NEWSLETTER No.36 Autumn 2002

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LETTER FROM THE CHAIRMAN

Dear Fellow Members,

This autumn, WIRG played host to the Historical Metallurgy Society at its annual conference, held at Seaford. The last time the conference had taken the Weald as its theme was more than 20 years ago, so it was a great pleasure to show their members, some of whom had travelled from as far as America, the most prolific iron production area in Britain before the Industrial Revolution.

This year I seem to have spent a lot of time talking to people about the iron industry in the Weald – in evening classes and lectures to local societies, in articles, and now even on television programmes. But what makes all this such a pleasure is the genuine interest that the public have in the subject, for there seems to be something for everyone, whether it is archaeology (there are almost as many programmes on the television about archaeology at the moment as there are on gardening or cooking), the countryside, guns and warfare, local history, or of course genealogy (rapidly becoming the nation's favourite pastime). And we need to respond to this interest, by working to provide the means by which people can access this part of their heritage.

Experiments at the Group's bloomery on Ashdown Forest have begun to show results which are comparable with others being carried out in other parts of the country, and an exchange of data has begun to take place. It remains the aim of the smelting group to replicate the cinder we find on our forays, and by that means to come closer to the methods used by Roman and medieval iron makers.

As always, the Committee and I look forward to hearing of any newly discovered sites, documents or artefacts. For the meantime, though, I wish you an enjoyable new year.

Yours sincerely

Jeremy Hodgkinson

ANNUAL GENERAL MEETING

There was a good attendance at our AGM in July. The following report was presented by the Chairman, concerning the Group's activities for the year :

The Committee has met four times in the past year, and at each meeting has received a report on the Group's finances, and on the Tebbutt Research Fund. The Group has been represented on the Ashdown Forest Training Area Conservation Committee and the steering committee for the proposed Historic Ironworking Centre at Horam, Sussex.

The Group's Annual General Meeting for 2001 was held at Ellens Green, Surrey, on 28th July. Diana Chatwin gave a lecture on the historical background to

the Dedisham ironworks, and members visited the sites after lunch. During the meeting, grants from the Tebbutt Research Fund were presented to Irene Schrüfer-Kolb, of Leicester University, to assist with a project to compare material from Romano-British ironworking sites in the Weald and the Midlands, and to Mike Clinch, Secretary of the Kent Underground Research Group, to assist in the expense of surveying the Snape iron mine, near Wadhurst.

The Winter Meeting was held on 2 February 2002 at Nutley, where members heard a lecture by Paul Booth, of Oxford Archaeology, on the excavation of the Romano-British settlement and associated ironworking, at Westhawk Farm, near Ashford, Kent.

The Field Group meeting took place on Sunday 9 September and a programme of seven forays was planned, with some which had been postponed in the previous season rescheduled. The aim of the first foray, to Park Wood, Burwash, in October, was to excavate material which could date the site, which had been discovered earlier in the year. Unfortunately, neither of the sherds of pottery discovered was considered a reliable guide to the age of the site, when submitted for expert identification.

At the November foray, fieldwalking in the extension to the 1970s Study Area continued, and a previously unknown bloomery site was discovered north east of Heathfield. Trial trenching of the bloomery site at Stumbleholm, Ifield, was the subject of the December foray, but again no datable material was recovered. Two forays to continue fieldwalking in the Blackham area in the north for Hartfield parish were included in the Field Group's programme, and the first of these, in January 2002, was particularly rewarding, with four hitherto undiscovered bloomery sites being found. Another site was also found when the Study Area was revisited in February.

n March, two short forays, explored the possibility of early water-powered sites. The site of a former pond at Spoods Farm, Hadlow Down, yielded insufficient evidence, although ironworking had taken place nearby; and documentary evidence of medieval ironworking at Warbleton could not be positively associated with a former pond site in that parish. The final foray, again to Blackham, in April, failed to live up to the success of the earlier one to the same area, and no new sites were discovered.

A suggestion during the season, that an 'indoor foray' should be held, so that Field Group members could meet and discuss matters of mutual interest, resulted in a gathering at Dot & Tony Meades' house in May. Those attending enjoyed an unstructured opportunity to bring items or documentary material and talk about them in a relaxed atmosphere. The occasion is likely to be repeated.

The leaflet announced at last year's AGM was printed during the summer, and is being distributed to libraries, and made available at lectures and conferences. Two newsletters have been published during the past year, with a regular mix of short articles and notices. My thanks to Dot Meades, the editor, and to Brian Herbert, who was able to arrange printing until last autumn. David Brown has been able to organize printing of the latest issue. Under David Crossley's editorship, Volume 22 of the Group's annual Bulletin, *Wealden Iron*, is published this summer, through the continuing generosity of West Sussex County Planning Department.

During the year, Chris Broomfield expressed a wish to hand over the management of the Group's internet web site and, following an appeal in the Newsletter, Tony Singleton offered to take over. He has refreshed its appearance and there are plans under consideration to extend the scope of the site. Links to other web sites of potential interest to members are added from time to time, and those with access to the internet are urged to log on periodically to see what updates have taken place. (www.wealdeniron.org.uk Suggestions for themes that might be included on the web site will be welcomed.

Experimental iron smelting has continued, and added impetus has been given to the trials at Pippingford by the opportunity to have the results analysed, and by comparison with other groups who are carrying out similar work. A regular team is now established, and with supplies of local raw materials more easily available, the number of smelting days is likely to increase. A demonstration smelt is being organized for the weekend of the Historical Metallurgy Conference in September. It is hoped that reports of the experiments will soon be published on the Group's web site.

The Committee has been considering ways in which some of the Group's money might be spent. Royalties received from the sale of copies of *The Iron Industry of the Weald* have given the Group a modest income, and suggested projects in furtherance of its aims have included the conservation of key primary

sources, some of which, because of their condition, are not in a fit state for use by researchers at the record offices where they are held; and the publication of such sources electronically.

The Group has continued to be consulted on matters concerning Wealden iron. Among those who have done so in the last year are Maidstone & District Archaeological Society, BBC Television, Granada Television, West Sussex County Planning Office, the Department for Farming and Rural Affairs, and the Sussex Industrial Archaeology Society. Also, during the past year, the Group mounted an exhibition at a Local History Fair in East Grinstead.

It has been sad to note the deaths of two redoubtable members of the Group: Charles Blick, while never an active member of the Group, retained a professional interest – he had a lifetime in the iron and steel industry – and for many years he provided a valuable link with the Historical Metallurgy Society, of which he was founder member. Even in retirement, and following a serious illness, his correspondence always bubbled with enthusiasm and encouragement. Margaret Tebbutt had been a Committee member, an editor of the newsletter, and an indexer of the earlier Bulletins. She remained an active member of the Field Group, and was always delighted to present the awards of the Tebbutt Research Fund, which had been set up in celebration of the work of her late husband, Fred. Her wise counsel will be sorely missed.

In expressing my thanks to the officers and committee members for their support, I must pay special tribute to Shiela Broomfield, who this year relinquishes the post of Hon. Secretary after fifteen years. She has been able to bring to the role all the essential organizational and administrative skills, together with a strong personal interest in archaeology, as well as a thoroughly useful acquaintance with a substantial number of key individuals in archaeology in the south east. I am delighted that she has expressed a wish to remain on the Committee.

Jeremy Hodgkinson July 2002

The Making of the High Weald – Dr Roland Harris, Rural Character Adviser for the High Weald AONB Unit

In an interesting and thought-provoking talk, Dr Harris initially outlined the natural environment of the High Weald, from its geological structure and landforms to its vegetation. He emphasised, however, that the Weald was a landscape shaped by man, and that the human colonisation of the region, as much as its natural inheritance, defined its character. Dr Harris then charted this colonisation, from the evidence of Mesolithic occupation, through the transhumance of communities from the Downs scarp-foot areas, to the beginnings of permanent settlement. He suggested that such transhumance may have predated the Roman occupation and continued through it into the Saxon period, and questioned whether this argued against the existence of an Imperial Estate in the Roman period that excluded all but industrial activity. Dr Harris also drew particular attention to the work of Jaime Kaminski on the iron industry in the Weald in the Roman period, which is unpublished, but which some WIRG members may remember hearing six years ago, and referred to the inconclusive evidence for woodland management in the Roman period. Dr Harris concluded by describing the gradual process whereby the growth of new settlements in the Weald was linked to the assarting of waste.

Dr Harris is the author of a booklet on The Making of the High Weald, published by the High Weald Unit, and he told the members that he was intending publishing his researches on a web site, which could be updated with the latest research.

JH

A Tribute and a Presentation to our Retiring Secretary

Thank you, Shiela, for all your hard work for WIRG over the last fifteen years! That was the message from us all at this year's AGM. As Vice-Chairman and editor of the Newsletter, I have on many occasions been grateful for Shiela's unfailing support and so I should like to add a little to our Chairman's tribute.

For the last fifteen years; she has kept notes of committee meetings, communicated with other groups on our behalf, sent out innumerable notices of meetings, committee minutes, arranged our public meetings, etc. All done promptly and with no fuss.

Moreover, we have been by no means the only ones to benefit from her generous gift of time. I think that none of us realized quite how much she has been involved with other societies - mostly archaeological - during that time. To name but a few:

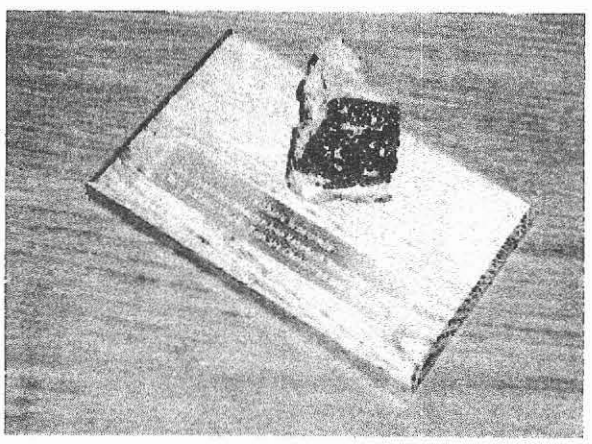
The Council for British Archaeology South East. Since its inception she has served successively as committee member, vice-chairman, chairman, secretary and throughout that time has been their membership secretary. Pressure of other work has meant that she will give this up in

November. **London Archaeology** has been the magazine of record for archaeology in the metropolis for over thirty years. Shiela has been treasurer and subscription secretary for more than twenty years and also handles distribution of the magazine to subscribers from her home. **Kent Archaeological Society**. Shiela is a member of their Council, the Fieldwork committee and the Finance committee and since May 2000 has been membership secretary **Tonbridge Historical Society:** committee member since 1980, chairman and now secretary She has led the archaeological group since 1980.
Shiela has also a good deal of practical archaeological experience and is not afraid to get her hands dirty in a good cause; some years ago she took a diploma in archaeology as a mature student to further her expertise. **Tonbridge Music Club:** treasurer and membership secretary - Shiela says that she enjoys this as a change from history and archaeology.

Bearing all this in mind, we must count ourselves fortunate to have had Shiela as our secretary for the last fifteen years. We were sorry when she resigned but quite understand that she has to reduce her work load and are grateful for all her kind and efficient work for the Group. We are pleased that she will remain on our committee.

As a memento of her fifteen years with us, Shiela was presented with a mounted piece of the fifteenth bloom to be smelted by our experimental smelting group. The piece of bloom was partly ground and polished (one side was left in its natural state) and mounted by John Baillie

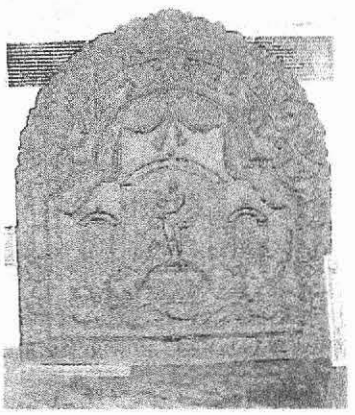
DMM



To Shiela Broomfield
Hon. Secretary Wealden Iron Research Group 1987-2002
With grateful thanks from the Committee and Members

FIREBACKS IN DORCHESTER MUSEUM

Dorset County Museum in Dorchester has a number of cast iron firebacks on display. As so often, there is no mention of Wealden Iron in the item descriptions as such. Museum records only reveal that they were acquired in the late 19th and early 20th centuries, mostly from houses in Dorchester. Some if not all the patterns may be familiar to readers. There is a version of the Lenard fireback, badly cracked at the base, which the display informs was manufactured at Brede Furnace in 1636 (ie as inscribed). Another, inscribed "C.L.R." centre top depicts the Royal Oak in which Charles II hid during his flight after the Battle of Worcester 1651. This is also damaged with part of the base missing. Recorded as manufactured in the 17th century.



Neptune

An unsourced fireback *(see illustration above)* shows Neptune under a canopy; a waterfall at his feet cascades into a pool in which three dolphins play, and three seahorses arise. It is inscribed "DUW YDYW EIN CADERNID" (GOD IS OUR STRENGTH) and is estimated to have been manufactured in 1724 or later that century. Two other firebacks are plain, one dated 1728 with unknown provenance.

A fireback in good condition represents a scene from the biblical three day pestilence story, told in II Samuel XXIV. King David kneels by an altar on which is a burning sacrifice. Behind him Araunah the Jebusite or the prophet Gad stand, while a flying angel holds a sword and skull aloft, with Jerusalem in the background. This was acquired from "Morton's House", at nearby Corfe Castle. Another fireback shows the same scene with identical dimensions. This one is in poor condition and broken at the base, described as being cast from a broken original. How-

ever, this fireback is larger because it has a wider border *(See illustrations below)*. There are no manufacture dates with either.

My thanks to Jonathan Lockett of Dorset County Museum, who supplied the information about their biblical fireback.

I feel that firebacks should be reported/archived somewhere, especially if they are in Museums outside the usual counties. A good starting point is a book by J Manwaring Baines, a past curator of Hastings Museum, who suggests that classical and biblical scenes were a continental fashion which was copied here. ***Helen Pearce***

Might I suggest that anyone who comes across firebacks when travelling or holidaying in this country should send the details to me for publication in the Newsletter. In this way, it would be less of a task for any one person and potentially many locations could be covered. An archive would be gradually built up. Many houses that are open to visitors have firebacks, as well as the museums.

DMM

The original and the copy—the three day pestilence

Note the larger border on this copy

BOOK REVIEWS

R R Angerstein's Illustrated Travel Diary, 1753-1755

Furnaces to cucumbers - The illustrated travels of a Swede in Britain 1753-55

In 1753, the Swedish engineer, Reinhold Rücker Angerstein spent two years journeying through England and the Welsh borders to assess the Nation's development in matters of technology, engineering and agriculture.

Financed partly by the Swedish Government, partly by the Swedish Iron Producers Association (Jernkontoret- still in existence) and partly by private companies, he was one of at least 20 Swedish engineers who visited Britain in the 18th and 19th centuries to ascertain the market for Swedish bar iron in Britain and the technological competence of the country's iron industry in competing with that of Sweden. The British demand for iron grew rapidly in the 18th Century as the Industrial Revolution took hold, and over half of this iron was supplied by Sweden. In 1699, Swedish exports of iron to Britain amounted to 15.3kt, accounting for half of all Swedish iron exports and 80% of Britain's iron imports. By the time of Angerstein's visit, imports of Swedish iron had increased in volume to 24.5kt - nearly 60% of Sweden's total exports - but this only supplied 64% of Britain's needs, the remainder being produced domestically or imported largely from Russia and to a lesser extent from Spain and America. In fact, by 1767, iron imports from Russia exceeded those from Sweden, which was never again the dominant supplier.

This awareness of the highly competitive nature of the trade in iron is reflected in many of Angerstein's diary entries where, in each region of the country he visited, he compares the prices of imported iron and locally produced iron. The latter provides an invaluable insight into British ironmaking as it not only includes the prices of raw materials but also the wages paid to the different categories of workers.

A very revealing conclusion is that the production costs of British iron were twice those of Swedish. For example, he quotes the selling price of Swedish bar iron at forges in Värmland as £9-15 per ton and the price of the same iron sold in Britain as £18, which was still less than that of locally produced iron which was also inferior in quality - at least as far as steelmaking was concerned. He puts much of the

higher cost of production in Britain down to the high cost of charcoal - ten to fifteen times more expensive than in Sweden - and chastises the British for not planting more trees and managing their forests better.

Surprisingly, although coke had been introduced for ironmaking in Britain some 45 years earlier (1709 by Abraham Darby 1st), he reports on only two blast furnaces using coke - that of Abraham Darby in Coalbrookdale and the Clifton Blast furnace near Workington in NW England. He records that iron made from coke was more expensive than that made from charcoal and that while it was suitable for making castings, it was unsuitable for fining to bar iron; he comments that the cause was more related to the refusal of the smiths to adopt new habits in fining, than to the iron itself. The higher cost of coke-produced iron was attributed to a high wastage of coal on coking in 'beehive' piles and the lower productivity from the coke blast furnace, for example only 12 - 13t of iron per week was produced when fired with coke compared with 18 - 19t when charcoal was used. He does, however, comment on the use of 'mineral' coal in fining hearths (to produce low carbon bar iron from pig iron) and comments on the exceptional cost saving this provided, the cost of fuel per ton of refined iron dropping 92%, from £3-15s (£3.75) when using charcoal to 6s (£0.3) when using coke. (However this was before the time of Court and his reverberatory puddling furnace of 1784 so quality would have been compromised).

On his visit to Coalbrookdale he witnessed the wide range of artefacts cast and the cheapness of these, and here demonstrates his technical prowess when witnessing workmen filling cavities in the castings with copper, commenting (in his diary - not to the workmen) that placing burning coals on top of the casting head would have ensured better feeding during solidification. The boring of cylinders for Newcomen steam engines is illustrated and described - but some of the workmen evidently had a joke at Angerstein's expense as he refers to a cylinder being cast for an engine in Redruth (for the Cornish tin mines) as being large enough for a man to ride his horse through - in fact even the largest cylinders did not exceed 90 inches. Not surprisingly, there is no reference to the world famous cast iron bridge at Coalbrookdale since this was not to be built until 1777.

Much of the Swedish bar iron was converted to steel by recarburising it in cementation furnaces. Here he faithfully records local preferences in operation, for example, the chests were packed with charcoal made from juniper in one location, while oak was preferred in another. He comments on the preference to use Swedish iron from the Dannemora region for steelmaking and rightly identifies the higher concentration of manganese in this iron as being beneficial in the cementation process.

Angerstein was not always welcomed by the owners of the works he visited and sometimes resorted to bribing workmen to gain access. He spent less than 24 hours in Sheffield where his keen interest in Huntsman's crucible steelmaking process was such that he was warned to leave the City. However, he succeeded in visiting eight of the 10 tinplate works then operating in Britain following the perfection of the process by Major John Hanbury in 1728. Angerstein's interest in tinplate was no doubt to report back to one of his private backers, Jennings and Finley, who had unsuccessfully tried to establish a tinworks in Sweden.

Regrettably, Angerstein's travels took him no closer to the Weald than his final journey from London to Dover. His keen observations would have been an invaluable source of information on the operation of the blast furnaces in the Weald. We can be consoled with his descriptions of blast furnaces, finery forges and chafery forges, in particular in the Welsh borders and Cumbria. However, the fact that he did not consider it necessary to visit the Weald probably reflects a 'quiet' time in demand for ordnance - still a major activity of the region. For example in the period 1750 – 1770 Wealden blast furnaces supplied 15000t of ordnance to the Crown (this figure excludes cannon cast for merchant shipping) compared with 3500t from all other sources. However, Angerstein's lack of interest in the region may also reflect the Weald's rapidly dating technologies. Soon, Staffordshire was to become the centre of canon manufacture with Wilkinson's patented boring machine (copied from a Dutch model in Woolwich Arsenal), the casting of solid cannon bodies and the remelting of pig iron with scrap in an air furnace to better control the carbon content and temperature of casting. Also, Abraham Darby had perfected the casting of thin walled iron vessels and every day utensils at Coalbrookdale in his coke fired furnace.

Interestingly, Angerstein's observations on the higher production costs of pig iron made from coke compared with that from charcoal, and his recording of only two coke fired blast furnaces in his travels, indicate that it was not the change from charcoal to coke in the blast furnace that was losing the Weald its iron industry, but rather its inability to increase its output to take advantage of the nascent industrial revolution driven by steam, a commodity that required plentiful supplies of cheap coal.

While there are some 83 references relating to iron in the diaries - some running to several pages - Angerstein records almost everything he found of interest. There are many entries on mining, from the tin and copper mines of Cornwall, to the lead mines of Derbyshire and Cumbria. Numerous entries describe coal mining and include a sketch of a 'spark' machine to give light underground without the 'risk' of igniting firedamp (methane), which a naked flame was known to do. Comments on society are also sometimes included, from the Cornish 'hags' smoking pipes, to the fear of highwaymen on his travels and the sight of gallows along the road to deter them.

Also scattered among the dominant entries on engineering topics are comments on agriculture - the type of crops grown, the merits of marl over lime in fertilising fields - and even recipes, for example how to pickle cucumbers.

The translation of the book into English was evidently a labour of love. Commenced by Torsten Berg, the task was completed on his death by his son Peter. The English is excellent, the only possible confusion being the frequent reference to 'coal' instead of 'charcoal', but the distinction is made clear by the use of the term 'mineral coal' wherever the fossil fuel is referred to. The 378 page book includes some 360 sketches redrawn at the time from Angerstein's original daybooks. These in themselves provide superb detail of many of the structures and equipment.

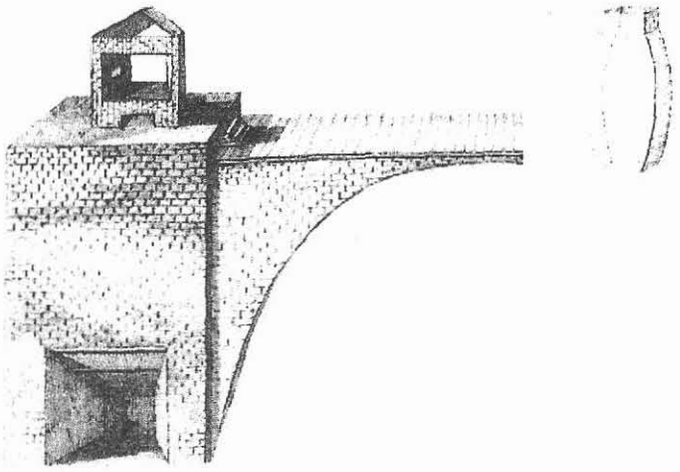
Each of the six journeys undertaken are recorded as separate chapters liberally annotated with comments by the editors. There are also 10 pages of introductory text, three appendices listing source materials, iron identification stamps and details of translation methods and weights, measures and currency conversions. There are also 38 bibliography references and an excellent index

The book provides one of the most comprehensive records of industry and life in Britain in the mid 18th century available today. While this is a bonus for British readers, the descriptions of the technologies employed are relevant throughout Europe and beyond. Indeed, after leaving England, Angerstein travelled for a further six months through Belgium and Holland. So perhaps there are further archives held by Jernkontoret ripe for publication.

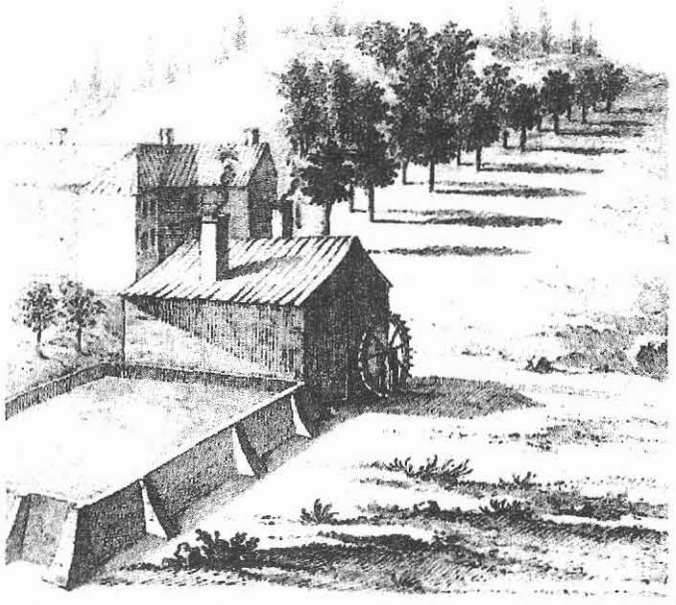
RR Angerstein's Illustrated Travel Diary, 1753-1755, Translated by Torsten & Peter Berg is Published by the Science Museum, London. ISBN 1 900747 24 3 (hardback 378pp) Price £34-95. (Available from Gazelle Tel +44 (0)1524 68765 www.gazellebooks.co.uk)

Tim Smith

Illustrations from the Diary:



Flaxley Blast Furnace, Gloucester, produced between 12 and 22 tons of iron a week



The water wheel at pontypool forge (note the water is taken from the bottom of the pond)

Ruth R. Brown, 'Thomas Westerne: The-Great Ironmonger', *Journal of the Ordnance Society*, 13 (2001), 39-53.

Thomas Westerne was one of the most important figures to emerge in the Wealden iron industry during its enforced restructuring in the second half of the 17th century. His career owed much to his marriage with Martha

Gott, whose family had many connections with the iron industry. That connection was reinforced a generation later when Westerne's daughter, also Martha, married her cousin, Peter Gott. Westerne had been dealing in iron just before his marriage in 1751 but within a few years he had taken on Brede furnace and begun casting ordnance for the government. Later he was to include the East India Company and other overseas buyers as customers. Westerne also involved himself in the politics of the City of London, and with the wealth accumulated over 40 years of business was able to purchase a country estate at Rivenhall in Essex, where he was buried beneath a handsome iron plate in 1707.

Ruth Brown's interesting and readable account tells the foregoing narrative in considerable detail, charting the complex family alliances (with two useful family trees), and detailing the various ventures in the ordnance trade with which Westerne became involved. The careers of several of his children are also touched upon. The paper is fully referenced, and a list of sources is given, although a notable omission are the Dunn papers, microfilm copies of which are in East Sussex Record Office, and which include a number of accounts of Westerne and others at Beckley and Socknersh furnaces. One quibble...Collins' forge was not at Westfield, but at Burwash, and was sold by William Westerne to John Fuller in 1700.

JSH

FORAY to Blackham - 20th April 2002

The purpose of this foray was to search an area of land which lies between two areas previously examined in 1999 and early 2002. Both of these areas had yielded evidence of ironworking. The new area totals some 80 acres and is roughly rectangular in shape; it consists of a mixture of pasture, set-aside and woodland, bounded on the northern and eastern sides by streams.

The foray commenced at Langley Farm (4789 3985) with an examination of the bed of the northernmost stream which lies just below the farm. At this point the water course was some twenty metres wide and contained the remains of an impoundment which it was thought might have been a source of water for the Heathe Place Farm complex, the water being raised to the required level by means of an hydraulic ram, possibly in the 19th or early 20th century. Bloomery slag was found along the top and on the sides of the dam, suggesting that the impoundment had been constructed over an ironsmelting site.

We continued to explore the stream and its banks eastwards to Holywych Oast [4837 4027] and whilst some small pieces of slag were found nothing of note was discovered. The party's attention was drawn by the owner of the Oast to the existence of a small quarry adjacent to the house, which could have been a source of sandstone for the construction of local buildings.

From Holywych Oast the route of the foray turned south along a bridle-path leading to Lunds Meadow (4850 4000), some 25 acres in area and currently under set-aside. The surface of this field revealed numerous examples of Cyrena limestone and at one point, a marshy depression where the underlying Wadhurst Clay had broken through the sandy soil of the Ashdown Formation.

Although this field is known to have been under cultivation for many years, the scars left by mine pits of an unknown era are still discernable. The woodland to the south of Lunds Meadow, Great Wood, also bore evidence of a considerable number of minepits both large and small, contiguous with those found in Cullinghurst Wood during the foray earlier in the year. The possible site of a bloomery was found on the east bank of the stream at 4850 3960.

EXPERIMENTAL SMELTING

Smelting team members inspect their bloom

The smelting group's activities this year:

The smelting team has managed 5 smelts so far this year, with only one dismal failure, although, in retrospect there was a good reason for this.

Our first task for the year was to win some more ore

from Sharpthorne Brickworks, Sx. "Win" is perhaps an exaggeration because it was all exposed on the sloping quarry face, and very little exertion was necessary providing a pick axe could be wielded and the plastic (farm) bags of ore could be dragged to, and then lifted into the van, where once again we were fortunate in having a member with suitable transportation. We are indebted to "IBSTOCK Building Products Ltd.", and specifically Mr D.W. Myles, for allowing us into the quarry and even letting us drive to the location to pick-up the ore, thus relieving us of the task of barrowing the ore several hundred yards (metres) across the quarry. Our new supplier of charcoal is Mr Mann of Edenbridge, and at the moment he has his portable kiln at Tulley's farm near Crawley, which is very convenient as on one occasion, 4 sacks were transported by car, complete with an oak anvil, and just leaving room for my wife, Valerie!

Various combinations of tuyere angle, ore to charcoal ratio, and air- flow rate have been tried, but all give a similar smelting efficiency; this is all rather annoying as we should like to come up with some consistent optimum operating conditions. For example, the tuyère angle has been varied from 15° "up" to 30° "down". The former experiment was an approximate copy of Henry Cleere's experiment at Horam in 1970; it did show up a problem when the slag actually ran down the tuyere and solidified, prematurely stopping the experiment: but still we produced 1.54Kg of iron at an efficiency of 16%. The efficiency of all experiments, wherever they are made, should be taken with a pinch of salt because it is difficult to ensure that there is no slag present in the bloom. Also, there are two ways to express the efficiency (1) relative to the weight of the roasted ore, (2) relative to the amount of potential iron [Fe] in the roasted ore; the latter method gives the biggest number and is the more popular!

We have varied the air-flow rate, on successive smelts, from 2 to 5 litres/second, but without any appreciable change in smelting efficiency, and the same is true for the ore:charcoal ratio which has been varied from 0.65:1 to 1.5:1. This might be compared to an experimental bloomery operating in America, [web address: http://iron.wlu.edu/] where Lee Sauder and Skip Williams are pumping at 20 litres/second, but of course, they are getting much bigger blooms albeit in a differently shaped and somewhat larger furnace.

Our spectacular failure occurred when trying to smelt iron ore from Snape Wood, Wadhurst, E Sx. This seam of ore was dug from two adit mines near the top of the Ashdown Sand, in 1857-58, long after the industry had finished in the Weald. The ore was sent to Staffordshire, by train, for smelting in a blast furnace, but the undertaking only survived for a year. The Kent Underground Research Group [KURG], which is clearing out the two adits, arranged to meet us at the site on a very wet Saturday, and we fortunately found the heap of ore outside the mine entrance, as mentioned by Straker (p290-291). Many pieces of ore were too large to move and too hard to break-up but enough was taken back to the smelting site for two smelts. It was duly broken up, with great difficulty, roasted, and re-broken small enough for smelting. Although 15Kg of ore was smelted, no bloom resulted. The ore was later analysed at Surrey University and found to have excessive silica (sand) for bloomery furnace operation, although it would have been suitable for a blast furnace.

The chemistry of the failure is as follows, and should be read in conjunction with the last two paragraphs of this article. Some of the Fe (iron) in the ore must mix with the unwanted, but significant, minerals within the ore, [silica or sand, alumina or clay etc] to reduce the free-running temperature of the slag within the furnace and allow the slag to be tapped away from the bloom. It would appear that all the Fe in the Snape Wood ore had been used up to make the slag molten enough to be tapped.

The infrastructure of the site has needed little attention; it remains much as Roger Adams built it c.1986. The furnace was rebuilt by the present smelting team in 1995 and has survived 20 smelts, with only minor repairs. It is probably much more robust than the Roman shaft furnace, on which it is based, because we made the wall about 1 foot thick [in those days, but now 300mm thick!]; we argued that a thicker wall would provide better heat insulation, but this has to be balanced against the energy required to heat-up a thick wall. The inside of the furnace gets damaged due to the heat, especially just below the tuyere, the hottest place, where the bloom is attached to the furnace wall, nevertheless, we are able to repair the inside with out too much difficulty, although it is a time-consuming task.

Various "gadgets" have been made to make measurements and help during the smelting process. For example we have a direct reading "specific gravity" beam to check the iron ore, this uses the usual principle of comparing the balance with the ore submerged in water and then in air. There is now a window in the tuyere pipe to allow a visual check to ensure that the tuyere is not blocking-up with slag. Soon, when a neutral density filter is added, it may allow us to see the bloom forming, as it is far too bright to see any detail at the moment.

Two of the 25 litre bellows, made over 25 years ago, have been "re-leathered" with artists' canvas that has been made air-tight with a silicone sealant.

It is always difficult to consolidate the bloom because we do not yet have a decent forging hearth, and have used the argument that we should not waste initial heat within the bloom as it comes from the furnace. Taking this to its extreme, we have actually hammered the bloom within the very hot furnace, where a long wooden pole substitutes as a hammer. Although this experiment has been successful, we are not sure that this was done in the past. The down side of the process is the extreme heat suffered by the hammer-man as he tries to look down into the red-hot furnace, especially when the hammer catches fire; not to mention the problem of turning the bloom to hammer another face.

The Historical Metallurgy Society's Annual conference was held in the Weald this year. A demonstration smelt was given on the Sunday and attended by a number of their members; a bloom was produced weighing 1.33Kg with an efficiency of 10.2%.

Our latest smelt, No.20, was carried out using small amounts of hammer scale with each charge [see final two paragraphs]. However, very little slag could be tapped during the smelt, but when retrieving the bloom a large piece of once-molten slag, weight 650g, had to be manoeuvred out of the tapping arch. The bloom weighed in at 2.2Kg, with an efficiency of 11%.

Bloomery tap slag in practice *always contains a great deal of the element iron, Fe, and actually contains more Fe than the bloom being smelted, which might be considered a waste of iron. However, this actual loss is a double-edged sword. First, the bad news: the Fe mixes with the unwanted, but significant, minerals within the ore, [silica or sand, alumina or clay etc] to produce a molten slag, which solidifies into the kind of material found on bloomery sites. There is an optimum amount of Fe required to minimise the slag's free-running temperature, depending on the unwanted minerals within the ore. Now the good news: once molten, the slag can be run-out (tapped) from the furnace and away from the bloom, hence its name "tap slag". So,it is reasoned that if an artificial source of Fe could be introduced into the furnace, say with each charge, this would make more Fe available from within the ore, so improving the smelting efficiency.*

Adding hammer scale with the charge *has been suggested, in order to reduce the free-running temperature of slag within a bloomery furnace. Hammer scale is produced on the surface of iron when it is being smithed, and takes the form of platelets 2 to 5mm across and about 0.5mm thick, and can, therefore, be considered an authentic product. Its mineral name is "magnetite", and chemically it is Fe_3O_4, and occurs naturally [although not in the Weald] and is considered a very rich iron ore. When added to the bloomery furnace in small amounts, it has little effect on the smelting process but can lower the melting point of the slag if introduced in the correct quantity.*

Should any member require further information or wish to give us information, concerning our smelting activities, my email address is :- brianherbert@btinternet.com

Brian Herbert

Smelting continues:

The team now has the ability to make iron but unlike their ancient predecessors are now to concentrate on making slag! The ultimate aim has always been to produce slag similar in appearance and content to the remains we find in the course of fieldwork and excavation. One way to attempt this would be to smelt in a furnace which would, as far as we can tell, replicate an ancient one. At the moment our furnace is of the shaft variety which we know was used in Roman times.

However, the difficulties of replicating a furnace are considerable. Firstly, no excavated furnace has survived up to its full height, so we cannot be sure about either the height or the shape of ancient furnaces. Indeed, it seems unlikely that all furnaces were the same in those days of difficult communication and secret skills; excavation has shown there were at least two distinct types and judging from the slag there could be more. The slag left on Wealden sites varies: we find rough slag, smoothish tabular slag with large crinkles on one side and fine ones on the other (often Roman) and also slag with distinct wood marks as if the slag has run into a bed of wood.

As with most archaeological puzzles, the original question may be answered but will inevitably throw up a number of others.

Members of WIRG are welcome to witness a smelt but numbers allowed on the site are limited by its size and-location. Each smelt lasts for approximately six hours from c.10am to c.4pm. If any member would like to visit and is willing to wait their turn, please get in touch with Brian Herbert, 1 Stirling Way, East Grinstead, West Sussex RH19 3HG. Tel: 01342 327032; e-mail: brianherbert@btinternet.com *DMM*

FORTHCOMING EVENTS

Wealden Iron Research Group

Winter meeting 2nd February 2003 at Nutley

Village Hall - further details later
Annual General Meeting : 19th July 2003 - details later.
A residential weekend course on Wealden iron at Pyke House, Battle: 25-26 January 2003. Tutor: Jeremy Hodgkinson. Booking details from Pyke House, Upper Lake, Battle, Sussex TN33 0AN.

Historical Metallurgy Society
Annual General Meeting 10th May 2003 at the Royal Armouries, Leeds. Focus: research frameworks in archaeometallurgy.
Annual Conference 12-14 September on Exmoor. Focus non-ferrous industries and Roman iron production.

NEWS, NOTES and THINGS TO DO

Links with the Historical Metallurgy Society. Our chairman, Jeremy Hodgkinson is now a member of the Council of the Historical Metallurgy Society. At the recent HMS conference on Wealden Iron held at Pyke House, Battle, Jeremy gave an excellent review of the Wealden iron industry, making full use of up-to-date technology and Tim Smith, another member of our committee and of HMS undertook the major part of organizing the conference. Over many years, there has been a close relationship between our two organizations, to the benefit of each.

New iron sites. WIRG is anxious to have a comprehensive list of iron sites, no matter who finds them. Please let JH know of any evidence you or friends find or any references in books, theses, articles etc. (address below)

Firebacks. Please send in details of any that you find, with a description, date and where cast if known.

The Tebbutt Fund. This fund was set up in memory of our notable chairman and researcher, the late C F Tebbutt. Applications are invited from members and others who would like some help with the expenses incurred in research into any aspect of the Wealden Iron Industry. The enquiry may be something on quite a small scale and the fund can help with travelling and other expenses such as photocopying which may be involved. The results of any such work will be published in one of the Group's publications. Applications to the Hon Secretary, Mrs Ann Callow (address below) who will pass them on to the trustees of the fund for approval.

Correction:
The place-name given in the account of the Winter Meeting should have been Westhawk not White Hawk.

Names and addresses for contact:
Chairman: Jeremy Hodgkinson, 3 Saxon Road, Worth, Crawley RH4 1SZ
Vice-chairman: Mrs Dot Meades, 7 Normansland, Fairwarp, Uckfield, E Sx TN22 3BS
Hon Secretary: Mrs Ann Callow, Glaziers Forge Cottage, Dallington, E Sx TN21 9JJ
Treasurer: Reg Houghton, 17 Woodlands Close, Crawley Down, W Sx RH20 3LJ
Wirg web site: www.wealdeniron.org.uk (has a link to the Historical Metallurgy site.

Copy dates for our publications:
For the **WIRG Bulletin** 31st March. Small pieces of original research welcomed. Please send to JH.
For the **WIRG Newsletters**: Autumn publication 7th October; Spring 7th February. Short articles on any aspect of the iron industry, forthcoming events, book reviews, etc. If sending by e-mail please send as an attachment, not as part of the message. Short items are welcomed; for anything more than 800 words please contact the Editor before sending in.

TRACKS AND TRANSPORT

One of the fascinating things about the study of Wealden Iron, is the way that new aspects of the study are continually being thrown up and new possibilities come into discussion. Helen Pearce's discovery of the Dorchester firebacks is one instance and another was suggested by Ann Callow, who was pondering on the significance of tracks and depressions near Glazier's Forge. It has often been suggested that we should include local tracks when we describe an iron site but with so many sites and so many tracks in the Weald this would be an enormous task in itself. In terrain like ours, tracks tend to multiply and spread out over a considerable area; as one became impassable, another was cut nearby and this went on for centuries.

A trawl through Cleere and Crossley confirmed the importance of main routes. There is evidence that the river Brede was used for transport in Roman times. Later, furnaces and forges with easy routes to navigable rivers or seaports had an economic advantage over those in more inaccessible areas. However, these apparently easy routes had disadvantages, not the least of which was interception by enemies in time of war, or piracy. Often, the ironmasters preferred or were obliged to take overland routes to their markets, in spite of long delays and local unpopularity when a combination of bad weather and heavy loads made the roads impassable.

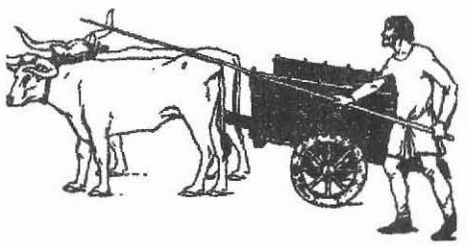
Apart from the major routes many local tracks were required - to furnaces and forges for raw materials and products, to local markets and to embarkation points on rivers and ports. Not to mention non- iron industry tracks made by timber haulage for house and ship building, clay for brickmaking, and drove roads for animals going to new pastures or markets. No wonder that, with the notable exception of Ivan Margary for the Roman era, no-one has attempted a comprehensive survey of ancient roads and tracks.

Ann made another observation, this time about Burwash Forge. "We observed, on the green land to the west of the site, that there are narrow tracks up the steepest part of the hill, which open out once the slope decreases, into a very wide area bounded by ancient banked hedges. Could this be a kind of marshalling yard? - you bring your goods in on carts and then offload them into smaller amounts for taking down the steep slope to the more restricted area of the forge (and vice versa for taking it away). The wide area was paved with forge bottoms..." By now, though, we had moved on from tracks to transport.

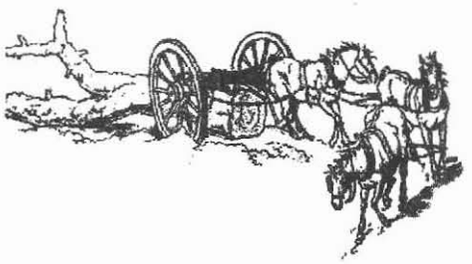
The iron industry needed transport for three main items: for charcoal, for iron ore and for iron products. Surprisingly little has been written about the humble vehicles and animals that were so extensively used. Straker says that most of the transport of charcoal and ore (cole and mine) to the furnace, of sows to the forge and of the finished product to the water was in ox-wains (ox carts). He quotes the inventory of Sheffield Furnace 1549, in which there were "14 drawynge oxen for th' use of the iron mylles there and two wyenmen (carters), hyred by the year for all careges, and their weges yerly, every of them xl^{s} (£2.00),a ly'ury (place to sleep?), mete and drinke." Hogge and later Fuller paid the local farmers by the load, to use their own animals and vehicles or to bring in materials on horses backs. Oxen were particularly suitable for haulage in the Weald due to the heavy nature of much of the clay. They could be used in ones to twos to pull smallish carts, or by the dozen or more for heavier loads. No doubt on lighter land ponies and mules were used, both for pulling and as pack animals.

Written evidence is sparse about the vehicles the animals pulled although we know that these must have varied according to the type of work. Pictures are more helpful. Some kind of tug for the cannon, perhaps similar to known timber tugs? We discussed pack animals and the amount they could carry. Ten years ago we saw mules were carrying building materials through the steep and narrow cobbled of Granada. Their panniers were woven of willow and thus were very light and strong. They were attached to a padded wooden frame. Donkeys had been seen carrying sacks of charcoal supported on panniers in Africa. The sacks are large (mail bag size) and stuffed to the top and laced up with a length of cord or vine. The tracks we find are frequently too narrow for carts but a train of pack horses or mules could have carried considerable quantities of ore or charcoal (remember Kipling's "four and twenty ponies, trotting through the dark").

No doubt the discussion will go on. We hope others will join in our deliberations and perhaps present new evidence. In the meantime, here is a little pictorial 'evidence':



12th century ox cart made of woven willow



Hauling timber

Horse-drawn sledge, carrying ore

(with acknowledgements to Hoover, HC and LH, Agricola, De Re Metallica p 168, Dover Publications, New York, 1950.)

With thanks to Ann Callow, Brian Herbert, Tony Meades, and Tim Smith. Any mistakes are my responsibility. ***Dot Meades.***