BROSELEY LOCAL HISTORY SOCIETY

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EDITORIAL

Broseley Local History Society

The Society was originally formed as the Wilkinson Society in 1972 and was renamed in 1997 to reflect its main purpose:

'the research, preservation and promotion of Broseley's unique heritage'.

Meetings are held on the first Wednesday of each month beginning at 7.30 pm, at Broseley Social Club; and annual events include a summer outing, an autumn walk and a winter dinner. Members receive a quarterly newsletter and an annual journal. The Society's collection of artefacts is at present stored at the IGMT Tile Museum at Jackfield.

The Society has a web site which contains information about Broseley, copies of the newsletter and articles from previous journals. This can be found at *www.broseley.org.uk*

The Journal

This year's journal is devoted entirely to the edited texts of papers presented at the Annual Wilkinson Lecture in March and the Wilkinson Bicentenary Day School in June. These articles represent recent research into the life and achievements of John Wilkinson on the occasion of the 200th anniversary of his death. Our thanks to the contributors and to Steve Dewhirst for design and typesetting.

Contributions for the next issue would be welcome and should be sent by 31 August 2009 to the editor, Neil Clarke, Cranleigh, Wellington Road, Little Wenlock, TF6 5BH.

John Wilkinson's Transport Interests

Neil Clarke

Introduction

This year marks the 200th anniversary of the death of one of the most remarkable men of his Age. John Wilkinson (1728-1808) was an ironmaster, inventor and entrepreneur who had business interests in many parts of the kingdom. Beginning his working life with his father at Backbarrow and Wilson House in that part of North Lancashire now in Cumbria, Wilkinson eventually owned ironworks at Bersham and Brymbo near Wrexham in Denbighshire, at Willey near Broseley and Snedshill, Hollinswood and Hadley near Oakengates, all in East Shropshire, and at Bradley near Bilston in South Staffordshire. At these coke-fired, steam-powered ironworks, he developed new techniques which revolutionised the iron and engineering industries, in particular the boring mill for cannon barrels and steam engine cylinders and the cupola furnace for remelting pig iron for casting; and he found many new uses for iron. He owned residences at all the places where he operated, and he acquired large estates at Castle Head in North Lancashire (Cumbria) and at Brymbo in Denbighshire, on both of which he experimented with new farming techniques. He had interests in copper mining in Anglesey, Flintshire and Cornwall, mined and smelted lead at Minera near Wrexham and had a works for producing lead pipe at Rotherhithe on the south bank of the Thames in London. In addition, he had extensive dealings with Boulton and Watt at Soho in Birmingham over the production of steam engine parts.

Small wonder then that John Wilkinson would need to spend much time and effort dealing with his transport requirements. Raw materials had to be conveyed to his various works and finished goods to home and foreign customers, and he himself, as a hands-on employer, needed to travel extensively between his various works and houses, and on business to other parts of this country and on the continent. What little primary material survives suggests that Wilkinson not only used well-established means of travel and transport, such as horses, river navigations and coastal shipping, but that he also took a leading role in promoting newer forms, such as canals, turnpike roads and railways.[1]

Personal travel

For his own personal travel arrangements, Wilkinson, like others at that time, relied on horsepower – horseback for daily use and shorter journeys, and the use of his own private carriage and stage coaches for longer journeys. Although using horses was commonplace and therefore unlikely to be recorded, we do know something of his horse riding from at least two sources. There is the very touching story of Wilkinson's promise that he would reappear in the Bilston area exactly seven years after his death, mounted on his big grey mare. Such was Wilkinson's reputation, that several thousand people assembled at Monmore Green, Wolverhampton, on 14 July 1815 and, needless to say, were disappointed to see neither their former master nor his horse.[2] A second example reminds us of the hazards of riding horseback in cold weather. Writing to Matthew Boulton from his home in Broseley in October 1792, Wilkinson says:

> We had a meeting on the evening of the 4th to settle the intended canal from Donnington Wood to Shrewsbury that detained me late, and in coming home with a cold sleety south-east wind on my left cheek, I have caught such a cold in my

Portrait of John Wilkinson by Lemuel Francis Abbot (1760-1803) (Courtesy of IGMT)

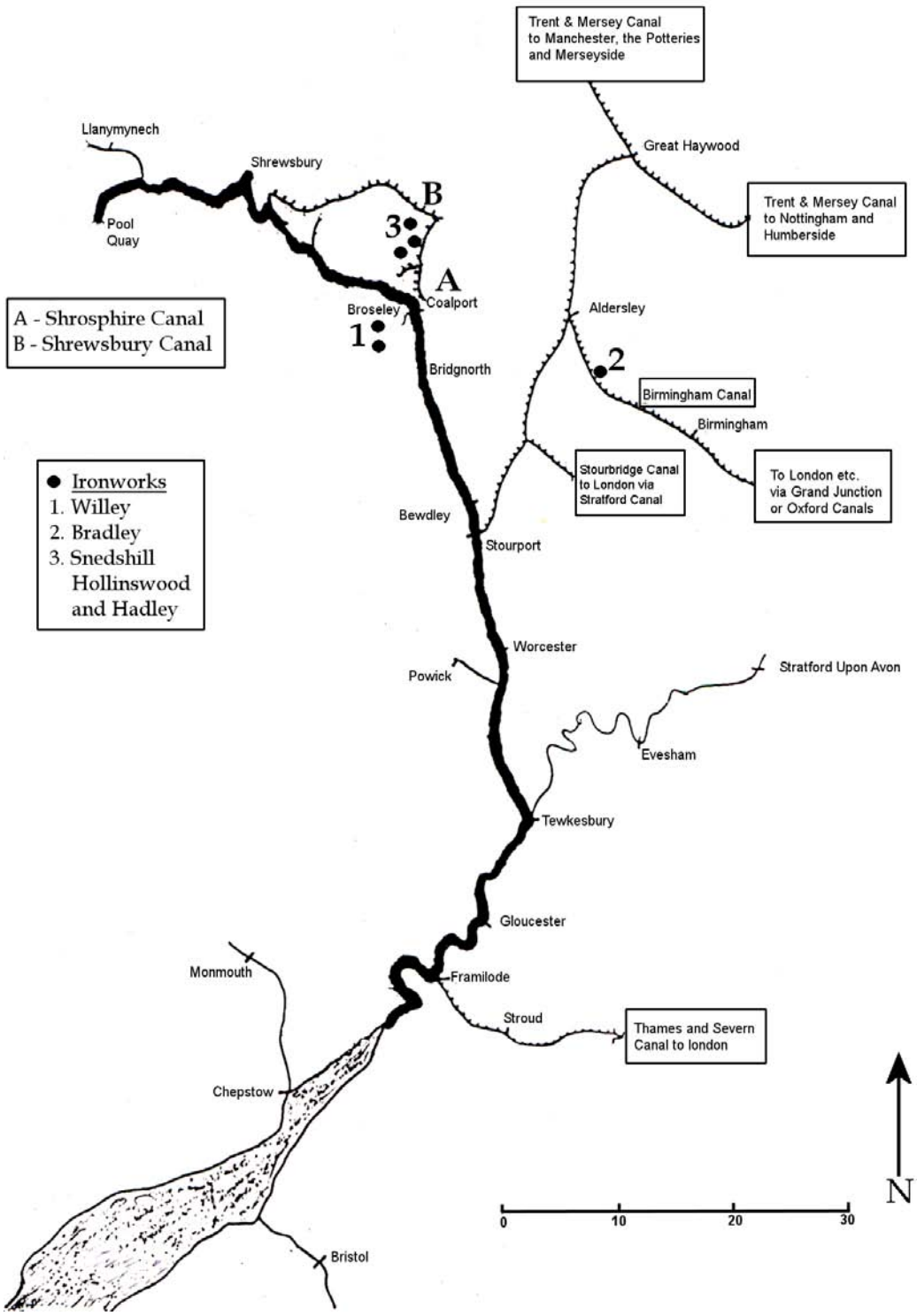
face that I have been confined ever since and expect to be here at least a week longer.[3]

For longer journeys, Wilkinson would have used his own personal carriage or chaise. All large houses at that time had a stable block and coach house, and no doubt each of Wilkinson's residences would have had these facilities – at the *Court* near Wrexham, his home with his first wife, Anne Maudesley, who tragically died in childbirth in 1756; at the *New House* (later known as the *Lawns*) at Broseley, where he set up home with his second wife, Mary Lee, in 1763; at *Hallfields*, Bradley, where nothing now remains of the house; at *Castle Head*, built in the late 1770s and to which his wife Mary moved; and at *Brymbo Hall* (now demolished), acquired with the estate for £14,000 in 1792, where he installed his mistress, Anne Lewis. So, when staying at one of these residences and needing to make a longer journey than by horseback, Wilkinson would have used his carriage and when a change of horses was needed, posting inns along the way could provide this facility. For example, when Samuel More, the Secretary of the Royal Society for Arts, Manufactures and Commerce, visited John Wilkinson in July 1776, he was conveyed with his host from Birmingham to Broseley via Bradley in a chaise, the journey took four hours, and the last change of horses took place at Bridgnorth.[4] Secondly, there is the well-known reference by Thomas Telford, writing in October 1793, about the meeting of the Ellesmere Canal proprietors where he was appointed General Agent: 'I had', he said, 'the decided support of the great John Wilkinson, king of the ironmasters, himself a host. I travelled in his carriage to the meeting and found him much disposed to be friendly'.[5] On this occasion, travelling from Broseley to Ellesmere, a distance of some 35 miles, Wilkinson would more than likely have picked up Telford in Shrewsbury, where he resided, and at the same time have changed horses at one of the many posting inns in the town.

For even longer journeys, to his northern home at Castle Head and to London for example, Wilkinson would no doubt have had to rely on stage coach services, where they existed. His journeys to Castle Head involved poor roads in Lancashire and the somewhat hazardous crossing of the sands of Morecambe Bay, which travellers were compelled to use to reach Wilkinson's house from the south. Crossing the sands in a coach, on horseback or on foot at low tide, while trying to avoid the quicksands and keep an eye on the incoming tide, was not for the faint-hearted. The coach from Lancaster drove the few miles to Hest Bank, where it was met by the 'Guide-over-the-Sands'. The holder of this post, which dated from the early 13th century, then escorted the coach across the sands to Kents Bank. Wilkinson entertained many of his contemporaries at Castle Head, including Matthew Boulton, Erasmus Darwin, Joseph Priestley, Josiah Wedgwood and foreign visitors, and apparently all of them commented on the condition of the roads; as in this letter from James Watt to Matthew Boulton in 1785: 'I returned from Castle Head last night and brought home Mrs Watt and the children in good health. Mr Wilkinson is doing great things in the way of draining the mosses. He has got a fine situation at Castle Head but most villainous roads to it'.[6]

When he travelled to London from the Midlands, Wilkinson had an easier time of it. By the end of the 18th century there were a number of coach services from Shrewsbury to London, and those which went via Shifnal, Wolverhampton and Birmingham or via the Iron Bridge and Bridgnorth would have been particularly useful to him. For example, following the opening of the Iron Bridge in January 1781, the stage coach the *Diligence* left the *Unicorn* in Shrewsbury at 5 am on three mornings a week and travelled by way of Coalbrookdale, Broseley, Bridgnorth, Stourbridge, Bromsgrove, Stratford and Oxford, arriving in London 24 hours later.[7]

One recent biographer of Wilkinson claims to have found a letter which refers to the ironmaster travelling from Broseley to London by water by way of Bristol.[8] This would have been unusual in normal circumstances, the stage coach providing a quicker and more convenient mode of travel; but such a journey was possible, particularly if Wilkinson had business to attend to in Bristol. Passenger boats certainly operated on the River Severn in the late 18th

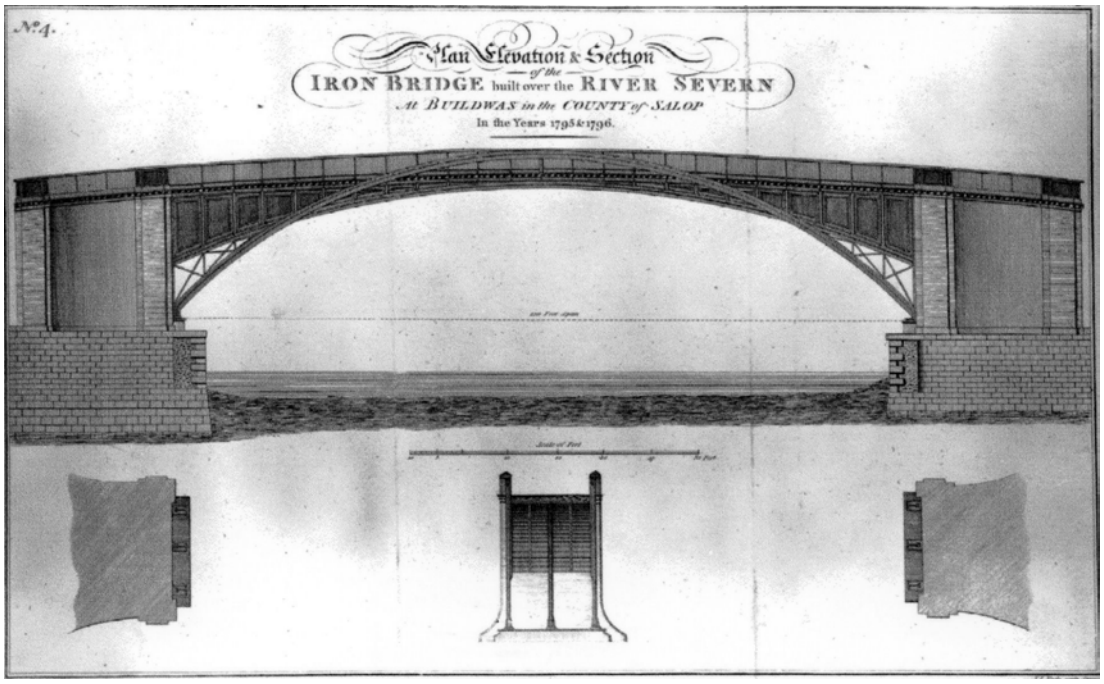


"Wilkinson's Waterway:" the river Severn, its tributaries and canal connections linking Wilkinson's enterprises in the West Midlands with inland markets and to the ports of Chepstow and Bristol

century. In 1754, for example, the much-travelled Richard Pocock noted that passengers from Shrewsbury went by river to Gloucester if bound for Bristol or Bath, or to Worcester if they were going to London; and in 1773 John Price of the *Wherry Inn*, Shrewsbury offered a timetabled service to Gloucester, departing at 6 am on Mondays, staying overnight at the *Green Dragon* in Worcester, and arriving on the Tuesday at the *Mermaid* in Gloucester. The wherry returned on Wednesday mornings and, after overnight stays at Worcester and Bridgnorth, reached Shrewsbury on Friday afternoon.[9] So, travelling by water to Gloucester and coach to Bristol and then by coach to London was certainly possible in the late 18th century, but it is unlikely to have been the usual way that Wilkinson reached the capital from the West Midlands.

River Severn

Even if John Wilkinson occasionally travelled along it, the importance of the River Severn to him was more as a means of



Buildwas Bridge (Courtesy of IGMT)

conveying the products of his business interests, and to that end he was also involved in a number of schemes to improve its navigation. Iron from his Shropshire furnaces was carried downstream to the forges of the Severn valley and, via Stourport and the developing canal network, to the forges of the Black Country, to his ironworks at Bradley and to Birmingham. Iron goods made at Willey and Bradley, such as cannon and shot, steam engine cylinders and water pipes, were conveyed by boat to Bristol and Chepstow for coastal transit to other parts of Britain and by sea to continental ports.

In the 18th century the River Severn was navigable for some 170 miles to Pool Quay, near Welshpool; but low water at certain times of the year hindered traffic on the river, and vessels sailing upstream also required haulage by gangs of men known as bow haulers. In 1772 Wilkinson was one of a number of local ironmasters who promoted an Act of Parliament 'for making and keeping in repair a road or passage for horses on the banks of the River Severn between Bewdley Bridge and a place called the Meadow Wharf in Coalbrookdale, for haling and drawing vessels along the said river'. It was to take another 28 years and a second Act of Parliament before this was fully achieved, and not until 1809, a year after Wilkinson's death, that the horse towing path reached Shrewsbury.[10]

Wilkinson also supported a proposal to make the river navigable throughout the year for vessels drawing 4 feet. This was a plan drawn up in 1784 by William Jessop to construct 13 or 14 locks between Worcester and Coalbrookdale and to dredge the waterway downstream from Diglis. Although the principal merchants and ironmasters using the Upper Severn supported the scheme, it was the opposition of bargeowners and some landowners which prevented any proper progress being made.[11]

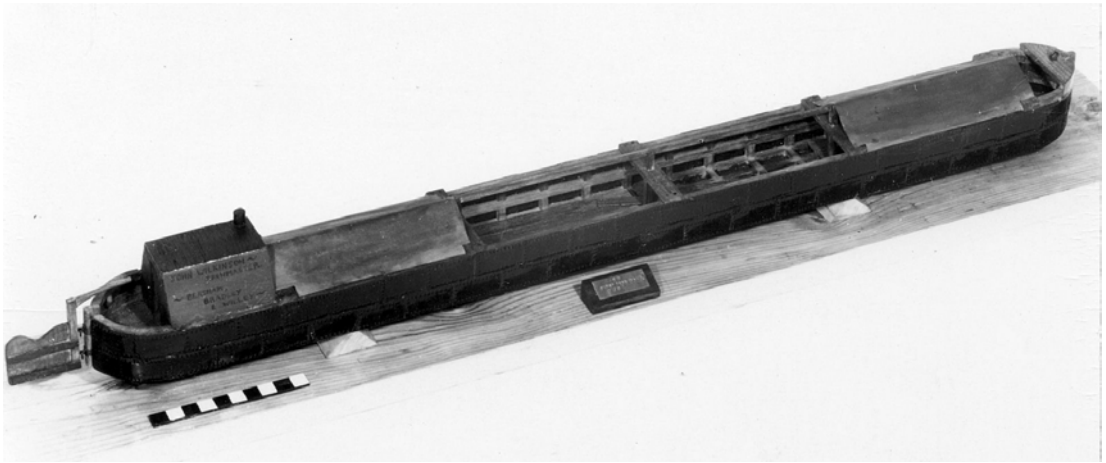
An improvement to navigation on the river was the design of bridges built across the Upper Severn in the late 18th century; and John Wilkinson was involved in the construction of the three bridges built in the Severn Gorge. The first of these was the Iron Bridge. The need to improve communication across the river was mooted as early as 1773 and a bridge was authorised by Act of Parliament three years later. The proposal of the architect, Thomas Farnolls Pritchard of Shrewsbury, to use iron was supported by Wilkinson from the start. Abraham Darby III of the Coalbrookdale partnership was commissioned to build it but there was wavering support from the other shareholders, and it took the combined persuasive powers of Pritchard, Wilkinson and Darby and a new assignment of shares to enable work to commence in late 1777. In the new assignment of sixty four £55 shares, Darby held fifteen and

Wilkinson was the second largest shareholder with twelve. The building of solid abutments and difficult approach roads, together with modifications to the design, meant that the bridge was not finally opened until New Year's Day 1781. For Darby and Wilkinson the Iron Bridge publicised the potential use of iron as a building material. Its single semi-circular arch, with a span of 100 feet, gave clearance for most vessels sailing beneath it and made it less prone to damage from flooding; and provision was made in the abutment on its north bank for a tow path arch. That Wilkinson had played a leading role was acknowledged by Thomas Telford, who was later acquainted with many of those involved with the project. Writing in 1830, Telford said that he did not know who first proposed building the bridge but that 'the late Mr John Wilkinson had some share of the merit, certain it is that he was very active in promoting the first iron bridge'.[12]

Another bridge was being built in the Severn Gorge at the same time as the Iron Bridge. This was two miles downstream at Preen's Eddy, soon to be known as Coalport. The scheme was first promoted in 1775 by local landowners and industrialists, including John Wilkinson, who obtained an Act of Parliament two years later. As built, it was a timber bridge of two spans with a central pier and abutments of stone - not at the cutting edge of technology like the Iron Bridge, but an improvement from the navigational point of view on the medieval multi-arched stone bridges with massive piers at Buildwas, 4 miles upstream, and at Bridgnorth, 9 miles downstream. Coalport Bridge was rebuilt as a single span iron and timber structure following damage in the Great Flood of 1795, and assumed its present all-metal form after further rebuilding in 1818.[13]

The third bridge built in the Severn Gorge in the late 18th century with which Wilkinson was connected was at Buildwas. The old bridge was damaged beyond repair in 1795 and replaced by a new structure the following year. Wilkinson's role in this was to adjudicate, together with local ironmaster William Reynolds, between designs submitted to the County Magistrates by the Coalbrookdale Company and by Thomas Telford, the County Surveyor. Wilkinson and Reynolds recommended Telford's design, which was in fact then constructed at Coalbrookdale ironworks. One can see why they were impressed with the design. Telford had adopted the so-called Schaffhausen principle, whereby iron ribs of comparative flat curvature – to counter the earth pressure on the banks – were superimposed upon ribs of small curvature, to carry the weight. This meant that the new bridge was less than half the weight of the Iron Bridge's 378 tons but had a greater span – 130 feet compared with 100 feet. Like the Iron Bridge, Telford's bridge at Buildwas proved less of a hazard to navigation and was less prone to damage from flooding than its medieval predecessor.[14]

In addition to his involvement in schemes to improve the navigation of the Upper Severn, Wilkinson also experimented in the construction of vessels which traded on the



Conjectural model of 'The Trial' made by the late Ralph Pee (Courtesy BLHS)

river. In the 18th century the most common form of boats on the Upper Severn were barges and trows, wooden sailing vessels, varying in size, the largest of which were able to carry up to 80 tons of cargo. But in July 1787 Wilkinson broke with tradition when he launched a vessel made of iron. There is still some debate over whether this was made of cast or wrought iron, but the most recent research favours cast-iron plates.[15] It seems that these plates were carried from Willey ironworks down the 2½ mile railway to Willey Wharf and fabricated on the river bank. It is certainly recorded that the vessel's plates were 5/16 inch thick and 'put together with rivets like coppers or fire engine boilers'; there were wooden stern posts and the gunnel was lined with elm planks. Named the *Trial*, the vessel's dimensions were similar to those of canal narrow boats, 70 feet long with a beam of 6 feet 8 inches; she weighed 8 tons, drew 8 to 9 inches of water when light and could carry up to 32 tons of cargo in deep water. The *Trial* could operate both on the Severn and on narrow canals, thus avoiding the need for transhipping at Stourport goods which were bound from the Coalbrookdale Coalfield to the Black Country and Birmingham. In fact, the vessel's first voyage was to Birmingham, where she arrived before the end of July 1787 with a cargo of 22 ¾ tons of iron. In September Wilkinson launched a second iron vessel, designed for the Birmingham Canal, and the following month completed a third, a 40 ton barge for the Severn.[16]

However, although Wilkinson's experiments were important in the long-term history of shipbuilding, they appear to have made only a limited impact on the Severn Navigation and the Midland canals. Erik von Svedenstierna, a Swedish visitor to Bradley in 1803, suggested some reasons in his tour journal:

> On the canal close to the works lay several barges of 20 tons, built from iron plates, and of just the same form as the ordinary wooden barges, that is to say, flat bottomed, blunt at the stern and triangular forward. In general they lay higher in the water and glided more easily than the wooden ones, remained fairly watertight, and withstood powerful blows, but cost three or four times as much as a wooden barge. Since one of the latter, with some maintenance, can be used for 20 years, it is still undecided how this experiment will pay. Wilkinson is said also to have built a larger vessel of iron plates on the Severn, which, however – I do not know why – has turned out less happily. He was at the time in London, and I was therefore not able to make his acquaintance personally, whereby I lost the opportunity of learning something about his experiments and installations.[17]

Ships

Vessels of a different kind were employed by Wilkinson for shipping his goods around the coast and exporting them abroad; some of these he owned, others he hired. Several Wilkinson-owned sea-going vessels are recorded in the Boulton & Watt letter books, the most frequent being the single-masted sloop *Mary*. These operated from the ports of Chester, Bristol, Chepstow and London. Wilkinson seems to have shipped much of the high quality castings, ordnance and steam engine cylinders produced at Bersham through Chester, and products from his Shropshire and Staffordshire works through Bristol and Chepstow. Cargoes carried to London included cannon for testing at the Board of Ordnance proof yard at Woolwich and lead for the Rotherhithe pipe works.

The lucrative trade with France that Wilkinson and Boulton and Watt were beginning to develop from the mid-1770s was hindered by French participation in the American War of Independence after 1778. They spent much time and effort in attempts to ship two cargoes of water pipes and steam engine parts for the Paris Waterworks Company through the war-time controls on trade with the help of passports granted by the two belligerent British and French governments. These cargoes eventually left Chester and Chepstow in 1780 and 1781, carried in the sloop *Mary* to a port at the mouth of the Seine; there they were transhipped to river barges for the journey to Paris.[18] Such transactions, although quite legal, did nothing to diminish both contemporary suspicions and later

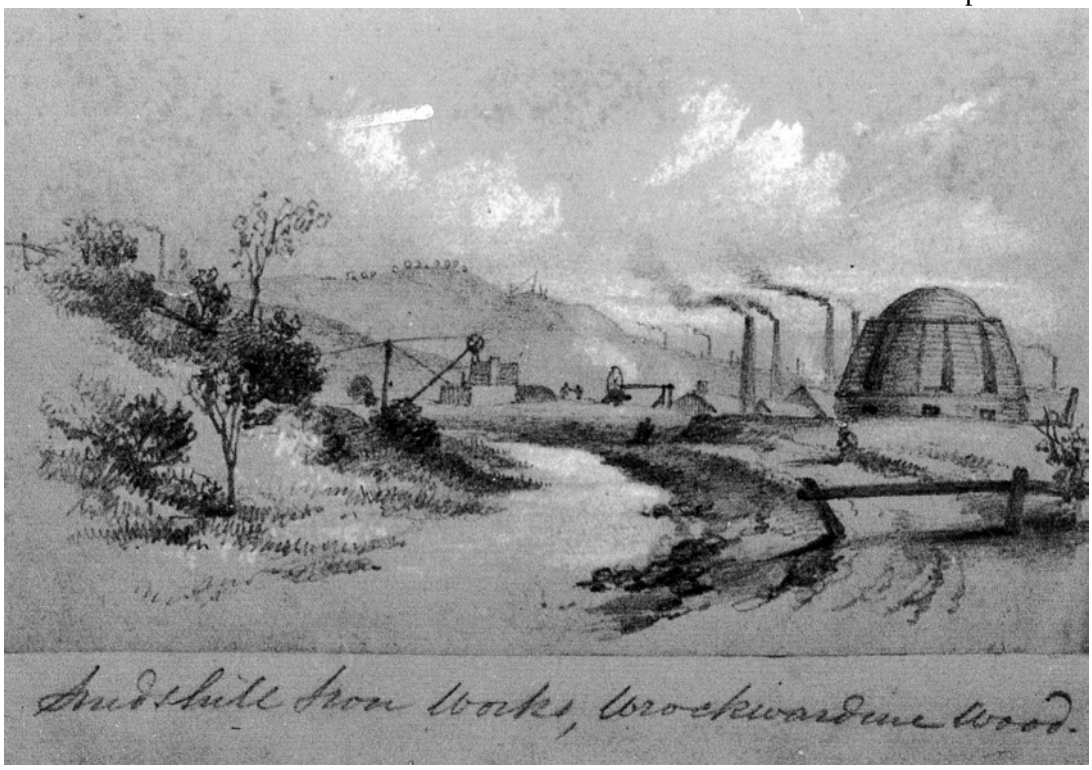
legends that the ironmaster sold munitions of war to the enemy. As far as can be ascertained, the only guns manufactured by Wilkinson which may have reached the French were those in a shipload captured at sea by the privateer vessel *Black Princess* on their way from Chester to Wilkinson's wharf at Rotherhithe for proofing at Woolwich.

The fact that there were times when he had to hire other vessels can be understood when we consider that perhaps Wilkinson's own ships were engaged elsewhere, were undergoing repair or, in at least two cases, had been lost. We know that his vessel the *Hawke* was destroyed by enemy action and the two-masted brig *Bersham* lost at sea. Crews lost to Royal Navy press gangs, or who deserted, also caused him problems. Wilkinson's desperation to find a suitable vessel can be heard in the words of a letter to Boulton & Watt in February 1781: 'I have near 600 tons of Government guns now ready to ship', he writes from Chester, 'and though they are in the greatest want of them I see no prospect of getting a single lading away at this time'.[19] The ongoing problem of getting steam engine parts to Hayle in Cornwall prompted Wilkinson's shipping agent at Chester, Hugh Jones, to recommend that he should purchase a vessel of 50 to 70 tons specifically for the Cornish trade, or explore the hiring of ships in Liverpool. On at least one occasion Jones had to resort to sending steam engine parts by wagon from Bersham to Shrewsbury for river borne transit to Bristol.[20]

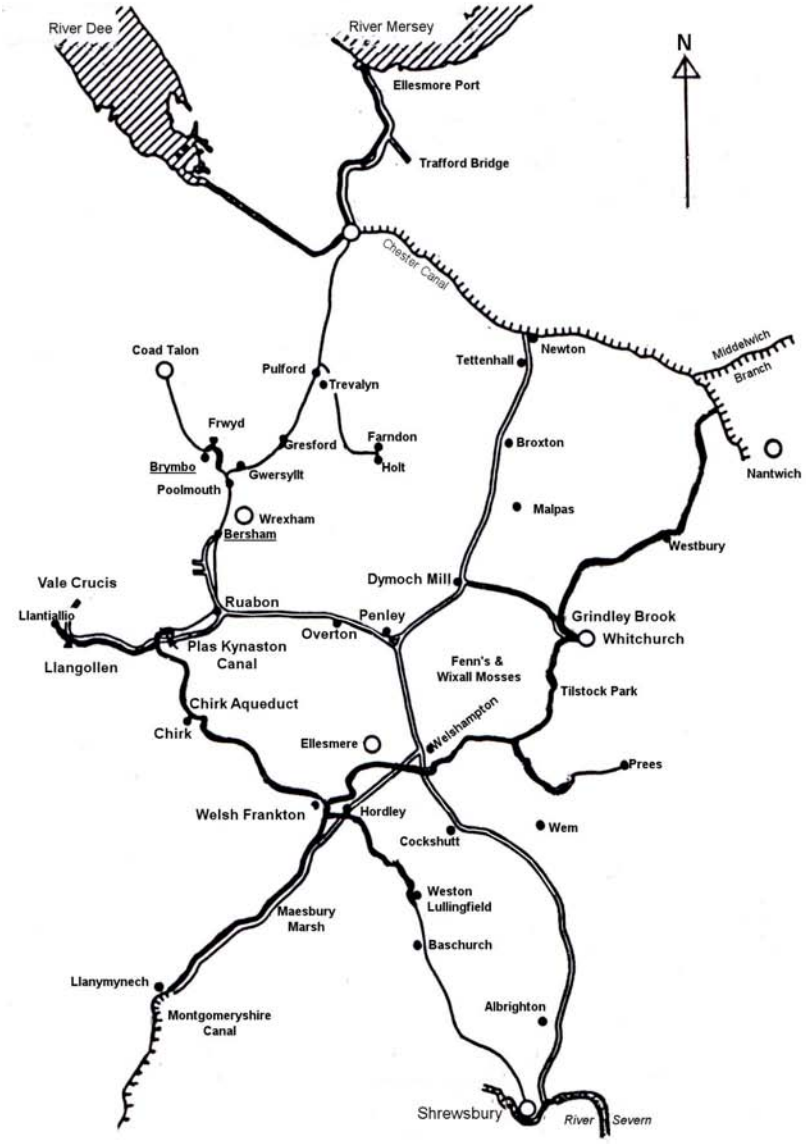
While recognising his frustrations with shipping, it is difficult to understand what led Wilkinson in the early 1790s to sell off what were apparently his remaining ships. In a letter to James Watt in 1791 he relates that while in Bristol he met with Captain Hodgson of the vessel the *Meadow* to release him from his contract, and at the same time he also sold his ship the *Recovery*.[21]

Canals

Wilkinson, like his fellow industrialists, saw in canals an ideal way to move the heavy and bulky materials that were part of his trade. His earliest involvement appears to have been with the canals that James Brindley was building in the West Midlands in the late 1760s and early 1770s. Brindley, architect of the Grand Trunk System linking the country's four main river systems, was engineer of the Birmingham Canal Navigations, which in 1768 was authorised by Act of Parliament to link Birmingham with the Staffordshire & Worcestershire Canal at Wolverhampton.[22] The original line of the Birmingham Canal followed a circuitous 22-mile contour course and served, amongst others, the developing industrial area around Bilston where Wilkinson was in the process of



Snedshill Iron Works, with the Shropshire Canal in the foreground and the ironworks in the background. Unknown Artist, (courtesy IGMT)



The Ellesmere Canal

Eastern Scheme (earliest proposal)
Canal as intended (Western Scheme)
Ellesmere Canal, as built

Of the proposals to link the Severn with the Dee and the Mersey, the Western Scheme, via Ruabon and Weston Lullingfield was supported by Wilkinson, who had a number of industrial interests in the Wrexham area. The canal as built failed to further these interests.

setting up his Bradley ironworks. It seems likely that the 'John Wilkinson' named as one of the commissioners for settling land purchase disputes in the Birmingham Canal Act was in fact the ironmaster. He had also been named a commissioner in the Trent & Mersey Canal Act of 1766.

Wilkinson's name occasionally appears in the minutes of the Birmingham Canal Company, for instance in 1790, when he supplied a steam engine to pump water from disused mines at Broadwaters into the new level, and in 1802 when he offered to build a ½ mile extension from the Walsall terminus to his limeworks.[23] In addition to the information supplied by the Swedish visitor to Bradley in 1803, we know from the Admiralty Boat Registers of three 20-ton iron boats belonging to Wilkinson operating on the Birmingham Canal in 1795, each with a crew of two, the master to steer and the other member to drive the horse.[24] The Birmingham Canal clearly played an important part in the development of Wilkinson's Bradley ironworks from a single furnace in the 1760s to a fully integrated ironworks by the end of the century.

The link between the Birmingham Canal and the rivers Severn, Trent and Mersey was the Staffordshire & Worcestershire Canal. This joined the Severn at Stourport and connected with the Trent & Mersey Canal at Great Haywood near Stafford. Following the completion of the Trent & Mersey Canal in 1777, Wilkinson's transport costs for consignments from Bradley going north would have been considerably reduced: the cost of carriage from Wolverhampton to Liverpool by road was £5.00 per ton and by canal £1.5sh. per ton, a quarter the cost.[25]

The link between the Birmingham Canal and his Shropshire interests, via Stourport, became increasingly important to Wilkinson. Iron had been shipped down the Severn by the Coalbrookdale partners in the early 18th century and this traffic increased as Wilkinson and others opened new furnaces in the second half of the century. This was the case when furnaces at Snedshill and Hollinswood in the northern half of the Coalbrookdale Coalfield were brought into blast by Wilkinson in the 1780s; and it was to get the output of these new furnaces to the Severn that he supported a proposal to build a 7-mile canal to the river in 1788.

The Shropshire Canal Navigation was planned to link mines and ironworks in the Oakengates area from a junction with William Reynolds's Ketley Canal to two points on the River Severn; but Wilkinson's personal petition to Parliament succeeded in getting it extended a further one mile northwards to link with two other small tub-boat canals.[26] No doubt his motive in urging an extension was to enable him to get supplies of limestone for his two ironworks from the Lilleshall quarries via the Donnington Wood Canal. The Shropshire Canal took

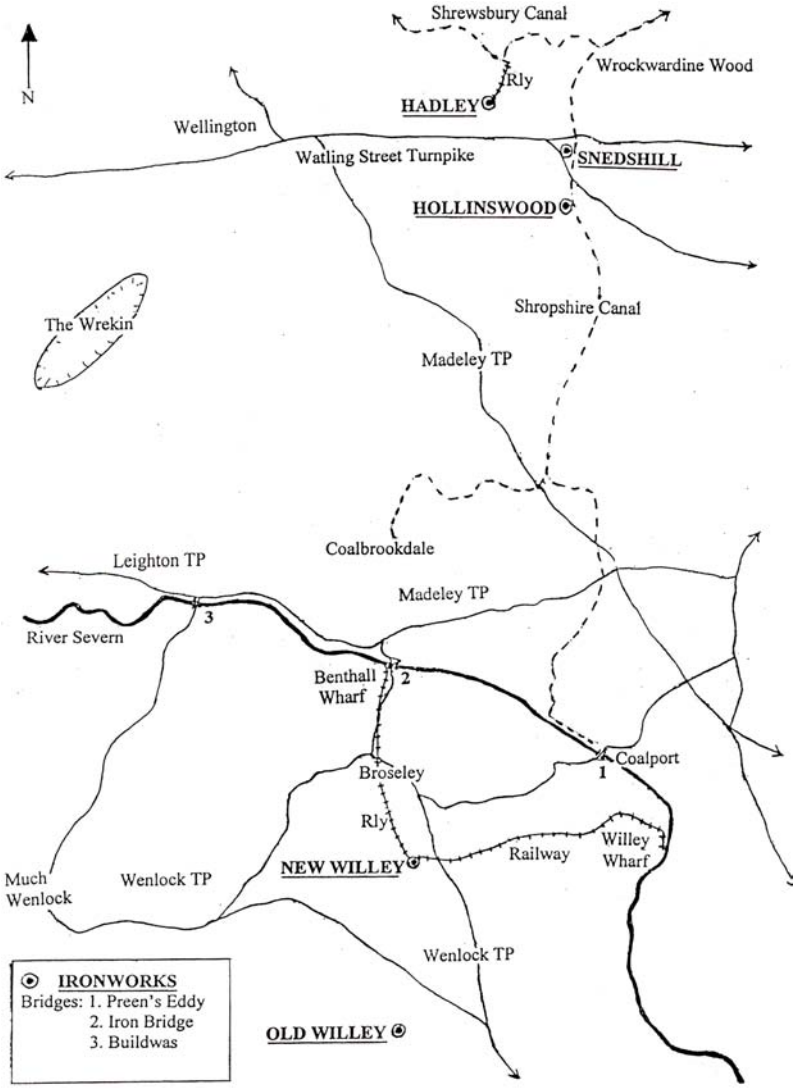
some four years to open fully to Coalport, and during that time Wilkinson was one of the leading shareholder (holding 55 of the five hundred £100 shares), served as unpaid treasurer on the committee, advised on technical matters, and supplied a steam engine to pump water from Randlay reservoir into the canal and also rails for the canal's three inclined planes.[27] Iron from Wilkinson's Snedshill and Hollinswood furnaces was carried along the Shropshire Canal after its opening in 1792; this was transhipped to river vessels at Coalport and back to canal barges at Stourport on its way to Black Country forges, Bradley ironworks and Birmingham.[28]

Another tub boat canal which Wilkinson helped to promote and in which he was a leading shareholder was the Shrewsbury Canal, authorised by Act of Parliament in 1793 and opened fully four years later.[29] This canal was built primarily to carry coal from the mines in the Oakengates area to the county town; but Wilkinson may also have seen the possibility of the canal as a link in transporting pig iron from Snedshill and Hollinswood to his ironworks at Bersham. Although this was not realised, since he was soon to sell those two furnaces, the Shrewsbury Canal did prove of value to him when he sank mines and opened a new furnace at nearby Hadley in 1804. One of the pioneering features of this canal was the iron aqueduct over the River Tern at Longdon, designed by Telford and cast by William Reynolds at his Ketley ironworks. Other than being in close contact with both Telford and Reynolds on a number of projects at this time, there is no specific evidence to link Wilkinson with the actual construction of the aqueduct.

The canal perhaps most associated with John Wilkinson is the Ellesmere Canal. The canal was authorised by Act of Parliament in 1793 and its promoters aimed to link the Severn at Shrewsbury with the Dee at Chester and the Mersey at what became Ellesmere Port. Various routes were proposed, but that prepared by William Jessop, who was appointed engineer of the company, promised to tap the rich mineral resources of the Denbighshire Coalfield.[30] This proposal would naturally arouse the interest of Wilkinson, who had been mining coal, making iron and operating lead smelters in the area around Bersham for over three decades, who was about to develop the Brymbo estate, and who also looked for a link with his East Shropshire concerns. A contemporary account recognised Wilkinson's interest:

> A number of wagons are constantly employed in carrying goods between Bersham furnace and Chester, which being 14 miles land carriage is attended with a great expense. But this inconvenience will be removed by means of the Ellesmere Canal, which is to pass by these works; and a cut from it, called the Brymbo branch, will go to a new and large iron foundry now erecting by Mr John Wilkinson, who has also great iron works in Shropshire.[31]

Wilkinson was a leading promoter of the canal from as early as 1791; he was a shareholder and committee member; the Shrewsbury bank of which he was a part-



Wilkinson ironworks and transport links in East Shropshire

ner (Eyton, Reynolds & Wilkinson) became the company's treasurers; and he supported the appointment of Thomas Telford as 'General Agent, Surveyor, Engineer, Architect and Overseer of the Works'.[32] However, his interest in the canal seems to have decreased as it became apparent that the original main line would not be completed because of the costs incurred in crossing the valleys of the Dee and Ceiroig and problems with the route north of Ruabon. Instead of the original plan, the link with Chester and the Mersey would be the longer route along the realigned Whitchurch branch and the Chester Canal.[33]

Wilkinson did attend general assemblies of the Canal Company in 1795 and 1797 and even took the chair at the meeting of 1798, but in general his votes were cast by proxy at these meetings, and by the time of his death in 1808 he had sold his shares in the concern. A man of Wilkinson's pride may also have taken it amiss that his tender for the iron plates for the Pontcysyllte aqueduct was not accepted by the canal proprietors.[34]

In fact, it could be argued that John Wilkinson was not entirely successful in his canal ventures. Not only did some of the canals not fulfil his expectations, particularly the Ellesmere Canal, but others he promoted were not built at all. This was the case with a proposal in 1779 to create, in connection with the reclamation scheme on the north-east fringe of Morecambe Bay, a waterway navigable from near the mouth of the River Kent to the River Lune at Lancaster. Wilkinson appears to have invested some money in the scheme but, with insufficient support, nothing came of the idea.[35] Another abortive scheme he supported was the Flint Coal Canal in North Wales. This canal, authorised by Parliament in 1788 to link the Greenfield Copper & Brass works, in which Wilkinson was a shareholder, with the estuary of the Dee was never actually started.[36]

Wilkinson seems to have realised how he and his fellow industrialists had been caught up in what we now call the 'Canal Mania' when, in a letter to Matthew Boulton in October 1792, he wrote: 'In canals as well as in furnaces, the world seems seized with madness'.[37]

Turnpike Roads

Of the three bridges built in the Severn Gorge in the late 18th century with which Wilkinson had some involvement, two – the Iron Bridge and that at Coalport – were toll bridges but the third, Buildwas Bridge, was a county bridge and therefore toll-free. The roads leading to the bridges were turnpike roads. John Wilkinson is known to have been a trustee for a number of such roads. Clearly, much of the output of his ironworks, when not carried by canal or river, would have been transported by teams of horses drawing wagons along the roads. This is certainly the way pig iron was conveyed from the furnaces at Snedshill and Hollinswood to Bersham ironworks, and also to Bradley ironworks before the opening of the Shropshire Canal.[38] According to the *Salopian Journal*, one particular load that earned legendary status was the shipment of a huge iron plate weighing 18½ tons from Bersham foundry to a glassworks at St Helens in 1801, which required a specially constructed vehicle drawn by 8 horses.[39]

Wilkinson was a member of several turnpike trusts in East Shropshire set up between 1759 and 1778. The Wenlock turnpike roads served his interests south of the river, and the Madeley and Leighton turnpike roads north of the river. In the case of the last one, he apparently acted for a time as clerk to the trustees.[40] In the Black Country, the network of roads around Bilston was turnpiked in 1766; Wilkinson was a named trustee in the Act of 1772 which legislated for further improvements to the road from Birmingham, through Wednesbury and Bilston, to the outskirts of Wolverhampton, part of the later Holyhead Road.[41] He was also active in improving local roads in Denbighshire. In 1764, for example, he was jointly responsible for erecting a new stone bridge between the townships of Bersham and Esclusham, and in the 1790s, to enable him to exploit the resources of his new Brymbo estate, he promoted the turnpiking of the road from Minera through Brymbo towards Chester.[42] Further north, according to his

visitors to Castle Head, Wilkinson would have had his work cut out to improve the roads of north Lancashire and southern Westmorland. Their improvement came later.

Railways

A final mode of transport that Wilkinson utilised was railways. The earliest railway recorded in the Severn Gorge area was that carrying coal from Broseley to the bank of the river at the Calcutts in 1605; and by the early 18th century a number of these wooden wagonways linked local mines with such wharves.[43] When the New Willey Company was set up in 1757 with Wilkinson as one of the partners, it was given permission from the landowner George Forester to lay a connecting line to an existing railway which ran down Tarbatch Dingle to the river, a total distance of 2½ miles.[44] But apparently, one track was not thought to be enough for the expected traffic, and two years later the Company was granted the right to build a second track. At this time double track railway was something of a rarity; single track with what was called 'pass-byes' being the norm. However, the Willey lease of 1759 permits a 'double railway' with an unusually large maximum width of 10 yards.[45]

Wilkinson, as an exponent of all things iron, followed the Coalbrookdale practice introduced in 1767 of laying iron on top of existing wooden rails to prevent excessive wear (he may even have been one of the first to construct rails entirely out of iron); and he possibly also adopted the use of L-shaped plateway rails, which were introduced into Shropshire in 1788. Wilkinson had another outlet to the Severn via the Benthall Rails, and it has been suggested that he used a third railway route to a wharf on the river which would have been a better launching site for the iron vessel, the *Trial.* Suffice to say that this view is based on a particular interpretation of landscape features; no such documentary evidence has yet come to light.[46]

No doubt Wilkinson employed similar railways in and around his other industrial sites, particularly in the Wrexham area. In his report to the Ellesmere Canal Company in 1800, one of the reasons William Jessop gives for abandoning the building of the canal between Pontcysyllte and Chester is the competition from horse-drawn railways between Flintshire collieries and the Dee.[47] He could equally have been acknowledging a similar use of railways by Wilkinson, who by then had become totally disillusioned with the canal project.

In the last years of his life Wilkinson is likely to have been aware of Richard Trevithick's experiments with high-pressure steam, if only from the locomotive being built at Coalbrookdale in 1802 under the sponsorship of his fellow ironmaster and friend, William Reynolds. But whether, as alleged, he prophesied as early as 1779 that 'You will live to see wagons drawn by steam – I would have made such a wagon, if I had had time', seems highly unlikely.[48]

Conclusion

John Wilkinson must have travelled many thousands of miles in the course of running his extensive business interests. Following his death at Bradley in July 1808, he made his very last journey to his beloved Castle Head, where he was to be buried. But this was not without incident. The hazardous crossing of Morecambe Bay almost led to the loss of the wooden coffin containing his body, which had to be retrieved from the sands. The following month, according to the *Gentleman's Magazine*, the iron coffin in which he was to be buried at Castle Head and the iron obelisk which was to be placed over his grave were sent from Bradley ironworks and arrived by sea at Ulverston.[49] They would then be conveyed by wagon the 15 miles or so to Castle Head. In fact, that turned out not to be his final resting place – but that is another story!

Notes and references

This is an edited version of a paper presented to the Newcomen Society (Midland Branch) at the Thinktank, Birmingham Science Museum on 5 March 2008 which focused on Wilkinson's activities in the West Midlands.

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4. *Journal of Samuel More*, 13 July 1776 (private collection, courtesy Anne Turner)
5. Thomas Telford to Andrew Little, 3 November 1793 (quoted in Sir A. Gibb, *The Story of Telford*, 1935).
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20. B&W Coll., Hugh Jones to Boulton & Watt, 5 February, 7 August and 8 September 1781.
21. B&W Coll., John Wilkinson to James Watt, 16 August 1791.
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23. Quoted in S. R. Broadbridge, *The Birmingham Canal Navigations*, vol.1 1768-1846 (1974), pp.79, 90.
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27. The National Archives RAIL 869, Shropshire Canal Navigation Company Minutes, 12 June and 24 October 1788, 18 May and 1 October 1789, 10 December 1790, 6 October 1791; Wilkinson became the largest shareholder by 1797, holding 78 shares.
28. Ironbridge Gorge Museum Trust, Janet Butler Papers, Box 5/88, pp.190-1.
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30. 33 Geo.III, c. 91; E. Wilson, *The Ellesmere and Llangollen Canal* (1975), p.6.
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The Wilkinsons at Bersham

Stephen Grenter

Introduction

John Wilkinson operated Bersham Ironworks for about 50 years, from sometime in the 1750s, whilst his father Isaac was in charge there, until his death in 1808. During this period he transformed what was already a long established ironworks into a works of international reputation, famous for the quality of its manufacturing. I've often thought that had John lived slightly later, he would be as famous today as for example Brunel, Telford and Stephenson. Sadly for his place in history, he missed out on the great flowering of the Industrial Revolution in the 19th century. However without his industry the Revolution that was to transform Britain in so many ways would not have taken the course that it did.

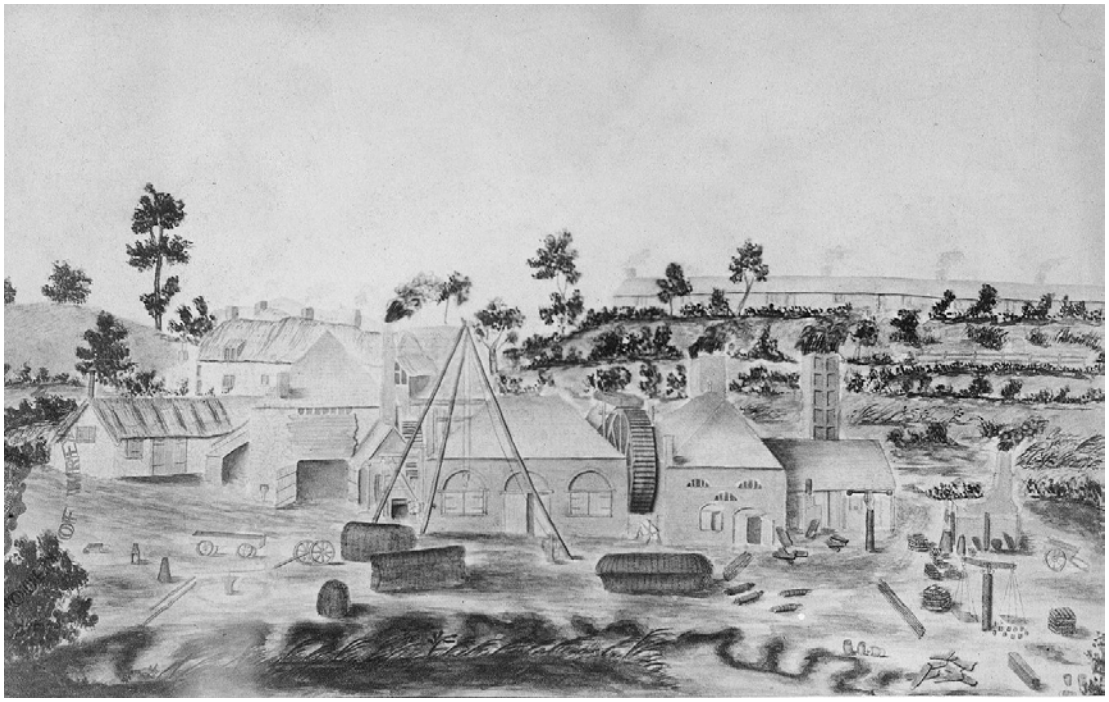
I am indebted to the work of Janet Butler in this account of the history of the ironworks; her unpublished thesis has shone light on significant areas of John's time at Bersham that had previously been murky to say the least. Janet discovered industrial archaeology and the Wilkinsons whilst digging at Bersham on excavations directed by the author, an interest that was later to become her passion. Sadly Janet passed away soon after completing her thesis.

The Early Years

Bersham nowadays is a small, quiet rural village just to the south west of Wrexham. Actually, a lot more people visit Bersham than they realise because the A483 dual carriageway that links Oswestry, Wrexham and Chester cuts the village in half. The village sits in the Clywedog valley, a river that rises in Minera to the west, flows to the south of Wrexham before joining with the river Dee south of Chester.

Of course, a river would be a necessity in the early 18th century for powering machinery and this area also has a broad flood plain to allow for the construction of an ironworks. You also need reasonably easy access to the raw materials of iron making – a source of iron ore, usually ironstone; a fuel, charcoal and increasingly thereafter coal for coking; and limestone, which reacts chemically with the impurities in the iron ore and floats off as a slag. All of these ingredients are available close to the ironworks site, making it an ideal location for a budding industrialist in the early 18th century.

The history of Bersham Ironworks spans about 100 years, from sometime in the first decade of the 18th century, when a furnace was blown in by Charles Lloyd, to the



The Eastern and Western Works at Bersham, sketches by Westaway-Rowe, c.1780.

The eastern part of the ironworks was later completely dismantled. The long one-storey building in the background is the row of workers' cottages, known as Bunkers Hill, now sadly completely demolished.

closure of the works in 1812. The first we know of an ironworks in the area was in 1670 when mention is made of a furnace then held by Sir Richard Lloyd of Esless Hall. We don't know precisely where this furnace was, but its location in Esclusham parish suggests somewhere to the south of the river, unlike the later ironworks which was built on its north side.

The site of the works to be later made famous by Iron Mad Jack was initiated by Charles Lloyd of Dolobran forge. His time was notable more than anything for the first recorded use of coke in the blast furnace in 1721, admittedly some years after Darby's success at Coalbrookdale in 1709. The furnace appears to have been producing pig iron for a local forge at Pont Y Blew near Chirk at this time, and was one of three furnaces in the area; the others being in Ruabon and Acrefair, to the south. Lloyd didn't have a happy time at Bersham. He had met one William Wood, an example of a new breed of industrialist with an extravagant vision (he apparently wanted to be the first person to make a million pounds through the iron industry) and no foibles whatsoever about how he did so. Wood had a talent for getting well meaning people to invest cash in various initiatives, which sooner or later would go pear shaped, leaving the investors, but not usually Mr Wood, in debt.

Lloyd, sadly, was one such victim, going bankrupt in 1729. The works were then taken on by John Hawkins, previously a manager at the Ruabon works and a son-in-law of Darby's. It was, I believe, during Hawkins's time that the ironworks started to move away from the wrought iron trade towards the cast iron trade. Hawkins's links to Coalbrookdale led to the latter making substantial financial investment in Bersham, particularly in 1733 when money was supplied to build 'an air furnace and moulding room and various repairs to the wheel and furnace'. This investment allowed Coalbrookdale to concentrate on more profitable work, with Bersham producing the more every-day castings. However, Messrs Ford and Goldney, who ran Coalbrookdale at this time, were never much enamoured with Hawkins, a position not improved by Hawkins siphoning off funds meant for works improvements for his own use. Following his death in 1739, the works eventually passed into the hands of Joshua Gee, with the works apparently reverting back to the production of pig iron for forges at Tern, also managed by Benjamin Harvey.

The first period of Bersham's existence, then, had been less than successful: it had suffered from the destructive presence of William Wood and had seen a succession of incompetent managers. Investment by Coalbrookdale had seen some improve-

Of the western works, none of the ironworks buildings to the south of the River Clywedog have survived. The chimneys of the air furnace of the surviving octagonal building can be seen on the right of the picture. Note also the weir built when the Wilkinsons altered the course of the river as part of their plans to expand the Bersham ironworks complex.

ments, but the works seemed to be bumbling along, fulfilling an essentially local need for cast or wrought iron. To take it onto a higher level, it needed to manufacture items for a national or even an international market and it needed to be run by someone with vision, drive and boundless energy.

The Wilkinson period

John's father, Isaac Wilkinson, arrived in Bersham sometime in 1753. Isaac had worked his way up through the fledgling industry and was more or less at the height of his powers when he took over what was in many ways a failing enterprise. As we have seen, years of mismanagement and incompetence had taken their toll and the works were crying out for a new beginning. Isaac was in many respects everything his predecessors hadn't been. He appears to have been a reasonably competent manager; he was forever pushing the technological envelope (much like his son); and had, through his previous experience, a deep understanding of the foundry trade.

During his decade in charge at Bersham, he very much laid the foundations for the ironworks' later success. In this he was aided, much like John was later, by the outbreak of a war, in Isaac's case the Seven Years War in 1756. Described by Winston Churchill as the first 'World War', hostilities found the fleet in dire and urgent need of cannon, a need that Isaac, with his new method of casting guns in dry loam or sand (patented in 1758), was well placed to profit from.

Perhaps Isaac's most important invention was that of a furnace blowing engine. The patent of 1757 describes the blowing of the furnace by means of a mechanism into which water fell, compressing the air as it did so; this compressed air was then fed though blowing pipes to the furnace itself. Aitken, a near contemporary, noted that it was Isaac's failure to get this machine to work properly that led to his eventual departure. John, of course, was later to get the idea to work and was the first to successfully blow a furnace with a steam engine.

We do know that Isaac was having problems with blockages in his blowing pipes, because a letter has survived from Isaac to Squire Yorke of nearby Erddig Hall, asking to borrow a ferret. This ingenious system of blockage location involved the introduction of a rabbit into the pipes, followed by the aforementioned ferret; the resulting commotion identified the location of the blockage and presumably a recently deceased rabbit.

Isaac certainly made many improvements to the works. He installed a steam engine to pump the water around the furnace after it has passed the water wheel, and this engine was apparently of 'great magnitude' and 'shook the ground for miles around'. Why Isaac should go to the expense of this engine is not certain: it's possible that he was having problems with the flow of the river or he may have been trying to improve the blast, possibly because he was using coke in the furnace. He was also heavily engaged in securing rights to minerals in the area and then building wagonways to transport them to the ironworks. Isaac had an interesting arrangement with his partners by which he alone gained financially from increases in output; he also had a company clerk, one Therry Smith, who was less than diligent in working out the company's accounts.

John, by then in his twenties, worked as a manager at Bersham at some point during this period. By the end of the decade he had started to take an active interest in the running of the ironworks, and his second marriage in 1763 to Mary Lee, who just happened to be a major shareholder in the company, put him in a position where he could take action. A dispute arose between John and his father. John wasn't at all happy about the state of the accounts; in particular, he questioned the amount of Isaac's personal profit, noted as £5,521.2s.2¼d, and, following scrutiny of the books, had it reduced by over £1,000. Mr Smith was also dismissed and moved to Liverpool.

1763 was a notable year in the history of the ironworks. First of all it was the year that resulted in the diversion by Isaac of the river Clywedog onto its current path, an event of particular significance to me as an archaeologist because it resulted in the creation of this plan of the works, a plan that has proved impressively accurate.

The year also brought the signing of the Peace of Paris, a treaty that was finally to see the end of the Seven Years War. The iron

industry, which had expanded significantly to meet the demand of the new war, went into a correspondingly sharp decline. The collapse in demand let to the end of Isaac's already strained partnership and the works were sold at auction in 1766 to a William Higgons of Llanerchrugog Hall for £5,060. Isaac eventually retired to Bristol after a brief involvement in the establishment of a new works in Merthyr.

It would appear more than likely that Higgons had bought the works on behalf of someone else, although why he should have done so is not clear. Litigation resulting from the break up of Isaac's partnership was to go on for the rest of Isaac's life, with claim and counter claim being pursued through various courts. It might well be that someone thought it prudent to make a clear break with whatever had gone on before by getting somebody unassociated with its past to buy the ironworks, and interestingly there seems some doubt that any money actually changed hands.

Although actual evidence is pretty scarce, the first few years of John's time at Bersham seem to have been a little on the quiet side. An admittedly sketchy plan of the works dating to apparently 1771 shows essentially the same building footprint as that shown on the 1763 survey. However, considering the decline in the industry brought on by the end of the war and by the relative calm on the international scene, this perhaps should not be surprising. That wasn't to say, however, that John wasn't fully occupied.

A Wilkinson Cannon at Fort Amherst, Chatham

Guns

Sometime in the late 1760s or early 1770s he (or Charles Roberston, one of his employees) hit upon the idea of casting iron guns from a solid and then boring out the 'bore' in a specialised boring mill. In 1773 John, through the agency of Anthony Bacon, sent three 18 pounders to the Board of Ordnance at Woolwich at his own expense for proofing. These guns were found to be superior to those manufactured by the traditional method and could be sold at a premium. Patented in 1774, the timing couldn't have been better, because in 1775 the outbreak of the American War of Independence led to another boom time for the iron industry.

John's method, after casting the gun solid vertically in a casting pit, was to drill the bore with ever increasing diameter drills until the boring bar itself could be inserted. The gun was attached to a waterwheel in order for it to spin and the boring bar, with cutting blades inserted into slots in the bar, was cranked into it from an adjacent bench. We have actually excavated a boring bar, now on display at Bersham Museum. It's clear now that Bersham was starting to attract an audience for its technological advances. In August of 1775, Bersham was visited by Marchant de la Houliere, a French infantry brigadier who was touring Britain on a fact finding mission to discover new methods of manufacturing guns.

De la Houliere witnessed a 32lb cannon cast from four air furnaces simultaneously, each of which held 20cwt of iron. He was so impressed with what he saw that he invited John to go to France to build them a facility like at Bersham. John was too busy to go, but William Wilkinson, John's brother, was excited by the prospect and went instead, establishing an ironworks at Le Creusot Montcenis.

Despite John's patent being overturned 'in the national interest', from the outbreak of the war in 1775 Bersham manufactured

View of excavations at Bersham Ironworks from the top of the blast furnace, showing casting pits and the octagonal building.

large numbers of cannon ranging from half pounders to 32lb main armament guns. Only a fragment of a gun has ever been found at the site of the ironworks and that was found in topsoil. Bersham guns, however, are known today at Gosport, Chatham and Londonderry in this country; in Madrid, Vienna and Corfu in Europe; in Istanbul; in Canada and the West Indies; on Ascension Island; and last but not least, in Mozambique. John, however, was all too aware that the urgent and profitable demand for guns would vanish as soon as the war ended, so he invested time and energy, and to some extent diverted resources, away from 'the gun branch', as he called it, towards a new area of trade, 'the engine branch', which he rightly saw as a 'more lasting trade'.

Engines

James Watt had been tinkering with steam engines since 1762. His work to improve their efficiency was very much dependant on the availability of accurately bored engine cylinders. The Coalbrookdale Company couldn't provide the quality required, so John Wilkinson was approached instead. John, of course, because of his experience with guns, was well placed to assist and an 18 inch cylinder was duly despatched in 1775 for an experimental engine.

Such was the quality of the Bersham castings and the accuracy of the bore, that the majority of Boulton & Watt engine cylinders were manufactured by the Bersham Company for the rest of the century. Watt once remarked that John was able to bore the cylinder 'to the accuracy of a thin sixpence in the worst part'.

Profits

The manufacture of guns and increasingly engine parts made Bersham extremely busy (in 1779 it was working a night shift to

cope) and it had become extremely profitable. The company's books show a jump in profit from £8,912.10s.2d in 1779 to £46,196.17s. 5½d in 1785. For comparison, £46,295 equates to over £4 million in today's money. So the ten years from 1779 saw declared profits of over £414,685, amounting to some £41,173,407 today. Another very interesting fact about these figures is that between 1783 and 1789 the annual profits remain reasonably constant at between £45- and £41,000 a year. It's significant because the American War finished in 1783, indicating that by this time the ironworks' success was not longer dependant on the demand for guns.

Another reason from the increase of profitability was the development of a satellite ironworks at Snedshill, in Shropshire, which came on stream during 1780. It just produced pig iron for the foundries at Bersham and was wholly owned and operated by the Bersham Company. It may be that the old furnace at Bersham was blown out at about this time because of this.

The period from 1775 to 1790 was perhaps the golden age of the ironworks: profits were going through the roof, it was at the leading edge of the technological developments of the age and was working full tilt. This period saw rapid developments, new steam powered boring machines were built, and the works expanded significantly. This was not only to the south of the old ironworks site, on land owned by Sir Thomas Myddleton of Chirk Castle, but also further down the valley, where several industrial complexes were built - at Esless mills, at Abenbury forge, at Turkey mills - each of which specialised in certain elements of the manufacturing process. Workers' cottages, known as Bunkers Hill, were also built nearby. New inventions were also developed. It's widely thought that the cupola furnace was invented at Bersham during this period, possibly by William. John also tried various experiments with rifling the gun bore; he invented a new method of making lead pipes; and various new fuels and iron sources were experimented with.

The decline and fall

The decline set in with the return of William Wilkinson from France in 1789. Initially he accused his brother of fiddling him out of his fair share of the profits of the ironworks, which, as we have seen, had gone up slightly since he left. William's humour was further strained by John's purchase of the Brymbo Hall Estate, to the north of Bersham, in 1792 and the subsequent construction of a bright new ironworks on land that he owned himself. William, probably not unreasonably, felt that he should have had a say in this development, since its construction would have a detrimental impact on the profitability of the old Bersham works down the road, which it certainly did.

Relations rapidly deteriorated and led to the sale of the ironworks in 1795, with John buying his brother out. Bersham from then on went into a steady decline. What had been seen as an advantage when the works were established, i.e. easy access to a river to power machinery, was now seen as a hindrance, with steam engines now doing all this work; similarly, the raw materials had to be brought some distance to Bersham, whereas Brymbo was built literally next to a coal mine.

This decline was hastened by William's antics in trying to persuade key employees to desert Bersham in favour of Boulton and Watt's new foundry at Soho in Birmingham. There were several occasions in the late 1790s when the works were at a complete standstill due to the fact that some key worker has left.

Both John and William passed away in 1808, still at loggerheads. William was buried in the Dissenters graveyard in Wrexham, whilst John, after somewhat of a tortuous route, eventually ended up in Lindale church. The old ironworks carried on for a few years under Thomas Jones Wilkinson before finally being sold to pay legal fees in 1812. What ironworks buildings remained were quickly converted to agricultural use, and soon even the existence of the works faded from memory.

Iron ships in green fields (1777-1833): Wilkinson's legacy

Richard Barker

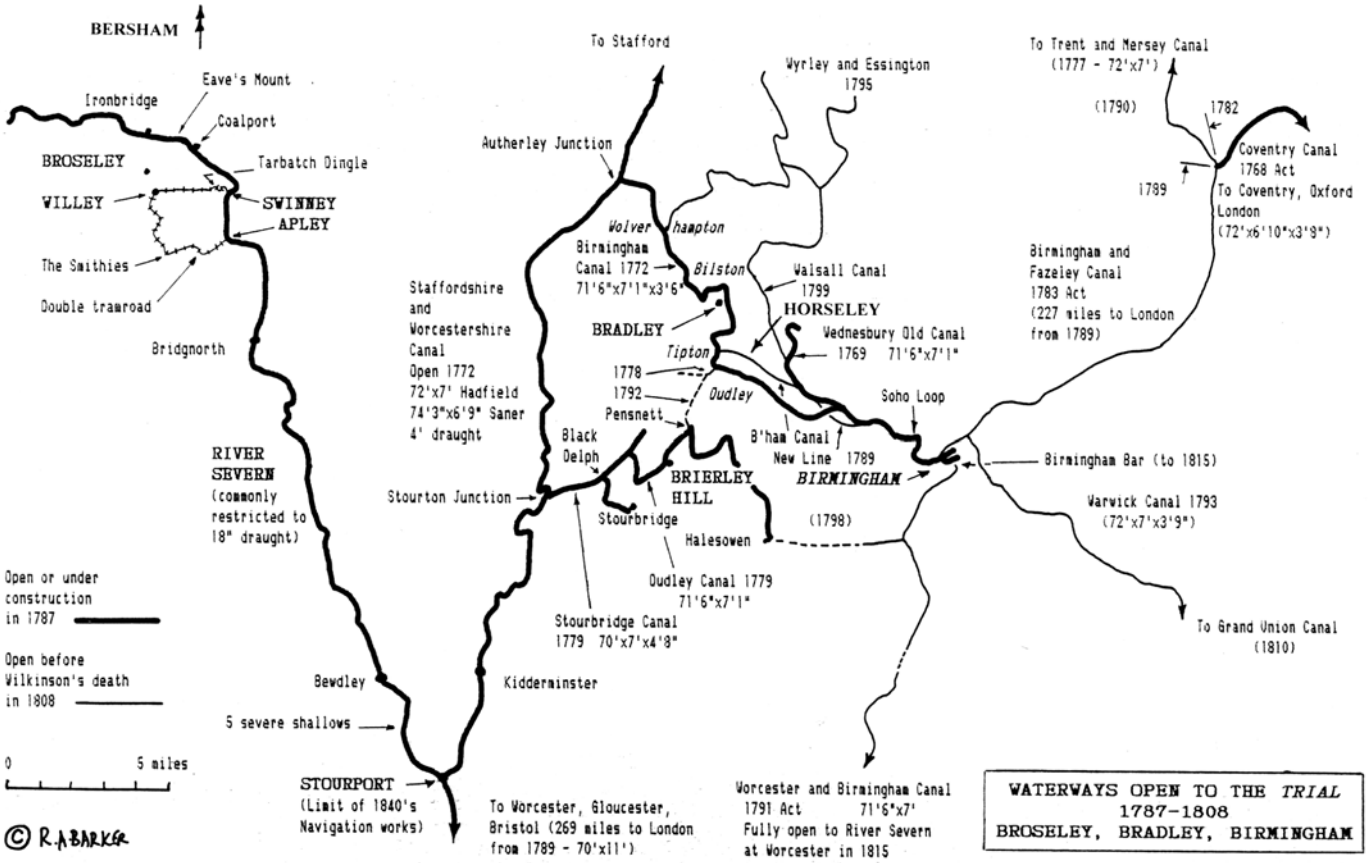
Introduction

The present paper is intended primarily to extend, and in a few details to revise, the paper prepared for the bicentenary in 1987 on John Wilkinson's connection with iron barges[1]. Some of this new material was presented at a meeting at NMM Greenwich in 2001[2], but was never published. The dates in the title were chosen as the earliest recorded creation of an iron-hulled working boat (1777), which Wilkinson presumably knew about, as it appeared in the widely read *Gentleman's Magazine*, and 1833, by which date iron boat and shipbuilding was firmly established, and linked with steam power, very widely. The fact is that with the exception of one strand, that of water tanks, there can be little additional emphasis on John Wilkinson: iron boat and shipbuilding was developed by others after 1787-8, not by Wilkinson, as far as we know. There is little doubt that Wilkinson had the greatest impact on the initial spread of iron hulls, not least as those early iron barges would have been seen across the Black Country, where iron shipbuilding was actually developed. That is the reason for my title: it was developed in the then relatively open and green countryside, not on the seacoasts or by shipbuilders. It is however curious that while there is extensive evidence for the existence of iron canal boats by about 1804, there is no clear evidence that I have found as to who built them, or when they actually began to do so; and none that John Wilkinson was involved after his early trials in 1787-8. That appears to be the extent of his direct legacy. Without new Wilkinson evidence, this paper will explore, with a sidelong glance, the practical difficulties of working iron for structural purposes generally, in which Wilkinson played a very major part, improving the quality of the material, reducing the cost, and driving and enabling early developments in steam power, for others to follow.

We only know explicitly of perhaps three barges built for the canals from the Severn to Bradley, and what might be supposed an ill-fated attempt to build a broader barge for the Severn - ignoring the possibly mythical Lindale boat, though Stockdale is adamant as to local oral tradition. The only direct records we have of any of those barges are Svedenstjerna's account[3] of seeing "several" 20-ton Wilkinson barges at Bradley in 1803, and brief and unsatisfactory records in the *Gentleman's Magazine*, *Birmingham Gazette*[4], etc; and Stockdale's evidence, only referring to three in all. It has never been practicable for this writer to search long runs of local newspapers for the Severn or Birmingham, but it is of course possible that they might reveal many more early accounts pertinent to early iron barges; though no evidence has been seen that other researchers have yet found anything definitive either.

So: we have some puzzles, from the lack of known evidence. Did Wilkinson just drop out of building iron barges shortly after 1787, and if so why? Whether Wilkinson was involved or not, when did others start to copy and develop the ideas? There is even a new doubt as to whether the *Trial* was correctly the name of the first canal boat, or of the river barge, to be discussed below as a postscript.

In 1987 this writer put forward a hypothesis that the first barges were all made of cast iron, like water tanks used with steam machinery and otherwise, some large boilers of the era, and indeed major aqueducts that still stand. This rested on the fact that there is no direct evidence for either cast or wrought iron; and on what is otherwise a puzzle: they were built at Broseley, a works primarily producing cast-iron, and for, but not at, Bradley, which produced primarily wrought-iron. Particularly for river use, cast iron may have proved fragile, and that might offer an explanation as to why there seems to have been something like a 15-year lag before we actually hear of other iron barges. It is perhaps most likely that having made his point, and costed the results, Wilkinson simply put the idea aside, and iron barge-building had generally to wait for cheaper plates and techniques. But cast-iron remains a hypothesis, and no new evidence has emerged, except the curious water tanks at *The Lawns*[5], only noted briefly in 1987. These are of course cast iron, and the dimensions of some of the plates are very suggestive of a nominal 7-foot canal boat. Indeed, they



may be significant, and they will be referred to in detail below. Dating is uncertain, but they are certainly pre-1800.

Iron ships in green fields

The development of iron shipbuilding is not a phenomenon of established shipwrights in coastal arsenals, but rather the product of riparian and canal-side entrepreneurs of the black trades. It was perhaps more an offshoot of the established steam pumping industry, and more especially of the associated boiler-making: there was considerable early synergy, especially in the Black Country. The use of steam for propulsion in wooden hulls is slightly earlier, depending on criteria for the notion, or practical success. However it was not widespread any earlier than iron canal boats.

In its early phases the construction of iron hulls was far from a sophisticated industry, neither producing precision products, nor following the mathematical developments of naval architecture. Not only were many (though not all) of the critical individuals far removed from scientific circles, and building flat-bottomed river and canal craft, but the methods of manufacture were rough and ready. Iron in the form required was intractable; battered into shape with hammers, not finely fashioned with machine tools. (That is well illustrated in a small canal icebreaker on display at the National Waterways Museum, Gloucester; supposedly built as late as the mid-nineteenth century, but with fairly irregular plates - possibly even re-used hammered plates: no study of the boat has been seen). Some very revealing later texts for the realities of heavy iron-working will be introduced. Some common misconceptions about the earliest iron vessels will be addressed, in the light of recent findings. This paper cannot offer a comprehensive synthesis in support of the observations to be made. It is an almost anecdotal collection of evidence, English and French. Iron used in isolation in bolts, knees, or bracing, is not considered. Neither will the use of copper and iron in small hulls such as Fulton's submersible of 1801 be considered here.

Selected chronology of developments

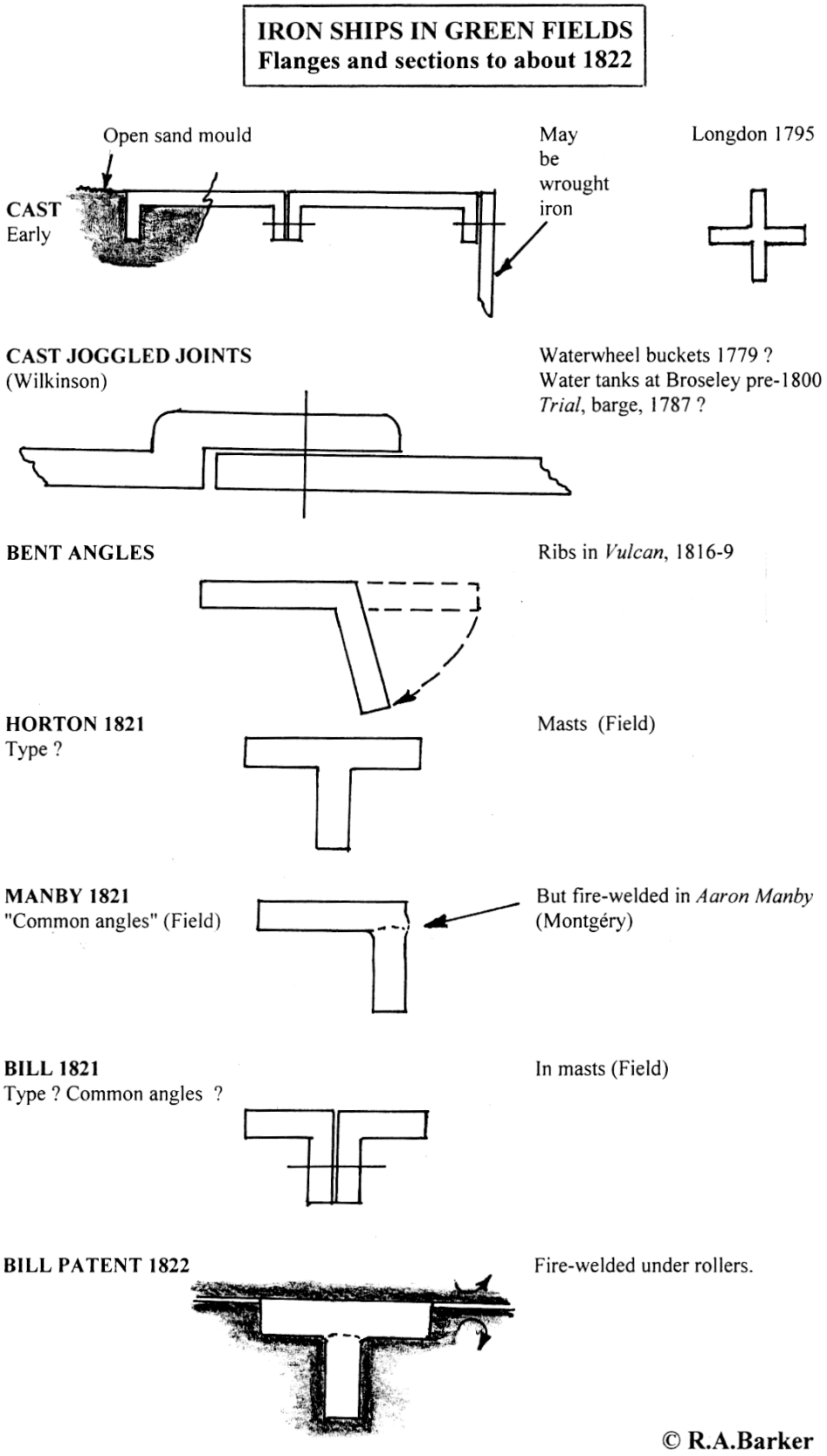
Sheet metal for shipbuilding occurs in classical times as armour (or fire-proofing); as sheathing of underwater parts; and as models from Ur onwards. Mersenne's may be the first modern suggestion of iron hulls proper, in 1644, but the first known metal hull arises in an unexpected context: a small

12-foot pleasure boat for 15 persons, of sheet-iron plates, was launched in York in 1777. It was conveyed by two men, which perhaps sets a limit of around ⅛ inch plate thickness, and suggests narrow rolled plates from a slitting mill, or perhaps part-reduced tin-plate stock. Curiously, the *Gentleman's Magazine*[6] has it indexed as "cast-iron, boat of".

In 1783 Boulton & Watt supplied their new rotative engine for John Wilkinson's new hammer (not rolls) at Bradley, which was the most advanced plant for boiler plates. At a similar date, c.1782, Horsehay is reported to have erected a new *forge* capable of making boiler plates, according to Trinder; however more recently Trinder states that a *rolling mill* produced those plates, with no new evidence presented, and this has to be discounted in the search for rolled boiler plates. There is said to be new evidence this year for developments at Horsehay[8], but nothing has yet been seen that states *rolled* boiler plates, or that is clearly distinct from hammered plates.

Wilkinson launched the first of his canal barges on the River Severn in 1787[9]. There may, or may not, have been a smaller boat built at Wilson House as much as 33 years earlier, for peat workings near Wilson House, but there is no secure evidence; Stockdale reports, perhaps from Wilkinson letters extant in 1872, that trials had also been made at Bradley c.1785-6, but gives no actual text. This 1787 barge was the first of several: in 1795 three boats were registered to Wilkinson in Staffordshire, which we might suppose were his iron canal barges, but the total number is uncertain. The purpose is manifest, not least in the dimensions recorded (in Birmingham, by others): it was to serve Wilkinson's works for wrought iron at Bradley on the Birmingham Canal, which had recently been connected to the Severn. (See Figure 1 for places and waterways named). That is but one of many enigmas about this first iron barge. Why was it built at his iron foundries at Broseley, if it was of the wrought iron normally assumed? This writer assembled the evidence in 1987 [*WSJ* 15, *op.cit.*], concluding that these barges were at least as likely to have been of cast iron as wrought iron; or a combination. Not least, Rees' *Cyclopaedia* [Art: Canal, 1806] generally considered to have been written by experts, and certainly closer to events than most commentaries, twice states that the barges were of cast iron; indeed "John Wilkinson introduced *some* barges made of cast-iron plates for navigating this *river*". Wilkinson was known as the King of the Ironmasters; Shropshire was also the home to very large flanged cast iron plates in bridges (Ironbridge, 1779) and aqueducts (Longdon, 1795). It is clear that angle irons and tees to joint and frame flat hammered plates were not yet developed. Nonetheless, the plates of the barge as seen by a journalist when afloat in Birmingham are described as $^{5}/_{16}$ inches thick, joined with rivets, like a boiler; Svedenstjerna used the ambiguous term *jernplåtar*. Timber was confined to posts, gunwales, and "beams". It is sometimes suggested that there was a timber framework, but this is not based on evidence.

One common error is to suppose that these barges follow directly from Cort's patent of 1783 for rolling iron - the patent is actually for bar stock formed and improved in grooved rollers[10]. There is further confusion from the fact that iron was rolled for tinplate by the 1690s; at one time associated with improving the surface of hammered plate in flattening rolls attached to slitting mills, with a width of around 8 inches. In fact there is an account of 1697 describing Hanbury's reduction of tin-bars 24x4 inches and probably ½ inch thick for 24-inch wide plate at Pontypool[11]. Flower[12] makes it plain enough that substantial reduction of thickness in rollers was limited to tin-bars 6 inches wide even in 1807, being the feedstock for progressive rolling to tinplate, which rarely exceeded about 14 inches width even in 1817. Flower states that the new rolling mills for Reynolds at Ketley in 1785 were to Cort's patent, that is, grooved rollers, as were Crawshay's at Cyfarthfa in 1790. Plates of even 8 inches width, with a structural overlap of at least 1.5 inches between riveted plates, are not a probable option for a large vessel. Hammered plates, still limited to approximately 56-112 lbs each, are more likely, as used in boilermaking. Wrought plates forming the vertical sides of a barge, riveted to each other and to flanged cast iron bottom plates seems a possible compromise solution. (Riveting of cast iron was practised in engine building). There are too large cast iron plates at



The Lawns, in water tanks that are very suggestive of a link (see below). Figure 2 illustrates the developments in forming flanges described in this paper.

Rolled boiler plates were first made in 1790, at Horsehay, according to Rhys Jenkins[13]: but they were reportedly only 8 inches wide. John Curr[14] described boilermaking in 1797, by which date boiler plates were rolled up to 17 inches width.Rolled iron plates are known to have been made at Bradley in 1803 under rolls up to “three to four feet wide”, but nothing is known about the thicknesses. In 1807 it is thought that

only two Shropshire ironworks could actually produce rolled boiler plates. Even in 1813 Trevithick could obtain nothing larger than 12x36 inches in Cornwall. It was in the period 1802-8, from remarks collected by Grantham[15] and other sources, that iron canal boats had become common in the Midlands. All these were apparently wrought iron.

In 1808 Trevithick patented iron tanks for use in the holds of ships, combining ballast and water tanks, and including cargo containers and buoys amongst the potential uses. After initial reluctance from a Navy Medical Board these were adopted very rapidly, and by many navies. (When told of the scientific and medical insistence that iron tanks would poison the water, Trevithick stormed out, justifiably calling them a lot of old women; by 1814 they had been adopted by general order)[16]. The construction was mostly from wrought iron plates, and extant models of tanks show single sheets per face, and some of those were flanged. Where such plates came from is not clear; cast iron is stipulated as an alternative in the Patent. A standard Admiralty tank by 1832 is recorded as 48 inch cube, weighing 784 lbs (i.e. 3/16 inch plates), and holding 464 (wine) gallons. Plate size had become effectively unlimited before 1836. A second patent of 1809 by Trevithick and Dickinson extended to iron ship construction[17]: not just iron hulls (predicted to be lighter, cheaper, more durable), but floating docks, telescopic iron masts and spars, iron chests for seasoning and bending timbers, and many other ideas. The text acknowledged the existence of numerous iron vessels on inland waterways, and anticipates much of what followed. Many of the new ideas were being implemented by others from about 1819.

From 1810 to 1814 various river and canal barges and lighters appeared on the Severn and Thames (the latter definitely transported in pieces, anticipating the *Aaron Manby*)[18], and on canals.

The *Vulcan* was designed and built in 1816-9, and launched on the Forth and Clyde Canal, the first vessel known to have rounded bilge and ship-form, entirely framed and plated in iron - apparently re-shingled from faggots of "best picked scrap iron"[19]. The frame angle irons were bent up at the forge as no rolled angles existed. The plate width was 24 inches, butted flush on the frames. Its shipform is perhaps explained by its use as a packet vessel, with speed and deck space the objectives; rather than capacity, with the full depth of a canal available. Montgéry states that a similar but larger vessel made a passage to Smyrna in 1818, but gives no source.

Aaron Manby built a steamer at Horseley on the Birmingham Canal, which was dismantled, and re-erected on the Thames (in 1821-2) before it made the first sea passage by any iron hull[20]. The *Aaron Manby* was evidently a deliberate attempt to exploit the shallower draught of iron hulls, and proved very successful on the Seine (albeit financially disastrous for Napier), being widely copied. It also set a pattern of fabrication of iron hulls for river vessels, that could be dismantled for transport by canal, and overland or overseas, and re-erected, which would be adopted very widely. As rolling improved, some vessels were made with hull plates of an eighth-inch thickness (or in *Codorus*, below, only one-twelfth). Disasters with Thames passenger steamers eventually forced the use of thicker plates.

Field's diary[21] refers to angle irons, and common angles (as also to machine punches and shears being the norms in Staffordshire by 1821 - Simond[22] reports shears in 1811 in Birmingham). Yet he also describes the mast then making at Bill's yard in 1821, as using angles back to back to make a tee, rather than the fire-welded tee of Bill's 1822 patent[23]. Horton at the same time had used a "tee" in his mast[24]. How the funnel of the *Aaron Manby* was made does not seem to be recorded, but Montgéry[25] adds that the frames were fire-welded angles (see below). It is symptomatic of our lack of knowledge of early iron working that we can go from no rolled angles in 1819 (*Vulcan*) to "common angles" and "forge-welded angles" in 1822 in this vessel; while being unable to supply a definitive chronology for the manufacturing process; or for rolled plate widths. Certainly when the Newcomen Society discussed the history of the making and rolling of iron in 1927[26] it was concluded that boiler plates were first rolled only after "about 1800", based on a letter from Watt to Boulton in 1798; while also reporting rolled plates (averaging only 19lbs each) at Horsehay in 1798, from "the Norris MS" (evidently the

same source as cited by Jenkins, as note 13 above). The topic is not short of contradictions. Rail sections were covered by Birkinshaw's Patent of 1820[27]. A tee was difficult to roll as it could only be done by heavily reducing the section, not bending, according to Hall; which indicates no knowledge of fire-welded tees or angles.

Bill enrolled a Patent in 1828[28] for making canal boats with wooden floors and sides of rolled plates, supported by tee frames. In the process he reveals that his tees were to be fire-welded from two flats, rolled together (and subsequently bent into a right-angle for the bilge), which he claims as original. The flange is termed here both face and fore, and is of 4 inch x ⅜ inch flat; the rib is 2 inches by ⅜ or ½ inch. He also describes "angle irons" for gunwales, narrow plates "turned over at right angles". The plates are to be a standard 9 pounds per square foot, or just under ¼ inch thickness and are to be up to 34 inches wide, and their length apparently up to the depth of the side - perhaps 4 feet. That implies blooms around twice the hand-held limit for hammered plates, probably rolled. His plates are to be riveted with countersinks, direct to his tee-frames, with a flush outer face. In this respect he follows the *Vulcan*; though his plates are wider.

Merigon de Montgéry in *Sur les navires en fer*[29] in 1823 proposed a number of innovations in iron ship-building - his future target is warships; including submarines, for which he predicts use by pirates (- we could read this more topically as drug-runners[30]). Interestingly, he proposes rolled plates flanged on four sides, jointed with cast iron bolts, partly to reduce the drag from protruding rivet heads, without the effort and weakness of countersunk rivets. This is deemed an improvement on the *Aaron Manby*'s butt straps in each strake and overlaps between strakes. He describes the frames in that vessel as two flats forged together to form an angle. He suggests that a simple flat bolted between flanged plates would provide the frame strength, but nowhere addresses how he would make the flanged plates of sufficient accuracy and in the shapes required in ships. He does further suggest watertight horizontal compartments, and double bottoms and sides, albeit possibly made with one wooden skin. His account is largely speculative, but reveals a number of interesting details culled selectively from English practice - he ignores Wilkinson. Thus flanged plates were absolutely standard in bridge decks, aqueducts, and water tanks; cast iron bolts were used in water tanks at Wilkinson's own home; fire-welding of tees and angles is described; *Aaron Manby* was the immediate model for all iron vessels in France at this point.

In 1832-3 Thomson, who had gone to France as an engine erector for Fawcetts, built an iron steamer on the Loire, after Gâche had declined his idea. Thomson describes a process of working in isolation, "worse off than Noah", and beginning by weighing sheet and bar iron[31]. The reduction in draught was small - a few centimetres, but on a river subject to very shallow water in summer this was sufficient to make a commercial success of the venture. The new vessel attracted attention when it was trialled with only 8 inches depth in the river. Nonetheless, the account may be slightly ingenuous, as similar craft had been plying the Seine, for the same reasons, since the *Aaron Manby* in 1822. Thomson's role is not noted in French commentaries.

The water tanks at *The Lawns*

There is an additional piece of evidence at Wilkinson's own home in Broseley, which was inventoried in 1800. There are cast iron water tanks there, employing thicker plates, but one includes plates in the side and bottom that are extraordinarily similar to the size that might have been used in the first canal barges[32]. Their arrangement is almost modular, for no apparent reason in the water tank. That is, the base and two ends are of plates 76x38 inches, while two sides are of joggled plates of half that size. It is part-flanged and part with a joggled joint that would provide a flush exterior, of more value in the sides and bottom of a barge than in most water tanks; similar joints appear in the Bersham water-wheel. The iron is of reduced carbon, matching Wilkinson's use of reverberatory furnaces. There are cast-iron bolts in these tanks. These plates are in fact far too thick to match the description of the canal barge that we have - calipered at ⅜-⅝ inches, but the thickness could be varied in an open mould, from the same pattern; and Wilkinson also cast large, very thin, curved plates for water-wheels, as existing at his Ber-

sham site, which include the same joggled joint detail as tank 1 at *The Lawns*.

Popular expectations

Many of the early iron vessels have acquired stories about public astonishment at their floating. Wilkinson made a spectacle of the expected sinking of the first 1787 barge, the *Aaron Manby* was deemed to be an "imposture" - an impossibility[33]. William Bourne had summed it up in 1578[34]: "…according to the simple opinion of the common people, who think that things do sink or swim, for that [they are] wood, iron or stone….", despite their kettles floating in a bowl.

Samuel Smiles had seen the original of John Wilkinson's letter of 14 July 1787[35]: "...Yesterday week my iron boat was launched. It answers all my expectations, and has convinced the unbelievers, who were 999 in 1000. It will only be a nine days' wonder, and afterwards a Columbus's egg[36] ". Smiles observes that wood continued for rather more than nine days to be thought the only material capable of floating. One might, then, smile at a story from Staffordshire, that a lead coffin in use in Lichfield in the seventeenth century was known to float in the vault of St Michael's church, which frequently flooded[37].

Origins of practical iron vessels

It is evident from the above chronology that before the early 1820's, when steam and iron were finally merged, that all the early development of iron hulls was done by entrepreneurs with no history of shipbuilding, and in centres that were mostly remote from the sea; primarily in the English Midlands, and specifically on and for the canal systems; whence the title[38]. The common factor is probably the general iron, engine and boiler-making trades of these areas. Up to rather later than 1833 there was little interaction between the skills and processes of iron and traditional shipbuilding. While barges could be dismantled and launched in docks or sideways, there was probably little need to integrate the trades.

Wilkinson's first trials have been ascribed to impatience with wooden barge builders, but a more likely explanation is his epithet of "iron-mad"; possibly compounded by a shortage of canal boats during the period of canal mania. Neither is shortage of timber an explanation for the early barge building, far inland. Even river barges were not much in competition with shipbuilding, as they could virtually be built from the off-cuts of large-scale shipbuilding. Canal barges contained almost no ship-timber, and commonly their bottoms were already short transverse slabs of elm. Durability and freedom from rot and leakage are more likely explanations; and regularly mentioned thereafter. The degree of rusting in salt and bilge water was a less pleasant surprise.

To what extent the earliest barges were built in expectation of lighter draughts is an open question, though that result was soon appreciated, and also that this was of particular significance in river navigations. Wilkinson did build at least one river barge for the Severn, which in Shropshire is as shallow as the Loire; and light weight was one of his aims. Randall cites a letter of 20 October 1787[39]: the river barge had "exceeded expectations" in this respect. The first barge in 1787 was certainly intended for canals, where the benefit was more marginal, but not trivial. The draught of 8 inches compares with the average of 9.8 inches for the registered wooden canal barges working on the River Trent between 1801-8, which is equivalent to two tons of cargo at any draught even in a canal narrow boat, and highly significant in rivers that frequently and for long periods offered less than 12 inches of water.

Cost is again unlikely to be a favourable factor until large rolled plates and rolled sections were available; though the ironmasters could of course build without on-costs or middlemen, and expand their markets, by using their own products. No cost information survives prior to the *Aaron Manby*: Montgéry indicates that a similar wooden hull would have been much cheaper.

It is equally conspicuous that there was little immediate connection between engines and iron boats, despite the physical proximity and even identity of the entrepreneurs. While the focus was on canal barges, and propulsion usually through side paddle wheels this is understandable. The size of early engines was also a factor: simply not practicable or competitive with horse-power on canals. Trevithick is possibly one key figure here (though there is no overlap with Wilkinson or Manby), as his high-pressure work made small engines and boilers via-

ble; and indeed he reputedly converted an engine waiting on board a Severn river barge for depth of water, in 1804, from cargo to power-plant[40]. Many of his engine parts were cast on the upper Severn, at Bridgnorth. Nonetheless, the *Aaron Manby*, as an example, still had low-pressure engines, albeit in a larger hull.

Transfer of technology

A long succession of foreign visitors (Angerstein, Jars, Rochefoucauld, Périer, Simond, Dupin), toured the arsenals and factories of England in the eighteenth and early nineteenth centuries, often obtaining admittance to view processes, and entertained by the entrepreneurs; some members of the Lunar Society, which included both Watt and Wilkinson, sought out by all-comers. Introductions came from the academies, and intermediaries amongst the Englishmen who had visited France. Sometimes they came to place actual orders, as Périer did in 1778-9 during a period of war, to obtain the Chaillot engines and pipes for the Paris water supply[41]. Thereafter his own 1778 Chaillot workshops built such engines; though they were partly (5%) staffed by English artificers even in 1825; the Charenton foundry set up by Manby, Wilson and Napier about 1819, which built all but the first two of their iron steamers for the Seine, even more so (62%). It is a curiosity that none of the resulting accounts refer to iron vessels, or Trevithick's patents, or Wilkinson. Simond, who travelled in 1810-11, predicted and recommended the substitution of iron for wood in shipbuilding in 1815. Montgéry has a captivating remark following a reference to Simond: “trop souvent, les innovations les plus importantes furent proposées par les Français, et exécutées par des étrangers”. Actually he may be taking this plaint from a comedy by Henri Simon, *Le bateau à vapeur*, of May 1816[42] , which features *L'Élise*, that was, perhaps[43], the first steamer to cross the Channel in March 1816. Unfortunately for the plot, this vessel was ex-*Margery*, a Clyde, then Thames, steamer[44]. Montgéry has other notions from Simond; but does not advocate Simond's tin and platinum coatings for his iron ships, nor propose to cast them in one piece.

By any standards, the key entrepreneurs here, Wilkinson, Boulton & Watt providing his early engines, Trevithick, Manby, were giants of their day. Wilkinson and his brother William had a particular role in introducing engines and military iron technology into France, via the Périer connection, Indret and other works. Wilkinson's activities, unfortunately, have left little trace of practical details, except where he appears in the Boulton & Watt archives, and at Bersham; though some of his water pipes may still be in use in Paris.

At the end of our period, Dupuy de Lôme's early works of 1843-4[45] are still effectively copies from John Grantham's, supplemented with other practical British examples from a mission of 1842.

Practical ironworking

After three centuries of intellectual interest added to the intuitive skills of all shipwrights, shipbuilding had in 1800 reached a high level of sophistication, in the working of raw materials, in structural refinements, and in elegant mathematical theories of stability and form; all applicable to the largest ships of the time, but probably of little relevance to the majority of wooden ships, which sufficed with techniques essentially of the early sixteenth century.

The introduction of iron for complete hulls, however, marked a profound disjuncture. No longer was iron just used in spikes, round bar, and hand-forged brackets, but in large sheets, and structural sections. The disruption was not just to the craft skills required, but to the level of infrastructure. The new materials were intractable without fierce and sustained heat, and great force and power. The characteristics were extremely variable from one batch to another, and from one ore/fuel combination to another. True, the individual components of hulls may have been lighter than their wooden counterparts, but they could not easily be modified cold. The problem was not new, and can be directly compared with boilermaking (but not engine-building, which had more to do with casting and machining). Boilers were still experimental too. Thomson describes substituting a high pressure boiler of his own design in the field, for an old low pressure one, about 1827: the other side of the coin was that one of his boilers is recorded in detail in 1842, because it had exploded (not, of course, a rare event at that period, and one of the reasons low pressure continued in parallel, especially where weight was not critical).

Cast iron was still used into this period (and reputedly even timber) while pressures remained low - a few pounds per square inch at most, before Trevithick's 50 psi. From around 1750, when blooms were first made into boiler slabs at the forge, it is likely that the older copper (and even lead) sheets were displaced for all industrial work, but the few practical accounts we have reveal just how difficult the reality of iron-working was until at least a century later. Accounts such as Grantham's, who first wrote in 1842, describe the finished product in glowing terms, but little of the battle to achieve it.

Take winter. From 7-22 January 1838 the riverside yard of Guibert at Nantes could not work on iron hulls: not only could the workmen not hold their tools in the cold, but even plates rolled in the workshops developed cracks[46]. Poor Guibert was then flooded out for more than two months. This account incidentally also describes construction in sections, upside down on wooden frames, subsequently lifted together by crane. An early American account, for the 60-foot steamer *Codorus* of 1825 also includes a sketch of the whole hull upside down[47]. (As an aside this hull was exceptionally light - five inch draught, but achieved with plating and ribs, bent in-situ from plates, of only ⅛ and $^{1}/_{12}$ inch thickness).

One of the most important accounts is by Piggott, in 1865[48]. He describes, with some dates, the slow process of mechanisation. Throughout our period, rivets were hand made, initially from square-hammered bar, re-worked at the forge at a rate of 300 per day. Rivet holes were punched by hand, in cold plate. Three-eighth inch plate took half a dozen blows of a 14 lb sledgehammer. Screw presses followed, and from about 1825 steam was used for punching and shearing.

Some of the dimensional information for these old boiler plates is recorded by Curr in 1797 - half-inch rivets at no more than 2 inch centres, with overlaps of about 1½ inches. Jointing was by “fearnought” flannel luting, by beating up the plate edges with chisels for an initial seal, and the use of acidified filings as a paste, coupled with time for rusting.

The early hammered plates Piggott describes were about 24 inches by 15-18 inches, with thickness varying from ¼ inch at the edges to ⅝ inch at the centre. Only the thin edges could be punched, and the plates were fitted largely as delivered. Half-plates were provided as closers. The early hemispherical boilers presented particular problems, with plate tapers effectively guessed, and compensated for as work progressed. At least, he says, the old hammered plates were of superior metal quality compared with early rolled plates. He gives a vivid description of the process:

“Setting plates and putting them together used to be pretty nearly one process in boiler making, for each plate was formed to its approximate shape and then temporarily fixed in its place on the boiler while red hot. It was then and there hammered into its required form, and when cooled was marked for punching from the holes of the adjoining plates to which it had been fitted. Many rude contrivances were resorted to to place and keep the work in shape, and it was no uncommon thing for a boiler, when it was put together ready for riveting up, to be so full of stretching screws to pull in one place, and props to push out in another, that there was little space left for the holder-up man”.

Piggott gives the output from 1831 as no more than 5 tons per man per year - no more than one plate per man-day in actual boiler assembly.

Most of a barge would at least be flat surfaces (the ship-shape *Vulcan* was almost an aberration in this sequence), but this passage indicates why extensive building in iron had to await both wide rolled plates, and power tools (rollers, shears, punches), effectively only available in the period from about 1820. Before that, there could be only tanks and canal boats; followed by river steamers, and only in the 1830s by large ships. Even Brunel first proposed the *Great Britain* as a wooden vessel, and was only able to contemplate iron at the end of 1838.

There is an entertaining account of reality in the iron shipyard from as late as 1874, in *Naval Science*, by an anonymous contributor[49]. While it may be slightly polemic, it must reflect more than a grain of truth, and the gap between specification and cold metal. If it was thus in 1874, one wonders what the real situation was in 1833, or earlier; it certainly helps to explain any preference for cast plates at an earlier period. Long extracts are given in

the 1987 paper and will not all be repeated here.

"…. keel plates, are often most severely burnt and unmercifully battered through the want of proper care and foresight in the first heating and bending to form.

…. The under surface is chipped fair, but the fact remains that it is "slop-work", unpleasant as the phrase may sound.

…. even were the bevellings given not quite correct, they could not be far out in the breadth of the flange of an angle iron; that even if they were out here and there, iron was of a ductile nature, and a few good blows from a sufficiently heavy hammer would set matters right.

….the plating is brought on to this unfair and ill-bevelled collection of frames, and if it be of only moderate thickness it cannot possibly be got to fit them, notwithstanding the screwing and battering that it and they receive….the plating itself has been battered and distressed and "drifted" out of its natural strength

….For the most part these evils are not observable when we congratulate ourselves upon a successful trial, for even in an iron vessel a large proportion of the vital work is covered up; cement and ceiling - so easily applied, so quickly wrought - may hide from a too inquisitorial eye much that may be open to serious objection; and how often may we note how quickly these stages of the work are carried out?"

The writer had then added:

"…but perhaps much of the cause lies in the fact that the class of men who perform the work cannot be said to be skilled mechanics in the strict sense of the term. It is almost impossible to refer to the subject without experiencing the natural regret that our shipwrights in years past should have deemed such work beneath their dignity, and allowed it to pass to a class then so much inferior to them, for some of the best fitted work we have ever seen has been performed by shipwrights, and notably in some instances where it has been their first attempt[50]".

"….pass to an inferior class….”? This may say a lot about the social attitudes of the writer, but is extraordinary for other reasons too. It was in fact those very boilermakers who had initiated and solved, practically, the problems of iron in shipbuilding, in the arguably more difficult boilers, far removed from the centres of traditional shipbuilding. That would be very much in the spirit of John Wilkinson.

There is however a twist to the tale: it is as suggested a polemic, justifying the Admiralty's actions in employing traditional shipwrights for iron-working, in terms of their alleged success, while describing typical defects of iron shipbuilding elsewhere. Barry in 1863 had presented a complete contradiction of how the "wood-iron" men had fared (taking for example 6½ days for a piece of work such as cutting a hole for a coal-shoot in a ⅜-inch plate which would have taken the iron-workers proper 5-6 hours; that the Admiralty had tried to conceal the "discreditable" defects in the ship; and appealing for the employment of practical iron-men[51].

The shipwrights did not much enjoy the change, and their reaction is recorded about 1862: "...my face as black as a sweep, my throat like a flue, full of soot, my dinner forms a sweep's brush, cleaning the space as it goes. I wish those who have their dinners without a pair of gloves made of tallow, grease and soot would drop amongst us just after 12; then they would have no need of visiting the Zoological Gardens....."[52] and "...Going down in a diving bell to the foundations of Blackfriars Bridge is on the whole a more inviting undertaking than going down to the lower parts of the *Achilles* among the blocks, props, smiths' fires, ashes, and other things below"[53]. But again, the boilermakers had already been working in such conditions for a century.

The identity and late reports of the *Trial* - a postscript

At least one writer persists in following Randall's misdating of two contemporary reports of the early iron barges, despite the note made on that by this writer in 1987[54]. What has emerged is that the inconsistencies were not pursued far enough in 1987.

Received history has been that the first of the 1787-8 barges was named the *Trial*; but received history has a distressing habit of being wrong. There are only two sources for the name at all. The clearest statement is ostensibly that of Randall, in 1879: the first launch was of the *Trial*, July 1787, she carried 30 tons, her captain was Edward Palmer. Randall is however the source of

confusion: he reports one of the Wilkinson letters and press reports on the last known launching as 1787, when Stockdale is clear that they were in fact dated 1788[55].

James Stockdale too, immediately following the text of Wilkinson's letter to him of 14 July 1787 (the same as that cited by Smiles, above), is unambiguous that this first launch was for the vessel named *The Trial*, her captain was Palmer. But then he adds that she was of some 70 tons burthen (some say only 40 tons). He continues with a letter of [Monday] 20 October 1788 from Wilkinson, which says that since 1st September two vessels had been launched, one a canal boat, the other a barge of 40 tons, for the river, floated on Monday [13 October?]. This is clearly the vessel reported by Aris's *Birmingham Gazette* (late, via London papers) on Monday 3 Nov 1788. Bearing in mind the small tonnage of a canal boat, it is possible that Stockdale has confused two boats, and that the 40-70 ton boat, named *Trial*, master Palmer, *might* have been the river barge; and the canal barges perhaps only numbered. That indeed is probably the evidence of the Staffordshire barge register of 1795, where Wilkinson had three boats, Nos.1-3, each of 20 tons, though these were not explicitly of iron[56]. Stockdale had his own inherited sources, and had published in 1872. Trinder has suggested that the *Trial* could carry up to 45 tons[57], but the draught available in canals around Birmingham would set a limit of perhaps 32 tons for the traditional narrow canal boat identification.

There have been recent researches in newspapers. Thus Randall had latterly placed a short item in the *Wellington Journal*, which was cited in passing by Trinder in 2005[58]. Paul Luter has sent me various items recently, following the same source. One is the result of a conversation Randall had with an anonymous naval architect c.1903[59] - this writer does not believe it is in Randall's words, and almost line by line it is demonstrably untrustworthy. Two items do stand out, but as a whole the items add to the confusion rather than resolve it. Firstly, there is a statement that the *Trial* had a Register certificate issued at Gloucester, implying that it was used below Gloucester on occasion (or, possibly, that a 1795 barge register certificate was extant, though it should then have been registered in the county of ownership). The master was Palmer. Either way, any such certificate would reveal a great deal more reliable information, but the extant Gloucester registers do not contain any such vessel; and the 1795 registers are almost entirely missing. That certificate is said to give the *Trial*'s *register* tonnage as 35 tons - not a deadweight capacity, which is said to have been at least 45 tons (and so not a narrow canal boat). In other words, Randall flatly contradicts his own 1879 text. Had he seen a certificate, and realised that Stockdale was mistaken? Without the certificate we will never know, but we must note the possibility that the *Trial* was actually the name of the river barge, not of the canal boat. In the present state of evidence, Randall may just have caused further confusion.

There is a second claim in this, attributed to Randall, that the *Trial* lay abandoned in the mud at Coalport, possibly as late as 1903. Trinder had given this statement, as Randall's own words in the *Wellington Journal*. Curiously there are no photographs of this wonder at Coalport, nor, apparently, any other record of what ought to have attracted some interest in such an early tourist area. *Trial* incidentally appears as the name of at least four wooden barges on the Severn in the nineteenth century. There is a drawing published with the 1903 *World shipping* report, but it is unreliable, and surely created for the report. The drawing is of a rigged vessel afloat and in service, made of large regular rolled plates; it is a broad sailing trow, certainly not a narrow canal barge. There are other snippets identified by Paul Luter: Randall again, in 1907 (*Wellington Journal*) using the term forged plates; and some works accounts for boilers from Shropshire (Horsehay, 1796). However, nowhere do those seen report *rolled* plates and the dimensions are only those to be expected of hammered plates; and the sources post-date Wilkinson's iron boats. Finally an 1890 statement from J.Slater that Wilkinson had made his first iron boat as an experiment at the old Bradley works, but without any date given. This may just be the old unsubstantiated rumour from Stockdale of a preliminary experiment in c.1786. While the *search* has great merit - there are problems with the received history of rolled plate too, not least from the history of tinplate - nothing definitive has yet emerged for this

topic. There was also a small iron vessel by Betancourt [see *BLHS Jnl* 27, 2005, p54; also *WSJ* 19, 1997, pp13-5], floated on the Severn, built either for a canal weed-cutter or a river mill, but this only dates from 1795-6.

Conclusion

Iron shipbuilding was well advanced in practice long before traditional shipbuilders, and certainly any proponents of mathematical naval sciences were involved. While the strength of iron, and its jointing, its watertightness, and in principle its freedom of form, permitted great and rapid advances in shipbuilding, there was another side to iron. The processes of working iron into the required forms, and developing the machines and infrastructure to facilitate them (as indeed to launch the results, as in Brunel's experiments on friction for the *Great Eastern*), were also major intellectual achievements, but of a very different kind. Even by 1850, they had not all been solved.

Notes and references

1. R.A.Barker, 'John Wilkinson and the early iron barges', in *Wilkinson Society Journal*, No.15, Broseley 1987, which is available online at http://clara.home.net/rabarker, or on the website of the Broseley LHS. Most of the source texts for the early barges were transcribed into this paper.
2. R.A.Barker, 'Iron ships in green fields', presented at the 8th Anglo-French Naval Historians' Conference, *Science and the French and British Navies, 1700-1850*, Greenwich 2001.
3. W.A.Smith, 'Swedish view of the West Midlands in 1802-3', in *West Midlands Studies*, Vol.3, 1969, pp66-7; a translation of the account by E.T.Svedenstierna of his travels in 1803. Original text: Eric Th. Svedenstjerna, *Resa, igenom en del af England och Skottland, åren 1802 och 1803*, Stockholm 1804. Text kindly made available by Carl Olof Cederlund, Statens Sjöhistoriska Museum. At that date there was apparently still a barge on the Severn, but for some reason the experiment had been less successful.
4. *Gentleman's Magazine*, Vol.57, 1787, p732, and *Aris's Birmingham Gazette*, 30 July 1787 and Monday 3 Nov 1788. Texts in the 1987 paper. These ambiguous records do not *positively* refer to more than three vessels in all, one in July 1787 and two in Sep-Oct 1788: the records often only state "lately".
5. R.A.Barker, 'Iron Boat Studies, 1990', in *Wilkinson Studies*, Vol.I, Merton 1991, pp53-62 (and on-line). Paul Luter kindly sent me a copy of an 1805 Alexander Brodie patent (No.2856) for cast iron steam boilers which has construction not dissimilar to Tank 2 at *The Lawns*: large flanged plates (the drawing is very sketchy, but the plate widths are around 6 feet), with internal stays, and assembled "with rivets or screws and nutts and pasteboard". This just reinforces the point that large wrought iron plates were not so easily come by, long after the *Trial*. [Postscript: Frank Dawson has drawn attention to a 1783 Wilkinson water tank still at Castlehead, cast in one piece, 2.5x1.1x1.1m, which clearly merits close examination].
6. *Gentleman's Magazine*, May 1777, pp244 and 291 (taken from *York Courant* 27 May).
7. B.Trinder, *The industrial revolution in Shropshire*, Chichester 1973, pp66, 78; contradicted in his *Barges and bargemen*, Chichester 2005, pp98, 154.
8. *Pers.comm*., Paul Luter, 2008.
9. Variously at Willey Wharf, and within sight of Apley rookery - or Apley Forge. The debate continues for lack of clear evidence. For Apley see R.Pringle-Scott, 'The Trial enigma', in *Wilkinson Studies*, Vol.II, Merton 1992, pp11-20.
10. R.A.Mott (ed.P.Singer), *Henry Cort: the great finer*, The Metals Society, London 1983. Cort's site at Funtley is reported in R.Riley, 'Henry Cort and the development of wrought iron manufacture in the 1780s: the naval connection', in *Transactions of the naval dockyards society*, Vol.3, 2007, pp51-5.
11. F.W.Gibbs, 'Rise of the tinplate industry', in *Annals of Science*, Vol.6, 1948-50, pp390-403, Vol.7, 1951, pp25-61, 113-127, Vol.11, 1955, pp145-153 - especially Vol.7, pp49-50. That is still a very small plate (about 13 lbs), reduced to 5/16th inch thickness. Hanbury's patent is only from 1728. The real history must be uncertain. Rolling of copper (hot) and lead was common in the eighteenth century (there is indeed a da Vinci sketch of a mill); iron was a different proposition. See also P.W.Flower, 'Origin and progress of the manufacture of tin plates', in *Journal of the Iron and Steel Institute*, 1886, No.1 [*not* Volume], pp36-60+plates; p38.
12. P.W.Flower, *A history of the trade in tin*, London, 1880.
13. Rhys Jenkins, 'Boiler making', in *The Engineer*, 19 July 1918, p52. (A series of such articles, including two on slitting mills, was reprinted as *Links in the history of engineering.... Collected papers of Rhys Jenkins*, Newcomen Society, 1936). Jenkins' authority for that information is W.G.Norris of the Coalbrookdale Company, using their records, but there is an oddity in the printed data. The only Shropshire works to make *rolled* plates, after 1790, was Horsehay, but they *produced* plates 4 feet by 8 inches by ½ inch thick. That is thicker than most boiler plates. Jenkins,

taking the 8 inch width on trust, supposes that they were in fact still produced in a slitting mill. The original statement was published as Appendix 1 to a paper in *Proc.I.Mech.E.*, 1903, pp673-680; p678. Compare with Curr's plates, below. J.W.Hall reports other evidence in 'Notes on Coalbrookdale, and the Darbys', in *Transactions of the Newcomen Society*, Vol.5, 1924-5, pp1-14, p5: the size of hammered plates in 1772 had been 40 lbs, but "when in 1798 they were rolled at Horsehay", the average weight of 233 plates was only 18 lbs.

14. John Curr [sometimes given as Carr], *The coal viewer and engine builder's practical companion*, 1797 (facsimile London 1970). Curr's schedules of boiler plates required tapered plates that were never less than 12 inches wide at some point, even in very small boilers, and were up to 17 inches wide; the very largest (other than pairs of crown-plates) were listed as 5 foot 9 inches long, and 7.3 square feet each.
15. J.Grantham, *Iron as a material for shipbuilding*, London 1842, pp5-10.
16. F.Trevithick, *Life of Richard Trevithick, with an account of his inventions*, London 1872, 2 vols, vol.1, pp285-294 esp.
17. Trevithick, *ibid*, pp302-320 esp.
18. J.Randall, *Broseley and its surroundings*, 1879, pp106-9.
19. F.M.Walker, 'Early iron shipbuilding - a reappraisal of the *Vulcan* and other pioneer vessels', and Discussion, in *Institution of Engineers and Shipbuilders in Scotland*, Vol.133, 1989-90, pp21-34.
20. W.H.Chaloner & W.O.Henderson, 'Aaron Manby, builder of the first iron steamship', in *Transactions of the Newcomen Society*, Vol.29 (1953-4), 1958, pp77-91.
21. J.W.Hall, 'Joshua Field's diary of a tour in 1821 through the Midlands - Part I', in *Transactions of the Newcomen Society*, Vol.6, 1925, pp1-41; Part II in *TNS* 13, 1934, pp15-50.
22. L.Simond, *Voyage en Angleterre…/Journal of a tour….1810-1*, editions 1815, 1817.
23. See R.A.Barker, 'Iron boat studies, 1990', in *Wilkinson Studies*, Vol.1, 1991, pp59-60.
24. J.W.Hall, 'Joshua Fields diary....', as note 21 above, part I, p27 (and cf p16).
25. Merigon de Montgéry, 'Sur les navires en fer', in *Annales de l'industrie nationale et étrangèr*e, Tome 12, No 46, Paris 1823, pp41-67. (The reference in this to L.Simond, as note 22 above, is incorrect).
26. J.W.Hall, 'The making and rolling of iron', in *Transactions of the Newcomen Society*, Vol.8 (1927-8), 1929, pp40-55 + plates. Statements at pp47, 55.
27. F.T.Evans, 'Roads, railways and canals.....', in *Technology and Culture*, Vol.22, 1981, pp1-34, esp.p9. Patent printed in summary in *Repertory of Arts, Manufactures and Agriculture*..., 2nd series, Vol.39, 1821, pp206ff.
28. Printed in summary in *London Journal of Arts and Sciences*, Vol.IV, 1822, pp117-9. B.Woodcroft, *Alphabetical index of Patentees of inventions, 1617-1852*, Rprt 1969, lists Robert Bill from 1811 (washing machines, patent 3418), beams, masts, etc, for ships in 1820 (4461), boats and barges, etc, in 1821 (4624) and tubes, cylinders, etc, for shipping in 1822 (4644).
29. Montgéry, *op.cit*.
30. There have been a string of press reports since c.2000, mostly in the Caribbean region, and with vessels up to some 24 metres length. Eg K.Semple, *The Guardian*, 21 November 2006.
31. 'Notes on steam navigation on shallow rivers, being the result of eighteen years' experience on the Loire and Garonne, by a Practical Engineer', in *The Artizan*, Vol.IX, Jan 1851, pp9-10; also Feb 1851, p37; H.E.Williamson, *Steam boats on the Loire, 1822-1852*, Farnham 1986 (privately published, but deposited in relevant English and French libraries). One of Thomson's boats, *Riverain 1*, suffered a boiler explosion in 1842. The official report with detailed drawings of the boiler is in *Annales des Ponts et Chaussées*, 1842. Competitors called their ultra-low pressure boats *Inexplosibles*.
32. R.A.Barker, 'Iron Boat Studies, 1990', *op.cit*., note 5 above; tank 1.
33. H.P.Spratt, *Birth of the steamboat*, London 1958, p115, citing E.H.D.E.Napier, *The life and correspondence of Admiral Sir Charles Napier*, London 1862, Vol.I , p121.
34. William Bourne, *A treasure for travellers*, London, 1578, Book 4, Chapter 1 (reprinted Amsterdam 1979).
35. S.Smiles, *Men of invention and industry*, London 1884 (reprinted 1997), p52.
36. Takashi Yoshinaka, 'Columbus's egg in Milton's *Paradise Lost*', in *Notes and queries*, 2007, pp40-3, provides a trail for this phrase. It is nothing to do with Columbus, but came from a story of Brunelleschi, recounted by Vasari, in which the wonder was making an egg stand on end (by first crushing a spot on one end). This was retold by Benzoni in 1565, who attached it to Columbus; it was picked up by Samuel Purchas, whose works as Boswell records were read by Milton, and feature in *Paradise Lost*. The question remaining is where John Wilkinson picked up the phrase.
37. Robert Plot, *The natural history of Staffordshire*, Oxford 1686 (facsimile 1973), pp166-7.
38. Compare the chapter 'Iron shipbuilding comes to rural London 1832-46', in

A.J.Arnold, *Iron shipbuilding on the Thames, 1832-1915*, 2000, pp6ff.

39. J.Randall, *Broseley and its surroundings*, 1879, pp106-9. The date was actually 1788.
40. Cited by B.Trinder, *The industrial revolution in Shropshire*, Chichester 1973, p167. It seems very improbable, for a variety of reasons.
41. R.A.Barker, 'John Wilkinson and the Paris water pipes', in *Wilkinson Studies*, Vol.II, Merton 1992, pp57-76 (and on-line).
43. Henri Simon, *Le Bateau à vapeur: comédie en 1 acte mêlée de couplets*, Paris, 18 May 1816 [BL ref 11738.n.30(3)].
44. *The steamboat*. Conversation set in the Café de Carafon (*limonadier*), Quai Voltaire.
42. Scene 1: *Le Moniteur*, announces that the steam boat, departed from London on the 17th of the month, has passed Rouen two days ago, and that it will arrive without fail in Paris today - What is this steamboat ? - Packet *L'Élise* - doesn't know of steam - oh, it is a new invention, which appeared for the first time nearly two hundred years ago, and to which we owe, I believe, steam pumps, the *Mongolfières* [balloons ?] and espresso coffee [*café d'ébulition*]. Scene 2: occurrence…. the steamboat has gone aground near the Ponts des Invalides…song: The boat goes on wheels. Scene 8: All is lost…it has arrived - what - this infernal steamboat…it appears that is no longer aground….dashed all hopes. Scene 16: the boat passes…
The *Moniteur Universal* item referred to by Simon has not been found, but on 28 Mars 1816 it reported that the arrival had been delayed by 48 hours because the master pilots refused to pilot her.
43. A case has been made for the *Eagle*, which according to a Parliamentary report of 1822 had gone up the Seine in 1815, though there is no corroboration for this; and the "Sharne" stated could have been the Shannon ?: C.Dawson, 'The first steamer to cross the English Channel', in *Mariner's Mirror*, Vol.91, 2005, p471-2. This same author in 'Early watercraft built of metal 1777-1838', *in Mariner's Mirror*, Vol.89, 2003, pp83-8, produces a collection of evidence that would be familiar from *WSJ* 15, 1987, and actually cites various items from *Wilkinson Studies*, Vol.1, 1991, with the notion that the *Trial* was of $^{5}/_{16}$-inch plates, "probably cast", but curiously omits the links.
44. H.P.Spratt, *The birth of the steamboat*, London 1958, pp94-5; also, H.P.Spratt & G.L.Bigot, 'Le premier bateau à vapeur à travers La Manche', in *La Revue Maritime*, New Series 130, Feb.1957, pp170-5 (copy kindly provided by Eric Rieth). This tells how the *Margery* was built on and for the Clyde in 1813-4, and then in 1814 was sailed to the Thames using its chimney as a mast (citing G.Aylmer, 'Early London river steamers', in *The Engineer*, London, 9 Sep 1932, p255), being sold or chartered to the Seine in 1816. Its wooden hull was still lying on the Seine in 1888. In contrast, in John Galt's story *The steam-boat* of 1822, the Edinburgh-London packet was a working steamer, whose "boiler, when the steam was overly strong, had a natural way of its own of breaking the wind off its stomach" (p158).
45. Dupuy de Lôme, *Mémoire sur la construction des bâtimens en fer*, Paris, 1844, 2 vols.
46. H.E.Williamson, *Steam boats on the Loire, 1822-1852*, Farnham 1986; *op.cit*.
47. A.C.Brown, 'The sheet iron steamboat *Codorus*', in *American Neptune*, Vol. 10, 1950, pp163-90; see also R.A.Barker, 'Iron boat studies 1990', in *Wilkinson Studies*, Vol. 1, 1991, *op.cit.*
48. G.Piggott, 'Boiler plate working', in *British Association, Birmingham and the Midlands Hardware District,1865*, ed S.Timmins, 1866, pp93-8 (reprinted 1967).
49. Anon, 'On the building of iron merchant vessels', in *Naval Science*, Vol.3, 1874, pp145-157.
50. The background to this last observation is suggested by events in M.Waters, 'Changes in the Chatham Dockyard workforce, 1860-90, Part 1 from wood to iron...', in *Mariner's Mirror*, Vol.69, 1983, pp55-63. A strike by iron-workers in 1862 led to shipwrights taking over plating and other work.
51. P.Barry, *Dockyard economy and naval power*, London 1863, pp131ff; and *The Dockyards and private shipyards of the Kingdom*, London 1863, pp34-5, 52.
52. Cited by Waters, *ibid* , from a shipwright writing to the *Chatham News* in December 1862.
53. Cited by Waters, *ibid*., from P.Barry, *Dockyard economy and naval power*, London 1863, p133; though Barry's context is working in the dock below the ship, not in the ship.
54. Trinder, 2005, *op.cit*., at n15, p154, also cites 1788, p276, but this item will be found in *the Universal Magazine*, not in the *Gentleman's Magazine* as stated.
55. J.Randall, *Broseley and its surroundings*, 1879, pp106-9.
56. R.A.Barker, *WSJ* 15, *op.cit*, 1987, p22.
57. Trinder, *op.cit*., 2005, p98.
58. Trinder, *op.cit*., 2005, p99, and note16, p154, cites *Wellington Journal*, 31 October 1903.
59. 'An early iron-built vessel' (by a naval architect), in *The shipping world*, 21 October 1903, p366. This journal seems to be rare, and is possibly actually *The shipping world and herald of commerce*; the original has not yet been seen. Note that this precedes the *Wellington Journal* item.

John Wilkinson's Trade Connections

Eric Alexander

This paper focuses on Wilkinson's links with Anthony Bacon, Richard Crawshay, the "Lunar Men" of Birmingham and Henry Cort

Anthony Bacon

The most useful source is a monogram by L.B. Namier in *Journal of Economic and Business History,* II (1929) pp20-70. Notable features of Bacon's career:

- it started in Whitehaven, Cumbria,
- he obtained a lease on land at Cyfarthfa, near Merthyr Tydfil, in 1765, to set up ironworks there,
- he bought the nearby "Plymouth" blast furnace from Isaac Wilkinson (John's father) and John Guest in 1766.

According to his entry in the Oxford Dictionary of National Biography, Bacon was John Wilkinson's partner in 1773. This is not confirmed by any other source, including John Wilkinson's entry in ODNB! Nevertheless, it is known that Bacon approached John Wilkinson at that time asking him to devise a process to make a cannon that could fire more accurately than any available at the time. John obliged with a method in which the barrel was cast, then rotated over an advancing borer: a method he patented.

However, when in 1774, the Government's Ordnance Board circulated a request to "Acquaint the gun-founders that the Board have agreed with Mr. Bacon for casting iron ordnance and boring them out of the solid at £18 per ton and that they therefore desire to know whether they will engage to provide guns bored out of solid at the same rate", they received a reply from a founder called Jones: "We cannot bore guns out of the solid, being threatened to be prosecuted by the person who has a patent granted for that service to himself only." This looks remarkable, since Wilkinson had allowed Bacon to make cannon by the patented method in the foundry at Cyfarthfa.

The Government reacted strongly to Jones's objection, following advice from the Ordnance Board Solicitor that "Such steps may be immediately taken as his Lordship may judge proper for the revocation of the said Patent, which if permitted to remain in force will not only be prejudicial to His Majesty's subjects but very detrimental to the public service." Wilkinson's patent was duly cancelled, but he did not suffer unduly, since Matthew Boulton realised that the process filled an important gap in his requirements: producing a cylinder with uniform bore for use in the steam engine developed by his partner James Watt.

Richard Crawshay

The most significant features of Crawshay's career are:

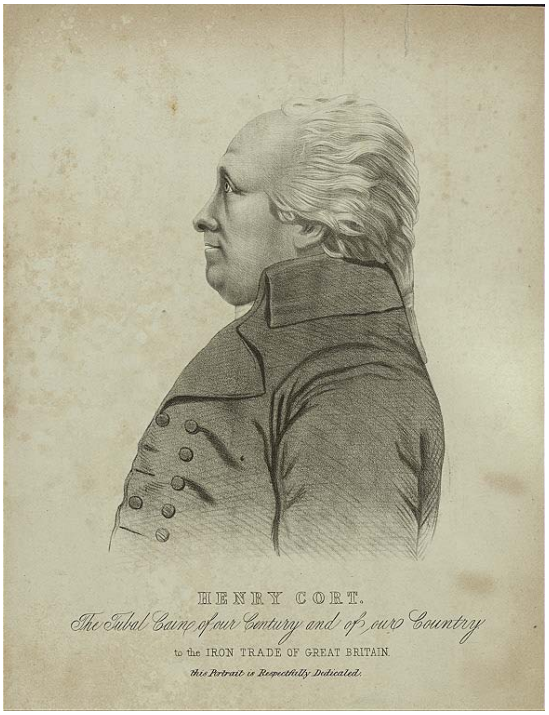
- taking over a London ironmongery business in 1763,
- becoming dominant partner at Cyfarthfa in 1787, after Bacon's death.

A useful source of information is *The Letterbook of Richard Crawshay*, based on material now in Gwent archives and covering the period 1788-97. A relevant letter from the book, dated 8 July 1788, features an introduction for William Wilkinson, "a friend for over twenty years", to a contact in Sweden (this at the time when William was completing his work in France).

Another item of interest was spotted by Janet Butler in her research among the Boulton-Watt archives in Birmingham (the results of which can be viewed in the archives at Coalbrookdale). She noted a letter from John Wilkinson to Matthew Boulton, dated 23 October 1796: "We have been a Week at the Bank where Mr Crawshay Jnr., Mr Wm Reynolds & Myself have been sitting to a Mr Wilson of Birm^{m} at the request of Mr Crawshay whose Picture he has taken in South Wales." There is little doubt that Wilson's portrait of Richard Crawshay is the one hanging in the Cyfarthfa Castle Museum at Merthyr, and replicated in his biographies; but the whereabouts of the other portraits has not yet been established.

"The Lunar Men"

This is the title of a book by Jenny Uglow. Those she identifies include Matthew Boulton, James Watt, Josiah Wedgwood, Erasmus Darwin (among founders of the group); and Joseph Priestley (who joined later). Their group was called the Lunar Society because it met once a (lunar) month, on the



Henry Cort (NYPL collection)

day of the full moon. Boulton and Watt were close associates of Wilkinson, who supplied the cylinders for their engines. Priestley was married to Wilkinson's sister Mary.

The Boulton-Watt collection at Birmingham is probably the biggest source of information about Wilkinson. Letters from him have also been discovered in the Wedgwood archives, and there may be further information in other group members' archives.

Boulton and Watt later fell out with Wilkinson when they discovered he was pirating their invention. A pertinent quotation can be found in Eric Robinson & D McKie, *Partners in science* (London 1970) from a letter of James Watt to Joseph Black, dated 5 December 1790: "We are going on well enough in our business, but are attacked on many hands, and among the rest of our invaders are our good friends John Wilkinson and William Reynolds. The former acts avowedly for his own interest, the latter from a purer motive."

Henry Cort

My website *henrycort.net* can be reckoned the most comprehensive and reliable source of information about Cort, since I have had the facility, not available to previous researchers, of computerised catalogues covering the archives of many record offices, notably the National Archives at Kew, and giving access to many unsuspected records concerning Cort and his associates.

Prior to this, the most comprehensive research was that done by Professor R.A. Mott in the 1960s. His findings, and the lengthy book he drafted, can be found in the Coalbrookdale archives. He was unable to find a publisher for the book, but in 1983 the Historical Metallurgy Society commissioned Peter Singer (last heard of in the Philippines a few years ago) to condense Mott's work into a shorter biography, entitled *Henry Cort: The Great Finer.* This remains the only full-length biography of Cort.

The principal source of Mott's findings is the Weale collection in the Science Museum Library. If you wish to view the collection for information on Cort, I recommend you first read my appraisal in *Trans. Newcomen Soc.* 75 (2005) pp341-358.

Henry Cort's career

Essential details are:

- 1757-1775 approx: navy agency, London.
- 1776-1789: iron trade, Gosport & Fontley; this is the inventive period; pertinent to the Wilkinson link is the presence of Cort's brother-in-law John Becher at Shut End, near Stourbridge,
- 1789-1800: "Twilight years" after collapse of his iron business; living in London (Bloomsbury).

Henry Cort's patents in England and Wales were granted:

- for rolling iron with grooved and collared rollers, and some minor processes: January 1783, enrolled 16 May;
- for "puddling", i.e. purifying cast iron in a coal-fuelled reverberatory furnace: February 1784, enrolled 12 June.

A patent in Scotland covered both processes.

Cort, Watt and Wilkinson

A visit by Cort to the premises of Boulton and Watt is recorded in a letter from Watt (in Birmingham) to Boulton (in Cornwall), dated 14 December 1782: "We had a visit to-day from a Mr. Cort of Gosport" In a follow-up to this visit, Cort wrote to Watt (27 May 1783, after enrolment of his rolling patent): "You were kind enough to say you would mention me to Mr Wilkinson…"

Later in the year, Cort gave a demonstration of his rolling process near Stourbridge, doubtless arranged through the services of

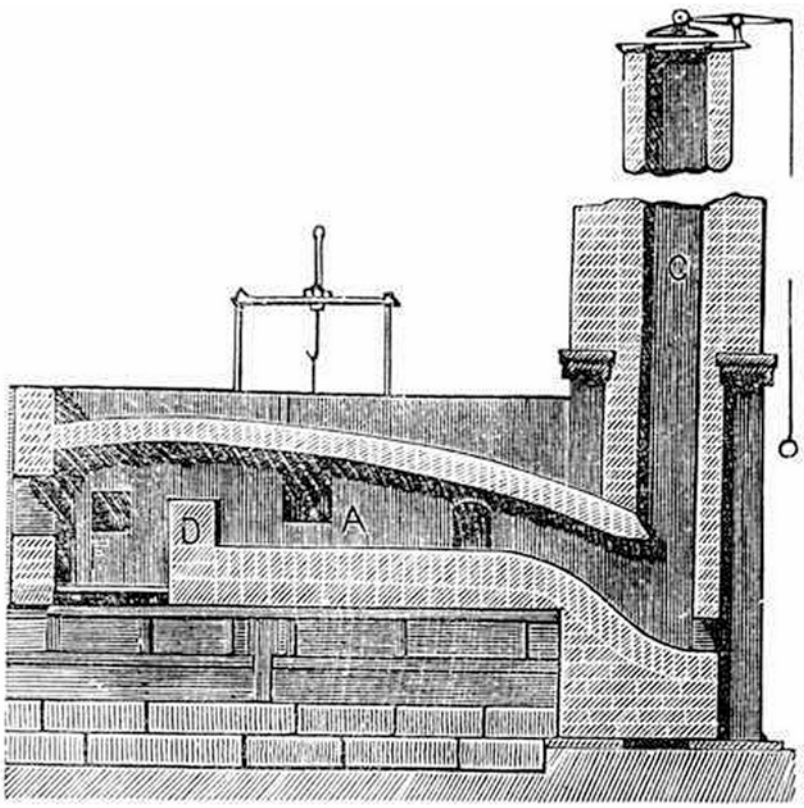
brother-in-law John Becher. A letter from John Wilkinson to James Watt, dated 22 October 1783, records: "My coming over depends on an experiment Mr Cort is to make at Stourton Mill."

In a further letter on 3 November, Wilkinson writes: "Some time this Week I shall go over to Stourton having been advised by Mr Cort that he is ready & has already performed to the Satisfaction of all present." The letter continues: "I told him at Stourbridge that I shoud give him 10 Days extra to be perfect before I paid him a Visit. – I find he has been attended by great Numbers of Spectators – among which was Mr. Kier – You will learn from him what the Trade can expect from Mr Corts method." This suggests that Cort and Wilkinson had actually met at Stourbridge, but no further evidence of this meeting has yet emerged.

Plans go awry due to an accident, as revealed in a Wilkinson-Watt letter dated 6 November 1783: "Read a letter from Mr Cort that he had met with an Accident in his Mill & that he woud advise when he was ready again to work." The mill, of course, was not Cort's (which was in Hampshire) but belonged to Francis Homfray. Another Wilkinson-Watt letter, dated 8 November 1783, adds: "Have not learnt the accident that has befell them – it must be more than breaking a Roll as that is soon replac'd."

However, Cort did not resume his Stourton demonstrations, for reasons that can be deduced from the record of the death of his brother-in-law John Becher on 7 November 1783, suggesting Becher had been fatally wounded in the accident. The date of Becher's death can be pinpointed because he was an officer in the Royal Navy. Although he was not on active duty at the time, his widow was entitled to a pension, and the Navy's pension records usually record the date at which the widow's entitlement began. In the case of Ann Becher, this entitlement continued for nearly 43 years!

Subsequent developments in the relationship of Wilkinson to Cort's rolling process are hinted at in a letter from Watt to Joseph Black, dated 6 June 1784: "Mr Cort has, as you observe, been most illiberally treated by the trade they are ignorant brutes; but he exposed himself to it by exposing his process to them, before it was perfect, and they saw his Ignorance of the common operations of making Iron, laughed at and despised him; yet they will contrive by some dirty occasions to use his process or such parts as they like without acknowledging him in it."

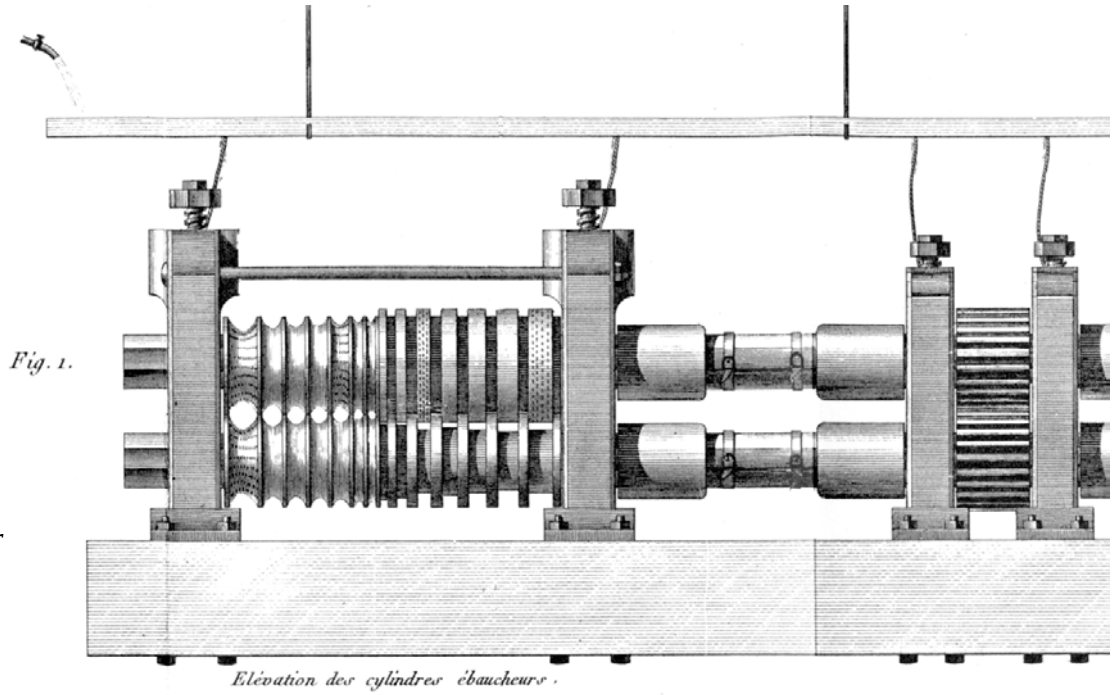


Puddling furnace

While allowing for Watt's obsessive attitude to patented processes, one must suspect that he had evidence for his opinion about Cort's treatment by the trade. Could Wilkinson be one of those in the trade for whom Watt had such evidence?

A clue emerges from a document in the Science Museum Library (RHJ 177B, needs to be ordered in advance), evidently the journal of an unnamed ironmaster based in the Sheffield area and visiting works in the Midlands and Shropshire in 1785. In his entry for 4 May, he reports having seen, at John Wilkinson's New Willey works, "iron rolled at Bradeley by Mr Cort's patent". Yet there is no record of Wilkinson being granted a licence for rolling iron, nor of his paying any money to Cort.

Further evidence emerges from the Weale Collection, which quotes Richard Crawshay's son William in May 1787: "There never was any Mill whatever charged with Blooms to roll the same into Bars before his (Cort's) process – that Wilkinson, Raby (and one other) might have used grooved rollers for rolling bar



Rolling Mill showing a pair of puddled bar rolls. "Voyage Métallurgique en Angleterre" 1839

iron of one form into bar iron of another form."

Wilkinson, Crawshay and puddling

Cort's gave several demonstrations of his puddling process in 1784. One of those taking an interest was Professor Joseph Black in Edinburgh, to whom Cort supplied (via an agent in Scotland) details of a demonstration at Wednesbury on 25 November, witnessed by:

- Mr Boulton of Birmingham;
- Mr Garbett of Birmingham (presumably Samuel Garbett);
- Mr Threlhold Clerk to Mr Wilkinson of Bradley;
- Mr Joseph Amphlett (who took away some of the wrought iron made by Cort, and reported favourably on its use for making nails);
- Mr Hallen Junr of Swedes (owner of the works).

At this stage, however, no ironmasters were sufficiently impressed to take up the process. The first to do so was Richard Crawshay after he and his partners had taken over the Cyfarthfa works in 1787. Further documents from the Weale collection tell how Crawshay tried to persuade other ironmasters to adopt the process. On 11 May 1787 he reported to Cort: "W. Reynolds and Homfray will follow: Wilkinson I know will not". However, on 21 August, Cort's financial backer Adam Jellicoe quoted Crawshay (whom he periodically met in London) as saying Wilkinson "is now a convert".

Over the next few years Crawshay had difficulties in getting Cort's puddling process to work reliably. Apparently Cort had achieved reliable results because his raw material was cast iron scrap, obtained from the Navy and originally smelted using charcoal. Crawshay, however, was working with coke-smelted pig iron, whose siliceous impurities accumulated inside the puddling furnaces and degraded their performance.

Evidence has been found that Wilkinson attempted to tackle the problem in 1790-91, while Crawshay's attempts at the same time are described in his letterbook. Recently unearthed evidence, however, suggests the remedy was found by Crawshay's neighbour Samuel Homfray (at Penydarren Ironworks) and Homfray's employee Joseph Firmstone.

It was several years before most ironmasters felt enough confidence in the puddling process to take it up. However, a description (spotted by Janet Butler) by Joshua Gilpin of "a New Mode of Making Barr" at Bradley in 1796 tells us: "In Wilkinson's Furnace the Lumps are carried directly from the Puddling to the large heavy round rollers which work backward & forward."

So we can be sure that Wilkinson had adopted puddling by 1796. Too late alas for Cort, who had been driven out of business by financial difficulties in 1789.

The Significance of the Women in John Wilkinson's Life

Frank Dawson

There were four important women in John Wilkinson's life, five if we are to include his mother, but she is such a shadowy figure with so little documented information about her it is difficult to form a view of the relationship that existed between them. If John Wilkinson was born in the back of a farm cart on the way to market, as northern folk memory has it, and since his mother went on to have five more children all of whom survived, she must have been a strong and healthy woman and most likely therefore a dominant force in his childhood; but of caring, of love, of motherly gentleness, we know nothing. She lived into old age with Isaac, his father, but since father and son quarrelled bitterly in 1762 she probably saw little of her eldest boy as his wealth and fame grew from then on. So we must pass by his mother, Mary, as of unknown, maybe unknowable, significance in his life.

The first great love of his life was undoubtedly Ann Maudsley, the daughter of a wealthy landed family from Rigmaden Hall in the Lune valley, Westmorland, north of Kirkby Lonsdale. The Maudsleys had held the Manor of Mansergh, in which Rigmaden lies, from 1661 and there is evidence of some opposition within the family to a liaison between their daughter and the son of a pot-founder from Lindale.[1] It may be why at this time father Isaac, as his prosperity increased, began to refer to himself no more as pot-founder, but as 'gentleman';[2] and why John, in the subsequent marriage record of 1755 described himself as 'merchant' of Kirkby Lonsdale, without any reference to his merchant ware, which was iron.[3] Some wooing of the family was clearly necessary even though it was a love match, and a measure of how successful that was is the fact that the young couple lived at Rigmaden for the first part of their married lives, from which address John acted as witness to the marriage of his wife's sister, also at Kirkby Lonsdale, the following year. John and Ann then followed Isaac, John's father, to Bersham soon after she had given birth to their baby daughter, Mary. It was a journey of a hundred miles, over what James Watt later called 'villainous roads', and soon after they arrived there and set up home in a modest house in Wrexham Fechan, Ann was in trouble. Whether it was the physical demands of the journey so soon after childbirth that took Ann into decline, or the depressive effect of their immediate step-down in status and the uncertainty of their prospects at that time, but she died in the autumn of that year. She was 23 years old. At a stroke, John lost forever the radiance that for a few brief years had filled his life. His desolation is still recorded on a memorial on the wall of Wrexham Parish Church, an ornate white-marble plaque, inlaid with black and a continuing testament to his loss.

Did he have to persuade Ann to move with him from Westmorland to Wrexham? And if so, did he now feel in part responsible for her death? And what was his response to be to the baby girl who now lived on as a constant reminder to him of what he had lost? The evidence is that it was more than he could bear. Baby Mary was put out to nurse and for the next seven years was brought up in the family of Mr John Flint, Gentleman, Controller of Stamps for Shrewsbury. It is from the time of this tragic loss in 1756 that John Wilkinson's focus as an ironmaster begins, and it might have been the catalyst that drove him.

For the next few years John worked with his father Isaac at the Bersham furnace, making cylinders for the old Newcomen engines and cannon for the government. It was an uneasy working relationship. They were both dominant males and the subsequent quarrel and parting was inevitable; but it was there that he first met the woman who was to become his second wife. Her name was Mary Lee, a wealthy spinster from Wroxeter, and she held a third partnership with Isaac in the Bersham ironworks. The remaining third was held equally by two lesser figures

ultimately out-smarted by John, who, by obtaining their third and then marrying Mary Lee, gained control of the company his father had set up.[4]

No information is available about the courtship of John Wilkinson and Mary Lee. Was their marriage in 1763 entirely a marriage of convenience. She was no mean catch. On the death of her father, Thomas Lee, she had received a moiety on his estate, valuable in terms of land and property rather than income.[5] She was 40 years old when she married John Wilkinson. Why had she stayed unmarried for so long? Was she beautiful? No likeness of her survives. Was her marriage simply an escape from spinsterhood into a more exciting life she'd had glimpses of already? Or did this young widower, five years her junior, capture her heart? She brought substantial wealth into the marriage, but at 40 she could not reasonably expect to bear him children. Did he settle for a consort rather than a woman, a partner to support him in his rise to power rather than a soul who could bring radiance and passion back into his life? It is probable he found both. From what we know of their life together for the next 40 years, from his confidence in her ability to manage 'Headquarters' in his absence, from the gentleness of his enquiries after her through friends when they were apart - the marriage, no matter how it began, grew into a strong and caring and, yes, a faithful association, ending only in death.

Following their marriage, the Wilkinsons moved into a substantial three-storey, double-fronted, north-facing Georgian house with a large secluded garden on the sunny south side in Church Street, Broseley, just across the road from Broseley Hall, where Mary's sister lived with Edward Blakeway, by then John's business partner of several years. The house was called 'The New House' at that time, not until later 'The Lawns', and it was his principal home, his headquarters and the centre of his business world for more than 30 years. Although he may have rented it initially, he later took it on a 99 year lease from the same George Forester from whom he had by then leased the furnaces and mining rights for his New Willey Company.[6] At the same time, as an indication of an end to grieving and the beginning of a new happiness in his life, his seven-year-old daughter Mary came back from the Flints at Shrewsbury and soon formed a strong bond with her stepmother and with her half cousins who lived over the road at Broseley Hall.

The third woman to have a strong impact on John Wilkinson's life, as she grew older, was this daughter Mary. Born and baptised in a land she never knew as a child, losing her mother when she was seven months old, fostered for the first seven years of her life and then growing up in her stepmother's household as her ever-busy father rose to ever-higher positions of power and acclaim - was she neglected, damaged, deprived? Emotionally? Psychologically? The evidence is that she survived remarkably well. The Flints, her surrogate parents in her early years, clearly loved her; a love she returned until she died, though there are no recorded details of her early life in Shrewsbury. Her stepmother, too, was fond of her, and perhaps accepted this little girl as the child she was by then unable to have herself. In spite of early traumas, Mary appears to have been fortunate in the adults who influenced her early life and helped her grow to womanhood; and her teenage years in Broseley were clearly times of position and privilege within the extended families of the Wilkinsons, Lees and Blakeways.

Details of Mary's education are not known, and much of it was probably in-house; but it is also clear from her father's pleasure in her company as she grew to womanhood, when she accompanied him on business trips in this country and on the continent, that she had been put through a formal education sufficient for her to understand the essentials of his affairs, and that was unusual for a woman of the time. It is likely that, in the absence of a son and with no prospect of one from Mary Lee, Wilkinson was schooling his daughter for a marriage within his iron-making world that would bring his business added strength and a son-in-law worthy to inherit it.

He was to be disappointed. Mary's first

liaison at the age of 19 was with a consumptive young doctor called Richard Blackley, a potential husband so far removed from her father's ideas of a son-in-law that she must have chosen, for whatever reason, to confront him.[7] However, the young man died before the relationship developed further, an act of Providence Wilkinson might have welcomed, and there was no enduring confrontation between father and daughter, at this point. Indeed, there followed almost ten years of harmony between them, until Mary fell in love a second time.

In August 1783, at Richard Reynolds's annual picnic on the Wrekin, John Wilkinson met for the first time a young cleric, a Classics scholar and by then intimate friend of Reynolds. His name was Theophilus Holbrouke. There is some evidence that he and Mary had been seeing each other before then. It was the beginning of the ensuing tragedy that befell them all. As the relationship between Mary and Holbrouke developed, there are furtive references to it in letters of the time and in the Journals of Samuel More, Wilkinson's closest friend.[8] The affair was conducted in a clandestine manner and clearly Mary knew her father would disapprove. He did and, when the secret was out, 'unable to be angry by halves', he forbade Mary to see Holbrouke further, on peril of losing her inheritance. But Mary stood firm. It was the beginning of the bitter break between them.

In 1783, just before Holbrouke had appeared on the scene, Wilkinson, ironically, had been the agent in securing for Mary a moiety in her grandmother Mawdsley's Westmorland will, which left her with property and a substantial sum of money. Cut off now from any hope of a dowry or income from her father, Mary and Theophilus asked Richard Reynolds to help them realise this as a dowry to enable them to marry.[9] As a young curate and with no significant connections, Holbrouke had little enough himself and few expectations in his own right. The stature and influence of Reynolds was enough to achieve an arrangement quickly, though there is no evidence that Wilkinson actively contested it. The two were married without banns by special licence on 8 October 1785 at Market Drayton.[10] It seems to have been a lonely affair, with only Holbrouke's close friend William Tayleur standing witness for him and the minister's wife for Mary.

Three miles from Market Drayton lies the pretty hamlet of Moreton Say, with its unusual church endowed by Clive of India and delightful vicarage and garden just across the road. It is the place where in 1781 Theophilus Holbrouke, an Oxford scholar but a Shropshire lad himself, had begun his ministry. In spite of his subsequent relapse from grace in the Church of England over his difficulties with the Doctrine of the Trinity, and since the tragic sequel to this marriage is focused here, it is likely that he chose to return to this idyllic place with his young bride.

The final transfer of Mary's inheritance under her grandmother Mawdsley's will was made to Holbrouke the following February, by which time Mary was heavily pregnant. In May she gave birth to a baby girl, who sadly died immediately afterwards and was buried on the 25th there at Moreton Say. Imagine the contrast of this bleak misery with the love and hope the young people had brought to this beautiful place fragrant with May blossom. They named the dead child Mary. Worse was to come.

There must have been complications at the birth, for within a month Mary the mother was also dead, buried with her dead child on 18th June.[11] The grieving Holbrouke placed a stark memorial tablet, recording the details simply in classical Latin, on the external, sunless north wall of the church. It remains there to this day, forever in shadow, with space below the names of his wife and daughter for his own one day to be added; but he lived on another 30 years and his final resting place was elsewhere. In that month that Mary lay dying no-one knows if she and her father were ever reconciled, or indeed if he ever spoke to Holbrouke again.

There are clear similarities in the fortunes of these men in their first marriages and

the latest tragedy must have brought back to Wilkinson a shadow from his earlier life. Both men loved their women deeply and, after a brief period of happiness, both lost them in childbirth. Both men met family resistance to their marriages. The tragic irony for Wilkinson was that his daughter, the surviving child of the first tragedy, had become the unhappy principal in the second. Did he ever ponder these things? Was he sorry to lose, in the prime of her womanhood, this strong-willed daughter, one time the light of his life; or did he, as with other uncomfortable things around him, cut himself free of her to concentrate on what he could influence and change. Wilkinson was ever a pragmatist, even in matters close to his heart, and it is likely that following this tragedy he paused, was affected by it for a while, was sad perhaps, but then set a new course and started his life again. He was 58 years old. It is a hinge point, at which he needed to make a new statement about himself and his work, as deteriorating personal and business relationships threatened to confound him.

During the last 25 years of Wilkinson's life, following the completion of his Castle Head mansion in 1781, his relationship with his wife, Mary Lee, deepened. Once this new house was habitable, she moved into it from their Broseley headquarters and remained there with few interruptions until she died. During this time John was absent for long periods, on journeys to the Continent, to London and to Cornwall, or simply managing his many interests at the heart of his business world 100 miles away in the West Midlands. His many letters throughout this period to his friends and business associates, and particularly those to James Stockdale of Cark, near Castle Head, carry messages or enclosures for Mary Lee, small endearments and expressions of concern for her health and happiness.[12] He was a vivid letter writer, but unfortunately the correspondence between himself and Mary Lee at this late stage of their lives has not survived, with one exception.[13] It is a brief letter, written on another abortive trip to Cornwall where business was not good, in which he reflects on what it is in life that is best for them and makes them happy. It shows concern for Mary Lee and a desire to be with her. He always returned to her and to what became their northern paradise together, with great joy himself. Those missing letters would tell us so much about him.

However, the death of daughter Mary meant he now must look to his succession. He had no other children, though he did have nephews, three of whom – Thomas Jones, William Johnston and Richard Watson -had managerial responsibilities within his empire and clearly had expectations, though Wilkinson himself always retained absolute control of important issues like policy, expansion and investment. But he wanted a son, from his own loins, and obviously felt in his sixties and early seventies that he was still vigorous enough to beget one; and it was also in the nature of the man to try to solve this problem for himself. At this point, there had to be discussions with Mary Lee. Most commentators have condemned the process eventually put in train, by which a single mistress bore him three children in his old age, as a betrayal of any Christian morality he claimed for himself and, more particularly, as a betrayal of Mary Lee. There is good evidence it was not the betrayal it seemed. First. throughout his association with the mistress, his caring queries after Mary Lee's health and happiness continued. Then, the mistress was from Brymbo and stayed there until Mary Lee's death, and there is no evidence they were ever in each other's company. Third, Mary Lee's epitaph on her memorial in Lindale church says simply, ‘She was humane, liberal and beloved’, telling words from her husband. And finally, in an age when wives had no property under the law and could not make a valid will, not only did John witness the will his wife drew up, but he then went to law to ensure that the bequests were executed according to her wishes after her death.[14]

Plenty of well-to-do men of the day kept mistresses, of course, and maintained them comfortably, sometimes with the knowledge of the wife who often accepted the situation provided the mistress did not

threaten her status or position. It seems to have been different with the Wilkinsons. This one mistress apart, there is no sound evidence that Wilkinson was a philanderer who chased after other women, in spite of his physical vigour which endured into old age, nor the second-hand stories about his lechery that circulated then and have done since. Conversely, it is clear that he was liked and respected through the years of his rise to power by the wives of his friends and business associates, for his supportive attitude to women in a society where they had limited status.[15] It is probable, therefore, that Wilkinson used this one mistress, with the concurrence of his 'humane, liberal and beloved' wife, simply to procure an heir.

The name of the mistress was Ann Lewis and she was a maid on his Brymbo estate. It is likely that she was identified as a suitable woman for the purpose by a certain James Adam, also of Brymbo, a man increasingly trusted by John Wilkinson and ultimately made trustee and executor under his will. Events proved that to be an unwise decision and a major misjudgement of character, which immediately raises questions as to precisely what relationship existed between Ann Lewis and James Adam at the time and later; the more so since they both lived at Castle Head for some 15 years following Wilkinson's death. There is very little primary information about Ann Lewis during the years she was with Wilkinson. Gilbert Gilpin makes derogatory reference to her in a letter of 1804, when she has a severe attack of indigestion at the table and Wilkinson has to take her off temporarily to help her recover.[16] They were dining with the Blakeways at the time. It has to be significant that they dined out together in company, that Wilkinson was comfortable with the arrangement, and that on this occasion they were with family friends who would clearly carry word back to Mary Lee. If the relationship with Ann Lewis began soon after Wilkinson purchased Brymbo in 1792, there is the possibility that his getting Ann Lewis with child did not come easily. It may be of course that it did not begin until later, but their first born, a daughter, arrived on 27 July 1802 when Wilkinson was 74 years old. He called her Mary Ann, Mary for his mother, his dead daughter and his second wife, Ann for his first wife and of course the child's mother. It was three further years before the second child arrived on 6 August 1805. It was also a girl. How he must have longed for a boy to have called her Johnina. And then at last the following year, when he must have begun to despair, on 8 October 1806, when he was 78 years old, a boy, and of course he called him John.[17] It is not known whether Mary Lee, by then an old lady in her eighties who died just two months later and who must have been failing at the time, ever saw this baby boy on whom her husband set such hope. With a son now to inherit, Wilkinson published his will and applied for a Coat of Arms, evidence perhaps of a wish to establish status in the context of his children's future. The Arms were eventually granted to the three children following his death in 1808, after they had assumed by Royal Licence the name of Wilkinson. The will became the subject of contentious and wasting litigation for the next 20 years.

Whether or not Ann Lewis came to live at Castle Head in the 19 months of his life that remained after Mary Lee's death is uncertain. A codicil to the will clearly shows that following her death he wished Ann Lewis to live there as his widow with his children so long as she remained unmarried. Since he spent most of the last year of his life there, the wording of a further codicil seems to confirm that she, too, was there, since he refers to 'the children which he may have by the aforesaid Ann Lewis and living at his decease or born within six months after'.

What begins to emerge, following his death in 1808, is the likelihood that Ann Lewis from the beginning had seized the opportunity to better herself and then used her female guiles to manipulate him for her own ends. She clearly sought respectability after his death and had the children christened into the Church of England as she lived on as the new Mistress of Castle Head. The suspect

long-term relationship with James Adam continued there, as he increasingly used his authority as executor and trustee to his own, and perhaps to her, advantage, incurring huge debts for the Wilkinson Trust; but they never married. James Adam died a King's Debtor in 1823 and the following year, with the estates wasting and her protector gone, Ann Lewis married a certain Thomas Milsom and disappeared from Castle Head, and from the record.

Something failed John Wilkinson towards the end. Throughout his life he had a record as a shrewd judge of character and an astute business man, yet he left a will and a trust deed that allowed ill-chosen executors enormous latitude which they quickly abused. Perhaps it was just a declining body and mind, the onset of Alzheimer's maybe. Or was it that his judgement in a quarrelsome old age became further clouded by a divided life between two women, the one the mistress who gave him, too late, the heir he would dearly have wished to have had from the other, the liberal and beloved wife, Mary Lee?

Notes

1. Cumbria Record Office Kendal [CRO], WD/RIG
2. Patent Office, Patent 675, 24 January1753, Isaac Wilkinson
3. CRO, Kirkby Lonsdale Parish Registers,WPR/19 1754-67
4. See Isaac Wilkinson's Bill of Complaint to Chancery, National Archives C 12 856 13,26 May 1768
5. Shropshire Archives [SA], Littlewood Peace & Lanyon Collection, Part 1, Dawley and Stirchley Box 5 1265/185-204
6. SA, Forester Papers 1224/7/26
7. Unpublished research, Holy Ghost Fathers Archive, Bickley (Kent), Father Taylor and Dr W. H. Chaloner
8. The Journals of Samuel More (in private hands), 18 August 1783
9. CRO, WD/RIG Box 6
10. SA, Market Drayton Church Registers , October 1785
11. Ibid., June 1786
12. Lancashire Record Office Preston [LRO], Stockdale Family Papers, Letters John Wilkinson to James Stockdale post 1783
13. Ibid., Letter John Wilkinson to Mrs Wilkinson 28 March 1788
14. SA 1265/203-4
15. Birmingham City Archives, Matthew Boulton Papers, Letters Anne Watt to James Watt 1785
16. SA, Letters of Gilbert Gilpin 1781/6/28
17. See LRO, Cartmel Church Register of Baptisms for 1808.