HMSNEWS
Historical Metallurgy Society

43 Winter 1999/2000

Forthcoming events

Saturday 13th May 2000. The HMS AGM will be held at Saltford Brass Mill, Keynsham near Bristol. A detailed programme is being constructed by Joan Day.

The **HMS Conference 2000** will be held at the Tank Museum in Bovington, Dorset, at a week-end in September, probably the 23rd-24th. There should be a short history of tank design and presentations on track link, armour plate, projectiles etcetera. The theme of armour, however, will not be confined to C20th tanks! **A call for papers will be made through the Spring HMSNews**.

Study Tour to Mexico. The Society's tour is going ahead in conjunction with Atalaya Tours. It will run from 20th May to 1st June 2000 (timed to follow on from the Archaeometry Conference in Mexico City), and will cover the major silver and copper areas of central Mexico, taking in Taxco, Guanajuato, Zacatecas, Fresnillo, and Pachuca; sites and collections visited will range from pre-Columbian mining and metallurgy via the Spanish colonial and the 19th century British involvement (Mexico has some fine Cornish engine houses, and even pasties!) to active modem mines and smelters, and me craft-silver of Taxco and other cities. There will also be time to tour the fine Spanish colonial architecture of the mining cites, and visit some of the main pre-Columbian archaeological sites.

The programme will include guided tours of the working sites, and other behind-the-scenes tours of sites and collections not normally accessible (Jamie Thorbum of Atalaya has extensive local contacts, but if any member has personal contacts in Mexico that might open further doors, please do contact Jamie!) The tour is open to non-members, but there is a discount for HMS members. The cost to members is therefore £850, plus airfares (around £500 from the U.K) if required.

Members who filled in the flier in the last HMSNews should have heard directly from Atalaya Tours in early November, anyone who has not been contacted, and anyone else interested, should contact Jamie Thorburn, Atalaya Tours Ltd, Ceinionfa, Capel Dewi, Aberstwyth, SY23 3 HR; phone/fax + 44 (0) 1970 828989.

David Cranstone

Applications for grants invited

Applications are invited to the **R.F. Tylecote Travel Fund** and the **Coghlan Fund**. Application forms may be obtained from Michael Cowell, Hon. Treasurer, Little Gables, 17A Thomcote Road, Northill, Beds SG18 9AQ. **Forms should be submitted by February 12th 2000.** E-mail mcowell@british-museum.ak.uk. Forms are also on the HMS web site.

Please note the Website for HMS has been changed and is now hist-met org

Annual Conference 1999 in Cumbria

The last Conference before we celebrate the Millennium one year early took us to the Lake District. We last visited Cumbria for the Mining Before Powder meeting, which was held at the Charlotte Mason College. This time we were at the St. Martin's College in Ambleside, which we found was the same place by another name. The theme was different, the magnificent scenery was the same. So it was when we held our Conference in Lancaster and went to the Lakes on the Saturday. That was back in 1985 and another conference visit was certainly due. 55 members and guests attended a most successful event. Even the weather managed not to repeat the 1985 monsoon, when "small becks" became raging torrents, wide and deep.

After a splendid dinner we were welcomed to the Conference by Colin Phillips, the President.

The evening lecture was divided between **Ian Goodall** (EH) and **Mark Bowden** (RCHME). The iron industry came to the Lakes initially because there was charcoal and iron ore to be found and the product could be sold without much difficulty. A huge number of platforms which have been used for charcoal burning have been found. There are more than 250 bloomery mounds a large number of which are undatable. While there are some records most of the bloomeries to which they refer cannot be identified. Excavation reveals nothing dateable Recent work on the Sites and Monuments record showed that some field-work was needed to fully record some sites that were seriously threatened by forestry and agriculture. Other sites were at risk from the increase in walking away from the roads. Some sites particularly at risk have been thoroughly surveyed and con-served to limit damage. We were shown the results of this work

The production of charcoal for the bloomeries and blast furnaces meant the management of oak woodlands to produce small wood. Large trunks cannot easily be made into charcoal. This gave rise to other industries. Oak bark was valuable for tanning and is not needed for charcoal so that this became another major industry. The remains of this trade can be seen in the characteristic foundations of the crude huts used by the workers. These seem to have been only occupied for short periods and have often been rebuilt several times. They may or may not be near charcoal burners platforms. Other forest related crafts were practised on a smaller scale.

On Saturday morning we set off in two fairly small buses. Once off the main routes the roads are narrow and winding. The first stop was at the Beck Leven and Bailiff Wood bloomeries. These were an excellent demonstration of the problems of dating and conserving such sites, nothing remaining but the slag. A geophysical survey has shown that any structures at Beck Leven may have been destroyed by ploughing, A splendid spot for a picnic though. In the woods a reconstruction of a bark strippers hut was of interest, particularly how well the unusual fireplace worked. Nearby there was a charcoal burners platform.

The next stop was the deservedly famous **Duddon Furnace**. This is the best preserved charcoal furnace site in Cumbria, and perhaps anywhere. We inspected the ore store and the huge charcoal barns, speculated on the ancient fire damage, and climbed up to the charging platform. We even got onto the plat- form once the key had been found. A strangely cramped and seemingly dangerous place when compared with furnaces such as the Dovey Furnace. I thought the site had improved since the last visit. Some of the party sat on the foundations of the furnace ancillary buildings to eat their packed lunch in a very pleasant place.

We stopped briefly as a matter of convenience in Broughton Market Square. This was an interesting survival of earlier days.

Soon after this we arrived at the **Newlands furnace**. The last HMS visit consisted of a walk around the outside and peering into a garage, which was part of the charging house. This time the visit was quite different. **John Marshall**, who has long championed this furnace, was able to take us inside the structures to the blowing house where he described how the oak lintel had been replaced. A triumph of engineering ingenuity. He also pointed out much less drastic work that had been done, much of it called in the trade "muckshifting", and more conservation that was needed. We were allowed into the "garage" to inspect the upper floor of the building, all by courtesy of the owner. We had time to walk up the leaf to see the source of the water for the wheel and take a quick look at the other ironworks buildings and the rest of the hamlet before thanking John for an interesting stop.

The next visit was to the sorry remains of the **Backbarrow Ironworks**. Unlike the last time that we visited this site we were able to go onto the site to see what was left. Regrettably a lot less than last time. The furnace still stands, though it is in a poor condition. The blowing engine is still there but the pipework and stoves have gone. We did go up to the site of the stoves but it is not possible to see what they were. On the west of the road more survives, but all are buildings which could have been used for anything. There is the remains of the railway siding, with the Lakeside and Haverthwaite railway still running past. Steam hauled still but tourists only.

From there we went to a more controversial and picturesque site, **Stoney Hazel**. Was it a bloomery? Or a Finery? Or even both. It had a short life. It was built in 1718, and was closed after fires in 1720. Much of the walls survive, with the dam and the race. There were two wheels, one for the bellows and one for the hammer. The hearth is visible as a square stone structure with the remains of a stone hood. Excavations have shown that the tree stump anvil foundation and part of the hammer frame still survive. They have been reburied to preserve them and the working floor, which is covered with smithing debris. An ore bin and the remains of the charcoal store are still to be seen there. The debate over what this site was is clearly not over.

We returned to the College in time for a quick drink before another soporific dinner. The evening was, as usual, devoted to members short papers.

Mike Davies-Shiel, who has been trying to get Backbarrow Ironworks preserved ever since it closed, told us of the history of the Works, accompanied by an interesting series of slides. They showed us what had been destroyed by the scrapmen and vandals over the years since the Works closed.

Robson Davies gave a brief account of the history of Millom iron and steel works. The works had been fortunate in its source of low phosphorus ore which enabled it to produce steel by the acid processes. Acid steel fell out of favour early in this century and Millom became a supplier of Haematite foundry iron. As the demand for iron decreased Millom decided that it should be making steel to survive. Robson described the development of a novel spray steelmaking process. Despite the success of a pilot plant the development was stopped by the Iron and Steel Board. (To whom big was beautiful - PH)

Peter King has been searching the Port Books of Gloucester and came across references to the Mathafarn ironworks on the Dovey estuary. These showed that the works was in operation in 1630 and 1634. In other searches he has come across references to a furnace which he now believes was at Sudeley (there are other spellings for the furnace) near Winchcombe (Glos). In a study of the iron industry of South Staffordshire in the early 17th century he has found two new sites, Deepmoor and Abbey Hulton.. In the Chancery proceedings he has found a reference to a collier who worked for Walter Colman. He moved to the works at Abbey Hulton, which was probably a furnace and forge, from some works in Cumberland. There is, as far as he knows, no reference to a similar works in Cumbria and would be grateful for any suggestions for its location.

Tim Smith has been fortunate to visit probably the only preserved open hearth furnace in the world. The first furnace in the works at Munkfors in Sweden was built in 1868 to a design by a local man, Johan Frederik Lundin. The regenerators for this furnace are still mere, though the furnace has gone. A second furnace of Siemens Martin design was built in 1877 but the surviving furnace was built in 1917 and worked until 1941. It is an 8 ton capacity acid furnace (UK furnaces were around 80 tons and usually basic at this time - PH). The fuel was waste wood from the nearby sawmill which was gasified in two vertical kilns. The furnace stands in its original building with two Lancashire hearth forges. The tools used in 1947 have been pre- served with the furnaces. Other exhibits relating to the works are on show and the site is well worth a visit.

Jack Lancaster has taken an interest in the Wilkinsons. Many people have written about "Iron Mad" John Wilkinson. His father Isaac has received much less attention. His son seems to have inherited his talents from Isaac who was also an inventor and metallurgist. Though he is usually said to be from the Midlands he was, in fact born and bred in Cumbria.

Martha Goodway has recently had the opportunity to test some modem replica phosphoric iron music wire. The problem with tensile testing is that it destroys the sample. This is especially true of wire. All you can do is test a piece as received, you cannot machine a test piece from it. When you have only a small sample it is preferable to infer the tensile strength from some other property. Testing the replica wire has shown that the hardness/strength curve for cold worked iron-phosphorus alloy

is different from the standard curve for steel. It has provided a basis for estimating the tensile strength of samples of historic music wire without destroying the sample

Nils Ekman told us of a travel diary written by a Swedish metallurgist who visited **Newland** and **Backbarrow** in 1828 and 1831 respectively. The blast furnace conditions were similar to those in Sweden, high grade ore and charcoal fuel The differ- ence that he found was the more economical Lancashire hearth and the high temperature bloom reheating treatment. These became the standard for the Swedish industry rather than puddling. The diary also has interesting details of the Newland iron- works.

Unfortunately the interesting video accompanying the talk had to wait until a few other visitors had finished watching some other stuff. They were not happy because the bar nearby was open and they found the lively discussions (of the proceedings?) distracting. They called it an awful noise.

Jeremy Hodgkinson began the proceedings on Sunday morning with an account of work as far away from the Lakes as you can get in England. Unlike the majority of the charcoal iron areas of the UK the iron industry of the Weald is well documented and almost totally gone. There are very few standing remains. It is necessary to rely on documents and the evidence of the hammer ponds and other water features. **The Wealden Iron Research Group** have undertaken surveys of some of the sites to try to understand the distinctive features of the works. We were shown the results of some of this work, and contemporary illustrations of the furnaces.

In contrast to the Wealden Iron industry the **North Pennines lead industry** has been largely left to decay rather than removed to re-use the land. The North Pennines heritage trust was formed in 1986 to conserve what remained. They have worked on the **Lambley Viaduct**, the **Allendale flues** and the **Coldberry Mines**. Their flagship conservation project is the **Nenthead** lead mining complex situated on Alston Moor in Cumbria. The works was developed in the 18th and 19th centuries by the London Lead Company. The remains here are the largest and probably the most important site associated with the former lead industries of the region. They were scheduled in 1982. The Trust currently have their headquarters at Nenthead.

Sam Murphy has been scouring the hills and dales of North Yorkshire looking for **bole smelting sites**. A site is often now no more than a patch of earth where nothing grows. They can be distinguished from recent clearance or tipping by the lead prills that can be found quite easily when you know what you are looking for. Occasionally larger pieces can be found and Sam showed us one of these on a slide, and later some of us saw the real tiling. The sites tend to be clustered together and were thought to have been well away from the mines. In **Swaledale**, **Arkengathdale** and **Wensleydale** there are more than 50 sites, some of them at the lead mines. The choice of site is determined by the topography, geology and the need to get there with the necessary materials.

Bessemer had a problem with his converters which **Jake Almond** told us about. The process consists of blowing air though a bath of molten iron to remove the carbon and other unwanted elements. When you have done that you have steel. The problem lay in how you blow the air through the bottom economically. The answer was found fairly soon in the use of cylindrical fireclay blocks pierced with various patterns of holes. These were not used in the basic converters where the holes were moulded into the bottoms. Some of the tuyère blocks were made in the works, but others were bought in from specialist manufacturers. The Eston works, for example, used three suppliers. He acknowledged the help of other people in collecting these blocks, and asked for suggestions for a suitable permanent home for them.

The President was left with the task of summing up the Conference. He pointed out that there were other metallurgical trades that left even less evidence than the small bloomeries, smithing being one example. He acknowledged the work that had been done since we were last in the Lakes but hoped that work would continue because there was much we still do not know. He thanked the organisers, the college staff and the speakers for an excellent weekend.

After lunch there was an optional excursion to the copper mines at Coniston. I must ask around for a report on that and add it later.

A splinter group, or should that be a sliver or a prill, went on a more adventurous trip to the silver mines in the North. We looked at some bole sites on the way to Roughtongill. We walked up **Roughtongill** to the top of **Balliway Rigg** and down **Silvergill**. On the way up we passed levels of various ages and plenty of spoil tips. The lowest level (90fm) was at the level of the dressing mill. Above that were, amongst others the Blind Wastel level opened in 1580 by the Germans. The 30fm level dates from 1700. On the top of the hill there are old workings and a shaft to the Silvergill vein. In Silvergill the outcrop of the Silvergill vein may have been worked in 1319. Amongst the later levels were Fortune/Golden Hugh (1575), recently reopened and gated Emmanuel (1571), and New Stolne (1573). At the bottom is a level about which nothing is known.

Membership List.
We intend to publish a new Membership List in 2000. The assembling does not take long these days but checking, printing and mailing are still "human" activities. We must therefore set a cut off date of 30th April 2000. Only paid-up members will be included because we cannot know whether those who have not paid will eventually do so. If you think you should be in the list please ensure that the Membership Secretary receives your subscription by 30th April. It is due in January so you have time.

The Spring Meeting and the Annual General meeting will be in Bristol on 13th May. If you know anyone that you think should be on the Council please contact the Secretary on 01792 233223. **Website for HMS hist-met-.org**

Archaeometallurgy

An Early Bronze Age stone mould from Scotland for casting flat axeheads

In June 1997, a fine example of an Early Bronze Age stone mould was found by Mr David Fetch at his farm at Glenhead, Canon Bridge, near Denny in Stirlingshire (NGR: NS 757 850), where it had apparently been grubbed up by his pigs. The find-spot lies on the eastern edge of the farm buildings at Glenhead under circumstances that suggest the mould may have been redeposited in modem times. While the original context and circumstances of deposition are unknown, there seems no real reason to doubt a relatively local provenance.

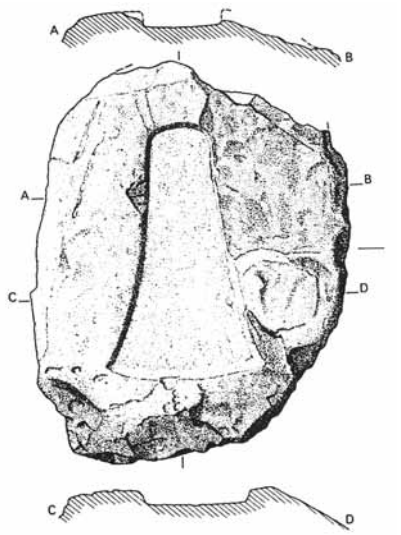


Fig 1 .Axe Mould from Glenhead Farm

The object, examined by **Trevor Cowie** and **Katherine Eremin** of **National Museums of Scotland**, consists of a rather irregular sub-rectangular block of red sand stone whose flat upper surface contains a single matrix (length 142mm) designed for the casting of copper alloy axeheads. The parent block has been fashioned from a small weathered boulder, some of the faces apparently having been roughly dressed to reduce its bulk (overall dimensions 220 by 175mm, with thickness varying from 95–105 mm). XRF analysis of the mould was undertaken to ascertain whether there were any residual traces of metals. No elements characteristic of copper alloys were detected, although it must be admitted that analysis of moulds to determine the metal cast is often inconclusive. In this case however, it may also be noted that the base of the matrix has a relatively freshly pecked surface, and together with the apparent absence of any obvious effects of heat, the evidence combines to suggest that the mould may not have been used. It is possible that spalling of the rock surface may have reduced the depth of the matrix to the extent that it became unusable.

This find is of considerable interest in that it represents the first Early Bronze Age mould to be found in central Scotland. Out of the fourteen stone moulds from Scotland considered to be for the production of metal artefacts of the period, only two other definite examples have been found south of the Grampians. The distinctive shape of the matrix on the example under discussion shows that flat axeheads cast from this mould would have belonged to the general series known as the 'Migdale' type, named after a well-known hoard found near Bonar Bridge in Sutherland. Typically, these are bronze axeheads with a narrow butt from which the sides diverge to meet a splayed cutting edge — all features readily apparent on the Glenhead mould. The mould thus belongs to the stage of the Early Bronze Age which saw the introduction of tin as an alloy of copper to make bronze, a transition now firmly dateable to the period from c. 2300–1900 CAL BC. Although Migdale type bronze axeheads have a wide-spread Scottish distribution, no recorded examples are known from Stirlingshire so that the mould is the first evidence for their production and probable circulation in the immediate region. What adds to the interest of this find is the relative proximity of the Central Scottish mineral sources, including historically documented copper-workings at Come, NW of Kilsyth, and in the Ochils.

Finally it may be noted that under Scottish law, archaeological finds of any material — not just precious metals — belong to the Crown and can be claimed as Treasure Trove. In view of its archaeological significance, the mould was so claimed and, following payment of a reward to the finder, it was allocated to Falkirk Museum Service (FALKM: 1998-37).

For a fuller account of this find see Cowie, T. An Early Bronze Age stone mould for casting flat axeheads from Glenhead Farm, Carron Bridge, near Denny, Calatria. Journal of the Falkirk Local History Society, 14 (1999) forthcoming.

The earliest antimony in Britain?

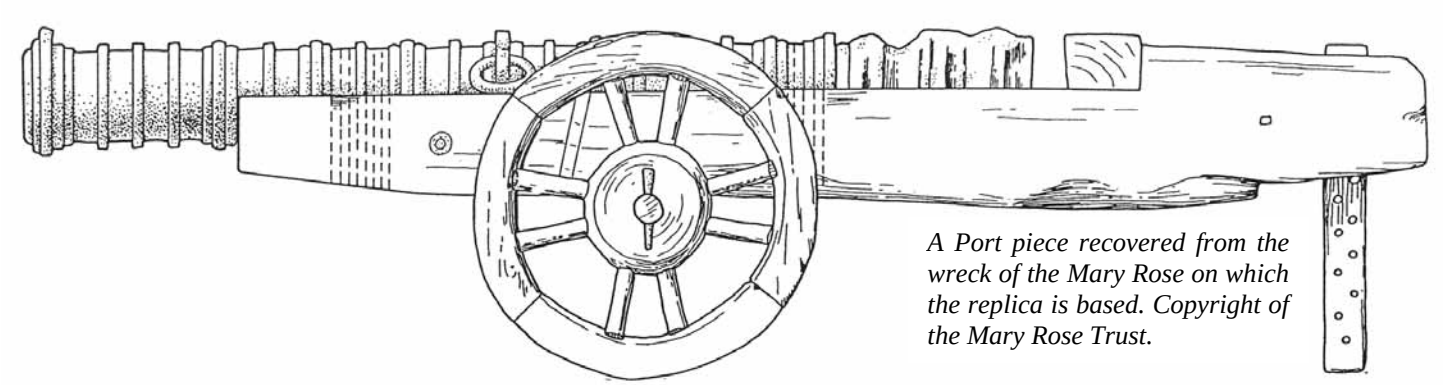
Tudor and Stuart non-ferrous metalwork excavated by the **Museum of London Archaeological Services** from **Southwark, London** is currently being studied by **Geoff Egan** of the Museum's Finds and Environmental services with analysis undertaken by **David Dungworth** at the **Centre for Archaeology, English Heritage** (former Ancient Monuments Lab). Amongst the artefacts examined is a 57g fragment of a small plano-convex ingot, (Catalogue No. 784), dated to the last quarter of the sixteenth century.

This was analysed quantitatively by EDXRF which showed that the only metallic element present was antimony. Historical records show that antimony was available in London by the late seventeenth century (Hacher & Barker 1974:227) although continental production is attested in the late sixteenth century (Agricola and Biringuccio). The Antimony does not appear to, have been an ingredient in any of the contemporary pewters as those that have been analysed contain no antimony. It is possible that the antimony was for specialised use, such as printing type (Tylecote 1986:87). This appears to be the earliest archaeological find of antimony metal in Britain.

Hatcher, J. & Barker, T.C. 1974. A History of British Pewter. London: Longman.
Tylecote, R.F. 1986. The Prehistory of Metallurgy in the British Isles. London: The Institute of Metals.

Further lead isotope data from Ross Island, Ireland

Thirty new lead isotope measurements of ores from southwest Ireland (Munster-Shannon Basins), including additional, archaeologically-dedicated sampling from Mount Gabriel, Ross Island and Ardtully, have been performed by the British Geological Survey (Ixer, Budd and Barreiro). These new data confirm that the published data (Rohl) for the original samples from the Killamey area (collected by Ixer to answer a number of geological problems and including a single sample of the chalcopyrite-tennantite ore from the Bronze Age mine site at Ross Island) show two distinct clusters. They also show there is no coincidence between chalcolithic type A metal and archaeologically acceptable Ross Island (Western Mine) Bronze Age ores as discussed by Ixer (1999).



A Port piece recovered from the wreck of the Mary Rose on which the replica is based. Copyright of the Mary Rose Trust.

Ixer (1999) explained the disparity between the lead isotope signature of the type A artefacts and the chalcopyrite-tennantite ores from Ross Island mineralogically rather than accepting an earlier suggestion that different ores from Ross Island are of different ages (Ixer and Pattrick 1995). The new data strongly suggest that different ores from the Killamey area, including those from Ross Island, are of different ages and the clustering cannot be explained away by invoking mineralogical or geochemical factors.

Preliminary archaeological interpretation of the new data still do not allow us to state that the lead isotopes from the Ross Island area confirm that the mine was a source of chalcolithic A metal — indeed they could be interpreted to show that chalcolithic A artefacts would have been made from any of the ores in the Killamey area other than the Bronze Age mine site. A resolution of the archaeological and lead isotopic data is being actively sought but it still remains too early to determine the correct relationship between the ores at Western Mine and any metal.

R.A. Ixer 1999. Role of ore geological and ores in the archaeological provenancing of metals. In Metals in Antiquity (Young, Pollard, Budd & Ixer, eds) BAR International Series 792, 43-52.

R.A. Ixer and R.A.D. Pattrick 1995. Cu-Pb-Zn-Co-Ag mineralization at Ross Island - Muckross Mine, Killamey. Abstract: Mineral Deposits Study Group, Manchester Meeting, December 1995.

Spanish Iron Age artefact studies

Mattias Karlsson and **Professor Antonio Criado** at the **Department of Materials Science, Complutense University** (Madrid), are involved with analytical investigations of Spanish ferrous artefacts. The objects originate from a number of archaeological excavations on the Iberian Peninsula, and date from c.400 BC up to Late Medieval times. Currently, analytical work is being carried out on ferrous implements from the Pre- Roman Iron Age. The objects originate from three archaeological sites, dating between 400 and 200 BC. The techniques employed in the analytical investigation are mainly metallography and electron probe microanalysis. The aim of the study is the characterisation of the iron and steel qualities of these early objects, as well as the identification of the smithing techniques applied in their manufacture. Some of the objects have been part of cremation burials, the effect of which is visible in the metal microstructures.

Reconstruction of a wrought iron cannon

Those in the UK who have been following the Channel 4 series "Arms in Action" this Autumn may be interested to learn of a more recent reconstruction project which has been undertaken by a team from the **Royal Armouries** with **Alex Hildred** of the **Mary Rose Trust**. This was to produce a replica "port piece" based as closely as possible on an original recovered from the wreck of Henry VIII's flagship, the Mary Rose which sank near **Portsmouth** in 1545. Despite their primitive appearance, these breech loading, stone shot firing iron guns clearly remained an important part of the armament of ships from the fifteenth to the beginning of the seventeenth century, but little is known of their effectiveness, hence the decision to re-build one.

Characteristically the guns were made of series of longitudinal staves rightly held together externally by iron bands and hoops, which were heated and allowed to shrink-fit into place. The skilled blacksmithing work was undertaken by Chris Topp & Co. The gun was first fired in February 1998. Unfortunately, but spectacularly, the first attempt with full charge and a stone ball damaged the gun at the breech end where an iron plug sealed the closed end of the chamber that contained the powder charge. Subsequent reworking has eliminated this area of weakness and trials have continued, demonstrating the effectiveness of this particular weapon. The replica is currently on display at The Royal Armouries Museum of Artillery, Fort Nelson, Portsmouth.

Investigations into the magnetic signature a late medieval iron smelting site

Research has recently been undertaken by **Alan Powell** a final year undergraduate in the **Department of Archaeological Sciences, University of Bradford**, into the magnetic response derived from an iron smelting site. This response or signature is the combination of the responses from magnetic anomalies associated with individual features of a site such as the furnace and the slag deposits. The research was part of a long term investigation into iron working in the North Yorkshire Moors, commencing with Dr. Gerry McDonnell's original studies of iron working sites throughout Bilsdale in 1972, and continuing to the present with the location and surveying of several other sites in the same area. Slag analysis and landscape investigations around Rievaulx have already been undertaken as part of undergraduate dissertations at Bradford. The 1996 geophysical survey and subsequent excavation in 1997 of the **Kyloe Cow Beck** (KCB) site in Bilsdale (SE583953) provided the basic data for the research; the site was identified as having two possible furnaces and associated slag heaps, with the larger of the furnaces being excavated. Analysis of samples taken from the site demonstrated the link between the magnetic characteristics of the furnace and slag, and the geophysical survey data.

The various techniques used to prepare the furnace samples for archaeomagnetic dating and to select the slag samples for compositional analysis indicated the magnetic characteristics of the furnace and slag material. These also demonstrated how much variation there was in the mineral and morphological compositions of the debris across the site. Optical and scanning electron microscopy (SEM) were used to determine the mineral composition of the slag samples. These micro-investigations suggested that either a different ore source or a different or modified iron smelting technique had been employed at KCB compared to the other bloomeries in Bilsdale. Archaeomagnetic dating suggested a final firing in the mid fourteenth century. In addition to helping to understand the history of iron making in Bilsdale and Rievaulx, the research has shown that through better interpretation of geophysical survey data, it should be possible to determine the features of iron smelting sites much more accurately. This will optimise future strategies involving the comparison of sites, selective excavation or conservation.

Development of ferrous rails

The **Materials Science-Based Archaeology Group** in the **Department of Materials, University of Oxford** is developing its interest in characterising material related to industrial history and archaeology. A project just starting, in association with the National Railway Museum, York, is a study of 19th century rails from cast iron tramplates at the beginning of the century, through wrought iron to early applications of steel. Rails have been chosen as providing a wide selection of well-dated samples with the possibility of documentary evidence for their origin. Samples already taken have been most informative as to technology and quality: mid-19th century wrought iron rails may contain as much as 10% slag by volume. We are now looking for contemporary records of problems with broken rails. If any readers can point us to significant examples available for sampling we will pleased to hear of them.

Other historically-based projects involve the metallurgy of **bronze artillery** and the characterisation of late **17th century laboratory vessels** from the site of Oxford University's first chemistry laboratory.

The group has recently re-located to: Department of Materials, Begbroke Science and Business Park, Sandy Lane, Yarnton, Oxford, 0X5 1PF. Tel 01865 283721 (Peter Northover) and 01865 283722 (Chris Salter).

David Starley

Any archaeometallurgy contributions for the Spring 2000 issue, by 25 February to: David Starley, Royal Armouries, Armouries Drive, Leeds LS10 1LT. UK. Tel. (0113) 220 1919, Fax (0113) 220 1917, email david.starley@armouries.org.uk

WEALDEN IRON RESEARCH GROUP

Volume 19 of the Group's annual Bulletin has been published this summer. Brief field notes include a summary of further fieldwalking in search of the 'ferraria' mentioned in the Domesday Book. Also, a bloomery near Heathfield has been dated to the Romano-British period, and a bloomery site, as yet undated, has been found near Bletchingley in Surrey.

Longer articles include a description of work proceeding on the experimental production of iron in a replica bloomery. The experiments, reviving those conducted by Roger Adams in the 1970s, have met with only limited success so far. The location of the Vachery Furnace, near Cranleigh, Surrey, is re-examined and a possible site suggested in Baynards Park. Frith Furnace, north of Petworth, Sussex, is the subject of a site survey. The works were in operation for about a century, and the plan shows an unusual water management system.

Wealden gunfounders' dealings with the Board of Ordnance at the beginning of the 18th century are described in another article, completing a survey from 1660 to the end of the industry in the region. Finally, there is a translation of the description of English ironmaking in Swedenborg's treatise 'De Ferro'. First published in 1734, this is believed to be the first rendering into English of this classic work. Swedenborg drew his examples from Cumbria, the west Midlands and the Weald.

Jeremy Hodgkinson

Correspondence

Gads of Steel. Further to the information in HMSNews 42 Professor H.P. Leighly, Jr. of the Dept. of Metallurgical Engineering, University of Missouri-Rolla, U.S. sends two references. The first is a definition in Webster's Collegiate Dictionary, (American), 1941, which defines a gad as "A pointed iron or steel bar for loosening ore, etc". It appears to be from the old Norse, ON, which indicates that it is of Scandinavian origin. Secondly he points out that in the 1912 translation of *De Re Metallica* there is an illustration on page 150. The text describes tools for the above purpose saying ". . . the upper end of them is broad and square, so that it can be struck by the hammer. The lower end is pointed." The illustration depicts one that is ". . . nearly three palms and one digit long, g two digits thick, and in the upper end it is three digits wide, in the middle it is one palm wide, and at the end it is pointed like the others; with this they cut out the harder veins". A note to this particular tool says it serves the same purpose as the "gad" or "moil, the latter are not fitted with handles, and we have therefore, not felt justified in adopting these terms, but have given a literal rendering of the Latin".

Lead pieces in the fields around St. Davids

Mr R.J. Lewis writes: "My hobby is metal detecting, and many years of searching fields around St. Davids has revealed a preponderance of lead, for example for every fifty positive signals, forty five comprise pieces of lead, which vary in size, but usually thumb nail, they inevitably show a white patination, presumably lead oxide deposits, and this usually indicates burial over a long period, they also have the appearance of having been melt- ed at some stage. The obvious question is - where did all this metal originate? A possible solution followed lateral thinking, pieces of anthracite are also common finds in the same fields, and it is accepted that as this was an integral

part of lime burning, finding these pieces is to be expected. It is fact that anthracite also gives a positive signal on the metal detector.

Could lead also arrive on the fields in similar fashion? Another question followed, where did the lead used to roof the St. David's Cathedral, and the Bishop's Palace come from?

I spoke with the Dean, and he had never considered the question, other prominent citizens replied in a similar fashion, but it was agreed with all parties that the local mines at St. Elvis, and Lochvane were not productive enough to satisfy that need. It was suggested that the most likely source would have been the Cardiganshire lead mines, some of which were owned by the Bishop. Assuming that this is correct, then it is probable that the lead arrived at the Bishop's harbour at Porth Clais in ingot form, and then transported to the Cathedral/Palace site for further melting to make roof sheets. This would involve numerous fires, and the large amounts of ash which would also contain splashes of lead from the process. The Medieval people would know about the potash content of the ash, and they would then have used it on the land in a similar fashion to the lime from the kilns. That is my hypothesis, but how to prove that the lead I recover is a residue of the roofing task?

A colleague has "surfed the net" and located a website of Isotrace Laboratories at Oxford, they are able to compare samples with their database of lead isotope compositions, but before I undertake a costly sampling exercise I would be grateful if you could let me know whether any members of your Society have carried out such tests at other Cathedral sites, and were any positive results obtained?

Since the question of origins of the lead was asked, there is much local interest in the outcome, so any advice you may be able to offer would be appreciated.

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European Journey

I spent several weeks in August, with American blacksmiths, travelling through Germany, the Czech Republic and Austria. The main object of the trip was to visit a number of black-smiths, and the Annual Czech blacksmith conference Hefaiston, held in the Helfstyn Castle, with many demonstra-tions and exhibitions. We journeyed through Berlin, Dresden, Prague, Prerov, Vienna, Weyer Markt and Salzburg.

There is a tremendous amount of building and restoration still going on in Berlin and Dresden, and almost all the wrought iron work we saw *in situ* had been remade in the original style.

Undoubtedly the most interesting part of the journey, as far as Historical Metallurgy Members are concerned was the Czech Republic and Austria.

In **Prague** we visited a **heavy forging factory** guided by the Director Karel Mentiek (Libenska Kovama Ceskomoravska 205, P.O. Box 8, 194 00 Praha 9). They produce a broad variety of forgings from structural and stainless steels; die forgings, produced on hammers and horizontal forging machines, and smith forgings produced on hammers; as well as stampings from rods and sheets up to 30mm thick. Since loosing their Russian market times are very hard and their future problematical.

At Prerov we visited Helfstyn Castle busy with the Annual Blacksmiths Conference. Here also is to be found a working reconstruction of a medieval **Trebuchet** of a type in use from the 13th century until their function was displaced by artillery. Constructed under the auspices of the **Comenius Museum** this machine for catapulting stones proved capable of throwing projectiles weighing from 80 to 100kg up to 200m necessitating a weight of 8tons. The Trebuchet is 17.5 high with a base measuring 15x8m. The throwing range is adjusted by varying the length of the delayed trigger in compliance with the ratio of the projectile weight to load weight.

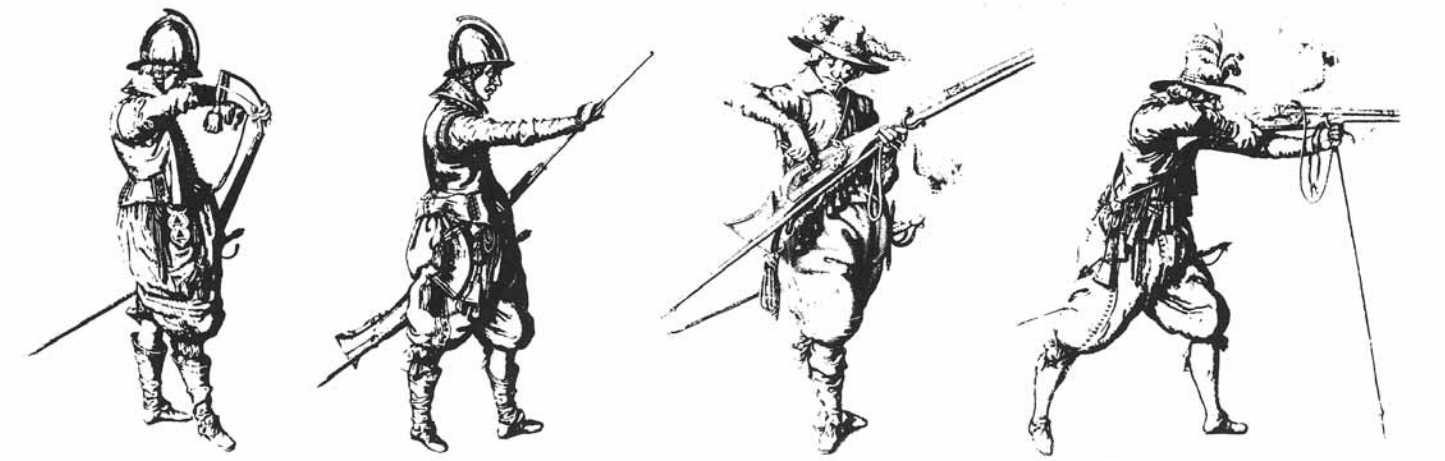
In **Graz** one finds the **Hanns Schell Collection**, (Wienerstrase 10, 8020 Graz. Tel 0043 (0) 316/71 56 56 38) one of the finest private collections of locks and treasure chests in Europe. They have recently brought out a superb book on the exhibits, **Prunkkassetten** or **Ornamental Caskets** with colour photographs ranging from African wooden door latches and bolts to metal locks and caskets of incredibly fine workmanship and great beauty. It is by **Ewald Berger** and has text in German and English.

Amazingly there is another lock and key museum in the town above the ironmongers *The Werkhof* Griesgasse 14–18 open every Thursday 15 til 18 (3 to 6) or otherwise by appointment.

The Armoury of Styria. The people of **Graz** in the Styrian area of Austria have always had a strong proprietary feeling for their Armoury. On the border of the Holy Roman Empire they felt bound in honour to protect the Empire and the whole culture of the Occident from the menace of the Turks. Rushing for- wards towards Europe the Turks had conquered Constantinople in 1453. When Belgrade fell to them in 1521 and Hungary lost her independence five years later their security was threatened for the next 200 years. In 1480 there were about 20,000 Turks roving central and southern Styria. It was necessary to keep a sufficient stock of arms and ammunition always ready for use.

Today their remains some 32,000 pieces of the original arms and armour, though there were once many more .After around 1700 the danger of the Turks ended and the defence was taken over by the State. Maria Theresa wanted to take the armoury to Vienna but the people would not part with it and diplomatically asked the empress to allow them to keep it as a monument to Styrian bravery. This request was granted and is why it remains the only armoury in the world to be preserved almost in its entirety. During the last war it was jealously guarded and secreted from the Russians in numerous castles in the country.

In the 16th century the arms were stored in a nearby loft in the Herrengasse, with the heavy guns in arsenal huts. However, in 1642 the armoury building was begun and completed in two years. To climb the stone steps up one floor after another and see the wooden racks closely packed with arms and armour is a most impressive experience. One is overwhelmed by the sheer quantity; every inch is utilised, with small objects, like powder



horns, hung in rows on the ceilings. The 32,000 arms include more than 3300 armours, breast plates and helmets, and more than 7800 small arms. For the most part they are the weapons of war for simple soldiers, and as such are perhaps more evocative than the more elaborately displayed exhibits in many museums. One can almost hear the call to arms, the hustle and bustle of passing out the arms with the enemy almost at the gate.

There can be few areas more rewarding to those interested in Metallurgy than a visit to the Styrian **Iron Road** in Austria. From Linz to Leoben one can trace a thousand years of iron mining and working. The **Iron Mountain** at Erzberg has been giving up its ore since the early middle ages, and today it is the largest iron-ore surface mine in central Europe. The iron ore is siderite and contains an average of 30 to 35% iron, about 2% manganese, and only very small amounts of unwanted phosphorus and sulphur. Underground mining has not taken place here since 1986, when it became no longer viable. Open cast mining, however, takes place on the terraces where the lower deposit outcrops face the town of Eisenerg. One can board a 5ton truck and "ride the Hauly", snaking along the twisting open cast terraces up the mountain. It is an impressive journey, the air grows cold as one rises towards the top, and looking far below a little blue lake can be seen at the lowest level. The ore is crushed here to a diameter of 10cm and transported to Leoben or Donawitz.

A few miles from the Iron Mountain lies the little town of Vordemberg that was once full of ironmasters houses and their Stuckofen or high furnaces for smelting the iron ore. In earlier times there were no less than ten furnaces in the narrow valley and today there are still the remains of several. They smelted by the direct method; the bloomery furnaces of the early Middle Ages beginning to be driven in the 13th century by water power. So long as the countryside was full of timber and the product required was wrought iron there was little incentive to go over to the Blast Furnace. By about 1760, however, most of the furnaces were the High Shaft or High Stophen furnaces, but few were the true Blast Furnace until the 19th century. Radwerk 10 is visible from the main road on the outskirts of Vordemberg. While from the main square of the town, with its decorative wrought iron well head of 1668, can be seen the large red stone building that is a mid 19th century Blast Furnace and is now the home of the Ironwork Museum. Quite unlike any remains we have in Britain, the stack is surrounded by a three story building, and rises from the centre of the roof in a bizarre fashion. Wagons and rails brought in the ore to the building on a level with the charging floor, and in later days was roasted in the actual building; a bank of ovens still remains.

The Curator of the Museum, a member of HMS, is Dr Gerhard Sperl, who as written a small but very comprehensive book on the area "Steirische Eisenstrasse" or "The Stryrian Iron Trail". This is now being translated into an English version. (We will give particulars about this when it is available).

We stayed in the attractive little town of Weyer Markt and made a number of visits in the area; nailmakers in Losenstein, Scythe makers in Laussa and Deulschfeistritz, a pocket-knife maker in Trattaibach and an armourer in Molln (A-4591 Molln, 8 Austria). Here Johann Schmidberger, and his sons, still make traditional armour and armourments, including fine swords, in a smithy that dates back to 1350.

Am I still on my feet — I leave you to guess.

Amina Chatwin

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