

## Winwoods of Bristol: Part one 1767|1788

### Hugh Torrens

#### Pre-Bristol origins

In view of the important place Shropshire occupied in the 18th century as a centre for industrial and technological innovation it is intriguing to discover that the engineering family of Winwoods of Bristol came from Shropshire in the mid-18th century.

John Winwood III the founder of the Bristol dynasty was born at Cleobury Mortimer in the southern part of the county and was baptised there on 17 February 1732 (O.S.)<sup>1</sup>. Cleobury Mortimer was then an important iron making centre<sup>2</sup> but there is no evidence that John Winwood III's immediate ancestors were directly connected in any way with the iron industry in Shropshire. Versions of the Winwood pedigree have been published<sup>3</sup> but a more complete version relating **only** to those connected with the Bristol business is shown in *figure 1*<sup>4</sup>

There is evidence that the Winwoods of Cleobury Mortimer were men of some stature. John Winwood I (1662~1743) is named as one of the churchwardens of the parish in 1733<sup>5</sup> and his son John II (1698-1766) was a churchwarden there in 1760-1761<sup>5</sup>. The bond for John II's second marriage to Jane Britten there in 1729<sup>6</sup> names him as a clothes dealer and it was witnessed by a Ludlow baker, so we know the Winwoods were tradesmen at this time.

On April 4 1766 John Winwood II was buried at Cleobury Mortimer. He died intestate but his Letters of Administration<sup>6</sup> dated 27 May 1766 give us the first indication of any Winwood connection with Bristol. In this John III, the founder of the Bristol business, is described as of 'the City of Bristol, Sugar Broker'. This vital piece of information shows that it was the sugar refining industry - so important in 18th century Bristol - which had brought the Winwoods first to Bristol. John III's younger brother Thomas (1740-1807) was to remain connected with this business for some years after John III had moved into iron-founding and engineering. The same statement also shows that the Cheese Lane Iron Foundry, known to have been established in 1764<sup>7</sup> and later occupied by the Winwoods, was not then established by them<sup>8</sup>. The same Cheese Lane was earlier the site of Abraham Darby's foundry before he moved to Coalbrookdale in 1708.

Of John Winwood III's life before 1766 we know almost nothing. He was certainly educated at the Free School in Cleobury Mortimer, under the Headmastership of mathematician William Brown (c.1716-1773), which was built from 1739 on<sup>9</sup> and to which he bequeathed £1000 consols on his death in 1810<sup>10</sup> for paying an Usher and other purposes for the benefit of the School. This strongly suggests he was proud of the education the school had provided for him.

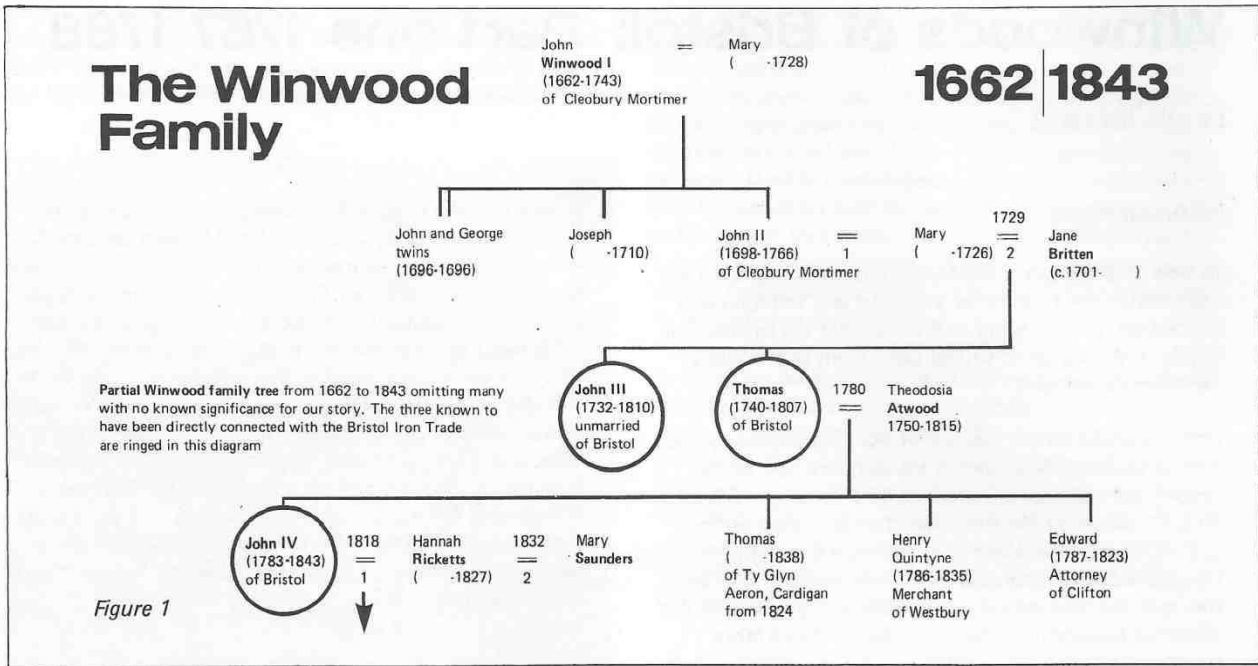
#### Bristol Operations

In 1767 (or perhaps, after May in 1766) John III had

moved into the iron trade probably using funds from his father's estates. In a published letter<sup>11</sup> dated January 13 1798 he writes that he has 'been concerned in no considerable branches of the Iron Trade for more than 30 years past'. He had certainly left the sugar broking business by 1775 being listed in the first Bristol Directory of 1775 only as 'Winwood, Harvey and Co, iron warehouse 95 on the Key' and also as 'Williams and Winwood, engine smiths and screw makers-80 West Street'. The entry for 'Harford and Winwood, fruit merchants, 36 Princes Street' in the same directory is probably connected with brother Thomas Winwood (1740-1807) rather than John III, if so it is the first reference to Thomas in Bristol. Winwood, Harvey & Co were then importers of Russian and Swedish iron, dealers in English bar-iron and in articles made from these<sup>11</sup>.

A quite unrelated entry in the same 1775 directory<sup>12</sup> is one 'John Jones, iron founder 40 St. Philips Plain'. Jones is a man who is completely forgotten today but he was a supplier of Newcomen engine parts to Cornwall from at least 1750 to 1775<sup>13</sup>. On 4 January 1777 John Jones was granted a patent (no.1143) for 'a Machine for Raising Water ... by ... Steam'. The patent is not illustrated and is thus difficult to follow but a contemporary illustrated advertising leaflet of 'Jones and Cos patent machine for lifting water' is preserved among John Rennie's papers<sup>14</sup>. From this and a letter dated 14 June 1777 from Thomas Dudley (a Boulton and Watt engine erector in Cornwall) to James Watt<sup>15</sup> we know it was on 'the principle of Capt. Savery and raised water 33 feet high' and was applicable to driving water wheels etc. Dudley reported that it was not likely to prove of much use in Cornwall and it was thus not to be regarded as any form of threat to the Boulton and Watt steam engine which had just been introduced to Cornwall and which Dudley was then erecting there.

In a letter written on 19 July 1781 by James Watt from Cornwall to his Birmingham partner Matthew Boulton<sup>16</sup> we learn for the first time that Messrs. John Jones and John Winwood had joined forces in a business partnership which was to form a much greater threat to Boulton and Watt. This partnership nowhere appears in the Bristol directories but must have come into being between 1775 and 1781, trading in exactly the same materials and articles as Winwood and Harvey<sup>11</sup>. This letter describes Watt's reaction to the newly patented (no.12981 steam engine of Jonathan Hornblower (1753-1815) of Penryn in Cornwall which had been patented only 6 days prior to Watt's letter. Watt writes 'Now to this damnable affair of the new engine. I would wish the patentees in hell. ... Ever since the ungrateful idle, insolent Hornblowers knew anything about our engines they have laboured to evade the act ... [Jonathan] has now completed and taken a patent for [his new engine] concerning which I learn as follows from public report - that Jonathan Hornblower is the inventor and patentee, that Winwood, Jones and Comp.<sup>y</sup> of Bristol are his partners and supporters with money - that Winwood was lately in this county [Cornwall] on a sleeveless errand is certain'.



That Watt could be equally sleeveless is shown by his continuing 'if their patent has not yet past the seals or if they have not specified, you should cause a good lead pipe, 2½ [feet] diam. 33 feet long with a valve and water box at bottom to be fixed to the lower communicating box of the Bedworth Engine which will invalidate their patent if they go on that scheme. We ought to have done this before ...'. Watt concludes 'now my dear sir, what are we to do, if this engine be good for any thing a lawsuit is inevitable and the event precarious, however we may stave off the evil for some years by the blessed chicanery of the Law. It will be highly necessary to prevent reports being spread of any engines being equal or superior to ours ... I fear this affair will hurt our credit unless some means can be devised of crushing it timely and if they succeed in doing anything to purpose and can evade our patent, it will go far to ruin us'.

Despite these remarks by James Watt, Jonathan Hornblower is today widely regarded as the father of the compound steam engine<sup>17</sup> and of practical expansive operation<sup>18</sup>, and the first in a distinguished line of Cornish engineers who so greatly contributed to the full development of the steam engine. John Winwood's involvement with this pioneer of the steam engine has however been forgotten and never explored in detail. Why they became partners is not known but the Shropshire connection is one obvious link. Cleobury Mortimer is after all only 20 miles south of Broseley where Jonathan Hornblower senior (1717-1780) was born and married, and where his eldest son was born before the family moved to Cornwall in 1745. The complex story of the Hornblower family, further complicated by a predilection for christian names beginning with J, has been well told by T R Harris in the Journal of the Trevithick Society<sup>19</sup>. The problem of many Hornblowers bearing identical initials has meant that they have been frequently confused and misidentified. Their connection with Bristol extends as far back as 1749 when Joseph Hornblower father of Jonathan Hornblower senior erected a Newcomen engine at Warmley for the brass company there<sup>20</sup>. Its erection, after manufacture in Birmingham, started in

August<sup>21</sup> and Hornblower then wrote of 'the pickle I am in here, having no one but James Baker that has any acquaintance with an engine. As to Mr. Champion [of the Warmley Company], I think there are few mortals "queerer". I hope I shall have done with them soon - in five or six weeks at most'.<sup>22</sup> Joseph died at Bristol in 1762.

Jonathan Hornblower has suffered in many accounts because of the intense rivalry that developed between the Boulton and Watt engine and the Hornblower and Winwood engine. As. Pole<sup>23</sup> later said 'he always maintained an excellent character in Cornwall ... but the mistaken and over-driven zeal of Watt's friends [and we should add Watt himself<sup>24</sup>] has led them to think it necessary for Watt's fame that the merits of Hornblower should if possible be buried in oblivion'. It has for example been often stated that Jonathan Hornblower had previously been an engine erector for Boulton and Watt<sup>25</sup> on the original authority of both James Watt junior in 1834 and others before him.<sup>26</sup> The inference or accusation followed that this gave him access to Watt's invention which he then abused. Yet we have the testimony of Jabez Carter Hornblower (1744-1814) that his brother never worked for Boulton or Watt<sup>27</sup> - and Jonathan's own statement that work on the first model of his engine finally patented in 1781 was completed and at work in 1776 **before** he even knew of Watt's engine<sup>28</sup>.

Jonathan Hornblower's patent was dated 13 July 1781 and he was then in business partnership with John Winwood in Bristol, who was twenty years his senior. The nature of the relationship has never been established. Dickinson<sup>29</sup> claimed that Hornblower's first engine was erected **for** Winwood while Nelson<sup>30</sup> said that Winwood was just 'a wealthy capitalist who was backing up' Jonathan Hornblower. This first engine was erected over 1781-1782 at a colliery near Radstock in Somerset which seems at first sight a strange location for a Cornish engineer, surrounded there by mining activity, to choose. As we shall see there were two important reasons for the choice of Radstock - one was the guarantee of a plentiful supply of light coal, not however of ideal

quality for the engine, which would not be available in Cornwall; the second was the proximity of the site to Bristol where John Winwood was based. Cornwall had relied on Bristol for its ironwork and other materials for a long period before this and this was to continue into the 1830's. Only the ironwork for the first Clifton Suspension Bridge in 1840 was at last to directly reverse this trend<sup>31</sup>.

### The Radstock Engine

The Radstock engine has been often mentioned and the best description of its technical working and the changes it underwent is by Jenkins<sup>17</sup>. The decision to build the engine at 'Radstoke' must have been taken soon after the granting of the patent, and building work there started in 1781. From August 1782 it was at work<sup>32</sup> and both Watt and Boulton received many regular reports of its progress and the problems which the engine engendered either by personal visits or from a series of industrial spies sent there by Boulton and Watt. This process of industrial espionage also operated in Bristol partly through the agency of Quaker soap and chocolate maker Joseph Fry (1728-1787). In April 1782 Joseph Harrison, an employee of Boulton and Watt, got to Radstock and Bristol and was able to report the current state of progress. No parts of the engine had then arrived at Radstock, they were then still at Jones and Winwood's works to which Harrison was refused admittance twice but succeeded on the third attempt. His report<sup>33</sup> on the unassembled engine includes details of the cylinders which he estimated to be 26 ins. dia. and 11 feet long and 18 ins. dia. and nearly 7 feet long. 'The nossels are fitting up at one Macdollinsons a general smith in Bristol' where Harrison was also able to gain access by ordering a pair of steel rollers which he did not need!

After the engine was set to work at Radstock the first reports were mixed. John Southern in letters to both Boulton and Watt in October 1782<sup>34</sup> reported that it 'answered very well - has drawn 13 or 14 weeks water out of the mine and that the proprietors are well satisfied' and with its consumption of coal. He also listed the 10 proprietors in the Radstock Company and the 2 engine tenders are named as Samuel Deverell [1759-1803] of Sal[t]ford and Thomas Palmer [junior] of Kingswood. George Watson<sup>35</sup> junior visited the engine in the same month and again elucidated the names of some of the partners in the colliery against whom Boulton and Watt intended to take action for using an engine which it was claimed infringed Watt's 1769 patent. James Lawson's letter of 14 October<sup>36</sup> described such of the technical features as he had been able to observe on a surreptitious 5 minute visit. His letter and John Southern's show the engine was then using a surface condenser with a nest of tubes in the base of the large cylinder<sup>17</sup> which worked by passage of cold water against the condenser.

In November 1782 two members of the then flourishing Bath Philosophical Society James Collings (c.1721-1788) and Dr. William Watson (1744-1824), both of Bath, visited the Radstock engine to investigate it for Matthew Boulton<sup>37</sup>. But they saw nothing but the end of the main beam and were ushered off the premises by one of the proprietors who were by now becoming seriously worried about their becoming involved in an unforeseen lawsuit with Boulton and Watt<sup>38</sup>. On November 20 Thomas Wilson (1748-1820), Boulton and Watt's main agent in

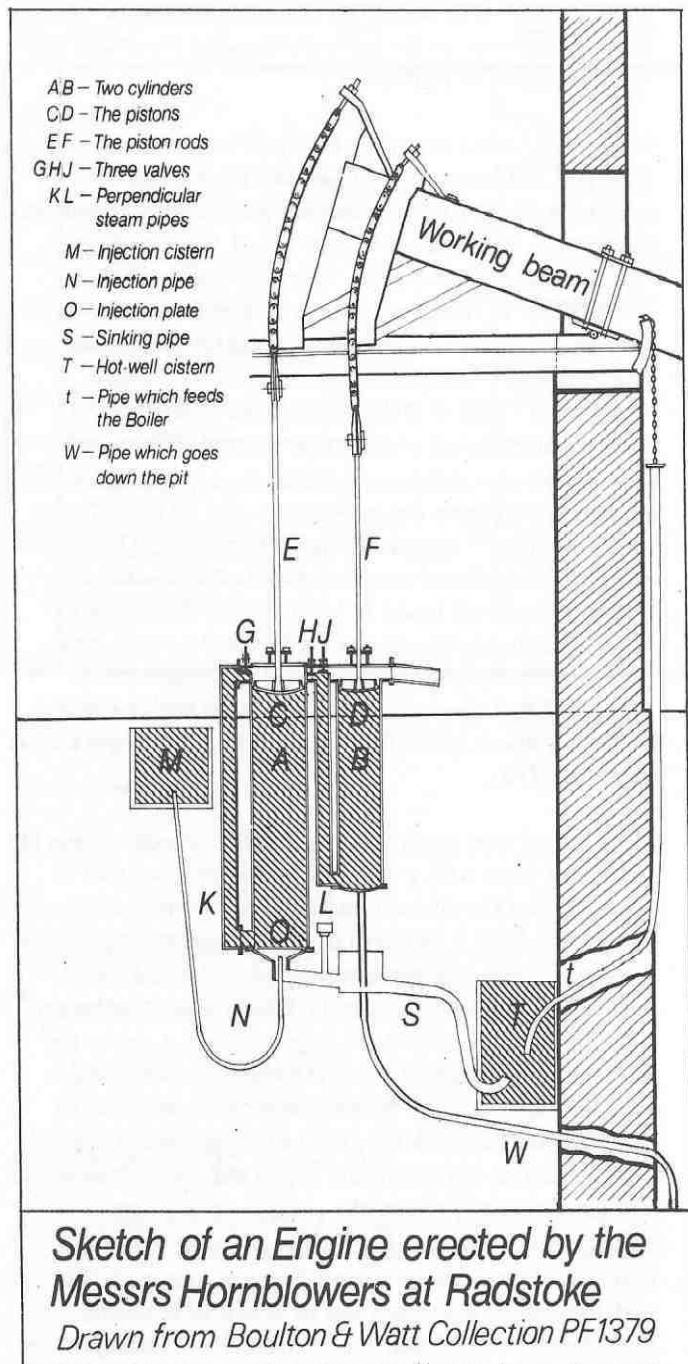
Cornwall and who thus had a highly vested interest in seeing Watt triumph over all competitors, was more successful. He approached the Vicar of Radstock who took him to see it as his friend. John Hill, not knowing his true identity, ordered them 'to be shown every part of the engine' but this ruse was only partly successful because the engine man was then found to be drunk!<sup>39</sup>

From these letters about the Radstock engine we learn that John Hill, inn keeper of Paulton, was the manager and a proprietor in the Radstock company and a 'man of property' in the area. Major James Tooker (1728-1813) of Norton Hall, Chilcompton and Capt. Francis Edwards Whalley (1743-1813) of Wrington were two other proprietors who were later to serve on the original Somerset Coal Canal Committee in 1793. Other proprietors were Richard Gould (died 1793) of Wells, John James of Welton and Capt. Charles Savage of Midsomer Norton. There has been some debate about the actual site of the colliery. Bluhm<sup>40</sup> suggesting the engine was at Radstock Old Pit while Down and Warrington<sup>41</sup> suggest Radstock Middle Pit. Old Pit was sunk in 1763 and coal soon found. At what must have been Middle Pit coal was found in 1779 and the shaft sunk by 1790. The chronology of sinking Middle Pit fits so well the date of installation of the Hornblower engine over 1781-1782 that there can be no doubt the engine site was Middle Pit where James Tooker and John James were known lessees in 1775.

There is no doubt that at first the double cylinder engine did not always work well, a fact that James Watt was able to gloat over and Hornblower and Winwood frankly admitted<sup>42</sup>. By October 1782 it had been decided to replace the original tubular condensing apparatus made of lead in the base of the large cylinder with a jet device hitting a copper diaphragm<sup>43</sup> but still inside the base of the large cylinder. Luckily the mine was not too greatly inconvenienced when the steam engine ceased work. As Boulton reported to Watt on 19 Oct. 1782 'At Radstock they have all along worked 2 water wheels in conjunction with the engine and each wheel works four pumps with 3 foot stroke ... viz the pumps are alternately connected with ye water wheel or with ye engine as occasion may require. These pumps work 3 ft each per minute which amount to nearly 19 thousand cubic feet per day [from] 82 fathoms'.<sup>44</sup> Drawings of the engine in this modified state seem to be the earliest of it to have survived. One has been reproduced in 1927<sup>45</sup>, the original drawing<sup>46</sup> is annotated 'Plan of Radstoke engine given by one of ye Hornblowers to Mr. Warltire and by him to William Murdoch'. This is John Warltire (c.1739-1810), an important itinerant lecturer on both science and technology, who lectured widely in the West Country in this period<sup>47</sup>. John Warltire started a new course of lectures in Bristol on January 16, 1783 and it must have been on this visit that he acquired the drawing. Another drawing in the same state, a sectional diagram, is undated<sup>48</sup> but from a reversed copy which has also been preserved<sup>49</sup> and which is dated February 1783 we know by when it was produced. It is reproduced here as *Figure 2*.

In December 1782 Joseph Fry of Bristol introduced Boulton and Watt to William Jones a millwright of Pen Street, Bristol who engaged in spying for Boulton and Watt<sup>50</sup>. By September 1783 Jones reported<sup>51</sup> of the engine that the 'main beam broke and is mended with the old timbers

cramped with iron which he does not like'; this was the one part of the engine of which James Watt had expressed his approval<sup>52</sup>



In April 1783 Fry wrote two long letters<sup>53</sup> to Watt giving details of Wm. Jones's Bristol discoveries. He stated '[Jonathan] Hornblower is only a servant, and the Proprietors of the Radstock work are not chargeable with these expences [of correcting and modifying the engine faults] nor John Jones and Son the Iron founders but John Winwood alone whom Hornblower has prevailed on to go these lengths and enter into these engagements'. The second letter reports a visit that Jones had made to Radstock with [Benjamin] Bond, Jones and Winwood's works foreman, and notes 'Doctor Horner has done very little to cure his patient of her violent spasmodic snoring'. Jones also reported that the earlier tubular (200 or more brass pipes of about 3/4 in. diam.) condensing apparatus was abandoned when the chain connecting the main beam to the piston in the large cylinder broke, and destroyed them. Jones ends by saying that a colliery near Paulton was in need of a steam engine but

would not consider a Hornblower-Winwood model. It is obvious that Jones was terrified that news of his espionage would get back to Bristol and it would be interesting to know how he is related to the Bristol firm of millwrights, who were later listed as engine pirates by Boulton and Watt (see footnote 87).

By June 1784 the engine was working well and Hornblower; and Winwood issued a printed notice of the 'Radstock Fire Engine' which is reproduced here as *figure 3*<sup>54</sup>. In September 1784 John Rennie who was then working for James Watt visited and made notes of the engine<sup>55</sup>. The printed notice introduces us to a new character in the Radstock engine story, Thomas Shore the engineman with experience of Newcomen engines since 1770, who worked the Radstock engine from at least January 1783 to August 29 1788. There seems no doubt he was the son of John Shore of Paulton named as the engineer for the Paulton engines in 1764<sup>56</sup>. Four of Thomas's letters survive<sup>57</sup> and show us how effectively Boulton and Watt had prepared their ground in the Radstock area! On Feb.21 1785 Shore writes to ask Mr. Boulton or Mr. Watt for a job as an engine man or a general smith; and ends his letter 'I desire you will not discover to no Person that I have rote [sic] to you'. His second letter is the most interesting as it gives us the crucial information of the actual relationship between Hornblower and Winwood. Shore writes 6 April 1785 'Our gentlemen [the Proprietors of the Radstock colliery] met Mr. Winwood and Mr. Jones belonging to the Iron Foundry in St. Phillips, Bristol in order to pay them for Our Engine. The estimate Hornblower gave the Gentlemen in the first place was 340 pounds and the Engine cost more than 900 pounds so the Gentlemen will not pay them onles they will give them a bond to endemnify them from all trouble for thay do expect you will enter a Laugh Sute (sic - lawsuit) against them and Winwood will not give it them'. This is more proof that Winwood was not the man for whom the Radstock engine was built nor merely Hornblower's financial backer as has been suggested. Winwood and Jones were the founders and engine smiths chosen by Jonathan Hornblower to put his highly complex engine together for him. Hornblower it must be remembered was described merely as a plumber and brazier in his 1781 patent. John Winwood was in addition a financial partner in Hornblower's 1781 patent although he is never named in this patent or the 1792 printed bill in which Hornblower (unsuccessfully) sought to expand his patent rights for an further term of years beyond 1795. We know from Jonathan Hornblower's letters to James Watt<sup>59</sup> that Hornblower held 3/5 of the patent rights and Winwood the remainder. Furthermore Winwood retained his rights until the patent expired in 1795. His share in it was not purchased by David Maberly as has been stated in the past<sup>60</sup>. The Maberlys in fact acquired a share in a quite different patent that of Isaac Manwaring (no.1792 of 10 February 1791) for a pendulum steam engine, which was improved by brother Jabez Carter Hornblower<sup>61</sup>.

Thomas Shore himself must have been a considerable thorn in the side of Hornblower and Winwood since it meant that the man in charge of the Radstock engine was himself siding with Boulton and Watt! We have seen how he relayed technical information to the Birmingham partners. As he wrote in February 1785 'I do not chuse (sic) to work where Hornblower have any thing to do with ... I should be glad to see you at Bath or Bristol if you should come there if it

do not sute to employ me'. In April 1785 he reported that James Stephens (c.1748-1816) and Co. of Camerton colliery and Jacob Mogg (c.1729-1806) and Co, of High Littleton colliery were to erect engines at these mines but 'the Gentlemen will not let Hornblower put either up'. Shore wondered whether Boulton and Watt might be interested in the contract! In June 1787 Shore writes to James Watt 'last week I had to (sic) Gentlemen came to see my engine at Radstock and the week before too (sic) more came by Hornblower's Orders, thay all belong to Coper mines in Cornwall. They all apered as gentlemen and they are a going to have sum engine erected and boath times that they came Mr. Hill [the managing proprietor] happened to be at the Engine so that I could not tell them as much as I should', [no doubt to disparage the engine's performance]. Jabez Carter Hornblower, Jonathan's brother, gives further information<sup>62</sup> about Shore's incalcitrance 'in defiance of all order and regularity, the man who tended the engine and pretended to understand it better than his master, would clandestinely detach the smaller cylinder from the other and work [the engine] only with the large one: but when-ever detected an idle excuse only intervened between it and the restoration of things'. When Thomas Shore left Radstock he was rewarded with a job, one gathers through Watt's influence, working on the Albion Mills contract in London as a Boiler maker in September 1788. His last letter adds that Jonathan Hornblower was then September 1788 'running a daily skool at Tewxbury (sic - Tewkesbury) in Gloucestershire'. one presumes to be nearer the Bristol scene of operations than he could be in Cornwall, During the early years of the construction of the engine (1783) he was living in Bristol. Brother Jabez Carter Hornblower was also based in Bristol in 1786<sup>63</sup> and one of the Hornblowers was there in 1785<sup>64</sup>.

There has been some debate about the number of engines Hornblower and Winwood erected in the Bristol area before moving the centre of their operations to the lucrative mines of Cornwall. Rhys Jenkins<sup>65</sup> stated that a second engine was set to work in the Radstock neighbourhood at a colliery at Timsbury by 1784, but this has been recently denied by Rogers<sup>66</sup>. Thomas Shore however confirms Jenkins' statement. His letter of 21 Feb.1785 reads 'Hornblower have erected another engine at Timsbury 3 miles from us. The pit [there] is but 30 fathom deep and there is 3 six-inch pumps in, and he do work but one with his Engine, he have not got Power enough. Thay do work the other 2 pumps with horses'. Watt's letters to Boulton of 21 Oct.1784 and 12 March 1785 also mention this engine<sup>67</sup>.

The site of the Timsbury engine is not known. The map of the Somerset Coal Canal surveyed in 1793 and probably issued in 1796 by John Cary shows 7 collieries to the west and north-west of Timsbury. Of these two were opened after 1794. Of the remainder Mearns Colliery seems at first sight a possibility especially as Down and Warrington<sup>68</sup> suggest it was opened soon after May 1783 which would fit with a steam engine installation in 1784. However there is evidence that Mearns colliery was in fact at work in 1766<sup>69</sup> and it is thus no more likely a site than any of the other four.

Rogers' denial of the existence of a second Radstock engine was justifiably prompted by a statement made by Boulton

and Watt in 1792 in opposing Jonathan Hornblower's application to prolong his 1781 patent in the same way that James Watt had successfully sought to prolong his 1769

JUNE 10, 1784.

## A STATE of the Fire Engine

A T

### Radstock Coal-Work in Somersetshire.

Bottom Lift of Pumps -	32½ Fathom	Bucket 4½ Inches Diameter.
Second ditto - - - -	18	ditto 4½ ditto.
Third ditto - - - -	22	ditto 5 ditto.
Top ditto - - - -	22½	ditto 5½ ditto.

95 Fathom, Mean Diam. 4. ⅞ Inches.  
Cylinder - - - 19 Inches Diameter.  
Length of the Stroke 5 Feet 8 Inches.

Burnt only two heaped Bushels of Coal in 2 Hours and 20 Minutes; made 1545 Strokes in exactly two Hours, and worked in the same Proportion the remaining twenty Minutes, which on an Average is 13 Strokes per Minute. The Coal was measured by an Iron Bushel of 18 Inches Diameter, and 9 Inches deep; one of which weighed exactly 88 lb.—By this it will be found (striking off five Minutes of the Time) that the Engine raised 9462 Gallons of Water 95 Fathom, in two Hours and a Quarter, with two Bushels of Coal; during which Time the Boiler was fed with cold Water, the hot Water Pump being by Accident then out of Order.

During the above Time the Barometer was steady at 26 Degrees.

From the above Dimensions the Weight of the Column of Water will be found to be 4609 lb. and the Power of the Engine 16. ⅞ lb. to a square Inch on the Piston.

That no wrong Conception may be form'd about the Burning of the Coal in the above Experiment, it must be observed, that the Watch was not set, nor one Stroke counted, till after some Part of the two Bushels was put under the Boiler; and that at the Expiration of the two Hours and twenty Minutes, the Fire was as good, and the Engine worked as fast as at any Time during the above Period. And it is supposed as the Radstock Coal burns very fierce, but is not very durable, that two Bushels of Tenby Coal would have lasted much longer.

Sometimes the Engine works 14 or 15 Strokes per Minute, but Care was taken during the above Trial to waste as little Steam as possible.

It must also be observed, as the Column of Water is so deep, and so small, the Rub and-Friction must be greater in Proportion than in larger Engines.

*We whose Names are hereunto subscribed, are Witnesses to the following Facts mentioned in the foregoing Account, viz.*

The Depth of the four Lifts of Pumps, and the Dimensions of the Buckets,—the Diameter of the Cylinder that works the Engine, and the Length of the Stroke,—that two heaped Iron Bushels of Coal of the above Dimensions and Weight, worked the Engine two Hours and twenty Minutes, after the Rate of thirteen Strokes per Minute, and that the Coal was fairly burnt in the Manner above described.

JOHN HILL, (one of the Proprietors.)  
THOMAS SHORE, (who works the Engine.)  
JAMES WALKER, (Clerk to the Proprietors.)

patent in 1775. This statement said that Hornblower had erected only two engines between 1781-1792<sup>70</sup>. Hornblower's own Case printed in the same year gave further details of why only two engines had been **successfully** erected in this period. The Radstock engine he said 'did not succeed at once' and this engine was thus condemned in popular opinion although the problems were soon resolved [probably by the jet condenser]. 'This circumstance concurring with the fears of the Public from a Pretended claim of Messrs. Boulton and Watt **rendered abortive all future attempts** ... till 1790<sup>71</sup>. The Timsbury engine, one of the future attempts mentioned here, must have been dismantled, either because it failed to come up to expectations or the proprietors feared prosecution, It was in any case in Hornblower and Winwood's interest to declare as few successes as possible to help their case in 1792.

A third engine was also built by Hornblower before they started supplying Cornish mines in 1790. This is the so called Penryn engine which started working in 1784 but about which little was known<sup>72</sup>. This was not a full scale model nor was it ever put into practical operation at a mine. It was not finally finished satisfactorily until 1787. On March 1 1787 Thomas Wilson wrote to James Watt<sup>73</sup>. 'It is finished and works very well, so says David Watson who has seen it ... Hornblowers say they have orders for 4 ... It seems they have made great alterations from their first plan particularly in the condenser. Murdoch has promised one to draw a sketch of it for your information. I find they have had their castings from the Dale Co [Coalbrookdale]; [Joseph] Rathbone and [William] Reynolds have been in the country [Cornwall] [and] were present when D. Watson was there and seem'd mightily to approve of it'. A drawing and an explanation, which are both dated 1787 and are certainly complementary, have survived<sup>74</sup>. They show the condensing apparatus was still in 1787 a jet in the base of the larger cylinder directed against a 'dashing plate'. It must be this drawing and explanation that were described in a later letter from Thomas Wilson<sup>75</sup>. 'Though they make a supposition in their description of a 12 inch, the drawing is from their Penryn one; the lesser cylinder being 9 in. and the larger 11 in.' The Penryn description was supplied by a Mr. Edwards and this engine is noted as an experimental one, loaded only with weights for testing purposes, and never put into use for mining.

Nor could parts of it have been used for later Hornblower engines erected in Cornwall as has been suggested<sup>76</sup>. The main significance of this engine for our story is that castings for it were supplied not by Winwood in Bristol who however financed it but by the Coalbrookdale Company in Shropshire doubtless because Jonathan Hornblower wanted to widen the sphere of influence of his engine. Penryn and not Bristol was chosen as the site, to demonstrate direct to Cornish miners what the engine could achieve<sup>77</sup>.

It has been said of the pioneer Radstock engine that after October 1783 it 'was not very successful and was replaced within a few years<sup>78</sup>. In fact it was still working in March 1792 when William Murdoch called to see it on his way from Cornwall to Birmingham and found it working with only the large 24 ins. cylinder<sup>79</sup>. In April 1791 Thomas Wilson reported that this single cylinder - working had been in operation for 3 or 4 years at Radstock<sup>80</sup>. How long this engine, and if always thus modified (see p.13) in operation,

continued at work is not known. An illustration of a 'construction near Bristol' first appeared in 1797<sup>81</sup> in an article by Watt's friend John Robison, suggesting that the Radstock engine was still at work then. Later versions such as that reproduced in 1818 and as *Figure 4* (on cover) from A. Rees's *Cyclopaedia* article 'Steam Engine' by John Farey junr<sup>82</sup> are based on it. Interestingly in view of the later history of Hornblower and Winwood's engine it now shows that a clearly separate conical condenser outside the two cylinders has been adopted (L in figure 4). Dickinson and Jenkins<sup>83</sup> have suggested that this was perhaps fitted after Hornblower had ceased to be concerned with the Radstock engine.

Evidence that the Radstock engine had ceased work by 1802 comes from the description in that year<sup>84</sup> of the main beam of an engine, said by John Farey<sup>85</sup> to refer to this Radstock engine. Here the Beam is said to **have** worked 'for many years under a great load', suggesting it had however ceased by 1802. It is probable that the steam pumping engine known to have been erected at Middle Pit in 1801<sup>86</sup> was the engine that replaced Hornblower and Winwood's which would then have been 19 years old.

Several writers have commented on the ingenuity and real skill shown in the construction of the Radstock engine<sup>81</sup> 'so costly and so difficult in its construction', comments which rebound just as much on the practical skills of Winwood, Jones and their workmen as those of the inventor (and his brother Jabez Carter who was responsible at least for the beam construction).

It is not certain how long John Jones and John Winwood were partners. Indeed the range of iron making and selling activities in Bristol in which John Winwood played a part is not wholly clear. It seems as if there were four separate undertakings in iron at the start which gradually diversified. From the *Directories* and other sources it becomes clear that John Winwood took over the Cheese, Lane foundry of John Jones between 1787 and 1792<sup>87</sup> presumably on the death of the original proprietor. It was probably in 1789 as a letter from Robert Sayer to Boulton and Watt dated 29 December 1789<sup>88</sup> asks if they could alter his existing engine to use in grinding corn at Bedminster Mills which 'is a patent engine of late Jones & Co now Winwood - the cylinder 22 inches [now used] for raising water'.

In addition to the iron trade John Winwood was certainly in business in Bristol in other fields. Shipping, in which the Winwoods later played an interesting role, was one of these. It is recorded<sup>89</sup> that John Winwood was one of the two owners of the sloop *Gypsey* in 1778 which was reported in 1779 to have been taken by a French privateer and sent into St. Malo.

### Hornblower and Winwood and the Cornish market

Cornish mine owners and adventurers had considered and were encouraged to erect Hornblower engines from 1782 on, very soon after Hornblower's patent had been granted<sup>90</sup>. But because of technical difficulties with the engine at Radstock and the fear of prosecution by Boulton and Watt if the Hornblower-Winwood engine was adopted no firm Cornish orders were at first forthcoming. With the successful installation of the experi-

mental Penryn engine there by 1787 the way was now clearer for Hornblower and Winwood to consider the proper exploitation of the lucrative Cornish engine market. How lucrative this was to Boulton and Watt can be seen from the figures quoted by Roll<sup>91</sup> and others of premiums paid to Boulton and Watt for savings due to the Cornish use of the Watt engine:-

1780-1791 (inclusive)	£76,000
1778-1798 (inclusive)	£106,200
1781 to Sept.1800 (inclusive)	£139,400

In mid 1788 Hornblower and Winwood decided to appeal 'to the Lords, Adventurers and Others concern'd in the Mines of Cornwall' with an eight-page printed pamphlet dated from Penryn in Cornwall, 1 May 1788<sup>28</sup>.

In this they pointed out that their engine had been misrepresented and that it was claimed to be an infringement of James Watt's 1769 patent. If this was so they asked, why had they not been already taken to court over the Radstock installation? They then contrasted their engine with Watt's in the following terms:-

The superiority of Mr Watt's Engine, over that of Mr Newcomen, which was in general use before, consists chiefly in remedying that great evil of cooling the cylinder, or steam-vessel, at every stroke of the Engine, by the admission of cold water, and as the steam-vessel must be as often heated, in order to preserve the elasticity of the vapour, there must be a great expence of steam to produce this effect. Now the application of this improvement to our Engine would be useless; nor have we adopted it, for we do admit the condensing water into the cylinder. Which is sufficient of itself to evince, that the principles of the two machines must be, and are very different.

But in order to prove yet further, that the two inventions are not at all similar, we observe, that ours consists in causing the steam, after it has operated in one cylinder, to pass from thence into another; and there (whilst it is succeeded in the first by a fresh supply from the boiler) produces a second effect. By this means the steam is employed to the greatest advantage that is possible, for while it actuates the first piston, it retains its full elastic force, but when it is applied to press on the second piston, the communication with the boiler is cut off; and it is then permitted to expand itself, by being admitted into a cylinder of greater capacity. Now it is evident, that in proportion as the steam loses its expansive force, by being admitted into a larger cylinder, it will in the same proportion, have an enlarged surface to act on, from an equal increase in the area of the piston; therefore the effect of the steam is the same, though its elasticity be diminished. We then further observe, that the same steam which is extended over the second or large piston, is by an open communication extended from thence under the surface of the small one. Thus it is, that while the steam is becoming weaker between the two pistons, it loses nothing of its efficacy on the large one, and the small one being pressed on by the steam from the boiler, cannot be supported by that which is under it, both the pistons are therefore at the same instant, forcibly impelled, and in their descent the steam below the small one is protruded from thence to follow the large one, in the second cylinder.

To enter here into a fuller explanation of the nature and principles of our Engine, so as to point out all its advantages, would be far exceeding our present design; but we hope this will be sufficient to convince every unprejudiced person, that the principles of Mr Watt's Engine, and ours, are widely

different; and that we have not varied the construction, with a view to effect an evasion, as has been hinted by our adversaries.

With respect to other Improvements which Mr Watt has specified, such as cloathing the cylinder, with wood and other materials, grease, &c. and steam on the piston; we consider every man as having a right to the use of, it being well known that they were all introduced into practice, prior to the date of his Patent. As to the application of an air-pump, we do not contend for, nor do we stand in need of it; as we do by a simpler, and more effectual method, expel such air as would be detrimental to the working of the Engine.

The fourth article of Mr Watts specification relating to steam on the piston, seems to be the principal matter of dispute; for which reason it is what we wish most to consider. And without dwelling on the vague and uncertain manner in which it is worded. we pass on to observe that so far from this invention being new, it was made public at least fifty years since, and in order to prove this, a description of it, illustrated with a copper-plate, may be seen at this day, where the expansive power of steam is employed to impel the piston, on a vacuum which is made in the upper part of the cylinder; and where the piston is connected to an iron rod that moves through the cylinder lid. Which plainly demonstrates, that the power of steam employed to force into a vacuum, intercepted by a piston, is of ancient date. Since which time others have also claimed an exclusive right to it, yet still at an earlier period than when Mr Watt first adopted it; and as a proof thereof, we need only have recourse to his own words at the end of his specification, which bear a subsequent date to the specification itself; wherein he says, that he does not intend that anything in the fourth article, shall be understood to extend to Engines of certain descriptions (which he has therein described). Now why was he obliged to insert this, if it was not understood that he himself did interfere with another persons' Patent, the term of which was not then expired? Is it not then very plain from hence, that he is not the original inventor of it?

That we did not even take the hint of our improvement from Messrs Boulton and Watt, we have evidence sufficient, who saw our Model at work in 1776, which was long before we heard of those Gentlemen or their Patent.

It is notable that Hornblower and Winwood did not in their view use a separate condenser. It was only later that this became a central point in the legal and parliamentary disputes that followed. That the possibility of disputes lay clearly before them is shown by their penultimate paragraph.

We are ready to treat with any set of Adventurers, and undertake, either to alter any of their present Engines, or build new ones upon our own Principles, allowing them terms so much to their advantage, as they can not reasonably object to: And also to indemnify them by a proper Bond, against all costs and damages at law, that may ensue from a Prosecution by any other Patentees.

How Cornwall and Boulton and Watt reacted to these proposals will be discussed in Part II.

#### Acknowledgements:

*This paper could not have been written without the help and encouragement of many people. Joan Ryder helped*

with Winwood genealogy and Jenny Tann kindly allowed me to see advance copies of her two papers in press with the Newcomen Society. I gladly acknowledge the kind help of the staffs of the Record Offices in Bristol, Hereford, Shrewsbury, Taunton and Truro, of the Reference Libraries of Bath, Birmingham, Bristol and Shrewsbury and of the National Library in Edinburgh, my own and London University Libraries and the Royal Institution library in Truro. Tony Woolrich and Joan Day kindly read an early draft of the manuscript and made a number of helpful suggestions.

References

1 Shropshire Parish Register Society (Diocese of Hereford) Cleobury Mortimer Registers 1904, Vol.9, pp 1-340. (Page 169, He described himself as nearly 70 in a publication dated 23 Oct. 1800).

2 Auchmuty S F F, History of the *Parish of Cleobury Mortimer*, 1911, pp 11-13. and Lewis S, *A Topographical Dictionary of England*, London, 1831, Vol.1, p 469.

3 Burke, Sir Bernard, *A Genealogical and Heraldic History of the Landed Gentry of Great Britain*, 13th edition 1921, edited by A W Thorpe, London: Burke, pp 1916-7. and KC Hodgson, *Out of the Mahogany Desk*, London: Research Publishing, 1971.010 24-25.

4 I gratefully acknowledge the great assistance of Miss Joan Ryder of Craven Arms in preparing this pedigree and in much other valuable discussion about the Winwood family.

5 Auchmuty S F F (note 2) pp 56 and 62.

6 Preserved at the Herefordshire Record Office.

7 *Bristol Directory 1877* Advertising section, p 432.

8 Farr G, Bristol Quay Bollards, *BIAS Journal* 3, p 5.

9 Lewis S (note 2) p 469.

10 Memorial in Cleobury Mortimer church; and *Shropshire Charities for Elementary Education: Shrewsbury*, 1906, p 21 .

11 Winiwood J, *A letter to Lord Sheffield dated Bristol* 13 January 1798. [Publisher not named] p 1-2.

12 Sketchley's *Bristol Directory 1775* reprinted 1971 by Kingsmead Reprints Bath.

13 Rogers K H, *The Newcomen Engine in the West of England*, Bradford-on-Avon, Moonraker Press, 1976, pp 24-25. and Vale E, *The Harveys of Hayle*, Truro: D Bradford Barton, 1965, pp 26 and 318.

14 National Library of Scotland Acc. 5111 Box 29, file 1.

15 Birmingham Reference Library, Boulton & Watt coll. Box 9.

16 Birmingham Reference Library, Boulton MSS Assay Office coll. letter W65, quoted in part only by Smiles S, *Lives of Boulton and Watt*, London, John Murray, 1865, pp 297-8.

17 Jenkins R, 'Jonathan Hornblower and the Compound Engine', *Trans. Newcomen Soc.* 1931, 11, pp 138-155, pls. XVII-XXI.

18 Cardwell D S L, *From Watt to Clausius*, London: Heinemann, 1971, pp 83 and 180.

19 Harris T R, 'The Hornblower Family - Pioneer Steam Engineers', *Journal Trevithick Soc.*, 1976, 4, pp 7-44.

20 Day Joan, *Bristol Brass - A History of the Industry*, Newton Abbot; David & Charles, 1973, p 81.

21 Rogers K H (ref.13) p 29.

22 Redding, Cyrus, *Yesterday & Today*, London, T C Newbv, 1863, vol.1, pp 132-133.

23 Pole Wm, *Treatise on the Cornish Pumping Engine* London; J Weale, 1844, vol.1, p 28-29.

24 Watt, J, The articles Steam & Steam Engines written for the *Encyclopaedia Britannica* by the late John Robison . . . with notes. [and the description of Hornblower's engine now omitted!] Edinburgh; John Murray, 1818, p 149.

25 *Dictionary of National Biography* sub Jonathan Hornblower junior; and, Robinson E & Musson A E, *James Watt and the Steam revolution*. London: Adams and Dart, 1969, pp 8 and 156 etc.

26 Robison John, Supplement to the 3rd edition of the *Encyclopaedia Britannica*, G Gleig editor 1801, vol.2, p 523.

27 Gregory O, *A Treatise of Mechanics, theoretical, practical and descriptive*. London, G. Kearsley, 2nd ed.. vol.2, 1807, p 385 and vol.3, pl.30; see also ref. 23, p.30.

28 Hornblower, J & Winwood J, *An address to the Lords, Adventurers and others concern'd in the Mines of Cornwall* [publisher not named], 8p. (p 6) 1788, see also refs. 17, p 153, 23, p 30.

29 Dickinson H W, *A short history of the Steam Engine*, Cambridge University Press, 1938, p 78.

30 Nelson W, 'Josiah Hornblower and the First Steam Engine in America', *Proc. New Jersey Hist. Soc.* 1883, (2) 7, pp 177-247 (p 233).

31 Noall, C, *Harveys, 200 years of trading*, Truro: UBM-Harvey, 1979, p 23.

32 Muirhead, J P, *The origin and progress of the Mechanical inventions of James Watt* London: John Murray, 1854, Vol.2, pp 152-3. and *Watt to Boulton, 18 August 1782*.

33 Matthew Boulton to James Watt, 13 April 1782. Boulton & Watt coll. Parcel D.

34 M Boulton papers (to Boulton 11 Oct 1782) Assay Office coll. *Boulton & Watt coll. Box 21, bundle 6 (to Watt [after 11] Oct 1782)*.

35 Matthew Boulton papers, Assay Office, col.W 115-117.

36 James Lawson to James Watt, October 14 1782. Boulton 84 *Watt coll. Box 21 , bundle 6*.

37 James Collings to Matthew Boulton, November 14 1782. M Boulton coll. letter C3.

38 Smiles, S, 1865 (ref.16) pp 320-4; and Wilson T, MSS Vol.1. James Watt to James Tooker, 21 November 1783, County Record Office, Truro, DDX 318.

39 Thomas Wilson to Boulton & Watt, 25 November 1782. Boulton & Watt coll. Box 21, Bundle 6.



- 40 Bluhm R K, *A bibliography of the Somerset Coalfield*, London: Library Association, 1968, pp 48 and 51.
- 41 Down C G and Warrington A J, *The History of the Somerset Coalfield*, Newton Abbot: David & Charles, 1971, pp 161-2, 167
- 42 Harris T R (ref.19) p 30.  
Muirhead J P (ref. 32).p 152-161.  
Hornblower J and Winwood J, (ref.28), p 6.
- 43 Jenkins R (ref.17). p 144 quoting from letter of Boulton to Watt, 7 Oct.1782. Boulton & Watt coll. Parcel D.
- 44 Boulton & Watt coll. Parcel D.
- 45 Dickinson H W and Jenkins R, *James Watt & The Steam Engine* Oxford, Clarendon Press, 1927, pl.97.
- 46 Boulton & Watt collection. Portfolio 1339.
- 47 Torrens, H S in Jordanova L J & Porter R S (editors) *Images of the Earth*. British Society for History of Science, Monograph No. 1, 1980, pp 229-231.
- 48 Boulton & Watt coll. Portfolio 1379.
- 49 Boulton & Watt coll. Parcel E.
- 50 James Watt to Matthew Boulton 3 December 1782. M Boulton papers Assay Office coll.
- 51 Joseph Fry to James Watt, 9 Sept.1783. Boulton & Watt coll. Box 2F.
- 52 James Watt to Matthew Boulton, 14 Feb.1782. M Boulton papers, Assay Office coll.
- 53 Joseph Fry to James Watt, 12 April 1783 & 29 April 1783. Boulton & Watt coll. Box 2F.
- 54 M Boulton coll. letter R58.
- 55 John Rennie MSS Box 22. Description of the Radstock engine, 24 September 1784. Nat. Lib. Scotland Acc.5111.
- 56 Rogers K H (ref.13), pp 41, 54.
- 57 Boulton & Watt coll. Box 21. Bundle 6 (3 letters) and M Boulton coll. letter S 240.
- 59 Jenkins R (ref.17) p.153.
- 60 Pole Wm (ref.23), p.38; and Harris T R, *Arthur Woolf (1766-1837) the Cornish Engineer*, Truro. D. Bradford Barton, 1966, p 22.
- 61 Harris T R (ref.191, p 22.
- 62 Hornblower J C (in ref.27), p 384.
- 63 Hornblower J C, 'Description of a model for communicating motion at a distance', *Bath Papers*, West Eng.Soc. 4, 1788, pp 302-304.
- 64 Elsass M, *Iron in the Making*, Cardiff: Glamorgan Co. Record Off., 1960, pp 18 and 244.
- 65 Jenkins R (ref. 17), p 140.
- 66 Rogers K H (ref.13), p 44.
- 67 Matthew Boulton papers Assay Office coll.
- 68 Down C G and Warrington A J (ref.41), pp.96-7.
- 69 *Philosophical Transactions*, Royal Society, 63, 1773, p 242.
- 70 quoted in Robinson E & Musson A E (ref.25), p 161.
- 71 quoted in Robinson E & Musson A E (ref.25), p 159.
- 72 Harris T R (ref.19) p 29; and Jenkins R (ref.17) p 140.
- 73 Thomas Wilson to Boulton & Watt 1.3.1787. Boulton & Watt coll. Box 32.
- 74 Drawing dated 1787 in Boulton & Watt coll. Parcel E. An explanation of it dated 1787 in Boulton & Watt coll. Box.21, bundle 2.
- 75 Thomas Wilson to Boulton & Watt 15.3.1787. Nat. Lib. Scotland Acc.5111. Rennie MSS Box 22, file 3.
- 76 Jenkins R (ref.17) p 140.
- 77 Hornblower J and Winwood J (ref.28) p 7.
- 78 Down C G and Warrington A J (ref.41) pp 161-162.
- 79 M Boulton to James Watt 26.3.1792. Boulton & Watt coll. Box 21, Bundle 2.
- 80 T Wilson to James Watt 30.4.1791. Boulton & Watt coll. Box 32.
- 81 Robison J, Article 'Steam Engine'. *Encyclopaedia Britannica*, Edinburgh: Bell & Macfarquhar. 3rd ed. vol.17, 1797, pp 770-772 & plate 480.
- 82 Farey John junior, Article 'Steam-Engine', plate V in A Rees (editor). *The Cyclopaedia*, vol.34, 1816-18, London.
- 83 Dickinson H W & Jenkins R (ref.45). P 305.
- 84 Hornblower J C 'On the Construction of the Beams of Steam Engines', *Nich. Jl.* 2, 1802, pp 68-69.
- 85 Farey J, A treatise on the Steam Engine. London: Longman, vol.1, 1827, p 388.
- 86 Down C G & Warrington A J (ref.41), p 167.
- 87 This is not the place to fully discuss the later activities of the Joneses of Bristol. However the Directories for 1794 and 1795 record "Jones and Son as Millwrights in Philadelphia Street" who by 1798 are recorded as "Jones and Co. Engineers and Millwrights, 66 Thomas Street". It is this firm which is cited in the list of Bristol Pirate Engine makers - (Matthew Robinson Boulton's diary for 1796-1797) as "Jones Millwright and Engineers, Ratcliffe Street". William Jones a Bristol millwright had been a spy for Boulton & Watt in Bristol in late 1782. It seems certain the millwrights are all related but unlikely there was any direct connection between the founder and the millwrights.
- 88 Boulton & Watt coll. Box 4.
- 89 Powell J W D, *Bristol Privateers & Ships of War*, Bristol: J W Arrowsmith 1930, p 263,
- 90 Harris T R (ref.19) D 30-1.
- 91 Roll E, *An early experiment in Industrial Organisation*. London: F Cass, 1968, p 84, and Fox H 'Boulton & Watt' *Ann. Rept. Roy. Corn. Pol. Soc.* N.S. 1, 1911, pp 538-539.