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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

In this issue we present two articles on the activities of the Wilkinson brothers - John in the established copper industry of England and Wales, and William in the nascent iron industry of France; and three articles with a local theme - the tar industry of the Ironbridge Gorge and the record of two former residents. The articles represent ongoing researches and reminiscences of the members of our Society and others, and we are grateful to the individual contributors. Our thanks to Steve Dewhirst for designing and typesetting this issue.

Contributions for the next issue of the Journal would be welcome and should be sent by 31 August 2006 to the Editor, Neil Clarke, Cranleigh, Wellington Road, Little Wenlock, TF6 5BH.

John Wilkinson - Copper King?

by Vin. Callcut

This is an edited version of the Annual Wilkinson lecture delivered on 2nd March 2005. The full text is available on http://www.oldcopper.org/john_wilkinson_-_copper_king.htm

Introduction

John Wilkinson developed interests in a very wide variety of money-making projects. Ironmaking was his first priority but his agile mind could see opportunities as they arose or, alternatively, make them for himself. On occasions he realised that he had made more money than he could easily re-invest in that industry with advantage. There was plenty of competition from other ironmasters and their ironworks nationwide. He needed to invest outside the industry. He frequently looked for opportunities where his special technical, financial and political skills were of advantage. The copper industry was an ideal choice amongst others.

It has been possible to obtain useful, and background, information from about 70 publications listed in the Bibliography. A main source has been 'The Copper King', the excellent biography of Thomas Williams by the late Professor Jack Harris of Liverpool. He makes reference to John Wilkinson on 28 different pages and it is obvious that without him Williams might not have been as successful as he undoubtedly was. Janet Butler's thesis contains 40 pages on Wilkinson's copper interests. Some of this is drawn from Harris and is combined with more from her other research work. Much other useful information is found repeated in different articles with varying detail.

When reading into the subject, it quickly became obvious that John Wilkinson was a leading entrepreneur in the copper industry during his day. His influences over all aspects have been underestimated. From mining through refining to production and end usage, he had great financial and personal influence. With his wide spread of successful interests, his nearest modern equivalent in spirit might be Sir Richard Branson. The question soon arose:

Was his status sufficient to earn the him the courtesy title 'Copper King'?

This review is written from the point of view of a 20th century industrial metallurgist with a strong interest in copper and its alloys. Its aims are:

- to appreciate Wilkinson's background, environment, important business colleagues and operations connected with the copper mining and manufacturing industries.

- to summarise the position of the British copper industry at the time being considered.
- to appreciate the standards set by other acknowledged Copper Kings and compare Wilkinson's achievements.

Wilkinson's Copper Background

How much copper did John Wilkinson have in his blood to start with? His first home was at Little Clifton in Cumberland, very near the border between Scotland and England. The exact position of this border has varied with time and there has been a significant movement of people and goods between the two over the centuries. In her survey of his family tree, Butler shows no known Scots amongst his immediate forbears but further back there undoubtedly would have been. At one time the economy of Scotland was partly dependant on copper when the Western Isles were on the main copper trade routes between Ireland and Sweden, so copper might well have appeared in his gene pool. Interestingly, the name 'Wilkinson' is an anglicised version of 'McQuillan', a McDonald Clan surname once proscribed by the English (Rennie p223). This was the name of a metallurgist of repute in Cambridge during the mid 20th century, Prof. A D McQuillan, who, together with his wife, wrote the first standard reference book on Titanium and its alloys. Perhaps the metallurgical line still runs in the blood. Other links that may be postulated in this paper are far less tenuous!

Wilkinson was brought up in the Lake District and during his most formative years was educated in Kendal. This is not far from Keswick where The Company of Mines Royal, set up in 1568, had previously extracted copper to meet the national need for strategic materials (Donald, M B 'Elizabethan Copper'). Wilkinson would have spoken with a Cumbrian accent that would have kept him unaffected by any local interest group prejudices of the time such as may have occurred between local areas of, for example, the Midlands, Cornwall, Shropshire, South Wales or North Wales. This would have given him quite an advantage in his business dealings with groups around the country

In 1738 his father, Isaac, patented his new design for a one piece casting for a box iron 'of one entire piece of any cast metal either iron, brass, copper or bell metal' (Frank Dawson, Ch I p 10). At Bersham there were five furnaces used for casting copper, each of 4 tons capacity, that were used to cast a 20 ton copper table (Paul Luter). Coincidentally perhaps, in 1761 when Isaac Wilkinson's Bersham

works collapsed, he retired to Bristol, centre of the brass industry, where he might be amongst friends.

During his formative years, John Wilkinson would have built up a useful knowledge of the technology of metals. This was essential background for an inquisitive mind also endowed with the lateral thinking ability essential for an innovative entrepreneur.

The exploitation and use of copper pre-dated that of iron in many respects. It is easier to refine due to a somewhat lower melting point. It is also easier to add alloying additions to increase strength and hardness. Much of the technology was transferable to iron making with some upgrading of the methods used. With his excellent grasp of technology, Wilkinson would have been aware of the benefits of technology transfer from copper and brass industries to the production of iron.

During the Chalcolithic age (3,000 to 2,500 BC, the Copper Age, first part of the Bronze Age), blast furnace design was developed for refining copper and lead. This furthered the understanding and development of good high temperature refractory materials for successful lining of the furnaces, especially so for copper that has the higher melting point than lead.

14th C- Wire drawing was developed in Nürnberg (Webster-Smith, p 45). The availability of brass wire was absolutely vital to the wool-based economy of both the Lake District and Shropshire.

It was used to make the multi-teeth wire cards used to tease out wool before spinning. Before brass was made in Britain it had to be smuggled in from Belgium and Germany because of import restrictions and tariffs.



Close up of wire teeth

This close up of a modern file cleaning card shows the basic wire shape that was used for the brass wires of wool cards in late mediaeval times.

16th C - Export sales of bronze cannon started in Elizabethan times and continued thereafter (Prain, p7).

- 1697-** Early rolling mills for copper and brass sheet were installed by the Dockwra Copper Company at Esher in Surrey (Day, p28).
- 1698-** The reverberatory furnace was developed for reliability at temperature in Swansea (Prain, p18). The fuel was not in direct contact with the charge as it is in a blast furnace.
- C1700-** The use of coal, and subsequently coke, instead of charcoal was pioneered in Abraham Darby I's Bristol Brass Company (Thomas, p4 on).
- 1714-** Steam cylinders for Newcomen engines were initially made of brass. That for the Bilston engine was cast at Bromsgrove Brass Foundry (Allen et al).
- 1738-** William Champion patented in England the method of production of zinc using a retort. Quantity production of cheap brass would now be possible. Previously, brass had to be made from copper by dissolving directly the zinc obtained from co-smelting copper granules with zinc ore (calamine) and charcoal. Now the alloy could be made by dissolving zinc metal in molten copper.

Brass has long had a good reputation when precision manufacture and long life is needed as with clocks, chronometers and watches. Brass has long been used to make accurate weights. And, of course, brass means money – it was in Bristol, the centre of the brass industry during the 18th century, that Wilkinson found the six merchants who helped to provide much of the capital for his big New Willey furnace project.

The Late 18th Century Copper Industry

This section summarises the statistics found that cover the relevant period and provides useful background information. Some of the figures may be approximate but they help the assessment of the events mentioned in this paper in the context of the national economy.

Production of the main mine areas

These are some tonnage figures for production in three main mining areas. They emphasise a sharp decline in production in Anglesey

Year	Tons per year		
	Cornwall	Anglesey	Ireland
1787 ⁽¹⁾	4,768	4,000	
1792 ⁽²⁾		1,000	120
1796	5,210		
1797			
1798	5,600	716	
1799		484	

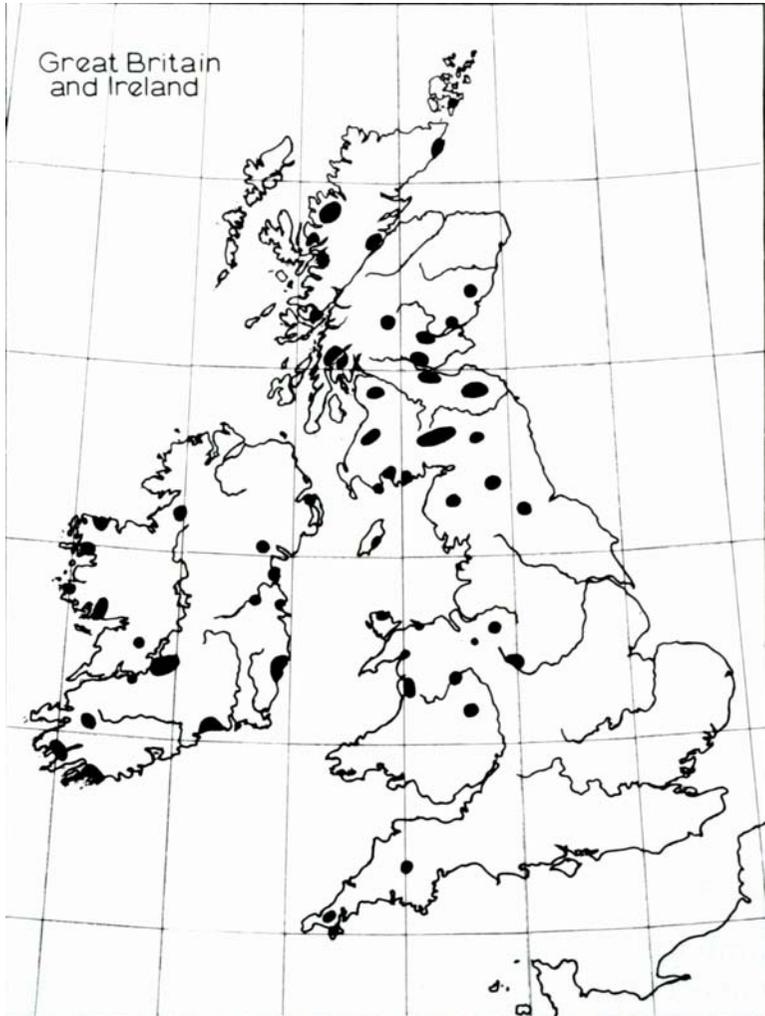
during the 1790s as the easily accessible ores were worked out.

(1) Preston, p36.

(2) Schmitz

Copper deposits in UK and Ireland

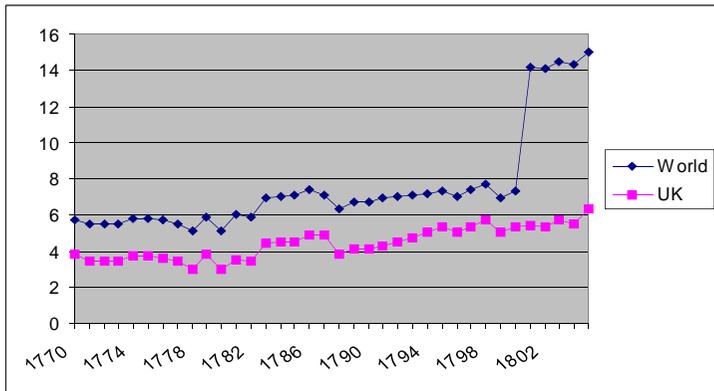
This map is taken from Prof. Tylecote's book on the pre-history of metallurgy in the British Isles. It shows the widespread availability of copper but cannot cover the grades of copper ores in particular areas. During the late 18th century the main mines being worked economically were in Cornwall, Anglesey and Ireland.



Copper deposits in Britain and Ireland (after Tylecote)

Copper Production 1770-1805

For most of this time, Britain was the largest producer of copper in the world. Towards the end of the period other mines came on stream



*Copper Production 1770-1805
Thousands of tons per year (Preston, p36)*

elsewhere in the world, notably in Spain and Chile. Some had high-grade ore that could be extracted cheaply and imported to the Swansea area economically. This was the time for John Wilkinson to reduce his interest in primary copper and become more involved with copper and brass fabrication industries and chemical plants. He did.

Copper Markets in England in 1790

The main areas of consumption were using most of the copper produced in England (Harris, p132).

Total British production around this time was of well over 4,000 tons including that from the main areas mentioned plus copper from Ecton

	Tons
Birmingham	2000
East India Co.	1500
Navy	1000
Coinage	600

in Staffordshire, Llandudno Great Orme mine and a few other small ones, some of which were in Shropshire (Brown, Ivor J). Copper cladding for wooden hulled ships was first applied to protect HMS Alarm in 1761 and then all ships of the Royal

Navy and the East India Company. Exports by the East India Company averaged approximately 1,500 ton/yr from 1787 to 1791 in a total of over 4,000 ton/yr of wrought copper. Naval demand rose from 300 to

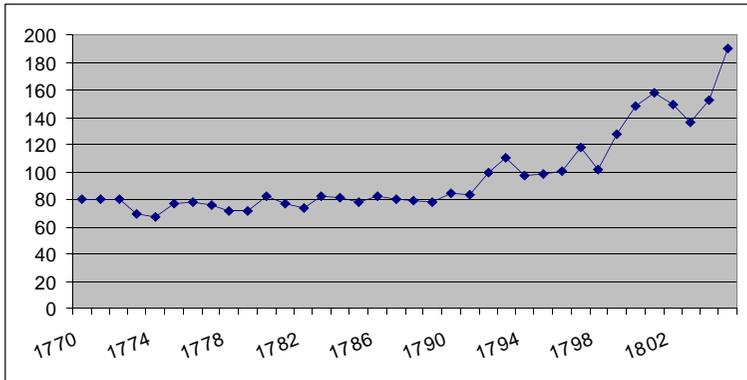
1,000 tons/yr 1780 to 1790. Birmingham demand rose from 1,000 to 2,000 ton/yr 1780 to 1790, not including coinage (600 ton/yr).

Inflation in England

Between 1750 and 1800 inflation was 66%. Between 1771 and 1800 inflation was 41% (Twigger). Then, as now, to retain the value of any capital, it had to be put to work or lose its value.

British Copper Prices 1770-1805

The general price trend is upwards, fuelled by the decline of Parys Mountain and the rise in demand resulting from industrialisation, wartime activities and inflation. Note that the official price is notional and may vary from prices charged as mentioned in several of the events described. Soon after this period, the price fell back to vary around £110 per ton. For copper prices, the word 'standard' refers to the standard price and not the quality of the copper.



*British Copper Prices 1770-1805
(In Pounds per ton (Schmitz))
1771-1779 Cornish Copper Standard
1780-1805 London Market FRTP*

Copper Price variables

When studying the economics of the copper industry, care is needed to check that any prices considered are relevant to the stage of manufacture and the added processing costs involved. There are four main prices, each of which has variations:

- price to miners paid per ton of copper in the ore
- price ex refinery including processing costs. This will also vary depending whether the product is ingot, cake or shot

- price ex warehouse that includes the cost of financing stock and possibly cutting it to size for small orders
- price as semi-fabricated plate, sheet or wire for the manufacture of finished products.

Prices generally state the point of delivery including transport charges. The money actually paid rarely corresponds to the published figures. Sometimes a premium may be demanded for better than standard quality or packaging. More frequently, discounts are negotiated for regular commitments. Payment due dates can vary from spot cash on the day to three or even six months forward and the price may then be adjusted according to prevailing interest rates on the money outstanding.

Some Copper Kings

'Copper Kings' were a very rare occurrence; possibly less than one per generation. They are typified by love of hard work combined with excellent technical abilities and successful business flair. Besides close involvement with the copper industry, they had a wide variety of other interests that demonstrated a broad spread of abilities and an understanding of how events outside the industry might affect the future. They were set above others by popular acclaim based both on their entrepreneurial business record and their successful spread of other public interests. Each had a dominant personality, though not necessarily an aggressive one.

Looking back over the last three centuries, some of the acknowledged 'Copper Kings' are Sir Ronald Prain OBE (1907-91), Sir Alfred Chester Beatty (1875-1968), the Americans William Andrews Clark, Marcus



The pans on Parys Mountain where iron was used to precipitate out copper from a leaching solution.

Daly and F Augustus Heinze (participants in the 'Wars of the Copper Kings', 1876-1905) and Paul Revere (1734-1818), John Vivian (late 18th/early 19th century) and Thomas Williams (1730-1802).

Thomas Williams

The copper mines at Parys Mountain in Anglesey were first worked during the Bronze Age but had been abandoned since Roman times. They were rediscovered in 1761 by Alexander Fraser and were being worked by Charles Roe of the Macclesfield Copper Company. In 1769, Thomas Williams, a solicitor, was retained to act for one of the landowners, the Lewis family, in a dispute over the mining rights. Details are in the books by Harris, Selgin, Hope and others. By the end of the litigation in 1778, Williams, the solicitor, had gained control of the Lewis holdings. He set up the Parys Mine Company with himself in control.

In 1780 he erected rolling mills and works at Greenfield, just east of Holywell in Flintshire, North Wales. A partnership was formed with John Westwood of Birmingham who had patented a good cold-rolling method that would help provide copper and copper nails for sheathing the Navy's wooden ships. Williams set up the Stanley Smelting Company with refineries at St Helens and Swansea. He also set up the Greenfield Company jointly with the Cheadle Company's refinery at Warrington and the brass works at Holywell. John Wilkinson had a one sixteenth share in these enterprises.

In 1784, Thomas Williams patented a method for making copper bolts & sheathing and was soon producing 40,000 bolts per week. By 1785, he also controlled the adjacent Mona Mine that made up the rest of the Parys Mountain deposits, then the world's largest.

During the same year, the Cornish Metal Company was set up by Boulton, Williams, Wilkinson, Vivian and others to sell copper jointly from Cornwall and Anglesey. Only a proportion of his Anglesey output was contracted to the Company. The rest he sold on the market cheaply which seems to have undermined the Company significantly. He was styled 'Copper King' by Matthew Boulton during this period (see Rowlands, p31).

He set up copper refineries in competition with the main Swansea refiners. He also invested in Cornish copper mines. He was a very close friend of John Wilkinson and seems to have relied on co-operation with Wilkinson for many of his financial and technical developments. In 1787 the Greenfield works was significantly enlarged to include Britain's then largest rolling mill. Structural castings were supplied by

John Wilkinson (see Butler). Also in 1787 the first 'Druid' penny and halfpenny tokens were struck for Williams, with Wilkinson not far behind.

Williams became MP for Marlow in Berkshire where he had his mansion and Temple Mills copper works. From 1791 to 1799 he gradually lost control of Cornish ores and suffered depletion of Anglesey ore quality. During its lifetime, the total output of copper metal from the Parys Mines was 130,000 tons (see Manning, W, p314). With hindsight, it is evident that Williams could have restrained production rates and retained his prosperity together with that of the Parys Mines by not selling all the copper that he could at reduced prices.

However, by 1799 he claimed to control a working capital of £800,000 in mines, refineries, fabricators and chemical works. His friend, Wilkinson had one sixteenth of the Stanley Co., which controlled the Middle Bank and Penclawdd smelting works in South Wales and the Stanley refinery in Liverpool.

As with Wilkinson's enterprises, Williams' businesses did poorly after his death. The mines were bought cheaply by John Vivian who successfully introduced Cornish deep mining technology and made the mines profitable again for some years.

Copper King Qualities

More details of the Copper Kings are included in the full article on the web site and in the books in the bibliography. There are strikingly common qualities that become obvious when comparing the abilities of acknowledged Copper Kings. These include:

- advanced technical skills and the ability to transfer them
- excellent financial foresight and acumen
- wide sphere of interests both in and outside the copper industries
- good at promoting themselves and their projects
- successful understanding of human relationships and political skills.

Above all these there is an essential that the individual must have qualifying achievements that are recognised to such an extent that he or she is nominated as 'King' by a recognised authority. The attributes listed will be compared with the achievements of John Wilkinson. He was fortunate to be present at the beginning of the modern copper age and was able to make a significant contribution to its success.

The Modern Copper Age

The circumstances leading to the start of the modern copper age were summed very well by Sir Ronald Prain in his opening paper 'Copper in Transition' to the 'Copper '83' conference of the Metals Society, Amsterdam, 1983:

'With the introduction of steam powered equipment was the beginning of the modern copper age, concluding a period of some thousands of years during which:

- science was all hypothesis and no facts,
- industry was all facts but no understanding and
- time was of no consequence'.

To appreciate the magnitude of the work done to develop industrial production during the late 18th century it is useful to remember what a formative time it was. John Wilkinson and his contemporaries were working at just the right time to develop industry and the country's prosperity at a vital stage during the Industrial Revolution.

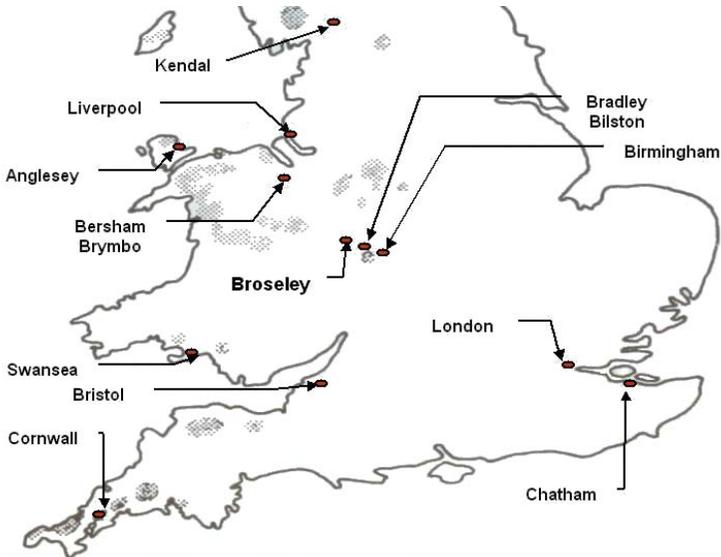
Since John Wilkinson was of vital importance for the manufacture of Boulton and Watt's steam engine, he was in an ideal position to liaise with the users, many of whom owned copper mines. He could see financial opportunities that were too good to miss.

Wilkinson's Interests in Copper

John Wilkinson had many interests in copper and some in brass at a variety of locations throughout the country. This is a brief summary list derived from the works by Butler, Davis and others (further details follow for the main items):

- brassworks at Bersham and Bradley
- sales of iron castings and scrap to copper mines for steam engines, structures and the recovery of copper by cementation (scrap iron plates were added to copper-rich water draining from the mine that had been lead to brick-lined precipitation ponds.; copper precipitated out leaving iron sulphate in solution; the iron was then precipitated out as valuable ochre pigment; residual copper in the water was used to pickle timber before use in shipbuilding; usage of the copper was therefore total leaving no process scrap)
- shares in Cornish copper mines, as listed by Butler, including such as Consolidated Mines, United Mines, Poldice, North Downs, Scorrier, Wheal Bussy, Tresaven and Chasewater
- shares in Mona Copper Mine, Anglesey (see Selgin, Ch2 p9)
- Cornish Metal Company

- copper refining capacity
- Birmingham Copper Co. Warehouse
- Greenfields Mills, Holywell, N Wales
- Stanley Company, St Helens, Lancs.
- wharfs and warehouses at Chester and Rotherhithe, London
- copper metal stock sales
- copper tokens for circulation in lieu of coinage.



Map showing Wilkinson's centres of interest in copper.

Wilkinson's Steam Engines 1775

One of the first Boulton and Watt steam engines made was the one installed by John Wilkinson at the New Willey Ironworks, Broseley, Shropshire. Every effort was made to ensure success in order to impress neighbouring ironmasters. It was custom to outsource the castings for such large machines. Apparently none of the parts was made at Soho; everything was done at Wilkinson's works (see Dickinson and Jenkins, p44). Watt supervised the erection in early 1776 and was well pleased with the excellence of the workmanship. This implies that Wilkinson supplied not only the iron castings but also the copper and brass components including boiler, water and steam fittings. Therefore there must have been a brassfoundry and a coppersmith's workshop at Willey. This would not be surprising since Wilkinson already had brassfounding experience at Bersham and Bradley and the equipment

needed would be relatively simple. A year later, Wilkinson also made the components for the 'inverted' engine used at New Willey to drive the cannon boring lathe.

Both Boulton and Watt favoured copper as the material for the boilers (see Dickinson and Jenkins p236). It was more easily worked and the craft of the coppersmith had achieved a high degree of perfection suiting the demands of brewers and distillers. Copper lasted twice as long as iron in service and then had a good scrap value. When iron was tried as boiler plate, it was found that British material was not good enough. Russian iron was specified instead. Wilkinson may have employed coppersmiths to do his local work although, by 1777, the copper boiler components for the Cornish engines were being made by John Freeman and Son of Bristol. With his experience and his well-known reputation for high quality finish-machined castings, he was the preferred supplier of main components for other engines.

Early in their development of the steam engine business in Cornwall, Boulton and Watt needed more capital than they had available. Wilkinson offered to subscribe but was not accepted. This will have proved a benefit later when relations between the engine makers and the Cornish mine owners became very strained. He retained their good will and confidence since he was not financially tied to Boulton and Watt.

Mine owners who owed Wilkinson for the cost of structural castings might have a choice of payment methods. Some did manage cash, others paid with tons of copper and yet others with shares in their mines. Alternatively, according to Butler, he took payment in block tin. Since the mines' prosperity would, and did, increase when the engines came on stream, he could foresee a good capital growth potential. He had shares in Consolidated Mines, United Mines, Poldice, North Downs, Scorrier, Wheal Bussy, Tresaven and Chasewater. These were generally accepted in lieu of payment for iron castings for machinery.

There was an agreement that required engine owners to pay a royalty to Boulton and Watt, being one third of their coal savings each year. The advantage to the owners was that their engines were paid for out of revenue rather than scarce capital. When the copper prices fell, their profitability suffered and they tried to renegotiate the terms. Wilkinson was then asked to act as an honest broker.

The Cornish Metal Company 1785

Cornish miners and Anglesey mine owners needed to set up a joint marketing company for copper together with interested refiners, users and financiers. This would control the market sensibly and help stop the

refiners from forcing prices down by what was known as the 'ticketing' system by which refiners made low offers on batches of ore at auction. With available finance, technical and commercial expertise and negotiating skills, John Wilkinson was closely involved and a significant force in the successful outcome of the discussions. It is well described by the late Professor Jack Harris of Liverpool in his book 'The Copper King'. He had made an extensive study of papers including the Boulton and Watt Collection in the Birmingham Reference Library and the records of Yorkshire Imperial Metals who had taken over many of the South Wales copper refineries and fabricators involved.

At this time, Anglesey copper could be mined cheaply from high grade ore and the mine owners could afford to sell at a lower price than Cornish miners. Also, while the Anglesey mines had their own small refineries at Amlych, the Cornish could not refine economically in Cornwall by bringing in return loads of Welsh coal from Swansea for the purpose. Besides the miners, many entrepreneurs from the Bristol, Liverpool, London and Birmingham areas were involved because of the need to call for cash to finance stocks of copper while being refined and sold (Harris p60). Until metal is made into a product and sold, no money is realised. Boulton had a strong interest in obtaining copper for his minting operations independently of Thomas Williams' Anglesey supplies (Butler). John Wilkinson was very interested to see the scheme succeed for the benefit of all concerned, including himself, and to stabilise the price of copper at about £80 per ton for the benefit of the Birmingham metal trade. Together with Williams, he was very forceful during the talks and obtained the agreement of the many free-thinking Cornish miners.

In trying to get agreement he was frustrated by the attitudes of some of the prospective participants. He said to Boulton: "For God's sake, endeavour to infuse a patriotic spirit in those that are to be the acting members in our metal company that the intention of so good an institution for the real interest of the copper trade be not defeated. There has been such egregious mismanagement in the conduct of smelting as well as ignorance of it in the mining part that I am inclined to make another effort to save the company." (see Butler).

As a result of these effort, Boulton reported: "Mr Wilkinson hath acted with great spirit and firmness. He and Mr Williams have drove the Cornubians, and Bristol men also, before them like sheep, and kept them in a constant fever until all the foundations of our future plans

were lay'd." (see Harris p 61, quoting a letter from Boulton to Watt dated 22nd July 1785).

When it came to the initial subscription, Wilkinson led the way by putting down £25,000 immediately and setting an example that gave confidence to all the others. It was a stock issue guaranteed to pay 8% and part of the capital subscribed was used in a sinking fund to ensure that the interest would be paid, irrespective of the success of the scheme. Wilkinson offered to smelt one eighth of the copper as part of the bargain, at a charge of 45/- per ton. This was presumably carried out either in one of his own furnaces or one owned by Williams.

An agreement was later signed by the Cornish Metal Company with five smelting companies including John Freeman and Company of Cornwall, Bristol and South Wales. Each agreement was aimed at covering all eventualities and had a large number of supplementary clauses to ensure that all were satisfied that they had a fair deal. Cornwall was to provide 3/5^{ths} of the copper, Anglesey 2/5^{ths} at a price fixed by the Cartel. At £80, the Cornish could make a living while the Anglesey mines made a useful profit, albeit on a smaller tonnage. John Vivian was made General Manager of the Company and was responsible for sales negotiations.

The controlled price obtained by the cartel gave the Cornish miners a better deal than they had previously enjoyed. Seven eighths of their output had a guaranteed price. Success was dependant on a steady copper price that was not to be undercut by the Anglesey mine owners. A separate agreement was made with the Anglesey mine owners who did even better because their production costs were lower. The main shareholders in Anglesey, besides Williams, were Lord Uxbridge (Marquis of Anglesey), Hughes and Dawes. Wilkinson soon joined them as a shareholder in companies connected with the Anglesey industries.

The Company agreed that warehouses should be established to sell the copper where needed in Birmingham, London, Bristol and Liverpool. Wilkinson and Watt could especially assure users in Birmingham that they would have continuity of supplies at an economic price.

In 1786 Boulton chaired a meeting of the Cornish Metal Company with Vivian, Williams, Wilkinson, Thomas Harrison (for Lord Uxbridge). Wilkinson objected to Vivian's secrecy with the minutes. Copper prices were fixed at £86 for cake and £88 for shot, this being £4 above 1785 Birmingham average. Anglesey sold well at that price but it gave the Cornish a very poor return.

Williams, Wilkinson, Boulton and Vivian met in London during 1788 to re-arrange the Cornish Metal Company stocks and back up Boulton's representations to the Privy Council to secure a national coinage contract (see: Harris p88). The monopoly policy was then to keep the price of fabricated copper high while keeping ore prices low so as to maximise profits for the Metal Company members.

The Company was less successful than expected for a variety of reasons but that is not to say that it was Wilkinson who lost out. Separate selling arrangements applied at various times to Cornish and Anglesey copper. Anglesey copper could be produced and sold more cheaply than Cornish at that time and independent sales undercut the Cornish miners, bringing the price down significantly. The Company was not as successful as hoped in establishing market control. Dissent was caused in Cornwall and some blame was attached to Vivian, though whether he deserved it is not clear. However, Wilkinson had sold his iron castings successfully in both Cornwall and Anglesey, had taken shares in mines in Cornwall, mines and manufactures connected with Anglesey, and also warehouses dealing in copper. He was brokering copper refining capacity and copper stocks. In addition, he could draw his 8% interest on the Company capital.

By 1787, the Company was in crisis. While the Company price was £80, Williams was selling his surplus at £76 in England or £74 to the East India Company. There was a private discussion with Boulton and Vivian at 'The Lawns' in Broseley before they went to see Williams.

Vivian and Boulton went to London during the same year to lobby Pitt about introducing copper for coinage and called for Wilkinson to join them. This attempt to increase the market for copper was not immediately successful.

In October 1787 the copper price had dropped as low as £48/ton and the company was financially embarrassed. Watt reminded everybody that the Agreement required that the 8% interest payable was based on a fixed price of £78/ton. This represented a £9/ton cost to the miners that was insupportable at a selling price of £48/ton. Wilkinson was able to advance £15,000 to the Company advantageously against the security of cash copper at £50/ton whereas the prevailing standard for Cornwall was then £67. Cornish production rose from 1798 onwards, making up for the gradual decline in output of Anglesey as their ore became depleted.

In 1790, the price for Cornwall was set at £74/ton with a complex agreement originated by Wilkinson for Williams. The result was that

Thomas Williams gained a five year monopoly of selling Cornish Copper. As part of the deal, Wilkinson had gained a seat on the board of each of many of the Anglesey subsidiaries. In 1791, Williams raised price further to c£86/ton but then refused to sell in Birmingham due to shortage of copper to meet all markets. In 1792 the Monopoly arrangement finally collapsed.

Summarising Hamilton's description of the events, there are several reasons for the short life of the Company.

- The stocks on hand in Cornwall and bought by the Company at the high fixed price during the inception were greater by far than expected, rapidly tying up the capital invested.
- Only 7/8ths of Cornish copper production was covered and rather less than that of that from Anglesey.
- Higher prices stimulated production in both Cornwall and Anglesey.
- Other copper was sold at lower prices.
- The sales effort on behalf of the Company did not match that of others selling copper.
- The agreement only involved five of the many South Wales smelters.
- Some of the Company Directors had split loyalties.

When the company was wound up, the shareholders regained their money, according to Barton. The other arrangements that John Wilkinson had bolted on to the Company structure had probably rewarded his foresight quite usefully.

Shares in Copper Mines

Wilkinson built up a portfolio of shares in Cornish copper mines such as Consolidated Mines, United Mines, Poldice, North Downs, Scorrier, Wheal Bussy, Tresaven and Chasewater, according to Butler. When these were bought and sold is not clear but the success of some of the mines is included by Symons in his review of Vivian's evidence in 1799 to the Parliamentary Committee inquiring into the copper mines, as given in British Parliamentary Papers. It is noted that many of the adventurers who invested were also equipment suppliers and content to take their profits on what they supplied. He also mentions the common saying of the time that 'It is much easier to throw tin into a mine than get it out!'

However, in a survey of the profits and losses made by a sample of sixteen of the many Cornish mines in the period 1792 –1798, Symons covers four of the eight mines in which Wilkinson had shares at some time. Consolidated Mines and United Mines both made a reasonable

profit. North Downs and Tresaven ended up slightly in the red. This would be regarded as satisfactory.

According to Butler, Wilkinson sold most of his copper shares sometime during the period of 1790-1805, going liquid in order to invest in more land around his 'retirement home' in Castlehead and district.

Birmingham Warehouse Company 1788

In 1788, Wilkinson joined the venture to set up the Birmingham Warehouse Company with the laudable intention of providing the Birmingham industry with steady supplies copper at reasonable prices. The others involved were Matthew Boulton, James Watt and John Hurd. Butler mentions that a subsidiary motive was to help Williams through a cash flow problem to the extent of £10,000. The arrangement with Williams was that they could take delivery at advantageous Liverpool or Swansea prices, unlike other warehouses who paid extra for transportation costs. In the early stages, Williams advised them to buy all they could in advance of a price rise to £84/ton. By October 1790, John Wilkinson and Matthew Boulton were opting out of the enterprise for various reasons to do with the supply of copper, its price variations and lack of return on their capital. Copper reserves in Anglesey were getting low and therefore the cost of extraction became higher than that of Cornish ore so their advantage was becoming lost. In the 1790s Wilkinson continued to invest elsewhere in copper as the prices rose.

Copper in Cast Iron

There are many known benefits to be gained by adding copper to cast iron such as increased strength, toughness and corrosion resistance. (These are described in three publications, see: LeMay, Pearce and Copper Development Association Book No 29.) In conventional grey irons, it improves graphitisation and refines the structure. To be successful, the additions of other elements such as silicon and manganese are controlled. When this technique was started is not known but there is an early illustration of the use of additions of Boulton's 1797 'Cartwheel' pennies to melts to achieve good results. They were a known standard weight of pure copper, easily dissolved and obtained at an economic cost.

According to Randall, John Wilkinson obtained a patent on 23rd January 1801 claiming to make pig iron equal in quality to any from Russia or Sweden by the addition of manganese. Since copper additions balance the chilling effect of manganese (CDA No 29 p39), he may well have



Adding 'Cartwheel' copper pennies to molten cast iron before pouring. (from CDA Publication No 29)

used the tokens as his 'secret ingredient'. Perhaps an analysis of his cast iron coffin would provide a useful indication.

Wilkinson's Copper Tokens 1787-93

Since the Government was not issuing small denomination coins, there was a dire shortage of money to meet demand for wages as spending money for workers who were earning only a very few shillings per week. At this time, according to Selgin, Wilkinson employed over a thousand workers. Silver coins of small value were impracticably minute. Wilkinson had encouraged his friend Thomas Williams to issue his Anglesey tokens for the same practical reason as well as the fact that Williams needed another tonnage market for his copper. Wilkinson started ordering tokens for himself very shortly afterwards.

In 1781, Francis and Samuel Garbett, friends of Boulton, had undertaken an officially commissioned report on shortage of coinage. Boulton had to wait more than ten years for the contract so turned to other orders such as the Parys Mines token ('Druids' – after the effigy on the obverse) and Wilkinson tokens ('Willeys' – because of where they were redeemable).

The tokens all bore the effigy of Wilkinson on the obverse. One design shows his hair tied back and showing two buttons of his coat. Some later

tokens showed him with extra sets of curls to his wig and with three buttons displayed.

The reverse of each token celebrated one or more of his achievements. Some are:

- the interior of a hammer shop with forgemaster using tongs to support work being struck.
- a nude figure of Vulcan seated on a low anvil with hammer raised to strike metal on a higher anvil. In the background is part of a sailing vessel.
- a two masted sailing ship, possibly a Swansea Copper Boat.

Most genuine tokens have been edge rolled with the inscription that covers the places where the tokens could be redeemed: 'WILLEY SNEDSHILL BERSHAM BRADLEY'.

The Wilkinson obverse was used with many other reverses by different mints to make a wide variety of forgeries or 'mules'. ('Mules' are tokens struck from dies where the obverse and reverse were not originally intended to match.) Sometimes the obverse was wrongly struck with spellings in the dies such as 'Wilkenson' and 'Wilkison'. The standard classification of tokens of this age is by Dalton and Hamer and there are well over a hundred 'D&H' numbers covering Wilkinson token varieties, forgeries and mules.

From the start the classification of the tokens was confused, being allocated to Warwickshire. Since then there have been many articles written covering the topic and it is difficult to know what to believe! They remain some of the best known and collected examples of tokens and continue to ensure that the branding of himself that John Wilkinson initiated will never be lost.

Token Profits

It is not easy to show how much profit Wilkinson made on issuing his tokens. To do so it would be necessary to know:

- cost of production
- cost of distribution
- profit on sales
- less redemption costs
- promotional value.

The promotional value came from the fact that Wilkinson's image was on every token, an intentional, useful spin-off. The tokens were universally appreciated at a time when small value coins were in short

supply. The number of contemporary forgeries made might have increased his redemption costs.

Janet Butler quotes his specification as 36 tokens per pound weight. This seems to have applied only from 1790. All of the issues, from 1787 through to 1795, featured Wilkinson's portrait facing right. Boulton was able to supply the tokens to better reproducibility by striking between dies fitted with a collar that retained the diameter accurately. They were edge rolled with the legend: 'WILLEY SNEDSHILL BERSHAM BRADLEY'. According to Selgin, steam driven presses were used for standard tokens from 1789 and die collars could be used in steam presses from the Autumn of 1790. Many tons were ordered, initially from Boulton and later from Westwood.

The 1790 Vulcan token was struck at 15cwt/week from Westwood to a total of 206,000 tokens. Seeing products from the opposition, Boulton commented to Wilkinson that he should have all tokens struck in collars. However, on December 11th 1790, Wilkinson complained to Boulton that the halfpence were four in the pound less in number than those which Westwood used to make for him (Turner, Wayne). In 1791 he was ordering tokens by the ton from both Westwood and Boulton. The 1792 Vulcan issue numbered 103,000 tokens. Hancock struck the tokens that have Vulcan in reverse (Dell, John, <http://victoria.tc.ca/Recreation/VNS/articles/wilkinson/wilktoken.htm>). If the Westwood tokens were struck without the use of collars it might mean that some tokens without the edge legend 'WILLEY SNEDSHILL BERSHAM BRADLEY' are genuine rather than fakes.

One calculation by Wayne Turner has been around for some time:

- tokens at 32 to the pound weight,
- value 2/8d against a ...
- Mint contract for striking at 1/11d per pound,
- profit 9d /lb,
- return on capital approx. 40%.

(Two shillings and eight pence of pre-decimal money, just over half a crown (2/6d) is now equivalent to 13p.)

It is not clear where the costings came from but it is very unlikely that anyone, even John Wilkinson, could have got away with making a profit of 40% selling tokens!

There were initial plans to issue tokens to the value of one penny but none was officially issued. Certainly the initial specification was for 32

tokens to the pound but the value would have been 1/4d which would have shown a loss of 5d per pound, equally unlikely.

To assess the value of the copper in the tokens a small sample have been weighed to check conformance to original specification. While ‘mint’ ones are not available, an effort was made to ensure that the sample tokens were not unduly worn. There was a check that sufficient detail still remained in the effigy. If it was not possible to count the number of buttons on Wilkinson’s coat, the token was too worn and the weight was not included. The numbers in the boxes are the sample sizes.

Token Weights

The upper section of this table shows the average weight of tokens measured for each year. The numbers are the sample size for each value and the numbers in the boxes show the sample size. Clearly the specified weight of each token diminishes with time. Measurements on

	1787	1788	1789	1790	1791	1792	1793	1794	1795	1796	1797
Wt	Token Weights - Grams per Half Penny										
g											
14.0	32/lb	3	5								
13.6											6
13.2											
12.8											
12.4											
12.0	37.5/lb			7							
11.6											
11.2					2	3					
10.8											
10.4							6				
10.0											
.	1787	1788	1789	1790	1791	1792	1793	1794	1795	1796	1797
d/lb	Rolled Copper Price - Pence per Pound Weight (Hamilton p 366)										
14.00											
13.50											
13.00											
12.50											
12.00											
11.50											
11.00											
10.50											
10.00											
.	1787	1788	1789	1790	1791	1792	1793	1794	1795	1796	1797

Typical token weights (g) for each year of production and copper prices (d/lb).

other makes of tokens such as 'Druids' from Anglesey and Shrewsbury tokens show the same trend downwards in weight with others.

This lower part of the chart shows the price of rolled copper for each year. It would be expected that the weight of copper per token would decrease as the cost of the copper stock rose. Obviously the token weights were being reduced well ahead of copper price rises in the interests of greater margins on sale of the tokens. For comparison, the '☼' block given for 1797 represents half of the weight of the 'Cartwheel' penny produced by Boulton when he eventually obtained the Government contract. This was based on an agreed fair weight of copper per coin – one ounce for one penny, two ounces for the tuppence. Boulton was happy with that price despite the much higher cost of the copper so the tokens issued during the 1790-1794 period must have netted quite a profit for either the mint or the customer or both.

Token Epigram

A supportive epigram on John Wilkinson's copper money was published in 'London Magazine' in 1787. (See Bell, quoted by Uglow and most other main articles on the tokens.)

*So, Wilkinson, from this example,
Gives of himself a matchless sample!
And bids the Iron monarch pass
Like his own metal wrapt in brass!
Which shows his modesty and sense,
And how, and where he made his pence!
As iron when 'tis brought in taction,
Collects the copper by attraction.
So, thus, in him, twas very proper
To stamp his brazen face on Copper.*

This commented on the fact that normally only the monarch's effigy was to be seen on coinage or tokens. Thomas Williams had used a symbolic druid. Perhaps it did imply that, besides being an iron master, he was also a Copper King.

Conclusions

This brief survey of available literature has shown that John Wilkinson took a leading part in the commercial development of the copper industry at a time when Britain was the world's largest producer. Some details remain to be clarified. However:

- he was cash rich as a result of his successful ironmaking activities and provided finance for the industry where good opportunities offered;
- he played a crucial role in the establishment of the Cornish Copper Company for the benefit of all. At the same time he did secure his own interests;
- he established an excellent reputation with the Cornish mine owners so that they called on him to adjudicate in several cases of dispute with refiners and financiers;
- he provided finance for mines, provided a refining service, set up a copper warehouse and traded in the metal for the benefit of Birmingham industry;
- he provided hardware for the copper mines, refineries and fabricators that was fit for purpose.
- copper and brass castings were made at his works as well as iron;
- he helped promote the use of copper for coinage at a time when there was government opposition; whilst doing so, he used his own effigy on the obverse that, for coinage, was traditionally reserved for monarchy;
- when needed, he came forward to mediate in commercial disputes and to represent the industry in dealings with parliament; and
- apart from the use of his profile on the obverse of tokens, he chose not to promote strongly his own activities with the copper industry.

Most of his ventures were made jointly with others or perhaps it is his joint ventures that have left us with the most comments from those involved. He could make use of the strengths of his colleagues. There are instances where he ensured that, while participating fully in such ventures, he nevertheless made arrangements that looked after his particular interests. These insulated him from possible poor performance of other members of the groups.

However, it seems that Wilkinson's financial records are not available. We can only speculate on the success of his efforts in the copper industry. From the extent of his involvement over a considerable part of his lifetime we can assume that he was satisfied that most of his efforts were worthwhile.

During his lifetime he was recognised only as an ironmaster while Thomas Williams was accorded the accolade of 'Copper King' by Matthew Boulton. Wilkinson was a shrewd commercial operator in his own right in many sectors of the copper industry. He also provided very

significant support for Williams and others. He certainly deserves to be thought of amongst the Kings of the Copper Industry.

Hopefully this paper fulfils its purpose of highlighting a section of Wilkinson's many interests that has been hitherto neglected. With contributions from experts, perhaps it can be updated for the Wilkinson Bicentenary conference in 2008.

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Bibliography

- Agricola, Georgius 'De Re Metallica', Trans by Hoover, H. C. & L. H., Dover Publications Ltd., New York. 1950, 638pp. ISBN 0 486 60006 8.
- Aitcheson, Leslie, 'A History of Metals', Vols. I & II, Interscience Publishers Inc, 1960, 647pp.
- Allen, J S and Elton, Julia M H 'Edward Short and the 1714 Newcomen Engine at Bilston, Staffs', Trans Newcomen Soc. 74, (2004), 281-291
- Atkinson, R. L. 'Copper and Copper Mining', Shire Album No 201, 1987, 32pp. ISBN 0 85263 895 7.
- Alexander, W. O. 'A Brief Review of the Development of the Copper, Zinc and Brass Industries in Great Britain from AD 1500 to 1900.', Murex Review Vol. 1 No 15 1955, pp 389-427.
- Allen, J S and Elton, Julia M H 'Edward Short and the 1714 Newcomen Engine at Bilston, Staffs', Trans Newcomen Soc. 74, (2004), 281-291
- Barton, D. B. 'Copper Mining in Cornwall and Devon', D. Bradford Barton Ltd, Truro. – 1978, 102pp.
- Barton, R. M., 'Life in Cornwall (Early 19th Century)', D. Bradford Ltd, Truro. – 1970
- Bell, R. G. 'Commercial Coins 1787-1804', Newcastle 1963, 145pp.
- Best, R. D., 'Brass Chandelier', A Biography of R. H. Best, George Allen & Unwin, 1940, 249pp.
- Bingeman, J. M., Bethell, J. P., Goodwin, P. & Mack, A. T., 'Copper and other Sheathing in the Royal Navy', Int. J. Naut. Arch. (2000) 29.2, pp218-229.
- Bradley, Kenneth 'Copper Venture' – Copper Mining Development in Northern Rhodesia, 1902-1931'. Mufulira and Roan Antelope Copper Mines Ltd., 1952, 112pp.
- British Parliamentary Papers 'The Copper Mines and Copper Industry of the United Kingdom', House of Commons Reports X, 5th April 1799, 651-728, (quoted by Symons).
- Brown, Ivor J. 'West Shropshire Mining Fields', Tempus Publishing Ltd. 2001, 128pp ISBN 0 7524 2363 0
- Buchanan, Angus and Cossons, Neil, 'Industrial Archaeology of the Bristol Region', David & Charles, Newton Abbot, 1969, 335pp. ISBN 7153 4394 7.
- Bulpin, T. V., 'Trail of the Copper King', Howard B Timmins, Cape Town, 1959 239pp.
- Burgess, F. W., 'Chats on Old Copper and Brass', T Fisher Unwin, London, 1914, 400pp.

- Butler, Janet, 'John Wilkinson', draft PhD thesis, Coalbrookdale Library.
- Cannadine, D., 'Engineering History, or the History of Engineering? Re-Writing the Technological Past', *Trans Newcomen Soc.* 74, (2) 2004, pp163-180.)
- Copper Development Association, 'Copper in Cast Steel and Iron', Copper Development Association (UK) Publication No 29, 1937, 132pp.
- Cordero, H. G. and Tarring, L. H., 'Babylon to Birmingham' Quin Press, London, 1960, 498pp.
- Dalton, R & Hamer, S. H., *The Provincial Token Coinage of the 18th Century*, (No publisher or place), 1910, reprinted 1967. 567pp.
- Davies, Ron, 'John Wilkinson – Ironmaster Extraordinary', 2nd Ed., Broseley Local History Society, 26pp. ISBN 0 9504999 5 1.
- Day, Joan, 'Bristol Brass: The History of the Industry', David and Charles, 1973, 240pp ISBN 0 7153 6065 5.
- British Parliamentary Papers: House of Commons Committee Reports X, 5 April 1799, 651-728, quoted by Symons.
- Dickinson, H. W. 'Matthew Boulton', TEE Publishing 1936, reprinted 1999, 218pp. ISBN 85761 112 8.
- Dickinson, H. W. and Jenkins, R., 'James Watt and the Steam Engine', First Edition 1927, Second edition 1981, reprinted Encore Editions 1989, 415pp. ISBN 0-903485-92-3
- Donald, M. B., 'Elizabethan Copper' – *The History of the Copper of the Mines Royal, 1568-1606*. Pergamon Press, London, 1955, 405pp.
- Donald, M. B., 'Elizabethan Monopolies – *The History of the Company of Mineral and Battery Works, 1568-1604*'. Oliver and Boyd, London, 1961, 256pp.
- Glasscock, C. B. 'The War of the Copper Kings'. Blue Ribbon Books, New York, 1935, 314pp.
- Hamilton, Henry, 'The English Brass and Copper industries to 1800', Frank Cass & Co., London, First Edn 1926, Second Edition 1967, 388pp.
- Harris J. R., 'The Copper King', A Biography of Thomas Williams of Llanidan, Liverpool University and University of Toronto Press, 1964, 194pp.
- Herfindal, Orris C. 'Copper Costs and Prices: 1870-1975', Johns Hopkins Press, Baltimore. 1959, 260pp, Library of Congress Cat Card 59-15390.
- Hiley, Edgar N., 'Brass Saga', Earnest Benn Ltd. London, 1957, 164pp.
- Hope, B. D., 'A Curious Place: The Industrial History of Amlwch (1550-1950)', (Wrexham, 1994).
- LeMay, Iain and Schetky, L. McDonald, 'Copper in Iron and Steel', John Wiley & Son, 1982, 423pp. ISBN 0-471-05913-7.
- Luter, Paul, notes taken from Aris Birmingham Gazette, private communication.
- McNelis, Sarah, 'Copper King at War: The Biography of F. Augustus Heinze', University of Montana Press, 1968, 230pp.
- McQuillan, A. D. & McQuillan M. K., 'Titanium', Institute of Metals, 1956.
- Manning, W 'The Parys and Mona Mines in Anglesey', *The Future of Non-Ferrous Mining in Great Britain and Ireland (1959)*., quoted by C J Williams.
- Marcusson, Isaac F., 'Anaconda' Dodd, Mead & Co., New York, 1957, 370pp, 57-9380
- Marcusson, Isaac F., 'Copper Heritage' *The Story of Revere Copper and Brass Inc.*, Dodd, Mead & Co., New York, 1955 253pp.
- Nash, W. G., 'The Rio Tinto Mine – its History and Romance', Simkin Marshall, London, 1904, 235pp.
- National Library of Wales 'The Vivian Archive, E66' (quoted by Symons).
- Pearce, J. G. and Bromage, K. 'Copper in Cast Iron', Copper Development Association, 1964, 127pp.
- Percy, John, 'Metallurgy' John Murray, London, 1861, 633pp.
- Place, Marion T. 'The Copper Kings of Montana', Landmark Books, New York, 1961, 184pp. Library of Congress No 61-7779.

- Prain, Sir Ronald, 'Copper in Transition' Opening address to the Metals Society Conference 'Copper '83', Amsterdam, 1983.
- Prain, Sir Ronald, 'Copper, The Anatomy of an Industry', Mining Journal Books, London, 1975, 298pp. ISBN 0 900117 07 9.
- Preston, G. W., 'Copper Through the Ages', Copper Development Association, 1934, 68pp.
- Randall, John, 'Broseley and its Surroundings', Salopian and West Midland Journal, 1879, 328pp. (available in CD-ROM format from Broseley Local History Society).
- Randall, John, 'History of Madeley', 1880, reprinted by Salop County Library, 1975 387pp. ISBN 0 903802 02 3
- Rees, Ronald, 'King Copper: South Wales and the Copper Trade 1584-1895'. University of Wales Press, 2000, 179pp.
- Rennie, J. A., 'The Scottish People, their Clans, Families and Origins'. Hutchinson, 1960, 351pp.
- Rowlands J., 'Copper Mountain', Anglesey Antiquarian Society, 1966, 203pp., reprinted Llangefni, 1981.
- Schmitz, C. J., 'World Non-Ferrous Metal Production and Prices 1700-1976'. Frank Cass 1979 425pp. ISBN 07146 3109 4.
- Selgin, Prof. George, 'Good Money: How some Birmingham Button Makers beat Gresham's Law, created the first successful Cash for the Masses, and kept the Industrial Revolution from Conking out.' Unpublished book, 2005. Dept. of Economics, University of Georgia, USA.
- Shoebottom, H Minar 'Anaconda: Life of Marcus Daly, the Copper King', Stackpole Co., Pennsylvania 1956 220pp.
- Stevens, H. J., 'The Copper Handbook' Vol. V., Horace J Stevens, Michigan, 1904, 882pp.
- Symons, John, 'The Copper Mines of Cornwall: Property and Profit', CHN Conference 2002, Worcester, summarising the report of the Parliamentary Committee on the Copper Industry, 1799.
- Thomas, Emyr, 'Coalbrookdale and The Darbys', Sessions Book Trust and Ironbridge Gorge Museum Trust, 1999, 228pp., ISBN 1 85072 217 X.
- Timmins, Samuel, 'Birmingham and the Midland Hardware District', Frank Cass & Co., 1866, reprinted 1967, 721pp.
- Toomey, Robert R., 'Vivian and Sons, 1809-1924', Garland 1985.
- Trinder, Barrie, 'The Industrial Revolution in Shropshire', Phillimore & Co., 1973, 1981, 308pp. ISBN 0 85033 428 4
- Turner, Wayne, 'John Wilkinson's Trade Tokens', J Wilk Soc 1974, 2, 10-12.
- Twigger, R., 'Inflation: The value of the Pound 1750-1998', Research Paper 99/20, House of Commons, 23rd Feb 1999 (quoted by Symons)
- Tylecote, R. F. 'The Prehistory of Metallurgy in The British Isles', The Institute of Metals, London, 1986, 257pp ISBN 0 904357 72 4.
- Uglov, Jenny, 'The Lunar Men, The Friends who made the Future', Faber and Faber, London, 2002, 588pp. ISBN 0-571-21610-2
- Webster Smith, B. 'Sixty Centuries of Copper', Hutchinson & Co., London for Copper Development Association, 1965, 96pp
- Williams, C. J. 'Great Orme Mines', British Mining No 52, Northern Mines Research Group, May 1995, 57pp. ISBN 0 901450 43 X.
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On the beginnings of the Industrial Revolution in France at Le Creusot

by Leon Griveau

A number of articles and letters relating to the activities of the Wilkinson brothers in France have been published in the Journal over the last eight years. This article was originally published in the 'Revue d'Histoire Economique et Sociale', vol.XLIX, 1971; it is based on three previously unpublished letters, one from Ignace Francois de Wendel and two from William Wilkinson, to a M. Martin, innkeeper at Couches in Burgundy. The author's detailed notes on these letters are omitted in this edited version. The English translation is by David Lake, assisted by Frank Dawson and Penelope Hinsinger. – Ed.

Wendel and Wilkinson: from collaboration to rivalry

Wendel and Wilkinson: these two are found in all the works of economic history where the writers are interested in studying the rich period of the C18th when the great metallurgical industry began and when the first establishment of modern capitalism, Le Creusot,¹ was founded.

William Wilkinson² was the younger brother and associate of the famous metallurgist John Wilkinson (1728-1808) “The Iron King of England,” the precursor of new foundry technology. From the middle of the C18th he understood the considerable innovation of smelting iron in a blast furnace fuelled by “de-sulphured” coal or “coak”, that is to say coke made from coal.³

Ignace Francois de Wendel (1741-1795), officer in the royal artillery, was also the master of forges, son and grandson of foundrymen established since 1704 in Lorraine. It was in a works of his father, at Hayange, that in 1769 Gabriel Jars, royal engineer, had succeeded for the first time in his endeavours to replace wood by coal as the fuel for a blast furnace.

Getting to make iron like the English was then a major pre-occupation in France, not only for the operators of forges and foundries, concerned about the scarcity and the increasing cost of wood, but also for the Ministers of the king, whose armies and above all the navy had increasing need for iron for cannon and shot. On this account numerous official missions of engineers abroad, mainly to England, many research projects, tests and practical trials by physicists and chemists, were commissioned by the state. During the same age of engineering, on the other hand, the construction of “Fire engines”, that is to say

steam engines, was going to free the blowing machines necessary for combustion in the furnaces, from their dependence on flowing water, and on the other hand the work of Lavoisier in France and Priestley in England revolutionised the theory of combustion of substances.

The new techniques could meet the needs of the iron industry on the condition of being applied in large undertakings of a then novel type, very different from the charcoal forges scattered all around. And that was only possible with the bringing in of considerable capital and with the goodwill and in truth the support of the royal powers. Also scientists, engineers, land-owners, mine owners, industrialists, businessmen, investors, top civil servants, ministers...came together in the multiplication of companies, of Societies, of the "great matters" of the age.

The letters that we are publishing give a significant sample of these contacts at Le Creusot. For it is precisely through and for Le Creusot, an industrial and financial business, that Wendel and W. Wilkinson came to meet and to work together.

In 1775 the Navy Minister, concerned to obtain enough iron cannon for the ships, had decided to modernise the foundry which produced such work at Indret, near Nantes. Failing to obtain the personal collaboration of the greatest of English ironmasters, he secured by contract that of his brother and associate. In 1776 William Wilkinson was accordingly at Indret. But in 1779 faced with results judged insufficient, an agent is sent there to inspect and report, I.F. de Wendel of Hayange. He soon inclined to the conclusion from his mission that to supply the establishment with first class material it was necessary to construct blast furnaces where one smelted the mineral by means of coke.

In 1781 he obtained by tender the operation of Indret for himself and the collaboration of William Wilkinson was guaranteed to him by a new agreement. Their joint search for a favourable location for the enterprise resulted in the choice of Montcenis, a small town in the bailiwick of Auton-in-Burgundy. There were there in fact several forges, two blast furnaces, iron mines and essential conditions for the intended project, and a working coal mine at the Le Creusot Coalfield..

This place had already seen off a number of developers since from 1775 three companies under different names had followed each other in trying to work iron there. Where his predecessors had not been able to achieve this, Wendel, engineer and artilleryman, forge master and businessman, enjoying good connections with the Court and with Bankers, was going to succeed.⁴

He had obtained for three years the services of Wilkinson to draw up plans and estimates for furnaces and forges driven by steam engines and fired by coal, to supply and install the equipment and to train the workers. The construction of this establishment in 1782 seemed well under way, since a commemorative plaque announced, in the name of the King, Louis XVI, of the Navy Minister de la Croix-Castries, of I.F. de Wendel of Hayange King's commissioner, and of Touffaire engineer, that this Foundry, the first of its kind in France, has been constructed to smelt iron ore with coke, following the method brought from England and put into practice by M. William Wilkinson.

Nonetheless, it was necessary to wait until the end of 1785 for it to be possible to make the first pouring of cast-iron with the new fuel. But the *Journal de la mise a feu* which describes in detail the various operations and marks a memorable date in the history of metallurgy in France carries with some others the signature of de Wendel without mentioning Wilkinson. Moreover, during the three years of his involvement with Wendel the Englishman only resided periodically at Montcenis, in all nine or ten months, and it is thought, without knowing the exact time, that it was actually nearer 1783 than 1785 that he ceased working there.⁵

It is thus rather strange that his compatriot, Arthur Young, passing through Montcenis the 3rd August 1789, could still write: It is there where is the works of one M. Wilkinson.⁶ Let us note also that in the years after his leaving he continued to interest himself in the progress of the Foundry, but this is not surprising; the eventual competition from a modern works in France could only trouble the Wilkinsons. What seems paradoxical is that an expert in iron had been "loaned" by a British firm even when it would be the first to be threatened by the success of continental competition.⁷ From collaborators, Wendel and Wilkinson had become rivals. Competition was keen between makers of iron on the continent and those of the islands at a time when an important innovation was, one could say, running in. The tentative steps, the successes, even the setbacks of some could be richly instructive for the others. Wendel, before Indret, had travelled in Europe at the King's expense like Gabriel Jars before him. When Wilkinson writes from Paris (Letter 3) he is finishing a long tour through Germany, Poland and Scandinavia, a journey of study and discovery through the great places of metallurgy. Technical success could be the result of some chance improvement, of a discovery, here or there, of a new process, seen in a moment.

One sees with what insistence Wilkinson asks his correspondent to tell him all the innovations, to write him a long letter about everything concerning the establishment. He asks questions about the processes of the Foundry and refining, of desulphurisation, about the number of furnaces, the machines, the products, as well as the disappointments in production. This drawing out of the information resembles what we would readily call today industrial espionage.

He has not forgotten the names of the Heads of Department and would like to know how they are going on: friendly curiosity? ulterior motive of being able to use them? The practice of enticing away experts was not unusual from one country to another. In the same way he enquired of certain forgemasters from Burgundy and Compté whom he had met on Le Creusot business (Letter 3)

One can scarcely understand how Martin, an innkeeper, could be able to give useful information if one didn't know (Letter 1) that Wendel had charged him with an important function, the management of a furnace repurchased by his company.⁸

This rivalry between the producers even took the form of a personal quarrel and denigration is not absent from Wilkinson's letters (Letter 3 in several places). On the other hand he praises his own constructions and offers his services.

The dates of the letters from Wilkinson to his informant Martin

Men of the metallurgical art, directors of powerful establishments in an essential branch, Wendel and Wilkinson are linked to the financial groups of the time. At the end of the C18th the British inventors such as Boulton and Watt whom Wilkinson said were his intimate friends (Letter 2), French engineers like the Periers, are associated with the providers of capital whose role economic historians have underlined in the great affairs of industry. Megret de Serilly, Baudard de Sainte-James, Calonne for example, act in concert with Wendel in the ups and downs of the Royal Foundry and the Glassworks of Montcenis. Wilkinson, at the same time as the first two and the Perier brothers, would be a shareholder in the famous Water Company.⁹ And it is significant that his letters of 1787 and 1789 come at times when financial and economic crises, along with technical setbacks, put in peril the works of Le Creusot.

- 15 May 1787. Wilkinson is not surprised by what has happened and, says he, for a long time he has been waiting for this disaster. From the

beginning Wendel had always had financial problems. The enterprise was only able to function with the co-operation extended to the engineers by the business groups of the general treasury for War and the Navy, and by state intervention. In 1780 the King had taken responsibility for a third of Wilkinson's salary, 72,000 livres annually for the period of the contract. On 1 January 1787 the Royal Foundries of Indret and Montcenis and the Glassworks known as The Queen's, a subsidiary of Le Creusot's activities, were brought together under a common business name Louis XVI took a share, thanks to the influence of Calonne, for a dozen of the 4000 shares of 2500 livres, representing the issued capital.

Now, in 1786, the Trade Treaty had been signed with England, which was going to make worse the competition and the lack of sales of French iron...and a grave coincidence, in the first months of 1787 Le Creusot lost its political support and its most valuable financial support at the same time. Calonne had to give up his Ministry at Sainte-James. Treasurer General of the Navy, laying down his responsibilities and imprisoned, the bankruptcy of the Treasurer for War, de Serilly, following soon alter this.¹⁰

From Birmingham where he was then living, at the house of his brother-in-law, the famous chemist Priestley, Wilkinson did not fail to ask what was happening at Le Creusot after this blow, after this disaster, as he said. He was informed as to the fortunes of this and that colleague, and the famous engineer, citizen of a constitutional country, promised the innkeeper to drink without ceremony, a bottle with him, never mind all these Portly Gentlemen, otherwise called the wealthy aristocrats(Letter 2)

- 29 July 1789 Wilkinson is in Paris where the Portly Gentlemen have been somewhat shaken. He is replying to a letter from Martin of the previous October, and says that he is upset that disputes have not been ended at Le Creusot. Actually things were not going well there. From October 1787 to October 1788 the works had only produced half of its potential output: one of its biggest customers, the Water Company, was in trouble; they couldn't pay the contractors. There was more than one reason for "disputes".

There were other disputes throughout the land. At Le Creusot public order, to tell the truth, had never been easy to maintain, with a heterogeneous work-force difficult to control. The news spread that two cavalrymen of the mounted police had been thrown into the blast furnaces by the workers, confirming what one knew of some local

difficulties. Wendel had been invested by royal proclamation with control of the police and the courts.

Arthur Young, who went from Monteenis to Auton the 4th August “through a miserable land where the farming is dreadful” recalled the Great Fear spread on account of “brigands-who burn and pillage,” Twenty leagues away the peasants of Macon were attacking the regime in their own way, destroying official documents. William Wilkinson himself gives us only a brief account of what had gone on in Paris fifteen days previously the troubles have greatly diminished One can remember nevertheless his maintaining that the people would soon be happier from precisely the fact of the troubles in question This fortunate bourgeois worker of a technical revolution witnessed the start of a political revolution of which he approved

The three letters

[Translators' note: the spelling and punctuation of the originals in our possession have been respected - in the French version – but may have suffered in translation.]

I Letter de Wendel to Martin

Paris this 13 September 1784

I am informing you, Sir, that we have decided to bring into production the furnace of Mevrin as soon as water levels will permit it.

The management of these works is entrusted to you acting in concert with M. Bettinger for the measures to be taken for their exploitation. M. Bruyer has instruction from his company to surrender the site, nevertheless you will only take up your abode there when I have made known to you very clearly the arrangements that will be taken in this business; you will continue to use the renowned D'Art as Master Founder and you will choose Morot as deputy. The salary of these two employees is agreed.

I do not know what those of the furnacemen were, they are generally paid ten ecus per month in all the forges, it will be very important to retain the security of these most reasonable wage rates in order that we do not set a bad precedent

The two blacksmiths who are employed here at this time at the establishment to serve the furnacemen I do not think there is anything inconvenient in that.

I am, sir, your very humble and very obedient servant,
Wendel, rue Neuve des Mathurins

II Wm. Wilkinson's letter to Martin

[The fold shows the address as:

A Monsieur

Monsieur Martin

Innkeeper of the Royal Sun at Couches in Burgundy.

The instruction of "Single" and an indication added: "by Chagni"]

Birmingham 15 May '87

Sir,

I am full of reproaches to myself for not having replied earlier to your letter of 4th August, to thank you for the news that you gave me about your country. Messrs Bolton and Watt, two of my intimate friends have visited Creusot with M. le abbe de Calonne. On their return they gave me the details of all that they do there: and it is a bit as I thought – they have seen the greatest disorder of spirits of their principals which doesn't surprise me after all that has happened.

I have waited for this disaster within the Company for a long time and that made me determined to have no business interests with them. I am sorry for M de Wendel he would have been better to have followed my advice. I learned that Baisse has quit and become a simple miner at Valenciennes. There is a rumour that the workers put two of the mounted constabulary in the blast furnace. I beg you to tell me if this is true – at the same time I wouldn't mind hearing what is happening in the furnace and what the consumption of the smelter is. [*Translator's note: Does William really mean "consumption of the smelter", which is how his French translates, or rather "production of the smelter"?*] Mr Watt tells me that the firebox was very badly assembled and he didn't think they would be able to make it work. What has happened to the Messieurs Raimbaut brothers? How are their affairs? I am not surprised that crucibles and furnace linings are consumed, that will always happen until they learn to smelt the mineral with a suitable mixture of which there is no lack in the area.

Tell me how Poisot's bricks are succeeding. I don't expect any good from placing them in the brickwork of the hearth. They could be successful in the walls or casing. I gather that they have adopted a new method for de-sulphurisation of the small coke. Let me know what it consists of. The method of which you gave me details has not worked, that is to say in the blast. Mr Watt tells me that the blast engine is very badly maintained and that the valves work very badly. All the new things that you have I would be very pleased to learn about, and that if

you have any new arrangement for the book-keeping as I don't doubt because you have a new Company I hope that you have taken care to handle your money as carefully as you should because there will be many more changes before everything is successfully arranged. Tell me the news about M Dulubre if he is still at St Cernin and everything else about the works. Would M. de la Chaise not have been concerned with all these charges which will be paying him for his contract. How does M. Degros come out of the business? I gave him my advice on all this in Paris. I intend to come to Paris this summer and I will come to see you informally. We will drink a bottle despite all these Big Men who are upset that I know them so well. Our old workmate, that is to say Mr B and Prevost. M.de Wendell, he is coming to see you. Please do me a long letter regarding everything about the works. I will be very happy to have the news. Remember me to your wife, and please believe me sincerely your friend,

Wilkinson, at Dr Priestley's in Birmingham.

III Wm. Wilkinson to Martin

From Paris 29 July 1789

[Addressee as per Letter II]

Sir,

On my arrival in this town I received the letter that you wrote to me on the 26 October last and that has followed me through England and Germany. A very long journey that I have just made in Sweden, Denmark, Poland and Germany has brought me finally to Paris, where my stay will not be long seeing one can have little pleasure during these troubles, which have greatly diminished for six days and soon everything will be calm and the people much happier than before. I have a nephew whom I am taking to Frankfurt to show him Germany as he already knows the French. This is the brother of the one you know already.

I am sorry to find that your disputes are still not over: one has not to hold on to little things so as to be disentangled, for there is no pleasure with those who have no understanding. They let themselves be persuaded by every manipulator and one can never be certain of anything that is done. I am not surprised at all the lack of success that they have had with all the machines etc., that is something that really goes without saying.

They want to raise water to work the hammers by the wheels they will have tried hard. To make some profit this Works must be put on the best footing after having tried all the others. At present there is no-one in

charge of the work, and the reputation of those proposed is not great. I note your telling me about your lead mine it will be a pleasure to help you with my advice for that (*two words illegible*) the mine. If you didn't have a better colleague than Monsieur Wendel I believe you would do great things. I see his projects everywhere failing. Everyone of a sort to achieve anything cannot live with him. He is here. I haven't seen him he has contacted me through M. Perrier whom I see often going to dine at his house. I haven't been again.

Our works are going well in England we are regularly making 200 thousands in bars per week at present we are busy with other furnaces and forges. As soon as you have some lead to cast you must come to England you will find at my place the best lead foundry that I know but in that as in all matters with Wendel be on your guard. I believe that he has some good qualities but he comes to nothing when he tries to cause trouble and since he has tried to stir up things with my brother by writing to him that I am drawing false letters of exchange in this country I don't want any more to do with him. I have his letters at present so this is not too rough.

What you note for me about the collapse in the mine doesn't surprise me at all, being done without understanding, not wishing to adopt ideas and experience: perhaps I shall see M. Bettinger. I will be glad if I have been of assistance to him with advice. You don't tell me any word of M. Francois who kept the books. It is not for that will come to see you it would take me 60 posts to go to Metz; meanwhile I am still not decided. Write to me by return. I am staying at the hotel at Eveches, rue des Filles St Thomas. If you see M. Raimbaut give him my best wishes as well as to all my old acquaintances.

Tell me what Olinet is doing at Lyons and if you have news of M. Rosineux at Pesmes and if the quality of iron at Comte is going up . When you write please tell me how many of the furnaces are in blast and what sort of goods they are making and how many finerys they have and how they are working be it in Rena-diere or the walloon way or the English. Finally if you have any further news it would give me pleasure. When you go to Montcenis give my best wishes to Mademoiselle de la Verchere. Not forgetting also to your wife in wishing you good health and courage to overcome all your difficulties, I am very sincerely, Sir, your very humble servant,

Wilkinson.

Tell me the news of M. Prevost

The technological enlightenment

These letters of two eminent metallurgists to an obscure correspondent reflect some aspects of the technological, economic and social aspects of the C 18th.

They show the meeting point of new kinds of people, engineers as big business men, financiers as promoter of industry. They illustrate the relations which were established between the world of science and technology, between those of profit and of speculation and politicians

They allow us to grasp how, in the beginnings of a new industry, success depends not only on a fundamental discovery, but also moreover on its practical application. Everything is connected, every technique has its importance, for itself and for its consequences on the others; the improvement of a secondary process opens the way to success of the whole, a delay or a deficiency in one field, conversely, obstructs general progress.

Wilkinson here gives the impression of an English technician, experienced, concerned about detail, interested in the successes just as in the failures. One imagines that he has done his best to have a network of informers in important places, which he sees in the course of his travels and with whom he corresponds.

His two letters which testify to the pre-eminence of England in the field of metallurgy, pre-eminence which gave rise to the travels of continental engineers in Great Britain, likewise show that she did not hinder English inventors from travelling through Europe. Le Creusot seems to have been, in this view, an opportunity and a place of privileged contacts of collaborations, of experiences, at the same time of competition which crossed over frontiers.

So, parallel to the literary cosmopolitanism of the C18th, to the intellectual exchanges, to the travels and to the sojourns of the “luminaries” of Letters and Philosophy, one finds the existence of an industrial elite who move around, stay in one place, make enquiries, collaborate, dispute.

On the other hand, these technological “luminaries” were often liberal in politics. We see Wilkinson for his part making fun of the “Portly Gentlemen” with his local correspondent from Le Creusot, emphasising the curiosity instead of the news item with a social resonance, a propos the Royal Mounted Cavalry. But most significantly, he salutes the French Revolution and gives his opinion: it will improve the lot of the masses. Thus it is permissible to think that these three unedited texts of

two of the protagonists in the hotbed of the French and European iron industries should have some claim to be published.

References

1 However one of the principals of Le Creusot, Eugene Schneider II, in his book *Coal (Paris 1945)* was able to talk about the Montcenis works and to describe the role of Wilkinson without mentioning Wendel.

2 In some accounts one finds confusion between the two brothers, John and William

3 The spelling 'coak' persisted up to the C19th. Thus in a prefectorial decree relating in 1832 to the forges of Hayange.

4 On the founding of Le Creusot and its ups and downs, J Chevalier, *Le Creusot, birthplace of heavy industry*, new edition Parts 1946. A Fargeton, *The Great Times of Le Creusot and the Montcenis region*, Le Creusot 1956. D Ozanam, *Claude Baudard de Sainte-James treasurer-general of the Navy and businessman (1738-1787)*. Museum of Iron Collection. Geneva-Paris, 1969, Ch 4, this recent work having the special merit of showing the respective roles of the personalities, of the economic conditions of the technical progress of private capital, of public subsidies and their interactions.

5 Letter from M A Fargeton to the author.

6 Arthur Young, *Travels in France*, Transactions H See, Paris, vol 1 p371.

7 J Chevalier op cit p187 quotes, without giving the exact date, a letter from W Wilkinson from which we translate a passage *The day when the French stop playing around and dancing and practise the art of iron, England will tremble.*

8 This Martin must have had a cordial relationship with Wendel since the latter obtained for him the right to hunt over the local land (Letter Wendel to Martin of 14th April 1786)

9 On the financial crisis the failure of Sainte-James and the consequences for Le Creusot, see D Ozanam op cit.

10 J Chevalier and D Ozanam op cit

'British Oil' - developments in the Ironbridge Gorge during the 17th & 18th centuries

by Paul Luter

It has been said that 'Lord Dundonald is rightly seen as the principal innovator in late 18th century Shropshire of processes for the extraction of by-products from coal, but he had several predecessors'. This short paper looks at the contribution made by these predecessors working on both sides of the river.

Eele and the British Pitch Works

On 29th January 1694, Martin Eele, Thomas Hancock, William Portlock, Gent, proprietors of the British Pitch Works at Benthall, obtained patent number 405 to produce pitch. The transcript of the patent tells us no description of the process was given. Martin Eele set up several large cauldrons in Jackfield for the extraction by his patented process of tar, pitch and oil.

The pitch works stood close by the River Severn alongside a railway leading from coal pits to a riverside wharf. The company also extracted bitumen from bitumen-bearing rock on the banks of Row Brook at Pitchford. It was reported that Eele's pitch had been proved inferior to imported pitch for preservative properties. Eele described the process in the Royal Society Philosophical Transactions.

Eele describes the stone being brought from mines to the Workhouse where it was ground by small horse-mills. After being made into a powder it was thrown into a vat of water, where the bituminous matter floated to the surface and was later separated from the precipitated grit. The bituminous material was then gathered together and heated to the "consistency of pitch". It was then mixed with another by-product of the tar producing a less viscous liquid. The uses of this product were, firstly, for coating the bottom of ships for protection against "worms" and, secondly, an oil or turpentine used for aches and pains.

The Slaney Manuscripts at Birmingham University Library inform us that in 1711 the British Pitch Works tar well at Benthall near the River Severn burned with great ferocity. A note tells us that Eele was missing-out on making profit out of the tar because he could not harness the volatile substance correctly. The report tells us that there was great noise from under the ground and that there had been a well thirty yards nearer the Severn in a lower situation. ²

A Coalbrookdale Partnership

After Eele's death, the Pitch Works on the Jackfield side of the river continued as the main source for pitch and tar products. However, after the coming of age of Edmund Darby in 1733 and probably between 1735-41, research now reveals that there were two companies set up on either side of the river, one at Coalbrookdale and one at Benthall. Both claimed to patent their own unique brand of "British Oil." Archibald Cochrane, 9th Lord Dundonald of Culross, confirmed that circa 1743 men at Coalbrookdale were making experiments to extract tar from coal.³ Raistrict also records the Coalbrookdale Company tar transactions regarding Levi Perry in his book "Dynasty of Iron founders".⁴

The elder of these two British Oil companies was controlled from Coalbrookdale by Edmund Darby, Samuel Boden, Levi Perry,⁵ Thomas Hancock and William Portlock, who according to their advertisement of May 1746 developed their oil in a laboratory at Coalbrookdale.⁶ Darby was born in 1712 and was the son of Abraham Darby I. He lived as a child at Madeley Court and in 1730 joined the Darby works. In 1735 he came of age and went into business for himself.

Edmund Darby became a grocer and general merchant. He died of a fall from a horse at Albrighton (or Abingdon) in 1756, aged just forty-four years. It is possible that Samuel Boden was carrying out experiments in "the laboratory at Coalbrookdale," in order to ascertain the oil's use for curing various human ailments. Certainly, Dundonald was aware of these experiments by 1746, along with others carried out by the Marquis of Rockingham near Sheffield and at Newcastle under a German named Baron von Haak. We know that Boden also owned a warehouse for distributing the oil in London; however, the quantities made at Coalbrookdale were not sold for profit, being below twenty-eight shillings per barrel.

As early as September 1743, people were recommending their cure. This included Jane Springett, the wife of Samuel Springett of Wiltford, Wiltshire, Gent, who had been a leper since 1732. She claimed she was completely cured after taking two bottles of British Oil. In May 1745, Edmund Darby, Samuel Boden, Surgeon and Levi Perry advertised themselves as the makers and vendors of British Oil. The advert tell us that (it was believed) British Oil had a capacity to expel poison from the wounds made by a mad dog, ease swellings, bruises and septic wounds, cure rickets in children and even help to knit broken bones.⁷ It seems the Darby, Boden, Perry, Hancock and Portlock partnership continued

until January 1753 when Samuel Boden advertised that the partnership had been dissolved.⁸

Michael and Thomas Betton

Meanwhile, on the Benthall side of the River Severn, Michael and Thomas Betton, having originally worked with Benjamin Batchelor and Company, glass manufacturers of Broseley until 1739, decided to re-start the old Eele-owned pitch works and produce a competitor "British Oil." Consequently, on 14th August 1742, Michael and Thomas Betton patented a process No. 587 entitled "An oil extracted from a flinty rock, for the cure of rheumatic and scorbutic and other cases." In the process, the harnessing of the tar, which was found lying next to coal in coalmines, meant the material was first powdered by being heated in a furnace. The process described by Michael Betton (1691- 1754), then of Wellington, is remarkably similar in nature to Eele's description, and could in fact be a slight refinement of the same process. In 1745 the former Pitchford pitch workings of Eele were leased to Thomas Betton of Broseley.

Rivalry between the two companies continued until January 1753, when the Coalbrookdale-based partnership was dissolved, although Edmund Darby was alive until 1756. Soon after the Coalbrookdale partnership folded, the Benthall based company also came under pressure when in June 1754 Michael Betton of Wellington, the patentee of the Benthall based "British Oil", was declared bankrupt.⁹ Michael Betton's wife Mary died in December that year and he was buried at Wellington All Saints Church, nine years later on 13th March 1763. However, the company seems to have continued through investment from Michael's brother, Thomas Betton. By June 1768 the sale of the British Oil was being advertised by Thomas Betton, as sole distributor.

Through adverts, Betton became the subject of a malicious attack in Aris's Birmingham Gazette, aimed to shake his business. In an advert of reply, Thomas Betton of Shrewsbury asked the public to exercise caution as George Betton, his son, was spreading lies. Thomas maintained that George did not know how to make the oil, a discovery that was granted to his brother Michael Betton of Wellington, who was no longer alive.¹⁰ Regular advertisements for Betton British Oil appear in Aris's Birmingham Gazette right up until November 1813.

Some adverts list the Company's customers, who included included Henry and Joseph Freeman of Elixer Warehouse, St Margaret's Hill, Southwark, London, Mr John Payton of Dudley, Mr Benjamin Cowley of Wolverhampton, Mr Patrick Lambert of The Three Swans Inn,

Walsall, Benjamin Haslewood, a bookseller of Bridgnorth and Mr William Garmson, an ironmonger of Eccleshall.¹¹

Dundonald and Reynolds

There is no evidence that the Betton family had tar-based business on the Coalbrookdale side of the River Severn. In fact they seem to have been based at Fiery Fields near The Calcutts at Jackfield. However, the Darby tar business, one time competitor of the Bettons, seems to have been located on the Coalbrookdale side of the river. It is possible that the early British Pitch Company workings may have come to the later attention of William Reynolds, prior to his excavations at Madeley Wood, which led to the discovery of a much richer and profuse deposit of bitumen. There seems to be a period of about thirty years or so before Reynolds's discovery, during which time the Pitch Company workings may have been overlooked.

It is possible that, between 1785-86, William Reynolds re-opened a pre-existing working, which he subsequently intended to develop into a canal, known today as the "Tar Tunnel". Certainly by March 1785 Reynolds had become aware of "the bill vesting in Archibald Cochrane, 9th Earl of Dundonald, his executors, administrators and assignees, the sole use of property of a method of extracting or making tar and pitch from pit coal throughout his Majesty's dominions for a limited time." Tar from Jackfield had already been answering well at Liverpool in treating the dock gates and preventing the ill effects of worm in the timbers. The owners of vessels on the River Severn also gained benefit from tar products.

Both works on either side of the River Severn seem to have been competitive and new enlightenment quite jealously guarded. In fact, in the light of these thoughts, one can more fully understand the contents of a letter from Samuel More, the secretary of the then Society of Arts. The letter of December 1787 told Abraham Darby III that the properties of the bitumen (at Madeley Wood) were superior to the tar which had been patented by Dundonald in 1783 and extracted from pit coal at Jackfield and other places.

By January 1786, there were twelve tar stew kilns on the ninety-six acre site at the Calcutts under Lord Dundonald, and later under Dundonald's "British Tar Company" kilns appeared at Donnington Wood, Ketley and Benthall as well as at Tipton, Bilston and Netherton. The Easthopes kilns at Broseley, built on a site called "Penball", went up for sale in October 1794, land with the mines of Alexander Brodie Esquire. On the Madeley Wood side of the river, the Madeley Field reckoning accounts¹²

show us that William Hombersley (1778-1840) and Darby Ford (1758-1824)¹³ were the under-managers of the tar tunnel for William Reynolds. We now understand that in June 1796 they built a railroad into the level for a total distance of 212 yards; thus the initial idea of a canal there was abandoned.

Between 1843 and 1847, a house was built over the tar tunnel entrance, which was afterwards reached through its cellar. The Shrewsbury Chronicle for 8th September 1871 reports experiments taking place in the Tar Tunnel where a Jacky pit was sunk. A jack or windlass meant a winding mechanism worked by hand. The tunnel acted as an entrance to the local coal mines until the 1930s and was used as an air raid shelter in World War Two.

Notes and references:

1. B. Trinder, *The Industrial Revolution in Shropshire*, 3rd edn (2000), p16.
 2. This well disappeared in 1755 when a pit shaft was sunk — information from the Dawley Observer, 10 June 1966 .
 3. National Library of Scotland, 2.148/4 (1793).
 4. A. Raistrick, *Dynasty of Ironfounders*, 2nd edn (1989), pp51 & 81.
 5. Levi Perry was married at Barrow Church to Elizabeth Smith on 12 March 1729.
 6. *Aris's Birmingham Gazette*, 26 May 1746.
 7. *Aris*, 19 September 1743, 29 October 1744 and 20 May 1745.
 8. *Aris*, 29 January 1753.
 9. *Aris*, 17 June 1754 — 'Michael Betton of Wellington, Glazier and Dealer in Oil and Chapman Bankrupt'.
 10. *Aris*, 13 June 1768.
 11. *Aris*, 19 December 1743.
 12. Shropshire Archives, 271/1.
 13. William Hombersley (son of Francis, underground mining bailiff for Lord Stafford), was the overseer of the Tar Tunnel; at the time of his death at Priorslee Hall in June 1840 he was an ironmaster. Darby Ford, also an undermanager at the Tar Tunnel, was the son of Richard Ford II of Coalbrookdale.
- [Note : a fuller account of the activities of Lord Dundonald will be given in the 2006 Annual Wilkinson Lecture by Paul Luter, the text of which will subsequently be published in the Journal — Ed.]

The Diary of Mary Ann Lewis

Mary Ann Lewis was born in 1888. She lived in Ironbridge and worked at Coalport China Works. She died in 1959. For 43 years of her life, between 1912 and 1954, she kept a diary, or rather a list of events and activities, covering 10 foolscap sheets. A photocopy of the diary (unfortunately minus the sheet covering the years 1925-26) was given to the Society and this was transcribed by Janet Robinson. In addition to family details, the diary includes entries of local interest relating to wartime activities, industrial disputes and the Ironbridge Gorge communities, with occasional references to events outside the area. Coverage of the years is erratic, with only three entries for the 1930s and four for the last nine years; some of the handwriting is illegible and its style changes several times (suggesting catching up on recording events from previous notes and memories). Nevertheless, it is an interesting document, providing information not available elsewhere, and exhibiting true local flavour. The following are selected extracts from the diary.

Wartime activities

The opening two and last two pages of the diary list activities connected with the two World Wars. For example, during the Great War, 'Will Storey enlisted on Sept.1st, 1914, the first out of Jackfield in Kitchener's Army'; there was a 'great recruiting rally throughout Shropshire on Oct. 2nd, 1915'; and in 1916, 'we were compelled to have dark blinds and the street lights out at 9 o'clock on Feb. 16th', and 'a German gun captured by the British in Sept. 1915 at Loos came through Ironbridge and paraded the streets on June 3rd'.

Local events recorded relating to the Second World War include the black-out – 'we were compelled to black out our windows from the beginning of Sept.1939' and 'all names and signs (were) blacked out June 1940'; the barricading of the Free Bridge and the Iron Bridge – 'sand bags were put along the rails on Friday, June 24th, 1940'; and early bombing raids – 'the enemy dropped 300 incendiary bombs on Gitchfield Brickyards on Oct.15th' and 'a Jerry dropped three stick bombs over in the lime kilns on Nov.9th, 1940 (which) broke a lot of windows along the Wharfage'.

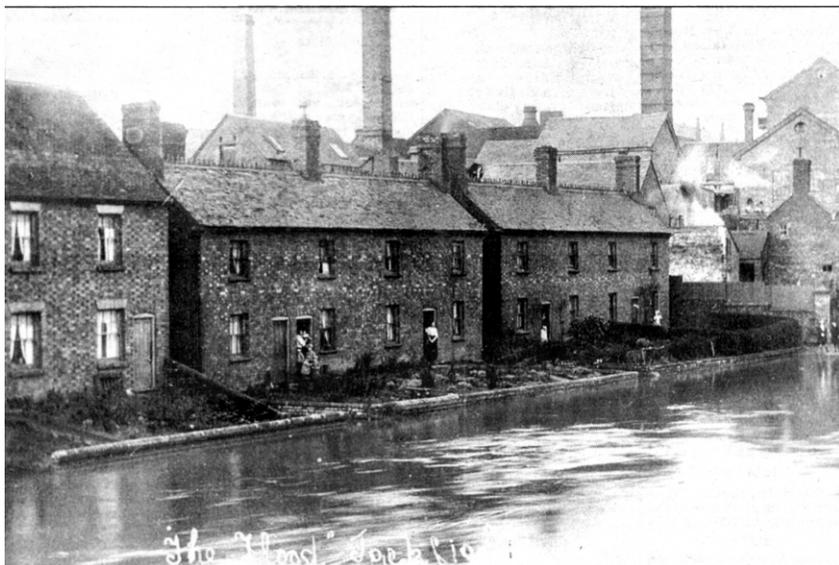
Industrial disputes

Strikes and events leading up to the closure of Blists Hill furnaces and Coalport China Works are recorded in the diary. In 1912, 'there was a coal strike in March' and 'Blests Hill furnace was closed'. There were

further coalminers' strikes in 1920 – 'colliers came out on Oct. 16th and were out three weeks' – and in 1921, when 'they came out on March 31st and started work on Monday, July 4th'. In 1923, the 'Coalport dispute lasted three months (and) policemen were on guard...the work people came out on strike on May 30th and started work again on August 23rd'. Within three years, 'Coalport China Works closed down and was transferred to Cauldon Potteries on April 14th, 1926'.

Ironbridge Gorge

There are numerous entries in the diary relating to the River Severn and the local communities. Of the four floods recorded (in December 1915, March 1923, January and November 1925), that of March 1, 1923 'stopped people going over the new footbridge at Coalport, it was up two or three of the steps'. Four drownings were noted, including Benjamin Bartlam, who 'got drowned by the Half Moon, Jackfield, on August 19th, 1920 and was not found until August 29th...down at Sweeney'. Also relating to the river, 'Coalport ferry boat turned over on December 11th, 1914' and, even more dramatically, 'a glider came up the Severn on October 27th, 1923, went almost as far as Shrewsbury, came back on Sunday 28th...it struck the Free Bridge... caught (sic) the ferry wire at Potter's Loade [Highley] and overturned'.



Flood at Ferry Road, Jackfield. 1923

The record of events and activities in the Ironbridge Gorge communities is wide ranging. War memorials were unveiled at Coalbrookdale on May 22 1921, at Coalport and Jackfield (the footbridge) on September 2 1922, and at Ironbridge, 'on Sunday, March 2nd, 1924 by Col. Garratt...it was snowing heavy when it was unveiled'. Two examples of extremes of weather are recorded – 'the terrific gale on Dec.30th, 1921 did a good deal of damage in Ironbridge ...£20 worth of damage was done at the Co-operative Store...the plate glass window of the boot department was blown to atoms'; and 'a very heavy thunderstorm on July 13th and 14th 1923, the worst we have had for years'. Well-known local buildings are mentioned – 'the Dog and Duck started to be pulled down in the month of May 1940'; 'the Central Hall opened on May 20th,1940'; and 'the big stack at Ladywood Brickyard was blown down by Roberts on May 15th 1943, it was 90 feet in height'. It is noted that 'the Midland Red bus started to run at Ironbridge on Oct. 27th,1923'. And a local murder is recorded – 'Mrs Edith Thompson and Fred Bywaters hung on January 9th, 1923 for the murder of her husband between October 3rd and 4th, 1922'.

Outside the area

Of the occasional references to events wider afield, three examples – 'we had a slight earthquake all round Shropshire and Staffordshire on June 24th, 1916... it did a lot of damage at Wolverhampton and Walsall'; 'Lord John Sanger's circus, (which had) visited Ironbridge on June 19th 1920, burnt down on Thursday, July 15th at Taunton...four lives being lost'; and 'the River Thames flooded on January 7th 1928, several people lost their lives...not known to have been so bad before'.

Memories of a Shropshire Lad, Part 2

by Dennis Mason

In this second extract from his memoirs (written in 1990), Dennis looks back at the various ways in which the people of Broseley 'made their own fun' during the last century.

Television, the radio, more money and better transport facilities have brought a wider, richer life to the countryside, but one adverse effect has been the decline of communal life. People provided their own amusements then and though the fabric of life might have been thinner it was in many respects richer.

The seasons played a larger part in life. Spring was not only anticipated eagerly as the end of dreary winter, but for almost all men it was the beginning of the gardening season. Almost all men it was the beginning of the gardening season. Almost no one had a greenhouse and the winter months were for the most part a period when gardening was non-existent.

The Broseley district had always been renowned for its gardens and even today has a flourishing horticultural society, plus the Benthall Flower Show, and has many fine gardeners. But it is difficult to believe just what a garden meant to almost all the adult male population of those days. Good Friday, whether it came early or late, was the day when everyone put in their potatoes, a much more staple crop then than now, because it represented a vital part of the family's diet. Seed was universally kept and usually cut into two with the cut side smeared with soot or lime to ward off disease, a practice seldom seen now, in spite of the high cost of seed potatoes.

The same vegetable crops were grown then as now, but there was very little artificial fertiliser used, and some fertiliser used then would be difficult to obtain now. There were very few water lavatories in the district and the 'jerry' was a respected item in every bedroom. The contents of this were not wasted by the keen gardener, but collected in a container outside and used (very effectively, I may add) to "bring on" the kidney beans and, by some, the onions!.

There were plenty of horses about then and it was a common sight to see small boys rushing around with a small, handmade cart on pram wheels and an old hand shovel, with which they loaded the small vehicle with the leavings of the horses. Horse manure was highly

thought of, especially when rotted outside, and this was a duty compelled on many small boys by their gardening fathers.

Most working men were so poor that every square inch of their gardens was used to help feed their families, but, although fewer than today, there were the aesthetes who grew fine roses, asters, gladioli, dahlias and chrysanthemums.

There were a number of flower shows in Broseley, the leading one being the Pheasant Show at the inn of that name. This show was the forerunner of the Coronation Flower Show, which replaced it in 1937 and which itself merged with the shows run by the Horticultural Society after it was formed in the Autumn of 1946. The Benthall Potato Show at the New Inn, Benthall was even older than the Pheasant Show and happily, although it has changed its name and location, is still in existence and thriving after nearly 90 years.

The cultivated products were not the only ones, which received attention. Cowslips (now almost a rarity) were picked in thousands by some of the older people for making wine. It was a laborious business because only the 'pips' were used for wine-making. The wine from this flower is very sweet, but its innocuous taste belies its extreme potency!

Other wild plants were commonly used for wine, notably elderberry, which made a rich, dark, brew with rather a peculiar tang. Homemade wine seems to be coming back into vogue, though then there were no fancy gadgets, the wine being made in the large clay steins then manufactured locally.

Half the population went 'blackberrying' in the early autumn, the favourite place being the Broadmeadow, a large tract of rough waste land (the scene of 16th and 17th century coal-mining) at Benthall. This was still a favourite blackberrying place for the few who still indulge in this prickly pastime until quite recently, but the whole area is now the scene of outcrop clay mining.

Although blackberries were also picked for consumption (and the inevitable wine-making), the bulk were picked in large quantities for sale to local agents who sold them to dyers. They were bought by the pet, about 14 lbs for blackberries but a much greater weight for damsons, and the price paid was so low that it was hardly worth the effort though, as I repeatedly state, most people were glad enough to get a few extra coppers. Damsons were also picked for the dyers. There were far more damson trees around then, the Smithies, two miles from Broseley, having many hundreds of them and presenting a wonderful

sight in the blossom season. One curious feature is that damson crops then were almost invariably heavy, whereas today's damson trees in the area are much more variable. Many of the trees are now old, of course, and fewer new ones are planted. The climate too has changed over the years, especially the Springs, which are now invariably cold and this may have something to do with cropping.

Haymaking was another much-enjoyed seasonal activity. The farmers were only too willing to accept voluntary (and unpaid) help from local youth. No one who has been brought up to see the neat, tied-up parcels of 'hay' that adorn the fields in Summer can have any idea of the fun that the old fashioned hay making provided. The grass was cut by the mowing machine and left for a while in straight lines, then it was made into 'cocks' by the willing helpers with pitchforks (known as 'pikels' locally). Much horseplay went on in the process and perhaps that is something of an understatement. Finally, the 'cocks' were loaded on to a horse-drawn dray and carried to the rick.

There is no doubt that modern methods have made grass harvesting far more efficient and profitable in our uncertain climate, but the fun and excitement have gone out of it, just as the old hay meadows have largely disappeared.

Winters seem to have been harder then. In very cold weather sliding took place on the Tileries Pools (now occupied by part of the Tileries Estate) and on the Moon Pool at Posenhall. Sometimes Willey Pools were thrown open to the public, but it had to be very hard weather for those large expanses of water to be safe for sliding. You will notice that I have avoided the word 'skating'. No one amongst the working population possessed skates and if they had they would not have known what to do with them. Mr. Frank Brooks, headmaster of Jackfield School, who lived near the Tileries Pools, would on occasions give a demonstration of skating to a crowd of awed admirers.

In a commanding position in the middle of Broseley was the old, 18th century town hall. It was not a very attractive building but had a small cupola which could be seen from all roads approaching the village, and looked quite romantic as one approached from the south. The original clock looked down from the front of the hall. This rather decrepit building was the centre of most of Broseley's social activities. The bottom storey consisted of a committee room and opposite a very bare place which served as a gents' cloak room and lavatory. At the top of steep winding stairs was a little landing where tickets were scrutinised, a place called 'the anteroom', which had access to the stage in the big

room, where all Broseley dances and most other social functions were held, a ladies' room and toilet and a small kitchen. The main room was heated by two large open fires, which smoked badly when the wind was in a certain direction, and to warm up the room they had to be lit some hours in advance of the event.

Dances in Broseley then followed quite a rigid pattern. There were about six a year of any account, the occasional 'sixpenny hops' being considered rather 'infra dig' by most. The social peak was reached by the Tennis Dance, for which a charge of two and sixpence was considered very high indeed, the usual charge for 'good' dances being one and sixpence. The Rev. C. S. Jackson introduced the Sunday School Dance on New Year's Eve, a very popular function and surely unique in that a prayer was said at midnight!. This appeared far less incongruous then than it may seem, and I well remember a well-known local character who had celebrated too well (there was no bar but The Vaults was handy to us all) and had not been too well behaved during the midnight prayer, apologising most profusely to the rector later. But there was no ill feeling on either side at the time or later.

In the years shortly after the First World War the Town Hall was often the scene of plays by travelling companies. These were cheap and very popular, though the plays were hardly what you might call 'cultural'.



Collection, Mr & Mrs Pope

Mollie Oswell, John Dixon, Gladys Davies, A. O. Jones, Pattie Davies, Norman Ball, Freda Roberts, Celia Casey, Annie Lloyd, Dennis Ridley.

Amateur Dramatic Society

“Maria Marten and the Murder in the Red Barn” was highly popular and so was “The Face at the Window”, “The Cat Creeps” and other Victorian melodramas, with the tear jerker “East Lynn” coming in between.

In those days Broseley was regaled with quite a few wrestling bouts, in some of which “The Great Hakensmith” featured. I don’t think he was the original, though formidable enough, but Broseley had its own champion in Billy Osborne, who beat him on one occasion at least, and this man also unofficially beat the world’s light-weight lifting record at one of these shows, at which I was present. Billy was quite a small, but very smart man, who looked twice as big when he stripped. He was a humble and quiet soul, but tremendously dedicated and Broseley thought the world of him.

A quite talented Amateur Dramatic Society flourished. The producer for many years was the late Mr. C.A.Potts, a local solicitor who had had experience of the stage in rather higher spheres. A yearly performance was put on and was very well supported, for the performance was of a high standard, although all the amateur actors were locals. The Society never attempted anything beyond the realm of farce, but were extremely talented within the limits in which they operated, and the Society’s annual performance in the Town Hall was an important event in the calendar of Broseley’s social life.

Concerts were also popular. The fare was all home spun, but presented with great gusto and was always well received. A point of social importance is that the number of local people taking part in this live entertainment was considerable, for quite a number of local organisations put on concerts from time to time and invariably provided the artists from their own ranks. The Broseley Choral Society disappeared before my time, but: there was a wealth of musical talent in and around Broseley and never any shortage of choral and instrumental soloists.

Broseley was really quite a lively place and there were far more folk involved in the various social activities than there are today, even though the place has almost doubled in numbers since those days. There is a lot to be said for “making one’s own fun”.

CORRESPONDENCE

Betancourt reveals more about Indret

During recent detailed research into the life of Augustine de Betancourt, Spanish engineer, which I carried out as a result of re-reading the excellent short review entitled "Betancourt sheds light on the Wilkinsons" printed in the Society's journal No. 19, (1997). I received from the Institute of Civil Engineers a copy in Spanish of "Betancourt y la fundicion de canones de hierro" recording great detail regarding the Indret cannon works.

Augustine de Betancourt Molina was born in 1758 at Peurto de La Cruz, Tenerife, in the Canary Islands. He was a brilliant engineer and a great artist who was very knowledgeable about many fields, and many historians regard him to be the Spanish equivalent of Leonardo da Vinci. He studied at the Ecole des Ponts et Chaussees (School of Bridges and Roadways) in Paris and founded the Escuela de Ingenieros de Caminos y Canales (The School of Road and Canal Engineering) in Madrid. He also formed the Corps of Civil Engineering in St Petersburg. Between 1784-91 he worked with William Wilkinson to build up facilities at the new cannon-making factory at Indret on the River Loire. In 1795, Betancourt travelled to England, and visited the Boulton & Watt Company at Soho Birmingham, which marketed the new double acting steam engine. However, due to suspicions about his motives, the engine was not shown to him. On his way back to London, from a distance, he saw a double-acting steam engine working in a flourmill. From its external appearance he deduced how it worked and Watt's innovations.

In 1796 he worked with William Reynolds developing a boat for cleaning weeds from the River Severn and Shropshire Canal. By 1798 he had returned to Spain where he put into practical use the knowledge he had gained regarding the double acting engine to work upon the rivers and canals there, thus contributing to the spread of the Industrial Revolution in Europe. Later Betancourt built Spain's first optical telegraphy system connecting Madrid and Aranjuez and he was also the first to fly a hot air balloon in Spain. On the eve of the French invasion of Spain, he went to Russia where he gained the confidence of Czar Alexander I. During 1817-18 he, along with the engineer Bazaine, developed steamboats along the Volga River and built up the canal systems throughout Russia. He contributed decisively to the modernization of the country, pioneering a large number of civil engineering works. He died in 1824 and was buried at the Alexander Nevsky Cemetery in St Petersburg.

The extract comes from a book entitled “Betancourt-Los inicios de la ingenieria, moderna en Europe” or Betancourt-the beginnings of modern engineering in Europe, reprinted by Colegio de Ingenieros de Caminos, Canales y Puertos and others in 1996. A translation of the reprint from Spanish is as follows: - It was 1789 when Betancourt learned that the English and French had discovered the existence of a new double acting engine unknown to the rest of the world. He established better conditions for the gathering of scientific information for the Spanish Navy on the latest advances existing in the grand cannon foundries now working in France. Betancourt visited Indret many times between 1784 and 1791 and, after visiting in 1791, he drew up a report, which was preserved in the Library in the Royal Palace in Madrid. The report entitled “A description of the Works at Indret a foundry for boring iron cannons for the French Royal Navy.” Betancourt’s description shows the works to be one of the most notable cannon factories in France, which had been modernised with the latest equipment made in England. Skillfully and excellently invented in France by the brother of the famous English ironmaster named Wilkinson, who drew up the first factory at Moncenis (Borgona) and several years later a more important, modern factory on the island of Indret on the Loire, two miles from Nantes, where the access to the Atlantic Ocean was good.

The translation continues: The secret report tells us about the cannon foundry works at Indret (Yndrid) and the necessary adjustments at their extremities, along with the grave dangers of flooding and the water levels. Also it tells us about the way they were able to break down the cannon and then move them from a vertical to a horizontal position in a cast condition. The report describes the use of a powerful boring machine in which a vertical hydraulic wheel receives the cannon and how the machine compensates for the unevenness of the surface caused by the changes in the tide. Betancourt also reports that given that at Indret they employ useless cannon as raw materials, the primary operation was to find out which fragments of cannon were sound by resorting to a powerful crane which dropped the cannon from a great height breaking them on impact. The shattered cannon were then transported by a system pioneered at Indret where an iron pulley above moves a wagon throughout the works to supply a variety of functions. The Indret works could drill or bore 150 cannon in a year (circa three cannon per week). The Englishman named Wilkinson had spent greatly and did not have any talent for this necessary business. At Moncenis and at Indret the French administration decided to do without his services and to put the works under private command. The new company

employed an experienced Frenchman at the head of Indret named M. Delamotte who allowed Betancourt, together with the very capable and hard working Paven Perrier, the friend of Betancourt, to built at the works the first double acting engine outside England. (Note Perrier had worked with the Wilkinson s from 1778)

Delamotte introduced important innovations to the works and many different improvements in the quality of the sand moulds. He worked with Betancourt to make many information sheets publishing significant news of a solution to the problem of deposits in the molten pool and problems with the crane at high tide which diminished capacity. He gradually replaced each defective machine in turn and increased the capacity of the mechanical boring of cannon by a several per cent annually. One answer to the problems was to install a double acting steam engine and to explore business possibilities in the Canary Islands. Consideration was also given to the movement in the hydraulics of the engine. The private administration of Delamotte and the sale of French cannon proved very effective, far outweighing the previous sale of cheap cannon, and benefited the economy by giving a 25 % increase in production. The superior quality cannon and the description of the work at Indret show the very hard work undertaken by Betancourt during a long period between 1784-1791 for the benefit of France.

Paul Luter

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