

Hopewell Furnace

Hopewell Furnace
National Historic Site
Pennsylvania

National Park Service
U.S. Department of the Interior



Molten iron was cast into stove plates and other products in the cast house, roofed with tiles to prevent fire

As relations between England and its American colonies disintegrated, Mark Bird, already an important figure in the booming colonial iron industry, built Hopewell Furnace in eastern Pennsylvania in 1771. When the American Revolution erupted in 1775, England's ministers regretted not having reined in American ironmasters more successfully. They knew the iron industry would now be turned against the mother country. Ever since colonists carried blast furnace technology to America in the mid-1600s, England had been worried by the industry's rapid expansion and American ironmasters' increasing skill at turning out cast and wrought iron products. Abundant natural resources in the colonies also favored the creation and expansion of an iron industry. It took an acre of woodlands to make enough charcoal to run an iron furnace for just one day. Pennsylvania's ancient forests proved ideal for such high demand.

Crown officials wanted to limit the colonies' iron industry to producing raw pig iron (rough cast bars). The bars would then be shipped to England and processed into profitable goods—that could be sold back to America. But the colonies weren't about to

give up such a lucrative enterprise. When Parliament prohibited the building of more ironworks, Americans simply defied the law. They both cast iron and refined it into wrought iron, from which they made a broad range of competitive products. At the onset of the Revolutionary War, American furnaces, forges, and mills were turning out one-seventh of the world's iron goods.

With the advent of war, the Pennsylvania iron industry played a critical role in supplying the new nation's army. In fact, George Washington took his army to Valley Forge in part to protect the supply lines for the products from the iron furnaces along the Schuylkill River. At Hopewell, Mark Bird turned from casting stove plates to supplying cannon and shot to the Continental Army and Navy. Unfortunately, like many American patriots, he suffered economic setbacks because of his support for Independence.

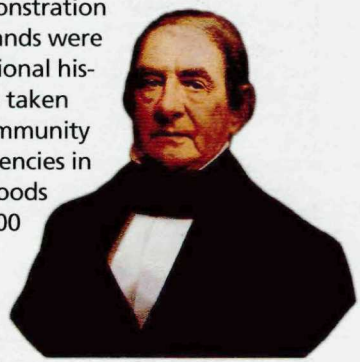
Both rural Pennsylvania community and iron plantation, Hopewell turned out products for a growing nation.

After the war, Bird had difficulty collecting debts from the new nation, and he also suffered financial reverses with the general economic depression that followed the peace settlement. A 1786 flood further added to Bird's financial woes, and in 1788 Hopewell Plantation was sold at a sheriff's sale. New owners converted to peacetime production, but the operation remained unprofitable. Natural disasters, national recession, and litigation closed the furnace in 1808.

By 1816 protective tariffs and better transportation systems had brightened Hopewell's future. The imaginative leadership of Clement Brooke, the furnace's resident manager from 1816–1831, brought Hopewell's best years, supplying iron products up and down the East Coast. But the financial Panic of 1837 undermined prosperity, and the iron operation never again matched its early success. The Civil War brought some relief in the 1860s, upping

demand for pig iron. But changing technologies—the Bessemer steel production process, particularly—and development of urban steel factories doomed Hopewell's operations. Hopewell Furnace went out of blast for the last time on June 15, 1883.

The property remained a summer home for descendants of the Brooke family, the last owners of the furnace, until 1935 when it was sold to the federal government. Originally made part of the French Creek Recreational Demonstration Area, 214 acres of historic furnace lands were set aside on August 3, 1938 as a national historic site. Today Hopewell has again taken its place as the center of a wider community as it joins state, county, and local agencies in the creation of the Hopewell Big Woods project. The goal is to preserve 72,000 acres of open land in southeast Pennsylvania. Mark Bird's 15,000 acres form the core of this ambitious project.



Clement Brooke

Touring the Park

- 1 The anthracite furnace was a failed attempt at hot-blast technology.
- 2 At hundreds of charcoal hearths colliers turned 5,000 to 6,000 cords of wood a year into charcoal.
- 3 Teamsters dumped charcoal in the cooling shed before moving it to the charcoal house.
- 4 Fillers carted charcoal, limestone, and iron ore via the connecting shed to the bridge house. At the base of the furnace the water wheel drove the blast machinery (not visible).
- 5 Workers' purchases at the office store were charged against credits for work.
- 6 In the cast house surrounding the furnace stack, moulders cast iron into stove plates and other products.
- 7 The blacksmith shop provided hardware and horse-shoes and was an informal gathering place.
- 8 A schoolhouse (foundation visible) education was democratic but rudimentary.
- 9 Some workers with families rented company tenant houses. Single men boarded with them or in a boarding house across the road.
- 10 The barn sheltered up to 36 draft animals and held a year's worth of feed.
- 11 In the springhouse and smokehouse, meats stored and cured foods.
- 12 The ironmaster's mansion, built in three stages, starting ca. 1770–1800, was re-modeled as late as 1870.



ILLUSTRATION NPS / L. KENNETH TOWNSEND

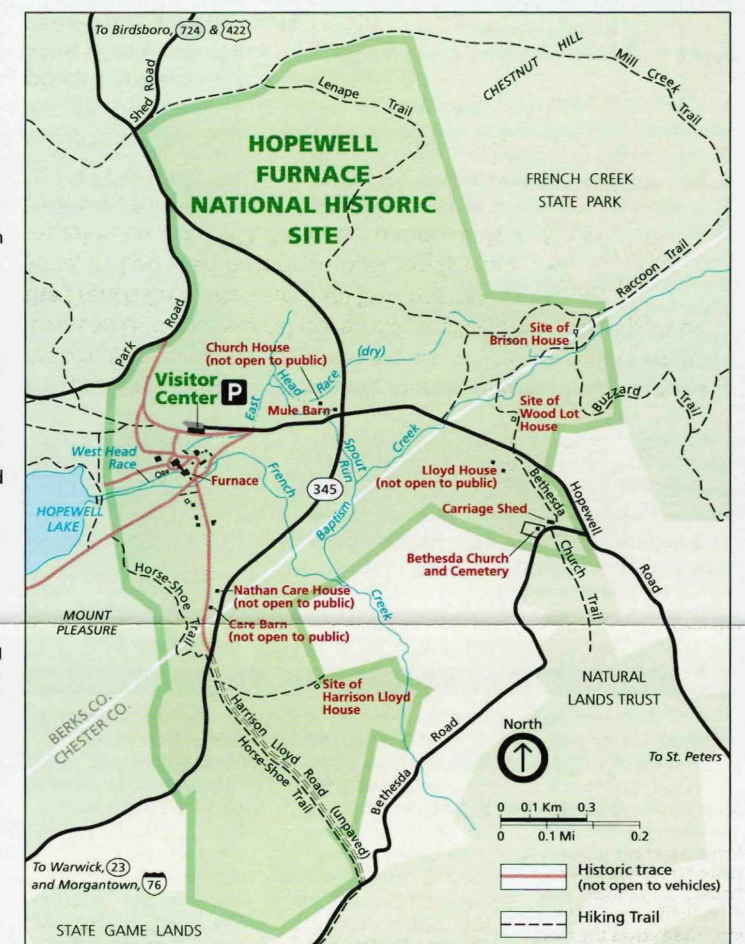
Enjoying Hopewell Furnace

Hopewell Furnace is five miles south of Birdsboro on Pa. 345. It is 10 miles from the Pennsylvania Turnpike's Morgantown interchange, via Pa. 23 East and Pa. 345 North.

The park visitor center and historic buildings are open Wednesday through Sunday and Memorial, Independence, Labor, and Columbus days. Summer activities depict village occupations. (GPS coordinates: lat. 40.20864 N and long. 75.767660 W)

French Creek State Park (610-582-9680) offers picnicking, camping, and swimming (see map).

Hopewell Restored
By the 1930s Hopewell and surrounding lands had little market value. In 1935 Louis Clingan Brooke sold the decaying property to the U.S. Government to be included in the French Creek Recreational Demonstration Area (RDA). RDAs were a Depression-era program to provide poor urbanites with outdoor recreation. But a Civilian Conservation Corps (CCC) architect, Gustavus Mang, recognized the iron plantation's historic value. CCC Camp 2213 moved into the area and stabilized five structures. Thanks to the CCC, Hopewell Furnace National Historic Site was established on August 3, 1938. Directed by the National Park Service, research and restoration continues today.



More information
Hopewell Furnace National Historic Site
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www.nps.gov/hofu
hofsuperintendent@nps.gov

For Your Safety
Beware of bees. Please stay off unstable furnace ruins, fences, and the other historic structures. Sharp slag can cut severely. Do not enter fenced areas or feed or handle livestock. Do not smoke in the historic area.

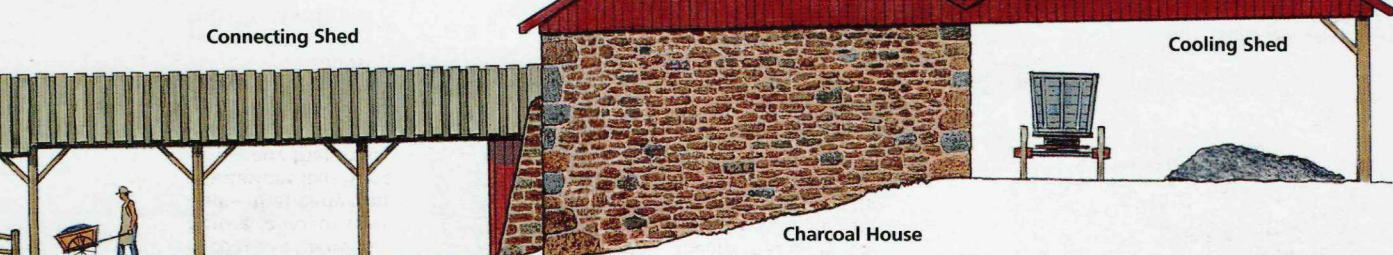
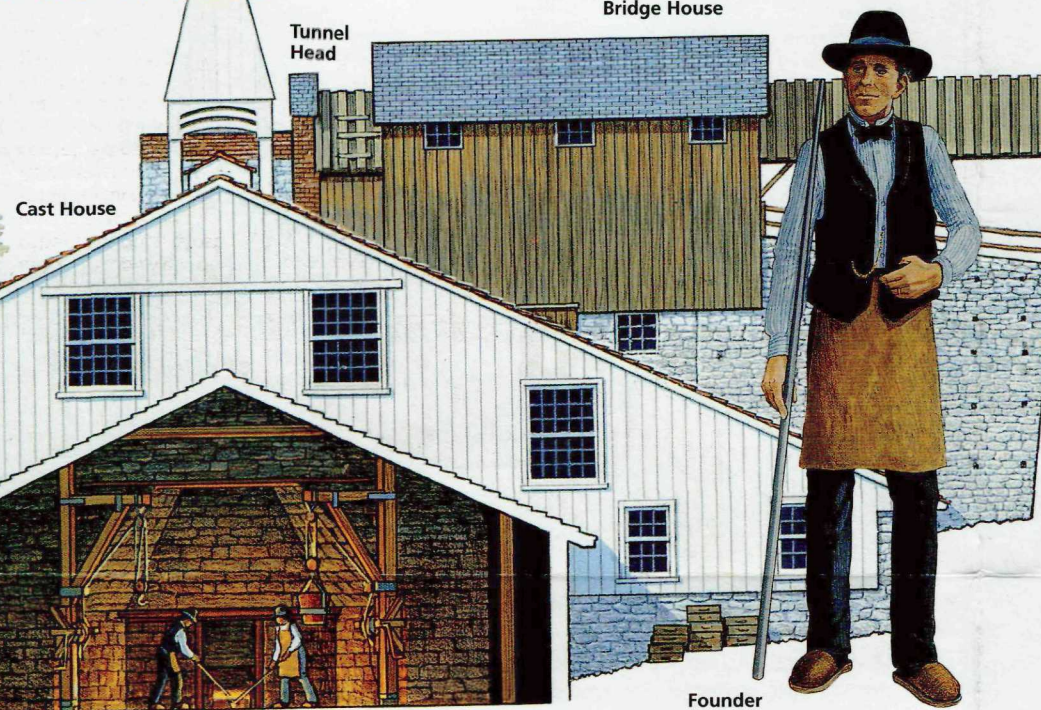
Hopewell Furnace is one of over 390 parks in the National Park System. To learn more about parks and the National Park Service programs in America's communities, visit www.nps.gov.

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An Iron Furnace at Work

The founder was boss, technician, and trouble-shooter. He directed the ceaseless round of activity at Hopewell Furnace. Raw materials—iron ore, limestone, and charcoal—were supplied by miners, woodcutters, and colliers and transported by teamsters. Fillers carted materials from

the charcoal house area to the bridge house and dumped them at the tunnel head. Guttermen and moulders stood ready below to skim off the slag and cast the molten iron when it was tapped by the founder.



An ancient alchemy sustained Hopewell Furnace: transforming mineral into metal. Since 4,000 years ago, when humans learned how to free iron from ore, the basic process has not changed. Iron oxide is heated in an intense flame fed by a carbon fuel. Oxygen in the ore combines with carbon monoxide released from the fuel and is expelled as CO₂. What is left is iron. The blast furnace's height lets the rising gases preheat the ore and gives the iron more distance to descend as it softens—so it absorbs more carbon from the fuel. Because iron's melting point falls as its carbon content rises, the iron becomes fully molten. A calcium-based "flux," usually limestone, is added. The flux combines with the impurities in the ore and forms slag.

They tended the furnace, the glowing heart of their community; it yielded iron and a way of life.

Raw Materials of Iron Making

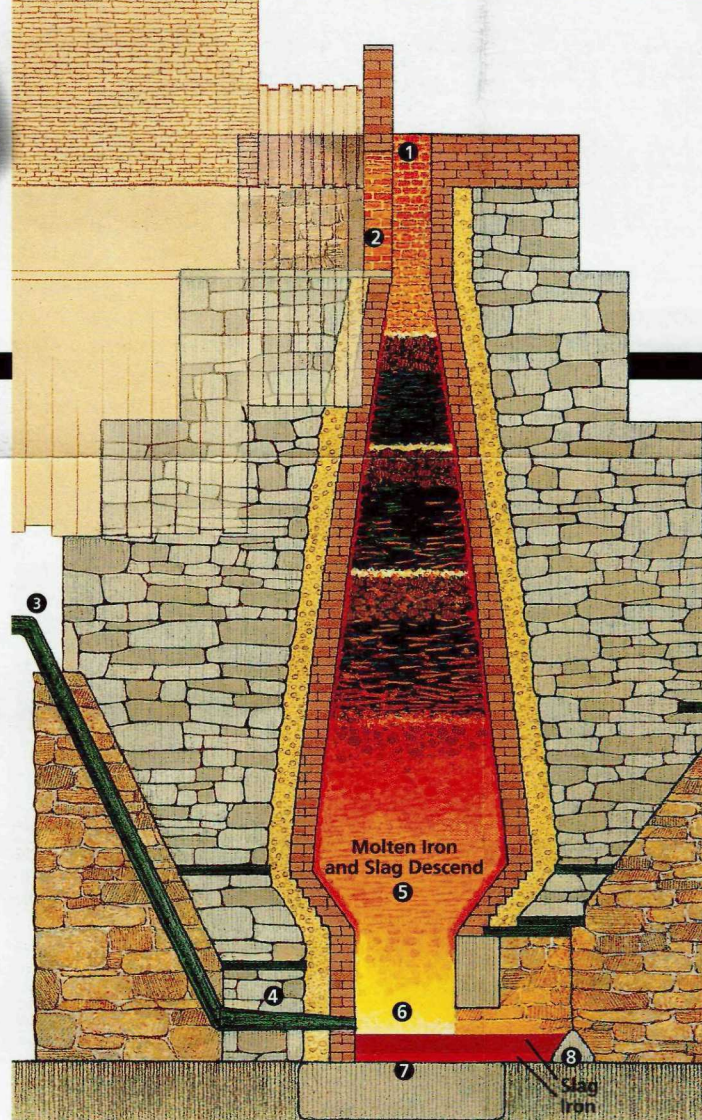
The basic ingredients of iron making—iron ore, limestone, and carbon fuel—are some of the most common materials on Earth, but are not found everywhere. Early furnaces were built where these materials were available. Iron is usually found in combination in the form of hem-

Iron Ore



atite, the magnetite used at Hopewell, or other iron ores. Most iron ore was dug in small surface mines. Any substance that contained calcium, like sea shells, could be used as a flux, but for most furnaces, limestone was cheap and abundant.

Limestone

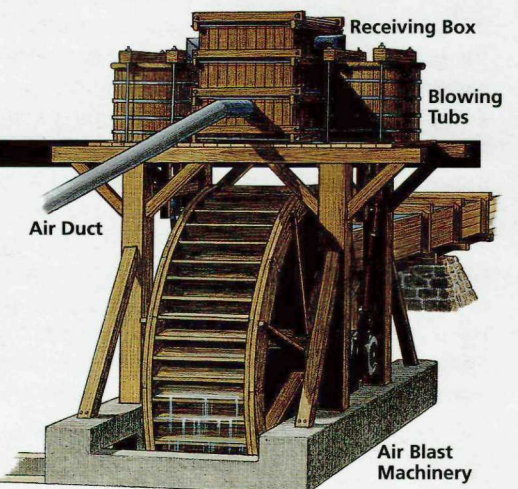


American forests were so vast—and bringing in coal so expensive before railroads were built—that early iron plantations like Hopewell made their own fuel. They slowly burned carefully built piles of wood to make charcoal, an almost purely carbon fuel that burns with in-

Charcoal



tense heat. The great demand for charcoal meant that early furnaces were sited on woodlands. One other ingredient was needed: air. It was directed into the hearth under pressure by the water-powered blast machinery, raising the fire in the furnace to smelting temperature.



The Work Force

Historians have styled rural iron making operations like Hopewell's, called "iron plantations," as feudal. This was a self-sufficient community of craftsmen and laborers living directly or indirectly governed by the furnace. It could be a difficult taskmaster—dirty, noisy, dangerous at times, ever needing to be fed and tapped. But a demanding furnace also meant community prosperity. A silent furnace meant lean times.

A traditional hierarchy governed the furnace's operations. At the pinnacle was the ironmaster, director of the enterprise and often an owner. Good ironmasters had to be financier, technician, bill collector, market analyst, personnel director, purchasing agent, and host to prospective buyers. His was a volatile job: bad luck or poor judgment usually meant failure. Success often brought wealth. A clerk helper kept the books, ordered supplies, served as paymaster, and managed the office store. The job well performed could be a stepping stone to ironmaster.

The quality of the iron was in the founder's hands. His job: keep the furnace blowing at peak efficiency. He supervised the other furnace workers: keepers helped him monitor the furnace and took the night shift; fillers charged the furnace with raw materials; and guttermen directed molten iron as it flowed from the furnace. Moulders, the highest-paid workers, had

the exacting job of casting the iron. Colliers (charcoal makers), miners, and woodcutters provided the raw materials for the furnace. Other workers included teamsters, who drove the wagons carrying raw materials and finished products; cleaners, often women and children, who finished the cast products; and teachers. Women supplemented family incomes by sewing, lodging and boarding single workers, and laundering. Some made extra income working as woodcutters and miners. Farmers fed the community, and some worked the furnace for part of the year. African Americans also worked furnaces—enslaved at first, later as temporarily employed runaway slaves and free blacks.



The Moulder's Art

In the "flask casting" method of casting, both sides of a stove plate were molded. This let the moulder produce a relatively light, curved plate. The flask was two wooden frames. The moulder laid the bottom half, the "drag," on a piece of wood called the "follow

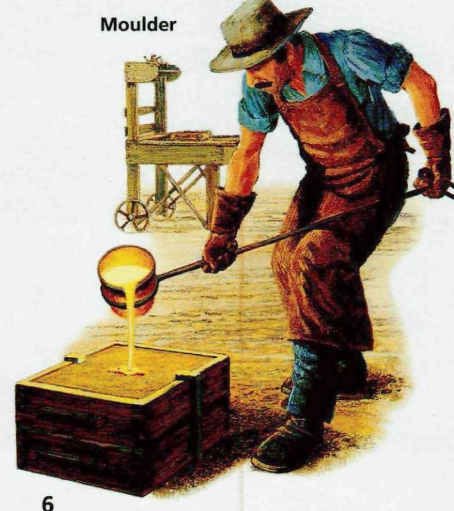
board," placing the wooden pattern inside. He then sifted fine sand over the pattern and packed the rest of the drag with coarse, damp sand 1. After scraping away excess sand with the "strike" 2, he placed another follow board on top and turned over the drag.

He then removed the first follow board, blew away loose sand from the edges of the pattern with a bellows 3, and "dressed" the edge with a moulder's spoon. He attached the "cope," the flask's top half, to the drag and again added fine and coarse sands. Before packing

the sand he inserted a wooden wedge to form a "gate" 4, allowing the molten iron to enter. Next he removed the wedge, separated drag and cope, and carefully removed the pattern with a pair of lifters 5. He next secured the two halves of the flask with iron clamps.

The final step was to pour the molten iron 6 through the gate. After the iron had cooled, he separated the halves of the flask and removed the gate from the plate. Other workers brushed off sand and filed rough edges, readying the plate for market.

Moulder



Finished Products

To make the most money from molten iron you would cast finished products at the furnace. Moulders cast several items: plowshares, pots, sash and scale weights, cannon, and shot. But as iron stoves grew more common in 1800s homes, Hopewell built its operation on stove plates.

Cast products made profits, but the age also demanded goods that the furnace's brittle high-carbon iron was not suitable for. The tough, malleable wrought iron needed for plow moldboards,

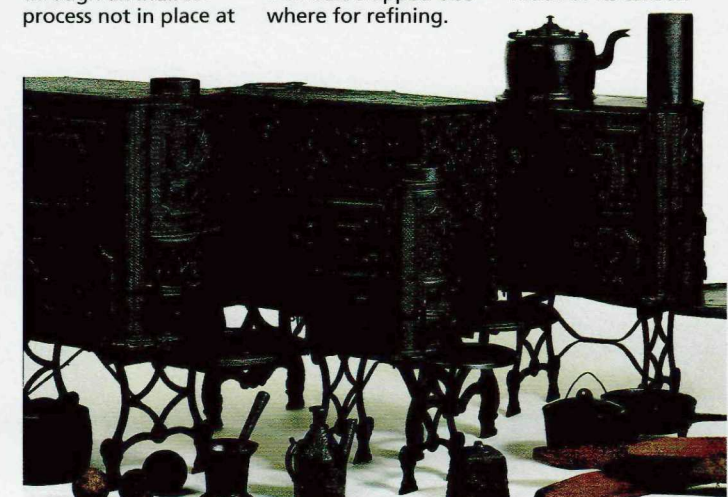
nails, and horseshoes had to be obtained through an indirect process not in place at

Hopewell. The molten iron was cast into pig iron bars shipped elsewhere for refining.

At a finery forge, the iron was remelted and much of its carbon

was oxidized, raising the melting point. The iron partially solidified into a pasty lump. The lump was then beaten to drive out the slag and align the fibers, producing wrought iron. More processing converted this iron into the bars and rods used by blacksmiths.

A lengthier process was used to convert iron to steel. Hopewell's owners often held interests in local forges and mills.



PHOTOGRAPHS: NPS / GEORGE FISTROVITCH

