

HMS NEWS

Historical Metallurgy Society 74 Spring 2010

What can you do for the Society?

The work of the Society is overseen by Council which meets three times a year. A nomination form is included with the mailing of this newsletter if you would like to nominate someone (or if you would like to be nominated). Much of the work of the Society is carried out by committees. One of the most important committees is the Membership, Promotion and Publicity committee which is seeking participation from members of the Society who could help with its mission of increasing membership, organising the meetings which are the lifeblood of the Society and spreading the good news about the Society's work. If you have a flair for organising and advertising then please put yourself forward. The Archaeology committee continues to encourage research into early metallurgy. Last year the committee helped produce the important research agenda *Metals and Metalworking*, which members will have already received. The committee is currently working on revising the Archaeometallurgy datasheets. A recent, exciting development in the Society has been the setting up of the History and Recent Metals committee which seeks to facilitate research into more recent metallurgy. This committee would welcome participation from more members of the Society.

If you would like to volunteer to work for any HMS committee contact the chairman Tim Young in the first instance. Tim Young, 54, Heol-y-Cadno, Cardiff, CF14 9DY. Tim.Young@GeoArch.co.uk

From the Membership Secretary

Would all members who wish to pay their subscription by credit card please note the following points.

HMS only accept Mastercard and Visa as stated at Note 3 on the payment invoice. I have recently had card payments sent on cards we are unable to process. Also with the tightened security, especially for overseas payments, would members please advise their card provider that HMS is a bona fide payment. I have spent a lot of time either emailing or writing to members, where authorisation for payment has been declined.

Could I also ask those members who have not yet provided me with an up to date email address to please do so.

Many thanks!

National Heritage Science Strategy

In response to a call following the House of Lords Science and Technology Committee inquiry on Science and Heritage a steering committee was convened with the aim of formulating a strategy for Heritage Science. Work on this has been underway since October 2008 with the strategy having been recently published (March 2010). Indeed, over the last year three reports have been produced which provide the evidence base for the strategy and will no doubt be of interest to our membership. All reports are available in PDF format on the NHSS website (www.heritagesciencestrategy.org.uk) or in hard copy on request (see details on website). The steering committee has engaged various stakeholder groups throughout the process and the strategy document reflects this wide process of consultation. The interim reports are available from the web address above and provide the basis for much of the strategy document.

The first report 'The role of science in the management of the UK's Heritage' defines the sub-sectors referred to in the report and identifies the material and contexts in which they are found. The three themes addressed are Understanding material behaviour, Understanding environments, and Improving practice. The overarching conclusion from the first report is that there is a reasonable understanding of how to manage decay, but a lack of detailed information on rates of deterioration and thresholds at which damage occurs.

The second report "The Use of Science to enhance our understanding of the past" reviews the motivation for, and types of scientific investigation of cultural heritage. The use of techniques and areas for improvement in each sub-sector are reviewed. Specific recommendations are made for tools and equipment and how access can be facilitated through shared purchase and use. How the use of instrumentation can be supported with guidance and advice and how widening access to data generated can improve usage are other points considered. Overall conclusions suggest that investigation should be driven by focused research questions; that results should further public understanding and engagement with cultural heritage and that there appears to be a disparity in the quantity of output both between and within the heritage sub-sectors.

The final report "Understanding capacity in the heritage Science Sector" profiles the profession and asks who heritage scientists are, their numbers and where they work. Career structure and training are issues which are considered along with knowledge transfer. Differential funding across the sector is recognised, whilst for public benefit better engagement is sought with social and economic sciences. In conclusion the final report recognises that economic pressures may impact future aspirations and therefore there is a need to consider how to re-focus budgets. *(Continued overleaf)*

The next edition of the HMS Newsletter will be published in July 2010. Contributions are welcome and should be emailed to r.doonan@sheffield.ac.uk by 1st July 2010.

National Heritage Science Strategy (*cont*)

Somewhat worryingly it is suggested that the sector as a whole needs to improve recording of how money is spent and get better at demonstrating and measuring the benefits that it provides. Whilst this last conclusion is laudable it is certain to concern heritage science workers who already feel overburdened by the various administrative processes that demand accountability.

The final strategy document presents a vision (see below) and emphasises the importance of demonstrating the public benefit of heritage science, whether this is through direct engagement with the public or through enhancing the value of heritage and how it is appreciated. This is one area where heritage science could certainly learn lessons from the physical sciences. The value of mass observation in collective science projects is well recognised in the physical sciences, from biologists asking the public to count dead flies on their number plates to assess insect demographics to astrophysicists collecting data on the visibility of constellations to map light pollution. This is something heritage science has not really started to come to terms with, archaeology has engaged the public through test-pitting in back gardens and to some extent the Portable Antiquities Scheme is an exercise in mass public engagement, quite how heritage science can extend in these areas is yet to be appreciated.

HMS through the actions of its chairman and council members engaged in the NHSS consultation and made efforts to highlight the role of heritage science in the investigation and conservation of historical metallurgical sites and associated material culture. Whilst some archaeologists have expressed concern that archaeology seems to be underrepresented in the document, the archaeology of metals and the issues it faces seem to have been well understood, no doubt in part a tribute to the efforts of those members mentioned above. Whilst such criticisms might be misplaced it is apparent that museum, archive and conservation work all figure significantly in the document. It is perhaps significant that the launch of the NHSS took place at Institute of Conservation's annual conference in Cardiff.

In summary, the final document seems to be more than just another list of recommendations and guidelines, it seems that along with the relatively recent HMS framework for research it will provide valuable support for those seeking to develop and justify diverse archaeometallurgical projects and will no doubt inform future research frameworks.



VISION

"Our vision is that the understanding and preservation of the UK's extraordinarily rich and varied material cultural heritage will be enhanced by better use of science and technology, and that the humanities and the sciences will be developed and enhanced by this collaboration. Heritage science will be a robust, internationally recognised, well co-ordinated, vibrant and sustainable community that contributes to the big questions confronting humanity by understanding and addressing the present needs and future requirements of our cultural heritage."

Early Mines Research Group

An HMS Coghlan Fund grant supported a reconnaissance visit to Southern Norway (Kongsberg and the Numedal Valley) in June 2009, and also the preparation of papers presented at the Mining in European History Conference of the HiMAT Project at the University of Innsbruck and at the TESME meeting (Archaeometallurgy: Technological, Economic and Social Perspectives in Late Prehistoric Europe) held at CSIC in Madrid, both of which were attended during November of last year.

The visit to Norway was at the invitation of a number of local amateur archaeologists led by Johan Jarnaes who lives in Kongsberg. The field visit was to inspect as yet undocumented archaeological sites found within heavily forested terrain, chiefly those associated with primitive metal mining, most probably for copper or native silver. Given the time constraints, the number of sites to see, and also the difficulties of characterising these in the absence of any previous archaeological work in the area, it was decided that a field assessment rather than the planned survey was more appropriate on the occasion of this first visit.

Most of the mine workings visited, whilst primitive in technological style, proved rather more ambiguous in terms of some of the key expected characteristics of prehistoric mining; such as the degree of weathering and alteration of the mineral spoil, and the presence (or rather absence) of cobble stone tool fragments. Indications of primitive firesetting were noted in at least half of the workings seen, even though firesetting in its more technologically advanced form was known to have been commonly employed during the period of post-medieval silver mining in the Kongsberg area. What does seem much more probable, in the light what was seen during the visit, is that mining here almost certainly pre-dates 1623, the official date of the 'discovery' of the silver deposits, and the commencement of the working of these mines by the German run Kongsberg Silberwerks. As a result the regional office of the Directorate of Cultural Heritage (through Inger Karlberg) has offered logistical support with future archaeological investigation of some of these sites, and as a result, another longer visit may be undertaken in 2010/11.

At the meeting in Innsbruck, a paper entitled '*Geological, mineralogical and environmental controls on the extraction of copper ores in the British Bronze Age*' documented the programme of archaeological work undertaken by the Early Mines Research Group, including some of the very first results from the recent excavations undertaken at the Ecton Copper Mines located on the side of the Manifold Valley in the Staffordshire Peak District. The paper given in Madrid, at a conference held to honour the well respected Spanish archaeometallurgist Salvador Rovira Llorens, by way of contrast to the above, looked at some of the most recent archaeometallurgical (smelting) experiments we have been undertaking here in the UK. Both papers are due to be published in the relevant conference proceedings.

Grant support for this work was also received from the McDonald Institute for Archaeological Research in Cambridge.

Simon Timberlake

HMS Conference in Honour of Gerry McDonnell

10th-12th November 2009 Bradford

There was an impressive turnout for the Bradford conference with a packed auditorium and an equally full line up of speakers and poster presentations. The programme began with a presentation by Jui-lien Fang, who presented her findings on alloying and colour change. It was a particularly interesting subject being relevant to current research themes in material culture studies and one worthy of the prize for best Student Presentation (Figure One). Jane Cowgill followed with a presentation on a particular type of slag known as "Iron Age Grey" that seems to be present only between 400-300 BC. It is thought to be so characteristic that it can be used to date a site. Despite its limited chronology, it is found at almost every British Iron Age site of every size, and despite its resemblance to them, it is never found with fuel ash slags.



Figure 1: Jui-Lien Fang receives the prize for best Student presentation from HMS Chairman Dr Tim Young.

Jim Brophy updated the audience on the Nidderdale Iron project, an impressive community based project which is going from strength to strength with an impressive range of sites now documented. Ed Kendall looked at usewear on Roman and Medieval knives. In common with Jui-Lien Fang's paper this approach ties directly to current concerns such as artefact biographies in Material Culture Studies and demonstrates the health of metal-centred studies. Samantha Rubinson presented aspects of her recently completed PhD and looked at how the analysis of iron alloys could be used to reconstruct economic patterns in the medieval period. HMS Chairman, Tim Young, presented his work on at Irish smithing slags questioning their size and formation whilst Susan LaNiece reported her recent study of an English medieval jug that appears to have been the product of sideline activities in bell foundries. Rachel Hewitt and David Starley looked at compositional and typological variation in arrowheads used during the War of the Roses. They concluded that shape was more important than composition. Day One was concluded by Jane Wheeler who argued that the impact of medieval and early modern iron working on woodlands in North Yorkshire could be understood through pollen analysis, and that it was

apparent that the area was carefully managed for production of hardwoods for charcoal.

Tim Taylor started the second day with a paper which looked at how prehistoric communities envalued metals and developed concepts of materiality when there was a conspicuous absence of metals. This was followed by Alan Doust who argued for a contextual approach to archaeometallurgical projects. Christina Clarke-Nielsen gave an impressively detailed account of raised vessel manufacture drawing largely on her experience as a metalworker. Giovanna Fregni looked at the effects of remelting on copper alloy composition noting the surprising stability of tin over remelting cycles. Burkart Ullrich presented his geophysical work on quantifying quantities of ferrous slags at archaeometallurgical sites. Roger Doonan presented a paper on the relationship between iron smithing and literacy in EIA Greece and noted that literacy and craftwork are both skills requiring dexterity and may be more related than what is often thought. David Dungworth asked why archaeometallurgists have dismissed the idea of a bowl furnace for iron smelting and suggested that evolutionary accounts of technology may well be to blame. Peter Halkon updated the conference on his work in East Yorkshire looking at Iron Age production sites and associated paraphernalia and their relation to the continent. Janet Lang reported on her metallographic analyses on the iron rimmed chariot tyres in East Yorkshire burials with particular focus on one piece iron bands or tyres. Reference was made to rural American blacksmithing and descriptions of how to fit the metal tyer to a wooden rim.



Figure 2: Conference delegates gathering in honour of Gerry (front centre)

The final day began with Maxime L'Héritier speaking about experiments using saigerprozess, a technique developed in 14th Century Europe for parting silver from copper. This was followed by Marie-Pierre Guirado also reporting experimental work in silver refining but this time by cupellation with particular attention given to the formation of litharge cakes. Peter Claughton continued the precious metal theme with a discussion of late Medieval lead/silver smelting slag and their apparent absence in the archaeological record. Litharge cakes received further attention from Justine Bayley, HMS Journal editor, presenting further work on their structure and composition. Patrice de Rijk detailed the ongoing work at the Stanley Grange Medieval Iron Project and the exploitation of ironstone in the 13th Century. Peter King spoke about the politics associated with the development of ironworks in the 1720's and the context of innovations. Eleanor Blakelock concentrated on Viking knife manufacture and how discrete fabrication traditions can be identified. Arne Esplund presented a total of two papers with his second on a two step iron process from Norway. The conference was concluded with Tim Young speaking on the formation of spherical hammerscale before making the closing remarks. All in all a great success and fitting honour to Gerry.

Ingots from the shipwrecks for the British Museum Collection

The British Museum has recently acquired a number of interesting items to augment its growing collection of ingots from shipwrecks. These document the development of the international trade in metals from about 1500 to 1900. Ingots sometimes can be rather anonymous items, but if they form the cargo of a well-documented wreck the details of their date, place of origin and destination are often revealed. Thus ingots that never made it to their destination can be more useful than those that made it safely to their destination port, and then for whatever reason were never used only to be found centuries later in some anonymous and undateable context (see Craddock and Hook 1997 for more on the British Museum's collection and the value of wrecks as good dateable contexts). All the latest ingot material has come from the seas around Britain, through the Receiver of Wreck. Mr. Robert Peacock, a professional diver has very kindly donated to the Museum ingots from off the Kent coast, and Mr David Wendes has provided and donated some material from off the Isle of Wight.

The first item is a single copper ingot associated with an as yet unidentified 16th century wreck from off north east Kent (Figure 1).



Figure 1 Upper surface of a copper Reißscheiben ingot from a 16th century wreck off the Kent coast.

It is a disc, 36 cm in diameter and about 4 cm thick, weighing approximately 19 kg, and is quite typical of the *Reißscheiben* ingots from the Late-Medieval -Post Medieval central European mines, that had been de-silvered (Craddock 2002). They are similar to the ingots that the Museum already possesses from the Elbe wreck (BM Reg. MLA 2002, 5-3, 1 & 2) (Craddock 2002 & 2004). The particular interest of this latest ingot is that it is the first ingot of this period to have been found in British waters, bound, presumably for London, when it is known that most of the copper used in Britain was imported from the Central European mines. The ingot carries three well preserved merchant marks as well as a mine mark, which should be identifiable (Figure s 2 & 3). Preliminary X-ray fluorescence analysis and energy dispersive X-ray analysis in the scanning electron microscope, both performed on drillings, showed the metal to contain several percent of lead and about 0.15% of silver, suggesting the copper had not been particularly well refined



Figure 2 Marks on the surface of the Reißscheiben ingot. The comma mark (right) is likely to have been stamped at the smelter, the crosses are merchant marks incised into the surface, possibly at Hamburg. (inset: sketch of marks)

and some of the lead with which the copper had been de-silvered was included in the ingot. The ingot also contains about 0.7% of antimony, and 1.5% of sulphur, typical of the metal from the central European mines.

The second group, also from off the Kent coast, comprises an ingot of copper and one of stibnite. The wreck is presently unidentified, but the cannon suggest a 17th century date. The copper ingot is similar in form to the ingot described above, but is rougher and more corroded, but not marked (Figure 3).



Figure 3 Top surface of a copper ingot from a 17th century wreck off the Kent coast.

It is 45 cm in diameter with a maximum thickness of about 2.5 cm and weighs 9 kg. XRF analysis on drillings showed the metal to be much purer with only traces of lead and antimony and silver being below the detection limit of 0.15%.

The ingot of stibnite, that is antimony sulphide, weighs about 4 kg and is clearly the filling of a deep crucible in the form of a truncated cone 14 cm in diameter at the top and 7 cm at the base, and 13 cm deep (Figure 4). The German technical literature of the 16th - 18th century, for example Agricola (Hoover & Hoover trans. 1912, p.428), and Ercker (Sisco and Smith eds. and trans. 1951, pp.285-6), describe the separation of stibnite from its ores in the Harz Mountains. This was done by heating the ore in an open vessel inverted over another vessel placed beneath into which the crude stibnite dripped to produce ingots identical in form to the example we have here. We suspect this may be the only such ingot to survive or at least to be

recognised, and thus it is of considerable importance. The stibnite could have been used as a pigment (for example, the *kohl* eye shadow of antiquity was supposed to be stibnite, although more usually it was of the cheaper galena). Another use was in the refining of gold (Ramage and Craddock 2000: 68-9). The sulphur in the stibnite attacked the base metals as well as the silver in the gold. Stibnite, or Wolf's metal as it was called by the alchemists, was popular amongst goldsmiths as it was quick and very effective, as described for example by Tholde in his *Triumph Wagen Antimonii*, supposedly by Basil Valentinus in the late 15th century, but only published in 1604 (Kelly 1990). It would seem likely this ingot was intended for the London goldsmiths.



Figure 5 Ingot of stibnite (shown inverted-Left) from a 17th century wreck off the Kent coast. The molten stibnite would have dripped down into a crucible whose form is preserved here. Right-Upper surface with preserving gas bubbles generated as the mineral cooled and set.

The third group are three copper ingots from the SS *Lapwing* which sank off the Isle of Wight *en route* from Liverpool to Rotterdam in 1872. There are two small ingots each approximately 27 x 8 x 5 cm and weighing about 7 kg, marked LOGAN (7), and a large ingot, 60 x 15 x 15 cm, weighing 110 Kg, and marked URMENETA-Y-TUAYACAN. All three are from Chile. The Logan ingots are from the firm of Edwards Logan & Co. based in Liverpool, who were copper refiners, and the large ingot was made by the Chilean mining family of Jose Urmeneta, both of which were important players in Chilean copper production and trade in the mid 19th century (Culver and Reinhart 1985). These are the first ingots of Chilean copper to enter the Museum's collection.

In the early 19th century the international trade in copper was dominated by Britain, with ores from the south west of England, etc, smelted at various places in Britain, but predominantly at Swansea, but as the trade grew so British copper ores were insufficient to meet the demand and new sources were required. By far the most important new source was Chile. However the Swansea smelters were anxious to preserve their domination of the smelting trade and did so by a securing a number of duty agreements. This situation continued until the 1840s when in a disastrous miscalculation, the export duties were dropped making it cheaper to smelt abroad (Mayo 1985). Thus from the mid 19th century Chile, soon to be followed by the rest of the world, began to smelt their own copper ores (although for many years using Welsh coal) (Percy 1860: 331-2). Partly because of the cost of fuel, the Chilean ores were smelted in Chile but then sent to Europe for refining as ingots known as *Chili bars*, this was especially to remove the sulphur

(Levy 1912, pp. 44-6). This is reflected in the composition of the Urmeneta bar which contains about 0.3% of iron, 0.4% of nickel, and 0.2% of cobalt and 2.1% of sulphur (equating to approximately 10% of copper sulphide, Cu₂S). By contrast samples taken from the ingots of Edwards Logan and Co., the refiners of Chilean copper, are much purer with sulphur below the detection limit of 0.2%. The cobalt content of the Urmeneta bar is rather unusual in early modern copper and could potentially be useful in identifying unrefined Chilean copper.

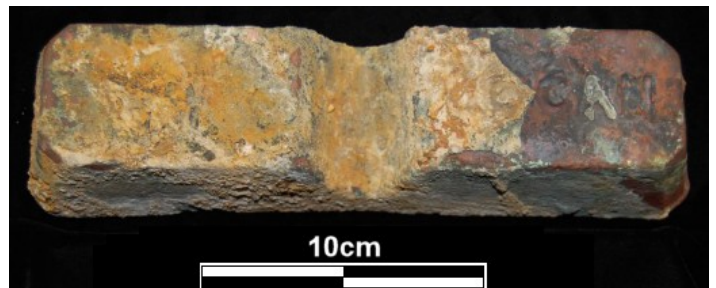


Figure 6 Ingot of copper from Chile processed by Edwards Logan & Co.

The commencement of copper smelting in Chile on an industrial scale, albeit using Welsh coal, fatally undermined the British smelters, and thus these Chilean ingots are an early example of what was to be the demise of the European industry, and some sixty years later the last smelters in Swansea (once known as 'Copperopolis') had closed down (Hughes 2000: 18).

Thus in some ways the 1st and 3rd groups complement each other. The 16th century ingot documents the beginning of the establishment of the international market in copper by Europe and the 3rd group, three centuries later, signalled its demise.

Paul Craddock, Duncan Hook and Nigel Meeks

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Forthcoming conferences

The coming months are destined to be busy ones for keen archaeometallurgists and historians of metallurgy alike. A number of conferences are set to take place both in the UK and overseas and will cover an immensely diverse range of metallurgical topics.

Between 29th April and May 1st the International Congress on Archaeological Sciences in the Eastern Mediterranean and the Near East will take place in Paphos, Cyprus. A whole day session is dedicated to Archaeometallurgy with papers ranging from weaponry in MBA Byblos (Ziad El Morr) to the investigation of Byzantine smelting residues (Nerantzis Nerantzis). Members interested in attending can find more details at <http://icasemne.net>.

The 38th International Symposium on Archaeometry (ISA 2010) will be taking place between May 10th - 14th, at the *University of South Florida* in Tampa, Florida. A 3/4 day session metals and metallurgical ceramics has been convened by Prof David Killick and is certain to be international in its focus. There website can be viewed at <http://isa2010.cas.usf.edu>.

The Wealdon Iron Research group is holding its AGM and summer meeting on Saturday July 24th at Lamberhurst Village Hall, Kent with a talk by Jeremy Hodgkinson: 'Ironworking in Lamberhurst' followed by a site visit after lunch. The Wealdon group are also planning a "cross-section excavation of Ashburnham – Penhurst leat." on the 18th April. All details can be found on their website at <http://www.wealdeniron.org.uk>

Further afield 2010 there is the Danville Iron Heritage festival taking place in Danville, Pennsylvania, USA, between 21st and 25th July (see <http://www.ironheritagefestival.net>). Amongst various offerings of iron-centred nostalgia there will be opportunities for participants to explore the origins and development of the Pennsylvanian iron industry. There are lectures planned and oral history events which cover the period 1829-1950.

In a similar but perhaps more dramatic vein is the International conference of contemporary cast iron art is taking place in Kidwelly, Carmarthenshire, Wales between 7th - 11th July 2010. This is only the second time it has taken place outside of the USA and with its motto being "meet, melt, make" it is sure to be of interest to HMS members. Over the duration of the conference many artisans and craftworkers will be melting and casting iron. Molten iron is not solely used for casting objects as a focus for the event is the use of molten metal in performance art! The displays look thrilling as well as challenging for the health and safety conscious. Many of the installations artists recognise the deep heritage associated with iron metallurgy and employ a historical dimension in their work. More information can be found at <http://www.internationalfe10.com>.

Last but not least is *The Festival of British Archaeology 2010: Saturday 17th July to Sunday 1st August*. Many events are planned across the country with several being relevant to the Historical Metallurgical Society, last year's festival included iron smithing, iron smelting and copper casting events along with excavations at a many important industrial sites. Details of the festival, including a live blog and programme of events is available at the Council of British Archaeology's website at <http://festival.britarch.ac.uk/>

Accidental and Experimental Archaeometallurgy HMS Annual Conference 2nd-3rd September 2010



Preparations are well underway for the next HMS Annual conference set to take place at West Dean College, which is near Chichester in West Sussex. The conference will address the many issues surrounding experimental Archaeometallurgy and will combine a lecture programme with a festival of experimental smelting and metalworking.

The intention of the organisers is to bring together a number of experts in the field and to have them conduct a programme of experimental work side by side. The lectures will be held in the College and the experiments will take place on adjacent college land. Overnight accommodation will be available at the college. With West Dean College offering residential facilities a near perfect environment will be available for participants, experimenters and volunteers to interact, discuss and critique each experimental effort.

The lecture programme is already full and will include important speakers such as Peter Crew, John Merkel (UCL), David Scott (UCLA), Gerry McDonnell and David Dungworth (EH) to name but a few. Topics covered will include *The Application of Metallography to Experimental Ancient Metallurgy*, *The work of of Professor R.F. Tylecote, the pattern-welding of Anglo-Saxon Swords, debates on the value of Experimental Practices and hypothesis testing, and experiments in assaying*.

The experimental programme is equally impressive with at least seven experimental reconstructions planned and covering both iron and copper metallurgy. David Dungworth will be attempting to reduce rich iron ores to a bloom in a bowl furnace, whilst both Skip Williams and Gerry McDonnell will be looking to product cast iron in a shaft furnace. Much interest has already been expressed amongst the membership and booking details can be found on the HMS website at <http://hist-met.org/conf2010.html>

Iron metallurgy on BBC Mastercrafts

The recent BBC series 'Mastercrafts' has covered a range of traditional crafts and stimulated much interest amongst the general public. The blacksmithing episode featured HMS Member Dr Gerry McDonnell smelting iron in a bloomery furnace.

In the news

Metal detecting

The recent excitement surrounding the Staffordshire Hoard (see issue 73) continues with the recent news that the largest archaeological Anglo-Saxon find ever unearthed, has been saved for the nation. The news comes after the National Heritage Memorial Fund (NHMF), the government's fund of last resort for heritage items at risk, pledged £1,285,000 – bringing the campaign to the £3.3m target, just over three weeks ahead of schedule. The association of such high figures with metal detecting finds has ensured a high profile for metal detecting not only in the news but even in soap operas with Mo Harris arming herself with a metal detector to search for treasure in Eastenders Albert Square. With public interest in metal detecting and the rewards that can be had at an all time high illegal detecting is bound to rise. Although not related to illegal detecting it has been widely reported that Kate Harding from Ludlow has been the first person prosecuted under the Treasure Act 1996. The PAS has recently clarified details of the case in light of misreporting in the media. Harding failed to report a piedfort of Charles IV of France. Piedforts look similar to coins, but experts agree they were not used as currency; therefore they are classed as artefacts and thus single finds of piedforts qualify as Treasure provided they are made of at least 10% of gold or silver.

Meanwhile in an effort to deter illegal detecting in East Anglia, Norfolk archaeologists are to team up with police in a bid to crack down on illegal metal detecting in Norfolk.

Norfolk has the highest number of recovered artefacts in the country declared treasure and a successful long-established working relationship with legitimate metal-detecting enthusiasts. There were 109 cases of items found in Norfolk being declared treasure in 2008-09. Recent finds include a hoard of 24 Henry III short-cross pennies in Breckland, and an early Saxon gold spangle from south Norfolk.

But illegal metal detecting, is a big problem and Norfolk Archaeology Unit (NAU) is to prepare a briefing note for police on the worst affected areas. Roman sites, such as Caistor St Edmund, are believed to be a particular target for night-hawkers, as well as the area around Snettisham in west Norfolk.

But night-hawking is a county-wide problem and raises fears among archaeologists and legitimate metal-detecting groups that valuable artefacts are being lost or sold online for profit. Dr Andrew Rogerson, senior landscape archaeologist at NAU, said Norfolk was the county with the best set-up for legitimate metal detecting, which was why this needed to be tackled.

"Norfolk has a national reputation as a place to come and filch and steal archaeological material," said Dr Rogerson. "It's a huge problem and it's enormously widespread. "We have started liaising with police and one of the things we have done is produce a map for them of the most obviously plundered sites."

Kevin Elfleet, from the King's Lynn Metal Detecting Club, welcomed the initiative. A Norfolk Police spokesman said the briefing document was still in a draft stage, but the force was happy to co-operate on the crackdown.

'Steel Route' to stretch across Sheffield city centre

A blueprint to transform neglected parts of Sheffield city centre has been unveiled by council chiefs. The Steel Route plans to stretch across the city and include many historic metallurgical sites. Officers are proposing to repave the streets and hope to bring empty buildings back into use, including Castle House, the listed former Co-op department store, at the corner of Angel Street and Castle Street.

The development should cause excitement for those interested in the history of Sheffield steel as the route will include the world's most complete example of a cementation furnace in Doncaster Street and a variety of cutlery workshops. The route is part of a larger plan by Sheffield City council to reinvigorate the city centre which has suffered in recent years as a result of shoppers being drawn to Meadowhall Shopping centre, itself built on the once thriving Dunford Hadfields steelworks.

Women of Steel Honoured

Almost seventy years after their patriotic efforts every woman who pulled on a Sheffield steelworker's boilersuit to make bullets, guns, planes or tanks in the war effort has now been officially recognised. The group of 'living history' – Kathleen Roberts, aged 88, Kit Sollitt, 90, Dorothy Slingsby, 88, and Ruby Gascoigne, 87, – were given a unique trip to London and a meeting with the Prime minister.

Chalcolithic/EBA metalworking site

Issue 6 of the CBA North Newsletter, reports an potentially important site being reported to the PAS finds officer for Lancashire and Cumbria, Stuart Noon. A single find of a copper dagger dating to 2500-2100BC was reported but on further questioning of the finder was found to be associated with three sizeable fragments of copper 'cake', a possible riveting tool, and a fish hook. Further investigation of the site produced crucible fragments all suggestive of an early metalworking site.

Other finds from the site include Iron Age terret rings and a series of very fine Roman brooches. Landowners permission is currently being sought before further investigations of the site commence.

Submissions to the Newsletter are welcome at any time, if you want to have something in a specific issue of the newsletter then it needs to be with the editor by the following deadlines.

1st March, 1st July 1st November

Contributions can be sent in any format (hand-written, typed, email, floppy disk, CD-ROM, etc).

Newsletter Editor, Roger Doonan

Dept of Archaeology, University of Sheffield, Sheffield, S10 4DN.

Email: r.doonan@sheffield.ac.uk

Membership Secretary, Mrs Lesley Cowell,

"Little Gables" 17a Thorncote, Northill, Beds, SG18 9AQ.

Email: lesley@mcowell.flyer.co.uk

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Obituary

Professor Ramamurthy Balasubramaniam



Prof. Balasubramaniam beside a bronze Mughal cannon at the Golconda Fort. February 2009.

Less than a year ago when I was working with Prof. Balasubramaniam (always known as Bala) and teaching at his institution, the Indian Institute of Technology, Kanpur it would have seemed inconceivable that I would now be writing this memorial to Bala, India's foremost archaeometallurgist, who died in December after a short illness aged 48.

Bala was born in Salem, Tamil Nadu in the south of India, on the 15th April 1961. He began his illustrious academic progress at the Benares Hindu University at Varanasi, where he was the undergraduate gold medallist, taking his degree in metallurgical engineering. He subsequently undertook research on the role of hydrogen in the stress corrosion cracking of a binary aluminium-lithium and of a ternary aluminium-lithium-copper alloy at the Rensselaer Polytechnic Institute at Troy, New York in America. On his return to India he was appointed lecturer in the Department of Materials and Metallurgical Engineering at the Indian Institute of Technology, Kanpur in 1990 and was to remain there for the rest of his career, living on campus with his wife, Dr. Gaitri Saini Balasubramaniam and their two daughters, Gowri and Gargi. Bala was made a full professor in 2001.

He was a very active researcher with over 300 papers and 10 books published. His output was in part possible due to his habit of rising very early and putting in several hours writing at the start of each day. He was very much a hands-on worker, preferring to tackle new material and to find and record new places, rather than just relying on previous reports. His research interests were many including the interaction of hydrogen with other materials, high temperature oxidation of metals, corrosion science (his labs were littered with lengths of rail supplied by the railroad companies), and more recently the study of early metallurgy. In the latter discipline he had in a very short space of time become India's leading archaeometallurgist, concen-

trating on ferrous metallurgy. His first and perhaps best known major study was on the Delhi Iron Pillar. Although many papers had been written on the pillar over the last century many questions remained unanswered, particularly how the complex and decorative capital on top of the column had been made, and above all, why in 1400 years the column had not corroded. Various suggestions from secret ingredients to a very dry local environment had been more or less unconvincingly postulated previously. In his excellent book *The Story of the Delhi Iron Pillar* (reviewed in the *HMS Journal* **42** 2, 2008) Bala used his experience in corrosion science and metallography to formulate the first convincing mechanism by which a corrosion-resistant surface could have developed in the open atmosphere. Not only that but Bala gave a full account of the construction of the pillar and the complex (wrought) top, and a detailed consideration the likely original location and history of the pillar, thereby displaying a deep knowledge and understanding of India's history and philosophy. This was also apparent in his major and ongoing study of Indian ordnance, published in the *The Saga of Indian Cannons*, profusely illustrated with the photographs he had taken on his tours (reviewed in the *HMS Journal* **42** 1, 2008). This is a fascinating field for the archaeometallurgist with such a wide variety of technologies ranging from the wrought iron bombards, the cast bronze cannon, and composite hybrids with bronze cast around a barrel made up of wrought iron staves, through to the establishment of foundries set up by the rival European powers to cast iron ordnance. Bala travelled the length and breadth of South Asia to find and record as many of these as he could and also to raise awareness that so many survived but so often were in incongruous situations, half buried by the sides of roads, completely unstudied, unrecorded and unprotected, at the mercy of every scrap dealer with the necessary kit to cut or lift them.

The history and technology of the Indian crucible steel industry was another of Bala's great interests (His home town of Salem was once a centre of the industry). He had already initiated new surveys of crucible steel making sites in central India and had carried out metallographic examinations on a number of steel artefacts, much of which is published in 2 issues of the *Indian Journal of the History of Science* (**42** 3 & 4, 2007) themed on crucible steel which should be essential reading for anyone interested in crucible steel generally.

Bala had a great appreciation of music both as listener and performer. We could often tell when he was in his office because of the sounds of a symphony or *raja* wafting out on the air. He and his family were also players, both he and his daughters were proficient on guitar and sitar. He was an excellent and often inspiring teacher, his vigorous style and ready wit made him one of the best lecturers around. This vigour extended to the cricket field and my last memory of him whilst I waited at Kanpur for the taxi to take me to the airport was of watching a match with Bala seemingly being everywhere on the field at once as he encouraged his side to greater efforts.

He was keen to establish a facility both for teaching and researching archaeological science at the prestigious Indian Institute of Technology, Kanpur and to that end set up a course in archaeometallurgy, the only such course in India. Thus his achievements will survive in his publications and his aspirations live on in the courses and research he established.

Paul Craddock