Iron in 1790: production statistics 1787-96 and the arrival of puddling

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ABSTRACT: The 1780s and 1790s were a period of great change in the British iron industry. These decades saw a rapid transition from most bar iron being made with charcoal in finery forges and hammers to the use of reverberatory furnaces fuelled with coal, and the iron being rolled into bars instead of hammer-forged. This change is illustrated by a series of lists, of which the fullest and most important was probably compiled in 1790, but partly updated in 1794. The list provides good evidence of the spread of potting and stamping and of a process to recycle scrap iron, but has a few surprising omissions. The subsequent successful adoption of puddling depended on the production of finers' metal, developed at Merthyr Tydfil in about 1791. This only gradually replaced the stamping process, which was the first to produce good bar iron without charcoal.

Introduction

A main purpose of this paper is to publish (as an Appendix) an edition of a list (hereafter the '1794 list') of ironworks, which bears the date 1794, and to examine its relationship with other lists from the period since 1787. The 1794 list is contained in a paper book, 230 mm by 185 mm, made by folding 13 sheets of paper. It bears the title, *List of the different Iron Works in England Wales Scotland and Ireland to the year 1794. Copied from the papers of the late William Wilkinson.* The 1794 list itself, which will be described below, is followed by a list (not reproduced here) of forges allegedly from 1749, but actually *c*1737 (see below) with the 'P[resent] State of each'; then a list of 'declined' charcoal furnaces and of 'coak furnaces'; and finally estimates of charcoal and coke pig iron production at 25 December 1791.[1] These retrospective lists seem to be research material used in the preparation of the main 1794 list, which is important enough to require a full description and an edition. However, before looking at the 1794 list and its precursors, this article will examine earlier estimates. Next, it will cover a series of lists and estimates from the period just before 1794. Then, the 1794 list and its content will be considered as to its date and content. Finally, the 1794 list and other documents from the period will be used to elucidate the nature and chronology of the advance in ferrous metallurgical processes in the period.

Earlier estimates

Statistical lists, such as these, are an important source for the size of the iron industry of the period. The first known estimate, from about the 1660s, of 20,000 tons, comes from the archive of the first Earl of Shaftesbury, in a paper advocating an import duty on Swedish iron.[2] The source of the figure is not known, but it could be based on the amount collected on an excise levied on iron during the Commonwealth. This tax on iron was not renewed when the excise was continued after the Restoration. This excise was farmed to Walter Noel, who sub-farmed it to Robert Foley and Edmond Pierce. Their agent John Smith compounded with ironmasters in Derbyshire and Nottinghamshire for annual or quarterly sums. This led to a difficulty when the Convention Parliament terminated the excise at the end of August 1659, part way through a quarter. Foley and Pierce found themselves liable to pay over sums for July and August that they could not collect.[3] The outcome of this is not known. Nevertheless, it is likely that information on

the yield of this tax and hence on iron production was available at the time. This may provide the basis for the figure in the Shaftesbury paper.

This estimate is followed by four surveys (in three lists) of the early and middle-18th century, editions of which have been published by Hulme and the present author.[4] With the exception of the first list (now dated to *c*1716), these are only lists of bar iron output from finery forges and are thus well known. That cannot be said of a series of inter-related lists from the late 1780s and early 1790s, culminating in the 1794 list, the main subject of this article, which falls into three parts.

Lists before 1794

The 1788 retrospective lists

The 1794 booklet begins with the 1794 list, but is followed by three others, which are clearly earlier. These three are not reproduced here, but are worth discussing, as they may have been prepared to check the completeness of the 1794 list or of a precursor. Their presence adds to the authority of the 1794 list, as an accurate reflection of the state of the industry at that date. The first bears the title, *An Account of the Barr Iron made at the different forges in England & Wales according to the account given to the Government in 1749 at the time when there was a Question of allowing the American Iron Duty Free and other Foreign Iron upon Duty that was then proposed. By the Rev[eren]d Tho[ma]s Knight*. The implication of the title is that the list is the one prepared in connection with lobbying Parliament in 1749, prior to the passing of the Iron Act 1750. However, that is not so. The data is that of the 1737 list, but in a different order, perhaps organised to fit the scheme of the 1794 list or a precursor of it.[5] Thomas was a brother of the important ironmaster Edward Knight, but was not himself involved in the iron trade. He died in 1764 and thus cannot have compiled the annotated version of 1788. He was presumably the compiler of one of the earlier lists, but more probably the earlier one, as Edward was heavily involved in the 1737 campaign but probably not in 1749.[6] Most of the 1788 'P[resent] State' annotations consist of the word 'down' (indicating closure); but Pleasley (Derbyshire) was a 'Corn Mill'; Cranage (Cheshire) and Sutton (Shropshire) were each a 'Co[rn] mill'; Whittington (Staffordshire) and Wolverley Lower (Worcestershire) were each a 'S[litting] mill'; Holywell (North Wales) was a 'cop[per] mill'; Kidwelly (South Wales) was a 'tin mill'; Maidenhead (Berkshire) and Forrest Forge were each a 'R[olling] mill'; Upleadon (Gloucestershire) 'Stands'; and Woodcock (Sussex – actually Surrey) was a 'Wire Mill'.[7]

Pleasley became a spinning factory in 1784,[8] while Whittington Forge became a slitting mill in 1770,[9] and Forrest Forge (at Llansamlet near Swansea) part of the works of copper firm, Lockwood Morris & Co in 1779.[10] This information is thus credible for the early 1780s, but was anachronistic by 1787.

This forge list is followed by *An Account of Charcoal Blast Furnaces, which have declined blowing since the year 1750, either owing to want of Woods or the introduction of making Coak Iron Jan[uar]y 1st 1788*. This is followed by a list of *Coak furnace* (evidently also closed).[11] The latter was analysed by Riden,[12] so that only brief remarks need be made on it. The origin of the confection of defunct charcoal furnaces is not apparent, but again the date is anachronistic. The list includes the following long closed furnaces:

- Hampton Load (Shropshire) probably closed when a lease expired in *c*1662.[13]
- Hawthorne (Derbyshire) [Hartshorne] perhaps when a 1683 lease expired in 1704.[14]
- Stone Hesald, Leicestershire [Staunton Harold, Derbs.] probably last worked in the 1620s.[15]
- Toadhole, Derbyshire probably disappeared during the Civil War.[16]
- 'Jenkins Furnace now Plym[outh] Furnace', South Wales presumably refers to the furnace operating at Merthyr Tydfil in the late 16th and early 17th centuries. The last known indication of its being in use is the sale of cordwood to Thomas Erbury of Merthyr in 1635.[17]
- Monkswood Furnace near Usk, South Wales does not seem to be recorded after the death of Richard Hanbury in 1608, but could have continued a decade or two longer in the hands of his successors.[18]
- Stainborough, Barnsley probably refers to Stainborough Smithies, a ruin leased for the erection of a furnace in 1723, but Samuel Shore and William Westby Cotton instead repaired Rockley Furnace, which could be what the list was referring to.[19] Alternatively it may refer to the surviving lower furnace at Rockley, whose stack survives.[20]

The *coak furnace* list also includes:

- The unidentifiable 'Cefn' near Merthyr,[21] (as well as 'Cefn near Pyle' [Cefn Cribwr], which as Cefn Crippo reappears in the 1794 list).[22]
- Bedlington Furnace, established in 1759.[23]
- Seacroft Furnace whose origin has been misunderstood: Raistrick and Allen published it as a furnace of one of the Spencer partnerships without citing any source, but none has been found from the period that they discussed.[24] Their source is likely to be

the published *Smeaton's Reports*, which deal with its blowing apparatus, dated 1780. Seacroft was in fact built in 1779: they evidently failed to appreciate Smeaton's work was for a new furnace.[25]

- Clifton (or Little Clifton) Furnace of John Cookson & Co was a successful and long-lived early coke furnace, referred to in passing in James Lowther's correspondence,[26] and belonging by 1729 to the same partnership as a Gateshead Foundry, which it supplied.[27] It closed in 1789 when Sir James Lowther found that he was obliged to sell them coal at shipping prices and therefore closed his local pits, thereby also flooding Cookson's mines.[28]
- The list ends with an unexpected item, perhaps a late addition to the list: Fordley North Park (also called Fernhurst Furnace) in West Sussex. This is so remote from any source of coal that its use of coke is highly improbable. It may appear where it does because it was a late addition to the list: its remoteness from other ironworks led to its initial omission, so that it was placed at the end of the whole list instead of at the end of its charcoal section.[29]

1788 and 1790 lists

The 1794 list may be related to a survey dated 1788 (Table 1), which does not survive in it entirety, but whose existence may be postulated because of secondary compilations from it and of various other satellites, some in manuscript but some only surviving in printed sources. The most important are the 1788 lists by county, of forges and furnaces, which were published by David Mushet in 1840[30]. They are not known from any primary manuscript source, first appearing as a new illustrative note, appended to a paper published (without it) in 1799.[31] The furnace list was quickly re-published by Harry Scrivenor in 1841.[32] The structures of the 1788 and 1794 lists are very similar. The counties appear in the same order, except that the 1794 list has Sussex after Scotland. The four northern counties are grouped together, as is the slightly unexpected group of four outer Midland counties, Nottinghamshire, Warwickshire, Derbyshire, and Herefordshire. Mushet's number of 'refineries'

Table 1: Forge data for 1788 and 1794 compared

	1788				1794		
	Forges	**Refineries**	**Tons each**	**Total tons**	**Forges**	**Fineries**	**Melting fineries**
Cumberland, Westmoreland and Durham[1]	5	9	50	450	4	9	
Yorkshire	11	25	70	1750	11	24	
Lancashire and Cheshire	8	11	70	770	8	10	
Nottingham, Warwick, Derby and Herefordshire	9	20	75	1500	10	21	3
Shropshire	14	28	90	2520	14	28	14
Staffordshire	10	13	90	1170	11	19[2]	20
Worcestershire	8	20	130[3]	2600	9	20	
Gloucestershire	4	8	75	600	6	10	
Monmouthshire[4]	12	26	90	2340	9	25	5
South Wales[5]	12	29	60	1740	11	22	6
North Wales	7	12	50	600	7	12	
Sussex	4	4	30	120	4	4	
Scotland	1	3	80	240	1	3	3
Total	105	208		16400	105	207	51
Melting fineries		60	5 per week	15600			
Total				31000			

Notes:
1. 1794: includes Northumberland, but with no forges there.
2. The increase may represent the addition of forges at Deepfield (furnace built 1788) and the unnamed works of Hawkes near Dudley, whose location at the end of the list suggests that it was built after 1790.
3. This high average output figure probably reflects several of the forges of Knight & Co working 'doublehand' (with two shifts).
4. The 1794 list places Brecknock here, but few (if any) of the forges were in that county. See text.
5. 1794: Glamorgan, Carmarthen, Pembroke, Cardigan, Radnor.

Sources: Data for 1788 from Mushet 1840, 44; data for 1794 compiled by author from 1794 list.

Table 2: Charcoal Furnaces in 1788

	No of furnaces	Tons at each	Tons in each county	Comments
Gloucestershire	4	650	2600	Lydney, Bishopswood, Flaxley and Redbrook
Monmouthshire	3	700	2100	Tintern Abbey, Pontypool, and Llanelly (actually Breconshire)
Glamorganshire	3	600	1800	Pentyrch, Caerphilly, and Pen-y-skedwin [Yniscedwyn]
Carmarthenshire	1	400	400	Carmarthen
Merioneth	1	400	400	Probably Aberdovey [Dyfi], actually Cardiganshire: as in 1790 list
Shropshire	3	600	1800	Only 2 in 1790: Bringwoood and Bouldon. The third might be Cleehill (coke in 1790)
Derbyshire	1	300	300	Probably Alderwasley
Yorkshire	1	600	600	Bretton
Westmoreland	1	400	400	Leighton, actually Lancashire
Cumberland	1	300	300	Duddon
Lancashire	3	700	2100	Halton, Backbarrow, and Newland
Sussex	2	150	300	Ashburnham and Heathfield
Total	24		13100	
Scotland	2	700	1400	Goatfield [or Argyll] and Bonawe [or Lorn]
Total	26		14500	

Sources: 'Blast furnace' in Rees, *Cyclopaedia* IV; Scrivenor 1841, 86-7; 1854, 87-8.
Note: comments are by author.

Table 3: Coke furnaces in 1788

	No of furnaces	Tons at each	Tons in each county	Comments
Shropshire	21	1100	23100	1790: 22 (including Cleehill)
Staffordshire	6	750	4500	1790: 9 (including the new ones)
Derbyshire	7	600	4200	1790: 8 (including Staveley)
Yorkshire	6	750	4500	1790: 7
Cumberland	1	700	700	Seaton
Cheshire	1	600	600	Dukinfield
Glamorganshire	6	1100	6600	1790: 8
Brecknockshire	2	800	2400	1790: omitted
Monmouthshire	[omitted]			1790: Beaufort and Sirhowy
Staffordshire, 3 new furnaces	3	800	2400	Probably Ettingshall (1788), Deepfield (1788) and Level (1787)
Total	53		48200	
Scotland	6		5600	Carron and Wilsonstown
Total	59		53800	

Sources: As Table 2
Note: comments are by author.

(fineries) in the forge list is similar to that in the 1794 list (see Appendix), though the latter (surprisingly) has the lower total of melting fineries (a species whose nature will be discussed later), unless Mushet's total includes the '8 Corts fur.' at Cyfarthfa. Accordingly the data obtained by Mushet probably included melting fineries at Penydarren (Glam.) built in 1787 and at Brierley (Staffs) in 1788. The differing number of forges between the two surveys may sometimes depend on whether adjacent 'Upper' and 'Lower' forges were counted as one or two forges. Nevertheless the similarities of presentation are striking, and suggest that the 1794 list

was prepared by updating a fuller (but lost) version of the 1788 list.

The furnace lists of 1788 separate charcoal and coke furnaces (see Tables 2 and 3). The first edition of Scrivenor's book also contains an appendix, in which he has lists of charcoal and coke furnaces, dated May 1790.[33] The charcoal furnaces (Table 1) reconcile easily between 1788 and 1790, except that there is one charcoal furnace fewer in 1790 in both Shropshire and Derbyshire, presumably due to conversion to coke between these dates. The original status of Cleehill Furnace (Shropshire) as a charcoal furnace is indicated by the price for pig iron supplied to the Knight Stour ironworks.[34] The Derbyshire charcoal furnace is probably Alderwasley, though it is alleged to have been replaced by then by the first furnace at Morley Park.[35] Walter Mather demolished Staveley Furnace, an old-established charcoal furnace that is the only other candidate, and replaced it with a new coke furnace on leasing the Staveley Works in 1783.[36]

The numbers of coke furnaces in the 1788 and 1790 lists usually correspond, once account is taken of the furnaces stated to be built in 1789 or 1790. The Staffordshire figure of nine in the 1790 list is obviously the total of the six in the 1788 list and 'Staffordshire, 3 new furnaces expected to be in blast the same year'. The 1788 coke furnace in Cheshire must be Dukinfield.[37] However, for Monmouthshire (then an English county), Glamorgan, and Breconshire, there is no obvious means of reconciling the figures. The 1788 coke list omits Monmouthshire, which should have had two furnaces, though Beaufort was in fact in Breconshire. Conversely, the 1790 list omits Breconshire, but Hirwaun (which was just in that county) is listed under Glamorgan. Possibly the best solution is that the 1788 Breconshire furnaces were Beaufort and Sirhowy (Monmouthshire) and that the 1788 list only counted one furnace at Dowlais (not two), with the second at Cyfarthfa being built shortly after that date. Alternatively, there could be transcription errors in the sources.

Riden suggested that the 1788 survey might come from *c*1785, when the Irish Propositions and then trade negotiations with France were controversial.[38] Certainly the iron trade gave evidence to the Board of Trade then.[39] However, the data fit better if a list of 1788 output was compiled *c*1790: perhaps in May 1790, the date that Scrivenor prints for lists of furnaces.[40] This takes the list into the period of the protracted negotiations (1790-93) for a renewal of the commercial treaty with Russia.[41] Since Russia was a major source of imported iron,[42] this treaty would be of particular interest to the iron trade.

Table 4: Estimated tons of pig iron produced by coke furnaces in 1791

Hawkins' average		No of works	Weekly average	Yearly average	Total
1400	Shropshire	23	26	1352	31096
1400	Glamorganshire	7	26	1352	9464
800	Yorkshire	8	15	780	6240
700	Lancashire	1	12	624	624
500	Cheshire	1	10	520	520
500	Derbyshire	9	10	520	4680
500	Staffordshire	15	10	520	7800
500	Cumberland	1	10	520	520
850	Monmouthshire	5	16	832	6160
750	Brecknockshire	2	15	780	1560
800	Denbighshire	1	15	780	780
1000	Scotland	12	20	1040	12480
	Total	85			80704
	Actual total				79924

Source: 1794 Booklet

Table 5: Estimated tons of pig iron produced by charcoal furnaces in 1791

	No of works	Yearly average	Total
Lancashire, Westmoreland and Cumberland	5	450	2250
Yorkshire	2	400	800
Shropshire	2	400	800
Gloucestershire	4	500	2000
Glamorganshire	2	450	900
Monmouthshire	2	600	1200
Carmarthenshire	1	250	250
Scotland	2	500	1000
Sussex	2	150	300
Total	22		9500

Source: 1794 Booklet

The Russia Company procured data on Russian iron exports. This presumably came from the Russian Customs records, since the data is in poods.[43] Nevertheless, there is little evidence of extensive lobbying over the renewal of the Russian trade treaty.[44]

1791 lists

The 1794 booklet ends with *An account of the coak furnaces now in Work in Great Britain with an estimate of the Quantity of Pig Iron they may be supposed to make weekly upon an average of 52 weeks in a year. Dec[embe]r 25 1791*. This estimate (see Table 4) is made by county with a weekly average for each, which is multiplied by 52 to produce a yearly average and then by the number of furnaces to produce an annual county output. This methodology is flawed in that furnaces inevitably have to be relined periodically, and water-powered sites often operated seasonally, so that operation for 52 weeks per year is unrealistic. In a column on the left is a quantity called 'Hawkins average', which is obviously another annual average output, but neither its origin not that of the weekly average is known. The total in fact works out at 79,924 tons, not 80,704. It is not clear whether this difference of 780 tons is the result of a transcription error in copying into the surviving list or an arithmetic error in its compilation: it could be that a county with a furnace making 15 tons per week has been omitted in the surviving transcript, but no omission is obvious. The application of the 'Hawkins' average' to the number of furnaces gives a total output of 80,650 tons. Riden believed this estimate to derive from a 1791 precursor of the 1794 list, the 1794 list which we have, less those furnaces built after 1791.[45] However, they do not reconcile precisely: in Staffordshire and Shropshire new furnaces of 1791 seem to be counted, but not all in Yorkshire and Glamorgan.

The 1794 booklet ends with *An account of the Charcoal Blast Furnaces in Great Britain with an Average Estimate of their produce for the last 5 years & which may continue for the next five years. Dec[embe]r 25 1791*. The methodology of this (Table 5) is similar to the 1788 list. The number of furnaces had decreased by four since 1788, and their output by 5000 tons – from 14,500 tons to 9,500. This is clearly the charcoal counterpart of the coke list, just described.

The 1794 list

The three other lists in the 1794 booklet, Mushet's published lists of forge and furnace output, and Scrivenor's 1790 list together provide a background to the 1794 list, with which the booklet starts (Fig 1 shows a typical page). They may derive from a separate survey whose existence can only be inferred. The existence of these six suggests that the 1794 list (printed in the Appendix) was the culmination of a body of work. The 1794 list has been used by various authors, including Riden, but no edition has ever been published. The list is important because it is the last known contemporary compilation of statistics on forge plant until Hunt's *Mineral Statistics* (from 1860) and *Griffith's Guide to the Iron Trade*

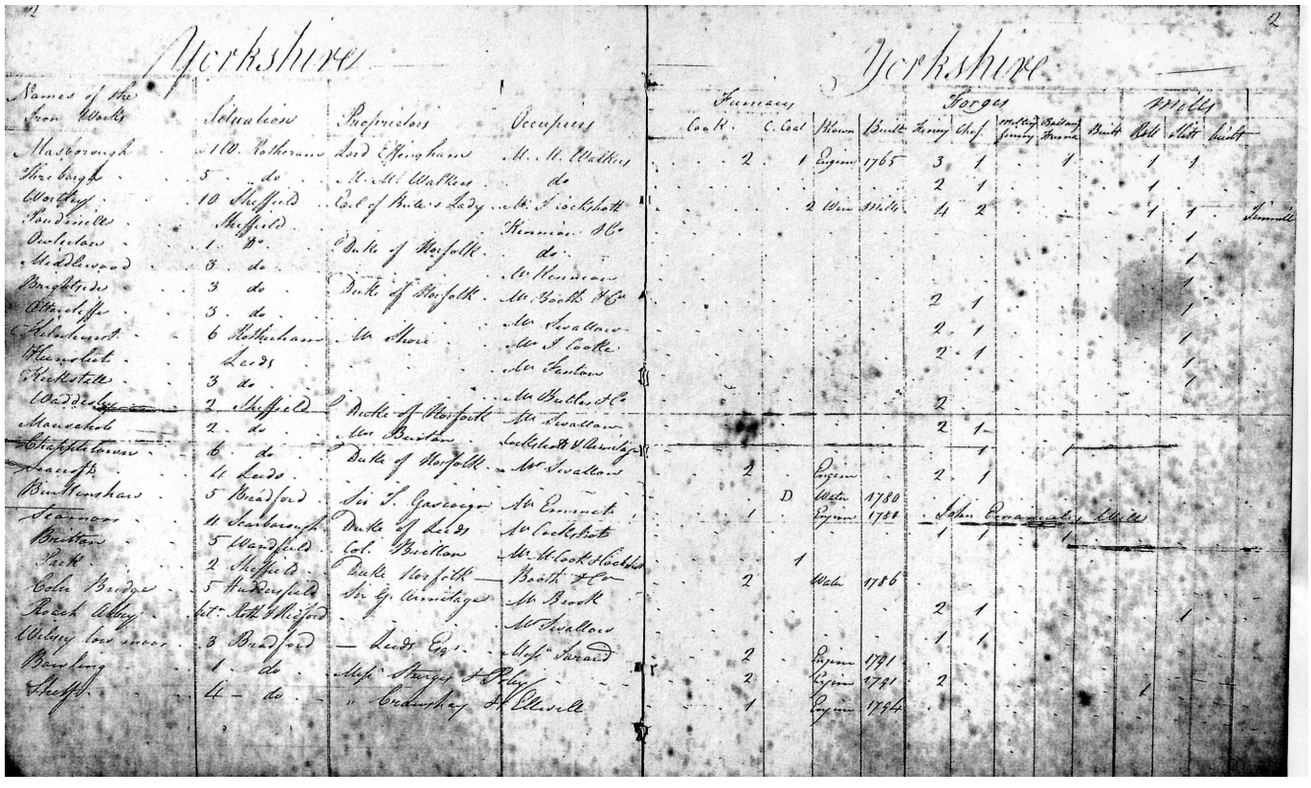

Figure 1: The Yorkshire pages in the 1794 list

(1873). Subsequent statistical compilations (of which there are many) focused on the numbers and output of blast furnaces. Evans has provided a detailed analysis of how the next two of the furnace lists of 1796 and 1805 were prepared, with editions of both. These lists need hardly be discussed further. Riden discussed context of this and later lists as part of his work on estimating pig iron output up to 1870, work now greatly revised (prior to the 19th century) by this author's.[46] He also discussed all the lists, in his introduction to the compilation of *British Blast Furnace Statistics* by him and Owen.[47] The present author also dealt briefly with the lists of this period at the end of his article vindicating the earlier lists of 18th century.[48]

As stated, the 1794 list bears the title *List of the different Iron Works in England Wales Scotland and Ireland to the year 1794. Copied from the papers of the late William Wilkinson*.[49] The stated provenance is presumably from the brother of the leading ironmaster John Wilkinson, who had been Boulton and Watt's main supplier of cylinders for their steam engines. Following William's return from France in about October 1789, he was in conflict with his brother, over their partnership at Bersham and William's claim for a share in the Snedshill ironworks (Shropshire).[50] He instigated Boulton and Watt into pursuing John for royalties on certain steam engines that he had built without their permission (as patentees).[51] This ultimately led to Boulton and Watt recruiting some of the Bersham foundry workers for their new Soho Foundry near Birmingham, though not all stayed long.[52] William's identity is probably also indicated by John's new Brymbo Furnace appearing at the end of the North Wales section of the 1794 list with the date 1796, and his Llwyn Onn Forge having the note 'paper mill' and date '97' against it. These matters would have been of interest to William, and are evidently his late additions to the list, subsequent to 1794. That William Wilkinson had such a list is confirmed by what Richard Crawshay told James Weale in 1809.[53]

The 1794 list spreads the information for each county or group of counties across the two pages of an opening. However, Staffordshire and Shropshire each require two openings. The first page has the situation after the proprietors and occupiers, but the format is consistent throughout, until near the end. Considerations of space occasionally led the compiler to write text across blank columns, but in the edition in the Appendix, this has been placed in the final column. The information divides into four sections:

- The names, situation, proprietors and occupiers.
- Furnaces: the number of coke and charcoal furnaces, whether blown by engine or water, with a date of erection.
- Forges: the numbers of fineries, chaferies, melting fineries and balling furnaces, with a date of erection.
- Mills: the number of slitting and rolling mills (never more than one of each), with a date of erection, and other plant.

The 1794 list is strikingly similar in structure to Scrivenor's 1790 list of ironworks, save that Scrivenor printed the coke and charcoal furnace lists separately. The seven columns of the 1790 list have the same arrangement as the first eight of the 1794 list. Otherwise, the differences are very minor. The 1790 'situation', the distance in miles from a town, is expressed as in the 1794 list, except that the latter often gives a compass direction. The spelling and other information sometimes differ, but mostly not significantly. For example, Snedshill (Shropshire) belonged to 'Lord Jerningham' in 1790, but more correctly to Sir William Jerningham in 1794, for he was then only a baronet. On the other hand, John Wilkinson's Bradley (Staffordshire) is given the (credible) date 1758 in the 1790 list, but 1772 in the later one: John Wilkinson took a lease from John Hoo of part of Tup Street Farm to build a furnace in 1757.[54] 1772 is perhaps the date of the second furnace there, Hallfields Furnace.[55]

Some of the information in the 1794 list is nevertheless anachronistic, and more appropriate to 1790 than to 1794. For example the Duke of Leeds sold his East Ayton estate (including Seamer Forge) to Joseph Dennison in April 1790, but the forge is still listed with the Duke as proprietor in 1794.[56] Lord Cardiff succeeded his father as Earl of Bute in March 1792, but 'Lord Cardiff' is listed as the proprietor (freeholder) of Dowlais and Hirwaun.[57] Less anachronistically, Lord Westcote, the owner of ironworks at Halesowen, was granted the English title of Lord Lyttelton in August 1794.[58] Elsecar (1794)[59] and Thorncliffe (1792), both in Yorkshire, do not appear in the list.[60] Surprisingly Coneygree Furnace (as 'Dudley Port') appears, but Gornalwood Furnace does not, though both derive from leases dated 31 May 1794.[61] Indeed, the few works that appear in the list as built after 1790 are all furnaces and all at the end of their page or section: three ironworks near Bradford (all 1791); Butterley (1792); Dudley Port (*ie* Coneygree – no date) and Gospel Oak (1794), both in south Staffordshire; Sauchie near Alloa (1793); and Brymbo (1796). Neath Abbey (also at the end of a page) had an engine, but no furnaces; the two furnaces were probably blown in late in 1793.[62] This points to much of the data coming from 1790, perhaps from the precursor of Scrivenor's list of

May 1790 with only received limited correction and updating subsequently, perhaps to ensure that the 1796 list was complete.[63] This will also become apparent when puddling is considered (below). On the other hand, the non-appearance of Cardiff Forge in 1794 is correct, for its lease was surrendered to the Earl of Bute in 1793 and it was unroofed about then.[64] Similarly the description of Prescott Forge (Shropshire), as 'stands' – without plant being named, fits 1794 when its owners John and Samuel Hallen were bankrupt.[65]

The edition appended to this article is intended to reproduce the content of the 1794 list, warts and all. M or MM attached to a name is obviously Mr or Messrs. Those knowledgeable in the history of particular works will be able to identify other errors, some perhaps transcription errors made in the course of the preparation of the surviving manuscript, which is itself a copy. For example, the occupier of Wortley Forges (Yorks.) was John Cockshutt (not T Cockshott); the owner of Birmingham Mill was Gooch not Googh, and Birmingham was in Warwickshire, not Staffordshire. Other factual errors can be detected. For example, Park (Old Park) in Shropshire was occupied by the three Botfield Brothers; Hawkins Browne was only a partner in the colliery.[66] On the other hand, 'Rolling mill (Butlers) for tinmills' against Caerleon – in addition to Butler's ownership of the Rocheston (or Rogerstone) Works – is correct, referring to the Ponthir Works there.[67] No doubt a long commentary could be provided on the contents of the list, but space does not permit that.

The information on the final pages, dealing with Ireland and southeast England is not in quite the same format as elsewhere. The dearth of the usual kind of ironworks perhaps led the compiler's correspondent to provide different information. In Sussex, the list conforms to the normal pattern, but uniquely an annual output is given. The furnace outputs are the same as in a list in the Weale MSS dated autumn 1787, but the production of each of the four forges was 10 tons higher.[68] In Ireland, it fits the pattern, but ironworks at Cork, Waterford, and Newry appear in the column for the date when they were built, so that their nature is not apparent. The Home Counties have altogether different headings: C, H, P, R, and Ball. These may be copper, hoop, plating, rolling, and balling furnaces (see below on 'Rolling'). 'Copper' is a credible expansion, but works processing copper ought not to appear in a list of ironworks. Nevertheless, this is not unique, for the Forest Works near Swansea is also in the list, though with no plant. It was (as stated) a finery forge until 1779 when it was let to Lockwood, Morris & Co of the Lower Forest Copper Works.[69] Hoop mills were a variety of slitting mill, producing iron hoops for barrels.[70] The listing of the plant does not seem to do justice to the subsequent breadth of the activities in Surrey of Alexander Raby and John Bunn (Colson's successor at Ham Haw Mill, near Weybridge), but perhaps the expansion of their mills into forges making or re-cycling iron occurred later.[71] As nothing appears in the P column, its correct expansion does not matter.

The iron industry in *c*1790

Furnaces

The lists discussed in this article come from a period when the iron industry had entered a period of technological transition, within what we call the Industrial Revolution. Despite the start of coke ironmaking at the beginning of the 18th century (or even the end of the 17th),[72] charcoal ironmaking continued as it had long done. Since the 1750s, some of the Shropshire coke furnaces had supplied pig iron to forges,[73] as also did a few elsewhere, particularly at Merthyr Tydfil.[74] However, several of the coke furnaces elsewhere were not associated with forges and thus were presumably concerned with providing foundry pig iron and producing cast iron goods. This applies to several of the coke furnaces in the 1787 closure list, including Little Clifton, Chester le Street [*ie* Whitehill], and Bedlington.[75] It also applies to the furnaces at Masbrough in Rotherham of the Walker Brothers, who in 1786 became the only peacetime gun-founding contractor for the Board of Ordnance after the end of the American War.[76] However, they also had a charcoal furnace and their own forges both there and at Thrybergh.[77] Dukinfield belonged to T. Bateman a partner in the noted Manchester engine builders, Bateman and Sherratt.[78] It seems also to apply to Birkinshaw (Yorks 1780), Chesterfield (Derbs 1780), Haigh (Lancs 1789), and Apedale (Staffs 1784).[79]

The charcoal furnaces that had relied on coalfield ironstone had almost all closed. The survivors were: Bretton (1790: 'Hague') and Masbrough (Yorkshire); two or three in south Shropshire (with ore from the Clee Hills); two owned by 'Hanbury esq' and occupied by David Tanner in Monmouthshire; Yniscedwyn (Glamorgan); and Carmarthen. Otherwise all the surviving charcoal furnaces (except in Sussex) were in places where haematite (or limonite) oxide ores were available. In south Wales and Gloucestershire these were mainly locally mined oxide ores. Elsewhere, all were located where they could use redmine from Furness or west Cumberland. This pattern led David Mushet (with several older economic historians following him to various extents) to argue that charcoal ironmaking has fled to

remote areas, because the charcoal supplies elsewhere were exhausted,[80] failing to appreciate that charcoal is a renewable resource. However, this is to ignore charcoal consumption in finery forges, which continued to exist in most ironmaking regions.

Melting fineries

Many old established forges are listed with the usual two fineries (or one or three) and a chafery, and these often remained in use for another decade or two. Rarely, one is listed as having different plant, mostly in Staffordshire. Cradley had a melting finery and a balling furnace in addition to the usual plant, perhaps in a new upper forge taking the water-power supply previously used for the furnace. However the associated Lye Forge had a melting finery, a balling furnace and a chafery, so did Wright and Jesson's [West] Bromwich Forge. At Wren's Nest Forge in Shropshire Wright and Jesson had two melting fineries, two balling furnaces and a chafery. The term 'melting finery' is treated by Percy as a synonym for the running-out fire or refinery used at the start of the fully developed puddling process.[81] However, Wright & Jesson's possession of melting fineries identifies these as plant for the potting and stamping process of ironmaking, for which they twice (first in 1773) patented improvements to the original process of Charles and John Wood. In these processes, iron was 'flourished' in a common refinery (a desiliconising process) then stamped into granules from which slag was removed by washing. The granules were heated in pots to weld them into a 'loop', after which it was forged into bars in the usual way.[82]

Melting fineries were heavily concentrated in Staffordshire and Shropshire (Fig 2). In many cases it is possible to determine the date of erection or conversion. Generally, melting fineries do not occur in works built before 1785. The only exceptions are:

- Cyfarthfa in Merthyr Tydfil, where Charles Wood set them up in 1767.[83]
- Wright & Jesson's works at West Bromwich (presumably *c*1773) and Wrens Nest (1775).[83a]
- Perhaps Stone Gravels in Derbyshire, where the furnace was built in 1780, but the forge's date is not stated, but it may have been working in 1783.[84]
- Cradley and Lye Forges (Staffs), which came into the hands of William Gibbons and Co in 1787,[85] but Matthew Boulton referred to iron being stamped there in 1775.[86]
- Swin [or Swindon] Lower Forge (Staffs), where two melting fineries are listed. This was built in the mid-1770s by one of the Homfray family and afterwards run by William Finch, who also rented their Swindon Forge.[87]
- John Wilkinson's forge at Willey, which probably only operated from 1780, when he began trials of Wright & Jesson's process,[88] until 1789 when he dismissed his forgemen there, so as to concentrate operations at Bradley.[89]
- Wilkinson's forge at Bradley, operating from 1783 when an engine was completed, of which more will be said below.
- One of the forges at Eardington (Shrops), of which more below.[90]

The means by which the process spread in Staffordshire and Shropshire during the currency of Wright & Jesson's patent is alluded to in a letter of 1781 from Boulton to Watt, discussing the risk of using the crank to produce rotary motion from a steam engine to power a forge, when the use of the crank on a steam engine was the

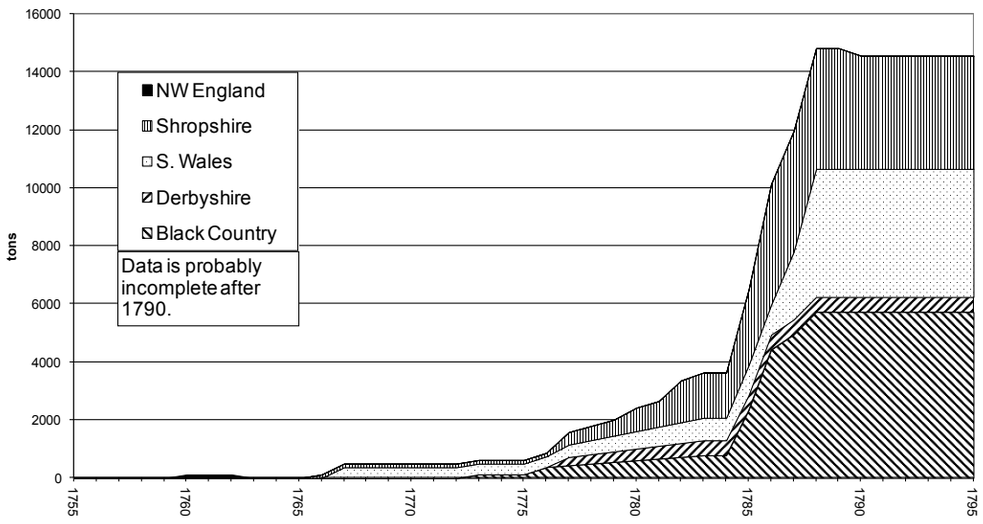

Figure 2: Iron production in melting fineries.

subject of a patent obtained by others. John Wilkinson was confident that he could make peace over the crank and make the patentees useful allies of Boulton and Watt. 'He thinks he can do the same thing between them and us as he did between Jesson and Wright's Co. and three or four other ironmasters who now make bar iron with pitcoal under their patent'.[91]

The take-off of this new process seems to have occurred quite specifically in 1785 (see Fig 2). This is a couple of years before Wright & Jesson's first patent was due to expire. Henry Cort toured the Midlands in 1784, trying to sell licences for his puddling process.[92] It is possible that Wright and Jesson responded to this by granting licences for more ironmasters to use their patent process, giving them access to a proven process rather than their having to take the risk of investing in a new one. Conceivably, the ironmasters may have used the original process of John and Charles Wood, which was now out of patent. The stated reason for Cort's willingness in 1788 to reduce the royalty that he charged to Richard Crawshay of Cyfarthfa from ten to five shillings a ton, was to encourage more ironmasters to take up the process;[93] but could Wright and Jesson have been charging the lower sum per ton?

A significant amount of new plant was provided in the years after 1785. Ketley (Shropshire) had six melting fineries, listed as built in 1786.[94] These were under construction when Cort visited in 1784, but the work was halted until Richard Reynolds had seen Cort's process.[95] Peter Onions (of Dowlais, Merthyr Tydfil) had also demonstrated his process to them in January and February 1784, following the grant of a patent to him, seven months before Cort's puddling patent. However, Richard Reynolds regarded Cort's and Onions' processes as no improvement on the Cranages', and declined to agree a licence with Cort.[96] John Wilkinson had six melting fineries and six balling furnaces at Bradley. Hallen's two melting fineries and two balling furnaces at Wednesbury date from 1786 (according to the list), but this forge may have been under discussion from 1783.[97] The two of each at the Level Ironworks of Gibbons & Co have the date 1787.[98] This site was sold by the Croft family at Ladyday 1788 (with Cradley and Lye Forges) to Thomas, William, and Benjamin Gibbons.[99] The Gibbons brothers had long had Pitchford Forge (Shropshire) under a lease expiring in 1790.[100] James Cockshutt's recommendation of Cort's process to one of the Gibbons brothers in June 1788 thus succeeds their major acquisition,[101] but they apparently did not follow this up, as Cradley Forge was still using the potting and stamping process (though starting from finers metal – not pig iron) in 1808.[102] This was most probably initially in the upper forge there, using the water-power made available by the abandonment of the charcoal furnace there.

Potting and stamping was thus the first non-charcoal using process to come into wide use. It began to free the iron industry from the limitation on its output imposed by the speed at which trees grow, for a fuel-crisis will inevitably ensue if charcoal is consumed faster than wood can be generated by coppice re-growth. The adoption of coke pig iron as the feedstock for some forges in the late 1750s had begun this process, and must have freed up some charcoal supplies hitherto needed to make pig iron. However, the great expansion in iron production, which is the best way of characterising the iron industry's Industrial Revolution began in 1785.[103]

Balling furnaces

The term 'balling furnace' presents difficulties due to being used for furnaces with slightly different processes. Gale regarded them as an obsolete kind of 'furnace for heating wrought iron scrap balls' but that the term was confused with the mill furnace.[104] Some earlier authors apply it to a furnace used at the end of the puddling process, particularly when producing the better kinds of iron.[105] The use of such a furnace was an option in Cort's puddling patent.[106] Forges with melting fineries often also had a balling furnace, commonly an equal number of each. The balling furnaces were presumably used at the end of the process in the same way as in puddling. However, balling furnaces also existed at some forges with no melting finery either on its own or, more usually, with a chafery. The latter seem to be involved in a process making iron from scrap wrought iron. Several travellers visited John Wood's Wednesbury Forge, sometimes called Wednesbury Field Forge to distinguish it from the older forge there, which was by then making saw blades and gun barrels from iron, rather than making iron. As Charles Wood's co-patentee, John might be expected to be using the potting and stamping process, but successive travellers mention the use of scrap.[107] In 1794, his widow Ann had two chaferies and two balling furnaces. John Wood was probably using this process by November 1740 when Sir James Lowther wrote about it, after alluding to the ironmaking project of one Payne,[108] using

> 'Pig iron, scrap or bushel iron and skull iron from the furnace I hear by so many hands that John Wood, one of the grand projector's sons carrys on at Wednesbury in Staffordshire somewhat in this way that I doubt not the truth of it. He make six ton weekly and sells it for £18 a ton.'

This indicates a date for Wednesbury Field Forge; John Wood bought its freehold in 1747.[109] He also took over Little Aston Forge in 1747,[110] but it was apparently given up soon after his death.[111] This scrap process was no doubt in turn developed out of the ineffective processes which John's father William and brothers tried to establish at Frizington (Cumberland).[112] Redbrook in Gloucestershire is listed with a chafery and balling furnace, as is Wickmill near Bristol, which was perhaps built in 1785 and had a rolling mill by 1789.[113] The owner of Marston Forge in Cheshire advertised in 1768 for a 'good baller of scrap iron [who] understands balling and heating the balls in an air furnace',[114] but the 1794 list (as 'Nothwich' [Northwich]) shows a finery and chafery. As early as 1763, Booth, Binks & Co of Sheffield established a 'tosshammer work for working up Hollands scraps' at Brightside, agreeing not to erect 'any forge or furnace for making iron'.[115] This was apparently replaced with a standard finery forge, presumably in 1782 when they renewed their lease and built a blast furnace.[116]

Cranage and Onions' processes

The 1794 list is almost silent about various other new methods, including those of the Cranage brothers, of Peter Onions, and Cort's puddling. It may be that the survey was based on the answers to particular questions and those asked failed to address newer plant: perhaps the compiler was unfamiliar with the processes. The Coalbrookdale Company had a forge at Rock Mills near Bridgnorth (now Fort Pendleston), but with no plant. They had leased this in 1760, and used it to exploit the Cranage Brother's process. However, it is possible that Rock Mills (also called Bridgnorth Forge) are so treated because the Company gave up using them, or rather William Reynolds & Co stopped, as they took over the mills on a company reorganisation in 1793.[117] Cort heard from Thomas Cranage that he and his brother had lost money over puddling, by neglecting their proper work for which they would have been paid.[118] The company had long before found the Cranage process less efficient than they would have wished.[119] The company had therefore gone over to the 'granulating method' (*ie* potting and stamping) sometime before 1785.[120] The lack of forge plant at Coalbrookdale and Horsehay is even more unexpected, either due to an omission or a temporary closure. Certainly, both forges (like the Bridgnorth forge) had stock in late 1793,[121] while Horsehay Forge was provided with a forge engine in 1784 and was still in use in 1796.[122]

Samuel Homfray in 1812 talked of a process known as 'buzzing', which he claimed was identical to Cort's process. This was used at Coalbrookdale and 'Yerton' (Eardington), and may be the Cranage process.[123] On the other hand, if buzzing is the same as 'bustling' or 'bushelling', it must take its name from 'bushel iron', implying that it was a process for re-cycling scrap.[124] 'Bushel iron' was old wrought iron, a 'sort of refuse iron that smiths cannot use'.[125] When Cort brought Henry Foxall to Ketley to teach Cort's process to Reynolds' men, one of them was a man called Sturges, who had worked at Mr Wheeler's forge near Bridgnorth (*ie* Eardington). Foxall asked if the method used there was not the same as that he was instructing them in. Sturges replied, 'No, nor anything like it'.[126] Eardington appears in the list with three fineries, two chaferies, two melting fineries, and a balling furnace. This probably covers both the forges there, built respectively in 1777 and 1782.[127] This suggests a traditional finery forge at one site and a potting and stamping one at the other.

Peter Onions took out his patent in May 1783, between the dates of Cort's two patents. He used a stream of cold water running under the furnace and had air tubes blowing cold air into it, but perhaps only used for part of the process.[128] He demonstrated his method at Ketley (or another of the Coalbrookdale Company's Works) in January and February 1784, after which William Reynolds wrote to Cort, 'Peter Onions has not succeeded and has with us entirely given up the point'; however, he was confident of succeeding elsewhere. This preceded Cort's demonstration of puddling at Ketley.[129] Onions' development work took place in South Wales,[130] presumably at Dowlais, his address when he enrolled his specification in September 1783;[131] this address is not surprising as John Guest was his brother-in-law and the original patent is among the Dowlais manuscripts.[132] James Cockshutt of Cyfarthfa wrote in 1789 that Mr Taitt had commended his iron.[133] The partners at Dowlais included John Guest (who was originally from Broseley, Shrops), William Tait, and William Lewis.[134] William Lewis & Co also owned Pentyrch ironworks, a traditional charcoal ironworks, built in 1740.[135] Peter Onions was at Pentyrch by October 1788, of which more will be said below.[136]

Puddling: the initial failure

Puddling is also notable in the 1794 list by its near absence. The origins of puddling have been much discussed, for example by Gale, Morton & Mutton, Mott, and more recently, Hayes, Evans, Alexander, and Hayman.[137] Some have been blinded by the ultimate success of the process or have uncritically accepted the propaganda produced by the Cort family, when seeking government compensation for the deprivation of the patent. In doing so, several have failed to appreciate the

initial difficulties that almost led to the process being abandoned completely. Hayes, largely from Richard Crawshay's letterbook, reached similar conclusions to this article,[138] while Evans emphasised the potential managerial advantages of the new process in breaking down the workplace culture of the forgemen.[139] This article seeks to produce a new synthesis from the primary sources. It is thus sparing in its citations of previous work, generally based on many of the same sources. As will appear, views on the significance of Cort's achievements both at the time and in 1812 were mixed. Richard Reynolds' view was that it was not novel; and Richard Crawshay's that it did not work. It only worked when finer's metal was substituted for grey pig iron as the raw material, which was first done at Merthyr Tydfil, rather than at Cort's Funtley Works, near Fareham, Hants.

Cort visited Scotland and demonstrated his process there in May 1784, obtaining a favourable (oral) opinion on the process from Dr Joseph Black the Edinburgh chemistry professor, though 'in the plateing and in the slitting mill [Cort's iron] did show some degree of a redshort quality'.[140] Good bar iron was made from bad Carron pigs.[141] James Watt wrote back from Birmingham that Cort's iron 'is one of the modifications of cold short iron and is known here by the emphatic name of *rotten tough*'. However Black thought this referred to what was made under Cort's first patent.[142] Sir John Dalrymple published a pamphlet advocating the process,[143] having observed the process in company with Dr Black, and thinking of building an ironworks, asked James Watt's advice about it.[144] Black heard in June 1784 that Landell & Chambers and W. Hawkes of Newcastle were interested, and the former agreed to pay the royalty that November.[145] Landell & Chambers were the owners of Derwentcote Forge.[146] However John Cooke of Kilnhurst (who took out a licence for Cort's process in 1788) described the process in use at Derwentcote in 1788 as involving stamping out the slag and then piling the metal on thin stones and heating it in another air furnace; this sounds like the process under Richard Jesson's 1784 patent, his second one.[147] Hawkes and Longridge had a rolling mill and a slitting mill at Bedlington, but no forge plant there. However Longridge & Co's Lumley and Beamish Forges only had a balling furnace and chafery in the list, the plant characterised above for works concerned with re-cycling scrap. Nevertheless, at Lumley, they leased a field beside the river Wear in 1784 as the site for a rolling mill, but nothing suggests that such a mill was ever built.[148] The question must therefore remain open as to whether any of these works had started puddling. Cort demonstrated his process at Pitchford and Wednesbury Field Forges in November 1784,[149] at Ketley in December and January 1785,[150] and apparently at Bradley.[151]

Elsewhere, the take-up was slow. Hawkes was asked his view of it by James Henckell, and Hawkes advised Cort to get such people to wait on him;[152] Henckell's Wandsworth ironworks included two air furnaces and two balling furnaces in 1790. Henckell had supplied double-headed hammered shot to the Ordnance Board in the previous war, but his guns proved unsatisfactory; he was bankrupt in 1784, but evidently resumed business.[153] George Daniel of Penygored, a Pembrokeshire tinplate works, sent Thomas Llewellyn to Fontley in March 1784 to observe the process, intending to start puddling in February 1785, but found that 'materials were too dear', after which Llewellyn went to work for Cort, an event whose consequences will be related in due course.[154]

The only reference in the 1794 list to puddling is '8 Corts Furn.' at Cyfarthfa. Crawshay had taken out a licence from Cort in May 1787, to pay a royalty of 10s per ton.[155] Crawshay expected W. Reynolds and Homfray to follow, as he (his London house) had his iron from them, but Wilkinson would not.[156] On visiting Funtley in June, Crawshay and his partner James Cockshutt agreed with Cort for the latter to send men 'to erect furnaces at Cyfarthfa and to instruct others' in the process.[157] This was done in August and September, when an even larger weekly output was obtained than anticipated, and even John Wilkinson appeared convinced.[158] By July 1788, they were making 20 tons per week at Cyfarthfa from eight furnaces.[159] In August 1788 Crawshay persuaded Cort to reduce the royalty to 5s, 'as the most probable method of bringing his patent into general use'. Crawshay then wrote a circular letter recommending the process, the recipients including Mr Gibbons of Stourbridge (mentioned above).[160] In September, Cort was visited by John Cooke of Kilnhurst Forge in Yorkshire, who agreed to pay the new royalty.[161] Reynolds & Co were also told of the change, and Crawshay's London house settled accounts with Cort & Jellicoe on the new basis, allowing £16 9s 2d,[162] evidently for slightly over 65 tons of iron.

All appeared to be going well, but then disaster struck, first technological problems and then unrelated financial ones. Scott & Co (of Rotherhithe) had been complaining of the quality of the blooms sent to them from Cyfarthfa for rolling since the preceding August.[163] 23cwt of blooms were needed per ton both at Fontley and Rotherhithe. If the blooms were rolled at one heat the yield was one ton of iron from 22 cwt blooms but the quality was impaired, leading Crawshay to order stamped blooms to be sent to Rotherhithe. He suggested

that blooms from Cort's process were inadequately shingled; later he asked Cockshutt to suggest how the dusty colour of Cort's blooms could be eradicated. He thought of reverting to 'the old way' (probably potting and stamping).[164] Before making any change, a series of trials were undertaken, probably starting in January 1789,[165] and continuing until March. Cockshutt wrote to Cort describing the results early in April. Cockshutt tried 'with a stream of cold water after Peter Onions' plan'; with Cyfarthfa and Plymouth metal; with sand and with metal bottoms; and with and without blast. He and his two colleagues reported jointly to Richard Crawshay on these: nothing made much difference. The iron bottoms caused much difficulty, and Peter Onions had discontinued them or covered them with sand. As Mr Taitt (of Dowlais) had 'commended Peter's iron', Cockshutt asked permission of Mr Lewis to send down T. Cooke, but Cooke returned disappointed, saying 'they do not work as well as we do'. Daniel Onions was sent to Cyfarthfa by way of exchange, and Onions told James Burch, 'we made better dispatch and yield [but] fell short of them in quality'. Crawshay then went on to talk about yields: he had told Mr Gibbons 30 cwt of pigs would make 22 cwt of blooms which would draw to something over 20 cwt of bars.[166]

They had helped Jeremiah Homfray build a furnace, presumably at Penydarren. Of this, Cockshutt wrote in April 1789:

> 'The iron he makes looks and draws very well, and he allows himself it draws sounder than their own … but he lately received but an unfavourable account of a small quantity which he sent into the North of which his father complains that it will not bear slitting but falls to pieces, and those rods which do not break, he can shake to pieces. Yet he says the iron works well under the nailers hammer and makes handsome nails.'[167]

His father was Francis Homfray and the iron was probably slit (and perhaps also rolled) at his Stourton Mill, near Stourbridge, where the family's business as manufacturing ironmongers was based. Stourton is more likely than the nearby Hyde Mill, where Francis Homfray junior was the partner. Stourton had both a slitting and a rolling mill in the 1794 list, whereas Hyde only had a slitting mill, though this was converted to a rolling mill by 1791.[168] This again demonstrates how the data in the 1794 list mostly relates to 1790.

Apart from Rotherhithe and Fontley, patent blooms had been sent to Harford & Co, probably for Melin Griffith, near Cardiff, though Harford Partridge & Co had a number of other works; and to Powick Forge near Worcester,belonging to Sampson Lloyd & Co. However the quality did not improve.[169] Ultimately (as mentioned), Crawshay met Samuel Jellicoe and told him that 'he should abandon the process as soon as he could go to Wales to settle his affairs & determine what plan to pursue. He said it would not answer'. He asked for the royalty agreement back, but it was apparently not given up.[170] Subsequent events are not clear. The Cyfarthfa rolling mill was ready that September (1789), but by then disaster had struck Cort. His capital was financed by a loan from his partner's father Adam Jellicoe. Unknown to Cort, this was from money in his hands as a naval paymaster. Adam's death meant that this was immediately repayable, but it was of course all tied up in stock. The result was that Cort's estate was extended for debt, effectively seized by the Navy Board.[171] Samuel Jellicoe seems to have obtained the works, which continued in operation for many years.[172] Cort offered in May 1790 to help the Navy Board exploit his patent, but received no answer.[173] Instead he was given a government pension, which was later continued to his widow and then to two unmarried daughters.[174]

These events go some way to explain the silence of the 1794 list over puddling. As mentioned Cyfarthfa had '8 Corts Furn.' Cort's own works at Funtley near Titchfield are listed, but with no plant or output. The lack of output is surprising, since production figures are (exceptionally) given for the Sussex furnaces and forges, with which it is listed. The omission might be credible for 1790 due to Cort's bankruptcy, but perhaps not for subsequent years. Pentyrch (Glamorgan) is listed as having '0 furnaces' and nothing else, but there is good evidence that a forge was operating there by 1794: a new melting furnace was built in July 1791, when its completion was celebrated with ale, followed by the adoption of puddling in December 1792.[175] However, Richard Crawshay wrote to James Cockshutt (the managing partner at Cyfarthfa) in October 1788, 'Patent blooms ought to be white like those made by Peter Onions at Pentyrch', which seems to show that a forge was working. The following January, he wrote, 'you are certainly not in Onions' secret in the make of iron his way'.[176] According to the list, Dowlais had melting fineries, balling furnaces, and chaferies, built in 1787; but nothing to suggest that it was not using the potting and stamping process. In 1794, William Taitt intended 'putting up cylinders to blow two melting fineries, a cupola, and if possible a hammer for stamping at the end of the shaft', using terminology applicable to potting and stamping,[177] but by 1796, finers metal was in use there.[178] Nevertheless puddling was only adopted there in 1801.[179]

Puddling: success using finer's metal

Several accounts of puddling as a successful process survive from the period around 1810 in the Weale manuscripts, two from Joseph Dawson of Low Moor (near Bradford) and one from Samuel Homfray.[180] Another appears in Rees' *Cyclopaedia*.[181] The feedstock of the puddling furnace in Cort's process was raw pig iron. The feedstock of the effective, indeed the all-conquering, puddling process (as practised by 1810) was a brittle white material known as finer's metal or refined iron, produced in a preliminary process in a refinery (or running out furnace). In this the pig iron was melted with a coke fire; the slag floated to the surface; and was tapped off. This removed some of the carbon, and particularly silicon, to leave white iron.[182] The process for making finer's metal was never patented, so that the evidence for its origin comes mainly from later accounts, of which there are several. When Samuel Homfray gave evidence in 1812 to a Commons committee (considering a petition from the Cort family), he attributed 'present improved quality of British iron to making finers metal'.[183] James Cockshutt, who had returned to Wortley in Yorkshire, wrote (commenting on Homfray's evidence):

> 'After many attempts, both at Cyfarthfa and Penydarran (the works belonging to Messrs Homfray & Co who had begun to make iron in the pudling furnace, and at first under the direction of a man taught & instructed by one of Mr Cort's workmen) to improve the color and quality of the iron, on which the ultimate success of the process seemed to depend, a method of combining, in some degree, the pudling with the former process by preparing the metal previous to the pudling process was put in practice, to which discovery the present extended practice of pudling, I believe & owing, as this discovery not only improved the quality of the iron, but also shortened the operation so much that the workmen are enabled to double the quantity in a given time that at first they were able to do.'[184]

In a later letter Cockshutt explained the difference:

> 'Though many trials have been made to use run-out metal in a common refinery, I do not know of one instance where it has continued, and for a striking reason. In the process in a common refinery, where the metal and fuel are constantly in contact, that very same kind of metal is obtained before the iron becomes malleable, and in that state has continually been exhibited by the workmen, who have long had a practice of running it out of the finery in that very state, to throw it back into the finery, to hasten the process, as they conceive. Now, in the state of run-out metal, the first formed and worst part of forge cinder having been separated, and while the metal thus continues insufficiently fluid to be run out, the metal, being thus freed from that pernicious cinder, is the great advantage to the puddling system, where no separation of cinder from malleable iron is made or drawn off, but the whole wrapped up together, while in the old method by a finery, this pernicious cinder is constantly let off by the workmen as it is formed (as in the process of preparing run-out metal) and then, it is in exactly the same state, and in fact is, run-out metal, so that by shortening the process, it may prove a saving of fuel. While in the pudling furnace the pernicious cinder being first separated by a previous operation, exactly as in the beginning of the process in a common finery, but with greater expedition, an improved kind of iron is obtained, and also with much dispatch – so that it appears to me, without the use of the pudling furnace, the discovery (if it may be deemed a discovery) of run-out metal would be of little or no advantage.'[185]

It thus seems that in saying that the process combined an older process with puddling he was referring to the traditional charcoal finery, rather than to the potting and stamping process, which is alluded to in correspondence with Cort as the stampering method,[186] also as the granulating method. Percy was told that S B Rogers (late of Nantyglo) regarded it as a modification of the old charcoal running out fires. He ascribed the invention to 'Mr Homfray of Tredegar',[187] the same Samuel Homfray.[188] The product of the first stage of that process may well have been similar, but there the metal and slag were separated by washing in the solid state, whereas in the running-out furnace, the separation was of molten materials, or at least of molten slag. While Cockshutt attributed to the development of finers metal to work at Cyfarthfa and Penydarren, the question must be raised of whether the source of the ideas may lie in what Peter Onions was doing at Pentyrch, indicated by Crawshay's allusions in October 1788 to 'patent blooms being made white' and Cockshutt 'certainly not being in the secret in the make of iron his way' in January 1789.[189]

The precise date is not clear for the breakthrough represented by the substitution of finers metal for pig iron as the feedstock for the puddling furnace. It was clearly after Crawshay told Samuel Jellicoe in June 1789 that he intended to give up puddling,[190] but probably before he dissolved his partnership with James Cockshutt in September 1791,[191] after which Cockshutt went home to Wortley in Yorkshire. Perhaps surprisingly when Crawshay wrote to William Reynolds that December, he did not mention finers metal. He said he had 'at last overcome the evils of pudling': he substituted sea sand

for sand mixed with common earth in the furnace bowl and replaced the clay lining of the furnace roof with cast iron plates.[192]

It is far from clear how fast the puddling process was taken up by the industry. All that can be said from the 1794 list was that it had hardly been adopted when its data on forges was collected, perhaps in 1790. Puddling was probably taken up at Ketley (Shrops). Samuel Thomas, Mr Reynolds' agent, expressed an interest in 1788,[193] but (as mentioned) the Coalbrookdale Company declined to pay a royalty, alleging the process was similar to the Cranages'. The process was observed, and described in 1791 in *Philosophical Transactions* by Thomas Beddoes,[194] who then lived in Shropshire, and perhaps saw it at Ketley, an identification confirmed by William Reynolds position as a trustee of Beddoes' marriage settlement.[195] His description is only of what happened in the furnace, charged with grey pig iron; he said nothing of a running out furnace.[196] However, running out had clearly reached Ketley by June 1797 when Samuel Purcell of Horsehay plied men at Ketley with drink 'for informing him about running out', which thus must have been different from the first process in potting and stamping.[197] John Wilkinson was puddling at Bradley when Joshua Gilpin visited in 1796.[198] The Botfields began puddling in 1794 at their Old Park ironworks.[199] Edward Knight's Mitton Forges went over to potting and stamping in 1796/7 and to puddling in 1799/1800, interestingly just after Cort's second patent expired.[200] At Cradley between 1805 and 1810, the works were making both stamped and puddled iron, but in both cases from 'run out plate'.[201]

Robert Thompson, who had been a manager at Cyfarthfa, but by 1812 owned the Abbey Tintern Works, had observed what Cort had done while at Cyfarthfa, but his letter was more concerned with denying other parts of Homfray's evidence: Homfray had claimed that 'nutt and bushell iron was thrown in the pudling furnaces' when the iron came to nature. Thompson said this was not possible, because these were not used there; in other words they were not available at Cyfarthfa.[202] James Cockshutt confirmed this.[203] However, interestingly, the alleged action foreshadows the later so-called wet puddling process of Joseph Hall, where iron oxide (in the form of a cinder from cooling forge tools) was added to the charge and reacted vigorously with the carbon dissolved in the metal.[204]

Rolling

What everyone who was concerned in the 1812 application by Henry Cort's sons for a continuing financial provision for the family, seems to have acknowledged was that the rolling of bar iron had greatly improved the quality of British iron. Samuel Homfray told the Commons Committee that this was not Cort's invention because Thomas Butler of 'Rochester, near Newport' [*recte* Rocheston or Rogerstone] had used fluted rollers.[205] This did not in fact precede Cort's use of them: the idea had reached Butler through Thomas Llewellyn, Cort's rollerman, who had called at Butler's tinplate mill in October 1785, on his way back to Penygored Tinworks to get his family. Butler asked Llewellyn if he 'thought they could roll bolts out of the shearings from the plates' [*ie* blackplates]. Llewellyn confirmed this was possible and explained how to turn rolls. Next morning he told Butler's foreman how to build furnaces and to turn the rolls. In the event, Llewellyn found work at Ynysygerwyn (in the Neath valley) and did not return to Fontley. However, Alexander Raby (who by then had a furnace near Llanelli)[206] traced him in 1812,[207] and procured an account of events from him.[208] Butler started building furnaces and long rolls for bolts in April 1786 and completed them about the end of November, as Llewellyn told Cort at the time.[209]

Cort himself admitted that 'Wilkinson, Raby and Horkell [Henckell] might have used grooved rolls for rolling bar iron of one form into bar iron of another form',[210] but apart from Samuel Homfray's erroneous allegation about Butler, no one suggested that anyone but Cort proposed the rolling of blooms. James Cockshutt confirmed this in 1812.[211] In fact the re-rolling of iron had gone on for a long time. William Pawlin and William Loggin had a patent for it as far back as 1683 for 'making several things of iron by millwork … as sheaths and tire for wheels, plates for fenders, half rounds of iron for kettles and other things of great and constant use'. They had in 1682 rented a mill at Crayford in Kent 'with a patent thereto belonging', which must refer to the 1679 patent to Thomas Harvey (a previous occupier of the mill) for 'drawing Spanish and Swedish iron into all sorts of roundes for bolts for shipping and other uses'.[212] Tyre or streak iron had a tight specification: 2½-3 inches broad, about ¾ inch thick and exactly nine foot long.[213] This was subsequently applied at a number of mills, mainly in Surrey and Kent, including (in *c*1790) James Henckell's at Wandsworth, Alexander Raby's at Cobham and Cox's Lock, and Crayford, Byfleet, and Weybridge (or Ham Haw) mills of Jukes Coulson & Co.[214] The relevant section of the 1794 list has different headings from the rest of it. All these mills had one 'H'; Weybridge, Cox's Lock and Wandsworth also had one 'R'; it is suggested these should be expanded as 'hoop' and 'rolling' mills. Each of these mills belonged to men

who successively occur in the records of the Victualing Commissioners as supplying them with hoops (for barrels).[215] They awarded a contract to Cort in 1780, and encouraged him to build a mill, with the objective of breaking the millowners' combination.[216] This cartel probably consisted of Alexander Raby and of Berdoe & Co of Byfleet and Crayford (where Berdoe's son-in-law, a different John Wilkinson was a partner).[217] The contract was not ultimately profitable for Cort.[218] By the date of the 1794 list, Jukes Coulson & Co were the Victualing Board's main supplier.[219] According to Alexander Raby's evidence to the House of Lords in 1784, the process for making hoops was the same as that of making rod iron for nails, except that the iron was passed through the flat rolls a further time to change it from a rod to a hoop.[220]

Elsewhere, the 1794 list distinguishes slitting and rolling mills. Many of the rolling mills can be identified as tinplate works. In some other places a mill is said to have one of each, which may refer to a single mill with two uses. That at Atherlee [Alderwasley, Derbs.] is identified as a lead mill.[221] Cort demonstrated his rolling method at Stourton Mill in Kinver in autumn 1783, but then some accident happened. The famous John Wilkinson (of Bersham and so on) expressed little surprise at the development: 'Ever since I saw the mill at Charleroy I have thought the rolls might be used *more* and the hammer *less*. Mr Cort may confirm *me* in that opinion & establish it in others but I have my doubts as to his making converts to rolls entirely'.[222] Wilkinson had visited Charleroy [Charleroi, now in Belgium] in January 1782.[223] Richard Reynolds & Co had built a slitting and rolling mill at Ketley, probably by applying new machinery to an existing engine. John Wilkinson converted his 1783 forge engine at Bradley to rolling, using the reciprocating rolls that he subsequently patented. His pirated 48-inch engine of 1789 for his 'great rolling and slitting mill' there may thus have been a second rolling mill.[224] Its construction was the occasion for closing his forge at Willey.[225] Crawshay's at Cyfarthfa, listed as built in 1790, worked from September or November 1789.[226] However, the rolling mill of Folliot Scott & Co at Rotherhithe, where patent blooms from Cyfarthfa and Fontley were initially rolled,[227] is not in the list nor (if not the same works) is Gardner and Manser's King and Queen Foundry at Rotherhithe which had a hammer and a set of rolls.[228] The appearance of Mr Homfray's Stourton Mill as both a slitting and rolling mill may indicate that it was rolling blooms from Penydarren.[229] Wortley had a tinmill from 1743,[230] but when John Cockshutt renewed his leases in 1793, this was a 'rolling mill heretofore used as a tin mill'.[231] This suggests that James Cockshutt (after leaving Cyfarthfa) introduced the rolling of bar iron, and presumably also puddling. On the other hand, Mr Thornywell of Clay Mill, with both kinds of mill and also a balling furnace and chafery, and Palmer and Mole of Wychnor (also near Burton on Trent) with a balling furnace and rolling mill, are more likely to have been re-cycling imported scrap, possibly under Cort's first patent. The list thus shows the beginnings of the rolling of iron blooms into bars, but the great spread of that clearly belongs to the period after the list was prepared.

The improved quality of British iron from the puddling and rolling process is apparent from the Navy Board's attitude to it. The Board organised tests on Cort's iron, apparently with satisfactory results in 1784.[232] This led to 150-ton contracts in 1787 and 1788 for 'feather-edged' iron made by his process, this being 'of great utility to forming the shanks of anchors', and the Board advertised from more in 1789 (after Cort's failure).[233] No evidence has been found of further purchases, and the Board apparently reverted to its normal practice of buying Swedish iron (mainly oregrounds), imported by John and William Wilson, and little other iron.[234] In 1796, Crawshay delivered two tons of iron to Portsmouth dockyard for trials.[235] In 1804, William Taitt (of Dowlais) and John Knight of Wolverley each contracted to provide 190 tons of British iron,[236] and in Knight's case this had begun with 12 tons in 1800.[237] In 1807, there were complaints of the quality of two kinds of second oregrounds iron, and the Board thought of only buying first oregrounds.[238] Wilson's 'Scotch iron' (presumably from Wilsonstown) was tried against Knight's and Taitt's and found equal to it.[239] Ultimately, the Board decided in January 1809 only to take 340 tons of Swedish and the other 1304 tons to be British iron.[240] In 1810, the iron bought appears all to have been British.[241] Puddling and rolling was thus triumphant.

Conclusion

This article has compared a number of related lists from a ten-year period around 1790. Comparing them with independent sources has indicated that they are generally reliable. A few unexpected entries and omissions have had to be questioned, including the lack of plant at the forges at Funtley, Pentyrch, Cobham, and three works of the Coalbrookdale Company (Coalbrookdale, Horsehay and Bridgnorth). The most striking omission is puddling, and this is not so easy to explain. However this is more explicable if a significant part of the '1794' list is derived from a precursor dated 1790. At that date the difficulties of puddling had been identified but not solved. The list thus throws valuable light on a period

of significant transition in the iron industry.

The 1794 list is the last general survey known for forge plant until Hunt's *Mineral Statistics* (from 1860) and *Griffiths' Guide to the Iron Trade* (1873). From 1796 the focus turns to pig iron production in furnaces, for which statistical compilations survive, made periodically until the start of the series of annual surveys of Hunt's *Mineral Statistics* in the 1850s. The pig iron data have been compiled by Riden and Owen.[242] The concentration on pig iron was initially due to the threat of a tax on pig iron or on coal used in making it in 1798 and 1806. However, the result is that we know little of how bar iron production developed over the years after the Industrial-Revolution period snapshot provided by the 1794 list and those others discussed here.

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References

Principal Archival Sources

1794 Booklet: Birmingham City Archives [BCA], MS 3219/6/16 (formerly called B&W, MII/5/10).

Butler Papers: Ironbridge Gorge Museum Library [IGMT], 1992/10018. The main source cited (apart from her thesis) is a collection of the correspondence of John Wilkinson.

Weale MSS: Science Museum Library [SML], MS 371/1-4.

Published and typescripts

Addis J O 1957, *The Crawshay dynasty* (Cardiff)

Alexander E 2002, 'Henry Cort and the Black Country', *The Blackcountryman* 35(4), 17-22.

Andrews C R 1956, *The Story of Wortley Ironworks* (3rd edn Nottingham1975).

Anon 1907-8, 'Local partnership deeds from ms. in collection of Richard Welford', *Proceedings of the Society of Antiquaries of Newcastle upon Tyne* (3rd ser) 3, 169-171.

Anon TS n d, 'Blast furnaces of Sheffield', Sheffield Local Studies Library, MP.2540M.

Ashton T S 1924, *Iron and steel in the industrial revolution* (Manchester).

Åström S-E 1982, 'Swedish iron and the English iron industry about 1700', *Scandinavian Economic History Review* 30, 129-41.

Beckett J V 1981, *Coal and tobacco: the Lowthers and the economic development of west Cumberland 1660-1760* (Cambridge).

Beddoes T 1791, 'An account of some appearances attending the conversion of cast into malleable iron', *Philosophical Transactions of the Royal Society* 81, 222-36.

Belford P 2010, 'Five centuries of ironworking: excavations at Wednesbury Forge' *Post-Medieval Archaeology* 44, 1-53.

Berg T and P (trans) 2001, *R R Angerstein's illustrated travel diary 1753-5* (London).

Booth T 2011, *Watermills of the river Rea in south Shropshire* (Congleton).

Butler J *c*1992, 'John Wilkinson', typescript, IGMT Butler Papers, box 6, no. 92.

Broadbridge S R 1980, 'British industry in 1767: Extracts from the travel diary of Joseph Banks', *History of Technology* 5, 119-142.

Chapman S D 1981, *Stanton and Staveley: a business history* (Cambridge).

Chappell E L 1940, *Historic Melingriffith: an account of the Pentyrch iron works and Melin Griffith tinplate works* (2nd edn Cardiff 1995).

Clayton A K 1955, The story of the Elsecar and the Milton Iron Works from their opening until 1848; typescript in Barnsley Local Studies Library, class B672.

Cleere H and Crossley D 1995, *The iron industry of the Weald*, (2nd edn Cardiff).

Cossons N (ed) 1972, *Rees' manufacturing industry* (Newton Abbot).

Cranstone D 1997, *Derwentcote steel furnace* (Lancaster).

Cranstone D 2011, 'From slitting mill to alloy steel: the development of the Swalwell ironworks', *Industrial Archaeology Review* 33(1), 40-57.

Crocker G (ed) 2000, *Alexander Raby, ironmaster: proceedings of a conference held at Cobham on 28 November 1998* (Guildford).

Crossley D and Saville R (eds) 1991, *The Fuller letters 1728-1755: guns, slaves and finance* (Lewes: Sussex Record Society 76).

Crossley D 1995, 'The blast furnace at Rockley, South Yorkshire', *Archaeological Journal* 152, 391-421.

Dalrymple Sir J 1784, *An address and proposals from Sir J.D. bart. on the subject of the coal, tar and iron branches of trade* (Edinburgh).

Deane P 1981, *The First Industrial Revolution* (Cambridge).

Dickinson H W and Jenkins R 1981, *James Watt and the steam engine* (Ashbourne).

Dilworth D 1976, *The Tame mills of Staffordshire* (Chichester).

Edwards I 1972, 'Some notes on John Wilkinson and his relations with Boulton and Watt', *Denbighshire Historical Society Transactions* 21, 109-16.

Elsas M (ed) 1960, *Iron in the making: Dowlais Iron Company letters 1782-1860* (Cardiff).

Evans C (ed) 1990, *The letterbook of Richard Crawshay 1788-97* (Cardiff: South Wales Record Society 6).

Evans C 1992, 'Manufacturing iron in the north east during the eighteenth century: the case of Bedlington' *Northern History* 28, 178-196.

Evans C 1993a, *The labyrinth of flames: work and social conflict in early industrial Merthyr Tydfil* (Cardiff).

Evans C 1993b, 'The statistical surveys of the British iron industry in 1797-8 and 1806' *Historical Metallurgy* 27(2), 84-101.

Flinn M W 1962, *Men of iron: The Crowleys in the early iron industry* (Edinburgh).

Gale W K V 1966, *The Black Country iron industry: a technical history* (London).

Gale W K V 1967, *The British iron and steel industry: a technical history* (Newton Abbot).

Gale W K V 1969, *Iron and Steel* (London).

Gale W K V 1971, *The iron and steel industry: a dictionary of terms* (Newton Abbot).
Griffiths S 1873, *Griffiths' Guide to the iron trade* (London).
Gross J (ed) 2001, *The Diary of Charles Wood of Cyfarthfa Ironworks, Merthyr Tydfil 1766-1769* (Cardiff).
Hammersley G F 1973, 'The charcoal iron industry and its fuel 1540-1750', *Economic History Review* 2 ser 26, 593-613.
Hancock H B and N B Wilkinson 1959, 'Joshua Gilpin: an American manufacturer in England and Wales 1795-1801' *Transactions of the Newcomen Society* 32, 15-28.
Hayes G G L 1990, 'Introduction', in C Evans (ed), *The letterbook of Richard Crawshay 1788-97* (Cardiff: South Wales Record Society 6), ix-xxiii.
Hayman R 2004, 'The Cranage Brothers and eighteenth-century forge technology' *Historical Metallurgy* 38(2), 113-20.
Hey D G 1977, 'The ironworks at Chapeltown' *Transactions of the Hunter Archaeological Society* 10(4), 252-9.
Hillen J 1951, *Old Surrey watermills* (London).
Hughes S 2005, *Copperopolis: landscapes of the early industrial period in Swansea* (Aberystwyth).
Hulme E W 1928-9, 'The statistical history of the iron trade', *Transactions of the Newcomen Society* 9, 12-33.
Hunt, R 1856-1881, *Memoirs of the Geological Survey and Museum of Practical Geology: Mineral Statistics of the United Kingdom and Ireland* (London); issued annually.
Hyde C K 1977, *Technological change and the British iron industry 1700-1870* (Princeton NJ).
Ince L 1991, *The Knight Family and the British Iron Industry 1695-1902* (Cardiff).
Ince L 1993, *The south Wales iron industry 1750-1885* (Cardiff).
Ince L 2001, *Neath Abbey and the Industrial Revolution* (Stroud).
John, L 2000, 'Alexander Raby, ironmaster and coalmaster', in G Crocker (ed), *Alexander Raby, ironmaster: proceedings of a conference held at Cobham on 28 November 1998* (Guildford), 36-40.
Kaplan H H 1995, *Russian overseas commerce with Great Britain during the reign of Catherine II* (Philadelphia: Memoirs of the American Philosophical Society 218).
Kent H S K 1973, *War and trade in the northern seas: Anglo-Scandinavian economic relations in the mid eighteenth century* (Cambridge).
King P W 1996, 'Early Statistics for the iron industry: a vindication', *Historical Metallurgy* 30(1), 23-46.
King P W 2001-2, 'Sir Clement Clerke and the adoption of coal in metallurgy', *Transactions of the Newcomen Society* 73, 33-52.
King P W 2003, 'The cartel in oregrounds iron: trading relationships in the raw material for steel', *Journal of Industrial History* 6(1), 25-48.
King P W 2005, 'The production and consumption of bar iron in early modern England and Wales', *Economic History Review* 2 ser 58 , 1-33, with corrigendum 59 (2006), 264.
King P W 2011, 'The choice of fuel in the 18th century iron industry: the Coalbrookdale accounts reconsidered', *Economic History Review* 2 ser 64, 132-156.
Lancaster J Y and Wattleworth D R 1977, *The iron and steel industry of west Cumberland: an historical survey* (Workington and Barrow).
Levine T H 2009, 'Dr Thomas Beddoes: chemistry, medicine and the perils of democracy', *Notes of the Royal Society* Preprint 2009. doi: 10.1098.renr.2009.0032.
Lloyd J 1906, *The early history of old Welsh iron works, 1760-1840* (London).
Lloyd H 1975, *The Quaker Lloyds in the Industrial Revolution* (London).
Magilton J 2003, *Fernhurst Furnace* (Chichester: Chichester District Archaeology 2).
Morley C 1998, 'The Walkers of Masbrough: a re-examination', *South Yorkshire Industrial History Society Journal* 1, 20-38.
Morton G R and N Mutton 1967, 'The transition to Cort's puddling process', *Journal of the Iron and Steel Institute* 205(7), 722-8.
Mott R A 1959-60, 'The Coalbrookdale Horsehay Works (part II)', *Transactions of the Newcomen Society* 32, 43-56.
Mott R A 1983, *Henry Cort: The great finer: creator of puddled iron*, ed P Singer (London).
Mushet D 1798-9, 'Historical remarks relative to the manufacture of iron and steel', *Philosophical Magazine* 2, 346-53.
Mushet D 1840, *Papers on iron and steel* (London), 44.
Mushet D undated, 'Blast Furnace', in A Rees, *Cyclopedia* IV (unpaginated), reprinted in Cossons 1972, Vol 1.
Musson A E and Robinson E 1969, *Science and technology in the Industrial Revolution* (Manchester).
Mutton N 1967-8, 'The forges at Eardington and Hampton Loade' *Transactions of the Shropshire Archaeological Society* 58(3), 235-43.
Nixon F 1969, *Industrial archaeology of Derbyshire* (Newton Abbot)
Page R 1979, 'Richard and Edward Knight, ironmasters of Bringewood and Wolverley' *Transactions of the Woolhope Naturalists and Field Club* 43(1), 7-17.
Percy J 1864, *Metallurgy II: Iron and steel* (reprint Eindhoven, Netherlands, nd).
Potter J F 1982, 'Iron making in the vicinity of Weybridge, Surrey', *Industrial Archaeology Review* 6, 211-23.
Raistrick A 1989, *Dynasty of ironfounders: The Darbys of Coalbrookdale*, 2nd edn (York).
Raistrick A and E Allen 1939, 'The south Yorkshire ironmasters (1690-1750)', *Economic History Review* 1ser 9, 168-185.
Rees A 1800-20, *Rees' Cyclopaedia;* partly reprinted in Cossons N (ed) 1972.
Riden P 1977, 'The output of the British iron industry before 1870', *Economic History Review* 2 ser 30, 442-59.
Riden P 1988, 'The ironworks at Alderwasley and Morley Park', *Derbyshire Archaeological Journal* 108, 77-107; with comment by M Johnson and postscript by author *ibid*, 109 (1989), 173-9.
Riden P 1992a, 'Some unsuccessful blast furnaces of the early coke era', *Historical Metallurgy* 26, 36-44.
Riden P 1992b, *John Bedford and the ironworks at Cefn Cribwr* (Cardiff).
Riden P 1993, *A gazetteer of charcoal-fired blast furnaces in Great Britain in use since 1660*, 2nd edn (Cardiff).
Riden P 1994, 'The final phase of charcoal iron-smelting in Britain, 1660-1800', *Historical Metallurgy* 28(1), 14-26.
Riden P and J G Owen 1995, *British blast furnace statistics 1790-1980* (Cardiff).
Robinson E and D McKie 1970, *Partners in science: letters of James Watt and Joseph Black* (London).
Scrivenor H 1841, *A comprehensive history of the iron trade* (also 2nd edn 1854).
Smeaton J 1812, *Reports of the late John Smeaton ...* (London).
Smeaton J 1950, *Smeaton's designs: a catalogue of civil and mechanical engineering designs (1741-1792) of John Smeaton ... in library of Royal Society* (London: Newcomen Society extra publication 5).-
Smith D M 1965, *Industrial archaeology of the East Midlands* (Newton Abbot).
Smith W A 1970-1,'The contribution of the Gibbons family to the technical development of the coal and iron industries', *West Midlands Studies* 4, 46-55.
Smith W E 1966, 'The Bradley Ironworks of John Wilkinson', *Bulletin of the Historical Metallurgy Group* 6 [p.57-8 in reprint

edition of *Bulletins* 1-6]
Stidder D 1990, *The watermills of Surrey* (Buckingham).
Tann J 1970, *The development of the factory* (London).
Tann J 1979-80, 'Mr Hornblower and his crew: steam engine pirates of the eighteenth century', *Transactions of the Newcomen Society* 51, 95-109.
Thorne R 2004, 'Stuart, John, first Marquess of Bute (1744–1814)', *Oxford Dictionary of National Biography* (Oxford).
Trinder B 1973, *The Industrial Revolution in Shropshire* (Chichester).
Tylecote R F 1991, 'Iron in the Industrial Revolution', in J Day and R F Tylecote (eds), *The industrial revolution in metals* (London).
VCH, *Victoria County History Staffordshire*, 20 (1984).
VCH, *Victoria County History Shropshire*, 8 (1968) and 10 (1998).
Wood O 1988, *West Cumberland coal 1600-1982* (Kendal: Cumberland and Westmorland Antiquarian and Archaeological Society extra series 24).

Notes

1 Birmingham City Archives [hereafter BCA], MS 3219/6/16 (formerly called B&W, MII/5/10) [hereafter 1794 booklet].
2 The National Archives [hereafter TNA], PRO 30/24/44/75, f.40-1; Åström 1982, 138; King 1996, 23.
3 TNA, E 112/537/28.
4 Hulme 1928-9, 12-33; King 1996, 23-46. There is a misprint in the latter's consolidated list in table 6 for Cradley and Lye, where the *c*1715 figure has strayed into the following column. The entries for these in its tables 1 and 3 are correct.
5 1794 booklet, 18-19.
6 Cf King 1996, 34-8; for Thomas Knight see Page 1979, 15.
7 1794 booklet, 18-19.
8 Nixon 1969, 193-4, 273, Smith 1965, 78-9.
9 *VCH Staffordshire* 20 (1984), 145.
10 Hughes 2005, 47-55; National Library of Wales [hereafter NLW], Badminton II, nos 1594-7. Certain authors, such as Flinn 1962, 14-15, have incorrectly described the forge as at Treforest. This may be due to wrong inference from Lloyd 1906, who (p.111) refers to a property called 'Forest' at Treforest, ignoring Lloyd's quotation, in relation to Yniscedwyn Furnace, of another 'Forrest', in Llansamlet as the residence of Robert Popkins (p.106-7).
11 1794 booklet, 19-20.
12 Riden 1992a, 36-44.
13 Herefs. RO, E12/VI/KAC/64 97 161-2.
14 TNA, C 78/1030/2.
15 Leics. RO, 26D53/514; Huntingdon Lib (California) Hastings MSS, HA 5465. I owe this reference to Richard Cust.
16 Details of a dispute over this and other ironworks appear in Yorkshire Archaeological Society Library (Leeds), MD.335/270/67-122 esp. 86; Notts. RO, DD.SR 211/128/1/1-20
17 NLW, Tredegar Park MSS, 70/352; Riden 1993, 31-32.
18 Riden 1993, 25-6.
19 Sheffield Archives, Wh.D 420; SpSt 60495/6; TC 698.
20 Crossley 1995, 391-421.
21 The problem is discussed at length in Riden 1992a, 38-9.
22 Riden 1992b.
23 TNA, E 112/1895/20; E 134/12 Geo. III/Hil. 10-11.
24 Raistrick and Allen 1939, 169-172; the author has found no reference to Seacroft either in the Spencer-Stanhope MSS (now divided between Sheffield and Bradford Archives) or, in that period, elsewhere.
25 Smeaton 1812, ii, 373-4; cf. Smeaton 1950, 63-5; Leeds Archives, DB.219/2-3 6 & 8;
26 *eg* Carlisle RO, D/Lons/W2/1/78, 3 Mar. 1737[8]; Lancaster and Wattleworth 1977, 19-20; Beckett 1981, 126-7; Wood 1988, 32-3, 36.
27 Anon 1907-8, 169-171; Cranstone 1997, 19-20.
28 Wood 1988, 76.
29 Cleere and Crossley 1995, 386; Magilton 2003, 62-3.
30 Mushet 1840, 44; Mushet undated, 169. For Mushet's authorship see Science Museum Library [hereafter SML], Weale MS, MS 371/2, 477-8. It should be noted that Mushet's papers are not known to survive.
31 Mushet 1798-9, 346-53.
32 Scrivenor 1841 edn, 86; 2 edn 1854, 87-8.
33 Scrivenor 1841 edn, 359-61 (not in later edn).
34 Worcs. RO, b899:310 BA 10570/2-3. I am grateful to Laurence Ince for pointing this out.
35 Riden 1988.
36 Chapman 1981, 17-19.
37 Cheshire RO, DDX 100.
38 Riden 1977, 446-7.
39 TNA, BT 6/113, f.227.
40 Scrivenor 1841 edn, 359-61.
41 Kaplan 1995, 152-161.
42 King 2005, 18.
43 TNA, BT 6/231-233.
44 None is mentioned by Kaplan 1995 and there is little on this in the Weale MSS.
45 Riden and Owen 1995, x.
46 Riden 1977, 442-459; Evans 1993b; Riden 1994, 14-26; King 2005.
47 Riden and Owen 1995, ix-xi.
48 King 1996, 38.
49 1794 Booklet, 1-16.
50 Butler typescript, 210-36.
51 Tann 1979-80.
52 Butler typescript, 273-83.
53 SML, Weale MSS, 371/2, f.458.
54 Herefs. RO, E12/S/378, lease of 20 Oct. 1784.
55 There has been considerable dispute on the dates of these, mainly since Smith produced an account of Hallfields Furnace claiming a date of 1766, shortly after buying Hall Fields, but this was not Wilkinson's first furnace at Bradley. See Butler typescript, 78-80; Smith 1966, 57-8.
56 East Yorks. RO (Beverley), Deeds Registry, CE/575, no. 863; cf. DDLo box 17(c).
57 Thorne R, 'Stuart, John, first Marquess of Bute (1744–1814)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2008 [http://www.oxforddnb.com/view/article/64138, accessed 15 June 2011]; *Burke's Peerage, s.v.* Bute.
58 *Burke's Peerage, s.v.* Cobham, Viscount.
59 Clayton 1955, 1-23; Anon TS, 1.
60 Ashton 1924, 156-61; Hey1977, 256-9; Anon TS, 2
61 Dudley Archives, DE/V, mining leases 1614-1796, 1794 leases.
62 Ince, 2001, 32.
63 As to 1796 list see above at note 46 and Evans 1993b.
64 National Library of Wales, MS, Bute box 48; Chappell 1940, 28.
65 Shropshire Archives, 1497/427; Booth 2011, 17-20; *London Gazette*, 9 December 1794: Issue 13730, p.1219.
66 John Rylands Library (Manchester), Botfield MSS, BOT 2/22/1 and 2/24/1.

67 'Copies of deeds relating to Llantarnam Abbey Park', MS in Newport Central Library, q M319 (900) DEE.
68 Science Museum Library, MS 371/1, 91.
69 As note 10.
70 The process is described in SML, Weale MSS, MS 371/4, 298.
71 Crocker (ed.) 2000; Hillen 1951, 124-6 (mistakenly attributing to Coxes Lock references that seem to apply to Haw Haw Mill); Potter 1982, 215-6; Stidder 1990, 113-4, 125; Surrey RO, Land tax assessments for Cobham.
72 King 2001-2, 39-41; King 2011, 133.
73 Trinder 1973, 81-2; Hyde 1977, 63-72; Ince 1991, 39-41, 117-20; King 2011, 133-5, 153. The point is not as clearly made in Trinder's 3rd edition.
74 Gross 2001, *passim*; Evans 1993a, 13-29.
75 Little Clifton: see notes 27-9; Whitehill: Riden 1992a, 39-40; Bedlington: see note 24.
76 TNA, WO 47/107-120, *passim*.
77 Morley 1998, 20-38; Sheffield Archives, WC.2725.
78 See note 37; Musson and Robinson 1969, 407-23.
79 The 1794 list attributes no forge plant to the owner.
80 Mushet 1840, 37; Ashton 1924, 15; Hammersley 1973, 597 (critically); Deane 1981, 106.
81 Percy 1864, 581-2, 621-7.
82 Morton and Mutton 1967, 723-4; Patent no. 1054
83 Gross 2001, *passim*.
83a Patent no. 1054; *VCH Shropshire* 10, 352.
84 Chapman 1981, 17-19
85 Smith 1970-1, 46-55.
86 Tann 1970, 37.
87 *Aris' Birmingham Gazette*, 12 Aug. 1793; 29 Oct 1798. The date is calculated on the assumption that the lease (with 80 and 78 years unexpired) was originally for 99 years.
88 Butler typescript, 183, 188.
89 BCA, MS 3147/3/13/8 (formerly B&W, Box 20/13), letter, Matthew Boulton to James Watt, 6 July 1789 – transcript: Butler Papers 88, 159.
90 Bradley: typescript, 190-1; Eardington: see text at notes 123-7.
91 BCA, MS 3147/3/5/28 (formerly B&W, Box 36), letter, Matthew Boulton to James Watt, 28 July 1781 – transcript: Butler papers 88, 129.
92 Alexander 2002, 17-22, 18-21.
93 See below at note 160: royalty of 10s per ton: SML, Weale MSS, 371/3, 187-8; reduction: *ibid*, 195v.
94 1794 booklet, 5.
95 SML, Weale MSS, 371/3, 158v.
96 Cort's dealings with Reynolds are described (from Cort's point of view) in a case for counsel: SML. Weale MSS, 371/3, 144-66.
97 BCA, MS 3147/3/534/58-60 (formerly B&W, Box 20, 7/57-59), letter, Matthew Boulton to James Watt, 22 Oct., 3 and Nov. 1783 – transcript: Butler papers 88, 141-2.
98 1794 booklet, 7.
99 Dudley Archives, DE/V/1/1 (recitals); Staffs. RO, D 1046. On the Gibbons family generally, see Smith, 'Contribution of the Gibbons family'.
100 *VCH Shropshire* 8 (1968), 118. The family's interest began only in 1757, not as stated there: NLW, Pitchford Hall 1925-6; BCA, 278121 and 278103.
101 SML, Weale MSS, 371/3, 194.
102 Dudley Archives, Z121.
103 King 2005, 9-13; Evans 1993b, 23.
104 Gale 1971, 16.
105 [J. Farey (?)], 'Iron' in Rees, *Cyclopaedia*: Cossons 1972, III, 188; S Homfray in SML, Weale MSS, 371/4, 227-8; [Joseph Dawson (?)], *ibid*, 371/2, 504-11(for authorship and context see 512-16); another text, *ibid*, 408-27 428-35.
106 Patent specification no. 1420: printed in Mott 1983, 101.
107 Dilworth 1976, 108-9 114 (as 'Wednesbury Bridge Mill'); Berg 2001, 47-50; Dickinson and Jenkins 1981, 264; Morton and Mutton 1967, 723. As to the other Wednesbury Forge, see also Belford 2010, 1-53.
108 Carlisle RO, D/Lons/W2/1/101, 4 Nov 1740.
109 Lichfield RO, D 15/12/73.
110 Worcs RO, b899:310 BA 10470, no. 142, 1746/7, p.6
111 It was in the hands of Samuel Beach by 1781: Staffs. RO, Land Tax Assessments for Little Aston.
112 P W King, 'William Wood' (in preparation).
113 Bristol RO, HA/B/10-12.
114 *Aris' Birmingham Gazette*, 26 Dec. 1768.
115 Sheffield Archives, ACM/S378, 306.
116 Sheffield Archives, ACM/S382, 136.
117 Shropshire RO, 4001/E/3/G5, f.15; 4001/E/3/G6, f.12; 4001/E/2/251.
118 SML, Weale MSS, 371/3, 153v-154.
119 Broadbridge 1980, 135-39; Hayman 2004, 113-20.
120 Mott 1983, 49-50.
121 Raistrick 1989, 214-6.
122 Mott 1959-60, 44-47, 50
123 SML, Weale MSS, 371/4, 233v-234; Hayman 2004, 117.
124 Gale 1971, 314; Hayman 2004, 117.
125 Crossley and Saville 1991, no. 182; Evans 1992, 189.
126 SML, Weale MSS, 371/3, 165-165v.
127 NLW, Pitchford Hall, 2188 2212-24 *passim*; Mutton 1967-8, 235.
128 Patent 1370 and specification; SML, Weale MSS, 371/3, 154; cf. 371/4, 255.
129 SML, Weale MSS, 371/3, 154-154v.
130 BCA, MS 3147/3/534/60 (formerly B&W Box 20, 7/59), letter, John Wilkinson to James Watt, 6 Nov 1783 – transcript: Butler papers, 88, 142-3.
131 Specification for Patent 1370.
132 Elsas 1960, 186-7, 245; Evans 1990, 190.
133 SML, Weale MSS, 371/4, 255.
134 Elsas 1960, vii, 238-9.
135 Riden 1993, 26.
136 Evans 1990, no. 95.
137 Gale 1966, 33, 39-40; Gale 1967,43-46; Gale 1969, 33-4; Morton and Mutton 1967, 723-724; Mott 1983, passim; Hayes 1990, xii-xvi; Evans 1993a; typescript, 113-8; Alexander 2002, 17-22; Hayman 2004, 113-20.
138 Hayes 1990, xii-xvi.
139 Evans 1993a, 95-100 and as note 137.
140 Robinson and McKie 1970, 141; SML, Weale MSS, 371/3,159-160.
141 Robinson and McKie 1970, 141; SML, Weale MSS, 371/3, 205v.
142 Robinson and McKie 1970, 142-4.
143 Dalrymple 1784; for context see SML, Weale MSS, 371/1, 100; 371/3, 155 206.
144 SML, Weale MSS, 371/3, 155 100.
145 SML, Weale MSS, 371/3, 206.
146 Cranstone 1993, 20, 24.
147 SML, Weale MSS, 371/3, 195 202; Cranstone 1993, 24; cf. Patent specification, no. 1396.

148 Sandbeck Park (Maltby, S Yorks) estate office archives, MTD/A27/2-3; MTD/A50/1 & 13; EMS/16/10; EMS/40, 36-7.
149 Smith 1970-1, 47; Staffs RO, Gibbons MSS, D 695/1/12/36, notes on yield.
150 SML, Weale MSS, 371/3, 156-8.
151 Alexander 2002, 18.
152 SML, Weale MSS, 371/3, 206
153 TNA, WO 47/95, 192; WO47/98, 851 973 1087; WO 47/99, 39 316 339 451; WO 47/100, 516-8; WO 47/103, 499.
154 SML, Weale MSS, 371/3, 242.
155 SML, Weale MSS, 371/3, 187-8.
156 SML, Weale MSS, 371/3, 189.
157 SML, Weale MSS, 371/3, 190.
158 SML, Weale MSS, 371/3, 190-1.
159 SML, Weale MSS, 371/3, 194v.
160 SML, Weale MSS, 371/3, 195; also Evans 1990, no. 22.
161 SML, Weale MSS, 371/3, 195v.
162 SML, Weale MSS, 371/3, 196.
163 Evans 1990, nos. 80 87.
164 Evans 1990, nos. 99 102-3 108 112.
165 Evans 1990, no. 113.
166 SML, Weale MSS, 371/3, 255.
167 *ibid*, 371/3, 255
168 *VCH Staffordshire* 20, 145-6; Ince 1993, 73-5.
169 Evans 1990, nos. 62 128 133 140; cf Lloyd 1975, 148-50.
170 SML, Weale MSS, 371/3, 196.
171 Mott 1983, 55-66.
172 Hants RO, Land Tax Assessments, Titchfield (Sarisbury).
173 SML, Weale MSS, 371/3, 209.
174 Mott 1983, 65-6
175 Chappell 1940 (1995 edn), 27.
176 Evans 1990, no. 95.
177 Elsas 1960, 179.
178 *ibid*, 84.
179 Evans 1993a, 99.
180 Dawson: SML, Weale MSS, 371/2, 408-27 428-35 504-11; Homfray: *ibid*, 371/4, 227-9.
181 [J Farey (?)], 'Iron' in A Rees, *Cyclopaedia*: Cossons 1972, III, 176.
182 Gale 1966, 39-40; Gale 1967, 46; Tylecote 1991, 236-8.
183 SML, Weale MSS, 371/3, 233v-234.
184 SML, Weale MSS, 371/3, 216.
185 SML, Weale MSS, 371/3, 217.
186 SML, Weale MSS, 371/3, 181-2.
187 Percy 1864, II, 625.
188 Ince 1993, 135.
189 Evans 1990, nos. 95 116.
190 SML, Weale MSS, 371/3, 196.
191 Addis 1957, 12; Evans 1990, no. 411.
192 Evans 1990, no. 427.
193 SML, MS 371/3, 194-5.
194 Beddoes 1791, 222-6. I owe this reference to David Cranstone.
195 Levine 2009.
196 Beddoes 1791, 222-6.
197 Mott 1959-60, 50.
198 Hancock and Wilkinson 1959, 22-4.
199 Hayman 2004, 117.
200 Ince 1991, 93-5.
201 Dudley Archives, Z121.
202 SML, Weale MSS, 371/3, 214v.
203 SML, Weale MSS, 371/3, 216
204 Gale 1967, 62-3.
205 SML, Weale MSS, 371/4, 233v-234
206 John 2000, 36-40.
207 SML, Weale MSS, 371/3, 240.
208 SML, Weale MSS, 371/3, 242.
209 SML, Weale MSS, 371/3, 240v-241
210 SML, Weale MSS, 371/3, 196v.
211 SML, Weale MSS, 371/3, 217.
212 Patents 209 and 229; TNA, C 78/923/3; TNA, C 105/33, parcel 10.
213 Kent 1973, 69; Bodleian Library (Oxford), MS Eng. Hist. C305.
214 On these mills generally see note 71. None of the sources cited there have adequately elucidated the function of these mills. J[ukes] Coulson & Co also appear in the 1794 list as occupier of Swallwell and Winnington [Winlaton] near Newcastle, earlier of Theodosia Crowley & Co This presumably refers to the partnership of Isaiah Millington, Jukes Coulson and Thomas Vardon who took over the Crowleys' contract as ironmongers to all the naval dockyards (except Portsmouth) on 25 September 1782: TNA, ADM 49/121 f.5 (also ff.8 47). This suggests that the accounts by Flinn (1962, 90-1) and Cranstone (2011, 46-7) of the business in this period is not quite right. They perhaps refer to ownership of the works, rather than occupation – presumably under a lease that expired before the preparation of the documents that were Flinn's source.
215 TNA, ADM 112/162-184, *s.v.* 'iron hoops'.
216 SML, Weale MSS, 371/3, 198-9.
217 TNA, ADM 112/166-9, *s.v.* 'iron hoops'; Berdoe: Surrey History Centre, G54/1/19: Mr J W Bardoe (a descendant) pointed out this document to me.
218 SML, Weale MSS, 371/3, 198-9.
219 TNA, ADM 112/173-84, *s.v.* 'iron hoops'.
220 SML, Weale MSS, 371/4, 298.
221 1794 list.
222 BCA, MS 3147/3/534/60 (formerly B&W Box 20, 7/57), letter, John Wilkinson to James Watt, 6 Nov 1783 – transcript: Butler papers 88, 142; typescript, 193. Emphasis in original.
223 BCA, MS 3782/12/73/146 (formerly MBP, Box 367/7), letter, John Wilkinson to Matthew Boulton 16 Jan 1782 – transcript: Butler papers 88, 132.
224 Edwards 1972, 111.
225 See above at note 88.
226 SML, Weale MSS, 371/3, 196; Evans 1990, nos. 174 & 176.
227 SML, Weale MSS, 371/3, 180.
228 Tann 1970, 82.
229 See above, at note 168.
230 Andrews 1956 (3rd edn 1975), 65.
231 Sheffield Archives, Wh.M./D/590.
232 Mott 1983, 41-44.
233 TNA, ADM 106/3621, 61; Mott 1983, 45.
234 King 2003, 25-48; National Maritime Museum [hereafter NMM], CHA/N/1, 32-138 *passim*.
235 NMM, Portsmouth warrant books, POR/A/39, 6 Feb 1796.
236 NMM, CHA/N/1, 119 121.
237 Worcs RO, b899:310 BA 10470/4, nos. 189-205 *passim*.
238 TNA, ADM 106/1655, 2 Mar 1807.
239 *ibid*, 27 Jul 1807.
240 TNA, ADM 106/2672, 13 and 31 Jan 1809.
241 TNA, ADM 106/2674, 26 and 30 Jan and 6 Feb 1810.
242 Riden and Owen 1995, xi-xx.

The author

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Appendix (pp124-134)

Source: Birmingham City Archives, ms 3219/6/16; formerly Boulton & Watt M II/5/10.

Editorial method: See text. On page 1 (only) the original has the situation column after the proprietor and occupier. Otherwise the objective has been to reproduce the original as exactly as possible, save that text in superscript appears on the line.

Notes: The situation is the distance in miles from the place named, sometimes with a direction. The 'blown' column contains the word 'Engine' or 'Water', reproduced as E or W. Material written across the columns and longer comments in the final column have been placed in the footnotes below, as have a few editorial comments which are in [square brackets].

1. [Probably Jukes Coulson & Co: see text note 214]
2. [and] tinmill 2 wiremills [should be John Cockshutt]
3. [D = Down]
4. John Emanuel's will [sic]
5. [blank except date]
6. (Interlineated)
7. [location blank - perhaps Partridge Nest, near Newcastle]
8. [location blank - possibly Sheepwash Mill, Tipton]
9. [location blank - unidentified]
10. [and] tinmill wiremill
11. 1 for bolts & 1 tinmill
12. [and] s fineryes [sic] wiremill [at Abercarn]
13. [also] 1 rolling mill for tinmill (Butlers)
14. [and] 8 Corts furn.
15. Ynysygiren tinmill
16. do [*ie* tinmill]
17. 2 forges each 2 [fineries] 1 [chafery] one on Mr Rice of Newton [meaning not wholly clear]
18. [Cefn Cribwr - actually a considerable distance west of Cowbridge]
19. now paper mill - 97 [1797]
20. [Q = Query (?)]
21. [The correct expansion of the letters in the heading is not clear: see text after note 66]
22. [and] 2 air furnaces
23. [should be 'Funtley' not 'Huntley']

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges					mills			[other and notes]
				coke	charcoal	blown	built	finery	chafery	melting finery	balling furnace	built	rolling	slitting	built	
Page 1: Northumberland Durham Cumberland Westmoreland																
Swallwell	5 W Newcastle		Messrs Colson & Co					2	1		1		1	1		
Darwincoat	9 W do		Mrs Cookson					2	1		1					
Winnington	2 W do		T Colson & Co											1		Note 1
Lumley	8 SE do	Earl Scarborough	Longridge & Co						1		1					
Beamish									1		1					
Seaton	1 Workington	Mr Christian	Seaton Co	1		W	1760	3	1					1		
Duddon	12 Ulverston	Mr Coupland	Mr Latham		1	W	174									
Force Forge	3 S Kendal	Lady Andover	Mr Wakefield					2	1							
Leighton	2 Milnthorp	Lord Derby	Halton Co		1	W	1715									
Uckington	Morpeth	Duke Northumberland	Geo Kendall & Co										1			tinmill
Bedlington	6 do	Bishop of Durham	Hawkes & Longridge										1			
Bedlington	do	Mr Ward	do											1		
Page 2: Yorkshire																
Masborough	1W Rotherham	Lord Effingham	MM Walker	2	1	E	1765	3	1		1		1	1		
Thribergh	5 do	MM Walkers	do					2	1				1			
Wortley	10 Sheffield	Earl of Bute's lady	Mr T Cockshott					4	2				1	1		Note 2
Pondmill	Sheffield		Kennian & Co											1		
Owterton	1 do	Duke of Norfolk	do											1		
Middlewood	3 do		Mr Kennian											1		
Brightside	3 do	Duke of Norfolk	Mr Booth & Co					2	1					1		
Attercliffe	3 do		Mr Swallow					2	1					1		
Kilnhurst	6 Rotherham	Mr Shore	Mr J Cooke					2	1					1		
Hunsleet	Leeds		Mr Fenton											1		
Kirkstall	3 do		Mr Butler & Co					2								
Waddesley	2 Sheffield	Duke of Norfolk	Mr Swallow					2	1							
Mausehole	2 do	Mr Burton	Cockshott & Armitage						1		1					
Chappletown	6 do	Duke of Norfolk	Mr Swallow	2		E		2	1							
Seacroft	4 Leeds				D	W	1780									Note 3
Burkenshaw	5 Bradford	Sir T Gascoigne	Mr Emmett	1		E	1780									Note 4

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges					mills			[other and notes]
				coke	charcoal	blown	built	finery	chafery	melting finery	balling furnace	built	rolling	slitting	built	
Seamoor	4 Scarborough	Duke of Leeds	Mr Cockshot					1	1		1					
Britton	5 Wandfield	Col Britton	Mr M Cook & Cockshot		1											
Park	2 Sheffield	Duke Norfolk	Booth & Co	2		W	1786									
Coln Bridge	5 Huddrsfield	Sir G Armitage	Mr Brook					2	1					1		
Roach Abbey	betn Roth & Ridford		Mr Swallow					1	1							
Wibsey Low moor	3 Bradford	_ Leeds Esq	Messrs Jarard	2		E	1791									
Bowling	1 do		Messrs Stuges & Poley	2		E	1791	2					1			
Shelf	4 do		Crawshay & Ellwell	1		E	1794									
Page 3: Lancashire and Cheshire																
Backbarrow	10 Ulverston	John Machell	B Barrow Co		1	W	1705	1	1							
Sparkbridge	5 do		do					1	1							
Newlands	17 do	exor G.Knott	Exor Geo Knot		1	W	1750	1	1							
Nibthwaite	6 do	do	do					2	1							
Caton	3 Lancaster		Mr Stringer					1	1							
Stanley	_ Prescott		exor T Rigby											1	1773	
Halton	2 Lancaster	Mr Bradshaw	Halton & Co		1	W	1756								1754	
Haigh	2 Wigan	Earl Balcarres	Lindsey & Co	2		E	1789									
Duckenfield	_ Ashton	_ Astley	T Bateman	1		W	1775									
Lym															1774	Note 5
Nothwich	1 Northwich	_ Barry Esq	Ns Ryder					1	1							
Lea Forge	5 Nantwich	Sir T Broughton	Hopkins & Latham					1	1							
Warmingham	4 Holmes Chapel nr Crewe		Mr M Paddy					2	1							
Bidston	2 Liverpool		Mr Grant										1			
Worsley	7 Manchester	Duke of Bridgewater	Duke of Bridgewater						1		1					
Page 4: Derbyshire Nottinghamshire Warwickshire and Herefortshire																
Atherslee	11 N Derby	Mr Hurt	Mr Hurt				1782	3	2				1	1		leadmill
Stayley	4 NE Chesterfield	Mr Mather	Mr Mather	1				2	1							
New Mills	5 Derby		do					2	1	1	1		1	1		

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges					mills			[other and notes]
				coke	charcoal	blown	built	finery	chafery	melting finery	balling furnace	built	rolling	slitting	built	
Burrows Ash	4 do	Lord Harrington	do										1			tinmill
Darby (sic)	Derby		Mr Evans											1		
Wiln Mill	7 S Derby		Mr Barnett										1			
Bullwell	4 Nottingham		Mr Mather					2	1							
Wingerworth	2 Chesterfield	Sir H Hunlocke	Mr Butler	2		E	1780									
Chesterfield	½ do	Jas Sheinels	Smith & Co	2		E	1777	1	1		1	1777				
Stone grovel	1 do		Messrs Barnes & Co	2		E	1780		1	2	1					
Dale Abbey	7 Derby	Earl Stanhope	Mr English	1		E	1790									
Bromford	4 Birmingham	Honble Mr Legge	Knight & Spooner					2	1							
New Wear	5 Monmouth	Mrs Osborne	Wm Partridge & Co					2	1							
Tydnor	3 Hereford	_ Hereford Esq	Jn Hawkins					2	1							
Llansiloe	12 do	Jn Skidmore	David Tanner					3								
Strangworth	2 Kineton	E of Oxford	Downing & Co					2	1							
Butterfly	2 S Alfreton	Mr Otram	Otram Jessop & Bereford	1			1792									
Morley Park	3 do	Mr Hurt	Mr Hurt	1												
Page 5: Shropshire																
Ketley	2 S Wellington	Lord Stafford	R Reynolds & Co	4		E	1758	2		6		1786	1	1	1787	
Horsehay	4 S do	Mr Slaney	do	1		E	1758					1786				
Coalbrookdale	2 N Broseley	Mr Reynolds	Dale Co	2		E	1720									
Madeley Wood	1 N do	R Reynolds	do	2		E	1759									
Dunnington	3 E Wellington	the 3 Lords	Wm Reynolds & Co	1		E	1785			4		1786				
Lightmoor	5 S do	Lord Craven	MM Homfrays	2		E	1758									
Snedshill	2 E do	Sir Wm Jerningham	J Wilkinson	2		E	1778									
Hollinswood	2 E do	do	do	1		E	1787									
Willey	1 S Broseley	Geo Forrester	do	1		E	1757									
Benthall	1 Broseley	S Harris Esq	MM Bankes	2		E	1785									
Coneybury	at do	Davenport Esq	do	1		E	1786									
Calcott	1 N do	Sir O Paul	Mr Brodie	1		E	1775									
Cleobury dale	1 Cleobury	_ Child Esq	M Botfield &Co					2	1				1			
Prescot	4 do	stands	do													

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges					mills			[other and notes]
				coke	charcoal	blown	built	finery	chafery	melting finery	balling furnace	built	rolling	slitting	built	
Clay Hill	4 do	Lord Craven	do	1		E	1783									
Brinswood	4 Ludlow	Ricd Knight Esq	M Downing & Cooley		1	W		3	1							
Hales Owen	Halesowen	Lord Westcote	Mr Attwood											1		
do	1 do	do	Mr Ward						1		1			1		Note 6
Upton	6 E Shrewsbury	J Corbett Esq	M Wheeler & Co					3	1							
Morton	1 Shadbury	A Corbett of Shadbury	do					2	1							
Yeardington	2 Bridgnorth	Mr Otley of Pitchford	do					3	2	2	1					
Withiford	6 Wem	Mr Corbett of the Park	T Dorset					2	1							
Uffington	3 E Shrewsbury	Mr Corbett of Sundon	M Wheeler & Co										1			
Page 6: Shropshire																
Kaynton	2 Newport	_ Briscoe Esq	Mr Hallen					2	1							
Sambrook	3 do		do						1		1					
Tiverton	9 do 9 Salop		do											1		
Longnor	6 Salop	Robt Corbett Esq	Mr W Jones					2								
Pitchford	6 do	Mr Otley of Pitchford	Lawrence & Hazledine					1	1							
Legiard	2 Penkridge		Mr Barker					1	1							
Rock Mills	1 Bridgnorth	Corpn Bridgnorth	Dale Co					[blank]								
Wren's Nest	4 Bridgnorth	Thos Stephens	M Wright & Jess (sic)						1	2	2					
Cleobury	2 Cleobury	Sir W Blount	Sir W Blount					3	2							
Hamptons Load	4 Bridgnorth	Wm Whitmore	Willm Jones					1								
Winnington	5 E Drayton	H Maynell Esq	Hopkins & Latham					1	1							
Bowden	_ Cleobury	Sir W Blount	Sir W Blount		1											
Park	3 S Wellington	Haw. Browne Esq	H Brown and Botfield	2		E	1790									
Page 7: Staffordshire																
Bradley	4 Hampton 10 Birm	J Wilkinson	J Wilkinson	2		E	1772			6	6		1	1	1787	
Tipton	1 Dudley	Lord Dudley	M Parkers	2		E	1783							1	1790	
Ettinsall or Bilston	3 W Hampton	Mrs Bickley	Mr B Gibbons	2		E	1788									
Deepfield or Coseley	4 W do	Mr Penn & Co	Stokes Pemberton & Co	2		E	1788	4								
Wedgebury	4 Hampton 10 Birm	Mr S Hallen	MM Hallens	1		E	1785		1	2	1	1786				

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges					mills			[other and notes]
				coke	charcoal	blown	built	finery	chafery	melting finery	balling furnace	built	rolling	slitting	built	
Cradeley	4 N Stourbridge	Lord Ward	Gibbons & Co					2	1	1	1			1		
Lye	2 N do	Willm Croft	Wm Gibbons & Co						1	1	1					
Level	3 N do	Lord Ward	Gibbons & Co	2		E	1786		1	2	2	1787				
Stourbridge	at Stourbridge	Jno Homfray	Mr G Briscoe						1		1					
Woollaston	1 do	Lord Foley	Mr Hill											1		
Ape Dale	3 Newcastle	Sir N Greesley	Mr Parkers	1		E	1784									
Stourton	3 Stourbridge	Mr Hodgetts	Mr Homfrays										1	1		
Hyde	4 Stourbridge	Mr White	White & Homfrays											1		
Kinver	_ Kinver	Mr Stokes	Mr Stokes											1		
Whittington	2 do	Lord Stamford	Mr Knight											1		
Gaddelsley	3 do	Mr Hodgetts	Mr F Homfray											1		
Swin Forge	4 Stourbridge	Mr Tongue	Mr Finch							2						
Heath	6 Hampton	Sir T Wrottesley	Mr W Finch						1		2					
Bromwich	4 Birmingham	Jarvis Clarke Jarvis	Wright & Jesson						1	1	1			1		
Cannock Wood	2 Rugeley	Lord Uxbridge	_ Hopkins					2	1					1		
Bustle Holme	2 Walsall	C Leonard	C Leonard											1		
Tipton Mill	3 Dudley	Mr Best	Finch & Co											1		
Wednesbury	4 Hampton	Mrs Wood	Mrs Ann Wood						2		2					
Park Mill	2 Birmingham	Hon Mr Legge	Mr Spooner											1		
Swin Forge	4 Stourbridge	Mr F Homfray	Mr Finch					1	1		1					
Page 8: Staffordshire																
Birmingham	in Birmingham	Sir T Googh	MM Lloyds											1		
Hince	4 Litchfield	Sir R Lawley	Mr Webster					2								
Congreave	2 Penkridge	_ Monkton	Mr Barker					1	1							
Burton	at Burton		MM Lloyds					2	1							
Clay Mill	2½ do		Mr Thornywell						1		1		1	1		
Weeford	4 Litchfield		Mr Beach										1			
Kings Bromley	7 do 7 Rugeley	_ Newton Esq	Mr Barnet										1			tinworks
Hadleys Forge	4 Stourbridge	Mr Attwood	Mr Attwood						1		1					
Whichnor	6 Burton 6 Litchfield	_ Levet Esq	M Palmer & Mole								1		1			

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges					mills			[other and notes]
				coke	charcoal	blown	built	finery	chafery	melting finery	balling furnace	built	rolling	slitting	built	
Little Aston	5 Sutton		Green & Price					1	1							
Coven	1 Brewood	_ Monkton	Mr Barker					1	1							
Rugeley	at Rugeley	_ Anson Esq	Mr Hopkins					1	1							
Brierley	2 Stourbridge	Bank & Onions	Banks & Onions	2		E	1790		2	3	2	1788				
		Sir T Heathcote	Kinnersley	1		E	1790									Note 7
Cannock Wood	1 Rugeley	Leacrofts heirs	Mr Barker										1			
Clatterbatch	1 Stourbridge	Mr Hallen	Mr Briscoe							1	1					
	2 Walsall	Lord Dudley	Hately & Hawkes											1		Note 8
Dudley Port	1 Dudley		Mr Parkes	1		E										
	1 do		Hawkes					4								Note 9
Gospel Oak	near Dudley	Bank & Demregin	do	1		E	1794									
Page 9: Worcestershire																
Lower Mitton	2 Kidderminster	Edwd Knight Esq	Mr Knight					3	1							
Ginnyhole	4 do	do	do					3	1							
Wolverley	2 do	Sir T Seabright	do					2	1							
Cookley	2½ do	do	do					2	1							
Wilden & Titton	1½ do	Lord Foley	Mr Hill					4	1							
Falling Sands	1 do	do	Mr Barnett										1	1		
Wolverley	2 do	Knight	Mr M Harper											1		
Powick	2 W Worcester	MM Lloyds	MM Lloyds					3	1					1		
Broadwaters L	1 Kidderminster	Jn Homfray	John Homfray						1		1					
do M	1 do	Lord Foley	MM Homfray & Co						1		1					
do U	1½ do	do	Jno Homfray						1		1					
Drayton	5 Stourbridge	Highway Esq	Jno Ryland					1	1							
Weybridge	5 Bromsgrove	R M Wild	do					2								
Page 10: Gloucestershire																
Lidney	8 Newnham or Chepstow	_ Bathurst Esq	Danl Hartford		1			2	2		1		1	1		
Lidbrook	5 Monmouth	Lord Gage	Hartford & Partridge					2	2				1			
Bishop's Wood	4 Ross	Lord Foley	Wm Partridge		1			1								

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges					mills			[other and notes]
				coke	charcoal	blown	built	finery	chafery	melting finery	balling furnace	built	rolling	slitting	built	
Flaxley	4 Newnham	_ Crawley Esq	_ Crawley Esq		1			2	1							
Redbrook	3½ Monmouth	Lord Gage	H Partridge		1				1		1		1			
Ailford Mills	4 Newnham	Raynon Jones	Dobbs & Taylor					2								wiremill
Fromeload	7 Gloucester	_ Purnell Esq	Purnell & Co											1		tinmill
Froombridge	7 Gloucester	do	do										1			wiremill
Willsbridge	Bath	_ Pearsall	_ Pearsall										1			
Wick Mill	6 Bristol 6 Bath	_ Haynes Esq	Haynes & Co						1		1		1	1		
Rowley	3 Lidney	Rev Mr Hickford	D Harford & Co					1								
Page 11: Monmouthshire and Brecknockshire																
Monmouth	near Monmouth	Duke of Beaufort	Hartford Partridge					3	2							
Abby Tintern	5 Chepstow	do	D Tanner		1		old	4	2							wiremill
Pontypool	1 Pontpool	Hanbury Esq	do		1		old	3	2				1	1		Note 10
Llanelly	5 Abergavenny	do	do		1		old			2						
Trostrey	7 do	Sir S Fludyer	Harvey Weston & Co					2	1							
Llangryny	3½ do	W Watkins	W Watkins						1	1	1	1785				
Tanners Forge	1 Brecknock	Lord Campden	Wilkins & Jefferies					1								
Beaufort	9 Abergavenny	Duke of Beaufort	M Kendalls	1		W	1780			2		1787				
Sir Howe	12 do	Col T Johns	Mr Atkinson	1		W	1778									
Mahon	10 Newport	Jn Morgan Esq	Hartford & Partridge					4	2							
Tredegar	3 do	do	do					2	1							
Rocheston	3 do	do	Mr Butler													Note 11
Abergwythen	12 do	Mr Glover	Glover & Son					4	1							Note 12
Caerleon	1 Caerleon	Thos Jones Esq	David Tanner					2	1							Note 13
Blanavon	6 Abergavenny	Earl Abergavenny	Hill & Co	3		E	1789									
Blandare	1 Pontpool	D Tanner	D Tanner	1		E	1790									
Ebwyth Vale	10 do 9 Abergavenny	Jno Mills	J Homfray & Ward	1		E	1790									
Clydach	5 do	_ Hanbury Esq	Cook & Freer	1												
Page 12: Glamorgan Carmarthen Pembroke Cardigan Radnor																
Cyfarthfa	1 N Merthyr	Lord Talbot	M Crawshay	2		E	1767			3	3	1767	1		1790	Note 14

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges					mills			[other and notes]
				coke	charcoal	blown	built	finery	chafery	melting finery	balling furnace	built	rolling	slitting	built	
Plymouth	1 S do	Earl Plymouth	Mr Hill	1		E	1766									
Herwyn	5 W do 18 Brecknock	Lord Cardiff	Mr Glover	1		E	1758									
Dowlas	2 E [Merthyr]	do	Dowlas Co	2		E	1758									
Penydaran	1 E do	Lewis Evans	M Homfray	1		E	1785		2	3	4	1787				
Pentyrch	6 N Cardiff	Lord Talbot	M Lewis	0		W	old									
Caerfilli	7 N Cardiff	Jno Morgan	Hartford & Partdidge		1	do	do									
Melin Griffith	4 NW do	Rev Jervis Powell	do					3	1							
Forrest	3 Swansea	Mr Poppin	Morris & Co													copper
Aberavan	6 Neath	Mr Talbot	Dr Lettson J Myers Exors					2	1							Note 15
Aberillas	3 do	Lord do	do					2	1							Note 16
Melinycourt	6 do	do do	do	1		W	old									
Ynyscydwen	10 do	Thos Aubrey Esq	Mr Parsons		1											
Clydach	5 do	Sir H Mackworth	do					2	1			1786				
Kidwelly	1 Kidwelly	Mr Morgan	Mr Morgan					2	1				1			tinmill
Carmarthen	½ Carmarthen	do	do		1	W	old	2	1							tinmill
Llandevain	6 Llandilo Vaur	Mr Vaugh G Green	Mr Parsons					2	1							Note 17
Penygoryd	2 Cardigan	Halliday & Co	Halliday & Co											1		tinmill
Llanfrede	6 Aberystwith	T. Campbell Esq	David Morgan					1	1							
Blackpool		Wm Knox Esq	John Morgan					2	1							
Cefn Crippo	Cowbridge	_ Bidford	Green & Price	1			1790									Note 18
Whitelands	4 H'ford West	Mr Morgan	Mr Morgan					2	1							
Cwmdwfran	6 Carmarthen	Mr Morgan	Mr Morgan					2	1							
Neath Abbey			Phillips & Wilson			E										
Page 13: North Wales																
Bersham	2 Wrexham	Mr Middleton	J Wilkinson										1		1788	
Abenbury	1 do	Mr Travis	do						1		1					
Pontyblew	10 do 5 Oswestry		Mr Rowland					2	1		1					
Llwyn Onn	2 Wrexham	J Jones Esq	do					1	1						1764	Note 19
Gwersyllt	3 do		Ainsworth & Hayton					1	1						1782	wiremill
Bodfarry	3 Denbigh		Eyton & Son					2	1							

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges					mills			[other and notes]
				coke	charcoal	blown	built	finery	chafery	melting finery	balling furnace	built	rolling	slitting	built	
Dolgelly	1 Dolgelly		do					2	1						1760	
Mathraval	9 Welshpool		Smithman & Co					2	1							
New Key	2 do		Pugh & Davies					2	1							
Machynlleth	17 Machynlleth	Mr Herbert Park						1	1							
Aberdovey	Aberdovey	Lewis Edwards Esq	Mr Kendall		1	Q										Note 20
Ruabon	4 Wrexham	R Myddleton	Jones & Rowland	1			1790									
Brymbo	4 Wrexham	J Wilkinson	J Wilkinson	1			1796									
Page 14: Scotland																
Carron	2 N Falkirk	Bruce of Kinnard	Carron Co	5		W	1760	3	1		1				1769	
Crammond	5 Edinburgh		Caddel & Eddington											1	1760	
Bunawe	Inverary	Duke Argyle	L G Knott		1	W	174									
Argyle	8 do	do	M M Kendall		1	W	1755									
Partic	2 W Glasgow		M Robertson & Co											1	176	
Dunster	Dunbarton		M Gillies & Co											1	17	
Wilslon town	6 S Whitburne	Mr Wilson	MM Wilson	2		E	1782									
Clyde	3 E Glasgow	Ed Dunlop	M Edington & Co	2		E	1787									
Muirkirk	12 W Douglas	Mr Strong	Mr Greave & Co	3		E	1788	1		3	1				1788	
Cleland	12 E Glasgow	Col Dalrymple	Col Dalrymple	2		E	1788								1788	
Sauchie	near Alloa	Lord Cathcart	Roebuck & Co	1		E	1793									
Page 15: Ireland																
Eniscorthy	Wexford County		Poundin & Co		1											
Munrath	Queens County		do		1											
Lucan	Dublin		Blair & Ormston										1			
Leixlip	do		Danl Marston											1		
Palmerstown	do		Boulton & Co											1		
Milton	do		Heavyside						1		1		1			
Cork	Cork		Hughes												1	
	Waterford		Wise												1	
	Newry		Benson												1	

Name of the iron works	Situation	Proprietors	Occupiers	furnaces				forges		mills						[other and notes]
				coke	charcoal	power	built	finery	chafery	C	H	P	R	Ball	built	
Page 16 (left): Middlesex, Kent, Surrey, Hants, Buckingham & Berkshire																Note 21
Wraysbury										1						
Byfleet			Mr Colson & Co								1					
Dartford																
Crayford			Mr Colson & Co								1					
Cobham			Mr Raby													
Wandsworth	4 London		Mr Hinckell								1		1	2		Note 22
Maidenhead																
Coxes Lock			Mr Raby								1		1			
Weybridge			Mr Colson								1		1			
Esher			Mr Tealing								1					
Ember			Mr [blank]							1						
Page 16 (right): Sussex																tons year
Ashburnham	Battle		Lord Ashburnham		1											200
Heathfield			Mr J Fuller		1											100
Robertsbridge			Mr Bourne					1	1							60
Marshfield			Mr Willis					1	1							40
Burwash			Mr J Fuller					1	1							40
Bibleham			Mr Collins					1	1							40
Titchfield	(say Huntley)		Mr Cort & Co													Note 23