conditions.

Blast shed: A structure attached to the side of a blast furnace stack, covering the tuyere arch and blast machinery.

Bloom: A hammered iron bar produced by a forge, usually taken to a rolling mill for additional processing.

Bosh: The hollow brick-lined core of a stone blast furnace. Raw materials were loaded into the top of the bosh, and molten iron was tapped from the bottom.

Casting arch: An open arch at the front of the furnace stack where workers tapped the molten iron into prepared sand molds.

Casting shed: A structure attached to the front of the furnace stack, covering the casting arch and sand molds.

Charcoal shed: A large barn-like building in which charcoal was stored prior to use in the blast furnace.

Charging bridge: A timber bridge connecting the top of the stack to the hill behind it, used when charging the furnace with raw materials during a blast.

Cleaning shed: A building near the stack where iron castings were smoothed and finished by workers known as molders.

Cooling shed: A structure in which charcoal was placed to cool prior to storage in the charcoal shed.

Crucible: A narrow chamber at the base of the bosh, from which the molten iron was tapped.

Pig iron: Cast iron bars produced by a blast furnace. The term is derived from their superficial resemblance to a sow and nursing piglets.

Stack: The massive pyramidal stone structure at the heart of the ironworks in which the smelting process occurred.

Tuyere arch: An open arch in the side of a blast furnace which contained the tuyere or pipe which provided the blast of compressed air to the bosh.

Rockhill Iron Works circa 1900 (Orbisonia Area Bi-Centennial 1960)

Sources of Information

This booklet is a condensed version of a much more detailed work titled ***Phase III Archaeological Investigations: Cromwell Grist Mill, Winchester Furnace, Rockhill Furnace. US Route 522 Improvements, SR 0522 Section 05BN, Cromwell Township, Huntingdon County, Pennsylvania*** (Scott D. Heberling, Paul A. Raber, and William M. Hunter 2003), prepared for the PA Department of Transportation and the Federal Highway Administration. Complete references for the information in this booklet may be found there, or are available from the author.

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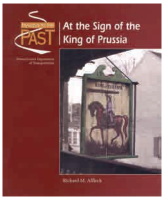
BYWAYS TO THE PAST



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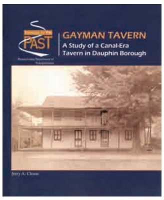

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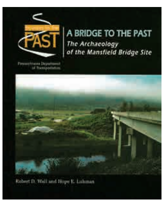

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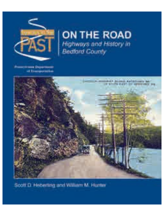

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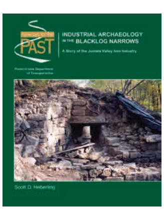

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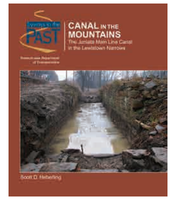

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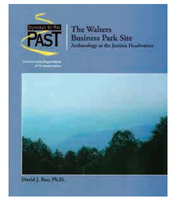

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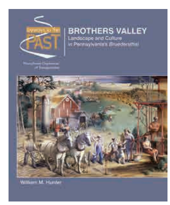

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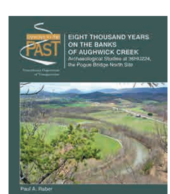

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Paul A. Raber
2017

In the early 19th century the Juniata River Valley of central Pennsylvania was the most important iron-manufacturing region in the United States. Its abundant timber, rich ore deposits and swift mountain streams were ideal for the production of iron. Scores of charcoal-fueled ironworks were established throughout the seven-county Juniata Iron District, making products that were internationally famous for their high quality. Recently, the Federal Highway Administration and Pennsylvania Department of Transportation sponsored extensive historical and archaeological studies at two ironworks and a nearby mill in connection with proposed highway improvements in southern Huntingdon County. The story of these long-abandoned and forgotten industrial sites sheds new light on an extinct industry that played a crucial role in the early development of central Pennsylvania.

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