WILLIAM HAZLEDINE

(1763-1840)

A PIONEERING SHROPSHIRE IRONMASTER

Andrew Pattison

The story of William Hazledine is virtually unknown today, even in his home town of Shrewsbury. He was, however, a figure of considerable importance in the history of engineering and technology, supplying the ironwork for no fewer than five world 'firsts'. These are Ditherington Flax Mill, Shrewsbury; the Chirk and Pontcysyllte Aqueducts on the Ellesmere Canal; lock gates for the Caledonian Canal; a new genre of cast-iron arch bridges; and Menai and Conwy suspension bridges.[1]

Courtesy of Shropshire Council, Shropshire Museums

William Hazledine as Mayor of Shrewsbury 1836, by Thomas Weaver.

Becoming an Ironmaster

William Hazledine lived most of his early life at Moreton Forge, a small ironworks about 7 miles northeast of Shrewsbury. His grandfather, father and uncle were millwrights (building and repairing mills), while other relatives ran the forge itself. William was apprenticed as a millwright to his uncle, which meant he had a solid grounding in technical drawing, carpentry, building work, surveying, and controlling the flow of water. From his upbringing he also learned the techniques of producing artefacts in iron and brass. In 1785 he set up his own business in Shrewsbury as a millwright and manufacturer of millstones, and shortly after he went into partnership in a small iron foundry in the town.[2]

In late 1786 the civil engineer Thomas Telford (1757–1834) arrived in Shrewsbury to rebuild the castle, and Telford and Hazledine soon became friends. Another important new arrival to Shrewsbury was the mason and master builder John Simpson (1755–1815), who moved in 1790 to oversee the building of the new St Chad's Church. The three men, Hazledine, Telford and Simpson, became lifelong friends as well as business associates, creating mutual confidence that would be important in many of Telford's major works.

Courtesy of: Shropshire Council, Shropshire Museums

Hazledine's Iron Foundry, Shrewsbury. Artist: Unknown.

Coleham Foundry

In Coleham, Shrewsbury, from 1790 Hazledine developed what became one of the largest iron foundries in the country. His works were steam-powered, and used cupola furnaces, first patented by Shropshire ironmaster John Wilkinson in 1794. A cupola is a brick-lined furnace charged from the top with pig (or scrap) iron, coke (or charcoal) and limestone. The coke or charcoal is lit and the temperature is raised by means of an air blast introduced through tuyeres.[3] The molten metal is then run off into moulds, either directly or via ladles. The cast iron produced in this way was of much better quality than before, and the whole arrangement made casting much easier. During this period the new science of metallurgy was beginning to shed light on the nature of iron, and it appears that Hazledine was up to date with these developments. As well as Coleham Foundry, Hazledine also had major ironworks at Plas Kynaston (now in the County Borough of Wrexham), Upton Forge, near Shrewsbury, and Calcutt's, near Ironbridge.

Ditherington Flax Mill

In 1797 Hazledine undertook his first major contract, the supply of the ironwork for the Ditherington Flax Mill, Shrewsbury, now recognised as being the first fully iron-framed building in the world, and hence the ancestor of all skyscrapers.[4] The internal structure is supported by a grid of cast-iron columns, with 17 rows of three columns along the length of the building. Thus each floor has 51 columns, making a total of 204 columns, and the columns on each floor are of different designs. Each floor has 17 lines of cast-iron beams, each cast in two lengths and bolted together in the centre of the building. There are thus 34 separate beams on each floor – a total of 136 in the whole building. Assuming there was originally a window at either end of each bay, there would have been 136 cast-iron frame windows, together with an unknown number of door frames. There are 19 separate roof sections, and each of these is supported by cast-iron trusses. As well as the many cast-iron components, there must also have been many smaller wrought-iron pieces, including door furniture, banisters, and other interior fittings. The whole complex structure needed to fit together like a giant Meccano set, and also to fit precisely with the brickwork.

Recent surveys have provided an opportunity to examine the composition of the ironwork, and samples from various parts of the mill have been tested. These examinations showed that the cast iron had nearly twice the tensile strength of the average for this period.

Courtesy of: Shropshire Archives

Ditherington Mill. Three lines of cast-iron columns run along each floor, supporting cast-iron beams. Each beam is cast in two halves which are bolted together through heavy flanges.

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The Pontcysyllte Aqueduct, Wrexham, North Wales.

'A Stream in the Sky'

While Hazledine was doing this work, Telford had become the resident engineer for the new Ellesmere Canal, which was planned to link the Rivers Dee, Severn and Mersey.[5] There was a great deal of debate and uncertainty as to the best way to build the aqueducts needed to cross the Dee and Ceiriog Rivers, as this would require a new approach to cope with the unprecedented height. Hazledine got the contract to supply cast iron for the bottom of the Chirk Aqueduct, which was opened in 1802. As this was a success, Telford and his team took the gamble of making the much larger Pontcysyllte Aqueduct with a complete iron trough. The quantity of iron needed was staggering.

The 19 masonry piers, up to 126 feet (38 m) high, support 18 cast-iron arches, each spanning 53 feet (16 m) and consisting of four ribs, each cast in three sections. This is a total of 216 castings. Similar calculations give a total of 216 'voussoirs',[6] 240 infill plates, and so on – literally thousands of major castings, before all the bolts, fixings and so on are added. The joints were made with flannel soaked in white lead and the whole liberally covered in tar. This aqueduct, opened in 1805, soon became a tourist attraction, and was described by Sir Walter Scott as 'a stream in the sky', adding that it was 'the most impressive work of art I have ever seen'. It has stood the test of time remarkably well, and remains the longest and highest aqueduct in Britain.

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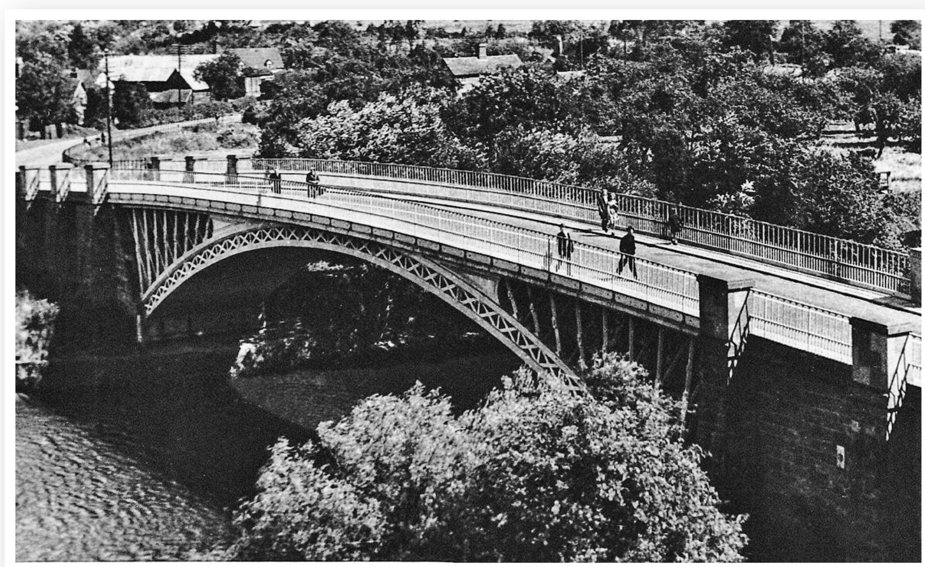
Hazledine's arch ribs reused in Telford Town Centre.

'Like a Spider's Web in the Air'

Emboldened by the success of the iron aqueducts, Telford began to design cast-iron bridges, and Hazledine supplied the ironwork for most of these.[7] The first small one was on the outskirts of Shrewsbury, and there were several other similar ones built in the vicinity of the town. Two arches from one of these were eventually reused to provide a pedestrian bridge in Telford Town Centre, an elegant addition in a modern setting.

At the same time, Telford was designing a new genre of large light-weight prefabricated cast-iron bridges with a lattice spandrel arch, described by the poet Southey as 'something like a spider's web in the air'. The first of these was at Bonar Ferry in Sutherland; it was cast at Plas Kynaston, and the locals were amazed when it was erected as a trial at the ironworks. It was then taken to pieces, and the components transported to Chester via the Ellesmere Canal, before being shipped round the north of Scotland to the site, while Hazledine's team travelled overland to erect the bridge.



Old postcard from Andrew Pattison collection

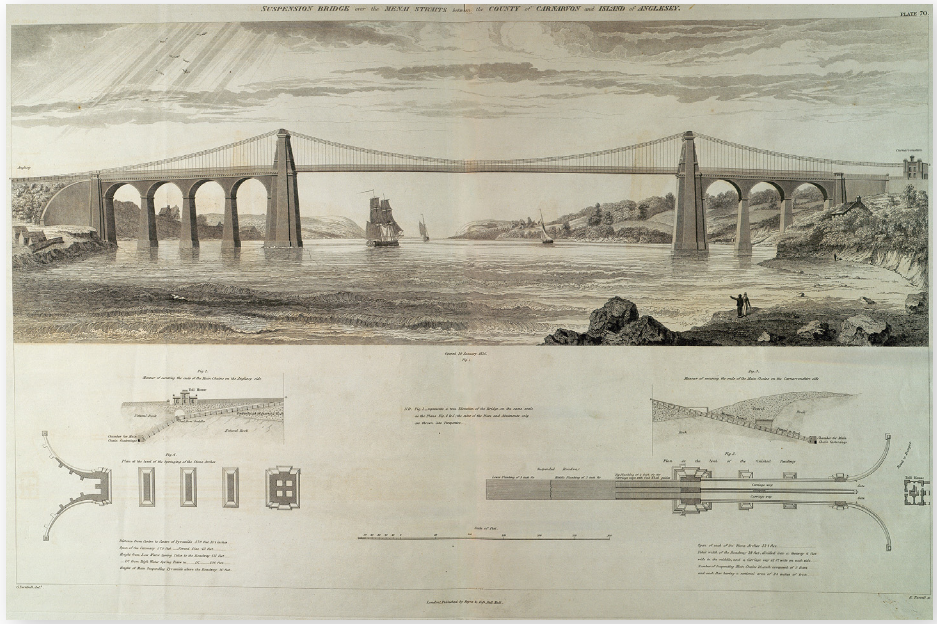
Holt Fleet Bridge, near Ombersley.

Holt Fleet Bridge

A number of these bridges can still be seen in the West Midlands and nearby areas. They are Holt Fleet, near Ombersley, Worcestershire; Mythe, near Tewskesbury; 'Waterloo' at Betws-y-Coed; and Eaton Hall, near Aldford, Cheshire. (Galton Bridge, Smethwick, is of the same design, but the ironwork was not done by Hazledine.) Most of them have been strengthened to cope with modern traffic, but they are essentially the same after 200 years.

Menai and Conwy Bridges

In the 1820s the building of suspension bridges was in its infancy, and so Telford's plan to build one across the Menai Strait to Anglesey (with a smaller one over the mouth of the Conwy River nearby) seemed rather reckless.[8] The fact that they were such a spectacular success must owe a good deal to the excellence of the ironwork supplied by Hazledine. For Menai alone there were sixteen main chains, each 1,710 ft (521 m) long, which together consisted of 14,960 eye-bars, around 16,000 connecting plates, and 6,000 screw-pins. The chains needed a saddle at each end to allow them to pass over the masonry towers, and then had to be firmly anchored into rock. The saddles consisted of cast-iron rollers with brass bearings, designed to allow for expansion and contraction of the chains with changes in temperature. The chains were anchored by being attached to cast-iron plates, which were then screwed into the bedrock by means of wrought-iron bolts 9 ft 6 in (2.9 m) long. Soon after the ironwork was begun, it became clear that to make all the pieces to the required tolerances would require a completely novel approach. So Telford dispatched his assistant John Provis to Shrewsbury to supervise the testing of all the ironwork. To achieve this Provis (presumably with Hazledine) designed and built a 'proving machine', which was installed at Hazledine's headquarters in Shrewsbury, to which all the ironwork was brought from Upton Forge via the Shrewsbury Canal. After testing, it was sent overland to Weston Wharf in north Shropshire, then via the Ellesmere Canal to Chester, and finally by sea to Menai.



Courtesy of: Shropshire Archives

Menai Bridge from the *Atlas to the Life of Thomas Telford, Civil Engineer* containing eighty-three copper plates, illustrative of his professional labours, 1838.

Another challenge that had to be overcome was forming the eyes in the eye-bars. Doing this under the hammer could result in irregular eyes with weaknesses where the metal had been worked, so it was decided to drill the eyes once the metal was cold using another specially-designed machine. This work necessitated the installation of a new, more powerful, steam engine which, as well as punching the eyes of both main-chain plates and links, was also able to cut the screw pins and to turn the rollers for the saddles, which each weighed 9 cwt (457 kg).

John Provis kept a meticulous record of all the tests he performed. This was probably the first project for which the materials had been so extensively tested and, considering that the iron was forged using "old" technology, the production of over 35,000 items with a rejection rate of less than 7 per cent speaks volumes for the skill of all those involved.

Conclusion

When Hazledine died in 1840 the railway era had just begun, resulting in the decline of the canals and roads. The new railway engineers, such as Stephenson and Brunel, seemed much more glamorous than the likes of Telford and Hazledine, who were quickly forgotten. But many of their works have remained, and we can now appreciate the extraordinary skill and enterprise that these men demonstrated in solving the engineering challenges of their generation.[9] ●

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References

1 A. Pattison, *William Hazledine, Shropshire Ironmaster and Millwright* (unpublished M.Phil Thesis, University of Birmingham): http://etheses.bham.ac.uk/3358/, p.2ff.
2 *Ibid*, p.61ff.
3 A tuyere is a nozzle through which an air blast is delivered to a forge or blast furnace.
4 *Ibid*, p.73ff. See Colum Giles & Mike Williams eds, *Ditherington Mill and the Industrial Revolution* (Historic England 2015) .
5 *Ibid*, p.92ff.
6 A voussoir is a wedge-shaped or tapered stone used to construct an arch.
7 *Ibid*, p.141ff.
8 *Ibid*, p.132ff.
9 *Ibid*, p.137.