

Experimental ironmaking in the 1720s: Thomas Tomkyns and his contemporaries

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ABSTRACT: Thomas Tomkyns had an effective (though inefficient) process for making bar iron from pig iron in a reverberatory air furnace, which he patented in the name of Roger Woodhouse in January 1724. Its implementation was delayed by Tomkyns being severely in debt, also by the rivalry of William Wood who had an ineffective process for making iron from its ore, but enjoyed political patronage from Sir Robert Walpole. The process was tried at Nine Elms in Surrey in 1726, then used successively at Oakamoor (Staffs) in 1728, at a copper works near Maidenhead (probably Temple Mills at Bisham, Berks), and finally at Lydney c1733. However, the low price of iron (due to Russian imports) in the mid-1730s rendered the process unprofitable. In this context, William Fallowfield, whose process used peat, stood little chance of commercial success.

Introduction

From the 16th century most iron made in England and Wales was produced by a two-stage process. First a blast furnace made pig iron, then a forge made this into bar iron. This consumed prodigious amounts of charcoal. It is likely that the output of the industry after about 1620 was constrained by the amount of wood available for the production of charcoal. Certainly, this would explain why there was little change in the amount produced between 1620 and the early 18th century (King 2005). Accordingly, finding an alternative fuel was a longstanding ambition. By 1720, coke pig iron was being produced but only for foundry purposes. The reasons have been much debated as to why the adoption of coke pig iron in forges was so slow (Hyde 1977, 37–41; Rehder 1987; Ince 1991; King 2011), and will not be considered here.

The Wood family

The Woods' process involved smelting pulverised ore and coal in an air furnace, but the product was not good

iron. Much information also survives on what William Wood, his sons William, Charles, Francis and Samuel, their brother in law William Buckland, and their financier Kingsmill Eyre did. Kingsmill Eyre was the Secretary of Chelsea Hospital, whose treasurer was Sir Robert Walpole, the Prime Minister. This meant that the Woods' aspirations enjoyed strong political patronage. Wood's process and detail concerning the activities of Wood and his associates will not be explored in detail here (but see King 2010; 2014) but they cannot be ignored for their activities are part of the scenery for the events described and something must be said of their background.

William Wood was of Huguenot descent and married the daughter of a Wolverhampton ironmonger, who presented him with a large family. From 1715, he engaged in a series of business 'projects', most of which went wrong. The ironworks business that he joined in 1715 was initially successful, but got into debt in the late 1720s, after being floated as a public company during the speculative frenzy of the South Sea Bubble in 1720 (King 2010, 68–74). Next he bought the right to produce copper coinage for Ireland, but the coins were so light

as to be unacceptable to the Irish. Sir Robert Walpole's government had to recall Wood's coinage patent and compensate him (Treadwell 1976). The inner financial machinations of this affair remain obscure, subsequent events clearly point to Walpole owing a debt of some kind to Wood. This explains Walpole's active support for Wood's application for a charter of incorporation for his last project, that of making iron in air furnaces, in the teeth of evidence that the process was incapable of making good iron.

Wood's iron project was financed by the (amalgamated) Company of Mines Royal and Company of Mineral and Battery Works (referred to here as the Mines Royal Company). They advanced a large sum of money to be satisfied by iron delivered to them from the works which Wood would build. James Lowther (from 1731, Sir James), the wealthy coalowner and MP, became involved in the affair at the request of his friend Sir John Meres who was the Governor of the Mines Royal Company. Wood had used its money to build works at Frizington, some miles inland from Lowther's estate at Whitehaven. Meres sought Lowther's help because Wood was very sparing in what he would tell the Mines Royal Company of his progress. Lowther's information led the company not to advance more money to Wood. This in turn led Wood to seek to incorporate a company of his own, to be called the Company of Ironmasters of Great Britain, with an authorised capital of a million pounds. Lowther then actively campaigned (with others) against its incorporation; he considered this was likely to become a vehicle for depriving the unwary of money they invested in it.

This affair was discussed by Flinn (1961) and Treadwell (1974), but the full story of it must be left to be told elsewhere (see King 2014). The campaign against Wood's project also involved supporting the aspirations of Thomas Tomkyns and his friends to exploit his patented ironmaking process. Tomkyns' friends (who were as bad as, if not worse than, Wood and his associates when it came to fraud) also sought an incorporation for themselves, but unsuccessfully. Pamphlets (mostly bound together in a British Library volume labelled *Tracts on Trade*), evidence given to the Privy Council (PC 1/4/106-7) and Lowther's correspondence (LL) provide considerable information about Tomkyns' process and what was achieved using it. This shows Tomkyns' process to be no mere flash in the pan, but an effective (though inefficient) means of making good bar iron. This is in contrast to Wood's process which was incapable of making good iron. However, Fallowfield's process will be described first.

Fallowfield's process

Very little has been discovered of Fallowfield's process. William Fallowfield described himself as a gentleman of Leek in Staffordshire. There is a specification for his patent, but it is somewhat vague. As fuel, he used:

'Along with ... charred peat or charred turf a small proportion of charcoal. When I see fit, and as the occasion requires to improve the metal and cause it to flow better, I use a fine earth much resembling Bole Armoniack, and a white sand, which in some places is made use of for plaistering instead of lime, with some marl, and as the iron stone or iron oar is different in its nature and melting, I proportion it accordingly. I likewise use some limestone and some clay impregnated with iron as the workmen see occasion.'

He used the same fuel to 'refine and draw out pig iron or sow iron into barrs, or any other shape of form' and to convert bar iron into steel (Patent Specification, no 490 dated 11 Feb 1726[7]). Nothing is said as to what kind of furnace is used. The implication is that the process was in use. Certainly a subsequent pamphlet refers to his making iron at his furnace near Leek for £10 per ton. He offered to sell it at twenty percent below the market price, but 'only on account of the vast rout and bustle that mankind has been amus'd with about [Wood's process] I have hitherto delayed putting forward my invention, which answers in all respects both as to the goodness of the iron and the cheapness of making it'. He also offered to lease the process at a royalty, but he gave no details of his methods (Fallowfield 1731; *Gentleman's Magazine* I (1731), 166–7, 452; Greenslade 1976, 117). Fallowfield was dispersing this pamphlet in April 1731 when a trial of Wood's process was imminent (LL 91, 22 and 24 Apr 1731). The furnace at Leek appearing, in a list of ironworks in Staffordshire compiled by Dr Richard Wilkes in 1735, was presumably his but that is the last known reference to it. One at Teanford (near Cheadle) appears in the same list; as no other reference to a furnace there has been found, this may have used Fallowfield's process (Shaw 1798, table facing page 1). Fallowfield died in 1740.¹

Thomas Tomkyns

Tomkyns came from near Bromyard in Herefordshire (Duncumbe 1812, 73) and was cashier of the Commissioners for Licensing Peddlers, Hawkers, and Petty Chapmen. His guarantors (as their secretary) were Richard Dowdeswell of Forthampton (near Tewkesbury) and his father Pakington Tomkyns of Buckenhill, Herefordshire (CTP, 274; TNA, T 1/244, f.235). The

latter had married (at Cotheridge, Worcestershire in 1712) Elizabeth Bohun, one of the co-heiresses of George Bohun, the owner of Spitalfields Market, London (Sheppard 1957, 137–47).² Thomas Tomkyns was not ‘proof against the temptations of Exchange Alley’ in 1720 and 1721 (CTP, 274; TNA, T 1/271/60). When the Treasury ordered his office to be opened in December 1723 the accounts were in confusion and there were no assets except £20.13s in bills signed by persons supposed insolvent. The guarantors were called on to pay the full amount (£6000) of their bond. The commissioners were allowed to compound, but Tomkyns was not for some years (CTP, 233 526 528–9; TNA, T 1/271/60).

The patent had been taken out in the name of Roger Woodhouse in trust for Tomkyns. Nothing is known of Woodhouse’s background, but in January 1730 he was a watch key maker living in St Giles Cripplegate Without, London. He claimed to be ‘well-skilled in the nature of minerals and metals, especially of iron and copper oars and mettles’. He stated that he made an experiment, eight or nine years before, ‘in order to discover if it was practicable to make sow or pig mettle malleable with sea or pittcole’. He needed assistance from Thomas Tomkyns (evidently financial) and expended ‘a great deal of time and pains in bringing the same to perfection’, which he and Tomkyns did ‘effectually’ (PC 1/4/106/34). Tomkyns stated that his interest in the subject began in 1721 (PC 1/4/107/16).

William Goostrey, an attorney who had known Tomkyns for 15 years, ‘being very intimate with him about Ladyday 1722’, was also involved. Tomkyns told him of the project. Having been born at Staveley where there were a furnace and a forge, Goostrey was well acquainted with ‘Mr Heford’ [William Hayford], the master of the ironworks there, and the manner of their working. Hayford had told him of the expense of their charcoal, which Goostrey told Tomkyns. Tomkyns then ‘made a calculation of the difference between the expense of making sow or pig metal malleable with charcoal ... and with sea or pit coal’. He found that if the project ‘could be brought to perfection,’ it would be a great advantage. He told Goostrey that he was resolved to bring it to perfection. This led to an agreement in October 1722 with Roger Woodhouse for him to assist Tomkyns. ‘When they apprehended they had brought the undertaking to perfection’ Woodhouse applied for a patent as Tomkyns considered it would not be proper for him to do so as cashier in the Hawkers and Peddlers’ Office. Woodhouse thus obtained a patent (no 460, dated January 1724), for the ‘invention of rendering sow or

cast iron malleable by means of sea or pit coal without coking, whereby he can render the same good and fit for several purposes of iron made out of charcoal’. He assigned this to William Goostrey by order of Tomkyns. ‘Tomkins having misfortunes in the world was obliged to keep out of the way’, and Tomkyns asked Goostrey to pay Woodhouse what he owed (PC 1/4/106/33–34).

Roger’s son George (also of St Giles Cripplegate Without), who called himself a refiner, described a demonstration of the process at Nine Elms in Surrey³ about four years before when he had made a bar and a flat piece of iron. Samuel Palmer and Henry Robinson, both gentlemen from Southwark, were present and said the material used was ‘an old cast back of a grate’ (1 cwt), and the iron had been made into a horseshoe. Henry Heylin of St Martin in the Fields gave the date as 3½ years before (summer 1726). He had part of the iron as it came from the furnace and had a blacksmith beat it into a bar (PC 1/4/106/36–39). Goostrey had ‘seen horsenails and horseshoes made with such iron and hath had [his] horses shod with the same ... The horseshoes wore as well as any [he] had in his life’ (PC 1/4/106/33). Horsenails required tough iron: the Navy Board specified that nails that are to clench should be made of ‘Swedish iron or best English rod iron commonly called horse nail rod iron or best tough rod iron and of the best of these’ (NMM, POR/A/1, at 22 Oct 1696).

Oakamoor

Soon after the trial at Nine Elms, works were established at Oakamoor in Cheadle, Staffordshire, ‘at a forge’ (PC 1/4/106/34 and 36), presumably the long established finery forge there, which subsequently became a tinplateworks (Chester 2002; Johnson 1954, 49–52; Awty 1957, 109, 115). Roger Woodhouse instructed Henry Brookshaw, his son and other workmen in the process, and they made several tons of ‘good sound malleable iron from sow or pig mettle with pitcoal only’ (PC 1/4/106/34). Henry Brookshaw referred to another workman Edward Jones as

‘A very intractable workman at learning Mr Tomkins’ method of refining iron with pitcoal, [who] did in working waste and consume an extraordinary quantity of pig metal for that [Brookshaw] could make a ton of bar iron by Mr Tomkins’ method at the allowance of four of five cwt less of pig metal than the said Jones’ (PC 1/4/107/36).

Tomkyns claimed to have

‘Made forty tons of malleable iron from sow or pig metal by the use of a pitcoal fire that proves to be of an uncommon goodness; ... iron can be made in this

way cheaper and equally good if not better than can be done with a charcoal fire' (PC 1/4/107/16).

In this period Tomkyns seems to have been free but keeping out of the way. In July 1728 he received a message that if he made full confession of his interest in the patent 'it would prove a means to make me easy in respect of the debt'. Instead 'Mr Wood and his accomplices' procured his arrest (Tomkyns 1730). This was on 7 July 1728 (Tomkyns Act). Wood then applied for a patent giving him the powers of Tomkyns. Tomkyns claimed to have been offered £10,000 for his invention if a charter could be obtained (Tomkyns 1730). Tomkyns sought his release to allow him to prosecute his ironmaking undertaking, so as to be able to make a composition for his debt. However he languished in prison for several years despite several requests to be released. As his deficit was £42321.6s, the decision not to release him is unsurprising (CTP, 233, 526, 528; TNA, T 1/271/60).

He had hoped to find a bail bondsman, but the size of his debt frightened people off. Rupert Hurst, the manager at Oakamoor was sick and wanted to go to Scarborough, writing to Tomkyns, 'Our brick is quite done and have been sometime, so that our finers play'. He wanted materials ordered. 'We have got the hammermen to [Oakamoor] who like our iron mightily well and say they would rather draw it than any finery iron they ever worked in their lives.' A Mr Hall was alluded to as not having been over (TNA, T 1/266, f.117), this may have been Edward Hall of Cranage, one of the Cheshire Ironmasters' partnership, which owned all the ironworks in the area, including (previously) Oakamoor Forge (Awty 1957, 86, 99–103). Tomkyns unsuccessfully applied for release again in June 1729 and May 1731 (CTBP 1729–30, 103, 117; 1731–4, 290).

In December 1729 William Wood petitioned for a charter of incorporation, but Tomkyns opposed this seeking a rival charter for his process. He was supported by Sir Thomas Mackworth, Sir Archibald Grant, Samuel Palmer, George Robinson and William Goostrey who sought a charter for Tomkyns' process (PC 1/4/106/21–23). Several of these men were concerned in the Charitable

Corporation, a pawnbroking company: Sir Thomas Mackworth had been a director a few years before, Grant was a director and Robinson their banker and circulating cashier while Goostrey was Robinson's attorney. Robinson and Grant (with John Thomson, the warehouse keeper, George Burroughs and William Squire) formed a Partnership of Five, which engaged in large-scale speculation in the shares of the Charitable Corporation and of the York Buildings Company, financed by fraudulent loans from the Charitable Corporation, made against fictitious pledges to it. Robinson, as a stockbroker, managed the speculation. Ultimately, most of the Five absconded abroad, when their speculation failed and their credit was exhausted, but that, again, is another story. After his return from abroad, Thomson was examined by a Commons committee. He stated that Robinson was the bane of the others of the Five, and said Burroughs and Squires had told him that they 'believed Robinson had imposed on them from the beginning, as he had done before on one who was Treasurer for Hawkers and Pedlars, whom Robinson had ruined.' This is a clear allusion to Tomkyns (Commons 1733, 546).

Maidenhead

Robinson was also concerned in a copper and brass works, managed by James Hallelwell, who described the use of Tomkyns' process there (PC 1/4/107/19). This was described as at Taplow near Maidenhead, perhaps because Robinson had an estate at Taplow (east of Maidenhead). However the works seem to be those at Temple Mills on the river Thames at Bisham, between Maidenhead and Marlow, in which Robinson and Sir Thomas Mackworth were concerned (Commons 1733, 546; LG 7231, 15 Sep 1733, 2; LG 7241, 20 Oct 1733, 2). Hallelwell said that he could make sow or cast iron malleable, giving costs (Table 1).

'Every [such] work ... will make 250 tons pa and each work will cost in erecting and to make it complete £800 and will require £1500 stock to work it [working capital]. 80 such works would make 20,000 tons and raise £184,000. The iron made in this manner is as tough good and fine as the best Swedish or any other iron imported into the kingdom and will sell for as much and is finer and better than common English

Table 1: James Hallelwell's estimate of the costs of Tomkyns' process. Source: PC 1/4/107/19

1 building with 2 hammers and 3 furnaces will make 5 ton of good bar iron a week. The expense will be:	
Refiners hammerman and labourer for working and drawing out into bars	£6.0.0
7½ tons of coal at 3/6 per ton (<i>sic</i>)	£1.5.0
9 tons of sow metle at £6 a ton	£54.0.0
Rent of water and ground to build on and wear and tear of tools and forge and furnace £150 pa – per week	£3.0.0
Total (that is £12.17.0 per ton)	£64.5.0

made with charcoal. And 80 works will employ 1000 men besides great numbers raising coal and making sow metal' (PC 1/4/107/19).

Edward Hughes who observed this trial wrote that the air furnace was swept clean and then heated with sea or pit coals. Then several pieces of sow iron, a piece of an old gun and a broken waggon wheel box were put in without any other metal or mixture. After it has lain in the furnace some time, the workmen rolled it into a large ball and took it out of the furnace. They put it under a very large hammer of 400lb which was lifted by a waterwheel and beaten into a bar (PC 1/4/107/37). The yield of 36cwt per ton product (given by Hallewell) is very poor, compared to the charcoal process, where the consumption of a mere 26cwt was an excellent yield and 28–29 cwt, a reasonable one (Hammersley 1973, 604; Ince 1991, 110–1). A good deal of the iron was evidently being burnt. However, the poorness of the yield was counteracted by the cheapness of the fuel. Nevertheless, the calculation made no provision for interest on the capital employed. If borrowed at 5% (the legal maximum), this would have cost £115 in interest, or about nine shillings per ton more. This compares with iron priced £18–19 at this date in the valley of the Worcestershire Stour (WRO, BA 10470/3) and £16.75 at Roche Abbey Forge in Yorkshire (SA, SIR/7–8 and 21–22). Profit would not have on the scale estimated by Hallewell, but would still be substantial. This may be the basis for the appearance of an otherwise unattested Maidenhead Forge (which had made 100 tons of iron per year) in the 1718–1735 ironworks list (King 1996, 32).

Over the following period, James Lowther, Robinson and Goostrey conducted a pamphlet campaign against Wood's proposed company, whose incorporation had the active support of Sir Robert Walpole, the leading minister. Ultimately this became politically impossible due to the failure of the Charitable Corporation in October 1731 when John Thomson and George Robinson fled abroad, unable to pay their debts (*LG* 7034, 26 Oct 1731, 1–2), and the failure of trials of Wood's process (see King 2014). An Act of Parliament was passed in June 1732 to enable Tomkyns to compound for his debt (Tomkyns Act). However, despite a favourable report from a treasury official, his offer of £100 was not initially accepted (*CTBP* 1731–4, 238, 242, 244, 290; TNA, T 54/32, 44–7); he was still in prison the following January. Believing his release was obstructed by the Woods' partner Kingsmill Eyre, he intended to petition Parliament again (LL 93, 25 Jan 1732[3]). Ultimately, his offer was accepted in June 1733. This was on the basis of the report a year earlier and of Tomkyns' affidavit that

he had been supported by the generosity of friends and he had 'not in his power any means of making a better composition or satisfaction' (*CTBP* 1731–4, 387, 447; TNA, T 54/32, 44–7). His father petitioned the Treasury for the discharge of his fidelity bond in 1736 on which he and his fellow surety had each paid £3000; this was referred to the Attorney General whose response is not known (*CTBP* 1735–8, 231; TNA, T 4/11, 77).

Lydney

Lowther's involvement in the campaign against incorporation meant that other people, such as his friend Sir John Meres and Francis Wood, continued to tell him of developments over the following years. In April 1736 Lowther wrote to John Spedding, his agent at Whitehaven, after seeing Frank Wood (Francis Wood, who took out the original patent for Wood's process):

'Fr Wood has a furnace near this town [London] and invites me to see the operations, but I tell him I am no judge, tho' a well-wisher. Tomkyns drew four Parliament men for £500 a piece to make iron in his way in Gloucestershire and the money is all squandered away. I believe Frank Wood works in Tomkyns' way, who pretended [*ie* claimed] to make very good pig iron and then bar iron with ore and pitcoal. Tomkyns blames Goostrey the attorney for the above miscarriage that he drew in above four Parliament men; and then laid out all the money in building 12 furnaces &c; and then buying great quantities of pig iron to make a show and raise a bubble; whereas they should have followed the making iron in three or four furnaces to have given proof of what they could' (LL 96, 13 Apr 1736).

This enables the works to be identified as at Lydney, where in September 1733 Benjamin Bathurst let the Pill [or Lower] and New [or Middle] Forges to Sir John Eyles, William Bowles, William Giles, Philip Roberts and William Goostrey for 21 years. An inventory of fixtures taken at the time includes '16 plates in the air furnace'. By July 1735 the landlord was bringing proceedings to enforce the lease (Hart 1971, 84–5). Tomkyns later called on Lowther, who then told Spedding:

'Tomkyns [*sic*] now in town says that bar iron is so cheap, it is not worthwhile to make it his way with pitcoale, but he will make pig iron cheap enough with pitcoal. So, [I] have advised him to concert with those that have Wood's first project for making pig iron, which he sais they can't make' (LL 99, 28 Jan 1737[8]).

Conclusion

Tomkyns took his advice and joined with others in a project to make iron with pitcoal, presumably in air furnaces. Nothing indicates that this became commercially successful, but the experience gained in this period enabled Charles Wood and his brother John to develop their ‘potting and stamping process’. A later version of this began to be widely adopted in 1785, making possible the great growth in iron production that made it a leading sector in the Industrial Revolution. Writing in 1766 on hearing of the Cranage Brothers’ patent, when building a forge for his process at Cyfarthfa in Merthyr Tydfil, Charles wrote dismissively of Tomkyns’ process, though confirming what Lowther heard. Nevertheless, his description of his process sounds rather more like that devised by his own family than Tomkyns’ process:

‘Making pig or cast metal maleable iron in an airfurnace without pots by putting it into an air furnace upon a sand bottom & suffering it to remain there until bro’t into nature then remove it into another air furnace & further refine it. This method was made use of by one Woodhouse I think a watchmaker 35 years ago & a patent obtained and several gentlemen supported him putting this into practice & good iron was made but the small quantity that could be refined in a week with great waste obliged them to give it up. I do not mention this to invalidate the method, it may have improved, & a better method discovered since that time’ (Gross 2001, 72).

The failure of Tomkyns’ process may be compared with another development of the same period. Whatever technological difficulties there were with making bar iron from coke pig iron using the traditional finery forge of the Walloon process, were overcome at Coalbrookdale in the late 1720s. From that time the forge there used as its feedstock only coke pig iron (with some scull iron – a steely waste from ironfounding). However, the output of the forge was extremely low throughout the 1730s. The failure to spread this success was, like the failure of Tomkyns’ process, due to the low price of bar iron in a period when Russian bar iron was being imported into England in large quantities for the first time and glutting the market. Only in a higher-price environment in the 1750s did coke pig iron become a regular feedstock for forges (King 2011).

Unlike many failed inventors, Tomkyns did not disappear completely without trace. He inherited the family estate near Bromyard and lived out his days there as a country gentleman (Duncumbe 1812, 73), but he did not

participate further in the iron industry. So little is known of Fallowfield’s process that nothing can be said of its success or otherwise. On the other hand, despite its poor yield, Tomkyns’ process was a technological success and may even have been a financial one for a time, until the influx of Russian iron made it uneconomic.

Acknowledgements

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Notes

- 1 ‘Some Memorial Inscriptions – Leek, Staffordshire’, <http://places.wishful-thinking.org.uk/STS/Leek/MIs.html> item F11 (accessed 7 Sept 2015).
- 2 Marriage from <http://www.familysearch.org/eng/default.asp>
- 3 Nine Elms is between Vauxhall and Battersea.

References

Abbreviations for archive sources

LL: Lowther Letters in Cumbria RO, Carlisle, D/Lons/W2/1/ [with file/volume, date]
 NMM: National Maritime Museum, Greenwich
 PC: Privy Council Papers, TNA [with reference]
 SA: Sheffield Archives
 TNA: The National Archives, Kew [T1 – Treasury Papers]
 WRO: Worcestershire Record Office

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- CTP: *Calendar of Treasury Papers 1720–8* (London 1899).
 CTBP: *Calendar of Treasury Books and Papers I–III* (London 1897–1900).
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 Fallowfield W 1731: *Mr William Fallowfield’s proposal for making iron with peat, at ten pounds a ton, in pursuance of a patent granted to him by his late Majesty*. BL, shelf mark 816.m.13(15).
 LG: *London Gazette*. <http://www.london-gazette.co.uk/search> [with issue, date, page]
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