



NEWSLETTER

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LETTER FROM THE CHAIRMAN

Dear Fellow Members,

I had hoped by this time to have been able to write of significant progress with the development of the Historic Ironworking Centre that I wrote about in the last newsletter. The absence of news is not bad, merely a sign of delay in the completion of the feasibility study being carried out by the Ironbridge Institute. The committee which was formed to move the project forward is determined that its feasibility is thoroughly assessed, and would not welcome a hasty decision. Apropos of all this, in the Spring I was fortunate enough to visit the U.S.A. again, and had the opportunity of looking at the Saugus ironworks, the first commercially successful ironworks in the New World. Originally constructed in the 1640s, it lies a few miles north of Boston, Massachusetts. Like the centre proposed for Horam, Saugus is a reconstruction, although rebuilt on the original site. It is a fascinating place, with furnace, forge and rolling mill side by side at the head of a tidal creek. It also has many connections with the Weald, whether in the origins of some of its original workers, or in the examples drawn upon during reconstruction. Some of you may recall the film we saw of Saugus, at a Winter Meeting several years ago. If ever you are in New England it is well worth a lengthy visit.

I had cause recently to review the nature of the field evidence which we have been gathering over the years, and it struck me that our view of the archaeology of the iron industry is still relatively superficial. Of course we are hampered by the paucity of evidence, but nevertheless we need to be more critical of what we have. For example, as we slowly discover the broad date range of the hundreds of bloomery sites in the Weald, we should attempt to place them in context. I was paying particular attention to the iron industry in the medieval period when this issue drew itself to my attention, but the Roman period illustrates the point better. We know that pottery, and other evidence, suggests that iron making in the Weald in Roman times was at its height between the first and third centuries, but how sure can we be that the majority of the small sites we most commonly encounter were not the result of a concentration of activity during a much shorter period? And in the Middle Ages we already have a reasonable idea, from the excavations at Minepit Wood and at Alsted, and from the accounts of the Tudeley works, what sort of set up a mediæval works might

have been, but are we applying that knowledge sufficiently when reviewing the results of our fieldwork? The 1998 Winter Meeting is going to be very much a members' meeting, and I hope that the opportunity will be taken to discuss these sorts of matters.

There have been some changes to the committee this year. Hugh Sawyer has decided to step down; his commitments to railway restoration taking much of his time. I have been glad of his sound advice on many occasions, and I was relieved when he agreed to continue to act as secretary for the Field Group. Ashley Brown, who was co-opted to the committee last year has joined as an elected member, and Bill Whiting, an active member of the Field Group and of the Experimental Bloomery team, agreed to be co-opted after the AGM. I welcome them both.

Once again, my best wishes for the new year.

Jeremy Hodgkinson

ANTHONY JOHN CLARK, PhD, FSA **1930 - 1997**

In the early death of Tony Clark, WIRG, and archaeology as a whole, have lost a skilled practitioner and a good friend. His achievements in the field of geophysical surveying and dating are widely known, but it was an amateur archaeologist that he first came to the notice of the Group, when he investigated the enigmatic, medieval, water-powered bloomery site at Coneyhurst Ghyll, near Ewhurst, Surrey. It was, however, in his more familiar role as expert in dating techniques that he had his greatest impact on the work of the Group, and his measurements of the remanent magnetism of hearths at Garden Hill and the middle Saxon site at Millbrook were of great importance. I first met Tony when he generously agreed (in return for Sunday lunch!) to carry out archaeomagnetic dating at the Smythford bloomery, which a group of us were excavating in the early 1980s, and it was a fascinating experience watching his meticulous measurement of samples of the clay hearth wall. Later his advice and willing role as go-between facilitated speedy action when the Field Group discovered parts of two Roman leather shoes, and there was a need to act quickly to avoid their deterioration. In 1981 the WIRG Committee made him an Honorary Member. JSH

WIRG NEWS

OXFORD ENGLISH DICTIONARY

A comprehensive revision of the Dictionary is taking place, and WIRG has been asked to draw to the attention of its members the editors' appeal for sources of words which would supplement existing entries. Researchers using original journals, diaries, wills, inventories, accounts, court records etc. are likely to encounter specialist vocabulary or usage. Sources dating from between 1500 and 1800 are particularly sought. Any member who knows of the existence of sources of this kind is asked to contact the Chairman, Jeremy Hodgkinson, who will co-ordinate any contribution to this project that WIRG members may be able to make.

EAST SUSSEX COURIER, ***Friday 17th October 1997***

This report shows the new logo for the High Weald Area of Outstanding Natural Beauty, which depicts an anvil. A spokesman for East Sussex County Council said the anvil had been chosen because the iron industry had been instrumental in shaping the landscape of the area. So far, so good.

Unfortunately he went on to say that the iron industry was "Founded by the Romans in the sixth century...." This must have been quite difficult, since history tells us that by then the Romans had long since departed our shores, or been slaughtered or enslaved by the occupying Saxons. Moreover, the iron industry was in existence during the Iron Age, before the Romans arrived in AD43. What a pity the ESCC spokesman did not get in touch with WIRG, or at least contact his own county archaeological officer to check his facts.

WASHINGTON POST HEALTH, ***Susan Okie, April 8, 1997***

A report that work-related exposure to certain metals over a period of two decades or more appears to increase a person's risk of developing Parkinson's disease, a degenerative brain disorder, according to a new study.

Manganese, copper and certain combinations of metals were mentioned, including lead and copper, lead and iron or iron and copper.

Point for discussion: it has always been assumed that Ralph Hogge's admission that he could neither read nor write meant that he was illiterate. Moreover he was too crippled to travel in 1584. No doubt overlong hours of work in difficult conditions which he must have endured at least in his younger days would have contributed to his disabilities. Could this article point to an additional cause. DMM

FORAYS

Foray to Peasmarsh

What was expected to have been the last foray of the 1996/7 season took place on a beautiful April day. Peasmarsh is a long way from our usual foraying territory, but has impeccable credentials, and 'looks right'. Bloomery slag had already been reported in the field next to the church, so the omens were good, and the geological map showed a cap of Wadhurst Clay to the south of the village. We set off, from Dew Farm, with the intention of fieldwalking the ground along the Wadhurst Clay/Ashdown Sand boundary; a strategy which paid off. After examining the known area of slag, we walked round to the north west side of the outcrop and came across a scatter of bloomery slag in a field. About 100 yards away in the next field we came across another. Both had been thoroughly dispersed by ploughing but the concentrations were unmistakable.

We rounded the end of the hill, overlooking Sir Paul McCartney's farm, and crossed the lane near a small nursery. The path was unclear and, in asking the owner of the nursery for directions, and explaining what we were up to, we learned that in the nursery garden there might be something worth investigating. A couple of us clambered over the gate and were soon examining a flower bed - with added bloomery slag! Site number four; not bad for a day. We made our way back to where we had started, without further sites being found, and I went to report our success to the farmer, only to find lambing in full swing. We will be returning to Peasmarsh next Spring, to walk the eastern end of the hill-top. It is practically as far to the south-east as you can get in the Weald, but it shows that there is nowhere we should not be looking, and if we are to live up to the name, Wealden, we must not leave out any of it. JSH

Foray to Ifield

For the first foray of the 1997/8 season we paid a visit to Stumbleholm Bloomery furnace site at Ifield in Sussex. An initial visit, to get permission, had indicated that there was a lot of forge cinder in the vicinity; no doubt from Ifield Forge, about 1 mile away.

The morning was taken-up with an inspection of two pieces of woodland called "The Grove", between which was a pasture centred on (TQ23303730); it is suggested that these three areas were once one wood. According to the geological map, this area is at the south end of an outcrop of iron ore in the Weald Clay and mine pits were shown on both pieces of woodland: but what of the pasture in between?

As expected, both pieces of woodland did contain mine pits, although there was a subtle difference between them; one being much more overgrown with older trees and the pits not well defined, whilst to the south the other seemed much younger with approximately 50 well defined pits. In neither area were there any very large pits, such as those we believe to be associated with the Roman period.

And what about the intervening pasture? Due to the fact that the grass had probably not been cut this year, a different type of wide-leaf grass could be discerned, patches of thistles could also be made out, along with a gentle unevenness in the level of the field: and each patch was approximately circular! On probing each of these areas, it was easy to reach down 2ft, whereas in other places only 6 to 9in was possible, suggesting that both woodland and field were once one woodland called "The Grove". The digging of ore ruins the fertility of the soil by bringing up the sub-soil, but this pasture has obviously recovered.

A field centred on TQ23153710 was found to contain much forge cinder and odd pieces of blast furnace slag and the occasional piece of bloomery furnace slag; this mixture could not be explained. However, close by in woodland at TQ23043706, a significant amount of bloomery furnace slag was found; this is the site of Stumbleholm Bloomery. The metal detector also indicated slag in the adjacent field; but the type could not be established without digging; this could be one of next season's forays! The barn, mentioned in "Straker" is still there with a floor made-up of slag; once again we were reluctant to investigate further.

After dinner, with extra sustenance supplied by our hostess's home-made cake, we made our way to an area of slag found by member Mrs Jean Shelley at TQ22253691; on the line of "Smuggler's Lane", now a footpath. Although the metal detector showed that slag covered an area about 30ft across, there was no "mound" of slag. A couple of very small excavations were made and at a depth of 9in a 2 to 3in layer of slag was found. Although some of the slag was definitely "bloomery" much of was of dubious origin; possibly from Ifield Forge, nearly 1.5 miles away. It was decided that the site was probably was NOT a bloomery furnace because; (1) the slag is on a flat, low-lying area with several ditches nearby; not a suitable site to build a bloomery furnace; (2) it is in line with "Smuggler's Lane"; (3) the thinness of the slag layer. The slag is assumed to have been put there to build-up a boggy, low-lying piece of the lane.

Slag has also been found at TQ23443638, just south of Ifield golf course, this must be investigated: but from there Ifield Forge is only 0.5 miles away!

A bay across the stream at TQ23683636 is assumed to be a pen-pond for Ifield Forge although the stream does not now enter the forge pond.

SMELTING

To date, five smelts have taken place in the experimental bloomery furnace on Ashdown Forest. The first three did not produce any iron but the last two may well have some small pieces of metal inside the bloom. This will be established at the WIRG General Meeting in January, at East Grinstead, when they will be broken open after the writer's short lecture of our efforts at smelting.

Some of the changes that have been tried include :-

- [1] Changing the ore size from about 1in to a size that will pass through a 5/8in sieve.
- [2] Reducing the air-flow from 3L/s to 2L/s.
- [3] Changing the charcoal-to-ore weight ratio from 1:1 to 1.5:1.
- [4] Altering the end-position of the tuyere from "flush with the inner surface of the furnace", to, "protruding 4in into the furnace".

Come to the WIRG General Meeting, in January, to see if we have had success!

A future change will be to reduce the tuyere diameter from 1in to 0.5in, say. The evidence for tuyeres in bloomery furnaces is minimal, especially the where/how/if they were used at all; (this should bring some comments!). One theory (the author's) is that tuyeres were used on the outside of thin-walled furnaces to thermally insulate the wooden nozzle of the bellows. Because of the thin furnace wall, the jet of air from the tuyere might continue well into the ore/charcoal burden to produce the correct smelting conditions: (note, our furnace has 1 1/2in thick walls.) Yet another possible change would be to reduce the thickness of the furnace walls, although this would alter the temperature profile across the furnace, due to the heat loss from the furnace walls, perhaps this does not matter providing centre of the furnace reaches the desired 1200Deg C temperature. **Brian Herbert**

AGM 1997

Mr Sidney Simmonds gave us an excellent talk on Elizabeth de Burgh, Lady of Clare, who owned the Summerhill estate and Tudeley ironworks.

The ironworks accounts are the only ones which cover a Wealden bloomery. They are to be found in the 14th century archives of Elizabeth de Burgh, Lady of Clare, whose estates included holdings in Norfolk, Suffolk, Essex, Surrey, Hertford, Kent, Dorset, Somerset and Gwent.

Tudeley is in Kent but the exact location of Tudeley ironworks is not now known. However, it adjoined the Forest of South Frith. Mr Simmonds referred to various maps showing Devil's Gill and Borne Mill which are believed to be associated with Tudeley. He told us that the Tudeley accounts have now been translated from the Latin, which will make them much more accessible.

The name is derived from the Saxon "Thieves valley". In the 7th century Tudeley was one of four churches in the Weald - Hadlow, Tudeley, Benenden and Palster (East Kent). There were good supplies of iron ore, water and wood nearby and the ironworks was sometimes worked by the estate and sometimes leased out. The accounts cover two periods 1330 to 1334 and 1350 to 1354 during which the ironworks was worked by the estate.

Mr Simmonds' talk filled in the background of the times; the often violent politics of the early and mid-14th century and the way that these affected the owner of the Tudeley iron-works, Elizabeth, Lady of Clare, granddaughter of Edward I. Her mother was Joan of Acre, daughter of Edward. Her father was Gilbert de Clare, Earl of Gloucester and Hertford, friend and sometimes foe of Edward.

The Clares were cousins of William the Conqueror and had many connections with the royal family through the centuries. Gilbert had played important roles in the Barons' Wars, fighting at Lewes and Evesham. In his own right he held Gloucester, Clare in Suffolk and Tonbridge. He was lord of Glamorgan in south Wales and of lands in Ireland and had married the niece of Henry III by whom he had two daughters. After the king he was the richest and most powerful man in the kingdom.

King Edward I worried about the power and loyalty of the Marcher lords and resolved to bind Gilbert de Clare closer to him. He therefore required him to annul his marriage, to give all his lands to Edward and to marry Edward's youngest daughter, Joan of Acre. After the marriage his lands were returned to him but entailed to Joan and her children. (The previous wife and daughters were well provided for but disinherited.)

Gilbert and Joan had four children in successive years from 1291: Gilbert, Eleanor, Margaret and Elizabeth. In 1295 their father Gilbert died and two years later their mother Joan, against the king's will, married Ralph de Monthermor, a young man from her household. After going on a campaign with the king, however, he was restored to royal favour.

In 1306 young Gilbert was knighted by his grandfather, Edward I and his sister Eleanor was married to Hugh de Spencer, one of the favourites of Edward, Prince of Wales and, by all accounts, a nasty piece of work. The de Spencers, father and son, aspired to be as powerful as the Clares and to take over their lands if they could. The old king died in 1307 and his grandson Edward II succeeded him. The de Clare sisters were more and more used as pawns in the power game played out by the new king's favourites.

Gilbert arranged the marriage of his sister, Margaret, to Peter Gaveston, another of Edward II's favourites, who was created Earl of Cornwall. In 1308 Gilbert married Maud, daughter of Richard de Burgh, earl of Ulster and the same year he arranged for his other sister Elizabeth to marry the earl's son, John de Burgh. In 1309 Elizabeth gave birth to a son, William, later earl of Ulster.

Those were turbulent times. Edward II and his favourites became so detested by the king's opponents that in 1312, to save his throne, Edward had to agree to Gaveston's execution. Margaret, his widow, was then 17 years old. Meanwhile, her sister-in-law Maud, wife of her brother Gilbert de

Clare, gave birth to a boy, John, who died within the year. A year later Elizabeth's husband, John de Burgh, died. His father was still living and she moved to Ireland with her son William. Elizabeth was therefore a widow at 18.

Worse was to come. On 14th June 1314, earl Gilbert, was killed at Bannockburn and the maintenance of the male line and cohesion of the vast estates and the power that went with their ownership depended upon his widow, Maud, having an heir, a son, by Gilbert. In the absence of an heir, the estates would come into the hands of Eleanor, wife of Hugh de Spencer; Margaret, widow of Peter Gaveston; and Elizabeth, widow of John de Burgh, Countess Maud's brother.

So important was it to Edward to keep the inheritance intact that he did all he could to avoid the decision about the partition of the inheritance. Countess Maud did her bit to help - for two years she claimed she was pregnant! In May 1315 the ambitious Hugh Despencer could wait no longer. Enticed by the prospect of gaining a third of the inheritance he sieged Tonbridge castle from its keeper, the archbishop of Canterbury and refused to surrender it; he did not believe in the pregnancy of Maud and demanded the King settle the inheritance.

Once again, the sisters became pawns in the power game, as Edward sought to ensure that their lands would go to his favourites. Elizabeth tried to escape: in 1316, after being placed in the king's custody in Bristol castle pending the settlement, she left against the king's wishes and married Theobald Verdun, a former justiciar in Ireland with lands in Ireland and Wales. He is supposed to have abducted her, but she had known him before and he claimed they had been betrothed in Ireland. In July the same year Theobald died and Elizabeth was again a widow.

The next year, Elizabeth was married off to Roger Damory and Margaret to Hugh D'Audley, both favourites of the king. The great de Clare family honours based on Clare, Gloucester and Tonbridge, and portions of their Irish and Welsh estates were delivered into the hands of the husbands of the three sisters. In 1320 Maud de Burgh died and the sisters acquired their share of her dower lands.

The power struggle continued. The baronage, headed by Lancaster, forced the king to exile the Despenchers, father and son but in March 1322 they returned and there was civil war; the Royalists won the battle of Boroughbridge. Elizabeth's husband, Roger Damory had sided against Despencer and fallen from royal favour; he was executed or died of wounds in Tutbury castle. He left no children and Elizabeth was widowed for the third time. Despenser sieged Elizabeth and imprisoned her in Barking Abbey. Under threat of death for herself and her daughter she was compelled to surrender her Welsh lands and castles to Despencer and to give a bond not to marry again or to part with any lands without consent. D'Audley was imprisoned and for the next four years the Despenchers were the real rulers of England.

The baronage fought back: in 1326 Eleanor's husband, Hugh Despenser was hanged, leaving a son and heir, also Hugh. On 21st September 1327 Edward II was murdered. His death and that of the Despensers brought relief and peace to Elizabeth. The first parliament of Edward III restored her Welsh lands to her and her freedom of action; she settled at Clare Castle in Suffolk, the estate from which her ancestors had taken the family name.

In 1354 an account of the Tudeley Ironworks for Elizabeth went via the Gravesend ferry to her one of her manors, Bardfield in Essex.

In 1359, Elizabeth endowed Clare Hall, Cambridge, with a Charter and Statutes of far-sighted wisdom and liberal provisions. They show the keenness and practicality of her insight into human nature and in its terms the tender piety of the Middle Ages are blended with the intellectual clarity of a later age. During her long and peaceful widowhood she was content to manage her various dower lands and her portion of her brother's estates. Much of her time and wealth was spent on charitable works.

Her arms, used by Clare College, are the most moving reminder of the life and loves of this great lady. The three red chevrons of the de Clares on a gold field are impaled with those of de Burgh, and her sorrows are portrayed by the border of black sprinkled with tears, and because of her riches, her tears are of gold. In 1360 she died, aged 65. Her son William de Burgh was an ancestor of the House of York. The present Lady of the Honor of Clare is the Duke of Lancaster, Elizabeth II, Queen of England.

The last known account of the Tudeley ironworks is dated 1375.

My thanks to Mr Simmonds for his notes which have expanded and corrected my own record of his most interesting talk. DMM

THE WINTER MEETING

This will take place in the Main Hall of East Court Mansion, East Grinstead on 31st January 1998. There will be four short, illustrated talks to include Mr Herbert on the experimental bloomery, Dr Smith on iron working in Sweden, Mr Hodgkinson on a relevant subject and another to be decided.

REVIEWS

Recent publications

Catherine Collinson, 'Enterprise and experiment in the Elizabethan iron industry: the career of Thomas Procter', *Yorkshire Archaeological Journal*, 68 (1996), 191-208. Instances of Wealden ironmasters being involved in other iron producing regions are sufficiently rare to merit a short review of a recent paper published in Yorkshire.

In 1589 Thomas Procter patented a method of making iron and steel using, among other materials, mineral coal. Procter lived in the Yorkshire Dales and, although primarily a farmer, he seems to have owned an ironworks in the area of Brimham; very likely a water-powered bloomery.

It appears that a number of lawsuits in which Procter became involved reduced his ability to acquire sufficient wood for charcoal for his works, and it was this, among other factors, that inspired his search for alternative fuels.

Procter mortgaged his ironworks to one William Brokebank, who subsequently bought it, only to sell it on to Thomas Dyke - hence the Wealden connection. Dyke, who already had Chingley and Dundle forges, as well as Horsmonden furnace, would have been able to bring his knowledge of the blast furnace process to the Dales, for by 1589 he had a furnace there, and a forge a few years later. Procter began to have dealings with Dyke when the former was appointed one of the commissioners to inquire into alleged infringements of the statute of 1558 which forbade the coaling of certain trees with 14 miles of the coast. Dyke was so accused, but the case was dropped through lack of both evidence and a determination to pursue it. However, Dyke was later brought up before the Court of Exchequer on the same charge.

The rest of the article is concerned with the career of Thomas Procter, and in particular his patent, but it provides the reader with an interesting insight into the interplay between the individuals involved in the industry (and how's that for alliteration!). JSH

Our thanks to Dr Tim Smith for the following two reviews. Although these are Swedish publications, they are relevant to the debate about the origins of the blast furnace in the Weald. Particularly so in view of Dr Paul Craddock's suggestion that the first British blast furnaces may have been in the Forest of Dean, and Mr Michael Edwards' thoughts upon how and why the new technology came from the Pays de Bray to New-bridge. Ernest Straker (Wealden Iron p 37) notes that the bloomery process continued in the Weald for about a century after the introduction of the blast furnace, even though it was eventually forbidden by law.

Ivar Bohm, *The Swedish Blast Furnace in the 19th Century* is available in English and Swedish from Jernkontoret, Box 1721, S-11187, Stockholm, Sweden. Tel 46 8679 1700 Fax 46 8611 2089. Price SEK 60 or in UK and Eire from; Merton Priory Press Ltd, 67 Merthyr Road, Cardiff CF4 1DD. Tel & Fax 01222 521 956.

The English translation of Ivar Bohm's monograph on Swedish charcoal blast furnaces is not new - it was published over 25 years ago - but it is well worth reminding a new generation of this excellently illustrated treatise on early blast furnaces.

The last charcoal fired blast furnace in Sweden, the Svartfurnace, ceased operation in 1966, bringing to an end an era

which grew rapidly in the 19th century when 400 such furnaces were in operation producing 70kt/y.

By 1900, the number of furnaces had fallen to 133, but with the introduction of preheating the air blast to a modest 100-200°C, productivity had increased to 500kt/y and charcoal consumption had fallen from 1.6t/thm to 0.8-1.1t/thm. Output peaked during the 1st World War when 719kt were produced a year.

Furnace types illustrated range from the earliest timber clad and stone furnaces with a single tuyere supplied by bellows, through the all stone 'Walloon' furnace to the 'modern' free standing 'Scottish' furnace, in which the stack reinforced with iron bands stands without the support of the surrounding building.

The 45 page A4 publication includes an illustrated glossary of ironmaking terminology which provides short descriptions of all aspects of the process including ore crushing and roasting, water power, bellows and blowing engines as well as detailed descriptions of the various components of the blast furnace. TS

 'The Importance of Ironmaking - Technical Innovation and Social Change' Edited by Gert Magnusson is available from Jernkontorets, Box 1721, S-11187, Stockholm, Sweden. Tel 46 8679 1700 Fax 46 8611 2089. Or in England and Eire from, Merton Priory Press 67 Merthyr Road, Cardiff CF4 1DD. Tel & Fax 01222 521 956.

With an output close to 725Mt a year, today's iron and steel industry is second only to concrete in size. In origin, it also claims second place, this time not to concrete but to the world's most 'socially interactive' profession!

The relevance of the history of ironmaking is fortunately recognised by the major metallurgical professional institutions, each having its own 'Historical' sub-committee, one of the strongest being that of the Swedish Steel Producers Association, Jernkontorets, an Association which celebrates its 250th anniversary in 1997.

The Proceedings of an international conference on technical innovations and social change in the iron and steel industry organised by Jernkontorets Bergshistoriska Utskott in May 1995 offer 71 papers (mostly in English) to professionals and amateurs interested in the technology of ironmaking, mining, transportation and the social structures which supported the industry.

Following two excellent keynote presentations tracing the history of ironmaking in Sweden, the Proceedings take on a pan-European flavour with papers presented on sites ranging throughout Western and Central Europe - with just two papers from other Continents.

Direct ironmaking receives the greatest attention with 21 papers devoted to various forms of bloomeries for the produc-

tion of 'sponge' iron. Results of archaeological investigations of sites are presented, estimates of the extent of the industry in the locality made and the results of experimental smelts in reconstructed furnaces presented. One most interesting point is that there is no evidence that charcoal was necessarily used as the fuel/reductant. In some Swedish shaft furnaces wood was used successfully, a result confirmed by trials in a reconstructed furnace which produced iron of exceptionally low carbon content (0.027%).

There is evidence that some bloomery shaft furnaces used water power to drive the bellows - although 'woman' power was a common alternative employed by the peasant farmers who operated these small furnaces - so there was a natural progression to the construction of the blast furnace in which sufficient 'wind' was supplied to melt the direct reduced sponge iron (its melting point decreases as its carbon content increases) producing a cast iron high in carbon content which required decarburisation in 'fineries' for ductile applications, or could be directly cast to make such products as cannon, shot and fire-backs. One of the most interesting findings has pushed the date of the emergence of the blast furnace in Europe back over 200 years to around 1275. Archaeological evidence of such a furnace has been found at Lapphyttan in Central Sweden, this location being argued as geologically suitable because of the low phosphorus content of the local ore. Whereas in the shaft furnace phosphorus reports to an acid silica slag leaving the solid iron uncontaminated, in the blast furnace, phosphorus will revert to the molten iron rendering it highly brittle. Hence, it took, for example, another 300 years before the blast furnace reached England, and a further 50 years or so before it was widely adopted.

Early blast furnaces are discussed in just 4 of the papers presented.

The social organisations which supported the industry were generally complex, for example, in Sweden, two parallel industries existed; a peasant industry in which farmers shared a common furnace which was only operated for a few weeks of the year to meet their own needs, and a larger scale industry, generally based on large estates owned by the ironworks, where land was leased to tenant farmers on the condition that charcoal was supplied to the works at a fixed (low) price.

Preservation of sites merited 11 papers, reflecting the interests of the many delegates from industrial museums who attended. Ironworks and Transport examines the logistics of supplying the industry with its raw materials and exporting its products. Ten papers are devoted to this topic, and just four to mining, surprising since the conference was located at Norberg, on the site of one of Sweden's oldest iron mines.

The Proceedings are published in two volumes, each with its own cover price. In an inspired marketing policy, Jernkontorets, have 'sprinkled' papers on the majority of topics throughout both volumes, so one is never enough. Volume 1

priced at SEK 250 (æ25) is the larger containing 44 papers (422 A4 pages) including the two opening keynote addresses and the only papers on early blast furnaces. Volume 2 priced at SEK 220 (æ22) contains 27 papers (306 A4 pages) and includes the list of participants with full contact addresses. It is also the only volume containing the session on 'Technical Studies' in which four papers discuss such techniques as Radiocarbon dating and petrography of slags. TS

WHO'S A WALLOON?

Vague geographic terms such as the 'Weald' or the 'Black Country' can be a total mystery to foreigners since they are not marked on a tourist map or defined in a guide book. Likewise, the 'Walloon' district of the 'Low Countries' has always seemed rather nebulous to me so I am grateful for the following definition given by Dr Paul Nilles, Director of the Belgium Centre for Research in Metallurgy (CRM), based in Liège.

The word Walloon generally designated the French speaking people of the Low Countries but was sometimes applied to Dutch speakers from the same area.



(Fig 1) Map of original Walloon region of the Low Countries.

Different explanations are given concerning the origin of the word 'Walloon': According to the French Dictionary, 'Robert', it stems from the Frankish word 'walha' meaning 'Latin' or 'Roman'. It is to be compared with the German word, 'welsch' which means foreigners - mainly French speaking people - in the German Empire. German and Flemish people called the Gallic people, 'Wahlen'; the change of the G into W was frequent in ancient times (cf. Wallia, Wales, Pays de Galles).

The name 'Walloon Metallurgy' is due to the fact that during the 16 century, iron production using the blast furnace was

essentially confined to the French speaking part of the Low Countries, ie the Namur Region, the Dutchy of Luxembourg (Habay) and the Principality of Liège.

The Technology

The Walloon blast furnace was built in cut stone and stood 5-6 metres in height. It consisted of a circular stack surrounded by a square stone wall, the gap between this and the shaft being filled with earth to provide insulation. A single tuyere, supplied with air from a pair of bellows driven by a water wheel, entered near the base of the inner shaft through an arch in one outer wall. A second arch was located 90° from this in an adjacent wall and contained the tap hole from which first slag then iron was tapped at regular intervals. The charge, consisting of alternate layers of charcoal and iron ore, was charged through the top of the furnace via a ramp. Later furnaces were enclosed in a building with a removable section of roof which was opened when the furnace was in use. Typical output was 2 tonnes of iron per day.

Amazingly, such a furnace still survives to-day as a reconstruction in the Maison de la Métallurgie et de l'Industrie in Liège. It dates from the 17 century and once stood in the village of Gorieux, near Liège.

Unlike the German furnaces, the Walloon's tapped their iron into a single large sow some 4-5 metres in length and usually semicircular in cross section.



Fig.2 Cast iron sows about 4-5m in length at Osterby Bruk, Sweden

The size of these sows necessitated the refining forge to be nearby. The iron was refined by heating it in a charcoal fired hearth into which air was blown both to raise the temperature and oxidise the carbon in the sow - which typically would be 4% at the start and had to be reduced to a few fractions of 1%. This was achieved by feeding the sow into the hearth (the finery) through a hole in its back wall. The sow was consumed bit by bit, being worked on by the smiths who would play the air onto the end of the sow to melt off a lump (a loop) and work this until it became a pasty 'ball' - the melting point of the iron increasing as the carbon content fell. The ball would then be hammered to compact it and squeeze out slag using a water driven helve hammer.

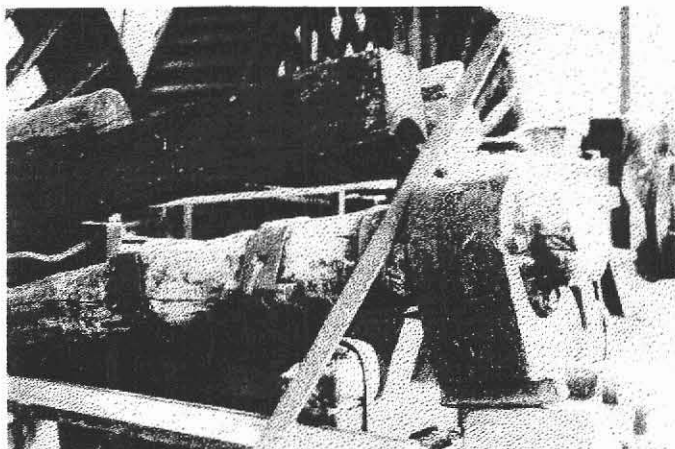


Fig 3 A typical water wheel driven helve hammer - note bar iron resting on shaft.

In the Walloon process, the 'bloom' so formed was transferred to a second smaller hearth (the chafery) where it was reheated, followed by further application of the helve hammer to further consolidate it

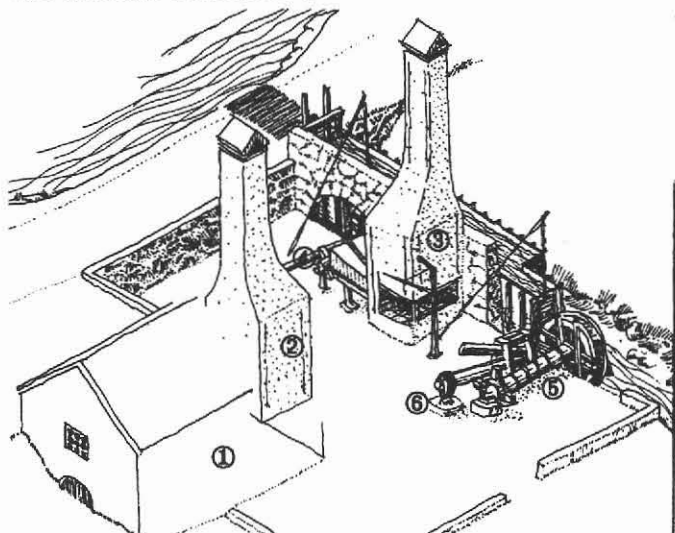


Fig 4 Layout of Osterby Bruk Walloon Forge.

1 pig iron shed; 2 Finery hearth; 3 Chafery hearth; 4 Axel tree for bellows; 5 Axel tree for hammer; 6 Belly helve hammer.

(Reproduced with the permission of Jernkontoret from 'Swedish Iron in 17th & 18th Centuries' by Prof Hildebrand).

Since the temperature required was not so high in this reheating process, sometimes coal rather than the more expensive charcoal was used since, at these lower temperatures, there was no danger of the fuel contaminating the iron.

Only one Walloon forge survives anywhere in the world today. This is not in the Walloon's home territory, but in Sweden at Osterby Bruk in the Province of Uppland, some 120km north of Stockholm.

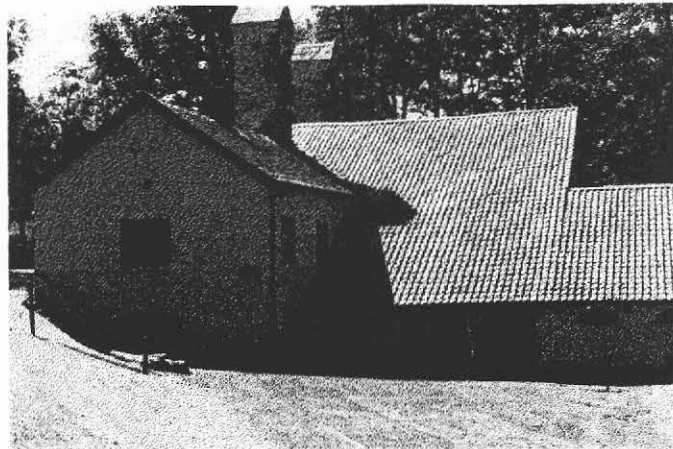


Fig 5. The only surviving Walloon Forge built in 1794 and operated until 1906 at Osterby Bruk, Sweden.

This forge was rebuilt in 1794, but records show that there had been a blast furnace on the site since the 16th century making use of the nearby phosphorus free ores extracted from the Dannemora mines.

The Walloon influence arrived in 1627 when Louis De Geer - who had been busy casting cannon for the Swedish crown at Finspång in southern Sweden - entered into partnership with Welam de Besche who had acquired the lease in 1626 from a German, Petrus Auleander, the lessee since 1622. The business prospered under Louis De Geer who acquired additional ironworks in the vicinity at Leufsta and Gimo and took full ownership of Osterby in 1643. The business passed to his son, Laurent De Geer on the death of Louis in 1652.

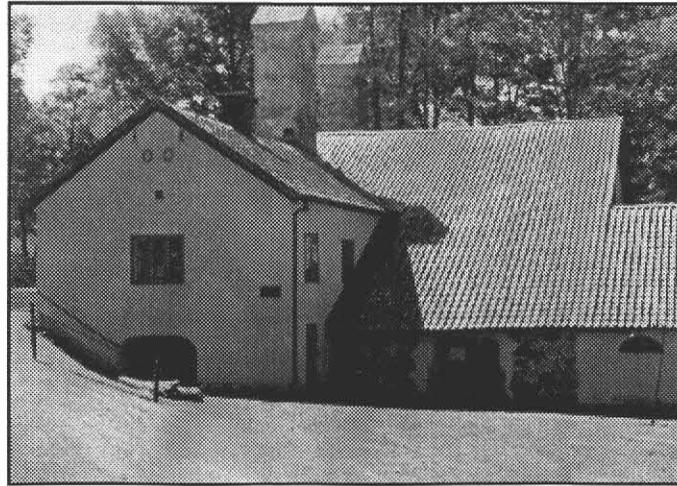
Visiting the works today, what strikes one is the massive size of the Finery hearth (some 2m square) and the size of the hole in the back wall (approx 1.5 x 0.75m) through which the sows were fed. The surviving forge, which worked until 1903, is in remarkable condition, although one helve hammer is missing and the later installation of a Bagg blowing engine to provide the air to the hearths has meant that the bellows were removed. In addition to a generous pile of sows outside the forge - so prolific that some are being used as gate posts - the product, bar iron, (about 2-3m long by 50x10mm in cross section flat bars of wrought iron) has been gathered from the surrounding area and now, lined up in the secure bar iron shed, proudly proclaims the identification stamps of the various forges in the district.

The Wallons' ironmaking skills spread into much of Europe, not least to our own Weald, albeit via France. Today, a steel industry still survives in the region, although one fighting for survival in a modern competitive world in which subsidise from State governments are banned by an EC dictate.

MANY THANKS to everyone who has sent in material for this issue of our newsletter - please keep it coming. DMM

Enhanced photographs for Tim's Walloon article

Fig 1



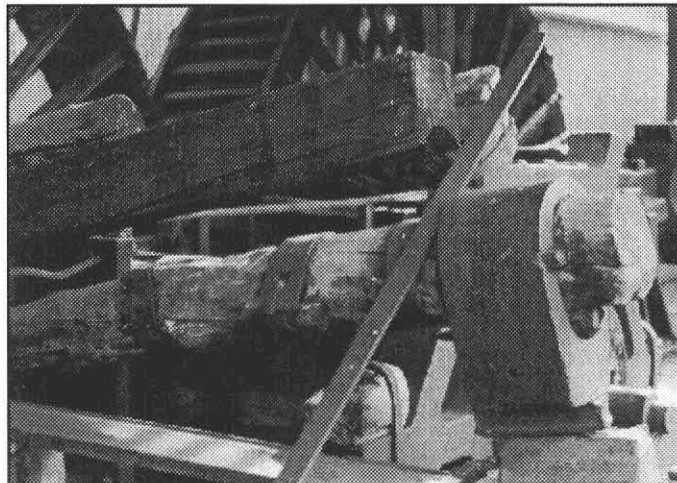
Osterby Bruk Walloon Forge

Fig 2



Iron sows at Osterby Bruk

Fig 3



Helve hammer - note bar iron resting on shaft