Museum Guide No. 2.01 (SJ 667047)

The Coalbrookdale Museum of Iron

A guide to the Museum and the Old Furnace

Ironbridge Gorge Museum Trust

The Coalbrookdale Museum of Iron

Iron is one of the foundations of modern civilisation. Without it there would be no motor cars, no railways, no airliners, no tower blocks, no refrigerators, no one-armed bandits, no dressmakers' pins, no surgical instruments. The methods of manufacturing the various types of iron in use today incorporate the contributions of scientists and technologists of many nations, and new ideas spread rapidly throughout the world. In the past, development was slower and more concentrated. It was here, at Coalbrookdale, in Shropshire, in the eighteenth century, that a remarkable series of innovations in the manufacture and use of iron took place, without which the Industrial Revolution in Britain would not have been possible. Nowhere in the world could be a more appropriate setting for a Museum of Iron.

Iron has been worked at Coalbrookdale for well over four hundred years. There was a bloomery furnace here on the property of the monks of Wenlock Priory at the time of the dissolution of the monastries in the 1530s. In the early seventeenth century Sir Basil Brooke carried out important experiments in steel-making in the Dale. Cast-iron goods for the building trade and parts for Aga and Rayburn cookers are manufactured here today at the modern foundries of the Glynwed Group. But the best-known owners and managers of the Coalbrookdale ironworks were the Darby and Reynolds families under whose charge, in the eighteenth and nineteenth centuries, its innovations became world famous. The Darbys were associated with the works from 1708 until the early years of the twentieth century. In this Museum you will see the story of the changing technology of ironmaking from earliest times to the present, but particularly during the Industrial Revolution. You will also see how one particular family affected the history of ironmaking, and how its members shaped the unique ironmaking community of Coalbrookdale.

Clearance work in progress at the Old Furnace, 1959

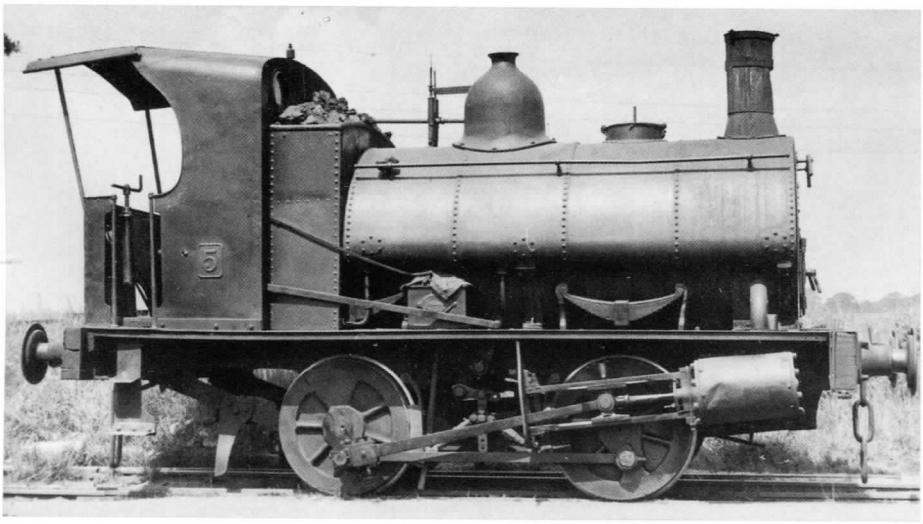
Cover:
The Great Warehouse clock tower, added to the building in 1843.

Coalbrookdale is a place of great significance in the history of industrial conservation in Great Britain. In 1959 the Old Blast Furnace was uncovered by Allied Ironfounders Ltd under the management of Dr G.F. Williams, and with the guidance of Dr Arthur Raistrick, to mark the 250th anniversary of the first successful smelting of iron with coke by the first Abraham Darby. At the same time a small museum was established nearby,displaying the products of Coalbrookdale over the centuries. This was one of the first projects of its kind, and it attracted steady streams of visitors. In 1968 the Ironbridge Gorge Museum Trust was founded, with the object of conserving for posterity the industrial monuments of the district, and two years later the Trust took over responsibility for the Coalbrookdale furnace and museum. It soon became clear that the existing building was too small adequately to display the vast collection of iron products which the Trust was acquiring. In 1976 Telford Development Corporation began conservation work on the Great Warehouse, adjacent to the old museum. During the first half of 1979 the former museum building which was of recent date was demolished and its contents absorbed into the new Coalbrookdale Museum of Iron in the Great Warehouse.

The Great Warehouse was built in 1838 at a time when the Coalbrookdale Ironworks was reckoned to be the largest foundry in the world, and was producing a vast and varied range of iron objects. It was used for the storage of castings before they were taken by plateway to the River Severn for despatch by barge. In 1864 the standard gauge railway line through Coalbrookdale was opened and the ironworks connected to it. On the ground floor of the Museum of Iron is the loading bay where iron castings were placed on wagons on which they travelled to customers throughout Great Britain.

The small saddle tank locomotive is one of a batch of six built by the Coalbrookdale Company in 1863-64. Two of the six went to South Wales, two were used at the Horsehay ironworks, while numbers 5 and 6 shunted at

Locomotive no 5 at Barden Hill Quarries, Leicestershire, before its removal to Coalbrookdale. *J.M. Jarvis*



Coalbrookdale. Of these No 5 was sold in the inter-war period and was eventually used at a quarry in Leicestershire, from which it was returned to Coalbrookdale in 1959. No 6 had its boiler and cylinders removed about 1925 and replaced by a Sentinel road wagon boiler and chain driven engine. Its chassis can now be seen under one of the railway arches between the Museum and the Old Furnace.

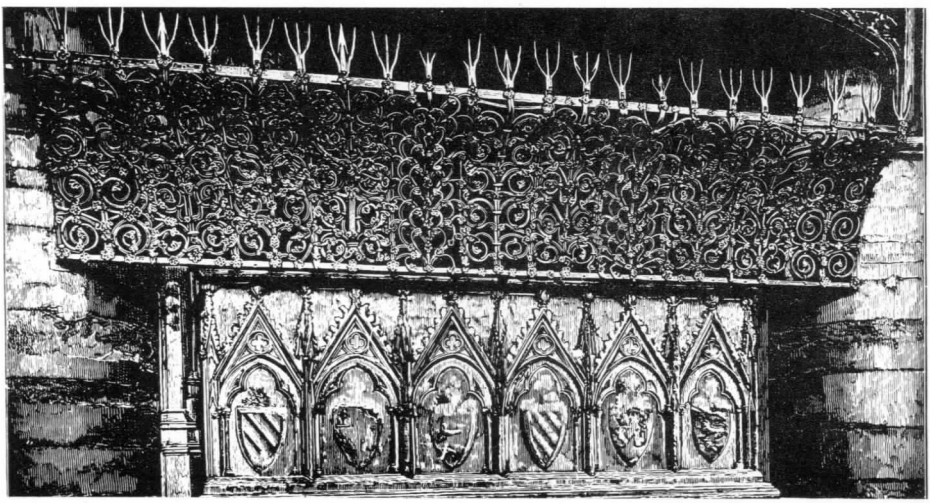
The 'Cupid and Swan' fountain

The 'Cupid and Swan' fountain was part of the Coalbrookdale Company's display at the Great Exhibition in the Crystal Palace in 1851, and was specially designed for the company by the artist John Bell. It is probably based on a Greek statue 'Boy strangling a Goose' in the Louvre. 'Cupid and Swan' went to a park in Wolverhampton after the Great Exhibition. It was taken to pieces and stored at a corporation depot in the town for many years before it was brought back to Coalbrookdale in 1959.

Varieties of Iron

On the first floor of the Museum of Iron you can see how iron has been made since it was first used by Man, and in particular how the techniques of iron-making were revolutionised by innovations at Coalbrookdale in the mid-eighteenth century. There is a full account of the history of iron-making methods in Museum Handbook 20.04 'Iron and Steel'.

The following types of iron are frequently mentioned in the display:
Wrought-Iron is a commercially pure form of iron, manufactured in Great Britain before about 1550 in a bloomery furnace and subsequently made from cast-iron in a forge. In the late nineteenth century wrought-iron began to be supplanted by mild steel. Today it is no longer manufactured in Great Britain,



but within a few years it will be produced at the ironworks at the Blists Hill Open Air Museum. Wrought-iron has a fibrous structure like a rope or a piece of wood. It can be hammered, bent, rolled and welded. It is strong in tension but weak in compression. It was used for edge tools, locks, nails and chains. In the form of plates it was employed for steam engine boilers, and in some bridges, like Robert Stephenson's Britannia tubular bridge over the Menai Straits. It is a material which has been used to great effect in ornamental gates and screens from the Middle Ages to the present day.

Cast-Iron is an alloy of iron and other elements, chiefly carbon, of which it contains about 4 per cent. Before about 1400 it was made only by accident when a bloomery furnace was overheated, but since that time it has been deliberately manufactured in blast furnaces, and has been the first stage in the manufacture of all sorts of iron and steel. Cast-iron has a crystalline structure and melts easily so that it can be poured into moulds to make castings. It is weak in tension but can withstand heavy loads in compression. It has been used in household utensils, numerous forms of decorative items, steam engines, motor car cylinders, the frames of large buildings, and in arched bridges. *Pig iron* is *cast-iron* in the form in which it is made at a blast furnace. The molten iron is run into a bed of sand in which moulds have been prepared which are said to resemble piglets feeding from a sow. In this form the iron is taken to the next stage in the manufacturing process.

Steel is a word used to describe several different types of iron:

Carbon steel, which usually contains between 0.25 and 1 per cent carbon, was made in small quantities in early times, and used in making weapons. It is still used for purposes where a great degree of hardness is required.

Mild steel, with a carbon content of about 0.25 per cent, was the invention of Henry Bessemer in the mid-nineteenth century, and is the commonest form of iron in use today, being employed for a great variety of engineering and constructional purposes.

Alloy steels have been made for just over a hundred years, and are combinations of iron with various elements in addition to carbon which have such special properties as high resistance to corrosion.

Left: Decorative use of wrought-iron. Grille in Westminster Abbey above the tomb of Eleanor of Castille, wife of Henry III, wrought in 1294 by Thomas of Leighton. A nineteenth-century copy can be seen in the museum.

Haystack boiler of a type widely used for steam engines in the early nineteenth century. The boiler is fabricated from plates of wrought-iron.

Varieties of Ironworks

You will see illustrations of several different types of ironworks on the first floor of the Museum of Iron. This list will help you to check on their functions.

A bloomery furnace, with bellows worked by men, animals or water, was the usual method of making iron (in small quantities) from iron ore, using charcoal as the fuel, until the sixteenth century. By 1700 most bloomeries in England had ceased to work, but they have been used until modern times in such countries as India.

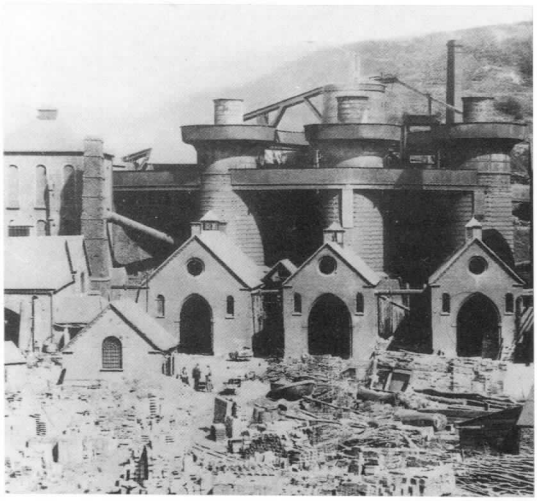
The blast furnace was invented in the Liège region about 1400 and introduced into England in the fifteenth century. It was a substantial brick or stone structure, used to make cast-iron from iron ore in relatively large quantities. It operated with bellows worked by waterwheels, and from 1776 more commonly by steam engines. The fuel was originally charcoal, but in 1709 Abraham Darby I succeeded in smelting iron ore with coke, and about 1755 coke became the usual fuel. The blast furnace remains the first stage of iron manufacture, but modern furnaces are very large and complex. While a mid-eighteenth century Shropshire furnace made about twenty tons of iron a week, a modern furnace can make more than 2,500 tons a day.

A forge is essentially a works where wrought-iron was made or used.

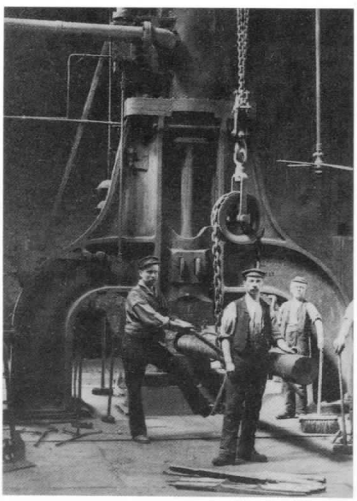
A finery and chafery forge was where wrought-iron was made from cast-iron before the late eighteenth century. It was a two-stage process, usually but not essentially employing charcoal as the fuel, and waterwheels to power bellows and hammers. From the late eighteenth century wrought-iron was most often made in a *puddling furnace* generally part of a *forge* where there were also *rolling mills* to shape the iron into rods, girders or whatever shapes were required. *A forge* can also be a workshop where a smith hammers wrought-iron or mild steel into useful shapes.

At a foundry cast-iron is melted and poured into moulds to make castings. A section of the Museum of Iron shows foundry techniques from earliest times to the present.

The early nineteenth-century blast furnaces at Blists Hill. Pig iron was produced here until 1912.



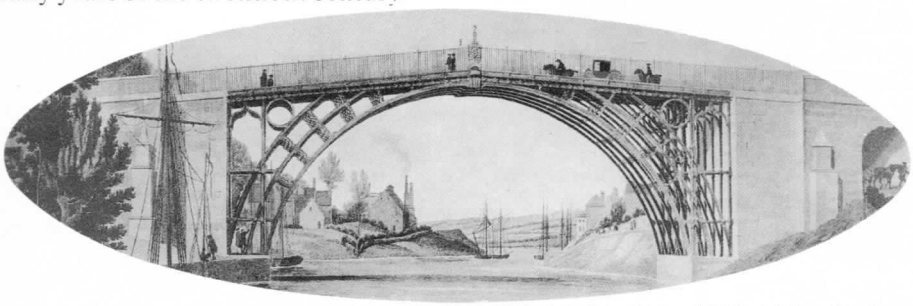
Forging a wrought-iron shaft under a steam hammer



Coalbrookdale and the Darbys

There have been ironworks in Coalbrookdale since the reign of Henry VIII if not earlier. The Old Blast Furnace was built in the mid-seventeenth century, but at the end of that century it was not a particularly successful enterprise. It belonged to none of the great partnerships which dominated the West Midlands iron trade, and those who worked it found it difficult to obtain supplies of charcoal. About 1700 there was an explosion at the furnace during a storm, after which Shadrach Fox who was then operating it left Coalbrookdale to work for Peter the Great in Russia. The furnace was derelict when, in 1708, it was leased by Abraham Darby.

Darby was a Quaker, born near Dudley but living in Bristol, who was involved in the foundry trade, and who, in 1707 had taken out a patent for the manufacture of bellied cast-iron cooking pots. He already had connections with the Coalbrookdale area as shown by his witnessing of a deed for the Broseley Quaker Burial Ground in 1706. After taking over the Coalbrookdale furnace he began to reconstruct it in the autumn of 1708. The old hearth was knocked down and new hearthstones were brought up the Severn by barge. New hide bellows were installed, and by Christmas the furnace was being warmed up prior to being put into blast. It was in this furnace in January 1709 that Darby began to smelt iron ore using coke rather than charcoal as his fuel. This was the first of the many innovations in the manufacture and use of iron made at Coalbrookdale in the eighteenth century. It was also the beginning of the connection of the Darby family with the Coalbrookdale ironworks. The descendants of Abraham Darby I were to be involved with the works until the early years of the twentieth century.



Engraving of the Iron Bridge, 1782, by William Ellis based on a painting by Michael 'Angelo' Rooker (1743-1801)

The most important members of the Darby and Reynolds families were:

Abraham Darby I. Leased the Old Blast Furnace in 1708, and the following year succeeded in smelting iron with coke. Built a second furnace lower down the valley in 1715, and established Coalbrookdale as a successful foundry.

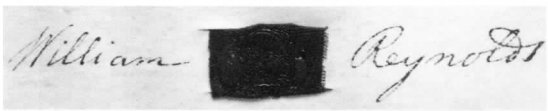
Abraham Darby II. Largely responsible for the great expansion of the Shropshire iron industry in the 1750s, when he built new furnaces at Ketley and Horsehay. In 1742 he used a Newcomen steam engine to re-circulate water between the pools of the Coalbrookdale works, thus avoiding the need to stop the furnaces in summer when water supplies had previously been insufficient. He built the Coalbrookdale Company's first wooden railways, and created a system which ran from Little Wenlock and Ketley to the Severn. He lived at a house called Sunniside on the hill above Coalbrookdale, which he built in 1750.

Abraham Darby III was the builder of the Iron Bridge. The structure was designed by Thomas Farnolls Pritchard, and the project received vital

encouragement from the ironmaster John Wilkinson, but Darby who was treasurer to the undertaking, personally supervised the project, and may have suffered considerable financial losses as a result. He lived at the Hay Farm, Madeley.

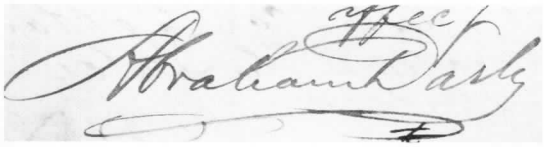
Richard Reynolds was a Bristol Quaker who moved to Coalbrookdale in 1756, and married the daughter of Abraham Darby II the following year. He introduced the first iron rails and encouraged the Cranage brothers in the use of coal in forging wrought-iron. He was a well-known philanthropist in Bristol and London.

William Reynolds was the pioneer of a multitude of innovations in ironmaking, canal building, engineering and the chemical industry. The digging of the 'Tar Tunnel' was begun at his instigation. He owned the glassworks at Wrockwardine Wood, and was the creator of the 'new town' of Coalport in the 1790s (It is described in Museum Guide 5.02).

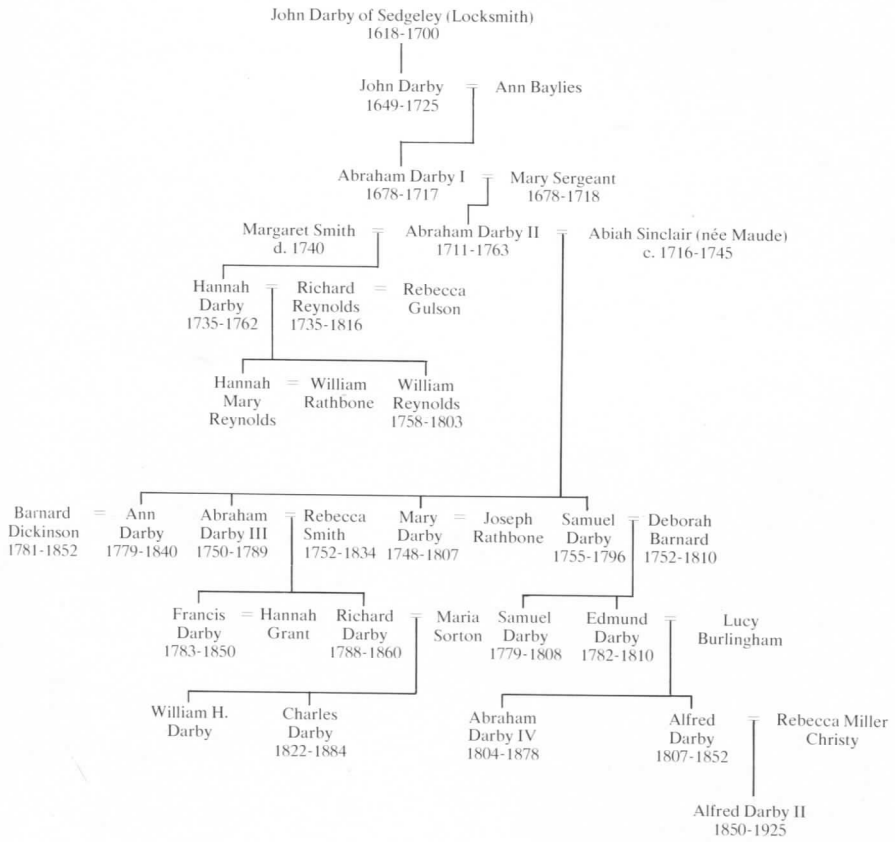


Francis Darby was a lover of music and fine arts who was largely responsible for introducing the production of art castings at Coalbrookdale in the late 1830s.

Abraham Darby IV, and his brother Alfred, were responsible for reorganising the Coalbrookdale and Horsehay works in the 1830s, and extending the family's ironmaking interests to South and North Wales. It was in the time that the wrought-iron plates for the hull of the SS *Great Britain* were rolled at the Horsehay forge (See Museum Information Sheet No 4 'The Coalbrookdale Company and the SS *Great Britain*'). He renounced the family's traditional Quakerism for the Church of England, and built Holy Trinity Church, Coalbrookdale in 1854.



Darby Family Tree (Simplified)



The Products of Coalbrookdale

Liverpool. 1842. To see how many things are now made of iron in England, one must visit one of the iron warehouses, as for instance that of Coalbrookdale, at this place. Tables, sofas, vases, inkstands, and an endless variety of articles fashioned into the most graceful forms may there be seen. *J.G. Kohl.*

Pots and Pans

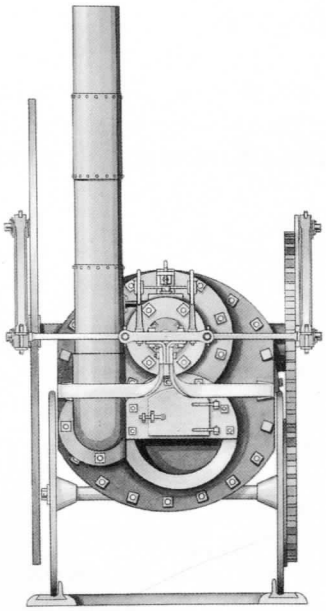
The first Abraham Darby was a pot founder before he came to Coalbrookdale. He took out a patent in 1707 (No 380) for a method of casting bellied iron pots in sand, using a four part mould box. Such pots, sometimes called 'furnaces', 'hoddy-doddies', 'Kaffir pots' or 'missionary pots' remained an important product of the Coalbrookdale foundry until about 1900. They were made in many sizes, the largest of them (up to 400 gallons in capacity) being used in institutional kitchens or in such industries as soap- or paper-making. Pots with two flattened sides were used for rendering blubber on the decks of whaling ships, and the Museum has evidence of such pots with the name 'Coalbrookdale' cast on them from as far away as Honolulu. All sorts of pots were exported. The American Quaker Elihu Burritt wrote in 1864:

'All Americans who were boys forty years ago will remember three English centres of particular interest to them. These were Sheffield, Colebrook Dale and Paternoster Row. There was hardly a house or log cabin between the Penobscot and the Mississippi which could not show the imprint of these three places, on the iron tea-kettle, the youngest boy's Barlow knife, and his younger sister's picture-book. To the juvenile imagination of those times, Sheffield was a huge jack-knife, Colebrook Dale a porridge-pot, and Paternoster Row a psalm book . . .'

200 gallon cast-iron whaling pot in Honolulu, Hawaii. Made by the Coalbrookdale Company.

Steam Engines

The first successful steam engine for the pumping of mines was erected by Thomas Newcomen near Dudley in 1712. Early engines had brass cylinders, but by 1722 iron cylinders were being cast at Coalbrookdale. Such cylinders were sold all over Britain and brought the Coalbrookdale works to national prominence. From 1779 the works cast cylinders for engines built by Boulton & Watt, and in the late 1790s castings were made for high pressure engines designed by Richard Trevithick, who in 1802 built the world's first steam railway locomotive at Coalbrookdale, although it seems never to have been put to work.



Richard Trevithick's Coalbrookdale Locomotive, c 1802. Museum drawing based on an original contemporary sketch. *Crown Copyright: Science Museum, London*

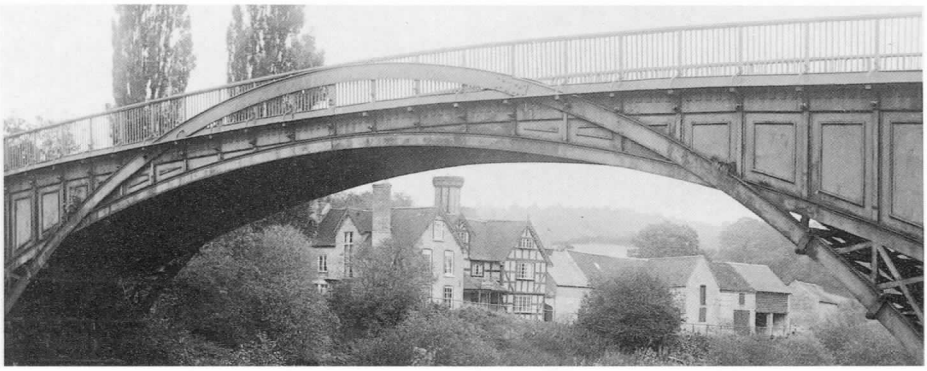
The Coalbrookdale Company continued to build steam engines in the nineteenth century, among them a huge 370 hp pumping engine with a 70 in x 10 ft cylinder called the 'Queen Victoria' built for the Bog lead mines on the Stiperstones in 1839.

Railways

The first railway in the Ironbridge Gorge dates back to the beginning of the seventeenth century. The first iron railway wheels were cast at Coalbrookdale in 1729 for use on a local colliery line. In 1767 the first iron rails were cast, slabs of iron measuring 6ft x 3¼ in x 1¼ in which rested on the tops of wooden rails. About 1790 this type of rail was replaced locally by the L-shaped plate rail, invented by John Curr of Sheffield. There was a dense network of such plateways servicing pits and ironworks, each company having its own system, with different gauges, rail lengths and sleepers from those of other companies. Some such lines continued in use well into the twentieth century.

Bridges

The world's first iron bridge was cast at Coalbrookdale, erected in the summer of 1779, and opened to traffic on New Year's Day 1781. By the mid-1790s the production of iron bridges was becoming an important part of the work of the Coalbrookdale foundries. The first iron bridge to be exported went from Coalbrookdale in 1791 to span a Dutch canal. Among the bridges built locally was one designed by Thomas Telford to replace a medieval stone bridge at Buildwas which had collapsed during a flood in 1795. Telford's bridge was erected in the following year and survived until 1905-06. Coalbrookdale bridges which still stand include those at Cound built in 1797 (SJ 555053), Bath, built in 1800 (ST 758653), Dublin, built in 1816, Alrewas, built in 1824 (SK 188139) Highley built in 1828 (SJ 753817) and Mavesyn Ridware built in 1830 (SK 092167).



Iron bridge at Buildwas, built by Thomas Telford in 1796. Replaced 1906

Stoves and firegrates.

A list of the Coalbrookdale Company's products in 1801 includes square ovens, octagon ovens, Dutch ovens, hob ovens, patent rotative ovens, and "grates in great variety". By 1850 some highly elaborate designs had been produced, including a grate with a reproduction of the Iron Bridge cast around the ash hole. After the Second World War the foundry again achieved notable successes in this field. Allied Ironfounders Ltd gained a substantial part of the market in domestic solid fuel appliances, two of the most popular designs being the 'Aga' cooker and the 'Rayburn' water heater, parts for which are still cast in the foundry which now belongs to the Glynwed Group.

Cast-iron firegrate with "Iron Bridge" design

Lion and boar, illustrated in the Coalbrookdale Company's Ornamental Castings catalogue July 1877

Art Castings

The production of ornamental cast-iron was introduced at Coalbrookdale about 1834 in the time of Francis Darby, and in the ensuing decades it became one of the company's specialities. Products included gates, fountains, inkstands, hat stands, seats and other ornaments for gardens, street furniture, cake plates, statuettes and relief plaques. A large display of Coalbrookdale products at the Great Exhibition in the Crystal Palace in 1851 brought great fame to the company. The ornamental gates exhibited in the Crystal Palace can still be seen in Kensington Gardens near to the Albert Hall. Such eminent artists as John Bell designed figures to be cast at Coalbrookdale, but some art castings, notably the 'Lord's Supper' plaque and the cake plates, were made to designs also used by foundries in Berlin and in Finspang, Sweden, as well as by other British ironworks.

Forehearth of the Old Furnace Coalbrookdale

Here in the Old Blast Furnace at Coalbrookdale, iron was first successfully smelted with coke in 1709. It was here that the iron for the ribs of the Iron Bridge was smelted in 1778. The first iron railway wheels, the parts for the first steam railway locomotive and probably some of the first iron rails were cast here or in adjacent foundry buildings. The furnace is one of Britain's most important industrial monuments.

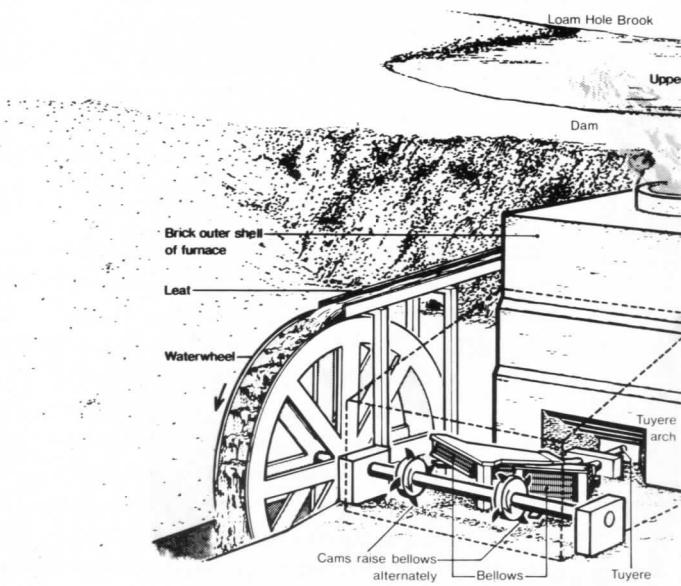
The Old Furnace (which name distinguishes it from the New Furnace, built by Abraham Darby I lower down the valley in 1715, and now covered by the Glynwed foundry) was probably built in 1638, the date cast on the lowest beam on the forehearth, but there is a tradition that this beam was brought to Coalbrookdale from the nearby ironworks at Leighton. Even if this did happen, there is no doubt that the furnace was in existence by 1660. The initials BEW and EWB which are cast on the same beam probably refer to the Brooke family who owned and operated the ironworks in Coalbrookdale before the Civil War.

The inscription ABRAHAM DARBY 1777 on the upper beam almost certainly records the re-building of the furnace to enlarge its capacity in order to make the iron for the ribs of the Iron Bridge. There are over 370 tons of iron in the bridge, and the capacity of the furnace was only about 20 tons a week. In its present form the Old Furnace probably dates from a re-building after an explosion in 1801. It remained in use until the depression which followed the end of the Napoleonic Wars in 1815. It was taken out of blast for the last time about 1818, and afterwards the Coalbrookdale Company smelted all its iron at Horsehay, Lightmoor and Dawley Castle, nearer to the coal and ore mines than Coalbrookdale. The Old Furnace was absorbed into a foundry complex, and engulfed by a mass of workshops of which the floor levels can be seen in the nearby retaining wall. It was uncovered by Allied Ironfounders Ltd in 1959.

This part of the furnace is called the forehearth. The furnace had an open top so that flames could always be seen at its rim, night and day, for as many months or years as it remained in blast. There were two sets of workers who operated shifts of twelve hours, but had to work a 'double turn' of twenty four hours at alternate weekends when the shifts changed over. The raw materials, coke, iron ore and limestone, were fed into the furnace in baskets, carried across the 'bridge' from a check house on the dam by teams of boys. The dam is masked by the retaining wall near the furnace, and impounds the Upper Furnace Pool from which water flowed to turn the wheels that powered the furnace bellows. The bellows were situated on the tuyere arch side of the furnace, at right angles to the forehearth. The 'tuyere' was the pipe through which air was pumped into the furnace itself.

Air was blown into the furnace and as the heat increased droplets of iron would trickle to the bottom and accumulate to a depth of about two feet in the crucible. The limestone would also melt, and floated on top of the iron, lifting from it many of the impurities in the ore and the fuel. Once every twelve hours the molten limestone would be run off and thrown away, to solidify as the glassy substance known as slag. The iron would then be allowed to flow out, usually into a 'pig bed' of sand. When the iron had solidified the pigs would be separated and then taken away to be re-melted, either in a forge where they would be made into wrought-iron, or a foundry where they would be cast into useful objects. Sometimes the iron would be run straight out of the blast furnace into a cup-shaped hole, and then ladled into moulds to make castings. The casting floor was protected from the weather by a roof, the socket holes for the beams of which can be seen in the wall of the furnace.

The Old Furnace Coalbrookdale

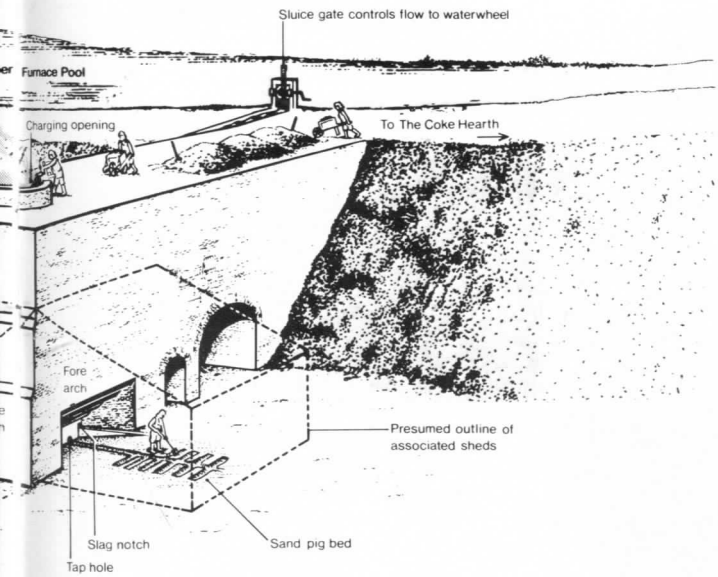


Samuel Ireland, an artist, visited the Coalbrookdale furnace in the 1790s, and wrote the following account of what he saw:

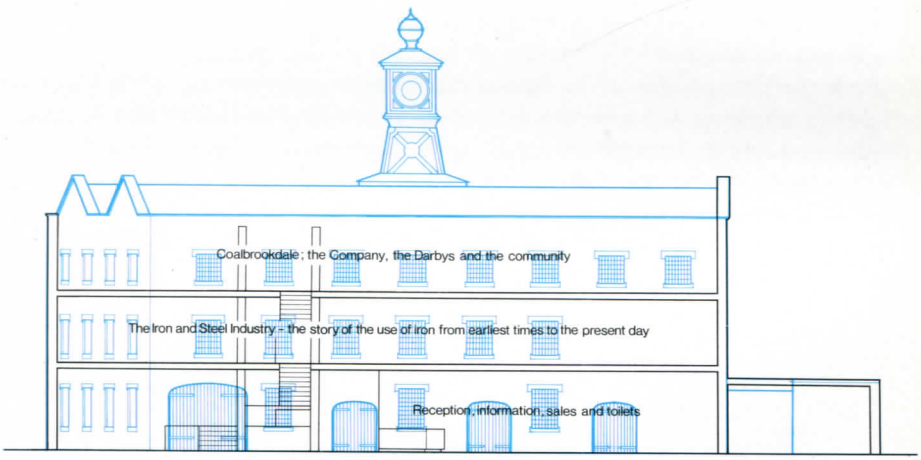
'The immense furnace stood in the centre of a large area walled around, communicating with each side of which was a colossal pair of bellows, whose alternate blasts, with a noise like the incessant roaring of heavy ordnance, excited an intense heat, which had to be kept up night and day, for a considerable time to separate the metal from the stone, and to reduce it to a state of fusion. The aperture whence the fused iron was to flow was guarded only by some clay and sand, constantly kept moist by the application of water. Preparatory to the opening of the furnace, a channel of damp sand was formed, from its mouth to a large circular basin of the same material, into which on its liberation, the burning fluid impetuously rushed. On a wide surrounding space were numerous moulds, in sand, for the fronts of stoves and other articles. Into these the fluid iron was poured from ladles with long handles, carried by athletic workmen, who filled these utensils from the great circular reservoir'.

The Snapper Furnace

From the forehearth side of the Old Furnace can be seen another blast furnace, beside the retaining wall near the main road to Wellington. This is the 'Snapper' furnace built about 1801 for the smelting of excess ore at periods when the demand for iron was high. There were similar furnaces at the nearby Ketley and Calcutts ironworks. Each produced between ten and fifteen tons of iron a week. The firebrick lining of this furnace was removed for use elsewhere in the works during the Second World War.



Further reading:
More detail on the Darby and Reynolds families can be found in Arthur Raistrick, *Dynasty of Ironfounders*, 1953, and Barrie Trinder, *The Darbys of Coalbrookdale*, 1974. The Museum publishes another Guide, No. 2.02 *Coalbrookdale*, which is a guide to the historic buildings and industrial landscapes in the vicinity of the Museum of Iron. Museum Handbook No. 20.02 *The Coalbrookdale Ironworks* is a concise history of local ironmaking, while No. 20.03 *A Description of Coalbrookdale in 1801* is an edited version of a guide for visitors written when Coalbrookdale was at the height of its fame.
No. 20.04 *Iron and Steel* is a thorough and clearly-written account of the development of ironmaking technology during the last three hundred years. Museum Information Sheets deal with such subjects as *The Coalbrookdale Token, The Quaker Burial Ground, The Coalbrookdale Company and the SS Great Britain* and the history of the Coalbrookdale locomotive.



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