CORNWALL IRON FURNACE

Administered by the Pennsylvania Historical & Museum Commission

National Historic Mechanical Engineering Landmark

The American Society of Mechanical Engineers
Susquehanna Section

Cornwall Iron Furnace
Cornwall, Pennsylvania
June 8, 1985
IRON

As they gather silver, and brass, and iron, and lead, and tin, into the midst of the furnace, to blow the fire upon it, to melt it...


The factors that gave rise to the Industrial Revolution have been the subject of endless speculation by historians who have concluded variously that these were simple and complex; the result of naturally unfolding events and deliberate design; and furthermore, that if there was a single root circumstance that made possible this most momentous event in the progress of civilization it was the development of sophisticated mining techniques; or the invention and spread of the steam engine; or the emergence of the factory system of manufacturing; or any one of a number of others. While all of these occurrences indeed were important contributors to the Industrial Revolution, they were underlain by a single crucial one upon which all the others were totally dependent and in the absence of which neither they nor nearly any other element of our industrialized society could have evolved: the large-scale, efficiently organized, wide-spread production of the ferrous metals. Without iron, cheaply and easily available, the machinery of the Industrial Revolution could not have existed. Without the steel into which a certain portion of the iron was converted the tools not only to produce iron and a line of cast-iron goods made by pouring the molten iron directly from the furnace into moulds. There also was a forge, in which a portion of the pig was reheated and worked under a tilt hammer to convert it into malleable wrought-iron blooms which in turn were rolled out and slit in the rolling mill to form that eminently useful item of commerce, nail rod. From that blacksmiths and other craftsmen produced an infinite variety of finished products, from nails and builders' hardware to plowshares and hoes to rifles and tools; the myriad iron objects so vital to life, both in the colony and “at home.”

IRON IN THE COLONIES

Although American colonial life depended principally on wood for most of its mechanical needs, nearly every wooden structure, vehicle, mill, tool, boat, and domestic appliance required some iron to join, band together, cut, or resist wear. For that reason the iron furnace made an early appearance in the American colonies. An even more compelling reason for this was exploitation by English companies of the rich iron ore deposits and limitless forests that provided the fuel for smelting it into pig iron and forging the pig into bar iron, both products shipped back to the mother country from the earliest period of settlement.

As early as 1619 a group of English investors established a blast furnace at Falling Creek near present-day Richmond, Virginia. But what would have been the first iron making establishment in America failed when the workmen were massacred and the furnace was destroyed by Indians. The first successful venture was in the Massachusetts Bay Colony at Saugus, near Lynn, north of Boston. The Hammersmith Ironworks, as it was known, went into operation in 1647. It was an integrated works, its heart the blast furnace that produced pig iron and a line of cast-iron goods made by pouring the molten iron directly from the furnace into moulds. There also was a forge, in which a portion of the pig was reheated and worked under a tilt hammer to convert it into malleable wrought-iron blooms which in turn were rolled out and slit in the rolling mill to form that eminently useful item of commerce, nail rod. From that blacksmiths and other craftsmen produced an infinite variety of finished products, from nails and builders' hardware to plowshares and hoes to rifles and tools; the myriad iron objects so vital to life, both in the colony and “at home.”

Forty-two naval cannon were cast here, along with much ammunition. This cannon, once displayed on the lawn at the ironmaster's estate, has been returned to the Cast House where it was made, probably in 1775.
The Cornwall Furnace

From its inception Cornwall occupied a special position among Pennsylvania’s iron furnaces. It owes its existence to the renowned Cornwall Ore Banks a few miles south of Lebanon, a deposit of extraordinarily rich magnetite ore that until development of the Lake Superior deposits was one of the most valuable iron-ore bodies in the U.S. It had been discovered in 1734 by Peter Grubb during a prospect. By 1737 he had purchased some 450 acres of the iron-rich land and in 1742 built a blast furnace, naming the site Cornwall for the English county of mining fame where his father had been born. Both mine and furnace survive to the present day in testimony to the vital role played by the American iron industry during the 18th and 19th centuries in the nation’s growth. The mine when in work played out in any case. With the cessation of operations, and accordingly, pumping, reinforced by the fact that the ore was about to dam the underground sections beyond the flooding accompanying Hurricane Agnes in February, 1883. Grubb operated the furnace only until about 1745 when he leased it to a company. He retained oversight of the ore banks, however, until his death in 1754 when it passed to his sons Curtis and Peter. The entire site was purchased from various Grubb heirs between 1785 and 1798 by Robert Coleman. Under the Coleman family’s stewardship Cornwall flourished during the century following, going out of blast, finally, in February, 1883.

At that point, the saga of the Cornwall Furnace ceases to be one simply of a successful Pennsylvania blast furnace that had been brought up-to-date in 1856, prospered during a heyday of some 25 years following, and then shut down in the face of competition from the newer, larger furnaces of the trans-Allegheny region that were based on the vastly more efficient technology of the hot-blast and coke fuel. The sequence was a common one. Even today the former iron-producing regions of Pennsylvania and many of the other central Atlantic states are dotted with the remains of many of these furnaces, in nearly all cases nothing more surviving than the stone furnace stack. The blowing and other machinery early was salvaged for either reuse or, more frequently, for its value as scrap metal; the timber roofs and walls of the buildings in time succumbed to the weather; and in more cases than not even the durable furnace itself was laid waste by local builders who took it as a source of ready-quarried-and-cut architectural stone. The history of mine and furnace diverged in 1883. Grubb operated the furnace only until about 1745 when he leased it to a company. He retained oversight of the ore banks, however, until his death in 1754 when it passed to his sons Curtis and Peter. The entire site was purchased from various Grubb heirs between 1785 and 1798 by Robert Coleman. Under the Coleman family’s stewardship Cornwall flourished during the century following, going out of blast, finally, in February, 1883.

That Cornwall was spared the depredations of weather and salvage is nothing less than a miracle of industrial archeology. That it has survived as the only 18th/19th-century American blast furnace with its original fabric essentially intact is the result of nothing less, apparently, than family pride—if not sentiment—bolstered by the means that made disposal of the land unnecessary. When the furnace went out of blast in 1883, it remained in the Coleman family which continued to operate other, more modern furnaces in the area. Clearly, the old site was kept and, most important, maintained, as a monument to earlier generations of Coleman ironmasters. In 1931 Margaret C. Buckingham, a great-granddaughter of Robert Coleman, deeded the furnace and its immediate ancillary structures, with their land, to the Commonwealth as a historic site, in the capable hands of which it survives today, in the visitors’ center and throughout the site the technology of ironmaking in general and the saga of the Cornwall mine and furnace in particular, are clearly laid out.

**THE FURNACE’S PHYSICAL HISTORY**

Cornwall had two distinctly different lives. When constructed in the middle of the 18th century it seems from the scant surviving descriptions to have been entirely typical of American iron furnaces of the period. It was a squat stone stack 20-feet square at the base and 11 at the top, with a height of 31 feet. The blast air was provided by a pair of wood-and-leather bellows nearly 21 feet long driven by an overshot water wheel taking its energy from the chimney.

This photograph of the front of the furnace was taken in 1898. Built in 1742, the furnace stack was rebuilt in 1856 and enlarged from 20 to 28 feet square at the base and from 11 to 21 feet square at the top. The hood over the arch is now missing, but the rake remains.

In the mid-19th century boilers were placed on top of the furnace stack to power the steam engine, which drove the blast equipment. The boilers are clearly seen in the brick structure atop the furnace. The furnace gases passed beneath them and were exhausted through the chimney.
The steam engine which drove the blast equipment was made at the West Point Foundry at Cold Spring, New York. It was installed around 1856. A 20 horse power, single cylinder engine, it has a fly wheel 9 feet in diameter. Steam was generated by two boilers on top of the furnace stack, using otherwise wasted heat.

Steam for the engine was provided by a pair of plain cylindrical West Point boilers set in the throat of the furnace, heated directly by the escaping furnace gases.

The result of this campaign of modernization is the Cornwall Furnace we see today. Interestingly, the basic ironmaking process remained the same. Neither anthracite coal nor coke were introduced as the smelting fuel although both by then had found limited use in some furnaces of the region, and the “cold blast” was retained despite the fact that the system of heating the blast air by heat exchange with the furnace exhaust had been in use for nearly a quarter of a century at a number of American blast furnaces. It was a process against which controversy still swirled, however. Although generally it was conceded that use of the hot blast did increase production efficiency, opinion among ironmasters and users was strongly divided on the question of the quality of the iron so produced. There was sufficient force of argument holding that a higher quality of both pig and wrought iron resulted from the “cold blast, charcoal process” that the adoption of the newer methods was far from immediate or universal. During the transition period from about 1860 to 1890 the principal uses for charcoal iron were for the production of specialty steels employed in the tool and allied industries, and for those elements of railroad rolling stock most subject to impact and stress reversal: car wheels and axles, and locomotive driving-wheel tires. Improved methods of steelmaking—particularly the widespread use of the open-hearth furnace—resulted in the ready availability of steels equal to those produced from charcoal iron and the eventual total demise of the old process.

Iron vessels cross the ocean;
Iron engines give them motion;
Iron needles northward veering;
Iron tillers vessels steering;
Iron pipes our gas delivers;
Iron bridges span our rivers;
Iron pens are used for writing;
Iron ink our thoughts inditing;
Iron stoves for cooking victuals;
Iron ovens, pots and kettles;
Iron horses draw our loads;
Iron rails compose our roads;
Iron anchors hold in sands;
Iron axes, knives and chains;
Iron augers, saws and planes;
Iron globules in our blood;
Iron ovens, pots and kettles;
Iron telegraphic wires;
Iron sections in spires;
Iron hammers, nails and screws.

Iron everything we use!

An anonymous 19th-century poem intended to instill in children an appreciation of iron’s universality.

The large gear wheel which ran the blowing tubes and provided the cold air blast measures 76 feet in circumference.

OFFICE OF THE CORNWALL IRON COMPANY LIMITED stands at the entrance to the ironmaster’s estate, adjacent to the furnace site. This building also served as an office for the estate and was built probably by 1875.
During its active existence and under the management of its many masters, the Cornwall Iron Furnace was a leading producer of pig iron as well as other products of the foundry floor. Now that its commercial usefulness has long since passed away and the quiescent silence of old age is wrapped around its ancient walls, few who now visit there can conceive it as it was in younger days, rampant and roaring with flame and noise, one out of many that have played their part in our iron age.

KEY TO THE FLOOR PLAN OF THE CORNWALL IRON FURNACE AND FOUNDRY

A–The engine room.
B–Cylinders of the blowing engine.
C–The great gear wheel.
D–Pinion and shaft.
E–Regulator valve for the blast.
F–Old water wheel pit.
G–Boshes of the furnace.
H–Damstone of the crucible.
I–Slag dam.
J–Pig iron moulds.
K–Entrance to the foundry floor.
L–Old entrance to the foundry.
M–Charging platform.
N–Foreman’s room.
O–Entrance to the weighing room.
P–Stairway to men’s sleeping quarters.
Q–Stairway down to the foundry floor.
R–Watchman’s room.
S–Steps up to the engine room.
T–Copper room, upper level.
U–Copper room, lower level.
V–Entrance to the blowing engine room.
X–Exit from weighing room to stairs P.
Y–Opening for the pitman, on early water wheel.
Z–Position of the early bellows.
1 to 4–Furnace arches as originally designated.
FOR FURTHER READING
Greenville, AN ENGINEER’S MISCELLANY. Philadelphia: Patterson & White Co., 1938. Chapter VI, “The Old Cornwall Furnace” (pp. 61-77), is the most complete account of Cornwall and contains the most detailed description of its physical plant, with photographs and measured drawings by the author (this plan is reproduced in this booklet). Long out of print but available in many libraries.


James M. Swank, HISTORY OF THE MANUFACTURE OF IRON IN ALL AGES, AND PARTICULARLY IN THE UNITED STATES FROM COLONIAL TIMES TO 1819. Philadelphia: The American Iron & Steel Association, 1892 (2nd Edition). While the references to Cornwall are sparse, this is regarded as still the best broad history of the industry in America.


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The American Society of Mechanical Engineers

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Cornwall Iron Furnace

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NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK
WHEN ERECTED BY PETER GRUBB TO SMELT THE RICH IRON ORE OF THE NEARBY CORNWALL ORE BANKS, THIS STONE-BUILT BLAST FURNACE WAS TYPICAL FOR ITS TIME, PRODUCING ABOUT 20 TONS OF PIG IRON AND CAST-IRON PRODUCT PER WEEK.

A MAJOR RECONSTRUCTION IN 1855-57 PRODUCED IMPORTANT CHANGES. THE FURNACE ITSELF WAS ENLARGED; THE BLAST-AMIRBELLS WERE REPLACED BY A PAIR OF WOODEN CYLINDER "BLOWING TUBS"; THE WATER WHEEL THAT HAD POWERED THEM WAS REPLACED BY A 20-HORSEPOWER STEAM ENGINE; AND A PAIR OF WASTE-HEAT BOILERS TO SUPPLY THE ENGINE WAS INSTALLED IN THE OPEN STACK OF THE FURNACE.

THE FURNACE WAS IN BLAST UNTIL 1883 IN THIS FORM, AND SO REMAINS THE ONLY ONE OF AMERICA’S HUNDREDS OF 19TH-CENTURY CHARCOAL-FUELED BLAST FURNACES TO SURVIVE FULLY INTACT.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS 1985

IMPORTANT DATES FOR CORNWALL IRON FURNACE
1734- Peter Grubb buys land containing iron ore which became the great Cornwall Ore Banks.
1739- Construction of Cornwall Furnace begins
1742- Furnace put in blast.
1785-98 Cornwall Furnace and mine pass into the hands of Robert Coleman.
1856-7- Furnace rebuilt and enlarged; steam engine and blowing tubs installed.
1883- Furnace goes out of blast in February.
1932- Furnace site is donated to the Commonwealth by Margaret C. Buckingham.
1966- Cornwall Iron Furnace is designated a National Historic Landmark by the United States Department of the Interior.
1976- Cornwall Iron Furnace is designated an ASM Historical Landmark by the American Society for Metals.
1985- Cornwall Iron Furnace is designated a National Historic Mechanical Engineering Landmark by the American Society of Mechanical Engineers.

The ASME Susquehanna Section—Mechanical Engineering Landmarks to date:
Kaplan Turbine—York Haven Hydroelectric Station
York Haven, Pennsylvania
October 20, 1980.

Worthington Pumping Engine—York Water Company
York, Pennsylvania
May 7, 1982.

Electric Locomotive GG1 4800—Railroad Museum of Pennsylvania
Strasburg, Pennsylvania
April 23, 1983