

THE CRUCIBLE

Historical Metallurgy Society News
Issue 83

Summer 2013



Percy Collection

INSIDE THE CRUCIBLE

Editor

Marcos Martín-Torres

Assistant Editors

Loïc Boscher

Siran Liu

Matt Phelps

Miljana Radivojević

Submissions

Submissions to The Crucible are welcome at any time, but deadlines for each issue are 1st March, 1st July and 1st November every year. Contributions can be sent in any format, but we prefer digital if possible.

The Crucible

thecrucible@hist-met.org

c/o Marcos Martín-Torres

UCL Institute of Archaeology

31-34 Gordon Square

London WC1H 0PY

United Kingdom

2 **From the Chairman's Desk**

3 **Archaeometallurgical News**

6 **Feature: The Future of Archaeometallurgy**

8 **Forum: Metal Detecting**

10 **One Minute Interview - Gilberto Artioli**

12 **Meet Your Council - Eddie Birch**

13 **Conference Reviews**

23 **Recent News**

24 **Forthcoming Events**



The **HISTORICAL METALLURGY** Society

www.hist-met.org

FROM THE CHAIRMAN'S DESK

It has been another busy period for the Society, with lots of activity on all fronts. The Society's 50th anniversary conference took place in June, and was an enormous success – both in terms of the papers presented and the social events and networking opportunities. A detailed report can be read in this issue of **The Crucible**; however special mention must be given here to Ellie Blakelock who organised it virtually single-handedly and whose attention to detail made it the success it was. The Annual General Meeting saw two retirements from Council, both of long-standing members whose service to the society has been invaluable. Mike Cowell stood down as Treasurer after 28 years and for which he deserves all of our thanks for keeping a tight rein during the financial vicissitudes of recent times. Peter King was elected as the new Treasurer, and we all look forward to that. Sam Murphy has retired as one of our Editors, and Tim Young was elected to join the editorial team. Andrea Dolfini and Sarah Paynter were also elected as new members of Council. The Annual General Meeting was followed by a wine reception at the UCL Institute of Archaeology, at which a special Duddon Furnace cake – made by Sophie Watson of the Clwyd-Powys Archaeological Trust – was cut by Henry Cleere and David Crossley.

The various committees continue to make progress in their areas of expertise, and again, detailed reports are presented here. I am delighted that two new Occasional Publications will appear in 2013. The first is the proceedings of the 'Accidental and Experimental Archaeometallurgy' conference, edited by David Dungworth and Roger Doonan which is in press literally as I write (see page 22); this will be followed later in the year by papers from the Bradford archaeometallurgy conference.

Already we are looking forward to the next meeting, which will be in Sheffield on the 19th and 20th of October to commemorate the 100th anniversary of stainless steel. I do hope that you are able to join us!

Paul Belford



Paul Belford cutting the Duddon furnace cake



Henry Cleere, David Crossley and Eddie Birch at the reception at the UCL Institute of Archaeology



Delegates getting lunch at Friends House.

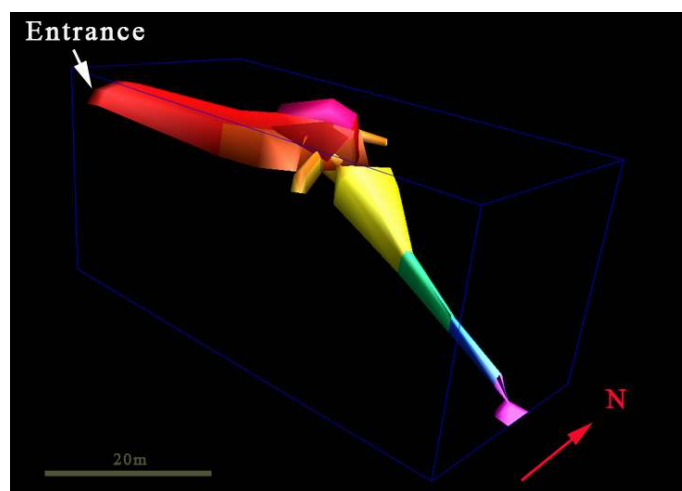
ANCIENT MINING AND METALLURGICAL ACTIVITY IN PANGAEON MOUNT

The Pangaeon mountain in northeastern Greece was mentioned by Herodotus (5th century BC) among other ancient writers as one of the richest gold prospecting sites. It was renowned for its precious metals such as gold and silver but also as a sacred mountain connected with the myth of Dionysus. The mythical King Cadmus and the Phoenicians were the first to extract gold from Pangaeon according to written sources. Thracians exploited them during the archaic and classical times, while they were an apple of discord between Thassos and Athens, until Philip II's conquest. Tyrant of Athens, Peisistratos, who was in exile around 550 BC, acquired enough riches and know-how in order to pay mercenaries and return to Athens as a powerful man and exploit the Lavrion mines. The mines of Pangaeon were also exploited by Romans and Ottomans during their occupation of Greece.

The abundance of gold and silver is evidenced by the vein and shear-hosted precious and base metal deposits in the rocks of Pangaeon. The ores at the central-eastern part of the mountain contain Fe, Pb, Zn, As, Cu, Ag, Au and substantial quantities of W, Bi and Sb related with various mineral assemblages including pyrite, arsenopyrite, galena, chalcopyrite, sphalerite as well as minor bismuthinite, tetrahedrite, malachite, limonite and rutile. The ore at the western part of Pangaeon contains Fe, Mn, Pb, Zn, As, Cu, Ag, Au and minor Cd, Ba and Sb. The deposits are related to the hydrothermal activity associated with the intrusion of a granodioritic magma in the Pangaeon marbles and amphibolites.

Detailed geological mapping and an extensive archaeological survey were carried out in the ancient mines and smelting sites in the wider area of the Pangaeon mount. Twenty five adits were explored, mapped and studied during a 4-years survey. Metallurgical slags from fourteen smelting sites were taken for comparative analysis with the mines' extracted material.

The most important mining areas in Pangaeon are Mavrokorfi and Asimotrypes. Mavrokorfi and Asimotrypes ore deposits contain metallic elements such as Au, Ag, Cu and Pb. In the "Mavrokorfi 1" mine the ore deposits rich in Au, Ag and Cu were extracted and carried to the adjacent "Valtuda" metallurgical site, the most extensive metallurgical site in the southern Pangaeon. Mavrokorfi mining process has two discrete phases of extraction. The older is dated to Roman times and the later to Ottoman times. Roman exploitation is characterized by narrow corridors that follow only the oxidized ore deposit (limonite). Ottoman period extraction focused on the oxidized ore and the primary ores.



3D-view of "Mavrokorfi-1" mine in Pangaeon Mount.

Slags from the fourteen smelting sites were studied in comparison with the adjacent ore deposits. The samples from the ore deposits and the metallurgical sites were also isotopically analyzed. In the "Valtuda" metallurgical area the preliminary results imply multi-temporal gold and silver exploitation with secondary extraction of copper. The site is dated to the Roman period from the pottery finds.



View from the inner part of Asimotrypa AS_3a mine.

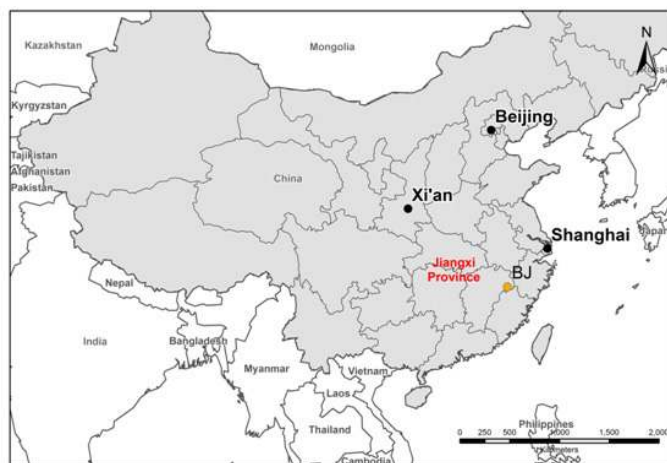
During Roman times Pangaeon was part of the territory of the city of Philippoi which had the status of a roman colony (Colonia Augusta Philippensis). The city was a powerful economic and political centre for a wider area and most probably was in control of the mines of Mount Pangaeon. Further study on the pyrometallurgical remains on the mount will clearly show the extraction process and the metallic products.

Markos Vaxevanopoulos

CHINESE GOLD AND SILVER PRODUCTION IN THE 7TH-13TH CENTURIES

China, as the largest economic entity of the world in the early 17th century, was importing hundreds of tons of silver every year and a lot of research has shown the effect of this massive consumption of silver on the world's economy and global markets. However, Chinese love of silver and gold can be traced back much farther. Archaeologists have found numbers of fascinating gold and silver hoards dated as early as the Tang Dynasty (7th-10th centuries AD) and the majority of these precious metals were produced domestically. Now the question is how gold and silver were produced in this period of China's history. Did people use furnaces or crucibles to smelt their metals? How was the production organized on site? Who were the miners and smelters of gold and silver? Are they specialists or farmers working in the off season? Unfortunately, all these questions cannot be answered due to the lack of work on this subject. However, the situation may be beginning to change.

A joint team of University College London, UK and Peking University, China has recently initiated an archaeological project on the survey and study of Chinese precious metal production sites dated to the Tang and the Song Dynasties (7th-13th century AD), aiming to achieve, for the first time, a comprehensive understanding of Chinese gold and silver



Map of China. Baojia site (BJ) is in Jiangxi Province, central south China.

production systems. The team is now surveying six different gold and silver production sites in both south and north China. During last field season, a potential gold production site called Baojia in Jiangxi province, central-south China, was investigated. Large numbers of mining trenches and mining galleries were found in the area. Ancient mining work generally followed veins and left irregular galleries of variable height and width. Beneficiation remains such as shallow pits carved on rocks and tailing heaps were also frequently identified in this area. Smelting slag was found in a small plain to the west of the mining district and is now covered by modern agricultural land. Several mortar-



Mining remains in the site of Baojia. 1: Mining trenches, 2: Beneficiation pits, 3: Mining gallery, 4: Tailings heaps.

lined pools were found next to the slag heap and might have been used for the final beneficiation before smelting. During an interview, local villagers told us that gold was found in a creek passing through the village in the 1980s. In the following gold rush the alluvial deposit was soon exhausted and gold seekers then traced the creek up to the mountainous region. Here they discovered the lost gold mines of ancient times. Today, small scale gold mining is still practiced in the region but the profit margins are quite low. It seems ancient people exhausted all high quality gold ores.

was used as early as the 7th century. Charcoal samples collected from the walls of testing pits have been sent to Peking University for radiocarbon dating and the result will hopefully anchor our technological study in a specific historical context.

The study of precious metal production in China is still in its initial stage. Many more surveys, excavations, and analyses are required for us to portray a picture of this important industry in the Chinese imperial period. However, we have already had a good start and hopefully more will come later.

Siran Liu

THE HISTORICAL METALLURGY SOCIETY GOES TO IRELAND (2014)

Next year's HMS Spring Meeting will be held in Ireland on the 12th and 13th of April. Base camp will be Blarney, just outside Cork City, with many accommodation options, lively pubs and, of course, the only place in the world dispensing 'the gift of the gab'.

On Saturday, a full day's visit is planned to east County Clare where an extensive charcoal blast furnace industry was established in the 17th century around several rich hematite mines. It is the location of the furnace owned by Foote and Beech in the 1630s, before they went over to New England to establish the Saugus ironworks and, in the 1690s, it was the main hub for a project involving zinc-plated iron production. The main importance of the area, however, is the exceptional preservation of the furnaces and we will be visiting the remains of several of these dating to the 17th and early 18th centuries.

On Sunday morning, the site of the ironworks established by the East India Company near Bandon (Co. Cork) will be visited. This interesting and surprisingly little known site, dating to the 1610s, is located within a defensive enclosure and while the furnace itself is demolished, part of the finery is still visible.

In the early afternoon an exhibition will be presented at University College Cork, where a selection of characteristic, and a few exceptional, remains of early Irish iron working will be on display. This will include a preserved slag pit bloomery furnace and artefacts such as various types of Irish tuyeres and early blooms. A short talk will offer an overview of the current knowledge on early Irish iron technology, the history of which has recently undergone a complete revision.

More information about this meeting will be made available on the Historical Metallurgy Society website and in future newsletters.

Paul Rondelez



A local villager is helping us measuring the depth of a slag deposit. Charcoal samples were collected from the wall of this testing pit.

Geological ores were sampled in several ancient mines and analyzed in the laboratory. The sulphidic primary ores are rich in galena, arsenopyrite, sphalerite and pyrite. Galena was interestingly found to be argentiferous and the main silver bearing phase is tetrahedrite, which exists as small inclusions in the galena. The oxidic secondary ores are composed mainly of haematite and quartz. Small metallic prills were identified in this type of ore and microscopic analysis shows that they are electrum (gold-silver alloy) with approximately 35% gold and 65% silver.

Several testing pits were excavated in the smelting area, which revealed slags and furnace fragments. Slag samples are all black and dense with flow features on the surface. Some interesting results have been acquired concerning the smelting technology employed in this site.

The date of this site is still vague as we could not conduct a formal excavation. Historical documents record gold mining activities at the site during the early 12th century AD. Inscriptions in the mining district show that the site

THE FUTURE OF ARCHAEOMETALLURGY AND HISTORICAL METALLURGY

It is impossible to predict the future of one's own research, let alone that of whole disciplines involving research by many individuals. These notes are therefore more suggestions than predictions, combining extrapolation of recent trends with identification of some lacunae that would benefit from scholarly attention. These observations are based on the intuition and impressions of the two authors; no literature review has been attempted which might form the basis for more comprehensive discussion.

It is worth saying at the outset that the dichotomy between 'archaeometallurgy' and 'historical metallurgy' is purely a reflection of convention, and does not have any bearing on methodologies or research priorities. In European contexts, a nominal cut-off may be identified somewhere in the mid-16th century AD, when increasing written sources (such as Agricola's *De re metallica*) mark the step from a predominantly prehistoric (archaeological) to a more historic (literature-based) framework of research. It is clear to us, however, that this separation is neither helpful nor indeed relevant for much of the rest of the world.

Geographical and technological coverage

The word archaeometallurgy was coined in the context of Near Eastern research, when Beno Rothenberg established the Institute for Archaeo-Metallurgical Studies (IAMS) in the early 1970s as a vehicle to promote his work in and around Timna. Ever since, the Near and Middle East has seen the bulk of archaeometallurgical research, broadly spanning the Aegean, Cyprus and Turkey to the Levant (particularly Israel and Jordan), Oman and Iran. Much of this has concentrated on copper and, to a lesser extent, lead-silver metallurgy. Elsewhere, only the Alps have seen a similar sustained interest, again mostly focussing on copper production.

In contrast, historical metallurgy received much of its formative input from Ronnie Tylecote, one of the founders of the Historical Metallurgy Society. Initially, this was mostly concerned with the industrial heritage of iron smelting in Britain and elsewhere, but soon covered also much research done on early iron smelting and manufacturing in central and northern Europe. It would be interesting to test whether this apparent correlation between metal (copper vs iron) and geographical research coverage (Middle East and Alps vs northern Europe) is a pure artefact of research history, or reflects a real difference in the relative importance of the two metals in those regions. The different chronological focus between the two seems to underpin at least some of the material differences, but is not sufficient to explain all of it.

Outside Europe, there is a strong interest in iron smelting in Africa and in bronze casting in China; it is again puzzling to see the seemingly strict correlation between geography and metal, considering that both Africa and China were multi-metallic for much of their history.

This leaves significant gaps in the geographical coverage of Meso- and South America, Russia including Siberia, Central Asia, and South and South East Asia. Of course, there is good work being done in all these regions – recent work extending both the range of metals and processes studied – but the quantity of data is meagre given their size and cultural complexity.

However, if the programme of the recent 50th anniversary conference of HMS is anything to go by, then there is a good chance that the future in this respect has already begun. One would therefore expect as much as hope that this trend gathers momentum, and that future work will see more on the metallurgy of metals other than iron and copper, more on metallurgy (pre-colonial and colonial / early modern) in the Americas, Africa, South and South East Asia, and Central Asia including Siberia. Such work will also offer fascinating opportunities to study mechanisms and effects of the creolisation of technology, as European and later North American technology influenced and was influenced by earlier local or indigenous practices.

Social and economic contexts

Historical metallurgy has a significant scholarly root in history, and consequently incorporates social and economic theory and data into its practice. This reaches from macro-economic and global studies, such as the influence of South American silver production on the economy in Europe and the European-Asian trade dynamics, to detailed studies of individual companies and biographies of industrialists. Although direct comparisons with prehistoric periods are difficult, it is nevertheless possible to consider historical data in the analysis of prehistoric sites, landscapes and networks.

The concept of efficiency can only be meaningfully discussed when wider economic factors are being considered: namely relative costs of labour, ore, fuel and transport within the overall economy. The spatial arrangement of ancient industries is not only determined by purely technical factors such as geological availability of ore, or access to water for power. Aspects of land ownership, competing interests in related resources (fuel, labour), and availability (or otherwise) of capital and transport infrastructure have certainly played as much a role in pre-history as in the later periods. In addition,

systems of kinship, social structures and power relations are important considerations.

Future research in archaeometallurgy should take inspiration from historical metallurgy in this respect. Again, we see already some of this happening, for instance in the 5th to 4th century BC industrial landscape of southern Attica around Laurion, and the established practice of provenance determination for Cypriot and other Bronze Age copper offers a good starting point for some of this. Geographical information systems (GIS), and the theory and practice which is already well advanced in landscape archaeology and industrial landscape studies have much to offer in this respect, and are likely to generate meaningful information even where historical sources are lacking.

Practical challenges

There are several challenges for the future. Firstly, there is the issue of preservation of the evidence. Metallurgical landscapes and individual sites are often threatened by subsequent development – indeed this was one of the driving forces behind the establishment of the Historical Metallurgy Society, and remains important today. But even preserving representative finds collections is a major challenge; few museums have the interest or capacity to deal with industrial waste which is neither pretty nor easily categorised. Here we face a major educational challenge, addressing the general public as well as decision makers in local and regional levels, up to national heritage legislation.

Indeed ‘outreach’ in its broadest sense should and must include the delivery of training for indigenous archaeologists and local communities in recognising, dealing with, and analysing the evidence. Too often in the past, European-led projects have gathered data without reference to local conditions, which has been detrimental on two counts. Firstly it fails to develop local appreciation for the resource and mechanisms for local heritage management; secondly it divorces the data from ethnographic information which may be vital to understanding and interpretation.

Given the limited ability to preserve and store original primary evidence, our efforts must focus on satisfactory documentation. This raises issues of data quality, compatibility and completeness, as well as the archiving of original samples. Recording standards need to be further developed so that data becomes consistent, or at least comparable. This includes proper documentation of sampling procedures and analytical protocols as well as open data access.

A large amount of data is routinely generated but not easily available; this includes grey literature from developer-driven archaeology as well as unpublished Masters’ and doctoral theses. Conversely, much of the academic literature remains behind the paywalls of large publishing houses, and is thus inaccessible to commercial archaeologists and independent researchers. Open access data repositories are clearly highly desirable, to enable information sharing between sectors.

Conclusions

The future of archaeometallurgy and historical metallurgy is bright, and has already begun. Research will increasingly reveal the diversity of processes in the past, covering previously neglected regions and materials, and hopefully applying a more balanced mix of methodological approaches to both prehistoric and historical assemblages. Concepts of economic and social study traditionally applied to historical research can be transferred to archaeology, and the analytical work typical of archaeometallurgy can make significant contributions to more recent remains, complementing historical sources. This is likely to lead more generally to a blurring of the distinction between historical metallurgy and archaeometallurgy, which would be a good thing for both sister disciplines. In practical and intellectual terms, greater collaboration between different research traditions, from different parts of the world and dealing with different periods, would greatly benefit the discipline.

In all these challenges the Historical Metallurgy Society must play an active part in promoting and directing some of these developments; but it is up to those many individuals to engage creatively with concepts outside their comfort zone, and to seek new paths to change all of our futures.

METAL DETECTING AND ARCHAEOLOGY: REPLIES

*The last issue of **The Crucible** re-ignited a very important debate, regarding the role of amateur metal detecting in archaeology (see *The Crucible* 82). The opposing views of Chris Cumberpatch and Peter Barker have attracted further insightful replies from Henry Cleere, Gez Smith and Erik Blakeley, which are included below. We are very grateful to them for contributing to this discussion, and remain open to further replies from our readers. Email your views to thecrucible@histmet.org*

Reading the Forum section in the Spring 2013 issue of **The Crucible** awakened some unwelcome memories for me. When I became Director of the Council for British Archaeology (CBA) in 1974 I was confronted by the menace of treasure hunting, a rapidly growing pastime that was threatening field archaeology in Britain. Indeed, I had personal experience of this practice since the Roman ironmaking site that I was excavating in the High Weald had been rifled on more than one occasion. We therefore initiated discussions with other organizations, notably RESCUE - The British Archaeological Trust and the Museums Association. It was decided to organize a protest campaign under the title "STOP - Stop Taking Our Past" which we launched with a press conference held in the Rooms of the Society of Antiquaries, coinciding with the wide circulation of press releases, radio and television interviews, and the distribution of leaflets and posters. It was agreed that the campaign would be run from the CBA and I found myself running it, since RESCUE had no permanent staff and there seemed to be some reluctance on the part of the Museums Association to play a major role. I found myself handicapped by an almost total lack of funds and all I felt able to do was to issue robust press releases and respond to the increasingly virulent counter-attacks of the treasure-hunting press.

We were very pleased when the Prince of Wales, the Royal Patron of the CBA, imposed a ban on all metal-detecting on Duchy of Cornwall properties. This was headlined in *Metal Detecting*, the readers of which were encouraged to write in protest to the Duchy, and copies of many scores of these letters were sent on to me. One day the Prince's secretary telephoned me to let me know that one particular letter was on its way to me by hand. This was from a treasure-hunting society somewhere in the West Midlands, which informed His Royal Highness that I had been arrested by police in their area using a metal-detector without permission on a Scheduled Ancient Monument, but that I had been released after the Ministry of Works had intervened on my behalf. I read this out to the very distinguished QC (Queen's Counsel) who was the CBA's Honorary Legal Adviser; after a pause he said that he

wished someone would write a similar letter about him and he would then be able to retire on the proceeds of the successful action for slander. I mentioned this later to the Duke's Secretary, who agreed with my QC but told me that any legal action would necessarily involve HRH, which was impossible, something of which I was sadly already aware.

The anti-STOP campaign continued and became increasingly savage, most of it being directed against me personally: I became very much the symbol of repressive archaeology. Unfortunately our almost complete lack of funds meant that we were unable to respond as effectively as we could have wished, despite the support of one or two journalists on national dailies, notably Martin Walker of *The Guardian*. We adopted another tactic and invited representatives of a couple of leading treasure-hunting organizations to meet us, but these meetings led nowhere (indeed, some of the views that we expressed at them found their way into the treasure-hunting journals) and an uneasy stalemate followed. There were some successful projects that led to metal-detectorists being enlisted to assist with archaeological survey projects, notably those led by the late Tony Gregory in Norfolk, but no significant progress had been made when I retired from the CBA in 1991. It saddened me later to learn of the creation of the Portable Antiquities Scheme (PAS), with the full support of the CBA and other archaeological bodies: to all intents and purposes the treasure-hunters had won the day.

Cris Cumberpatch argues the case against treasure-hunting cogently and in my opinion irrefutably, whilst Peter Barker puts forward the opposing case in terms that are all too familiar to me. I find the argument that "archaeology and metal detecting are two distinct approaches to enriching our knowledge of the past" specious and indefensible. There is no doubt now that the metal detector has tacit government approval and is here to stay. However, if its untrammelled use is not controlled the results will be increasingly destructive of our complex archaeological heritage. It has a contribution to make - and, indeed, I have benefited from the work of detector users on non-destructive projects in the Weald - but the collaboration must be genuine and not haphazard or motivated by one or other of the partners.

Henry Cleere OBE

I read with interest the debate about metal detecting in your latest issue, and thought I'd offer my comments.

I'm a detectorist, and have been for 16 years, following in the footsteps of my father, the late David G. Smith, a

Constantinian coin expert and metal detectorist in equal measure. I can fully understand the reservations some archaeologists have about detectorists, and to be honest I share many of them myself. The idea that a bunch of semi-retired older men with no previous archaeological experience should become the arbiters of what is and isn't worth recording troubles me greatly. Detectorist expressions like 'hedge fodder', for finds they consider worthless, make me wince.

However, there are some of us who very much consider ourselves part of archaeology, and take huge pride in the careful and considered work we do to help add to this country's archaeological record. Personally, I'm detecting a small area of Gloucestershire that has only ever seen one very limited excavation during some building works, and otherwise seems to be left blank on every archaeological map of the area I have seen. So far, I've added a great many finds to the PAS database, from Roman to Jacobean and everything in between. I take *everything* I find over 300 years of age to my local Finds Liaison Officer (FLO), and he carefully records the lot. Indeed, it amuses me sometimes to see the scrappy little bits of finds that end up on the PAS record as a result of my detecting. However, I feel strongly that if I'm taking it out of the ground, I have an absolute duty to record it, no matter how trivial it may seem.

The thing that strikes me about this debate time and again is that neither side is going to get anywhere through complaining about the other. Yes, there are irresponsible and ill informed detectorists out there, but what are archaeologists actually going to do about that? Posting regular complaints about us on the Internet will make not one iota of difference to the world.

Archaeologists should start to agree on what it is they don't like about detectorists, then look at how they can engage with us constructively to change this situation. Kurt Adams, my local FLO, is excellent, and through him I've learned how to conserve finds carefully, store them anhydrously to museum standards, and record find spots to 10 figure grid references. If more archaeologists took the time to teach detectorists some of their basic skills, the benefits to both sides would be immense.

I do what I can to convince my fellow detectorists that we have a duty of care towards all of the items we find. Perhaps more archaeologists should start to do the same.

Gez Smith

I fear there is a tendency on both sides of this debate to try too hard for the moral high ground in order to bolster their case. Archaeologists have to remember that theirs is still largely a destructive form of investigation and a vast amount of finds material and recorded data lie unsorted and unpublished as field archaeologists are tempted back to what they love best which is digging stuff up. Metal detectorists often have an interest in history but are heavily motivated by the treasure hunt aspect of their hobby. Debating a ban is as pointless as debating a ban on nuclear weapons. The scientific knowledge of how to make metal detectors is out there and as long as humans love shiny metal stuff there will be metal detectors around. Allowing responsible legal use of metal detectors within legal boundaries and regulated by codes of conduct means that the looters and pillagers are separated from the majority of detectorists who love their hobby but wish to act in a moral and reasonable way so that the illegal minority can be pursued and prosecuted without producing a law that is largely held in contempt.

The technical point about the depth to which metal detectors can operate is a very valid one and one only has to see how archaeologists (and not just TV's Time Team) strip away topsoil from sites with mechanical diggers to know that the archaeological importance of these layers is minimal. Ironically many unstratified but important finds are then saved by the use of metal detectors to check over archaeologists' spoil heaps.

The final point in assessing a reasonable stand point is the "What would I do?" question. I have an archaeology degree and was working in the Museum sector in Staffordshire when the Hoard was found a matter of 2 miles from my museum. If I had the chance to go back in time and change places with that metal detectorist, would I? Of course I would and I will not be so pompous as to claim that my main motivation would be the earlier involvement of a qualified archaeologist! To be part of such an exciting discovery and to have my pension sorted to boot would be far more important to me.

Erik Blakeley

LET US HAVE YOUR EMAIL ADDRESS!

We feel honoured that many of you have been members of HMS before emails were invented. We are trying to update our records, so please take a minute and email our Subscriptions Secretary, Lesley-Ann Cowell, with an update of your contact details at: lacowell1@gmail.com. Please note if you are happy for us to use this as the primary means to contact you.



GILBERTO ARTIOLI

Gilberto Artioli will be known to HMS members as the person who analysed the famous Iceman's axe, as well as one of the main leaders of the broader "Alpine Archaeocopper Project". Currently a Professor at the Department of Geosciences of the University of Padova, he admits to a "split scientific personality", as he combines his work on cultural heritage with active research in the characterisation of industrial materials, mainly cements. His impressive publication list, including over 250 items, shows that he manages to remain on top of several fields. For example, he has recently authored the handbook *Scientific Methods and Cultural Heritage*, published by Oxford University Press, but also co-edited a third edition of *Fundamentals of Crystallography* with the same publisher. Born and raised near the Po River Valley, "famous for good food and balsamic vinegar", he studied Geology at the University of Modena before completing his PhD on crystallography and structural mineralogy at the University of Chicago. Since then, he has "lived with neutrons and synchrotron X-rays" for most of his career, combining several positions at Italian universities with research stays at several US institutions, and moving into the field of applied and industrial mineralogy, materials characterisation, and reaction kinetics. He is currently Director of the CIRCE Center for the investigation of cements, and member of the Editorial boards for *Archaeometry*, *Archaeological and Anthropological*

Sciences, and the *European Journal of Post Classical Archaeologies*.

THE CRUCIBLE: Can you summarise your career in a couple of sentences?

GILBERTO ARTIOLI: As it often happens to scientists, I was dragged into archaeometry and archaeometallurgy following the requests of the archaeologists. In my case they were looking for a non-invasive way to characterise the copper axe of the Iceman, which is a unique piece. Neutrons worked just fine in this case. The interpretation of the manufacturing of prehistoric axes was a nice introduction to Alpine copper archaeometallurgy.

THE CRUCIBLE: What is your most memorable professional moment?

GILBERTO ARTIOLI: I firmly remember the first time I solved a crystal structure, it's a great experience to be able to penetrate the intimate structure of matter. It's like stepping in a different world.

THE CRUCIBLE: Who has been your most influential colleague, and why?

GILBERTO ARTIOLI: I had the pleasure to meet and learn from several scientists with inquisitive and open minds, Glauco Gottardi in Modena and Åke Kvik in Brookhaven both greatly influenced my perception of the

scientific method. Dedication and curiosity are key factors.

THE CRUCIBLE: What is your main current project?

GILBERTO ARTIOLI: Cement chemistry is my main interest. Concerning the cultural heritage the attempt is to contribute to Alpine prehistoric copper metallurgy, focusing on the provenance of the metal by isotopic and geochemical tracers, the interpretation of the smelting technologies, and the characterisation of the manufacturing processes. Together with a few dedicated collaborators in my research group, we also work on ancient glass, radiocarbon dating of mortars, bone diagenesis and alteration, and several other projects.

THE CRUCIBLE: What multi-million project would you like to develop?

GILBERTO ARTIOLI: There are no multi-million Euro projects in archaeometry. The funding for science and especially for the cultural heritage applications are steadily decreasing almost everywhere. As a consequence most projects are limited, fragmented and often incomplete. The preservation of the know-how within many research groups is also at stake because of the low level of recruitment. This is at odds with the needs of the investigation of cultural heritage, requiring long term training and large multi-disciplinary centres with adequate instrumentation and personnel. Thus my multi-million fantasy would be the funding of one or more centres serving the cultural heritage community in terms of a number of complementary analytical techniques and expert interpretation. These centres should have trained personnel, optimised characterisation protocols, and access to large scale facilities and extensive databases. It is increasingly difficult for small research groups to cope with these issues.

THE CRUCIBLE: Which publication should every HMS member read?

GILBERTO ARTIOLI: In chronological order: Herodotus, Agricola, and Tylecote. With them you get a great overview of the anthropological and technical issues involving metallurgy. Then one can move into the more specific scientific literature. I also think that one should always carry in the pocket *Il systema periodico* by Primo Levi, named in 2006 by the Royal Institution of Great Britain the best science book ever. I fully agree.

THE CRUCIBLE: Have you got any advice for young students interested in archaeological and historical metallurgy?

GILBERTO ARTIOLI: My only advice is to try to keep their enthusiasm along the way. They invariably approach archaeological science and archaeometallurgy because they are fascinating and challenging. Unfortunately in a time of shrinking budgets everybody gets frustrated by



Experimenting with Aeneolithic copper axes and neutrons with a D20 diffractometer at Grenoble.

the lack of positions, resources and by the absurd level of competition. I know it is hard, but in the midst of this jungle one should make all attempts to save at least part of the initial enchantment. This keeps us going.

THE CRUCIBLE: I would like to tell every reader of the Crucible that....

GILBERTO ARTIOLI: I am a sort of newcomer in the field of metallurgy, though I think that fresh thinking is sometimes important to challenge and test established views and common interpretations. The great technical and analytical advances of the last decades offer a variety of solid experimental tools to test our assumptions on ancient metallurgy, often born out of modern industrial processes. We are bound to show that ancient metallurgical processes were based on a vast knowledge of natural resources and a profound empirical experience of transformation processes. I feel that we often know much less about these issues than our predecessors did. Modern archaeometallurgy has evolved into a discipline of incredible complexity, so that exchange of data and ideas within the community is fundamental: let's throw this information into **The Crucible!**

FUTURE INTERVIEWS

*Who would you like us to interview for the next issue of **The Crucible**?*

Would you like any additional question added to our standard list?

Please let us know at thecrucible@hist-met.org.

EDDIE BIRCH

It is perhaps surprising that I was elected president of HMS last year as I am not a historian or archaeologist, nor a metallurgist. However, my university career (chemical) included time investigating the extractive metallurgy of nickel, cobalt and uranium (with summers spent excavating in Southampton) and my first “real” job was investigating the formation of inclusions in steel. My next job involved production and development of a range of aluminium master alloys, so I can claim to have been a practicing metallurgist.

In 1971 David Evans, a colleague and member of HMS, suggested I go with him to the Leeds conference. With a short break (I was re-recruited by my brother-in-law, Brian Bastow) I have been a member ever since. I was elected to Council in the ‘90s and became Chairman in 1999. I have also been Membership Development Officer and Programme Secretary, and helped organise a number of conferences.

While the origins of the Society were firmly rooted in the ferrous area, by the time I joined this was changing. Even today however many metals, and many areas of metallurgy, are under-represented in our activities. For example, we discuss pyrometallurgy at length, but I don’t remember us discussing electrowinning or froth flotation. I suspect this has as much to do with the lack of physical evidence and site specific historical records, as a lack of interest.

Currently my own interests are the preservation of more or less contemporary records so that future historical

metallurgists can put our own times into perspective, and a (still unstated) directory of foundries.

I have always enjoyed the HMS conferences, and know how much thought goes into maintaining as much balance as possible, geographical, ferrous/non-ferrous and historical/archaeological. Some of my best moments with the Society have been at conferences – Richard Doncaster’s “members’ contributions”; Martha Goodway asking the men from Rolls-Royce if they knew Royce had turned down the Wright Brother’s invitation to tender for an aircraft engine; the wonderful Holywell Music Room venue for the 2008 conference in Oxford – to name a few among many.

While we must not be complacent, I feel that there have been many innovations over the past ten years which should give us great confidence in the future of the Society. As one example, the introduction of the annual “Research in Progress” meetings provides a most interesting forum for new work, and its format is effective in encouraging participation by younger members of the historical metallurgy community.

Another example of innovation was provided by the scale of our recent anniversary conference which attracted valuable and interesting papers from around the world. As a relatively small Society our international standing poses challenges, but the conference made it clear that the rewards are well worthwhile.



Eddie Birch adjusting a rubbing of a Lucy & Co Eagle Ironworks Oxford manhole cover (Rubbing gifted by Brian and Pat Bastow).



Saturday lunch time, delegates gathered in the courtyard of Friends House.

HISTORICAL METALLURGY SOCIETY

50TH ANNIVERSARY CONFERENCE

LONDON, 14TH-16TH JUNE 2013

One could summarise the last HMS 50th Anniversary Conference as a sort of materialisation of the HMS logo: a true melting pot of specialists from different institutions and disciplines, working on different areas, in different periods, with different materials but all joined by a common aim: generating a better understanding of past societies through the study of one of their essential productions: metallurgy. A second shared target was creating and consolidating research networks, tools and environments for the exchange and discussion of this knowledge. This Conference has shown that, after 50 years, HMS is deservedly recognised as one of these essential networks.

The conference was held in central London and exceptionally well organised by Eleanor Blackelock. It combined talks and discussion with more social and informal interaction: tea and lunch breaks, a wine reception at the UCL Institute of Archaeology, a social dinner to which all the attendants were invited, or the trips to the Science Museum Blyth House Store or the Victoria and Albert Museum, which turned out to be excellent atmospheres for relaxed discussion.

Thirty-eight papers and 18 posters were presented by researchers from all over the world including Europe, Israel, USA, Canada, Colombia, Argentina, Australia and Japan, with an audience of over 100 people. At least 12%

of the contributions were the result of international co-operative teams, which illustrates how current research networks are broadening at a transnational level to address research questions of common interest. It is also worth mentioning that a significant proportion were women (30% of oral presentations and 50% of posters) and young researchers. Together with some of the most widely known archaeometallurgists, a new generation of young researchers had the opportunity to present and discuss some of the most recent projects and latest trends.

All contributions were structured into four main themes: Origins of Metallurgy chaired by Paul Craddock and Thilo Rehren; The Southern Continents chaired by Vincent Serneels and Marcos Martín-Torres; The Northern Continents chaired by David Bourgarit and Justine Bayley; and Future of Historical and Archaeological Metallurgy chaired by David Dungworth. The program itself showed the broad scope of the HMS membership: from Prehistory to modern times, from copper to gold and spanning the world.

On the first day, ten papers were presented on the origins of metallurgy. Some of them were examples of what P. Craddock defined in his opening talk as “the pendulous character of metallurgical research.” Old discussions on the independent invention of metallurgy or its diffusion in Eurasia are back in the agenda through new and stimulating

evidence from Eastern Europe (M. Radivojević) or South East Asia (O. Pryce). Local evidence of some of the earliest metallurgy in Western Europe was also brilliantly presented in Italy by provenance studies through lead isotope analysis (G. Artioli and his team); in France by the technological characterisation of the earliest metallurgical remains at the mining district of Cabrières-Péret (S. Rovira, P. Ambert and his team); or in Britain by the systematic radiocarbon dating of prehistoric mining works (S. Timberlake et al.).



Some delegates during the poster session.

Another swing of the pendulum brought new and inspiring insights into an old discussion regarding the latest evidence on the intentional production of arsenical copper in Chalcolithic Turkey (L. Boshier et al.). However, not all the contributions had a technological focus: A. Feuerbach discussed the origins of metallurgy as part of specific adaptive social strategies; and L. Nigro the role of early metallurgy and the emergence of the urban sites in Early Levant. Finally, J. Palermo gave a historiographic perspective on the origins of Iron.

The session on Southern Continents was an important step forward in beginning to redress a Eurocentric bias that persists in many conferences organised by European institutions. In this session, however, we could see some of the metallurgical ‘restrictions’ that Th. Rehren highlighted in his closing talk: two out of the three papers on African metallurgy were devoted to iron production (E. Ch. Lyaya; V. Serneels) with the only exception of one on trans-Saharan copper trade (L. Garenne-Marot and B. Mille). Four out of the five papers on South American metallurgy concentrated on noble metals, although presenting different approaches: C.I. Angiorama and M. Florencia Becerra presented robust evidence of silver extractive activities, while C. Gutiérrez Neira et al., and M. Martín-Torres and A. Uribe, presented non-invasive studies of gold objects cast by the lost-wax technique and convincingly stressed the high importance of their social contexts and roles. On the other hand, N. Bustamante and J. Escobar tried to infer pre-hispanic technological productions by

experimental sintering of gold and platinum. Regarding copper, B. Mille and his team presented a comparative study on the organization of copper production between the Atacama Desert and France, showing that small and large scales of production are not necessarily two steps of a linear trajectory, and that other social and economic aspects must be incorporated in order to correctly assess the metallurgical production in its context.

The twelve papers on northern continents encompassed studies on gold and silver, copper-based metallurgy and iron. Noble metals were presented in the studies of three hoards (Mildenhall, Derrynaflan and Staffordshire) from the UK (J. Lang and E. Blakelock et al); an original technological approach was proposed by S. Liu and Th. Rehren in China, where archaeometallurgical studies are mainly focused on bronze production and gold or silver are rarely considered. Another innovative technology was presented by M. Renzi et al. in Iberia, who proposed a method of silver production by de-silvering copper ores that was hitherto unreported for the Early Iron Age. A broader organisational model of silver production in this period was presented by M. Murillo-Barroso, based on lead isotope analyses.

Copper-based metallurgy was focused in the Levant with two approaches to copper trade networks by the elemental and isotopic composition of ingots (N. Yahalom-Mack et al.) or the manufacturing techniques of objects (C. Clarke). Tin was brought into the picture by J.-M. Welter, who presented a remarkable study on the physical and mechanical properties of tin bronzes. And finally, iron technology was centered on the industrial production of iron and steel from the 17th century up to present times (H.J. McQueen and L. McNally; J. Greenwood; K.E. Morgan; T. Smith).

The last theme, Future of Historical and Archaeological Metallurgy was mostly focused on iron production. A. Dolfini opened the session with a clarifying talk on the earliest copper metallurgy in Italy, and stressed the main goals and trends for the future research in relation to the state of the art. A critical and innovative topic – how to provenance iron objects – was addressed by two of the presentations (M. Brauns et al. and P. Dillmann et al.). T. Young presented a synthetic paper on the development of bloomery furnaces in Britain and Ireland.

Closing speeches were presented by Th. Rehren and P. Belford who gave illustrative clues on the future of archaeometallurgy and historical metallurgy research.

It has been a great pleasure to attend this inspiring and well-organised conference. Even though I have only been able to report my personal highlights, collectively all the papers and posters showed the strength of metallurgical research internationally, using a variety of methodological approaches and the latest analytical techniques where

necessary. I found it very gratifying to observe that, by and large, technological aspects are not the ultimate object of study and the social role and impact of metallurgy (in past or present societies) was at the core of most of these technological studies. The presence of academics, museum curators, students, metallurgists or archaeologists diversified the discussion and showed that, on its 50th birthday, HMS continues to be an extremely fertile crossroads of different metallurgical grounds.

Mercedes Murillo-Barroso

their hats and rifles made of silver displayed symmetrically around the body of the weapon. All the mechanical pieces were not just perfect, but also beautiful with engravings of waves, plants and creature's faces. Wood and metal parts fit perfectly, showing the expertise and art of two crafts of the period: carpenters and metalworkers.

The artefacts were stunning and it was privilege to be able to handle such wonderful objects.

Teresa Plaza



V&A handling session in the Metalwork, Silver and Jewellery Department.



Examining selected objects from the Percy collection.

V&A HANDLING SESSION

On Thursday, the handling sessions took place in the offices of the Metalwork, Silver and Jewellery Department of the Victoria and Albert Museum. A variety of objects displayed on a large table were waiting for us: a late medieval steel helmet; an intricately decorated 17th century sword with a blade from Toledo; a range of candle holders made of different metals; and an 18th century 5.5kg solid silver ewer; as well as other beautifully made and intricate objects.

We were attended by Angus Patterson, armour and arms specialist, and Kristen Kennedy, silver specialist, who delighted us not just with the story behind the different artefacts (such as the the silver chest thought to be Spanish that was in fact Bolivian), but also with explanations of the different metals and alloys used; techniques of manufacture (e.g acid etching, inlaying, examples of early electroplating) and their change over time and observations about details of the decoration. After the explications, we had an hour to handle the artefacts and enjoy an informal talk.

Among all the artefacts, my favourite was an 18th century hand gun, steel barrelled with wood and silver fittings; its details were simply fantastic: small dogs and hunters with

PERCY COLLECTION TOUR

John Percy is rightly famous among metallurgists for his pioneering work on 19th century metallurgy, which he published in his *Treatise on Metallurgy*, and so the opportunity to see his metallurgical collection would feel a real privilege to any self-respecting HMS member!

The collection is housed in the impressive surroundings of the Science Museum Stores at Blythe House and we were shown around by the enthusiastic and knowledgeable Susan Mossman, aided by Rebecca Stores. The room itself was an Aladdin's cave of shelves stacked with loose or jarred samples with hand written labels. Percy was a prolific collector, and though he is famous for his work on metallurgy he collected a vast diversity of over 4000 objects. These included a large collection of coal from seams around the UK, large chunks of glass and assorted minerals from across Europe. His slag collection contained contemporary samples from blast furnaces from diverse locations around the world, such as Wales, the USA, Russia, and even 200 year old examples of bloomery slags from Sweden. It seems that the collection of historical slags for analysis is nothing new!

Some of the most interesting artefacts had been especially selected by Susan Mossman for us to view. These included



Hundreds of jars of samples in the Percy collection.

a large bar of steel made in the Bessemer-Mushet process which had undergone shear strength testing. From the separate Park Collection, was a bar of some of the earliest made aluminium created by Faraday in the early 19th century. However, some of the most surprising objects were much older. There was a collection of ancient metal artefacts that had been sent to Percy for analysis; this included samples cut from a silver cup from excavations at Nineveh and a large sample taken from a bronze sword from Mycenaean Greece. This really shows that Percy was not just a metallurgist, but also one of the early pioneers of archaeometallurgy.

Percy collected materials from one of the most exciting periods of metallurgy and the benefits of this collection is in its breadth, size and completeness. This material has much to teach us, especially if coupled with the use of new, modern scientific techniques. Having been comprehensively catalogued, future research on this collection is an exciting prospect. This collection is probably the best of its sort in the world and the visit was a very rewarding experience.

Matt Phelps

BENO ROTHENBERG MEMORIAL CONFERENCE

TIMNA PARK, ISRAEL, 22ND-25TH APRIL 2013

A tremendously successful international conference, entitled Mining for Copper: Environment, Culture and Copper in Antiquity, was held last April in Southern Israel's world renowned Timna Park.

The event was held in memory of the late Professor Beno Rothenberg who passed away last year at the age of 98. He was being honoured for his years of dedication to the nascent discipline of archaeometallurgy, a term he himself coined. The congress was fittingly held in Timna Valley

where he discovered the world of ancient metallurgy and conducted his most influential work. He was, of course, also the founder of the Institute of Archaeo-metallurgical Studies at UCL and the driving force behind much of the research and projects it undertook over the last four decades.

The conference program involved more than 80 scholars from more than 14 countries giving some 55 papers and 5 posters on various subjects relating to ancient copper metallurgy. The papers included presentations from some of the most illustrious scholars in the field as well as early career researchers, all of which proved to be captivating. Particularly stimulating were a number of papers discussing the dating of the Timna copper exploitation (with the main period of use firmly within, and not earlier than, the Iron Age) and the role the site played in the greater regional context.



Prof. Thomas Levy showing delegates around the impressive remains of the Iron Age fortress of Khirbat en-Nahas.

Yet this busy schedule somehow managed to find enough time to fit guided field excursions to Timna Park led by Dr. Erez Ben Yossef, Nahal Amram led by Dr. Uzi Avner, as well as Wadi Faynan in neighbouring Jordan with guided tours by Prof. Andreas Hauptmann and Prof. Thomas Levy. Special highlights included mine shaft explorations, Bedoin-led cross-country adventures, and Khirbat en-Nahas, an Iron Age fortress set amidst an industrial copper smelting landscape in Jordan's Edom region.

Although we wish that Beno could have been there himself to see the fruits of his decades of labours, this conference was evidently an apt testament to his lasting influence on the field of archaeometallurgy. The conference organisers certainly made every effort for this to be a fitting tribute to his memory.

Special praise in organising this wonderful conference must go to Dr. Erez Ben-Yosef for his arduous work herding the distracted flock of academics. A task which in the end robbed him even of his voice!

Loïc Boscher



THEORY IN ARCHAEOMETRY: SOCIETY FOR AMERICAN ARCHAEOLOGY

HONOLULU, HAWAII, 3RD-7TH APRIL 2013

The 78th Annual Meeting for the SAA was convened in April, and as usual provided an opportunity for scholars to present on a wide range of topics in global archaeological research. Over 1000 papers were presented. Of particular interest to the archaeological sciences (and more specifically the archaeometallurgical) community was the session “Invention as a Process: Pyrotechnologies in Pre-Literate Societies”, convened by Miljana Radivojević from UCL’s Institute of Archaeology, and Benjamin Roberts of Durham University. One of the major themes of the session was to deconstruct a traditional focus on “the earliest”, “inventions,” and “origins”, to a more theoretically rigorous conceptualization emphasizing the interplay between technological invention and innovation, and the cultural underpinnings of technological selection.

Every archaeometallurgist knows that there is a wealth of archaeometallurgical data spread ubiquitously across the globe, with relatively few trained scholars able to process this data analytically (Knapp 2000). There has been an increasing awareness that archaeometallurgists and archaeometrists need not focus on cataloging finds or technical reports alone (although these are also very important). Instead, it has become clear that those with

the most intimate knowledge of the archaeometric data are also uniquely suited to generate explanations of human behavior (Binford 1962), and need not rely wholly on other scholars to provide anthropological interpretations. Archaeometallurgists seemingly have tended to shy away from embracing the big picture, universalist questions that well-contextualized metallurgical data is apt to address. It was therefore immensely refreshing to attend this SAA session and find that I was not alone in my desire to seat historical metallurgy within various theoretical frameworks.

Benjamin Robert’s talk, “Inventing Metallurgy I: A Global Perspective,” discussed how the scholarly primacy given to earliest inventions has tended to overshadow research into the “why” and “how” of metallurgical innovations on a global scale (namely Europe, Asia, and Central and South America). Likewise, Miljana Radivojević continued along this trajectory by focusing on what appear to be independently developed metallurgical traditions in the Balkans of the 7th-5th millennia BC, in her talk entitled “Inventing Metallurgy II: A Look Through the Microscope Lens.” Copper ores with particular aesthetic properties were selected for, and this technological adoption was studied

using optical, compositional, and isotopic techniques on copper minerals, ores, slags, metals/alloys, and technical ceramics. Thilo Rehren provided an insightful look into the pyrotechnological requirements of “Inventing Technical Ceramics,” processes on which metallurgical, pigment, glass, glaze, and pottery production are frequently dependent. He correctly argued that incremental changes are responsible for much of what we may call invention. These changes may be discernible only when approached from a long-term, evolutionary perspective, rather than a quest for a monolithic origin. Peter Hommel delivered a paper co-authored with Roger Doonan on early pottery invention called “Between Ideas and Objects: The Doings of Invention in Pottery and Metallurgy.” David Killick presented “Invention and Innovation in African Iron Smelting Technology,” in which he illustrated that the two terms should not be considered synonymously. A high degree of differentiation between African bloomery traditions demands that the spotlight be focused more on the dynamic reasons for variation than on previous disparaging arguments viewing African technological progress as static. In his talk entitled “Cast Iron Smelting in Early China: Archaeological Survey and Laboratory Simulation,” Qian Wei proposed an 8th century BC date for the earliest invention of cast iron in China. Research into the subsequent adoption of this technology was executed in part by 3D laser scanning, which aided in reconstructing the spatial evolution of the furnaces. Attempts to explain the adoption of specific silver smelting technologies over others in the Andes were presented by Carol Schultze in her talk “Invention of Silver Technology in the New World.”



Ben Roberts presenting his talk on 'Inventing Metallurgy'.

I would make one terminological amendment to the session that caused some confusion among the participants and audience. Instead of attempting to define and distinguish between the terms “invention” and “innovation”, which can tend to project analogous connotations, it may be more fruitful to employ the distinct terms “invention” and “adoption.” Invention is the creation of a new technology, whereas adoption occurs when this new technology can provide 1) like or superior quality over previous technologies, with 2) lower cost (or no increase in cost for superior quality), while 3) satisfying cultural tastes or

taboos, and is subsequently selected. All technologies that are eventually selected must undergo both invention and adoption for their material remains to be pervasive enough to become discernible and statistically significant in the archaeological record.

It is unreasonable to state that the question of theoretical approaches to archaeometry or archaeometallurgy is one that has not been posed before. A growing amount of archaeometallurgical work has indeed been focused on anthropologically pertinent issues, such as iron production lineages within technological and economic constraints (Charlton et al. 2010; Humphris et al. 2009), as well as environmental considerations such as fuel availability and efficiency during the Levantine Bronze Age (Ben-Yosef 2012; Kaufman 2012), to name just a few of the more recent contributions. The assessment of the field I provide may seem over-generalized, but the unfortunate fact remains that many archaeologists view archaeometrists merely as providers of raw data, while archaeometrists feel comfortable generating technical reports that they hope will one day be used by archaeologists (for a much more sophisticated look at these paradigmatic issues, cf. Thornton 2012). Of course, teamwork and collaboration between specialists and generalists is a fundamental aspect of archaeological research and should not be discarded. But it may also be fruitful for the next generation of archaeometallurgists to be trained formally in anthropological theory. This would at the very least facilitate a better understanding of the interaction between data and theory, and at best create scholars who can both acquire experimental results, and explain them.

Brett Kaufman

Ben-Yosef, E. 2012. ‘Environmental Constraints on Ancient Copper Production in the Aravah Valley: Implications of the Newly Discovered Site of Khirbet Mana’iyah in Southern Jordan.’ *Tel Aviv* 39:58-74.

Binford, L.R. 1962. ‘Archaeology as Anthropology.’ *American Antiquity* 28:217–225.

Charlton, M.F., Crew, P., Rehren, Th. and Shennan, S.J. 2010. ‘Explaining the evolution of ironmaking recipes - an example from northwest Wales.’ *Journal of Anthropological Archaeology* 29:352-367.

Humphris, J., Martínón-Torres, M., Rehren, Th. and Reid, A. 2009. ‘Variability in single smelting episodes - a pilot study using iron slag from Uganda.’ *Journal of Archaeological Science* 36:359-369

Kaufman, B. 2012. ‘Copper Alloys from the ‘Enot Shuni Cemetery and the Origins of Bronze Metallurgy in the Levant.’ *Archaeometry* 55 (4):667-690

Knapp, A.B. 2000. ‘Archaeology, science-based archaeology and the Mediterranean Bronze Age metals trade.’ *European Journal of Archaeology* 3 (1):31-56.

Thornton, C.P. 2012. ‘Archaeometallurgy in the 21st Century.’ *Reviews in Anthropology* 41 (3):173-187.

METALS UNDER THE MICROSCOPE: SOCIETY FOR AMERICAN ARCHAEOLOGY

I want to start by thanking the HMS for awarding me a grant from the R.F. Tylecote Fund to help towards the cost of attending the Society for American Archaeology (SAA) Annual Meeting in Hawaii. I am currently in the final stages of a PhD at Newcastle University that studies the emergence of the Bronze Age on the Isle of Man. The thesis includes the application of use-wear techniques to copper alloys to establish the impact and nature of early metallurgy. My use-wear analysis on copper alloy objects was the subject of the paper I presented: Metals under the microscope: use-wear analysis on prehistoric copper alloy objects (co-authored with Andrea Dolfini). The paper was part of the session, Novel Uses of Microscopy. The SAA meeting is always one of the biggest gatherings of archaeologists in the world and this year was no different: the conference lasted 5 days with over 200 sessions and thousands of delegates in attendance (it also had the added bonus of being in the beautiful Hawaiian islands!).

The session I presented in focused on discussing new uses of microscopy, ranging from 3D microscopes and cameras and their effectiveness, to the use of microscopes to look at submerged landscapes. The session attracted a range of papers but there was a particular focus on use-wear analysis on lithics. Andrea and I's paper discussed the use of binocular light microscopes to look at use-wear traces on Bronze Age axes. The first aim of the paper was to share information with other specialists and increase awareness of the application of use-wear techniques to metals. This is a developing field and one in which a limited number of practitioners work at present. The second aim of the paper was to create a conversation with other specialists from similar disciplines about how best to take use-wear analysis on metals forward.

Other participants presented papers that detailed a number of new kinds of 3D microscopes and case studies that used blind testing to establish how effective the new microscopes might be (Evans, MacDonald, Bellow and Ollé; Stemp, Coffey, Evans, Lerner and MacDonald). These paper highlighted the strength of some new microscopes for use-wear on lithics but also the importance of rigorous blind testing, something that has yet to be implemented in copper alloy use-wear. There was much to learn about how best to carry out blind testing and the potentials and pitfalls of 3D microscopes. Another paper considered the use of GIS to map more accurately the distribution and amount of edge damage on lithics (Lerner). At present use-wear analysis on copper alloys relies on qualitative discussions of edge damage, the application of a GIS method has the potential to make use-wear on copper alloys more quantitative and scientific. Other papers were more problem-orientated, for example, one paper considered how one could use the



Dinolite microscope image of axe use-wear. Photo by Rachel Crellin with permission of Manx National Heritage.

fracture patterns on lithic arrowheads to ascertain whether they had been fired as part of arrows, darts or spears for example (Pargeter, Hutchings and Lombard). The formation of use-wear marks in relation to the duration of work was considered by another paper (Macdonald, Evans, Giuscca and Leach). The paper found that after a certain use-duration the amount of wear marks remains constant meaning that there is a use duration threshold above which we cannot know how long the tool was used for. Whilst this lithics method is not directly applicable to copper alloys the need for copper alloy use-wear analysts to consider more carefully how wear builds up over time is a crucial avenue for future work.

There was much to learn from other specialists at this session and particularly during conversation at the dinner that followed. Collaboration with lithics use-wear specialists offers a fruitful way to advance copper-alloy use-wear. Lithic use-wear analysis has had many problems as well as victories over recent decades and we can learn a lot from this; furthermore the new techniques they are developing may prove to be useful in copper alloy use-wear. Additional collaboration with lithics use-wear analysts to consider how metal and stone tools are being used at the start of the Bronze Age will also help us to understand the impact of early metallurgy. I certainly learnt a lot at the conference and the contacts that I made have led to offers of collaboration and the use of equipment. I want to thank the HMS again for helping to make this possible.

Rachel Crellin



HMS SLAG DAY

IRONBRIDGE GORGE MUSEUM, 27TH APRIL 2013

Having enlisted as a volunteer with the Ironbridge Gorge Museum to be involved with industrial archeology projects in the Gorge, I was forwarded the notice for the Historical Metallurgy Society Archives and Slag Collections open day. As a conservator specialising in metals, I have known about HMS for many years, but the open day, held almost on my doorstep, sounded intriguing, too good to miss, and provided the spur to join at last.

The day started with a welcome and brief introduction to the archives from Louise Bacon to the small group of us attending the open day, some like myself, new to the Society's activities and others who were established HMS activists. Louise gave us a description of the archive and its care.

David Dungworth followed with a description of the slag collections and for those of us new to the HMS, it was fascinating to learn from the two speakers, how much has been achieved in such a relatively short time, and it was pleasing to learn that there is such a close collaboration between the Society and the Ironbridge Institute.

Despite the two introductions, I still did not quite know what to expect when we were about to start the hands on workshop sessions. It soon became apparent though! I started with the paper and photographs group and a daunting quantity of partially archived material, mostly photographs, with some notes and a few reports that comprise the Tylecote archive. The earlier archiving had assembled the material into logical associations, but it needed our second sweep to refine it into directly related material, and for me at least, there was lots of 'ah, yes, this photo of a hole in the ground with a bit of a lintel is the same as one I saw earlier but from a different position - now where did I put that?' Very quickly we started working as a team, cross checking with each other, and the personal recollections of the 'old hands' were invaluable, often making sense of indecipherable images. Gradually things started to fall into place, and even link up with objects the slag collection group were finding.

After a break for lunch, a visit to the Museum of Iron and a walk around the old foundry site with Shane Kelleher of the Institute, who gave us an insight into the objects on display, the history and archeology of the site, most of us

swapped activities and I went into the chilly stores to pick through boxes of slags, ores and a few bits of actual metal. The materials are all part of the Tylecote Slag Collection, which is a distinct historical collection housed at the Institute, but owned by HMS, as opposed to the National Slag Collection, which is owned by the Institute, although both the Institute and HMS have a say in what is added to the National Slag Collection.

The Tylecote Collection was kept in an *ad hoc* selection of boxes in the Institute's stores. In the boxes were plastic bags of samples, labelled in various ways and our task was to catalogue them. The samples were re-bagged in numbered bags which corresponded with new archival boxes and the information was entered up by David Dungworth on a database as we progressed. Deciphering some of the labels in, shall we say 'distinctive' handwriting on damaged labels was a challenge, but again, the 'old hands' were often able to come to the rescue, recognising a vital clue and recalling a past expedition.



Slag day visitors and HMS members help to sort the Tylecote photography collection.

I thoroughly enjoyed the day, it was informative, fascinating, friendly, there is much more to do, but there was a sense of making a useful contribution and a job well done. I was a bit worried about how I'd tell my friends at 'The Golden Ball Debating and Philosophical Society' how I had spent my Saturday. Given the potential for puns on the main object of our attention, there aren't many ways that don't leave you open to ribaldry, but, to their credit, they didn't sink to the occasion and were genuinely interested - a bit mystified, maybe, but interested.

Andrew Naylor



IAMS SUMMER SCHOOL

UCL INSTITUTE OF ARCHAEOLOGY, 17TH-28TH JUNE 2013

The Summer School in Archaeometallurgy organised by the Institute of Archaeo-Metallurgical Studies (IAMS) proved to be a fascinating and highly informative journey through the world of archaeometallurgy and all it entails. It turned out to be a truly rewarding experience for the twenty students from a variety of backgrounds that came from around the world.

I hoped to use the opportunity to enhance interest in minerals and mining and gain deeper insight of this previously unknown specialism. I gained a broad overview on a range of aspects related to the field, through a thoughtfully selected and delivered series of lectures and exercises. I left the course feeling wiser and confidently well informed, motivated and very grateful.

Our journey began with an introduction delivered with care and precision, by Prof. Thilo Rehren, into the origins of the field of Archaeo-metallurgy and its potential for future practitioners; due to much needed data and targeted research, in particular the potential of research into lead isotopes.

We gained insight into the minute intricacies of the behaviour of minerals during the processing of ore and became well acquainted with an array of terminology used in the field of metallurgy. In particular, I felt I had become an initiate and convert to the value and potentials of 'slag' and slag analysis, termed the 'black art', later in the week I was intrigued to learn of the church's once fear of the blacksmiths.

We travelled back in time with Dr. Simon Timberlake to survey sites and landscapes across Britain and learned of early mining communities, ancient mine excavations and intentions to reconstruct Bronze Age smelting and metal working processes. We gained an introduction to the important historical studies and contributions of Lewis Morris and William Dawkins. We studied various forms of stone tools of the period and listened to a fascinating tale of a 'lost and found' ancient mining shovel! It was also great to learn of a Hampshire based 'Iron Age village' project where participants gain experience of the full metal working process of the era.

Dr. Anna Feuerbach led us to the truth behind authentic 'Damascus' steel production process and presented video tours of various sword and blade producing cultures including India, Japan and Viking styles. Most notable was the insight in the making of 'Samurai' swords with the precision and care in mastering the skills required. There was stress to the importance of the study of metal artefacts within their cultural context, in order to gain their true relevance and value.

Through Dr. Bridgette Cech we were able to tour the Iberian Peninsula to witness the impact of Roman mining on communities and landscapes. This instigated an interest in aspects of engineering to gain full understanding of the how and why of Roman efficiency in the field; followed by a supporting group visit to the British Museum, to see an example of a water wheel used in the mines. Dr.

Cech shared her work, which involved local community participation into its own mining history. The rewards were quite clearly demonstrated through their recapture of past traditions, a joy to see this type of development and partnership.

Guided by Dr. Eleanor Blakelock, we were introduced to the skill of analysis and interpretation of 'phase diagrams' and grain structures associated with the transition phases in the metal alloying process. At first glance, the diagrams did seem complicated, however, with group exercises along with Eleanors' guidance, I felt empowered.



Teaching session on metallography under the guidance of Dr. Eleanor Blakelock.

We were later introduced to various methods of analysis available to archaeometallurgists. Dr. Marcos Martín-Torres was able to clarify their appropriate use, stressing the importance of the knowledge of the user over dependency on the machine, and illustrating suitable approaches with case studies ranging from Pre-Columbian gold to the bronze weapons of the Terracotta Army. We were introduced to the portable XRF with a concise summary of its potential as well as drawbacks. We were later treated to a visit into the laboratories where postgraduate researchers shared their expertise and introduced us to the sample preparation process. A final session handling a range of artefacts we had previously covered in class, followed by discussions, proved to be very fruitful.

I don't believe enough credit can be given to all concerned in the preparing and delivery of the programme, especially to Pira Venunan who made sure that everything ran smoothly. It was a valuable opportunity, I feel encouraged to continue my interest and study and hope to see the Institute for Archaeo-Metallurgical Studies grow from strength to strength.

Jennifer Fridye

ACCIDENTAL AND EXPERIMENTAL ARCHAEOMETALLURGY

HMS OCCASIONAL PAPER No 7

Experimental archaeology has acquired a central position amongst the many methods and techniques that have been used to expand our understanding of early metallurgy. Nevertheless, experimental practices remain mysterious to some and poorly disseminated among wider communities. This volume represents an attempt to remedy the paucity of published material and includes many contributions that underscore important theoretical and methodological concerns alongside a number of case studies.

This volume was inspired by an extended conference which saw numerous practitioners come together not just to present papers but also to undertake a number of parallel experimental reconstructions. Both papers and practical investigations are reported in detail and highlight the variety of approaches to such practices and the differing agendas that are brought to such activities. Leading figures from across this broad community have come together in this volume to provide a coherent publication which details the scope of a number of practices that together are known as experimental archaeometallurgy.

Accidental and Experimental Archaeometallurgy is available from Brian Read, 22 Windley Crescent, Darley Abbey, Derby, DE22 1BZ, United Kingdom at a cost of £13 + £2 UK postage (£5 postage outside the UK). Email: brian.read2@ntlworld.com.



'Accidental and Experimental Archaeometallurgy'. HMS Occasional Publication No 7, to be released 2013.

OBITUARY: BRIAN AWTY

Brian Awty, a long-standing member of the Society, has died at the age of 88. An impression of his research interests in the iron industry at the end of the Middle Ages can be derived from a listing (below) of the papers which he published in our Journal. These derive from his work in the French archives and from his collaboration with staff of the French monuments Inventaire, led by Jean-Francois Belhoste, who was the driving force behind the magnificent series of survey-volumes of French iron-working districts. Brian Awty's work is acknowledged by named joint authorship of the Normandy volume.

Brian's strength lay in his command of European languages. He was a linguist by training, even though he spent much of his working life as a librarian at the LSE. His main research on iron was done in the Departmental archives in Rouen and the National Archives in Paris. Key to this was the early development of property documentation in France, traceable in notary's records. British legal practice was behind on this, and Brian found French notarial papers a gold-mine in tracing the iron workers' late-medieval movements, from their arrival in France to their 16th century dispersal, in many cases to England. Latterly he had been working on records of iron workers in what is now Belgium. On the English side, he traced the arrival of iron workers from Normandy, their settlement and work in the Weald, and their spread to other districts of England. He made use of the Denization papers in the Public Record Office (now The National Archives) and cracked their content where others had given up. In recent years he was assembling the results of his work into a book on the iron industries of north-west Europe at the end of the Middle Ages, to c.1600, whose preparation for publication is being carried forward.

As well as working in the French and English archives, Brian Awty was a tireless field worker, tracing furnace and forge sites in Normandy, and relating these to the archive sources. He collected residues, which have been recently offered to the National Slag Collection at Ironbridge. He kept contact with the French archaeologists who have embarked on excavations on ironworks sites of northern Normandy, inspired by his work. The writer remembers with pleasure explorations with Brian, by bicycle, of the lanes, woods, fields and streams of the Pays de Bray, south of Dieppe. He was great company and the Society is the poorer for his passing, but the richer for his formidable academic legacy.

David Crossley

Brian Awty's papers in Historical Metallurgy:

Awty, B. and Barraclough, K.C. 1987. 'Denis Hayford: An early steel master.' *Historical Metallurgy* 21(1):16-17

Awty, B. 1987. 'The origin of the blast-furnace: Evidence from Francophone areas.' *Historical Metallurgy* 21(2):96-99

Awty, B. 1994. 'Were there medieval ironworking contacts between Sweden and Namur?' *Historical Metallurgy* 28(1):7-10

Awty, B. 1996. 'Early cast irons and the impact of fuel availability on their production.' *Historical Metallurgy* 30(1):17-22

Awty, B. 2003. 'The Queenstock furnace at Buxted, Sussex: the earliest in England?' *Historical Metallurgy* 37(1):51-52

Awty, B. 2006. 'The elusive Walloon finery forges of Liege.' *Historical Metallurgy* 40(2):129-137

Awty, B. 2008. 'The Austrian lift-hammer - its probable Walloon origin.' *Historical Metallurgy* 42(1):12-22

100TH ANNIVERSARY OF STAINLESS STEEL HMS ANNUAL CONFERENCE

SHEFFIELD, 19TH-20TH OCTOBER 2013

Another anniversary to celebrate this year, on the 20th August 1913, local metallurgist Harry Brearley made his first arc furnace cast of stainless steel in Sheffield. Therefore to mark this occasion the 2013 Annual Meeting we will be holding a two day conference in the Cutlers' Hall in Sheffield. There will be presentations on the Saturday and fieldtrips on the Sunday.

For more information please contact: HMSannualconf@hist-met.org or post to Eleanor Blakelock, Conservation and Scientific Research, British Museum, Great Russell Street, London WC1B 3DG, UK. Booking forms are available on the website. For more information visit www.hist-met.org.

HISTORICAL METALLURGY RESEARCH IN PROGRESS MEETING

UNIVERSITY OF EXETER, 10TH OCTOBER 2013

The annual Historical Metallurgy Society research in progress meeting will be hosted at Exeter University. These meetings are aimed at a wide variety of contributors, from historical and archaeological metallurgists to excavators, historians and economists. Whether you are a student, a researcher, an interested non-specialist, community groups, or a professional excavator, we invite you to meet others working in this field and present your research to an interested community.

For more information contact Tatagatha or Brice. Either email: hms.rip2013@hotmail.com or lookup online at: www.hist-met.org. The cost is £15 for HMS members and £20 for non-members.

FORTHCOMING EVENTS

Conference, Date and Location	Description	Website, Email and Prices
Bronze Congress 2013 3 th -9 th September 2013 Zurich, Switzerland	To provide an up-to-date overview on the many different areas that bronze research has dealt with in recent years. Subjects ranging from Iron Age, Greek and Roman bronzes, manufacture, restoration and written records.	http://www.prehist.uzh.ch/bronzekongress2013.html bronze2013@bluewin.ch €100; Student: €60
International Conference on Metals Conservation 2013 16 th -20 th September 2013 Edinburgh, UK	Metal 2013 is a five-day interim meeting of the International Council of Museums Committee for Conservation (ICOM-CC) Metal Working Group. The aim of the Metals Working Group is to foster conservation and to promote the conservation science of metals, to encourage the networking of conservators and metals experts, and to facilitate the dissemination of information on current conservation practice, research, and education.	http://www.metal2013.org/ Member: £550; Non-member: £625; Student: £300
BUMA VIII: The 8th International Conference on the Beginnings of the Use of Metals and Alloys 10 th -15 th September 2013 Nara, Japan	This international conference is an interdisciplinary gathering of scientists, engineers, archaeologists and historians with a focus on production and use of metals, with an emphasis on cultural interactions and evolutions over time and space, especially between the West and Asia. Themes cover iron and steel, copper and bronze, precious metals, casting, swords, alloys, mining and experimental metallurgy and conservation.	http://buma8.wiki.fc2.com/ buma.2013@gmail.com 30,000 Yen; Student: 25,000 Yen.
100th Anniversary of Stainless Steel. HMS Annual Conference 19 th -20 th September 2013 Sheffield, UK	On the 20 th August 1913, local metallurgist Harry Brearley made his first arc furnace cast of stainless steel in Sheffield. Therefore to mark this occasion the 2013 Annual Meeting we will be holding a two day conference in the Cutlers' Hall in Sheffield. There will be a mix of presentations on stainless steel, other recent alloys and metalworking techniques on the Saturday. The Sunday will be field trip based.	http://hist-met.org/AC2013.html HMSAnnualconf@hist-met.org Member: £50; Non-member: £60 Student: £40.
HMS Research in Progress Meeting 10 th October 2013 University of Exeter, UK	These meetings are aimed at a wide variety of contributors, from historical and archaeological metallurgists to excavators, historians and economists. Whether you are a student, a researcher, an interested non-specialist, community groups, or a professional excavator, we invite you to meet others working in this field and present your research to an interested community.	www.hist-met.org hms.rip2013@hotmail.com Members: £15; Non-members: £20
The Forgotten Past 21 st October 2013 British Museum, London, UK	Post-medieval small finds, once generally ignored, form a growing dataset due to changes in attitude amongst archaeologists and through the Portable Antiquities Scheme. This conference poses a number of questions on how artifacts are collected, recorded and studied and will discuss the current research in this area. Organised by the Portable Antiquities Scheme and Finds Research Group.	https://sites.google.com/site/frg7001700/conferences/forthcoming-conferences jparol@thebritishmuseum.ac.uk Members: £10; Non-members: £15
Medieval copper, bronze and brass - 2014 15 th -17 th May 2014 Dinant and Namur, Belgium	History, archaeology and archaeometry of the production of brass, bronze and other copper alloy objects in medieval Europe (12 th -16 th centuries). The aim of this conference is to present current knowledge of not only the medieval products, techniques, workshops and labour force, but also of the market and trade in these products. This symposium will present the research carried out in history and archaeology of materials and processes with, in some cases, the support of scientific studies.	http://www.laitonmosan.org/ laiton.mosan@gmail.com
International Symposium on Archaeometry (ISA) 19 th -23 rd May 2014 Los Angeles, USA	The ISA will bring together internationally renowned archaeological scientists and archaeologists with museum professionals, conservation scientists, policy-makers, representatives from non-governmental organizations and industry, natural scientists and engineers to discuss new findings, innovations in technology and scientific research, and address current and global challenges in archaeology and cultural property ranging from the looting and illicit trafficking of antiquities to the archaeology of transitional periods.	http://www.archaeometry2014.com/ Early Bird (before Feb 1st): \$320; Student: \$160.

