Industrial archaeologists interpret the physical record of ironmaking. Through excavations, study of sites, and artifact analysis they add to the information in documents, discover unrecorded aspects of artisans' skills, and uncover the environmental consequences of ironmaking. They can help Americans learn about a now inadequately presented component of the American industrial heritage. Visiting a forge or furnace that still has its equipment in place reveals aspects of the work of past artisans difficult to discover in other ways. Even when the machinery and buildings are gone, the landscape surrounding a furnace, forge, or rolling mill site can help a visitor visualize the former transportation links and workers' communities.

Iron miners in the charcoal-smelting era left pits, now usually lakes, and a few shafts and adits that searchers can find today. Until the mid-twentieth century, Americans had little interest in the surviving fabric of their industrial heritage. Owners often abandoned unprofitable ironworks after they sold off the machinery for scrap. If they wanted an ironworks site for other uses, they razed the buildings. However, they usually left stone blast furnace stacks alone since these structures had little scrap value and were difficult to demolish. Old foundations, slag piles, the remains of a dam, and black soil containing charcoal fragments can usually be found at abandoned iron-smelting sites.

Visitors can examine several stone furnace stacks in parks and museums, some with the associated buildings reconstructed. Other branches of the industry have not fared as well: no bloomery, finery, puddling furnace, cementation furnace, or crucible
steelworks has survived in North America. If we visit the sites of the major anthracite-fired, nineteenth-century blast furnaces, such as Hokendauqua, Pennsylvania, or Stanhope, New Jersey, we find few traces of iron smelting. Several stone stacks are preserved in a municipal park in Scranton, Pennsylvania, in a setting that hardly reveals its industrial past. The site of the largest mid-nineteenth-century rail mill in the United States is now a grassy field occupied by the Danville, Pennsylvania, high school. The sign on the school band's truck announcing that the football team is known as the “Iron Men” is the primary visual evidence of this industrial heritage. Mining left some visible landscape changes in eastern Pennsylvania. However, these are prominent only where new owners continued mining into the twentieth century, as at Cornwall.

The managers of most ironworks fueled with bituminous coal continued to operate them well into the twentieth century. As they added new equipment, they often incorporated the fabric of older operations into newer ones. At the Bethlehem Steel plant in Johnstown, Pennsylvania, a few buildings of the mid-nineteenth-century Cambria Iron Works remain among the twentieth-century structures of the steelworks. Because of this continuous use, few relics of nineteenth-century coke-fueled ironmaking survive intact.

So far, most American museums and historical sites that cover the iron industry have focused on early charcoal-fueled ironmaking. The museum directors have overlooked major parts of American ironmaking, including puddling, anthracite smelting, and crucible steelmaking. Additionally, many important sites in the history of American iron—such as the blast furnace that produced the iron used by Alexander Holley in his first successful Bessemer blow—remain unrecorded, unexplored, and unprotected. Others have only below-ground remains that archaeologists have yet to excavate and interpret. The sites described here are open to the public and are either unusually well preserved, well interpreted, historically important, or illustrative of the geographical settings of ironmaking.

FORGES OF ST. MAURICE

The Forges of St. Maurice National Park (Figs. 11-1, 11-2) is the principal Canadian monument to charcoal ironmaking. The wooden buildings and much of the stonework had vanished by the time the government acquired the site in 1963. The first proprietor, Poulin de Francheville, had sent his artisans to learn bloomery smelting at New England ironworks. In 1734 they were making only about 20 pounds of iron a day because, as one of them later reported, they had not time to learn “exactly how to smelt the ore and the conditions necessary in the hearth to achieve proper results.” Archaeologists uncovered enough remains of Francheville’s bloomery to show some of the sources of the artisans’ troubles. Its foundations failed because of soil slip-
11-1. Only foundations of the equipment used in 1883 remained visible at the site of the Forges of St. Maurice near Three Rivers, Quebec, when the Canadian Park Service acquired it in 1963. Late nineteenth-century artisans had smelted iron from bog ore in a blast furnace and cast it into railroad car wheels at an adjacent foundry. Archaeologists later uncovered remains of the eighteenth-century forges and furnaces that had been operated on the site, as seen in this picture taken in 1989. (Photograph by Carolyn C. Cooper)

11-2. Since no industrial structures survived at the Forges of St. Maurice site, the Canadian Park Service built skeleton outlines of the furnace and principal buildings to help visitors visualize the works that had once stood there. (Photograph by Carolyn C. Cooper)
So far—in contrast to the extensive work done at the Forges of St. Maurice—few of the artifacts recovered at Saugus have been studied by archaeometallurgists. Those that have been examined elucidate some of the problems that Winthrop and his artisans encountered at Saugus. They needed ore, fuel, and flux for their blast furnace. They used local bog ore and charcoal fuel made in the neighboring woodlands. In the 1640s English ironmasters had not yet adopted lime flux as a regular part of their furnace charges. At Hammersmith the founder used Nahant gabbro, a rock that contained enough of the minerals labradorite and clinopyroxene to make a flux with about 10 percent CaO, barely sufficient for blast furnace slag. Modern analyses show that the Saugus artisans produced high-phosphorus pig with variable composition that, while satisfactory for hollowware castings, would have made the finers’ task difficult. C. S. Smith found that metal from the Hammersmith finery had variable carbon content and abundant, poorly distributed slag. One artifact showed that the disks in the slitting mill had meshed badly and were in poor condition.
11-4. This map of the Shepaug Spathic Iron and Steel Company’s works at Chalybes (now Roxbury Station), Connecticut, shows how the designers arranged for a downhill flow of material from mine to roasting ovens, blast furnace, and steel mill. The company’s artisans made charcoal in the three kilns, and its first superintendent, Mr. Kolbe, lived across the river from the works. As at most New England ironworks, the surrounding community had other active businesses, in this case a sawmill, a gristmill, and a hat factory. Contour elevations are in feet. (Courtesy of IA: Journal of the Society for Industrial Archaeology; published in IA 10 [1984]: 20)

MINE HILL

Mine Hill in Roxbury, Connecticut, is the site of America’s first integrated steelworks (Figs. 11-4, 11-5). Although the wooden buildings are long gone, no one reused the property of the Shepaug Spathic Iron and Steel Company after the founder blew out the blast furnace in 1872 for the last time. Unlike most steelworks sites, this one remained undisturbed.

Because they believed the advice of distinguished scientists
that Mine Hill had a unique ore for steelmaking, a group of Hartford investors bought the property in 1865. Their artisans opened a mine, built ore-roasting ovens (Fig. 4-8), a blast furnace (Figs. 4-11, 4-12), and steelworks. Miners blasted adits into the granite high on the hill to reach the veins of siderite ore. The managers placed the tramway from the mine, the roasting ovens, and the blast furnace so that workers could move materials downhill through each successive process. They made a compact layout of the blowing engines, steelmaking furnaces,
11-6. This photograph of the Mine Hill works from the steel mill site, taken in 1994, shows the blast furnace with a blowing arch at the right and an access arch on the left. Bent iron brackets above the arches supported a blast main when the furnace ran on cold blast. The downcomer and pressure-relief valve from the conversion to hot blast remain in place at the top of the furnace. The roasting ovens are on the hillside behind. A pile of bricks just visible above the retaining wall marks the site of the engine house. The charging house extended from the foundation in front of the roasting ovens to the top of the furnace. (Photograph by William Sacco)

forge hammers, and rolls on the level area occupied by the blast furnace (Fig. 11-6).

The furnace builder, I. N. Bartram, used the then novel elliptical hearth and steam-driven blowers powered by waste heat from the furnace for the blast. Unfortunately, the successive superintendents could not translate the careful organization of the site into smooth operation. A set of samples that the proprietors gave to Professor Brush at Yale along with slag and wastes collected at the site shows that the investors had made a poor choice of steelmaking technique. Payroll and census records
show who worked at Mine Hill and how workers recruited in Roxbury moved on to other industrial opportunities in the community after the failure of the steelworks.

A visitor can trace the flow of material from mine through roasting ovens, blast furnace, and steel refinery from remains on the ground. Because the site and the surrounding land are owned by the Roxbury Land Trust, the geographical setting of a nineteenth-century ironworks is uniquely preserved at Mine Hill.

IRONVILLE

Beginning in 1828, Allen Penfield and Timothy Taft built a bloomery forge at a water privilege on Putnam Creek in the town of Crown Point, New York. A few miles west they built a blast furnace. Alexander Holley used pig iron from this furnace in his first successful Bessemer-converter blow at Troy. The proprietors got ore from several nearby mines and charcoal from the surrounding woodlands. They conducted early experiments with magnetic ore separators, and Ironville is said to be the site of the first industrial use of electricity in America.

Artisans and their families built the town of Ironville around the bloomery forge, adding a sawmill and gristmill along the creek; later, the proprietors built a large ore separator that supplied both their forge and the anthracite-fired blast furnaces put up by the Crown Point Iron Company on the shores of Lake Champlain (Fig. 11-7). A narrow-gage railway thirteen miles long connected the mines, separator, and blast furnaces. Ironville was an industrial village in a remote location within the township of Crown Point, whose economy for more than sixty years depended on ironworks. When the Crown Point Iron Company closed in the depression of 1893, people began leaving, reducing the town’s population to a third of what it had been. Much of the village, the ironmaster’s house, and the site of the forge and other industrial buildings at Ironville have been preserved by the Penfield Foundation. Analyses of slags collected at the forge site reveal how the Ironville artisans carried on their work.

RINGWOOD AND LONG POND

In 1736 Lord Stirling, a landed proprietor, sent Cornelius Board to search for copper ore near the New York border. Instead, Board discovered iron ore near Ringwood, New Jersey, where he joined with other adventurers in constructing a forge. The Ogden family of Newark bought the forge in 1740, enlarged the enterprise, and sold it in 1764, along with 50,000 acres of timber land, to the American Company, composed of English investors. Their agent, the German adventurer Peter Hasenclever, brought over 535 German workers to open mines and build roads, houses, and ironworks in one of the most ambitious colonial industrial ventures. Hasenclever reported in 1773 that he had built a furnace, two forges with eight fires, and a stamp mill
This photograph of the Crown Point ironworks in New York, taken about 1890, shows the cupola-type blast furnaces, fired with anthracite, built in 1873 and 1881. Because the site was flatland on the shore of Lake Champlain, the furnace designers provided elevators to lift ore, fuel, and flux to the charging platforms. The elevator towers overshadowed the furnace stacks. A narrow-gauge railway delivered ore from the separator plant located in Ironville. An easy walk from the nearby village would bring visitors to the furnaces. (Courtesy of Robert Vogel)

at Charlotteburg, New Jersey; a furnace, four forges with eleven fires, and a stamp mill at Ringwood; a furnace and a forge with four fires at Long Pond, New Jersey; and a furnace at Cortland, New York. Each place had numerous associated buildings, including smithies and sawmills. Inspectors appointed by the governor of New Jersey found that the furnace at Charlotteburg could make about 25 tons of pig iron a week and that the forge three miles downstream could make 250 tons of bar iron a year, as could the forge two miles farther downstream. After financial difficulties forced Hasenclever’s departure, Robert Erskin continued operations at Ringwood through the Revolution.

Through the first half of the nineteenth century, Martin Ryerson (of the family that later became major steelmakers) used the
forge on the Long Pond site. In 1853 the Trenton Iron Company, managed by Edward Cooper and Abram Hewitt, built first a charcoal-fired and then two anthracite-fired blast furnaces at Long Pond. Trenton Iron continued operations until 1882. Abram Hewitt built his country estate at Ringwood (Figs. 1-1, 1-2); it is now incorporated in Ringwood State Park. The state is developing an interpretative program and restoring the great waterwheels at Long Pond, where furnaces and remains of the ironworkers’ community survive.\textsuperscript{19}

\textbf{BATSTO}

The village at Batsto, New Jersey, preserves the setting of a south Jersey ironmaking community in the pine barrens. Charles Read built the first Batsto blast furnace in 1766 to smelt bog ore with charcoal made in the surrounding woodland. Artisans wielding long tongs collected ore from adjacent bays using specially built boats, one of which is preserved. By 1776 the Batsto proprietors were offering cast iron products for homes and mills, including kettles up to the 125-gallon size. During the war, they cast shot and later cannon for the Continental Army. Three of their first twelve cannon and five of the next twelve burst in proof testing; thereafter they improved their technique. By 1781, having more pig than they could use for castings, the Batsto proprietors built a forge and slitting mill. New owners took over after the war, rebuilding the furnace in 1829 and producing about 800 tons a year, mostly castings. Because they depended on bog ore, they were unable to make the gun iron for the government that brought high prices for the proprietors of other charcoal-fired furnaces. Competition from Pennsylvania in the market for ordinary grades of iron eventually forced the owners to abandon Batsto in 1848. After an unsuccessful attempt to develop the site as a water supply for Philadelphia, the Wharton family used it as a summer home. The state acquired it in 1955.\textsuperscript{20} While little remains from past ironworking at Batsto, visitors can see the geographical setting of a coastal ironworks well preserved there.

\textbf{HOPEWELL}

Some authors have described isolated ironworks in the piedmont district of Pennsylvania as “plantations.” Visitors to the Hopewell Village National Historic Site can judge for themselves how apt this description is because most of the community is preserved (Fig. 3-4). Mark Bird built the Hopewell furnace in 1771. The several owners who later operated it had their best years in the early decades of the nineteenth century, when they specialized in making cast iron stoves. Later, after an unprofitable venture in smelting iron with anthracite, the Hopewell proprietors were content to operate their obsolete furnace whenever the market for cold-blast pig iron was favorable, until 1883.\textsuperscript{21} It is now the Hopewell Village National Historic Site.
Bird located his furnace within extensive woodland suitable for coaling, at a convenient wagon-haul distance from several iron mines. He had only enough water power for the blast and could not add a finery to his works. In their last major improvement in technique, the Hopewell proprietors installed a new blowing engine in 1822. They could not have expanded the industrial base of Hopewell without adopting a new source of power. Consequently, the site today is representative of 1820s rural Pennsylvania ironmaking. The community consists of the manager’s house, a combined store and office building, barns for the many draft animals they needed to haul ore and fuel, and worker housing adjacent to farm fields. Although the National Park Service has sponsored several studies of artifacts found at Hopewell, few of the results have been published.

CORNWALL

In the first use of the richest ore deposit in Pennsylvania, Peter Grubb began mining the magnetite ores at Cornwall, Pennsylvania, in 1742. He smelted the ore first in his bloomery and later in a blast furnace. Robert Coleman bought the furnace in 1798, and the Coleman family ran it until 1883. Most of the fabric from the 1856–57 rebuilding remains, including the substantial stone buildings with Gothic windows (unusual at an early ironworks), the roasting oven introduced about 1825, the wooden blowing tubs, and the steam-powered blowing engine built by the West Point Foundry. Like their colleagues at Hopewell, Cornwall artisans raised food and fodder; their wagon and blacksmith’s shops are preserved. No one has yet made a full study of the surviving furnace records. Cornwall furnace is now a state historical site, with a visitors’ center in the former charcoal house. The open-pit mine with its unique miners’ village is nearby. Cornwall is the only charcoal-fired blast furnace in the United States with its buildings and equipment intact.

CURTIN

In about 1788 the settlers driven out by Indian raids returned to the valleys of Centre County, Pennsylvania. They began ironmaking with Centre Furnace in 1791 and with the Rock Iron Works, a finery forge south of Bellfonte, in 1794. Roland Curtin and Moses Boggs made the forge they built in 1810 the basis of a community that included a gristmill and sawmill. Curtin and his sons invested in furnaces to supply forges in the area and added a rolling mill to Curtin Village in 1828. Initially, they shipped iron to Pittsburgh by bending the bars to fit over specially designed mule saddles. A train of fifteen to twenty mules made the journey. The Curtins shipped iron to eastern markets using arks floated down Bald Eagle Creek and the Susquehanna River to Port Deposit. A canal reached Curtin Village in 1838 and a railroad in 1863. Until 1921 artisans at Curtin Village made cold-
blast pig iron with Pleasant Furnace, built in 1842. The village, with the furnace, ironmaster’s house, and workers’ cottages, is preserved by the Roland Curtin Foundation.22

**TREDEGAR WORKS**

Ironmasters built rolling mills fitted with puddling furnaces in towns and cities. After Americans stopped making wrought iron, they replaced most of the mills with other industries. The site of the Tredegar works in Richmond, Virginia, is one of the few that was not reused.

Richmond investors merged a foundry and an adjacent forge to form the Tredegar Iron Works in 1837. The works drew water for power from the James River and Kanawha Canal. Artisans made wrought iron by puddling pig brought from the Shenandoah Valley by canal boats. In 1841 the Tredegar proprietors forged chain cable and cast cannon for the federal government. When some of their cannon failed in proof, Joseph Anderson, a West Point graduate, agent, and later owner of Tredegar, undertook systematic tests to discover the best kinds of coal and iron to use in gun casting. He settled on Black Heath Richmond coal and iron from the Cloverdale cold-blast furnace in Botetourt County. By 1846 Tredegar could cast guns as good as those of any other founder. By making superior wrought iron, the Tredegar proprietors managed to sell to demanding New England manufacturers, such as the Douglas axeworks, in the 1840s and 1850s. After tests at the U.S. Navy Yard, Montgomery C. Meigs selected Tredegar iron for use in the wings and dome of the capitol in Washington.23

Black artisans supervised by white puddlers and rollers had worked at Tredegar since 1843. Anderson’s addition of six puddling furnaces to the nine he already had in 1847 precipitated a strike when the white puddlers refused to train additional blacks. Anderson discharged the striking white puddlers, found replacements, and expanded the black work force. As the business grew, Anderson recruited skilled workers from the North. He found that southern antagonism to industry gradually diminished, and he began taking young Virginians as apprentices to learn from the northerners. In 1848, when searching for a machine to make railroad spikes, Anderson settled on one invented by Tredegar artisan Joshua C. Carey, who had been pointing spikes by hand. At this time an active smith and striker could hammer out about 200 railway chairs a day. Robert A. Talley, a former Tredegar apprentice, designed a machine that made 2,000 rail chairs in the same time. Tredegar employees with ideas for new products left from time to time to start other businesses in the Richmond area.24

In 1861 Tredegar artisans showed their technical skills by rolling the armor plate for the *Merrimack* (the Confederacy’s *CSS Virginia*) and casting cannon (Fig. 11-8).25 The Tredegar works survived the war, and the proprietors faced the twin problems of
The Confederate cannon foundry building survives at the site of the Tredegar Iron Works in Richmond, Virginia. The site fronts on the early nineteenth-century Haxall Canal, which was rebuilt about 1900 to supply a hydroelectric power station. Tailraces from the Tredegar water-power system emerge through arches in the canal wall. The former Tredegar office building, originally a tannery, stands behind the foundry. The building to the left of the foundry was last used to store patterns; it had been a grain mill, and then a woolen mill, before it burned in the great fire of 1863 and was rebuilt by the Tredegar company. (Photograph by Patrick M. Malone)

raising new capital and changing markets. Because their water-driven rolling mills lacked the power and rigidity needed to roll steel, they concentrated on serving the remaining market for wrought iron. They produced rail, bridge iron, and spikes for the railway construction boom of 1869-73. The Tredegar managers kept their works in the mainstream of American ironmaking until the early 1870s. Then, as many users of wrought and cast iron shifted to mild steel, Tredegar stayed with iron, making most of its wrought products with recycled metal and casting railroad car wheels.26

The basic fabric of the Tredegar works remained as it had been in 1870, a collection of older and newer buildings tucked in wherever they would fit each other and the water-power system, until new owners razed it in the 1950s (Fig. 11-9). Although most of the Tredegar buildings are gone, a visitor can see the
rebuilt Civil War cannon foundry with its two air furnaces and the remains of the canal that served as both a source of water power and a transportation system. The Tredegar proprietors used water power to drive rolling mills and other machinery that most ironmasters would have powered with steam engines. The races and some of the turbines remain in place (Fig. 11-10).

TANNEHILL

About 1830 Daniel Hillman built a bloomery forge to smelt the rich ores that Alabama pioneers found along the sides of Red Mountain. A succession of proprietors made bar iron for local customers until 1859, when Moses Stroup built a substantial charcoal-fired blast furnace nearby. Stroup equipped his furnace with water-powered blowing machinery made in Philadelphia. The Confederate government’s ordnance department faced a serious shortage of pig iron as soon as the war began and pressed furnace operators to expand capacity. In 1862 William Sanders used government financing to build two additional furnaces and replace the water-powered blast with steam power. He faced a major problem hauling pig iron over eighteen miles of indifferent roads to a railhead. Union cavalry burned the ironworks buildings and wrecked its machinery on 31 March 1865.
11-10. Unlike the proprietors of most rolling mills, the managers of the Tredegar works never replaced their waterwheels and turbines with steam engines to drive the mill machinery. Instead, they added more turbines, like those shown here, and put in increasingly complex mechanical power transmission systems. (Photograph by Patrick M. Malone)

The furnaces chilled with iron still in their crucibles, and the proprietors never rebuilt.

The University of Alabama sponsored excavations at Tannehill in 1956 that turned up many artifacts now displayed in a museum at the site. The state established a park in 1969, and in 1976 it reconstructed the oldest of the furnaces so that iron could be made in it. Historic buildings from elsewhere in Alabama have been moved in to create an ironworkers' community.
In 1826 Thomas James, a successful ironmonger from Chillicothe, Ohio, whose father and grandfather had been ironmasters in central Maryland, and Samuel Massey, his forge superintendent, located a site in the Ozark wilderness near St. James, Missouri, where they could make iron goods. James raised the necessary capital from his established businesses in Ohio, and Massey managed the new works. They opted for a furnace and forge rather than a bloomery so that they could supply both cast and wrought goods. They found it costly to move artisans and forge equipment from Chillicothe down the Ohio River and into the wilderness. However, high transportation costs also meant that once they had their works producing, they could charge high prices to local customers. Massey and his artisans had the furnace and forge operating in 1829. They could make 9 tons of pig iron a day and convert half of it into bar iron at the forge. Settlers were streaming into Missouri, so the Maramec proprietors easily sold all the iron they could make. Additionally, the panic of 1837 depressed trade at the frontier less than in the East. The Maramec founders made pots, skillets, fire dogs, potash kettles, and coal grates, while artisans at the forge supplied bar iron for mill machinery, wagon fittings, axes, farm tools, and barrel skelps for gunsmiths. The ironworks staff, in addition to producing primary metals and finished iron products, formed a nucleus of professional expertise for construction of machinery. The ironworks’ sawmill and gristmill did substantial business in the surrounding region.

In the 1850s the Maramec proprietors penetrated larger markets by building a reputation for supplying iron of superior quality. They sold Maramec wrought iron to rollers of boiler plate and to crucible steelworks as far away as Pittsburgh, and pig iron to rolling mills in St. Louis and makers of railroad wheels along the Ohio River. To compete in these distant markets, the Maramec managers found that they had to maintain the uniformity of their products. They did this through improved equipment (a new blast furnace built in 1857) and process control (they kept records of which finer made each bloom so that they could deduct wages for defective metal). Because they had entered the national market, their business suffered in the depression of 1857 and again in 1874, when William James’s decision to invest in a larger, modernized blast furnace brought the works to bankruptcy. Had he not made this decision, he could have continued the Maramec works as long as there was a market for charcoal-made iron because he had adequate wood and ore reserves. The Maramec Museum in St. James, Missouri, is located at the ironworks site and includes remains of the works as well as other exhibits.
In 1864 the Peninsula Railroad linked Negaunee, near the Jackson Iron Company mine, and Escanaba, a port on Lake Michigan that had a longer shipping season than harbors on Lake Superior. Fayette Brown acquired some 15,000 acres of forest land adjoining Snail Shell Harbor, Michigan, across a bay from Escanaba, in 1866. He got limestone from the neighboring cliffs. By 1869 he had three sets of charcoal kilns built. Brown brought in Joseph H. Harris, an experienced constructor, to erect two stone blast furnaces 30 feet square and 40 feet high; he completed the first in 1867 and the second in 1870. Brown’s design used the modern Lürmann hearth and three tuyeres. He had eleven kilns of 75-cord capacity, each 18 feet high and 48 feet in diameter, at the harbor and additional kilns several miles back in the woods. Colliers made a load of charcoal at each kiln every three weeks. A narrow-gage railway hauled wood to the kilns and charcoal to the furnaces. An elevator located between the stacks brought ore, fuel, and flux to the fillers. In their first campaign, the furnacemen were making 14 tons of iron per day; a year later they averaged 17 tons, and by 1872 they had reached 30 tons. Clearly, they had taken several years to get the furnaces producing at capacity. Their furnace campaigns ranged from three to seven months. Harris had designed open-top furnaces. In 1874 a filler fell into one of them; remarkably, coworkers hauled him out without serious injury. In 1882, when Brown decided to raise the stacks to a height of 54 feet, he installed closed tops and charging cones. He also had the hot-blast stoves moved to ground level. Gas taken from the furnaces was burned at the bottom of the stoves, heated the air pipes, and passed out through stacks at the ends of the stoves. Underground pipes carried the hot air to the tuyeres. With the rebuilt furnaces, the Fayette artisans made 52 tons of iron a day.

Through the 1870s the Jackson managers believed their costs were lower than those of coal-fired furnaces in Pennsylvania. By the 1880s this was no longer true. The Fayette proprietors cut their forest for charcoal and then sold the land to farmers. With their wood supply farther from the furnace, their fuel cost had increased even though there was still plenty of woodland in the area. The principal market for Fayette pig had been the Pennsylvania Steel Company and other makers of Bessemer rail steel; in 1871 and 1872, they had charged their converters with 17,465 tons of Fayette pig. Makers of railroad car wheels and malleable iron foundries also bought charcoal-smelted iron because of its low silicon content (1–1.5 percent at Fayette). By the 1880s many of these customers had learned that they could get along without charcoal-made pig. The Fayette owners faced rising fuel costs and a declining market for their product, and did not invest in a charcoal by-product recovery plant that might have al-
lowed them to continue operations. They closed both furnaces in 1890. Because there was no other industry or commerce in the town, everyone soon left. The Fayette ironworks is now a Michigan historic townsite and state park. Furnace stacks and historic buildings survive, and a museum has been added. North of Fayette the Michigan Iron Industry Museum (near Negaunee) overlooks the site of Carp River bloomery forge.