Metallurgy in the Wye Valley and South Wales in the late 18th century. New information about Redbrook, Tintern, Pontypool and Melingriffith

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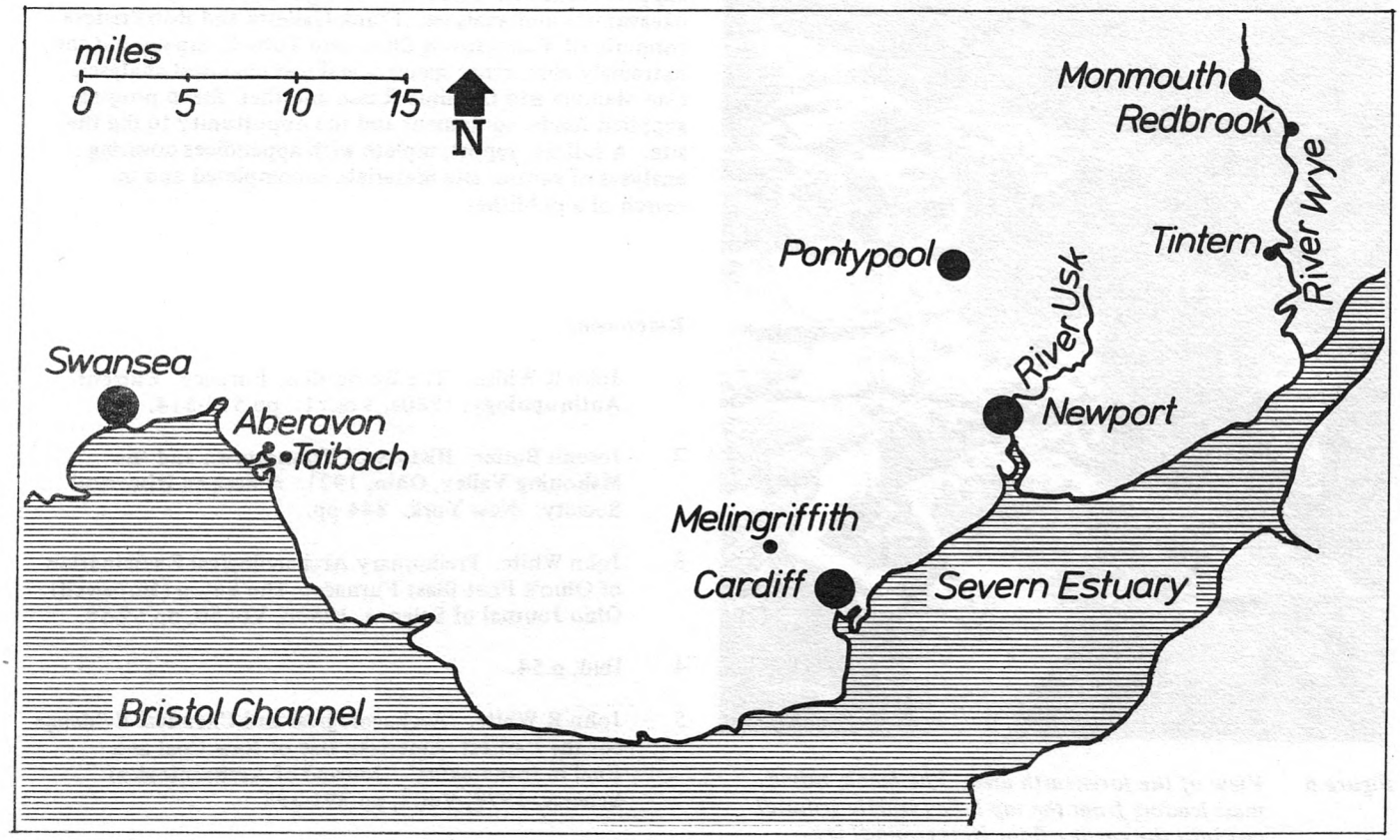

As part of a general investigation of manuscripts in the National Library of Wales describing tours in Wales during the early period of the Industrial Revolution, Peter Wakelin discovered the two manuscripts to be discussed here, and noting their significance, drew the attention of Gordon Tucker to them; the critical examination of the industrial parts of the narrative is due to the latter.

The more important manuscript is NLW MS 6497C [1], a handwritten book of 113 pages, the text being on the right-hand pages, while the left-hand pages contain inserted water-colour paintings, unfinished sketches or annotations, or are blank. Pages 1-97 contain the diary of a tour which starts at Clifton (Bristol) on Tuesday 16 July, and after visiting the Lower Wye Valley and parts of Monmouthshire and Glamorgan, returns to Clifton on Tuesday 20 August. The year is not stated in the MS, but we show below that it was 1782. Pages 99-113 appear to be a technical appendix which is reproduced in its entirety below.

The other document is NLW MS 2589B [2]. It is a printed book of 1775 with interleaves on which manuscript descriptions have been added; the date of these has not been precisely determined, but is undoubtedly in the last quarter of the 18th century.

The more important matters which emerge from these sources are:

1. The Redbrook copper works were still operating in 1782.
2. Cannon were being cast and bored at Tintern in 1782.
3. Iron slag was crushed by wooden stamps at Tintern in 1782 for supply to the glass industry of Bristol, the heavier iron-rich components of the crushed slag being separated by gravity in running water for re(s)melting.
4. Cylinders replaced bellows for blowing at Tintern between 1782 and 1788.
5. In the late 18th century iron wire was still being drawn at Tintern and Pontypool by the intermittent 'tongs' method which had seemingly changed little over two centuries.
6. Reverberatory furnaces were apparently in use in iron-making at Pontypool in 1782.
7. Iron ore was won near Pontypool by hydraulic (scouring) methods as late as 1782.
8. The condition of the workers at Monmouth and Tintern in 1782 was very poor, but much better at Pontypool.
9. A detailed account is given of the process of making tinplate at Melingriffith in 1782.

A more detailed discussion of these matters, and their historical importance, will now be given. A critical examination of the dating and authenticity of MS 6497C then follows, with finally a transcription of the relevant parts of the MSS.

Redbrook Copper Works

There has hitherto been much uncertainty about the dates of closure of the copper-smelting works at Redbrook, near Monmouth. It seems generally agreed that the works at Upper Redbrook, which were associated with the Coster family[3] had ceased operations in the 1740s or perhaps early 1750s, although Jenkins[4] allowed more latitude: 'The last we hear of the Upper Redbrook works is in the year 1786 . . . Probably it was then idle and had been so for some years'. Certainly the Swedish traveller Angerstein, reporting on 28 June 1754, stated that the upper works were not then in operation[5] and Joan Day in her book[6] reaches this conclusion from other evidence.

The works at Lower Redbrook were operated by the English Copper Company. In one paper[7], Jenkins avoided making any statement on the date of closure, which may be significant since in the earlier paper cited he had used information given by Phillips[8] to suggest that operations may still have been carried on at Lower Redbrook as late as 1790, 'no doubt on a small scale'. (Phillips' information was that John Wright, 'who came from Redbrook Copper Works', took over the management of the Taibach copper works of the same company in 1790). Although Hart (see ref.4) seems to suggest that the Lower Redbrook works had closed in c1740, the date of closure could not have been as early as this because Angerstein reported these lower works as being in operation in 1754.

There is a suggestion of one of the copper works at Redbrook being still in operation in 1787 in the diary of Viscount Torrington[9]. During a boat trip down the Wye from Monmouth on 28 July 1787, he observes 'the Red Brook where are great copper works'; but this is only a casual reference with no evidence of the works actually producing smoke or other signs of activity. Certainly there seems to be no positive evidence hitherto of operation after 1754.

The information that copper works at Redbrook were still in operation in 1782 is thus a significant contribution. The MS does not indicate whether it was the Upper or Lower works which were active, but from the evidence cited above, it must clearly have been the Lower. Unfortunately no mention is made of the number of reverberatory furnaces used, and no estimate can be made of the scale of operation. There is, however, the statement on p.73 of the MS that the copper works at Aberavon were 'much inferior to those at Monmouth', and as the former were then in full swing, the inference is that the Redbrook works were fully active. There is, too, the reference on p.109 of the MS to a rolling mill in use at Redbrook; moreover, the long description of the water-powered rolling and processing of copper on pp.101-3 of the MS appears to pertain to Redbrook. Although there is ambiguity, it is unlikely to be the works at Aberavon which are being described, since Phillips[10] is emphatic that there was no rolling mill there before 1800.

Cannon at Tintern

There are two references in MS 6497C to cannon-making at Tintern; in the diary of the tour itself the travellers apparently saw the 'boring of Cannon', and in the technical appendix it is stated that the Tintern furnace was 'originally intended for casting of Cannon'.

There is other evidence of cannon-making at Tintern at this time. Viscount Torrington[11] in his diary of a tour in 1781, describes how on the 16 June he was travelling from 'Trelach Grange' (Trelech Grange) to Tintern, and passing the works in the wooded valley (of the Angidy), 'approach'd a noble foundery of cannon'.

In visiting Chepstow later the same day, Torrington saw on the quay 'incredible numbers of iron water pipes (like cannon) each 9 feet long and weighing about 800 weight, which are going to France . . . near 21 miles of them are sent'. Grey-Davies[12] infers they came from Tintern and says 'Some writers say that they were cannon being sold to the French . . .' but does not give a reference to such a writer. Obviously some confusion was possible, but Torrington seems to make a clear distinction between cannon at Tintern and water pipes at Chepstow. But in any case, it is more likely that the latter came from Bersham in Denbighshire than from Tintern[13].

As water pipes would hardly need to be bored, the reference to the boring of cannon in MS 6497C would appear to be positive evidence of cannon-making at Tintern, confirming Torrington's casual reference.

At what site in the Angidy Valley at Tintern the cannon were cast is not made clear; direct casting from the blast furnace would seem to be ruled out by the topography of its site, so that remelting of the pig iron in another furnace is probable.

Crushing of Iron Slag by Stamps at Tintern

There is ample evidence elsewhere[14,15] of the fact that slag was crushed and powdered by stamps at Tintern (and other places) in the 1780s, with the suitable components being sold to the Bristol glass works. There were certainly water-driven stamps at the furnace in 1821[16]. What appears to be new in the description in MS 6497C is that the stamps were wooden (seemingly also the heads, although we must assume they were shod with iron). One would have expected cast-iron heads by this period, as in Cornish stamps[17]. The expression 'the light part . . . is carried down the stream which turns the wheel' accords well with a sloping paved surface below the terminal stone structure of the leat at Tintern, which has been uncovered in the recent excavations; above this surface and linked to the leat is a channel which might have been the wheel-pit of a small undershot wheel coupled to the stamps.

The leat referred to was the main water channel providing power to the furnace site; from the terminal basin the main water flow was taken, by an aqueduct, itself carried on piers the plinths of which still remain, to the large overshot wheel which drove the bellows; the diameter of 30 ft given in the MS accords reasonably well with the archaeological evidence.

There is difficulty over the statement in the MS that the heavy part of the dross, after stamping and separation by washing, is carried to the furnace and re(s)melted. According to analyses tabulated by Tylecote[18], blast furnace slag contained very little iron; since, however, finery and chafery slag had a high iron content, it seems possible that the slag concerned was of the latter type. This view is strengthened by the fact that the subject is mentioned in the MS immediately after the statement that the metal from the blast furnace must be twice melted (finery + chafery ?) before it is pure enough to make bar-iron. On the other hand, Hart (ref.14) quotes George Wyrral as saying that the 'scruff' from the furnaces (which he clearly distinguishes from forges) contains 'considerable quantities of granulated iron, and also of ragged lumps . . .'; there is also little doubt that Shaw (ref.15) thought that the dross was from the furnace.

Replacement of Bellows by Cylinders for Blowing at Tintern

It is known that blowing cylinders were in use at Tintern furnace by 1788 because Shaw mentioned them in that year (see ref.15) and Mushet[19] makes it clear that the blowing

cylinders at Tintern were of iron in c 1800 and that this use of cylinders was the first such use in a **charcoal** blast furnace in this country. The principle of iron cylinders replacing bellows at ~~blab~~ furnaces was, however, then over 30 years old, although not widely applied[20]. It is therefore of some interest that the MS of 1782 indicates that bellows were still in use then, thus dating the introduction of cylinders at Tintern to between 1782 and 1788. We feel justified in asserting that the MS description really does mean bellows and not cylinders because of the expression 'the mouths of two immense pairs of bellows'; cylinders do not have mouths, and two cylinders would not have invoked the term 'two **pairs** of bellows'. A 'pair of bellows' is, of course, a single piece of apparatus, and 'pair' would not be used in reference to something so essentially singular as a cylinder. That two pairs of cylinders (ie 4 in all) was not meant is supported by the fact that in 1821 a schedule of plant at the blast furnace included only 2 cylinders (see ref.16).

The description of the shape of the furnace in the MS is curious and hard to follow, but as visitors were unlikely to have seen the interior for themselves, this point is perhaps of little importance.

Wiredrawing at Tintern and Pontypool

The descriptions of the intermittent wiredrawing process and of the scouring process given in MS 2589B accord well with the postulations of Paar and Tucker[21], thus adding valuable support to their paper.

Reverberatory Furnaces and Slitting Mills at Pontypool

In the description of the ironworks at Pontypool (p 109 of MS 6497C) it is stated that 'the furnaces exactly resemble . . those made use of at the copper-works near Monmouth'. The latter were clearly stated to be reverberatory furnaces. In the description of iron-making it almost seems to be suggested that the reverberatory furnaces were used for **smelting**. Assuming this was not the case, it still leaves a puzzle, for Cort's reverberatory method of refining iron was not invented until 1784, Peter Onions experiments of 1783 at Coalbrookdale were in any case unsuccessful, and the reverberatory furnace of the Cranage brothers had been abandoned in 1767[22]. The 'potting' process, which also used reverberatory furnaces[23], does not seem indicated by the description, and in any case was little used until the 1780s. On the other hand, there may have been some confusion on the part of the observer; the furnaces may have been part of a foundry and could then have been 'air furnaces' of reverberatory type, used for re-melting pig iron[24]. Such furnaces were in use well before 1782.

On the same page of the MS is a detailed description of a slitting mill (the word 'slitting' being incorrectly written as 'tilling'). This accords exactly with the first recorded drawing of a slitting mill in England as given by Schubert[25], with date of 1758; the principle is different from that described by Plot in 1686[26].

Hydraulic Winning of Iron Ore near Pontypool

The graphic description of the methods of winning iron ore by crude rushes of water from upland reservoirs – variously known as scouring, patching, or hushing – is striking, particularly for the casual acceptance of the fatalities caused to the workers (a factor not noticed in other accounts), and also because one might have expected the practice to have ceased at Pontypool by 1782. Iron had been worked there for 200 years or so, and it would not have been surprising if the superficial ore (which alone could be obtained by scouring) had been exhausted.

Schubert[27] mentions that the practice of scouring persisted in places in South Wales until the early 19th century, and it was indeed quite usual then in the hills above Merthyr Tydfil and Ebbw Vale[28]; even as late as 1890 it was used at Maesteg in West Glamorgan[29]. At Pontypool it had certainly been practised in the mid-17th century[30] and extensively applied thereafter[31]. However, Coxe, only a few years after 1782, refers to true **mining** for iron ore near Blaenavon, only a few miles away[32]. Thus the description of scouring at Pontypool in 1782 in MS 6497C is important in establishing that the process was still in use there.

It was, of course, not only iron ore that was won by this method. Lead ore, in particular, was commonly obtained this way, and not only in Wales, but even more in the North of England.

It is fair to say that iron mining in South Wales is very poorly covered in the historical literature – in great contrast to coal mining.

The Condition of Labour

It is evident from MS 6497C that the condition of the workers in the Monmouth – Tintern area was very poor :

> 'At Tintern the misery and want endured . . . were extreme; at Pontypool, their situation was very different . . .' (pp 43-5).
>
> 'Labour is so cheap at Monmouth' (p 103).

This confirms what had been suspected before, that the industrial enterprises in the Lower Wye Valley had become severely run-down in the later parts of the 18th century. Yet the apparent prosperity of the workers at Pontypool is qualified by the description of the conditions of getting iron ore, already discussed above.

Tinplate Works at Melingriffith

In 1782 tinplate making was relatively new in Britain and the Melingriffith works were among the more important. They were first begun in about 1759, and in 1768 came into the hands of the firm which later became Harford, Partridge & Co. A history of the works has been given by Minchinton[33].

The description given in MS 6497C of the process of making tinplate, with all its complicated operations, is remarkably full, and much more detailed than any other account of that period known to us[34]. It is reasonable to believe it is accurate, as it accords reasonably well with descriptions of the process at a much later date.

The use of the term Block Tin is not understood. Since our transcription of the MS is correct, there must be an error in the MS itself.

Dating the Manuscript, No. 6497C

It seemed to us that the manuscript could not possibly be as late in origin as the 'circa 1809' quoted by the Department of Manuscripts at NLW. The copper works at Redbrook were in full swing according to the MS, yet we know from other sources that they must certainly have closed by 1790 at the very latest[35].

Reference is made in the MS to the sheathing of ships with copper, which, although known from the 17th century as discussed by Tylecote[36] in connection with Charles II's Dutch-built yacht **Mary**, nevertheless did not start on the

widespread basis suggested in the MS until the 1760s[37]; to the tinplate works at Melingriffith, which did not start until 1759[38], and above all, to the Aberavon copper works (presumably the works at Taibach) which did not start production until 1774[39]. It is thus clear that the MS must refer to a tour made between 1774 and 1790.

In the year of the tour, 20 August (the day of return to Clifton) was a Tuesday, as clearly stated in the MS. This means that within the limits given above, the year of the tour could only have been 1776 or 1782. The activities at Aberavon seemed to be in such full swing that 1782 seems more likely than 1776.

Having reached this conclusion, from the internal evidence, we thought of consulting the Department of Maps and Prints at NLW in case they had any information on Rose Sotheby who had signed so many of the watercolours in the MS. Mr M Davies was able to turn up some typescripts in a file, which led us to two notes published by Jerman over 40 years ago[40]. These made it clear that the spine of the original binding of the MS had the lettering 'WELSH/TOUR/E.S./ 1782', making it quite certain that the date 1782 provisionally determined from internal evidence was indeed the correct one. It is interesting to note, however, that the Department of Maps and Prints considered that the pictures had been added to the script at a later date, within the range 1786 – 1799; and that the volume had been bound in 1799. The initials ES were considered to be those of Elizabeth Sotheby, sister of the Rose Sotheby who did the paintings and drawings. We could detect no difference in the writing between (a) the signatures on the pictures, (b) the main diary of the tour and (c) the industrial/technical appendix. It is therefore possible that the manuscript was written some years after the tour, and this, on its own, would leave the possibility that the appendix had been based on information of a later date than the tour itself. It is noteworthy that while the diary of the tour is written in the first person, the appendix is written impersonally, as though it had been copied from some other source. Nevertheless, the writer of the diary had actually visited the copper works at Aberavon and compared them with those near Monmouth (p73 of MS; see also p25), and on the whole it seems reasonable to give the date of 1782 to the whole of the contents of the MS. However, a later date, up to the limit of 1790, would not alter the significance of most of the matters discussed earlier in this paper.

That the technical appendix was, in fact, itself a transcription of some other document by someone not well versed in the technicalities, is attested by two transcription errors on p 109 of the MS: 'Tilling-mill' appears twice, but, as indicated in square brackets in our transcription below, the first time it clearly should be Slitting-mill, and the second time Tilting-mill. This then leaves the possibility that the appendix, although written into the MS in 1782, was based on an earlier document. We have shown above, however, that it could not have been earlier than 1774, and again, even this date would not seriously diminish the significance of the contents.

TRANSCRIPT OF PORTIONS OF MS 6497C, TAKEN FROM THE MAIN DIARY OF THE TOUR, RELATING TO METAL WORKS.

p19. From Tintern Abbey we proceeded to the Iron-works in the Neighbourhood, & to see the boring of Cannon; this last is well worth notice; but the Others are in much greater perfection at Pontypool.

p25. The 22nd. we saw the Copper-Works, w^{ch}. are three Miles from Monmouth, on the lower Road to Chepstow, and were much entertained with them.

pp43 & 45. The 29th., in our Way to the Iron-Works, belonging to Mr. Hanbury; they are chiefly situated in his fine Park, w^{ch}. is remarkably well wooded, & prettily water'd by the small River Byrthia –– Pontypool owes its very Existence to these Works, & may probably in the Course of a few years, become a Place of consequence, as the Mines in its Neighbourhood, contain a great Quantity of very good Ore, altho' not so rich as that w^{ch}. comes from Lancashire, with w^{ch}. the Tintern Forges are supplied –– At Tintern the Misery & Want endur'd by the Workmen & their Families were extreme; at Pontypool, their Situation was very different; th^{r}. constant Pay is 9 Shillings a Week, & they are allow'd a House, & as much Coal as they chuse; we saw one of these Families sitting down to Dinner, on a roasted Shoulder of Veal, & a Dish of Peas, by the cheerful Blaze of a Fire, that might be envied by many a reputable farmer.

p73. At Aberavon we stopp'd to see the Copper works, but found them much inferior to those at Monmouth – The Workmen's Houses are dispos'd in a very pretty Manner, in two strait Lines, at some distance from each other on the Declivity of a very steep Hill; the Works are on the other side of the Road, & as they are large & built of Brick, they mutually give & receive Ornament, from the Contrast of the small whiten'd Tenements opposite to them.

TRANSCRIPT OF INDUSTRIAL / TECHNICAL APPENDIX, PP99-113 OF MS 6497C.

p99] Some Account of the Copper Works near Monmouth &c:
All the Ore here us'd is brought from Cornwall; in the first Place it is calcin'd, that is put into a slow Heat, & continually stirr'd, till y^{e}. greatest part of the Sulphur & Arsenic, which originally bind it, are evaporated; & till it becomes a black Powder –– During this Operation, a thick yellow Smoke hangs over the Works, which is very unwholsome, as well as detrimental to Vegetation – The Ore is then put into a reverberatory Furnace, resembling an Oven; the Fuel, which is Pit-Coal, is put in at the Back of the Furnace, & there is a Grate under it, the Ore is put in at the Mouth; & when melted (which takes up 4 Hours to a Ton weight of it) the Furnace is tap'd, that is the Ore is let out thro' an Opening at the Side (which had been previously stop'd with Sand) on removing of this, & breaking a Passage in the coarser Ore, the purer Copper bursts out in a most beautiful Torrent of liquid Fire, runs into Moulds prepar'd for it in Sand, & is broken in pieces by throwing wet Sand upon it, where you wish to divide it –– At the Copper-works at Aberavon, the first tapping of the Ore, is run into cold Water, which not only breaks it into small Particles resembling Shot, & makes it fit for a second Melting, without their having the trouble of pounding

p101] it, but also clears it of all the remaining Sulphur, which is left swimming at the Top of the Water – This is an entire new Method –– The Ore is sometimes melted 8 or 10 Times, according to the different Purposes for which it is to [be] us'd –– The second Melting at Aberavon, is sent to Birmingham, & when a little qualified there, makes the white Metal Buckles &c &c ––The coarsest Copper is beat with an immense Hammer, upon an Anvil of cast Iron, to make Bottoms for Boilers &c –– That a little finer is roll'd into Plates, for sheathing of Ships, & for the better sort of brasiery Work: this is perform'd by means of Two small Iron Rollers fix'd one above another which turn inwards, & are brought closer & closer together by a Screw, according to the degree of thinness requir'd for the Plate; This is taken out of the Fire red-hot (in a pair of iron Pincers) & push'd between the Rollers; it is received in like Manner on the other Side, pass'd over them, & push'd thro' again & again,

till it is arriv'd at the proper length, by which they judge of the thickness, as the Plate never increases in breadth -- The finest Copper of all, is ladled into Water, in order to mix with Bath Metal &c -- The Copper prepar'd for Brass, is poured into Water, thro' a Vessel with Holes in it, this they call Copper Shot -- They have

p103] within a few Years made a Discovery, of what is call'd Japan Copper, this is a secret only known here & at Swansea; it is form'd into small Bars, about 8 Inches long & 2 round, it is very highly varnish'd & of a most beautiful Colour -- The Chinese clip this Copper into small Pieces, stamp it with the Figure of one of their Pagods, & pass it as Money -- The Emporor of Japan us'd to carry on a great Trade with this in the East Indies, which we now begin to partake with him -- The Hammers, Rollers, & an immense p^{r}. of Shears made use of for cutting Copper of a great thickness, are all mov'd by Water-wheels -- The Copper-dross is run into various Moulds; these Bricks are sold for six-pence a Load, & could they be cheaply transported would be the best Materials possible for Building, as they become a fine vitrified black Stone, which nothing but the greatest Force can destroy; it is what all the Walls near Bristol are cop'd with - Notwithstanding the Copper passes thro' so many operations, yet Labour is so cheap at Monmouth, that it does not (even with the additional Expence of Fuel) bear the proportion of One Tenth to the Value of the Metal.

Some Account of the Iron-Works at Tintern & Pontypool.
The Blast, or Smelting Iron at Tintern is extremely curious. The Furnace is larger than those commonly us'd for this purpose, it being originally intended for casting.

p105] of Cannon; The Shape of it is a Cone revers'd, which from the lower End widens again, & forms a Square down to the Hearth; this Hearth has a very small opening behind, & a large One before; to that behind are directed the Mouths of Two immense p^{r}. of Bellows, that play alternately (by means of a Water Wheel 30 Feet in Diameter) & keep up a constant Blast, w^{ch}. acting on the melting Substance as it falls slowly thro' the narrow Part of the Cone, carries off the Dross at the opening before, while the purer Metal falls into a Channel in the Hearth, thro' w^{ch}. it is conducted into Moulds prepar'd for it in the Sand (these are call'd Sows, & from thence it derives the Appellation of Pig-Iron) & is broken in pieces in the same Manner as the Copper is -- The Furnace is charg'd (that is the Ore & Charcoal are put in) at the Top, where is a small opening; they are put in alternately; a Basket of Charcoal & 500 ~~lb~~ Weight of Ore, are half a Charge & in this charging the greatest Nicety is requir'd in regard to the Quantities -- As the power of the Blast is not sufficient to seperate at once all the Dross from the Metal,it must be twice melted before it is pure enough to make Bar-Iron: The Dross is also broken up, by means of several immense wooden Pestles, rais'd alternately by a Wheel: The light part of it (call'd the Cinder) is carried down the Stream which turns the Wheel, into a place appropriated for it, from whence it goes to Bristol, & serves as one of the Materials

p107] to make Glass of; the heavy part is carried to the Furnace & remelted -- All the Ore us'd at these Works comes from Lancashire -- At Pontypool the Iron Mine is about Two Miles & a half from the Works; it contains a great quantity of very good Ore, altho' not so rich as what comes from Lancashire; it is of two sorts which must be mixed together with an Addition of Lime-stone in order to make good Iron -- The Method by which they are procur'd is this -- The Ore is contain'd in a Rock, the upper part of w^{ch}. is of Lime-stone, & underneath is a Strata of Coal; when any of the Ore appears, a Torrent of Water is let down (from a Reservoir made at the top of the Mountain) upon it,to cleanse it from the Earth with which it is envelop'd; this Torrent also forces off large pieces of Rock, which falling into the Stream, the Water is stopp'd, & the Ore picked up by Women & Children, who gain a very good altho' a hazardous livelyhood by it; as the Reservoir sometimes gives way, & the Water rushing down with irresistable Fury, destroys in a few Minutes the Labour of Months, & put an instantaneous End to all the poor Wretches engag'd in this dangerous Employment -- This Method serves for the **Pin-Ore** -- The Other call'd **Vein-Ore,** runs in Veins in the Rock; it is no sooner discover'd, than the Earth is wash'd away in the Manner already describ'd, the Iron is then dug out, & when that Vein is lost, they proceed to wash away the Rock, until they find Another.

p109] The Furnaces exactly resemble both in Figure & Operation those made use of at the Copper-works near Monmouth -- The Ore is first calcin'd -- Then made into Pig-Iron -- When the Pig-Iron is taken out of the Troughs, it is heated again, till nearly in a state of melting, & then carried in Tongs, to receive the Stroke of a Hammer weighing 600 ~~lb~~, & w^{ch} repeats the Blow every Moment; the Pigs are sometimes heated 3 or 4 Times before the Bar-Iron is compleated - The Bar-Iron is then carried to the hammering Mill, where the Iron is brought to a greater degree of Density, by closing up the Pores of the Metal, thro' the means of Hammers, whose Strokes descend twice in a Moment altho' they weigh 704 ~~lb~~. This is in order to make the Iron fit for cutting Instruments, & for whatever requires particular Strength -- In the Cutting-mills, cold Iron Bars of the size of the small of the Leg, are divided into any given Length, (by a p^{r}. of Shears, whose Edge is an Inch wide) with as much Ease as Paper is cut with common Scissors -- The Bars are then made into Plates (These plates are y^{e}. 3rd. of an inch in thickness.) in the same manner as the Copper is roll'd at Monmouth -- They are next carried to the Tilling-mills [Slitting-mills] where they are sever'd lengthways, to make Wire-rods, Nails &c &c; this is done by means of Two Iron-rollers with Grooves in them, betwixt w^{ch}. they are plac'd red-hot, & One Turn thro. these Grooves compleats the Work - These Iron-rods are then carried to the Tilling-mill [Tilting-mill], where they are again made red-hot, & plac'd under a Hammer of 56 ~~lb~~ Weight, w^{ch}. gives 286 strokes in a Minute; a Man turning them

p111] about very fast, that no two Strokes may light on the same Place, his Seat is plac'd in a Groove, that he may retire as the Rod lengthens, & is drawn out into a coarse rough sort of Wire -- These jagged Rods are then carried to the Wire-works, where they are first temper'd, & afterwards plac'd in Troughs for 6 Weeks, with Water constantly dripping on them; they are then pull'd with Violence thro' an Engine in w^{ch}. there are Holes successively smaller & smaller, till y^{e}. Wire arrives at the required Fineness -- It is impossible to describe the Nauseousness of the Smell occasion'd by what is call'd the tempering Pickle -- In these Works all the Instruments that act upon the Metal to mould it into such a variety of Shapes are of Cast-Iron, & are mov'd by immense Water-wheels of the same Materials.

Some Account of making Block Tin at Melin Griffith

The Iron is at first made into Bars of 10 Inches & ½ in length, 3 in breadth, & 2 in thickness; after having been 3 Times heated, doubled, & pass'd thro' Rollers, it is converted into 8 Plates, each 14 Inches in length, great care having been taken every Time they pass'd thro' the Rollers to seperate the Folds; the Edges are then cut smooth, & the Sheets reduc'd to the proper Size; these are successively laid in 3 different kinds of Pickle; & after has been bent in such a Manner, that a

Man can take up a Dozen at a time, they are again heated; when taken out of the Furnace, they are slightly struck against the Ground, in order to beat off those Scales w^{ch}. they

p113] have contracted from the Pickle being hardned in the Fire; & when cold they are again pass'd thro' the Rollers, to smooth them entirely; they are afterwards put into 2 other sorts of Pickle: & 3 Times scowered with Hemp & Bran: The Iron Plates are now fit to be put into the first Pot of Block Tin (on the surface of which is a Coat of Tallow an Inch thick to make the Tin adhere to the Iron) where they lay half an Hour; they are then carried to the last Pot, where having been only dipp'd in, they are brush'd over to make the Tin lye smooth & equal, thrown into hot Grease to take off any superfluous spots, & scower'd 3 Times more; they are then pack'd up 150 together, in Boxes, which compleats the whole of the Business.

TRANSCRIPT OF NOTES ON IRON AND WIRE WORKS AT PONTYPOOL AND TINTERN IN MS 2589B.

There are two Forges for converting Pig-Iron prepared from the Ore dug in the Neighbouring Hills behind the Town into Bars & Plates for every Use. The Ore is smelted at a Furnace near the Mines about two Miles from Pontypool, & cast into Pigs. The Refiners mixt two Sorts of Ore together for smelting both w'ch are found in the Neighbourhood contained in a Sort of Peables; The Ore is of a rusty Color, w'ch is dug in large Pieces, but seperates into smaller Portions on being exposed to the Air. This is the richest Ore. The other is of a much lighter & whiter Color, not so rich; & helps the former in fusing w'ch would not so easily seperate from the Stone without it. However the Dross that comes from the Ore in Smelting is very serviceable to the Wyre-Drawers, who use it in polishing the Wyre, breaking & putting it with the Wyre into Cylindrical Trunks fastened to the Axle of a Water-Wheel; w'ch turning the Cylinders, the Dross by Friction assisted by Water polishes the Wyre, wearing off the Rough Particles of the Wyre by its superior Hardness. The Iron Forges are the same as that at Tintern, & the Wyre-Drawing Machine is the same likewise with that at Tintern. The Latter Machine is very simple, & worked by a Water-Wheel, w'ch turns a long Cylinder of Wood, on w'ch at distinct Distances are fixed iron Cylindical Rowlers fastened to two Pieces of Wood let into the large Cylinder. These Rolers as the Cylinder turns round strike the lower End of a beam w'ch by its middle is fixed in the Floor above, being half above, half below the Floor; This Beam plays on y^{e} pin it is fastened by, backwards & forwards as the Rolers strike it. And as soon as the Roler has passed under it a Chain fastened by one End to the Beam at the Bottom pulls it back with a Spring occasioned by a flexible Stick to w'ch the Chain at the other End is fastened. By this Motion the Beam pulls backwards & thrusts forwards an Iron Rod about 2 Foot long fixed to its upper End. And at the End of the Rod is fastened a Pair of Pincers made in this Form [a space is here left for a diagram, but none is included]. These Pincers are fixed to a Piece of Wood w'ch moves on an inclined Plane whose greatest perpendicular Height is next to the Beam aforementioned. The Thrusting of the Rod opens the Pincers w'ch close on being pulled back, so that when a Bit of Wyer is applied to the End of the Inclined Plane, the Pincers, w'ch descend to the Point of it, catch the Wyer & draw it towards the Beam before mentioned. It is a Man's Business to apply the Wyer thro an Iron Gauge, w'ch is bored with Holes of the several proper Sizes for the Wyer; The Pincers dragg the Wyer thro' these Holes w'ch transmit it of the requisite Size.

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References

1 Mr Dafydd Ifans of the Department of Manuscripts and Records at N L W has given the following information:-

The official description of N L W MS 6497C reads:

'A TOUR IN MONMOUTHSHIRE AND GLAMORGAN. A journal of a tour through parts of Monmouthshire and Glamorgan during the early part of the nineteenth century [circa 1809]. The volume is illustrated by over thirty water-colour drawings and unfinished pencil sketches by Rose Sotheby, some of them being original drawings by her and others being after Gilpin, Grimm, and J Smith. One original water-colour drawing, dated 1809, is by Maria E Sotheby, **English**, XIX cent.' This manuscript was purchased by the Library from Messrs Hodgson & Co., 115 Chancery Lane, London WC2 on the 24 October 1929, and was repaired and bound at this Library in 1964.

2 Mr Ifans has given the following information:-

The official description of NLW MS 2589B reads as follows:

'A TOUR IN WALES. An interleaved copy of Henry P Wyndham: **A Gentleman's Tour through Monmouthshire and Wales** . . . 1774 (London, 1775), with comments and notes by another traveller. **English**. XVIII cent.' The manuscript contains the following note: 'Bought from Mr F Crowe, Wrexham 21/10/1914 £1.1.0. The MS notes are in the autograph of Thomas Pennant.' Our accession register confirms this information. The volume was repaired and bound at our Bindery in 1963.

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4 Rhys Jenkins, 'The copper works at Redbrook and at Bristol', **Trans. Bristol & Glos Archaeol Soc, 63**, 1942-3, pp 145-167.

5 R R Angerstein, 'A Journey through England in the years of 1753, 1754 and 1755', from archives of Jernkontoret, Stockholm. English translation in the Library of the University of Liverpool; copy of relevant portion kindly supplied by Mrs J Day.

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8 M Phillips, 'The Copper Industry in the Port Talbot District', **Trans Aberafan and Margam Historical Soc, 6**, 1933-34, pp 91-113.

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33 W E Minchinton, 'The British Tinplate Industry', Oxford, 1957, pp 20-24.

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