

THE CRUCIBLE

Historical Metallurgy Society News
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SEM image of dross from ancient bronze melting

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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

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The **HISTORICAL METALLURGY**
Society

50TH ANNIVERSARY

The UK is one of very few countries where the use of a metal detector to search for ancient treasure is legal within certain limits, and finders are encouraged to report the objects they recover to the government-endorsed Portable Antiquities Scheme, where they are catalogued (www.finds.org.uk). This very issue of *The Crucible*, for example, reports on an HMS workshop that included a visit to a cache of Iron Age swords from South Cave, discovered by metal detectorists in East Yorkshire. Legally or not, however, metal detecting takes place in many archaeological sites worldwide, and anyone interested in archaeological and historical metallurgy should have an informed opinion about this matter. Should metal detecting be allowed? Does the occasional discovery of a spectacular find justify the potential destruction of countless archaeological contexts?

This issue of *The Crucible* introduces a Forum where archaeologist Chris Cumberpatch elaborates on what, he argues, are the “incompatible methodologies” of archaeologists and what he calls “object hunters”. Metal detectorist Peter Barker replies by claiming that metal detecting has done “much for the greater good of understanding our past”. Perhaps not surprisingly, the issue is far from resolved – but we are very grateful to both Chris and Peter for laying out their arguments so clearly and precisely so that we are all encouraged to think. It is unfortunate that both the UK’s National Council for Metal Detecting and the Federation of Independent Detectorists ignored our invitation to contribute to this discussion, in spite of the fact that they formally endorse the Code of Practice for Responsible Metal Detecting in England and Wales. We would like to extend our invitation to any readers of *The Crucible* who would like to add their thoughts or experiences, and would be particularly keen to publish the view from those outside the UK. For those who would like to read further (and occasionally heated) debate about collecting, metal detecting and the Portable Antiquities Scheme, they can do so in volume 20 of Papers from the *Institute of Archaeology*, published in 2010 (<http://pia-journal.co.uk/issue/view/3>) or the just published issue 33 of *Internet Archaeology* (<http://intarch.ac.uk/journal/issue33/index.html>).

The rest of this issue includes a mix of news and reports that hopefully has something for everyone: from research on the earliest metallurgy of copper in Europe, through a workshop on the earliest use of iron in Asia, and up to a review of the much more recent DVD box set on the steel industry launched by the British Film Institute, among others. We also include A Letter from North America reporting on the archaeological remains of English attempts at exploiting iron in early colonial Virginia. The One Minute Interview zooms into Professor David Killick, who is one of the world’s foremost archaeometallurgists, and has made many significant contributions to our understanding of technology within Africa and beyond. Many readers will not meet anyone new in the Meet Your Council section, since Justine Bayley will be a familiar face and name to most HMS members. However, we will hopefully find out more about her long and crucial involvement with our Society.

A peculiar highlight of this issue is a historic photograph of Ronald F. Tylecote examining a piece of slag! In 1962 Tylecote became, together with G. R. Morton, the founding father of the ‘Historical Metallurgy Group’ that has just turned 50. His support of our society continues to be celebrated through the R. F. Tylecote Memorial Fund, which sponsors travel and research expenses for our members (see <http://hist-met.org/grants.html>).

As we try to learn the job from our new virtual office at UCL, we are very keen to express our thanks to the many readers who took the time to send us congratulatory emails on our last issue – and also to those who rightly pointed out a few technical glitches. We appreciate your indulgence as much as your corrections, suggestions, view and articles. Please keep them coming, and keep spreading the word!

Hopefully by the time this issue of **The Crucible** reaches you we will be closer to summer (at least in the northern hemisphere). As I write this at the beginning of April there is still snow on the ground here in Shropshire. However HMS members are not deterred by such things, as the report on the Spring Workshop organised by Peter Halkon for the Archaeology Committee shows.

The Anniversary Meeting is only a few weeks away, and I am certainly extremely excited about this event. Many thanks in particular to Eleanor Blakelock for dealing with all of the logistics, as well as to the session chairs and others for developing an excellent academic programme. More details about the conference can be found in this issue of **The Crucible**. To coincide with the Anniversary Year the Society has set up an Anniversary Fund to enable more generous grants to be made in support of archaeometallurgical research and publication; full details will be available when we launch the Fund at the Anniversary Meeting.

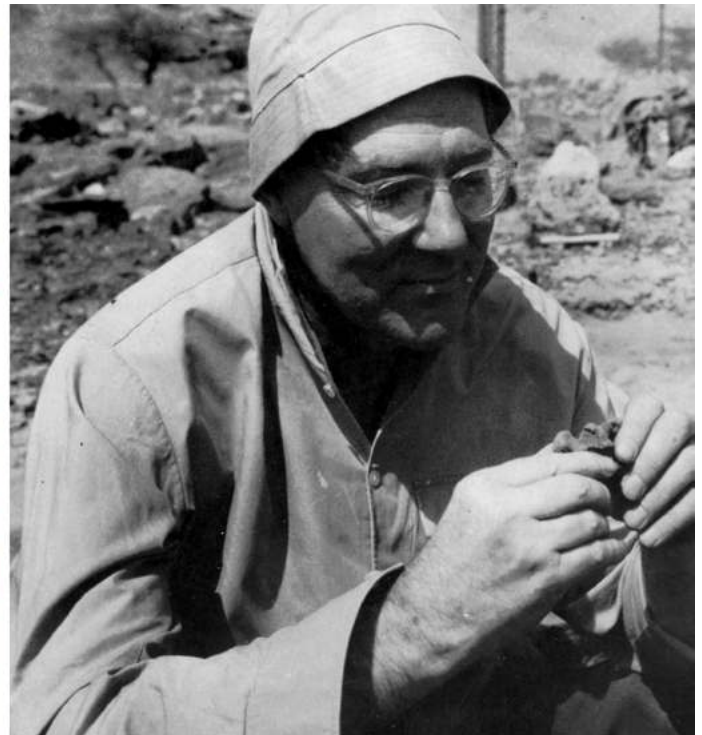
The various Committees of the Society have continued their hard work. As a result we will soon see a refreshed HMS website with lots of new content, we have an exciting programme of events stretching over the next few years, and the launch of the new expanded and revised series of archaeometallurgy datasheets is imminent. Care of our collections also continues, with the metallographic specimens now housed at the University of Oxford who are embarking on an active programme of research and conservation. The Publications Committee is working hard to bring the Journal back to schedule, and will also be releasing two Occasional Publications this year featuring papers from previous conferences in Bradford and at West Dean. All of the functions of the Society rely on the dedication of volunteers – it never ceases to amaze me just how much work does get done on this basis – but there is always room for more hands to make lighter work. Contact details are on the website; please don't hesitate to offer your expertise if you think you can help!

This mailing also includes details of the AGM. Council have put forward some suggestions for new nominations to replace retiring Council members, all of whom have made a very positive contribution during their time in office. Particular thanks must go to our Treasurer, Mike Cowell, who is stepping down from this role this year after more than 20 years looking after our finances. He has done a tremendous job in ensuring the financial stability of the Society – particularly during the challenging economic situation in recent years.

I hope that you all have a wonderful spring, and very much look forward to seeing as many of you as possible at the Anniversary Meeting in June.

Paul Belford

THINGS DON'T CHANGE



In this anniversary year there have been many highlights. Eleanor Blakelock sent this photo of people at the Birmingham conference in 2012 discussing slag on the fieldtrip (and how similar it is to an old photo of Ronald F. Tylecote to the right). It's clear to see that some things don't change. What has been your anniversary year highlight?

THE RISE OF METALLURGY IN EURASIA

The AHRC-funded project “The Rise of Metallurgy in Eurasia: Evolution, Organisation and Consumption of Early Metals in the Balkans” aims to investigate the how and why of the earliest known pyrometallurgical activities, which were documented in Serbia, c. 7000 years ago. It involves eight institutions from the United Kingdom, Germany and Serbia. The 3 year project, led by the UCL Institute of Archaeology and the Durham University team, was launched in July 2012, and under the close eye of international and national media, commenced excavations and geophysical survey of three Vinča culture sites in Serbia: Belovode, Pločnik, and Jarmovac.

The discovery of the earliest known copper smelting activity in the site of Belovode revived the debate on the origins of metallurgy, the first transformative technology. The advocates of two opposing perspectives, the diffusionist model of the spread of metallurgy from the Near East (Dr. Benjamin Roberts, Durham University), and the multiple inventions model (Dr. Miljana Radivojević, UCL Institute of Archaeology), are guided by Prof. Thilo Rehren (UCL Qatar), in exploring the origins of metallurgy in the Balkans. They are joined by renowned experts in provenance analysis (Prof. Ernst Pernicka, University of Tübingen), mining archaeology (Prof. Thomas Stöllner, Deutsches Bergbau-Museum) and geophysical survey (Dr. Knut Rassmann), and regional specialists in Vinča culture archaeology, Julka Kuzmanović-Cvetković (Museum of Toplica, Prokuplje), Savo Derikonjić (Homeland Museum in Priboj) and Dušan Šljivar (National Museum in Belgrade).

The four sites, Jarmovac, Belovode, Gornja Tuzla and Pločnik, have individually demonstrated evidence for three steps in the production of metal (in the same order): mining, production and consumption. Both Belovode and Pločnik are radiocarbon dated between c. 5350 BC and 4650 BC, while the sites of Jarmovac and Gornja Tuzla have thus far only been dated relatively within the Vinča culture. The new excavations at Belovode and Pločnik are targeted towards investigating the finer chronological and stratigraphic sequence of these settlements in relation to metallurgical activities discovered during earlier excavation campaigns directed by the National Museum in Belgrade and Museum of Toplica in Prokuplje. The Belovode 2012 excavation campaign revealed a dwelling structure in a 25m² trench together with associated pits. These were accompanied with numerous sherds of Vinča culture pottery and figurine fragments, flint blades, and tens of small malachite fragments, which could have been beneficiated and prepared for smelting. This assumption is supported by high temperature archaeometallurgical



Launch of the project (left from right): Savo Derikonjić, Ernst Pernicka, Julka Kuzmanović-Cvetković, Miljana Radivojević, Thilo Rehren, Michael Davenport (UK Ambassador to Serbia), Predrag Marković (Minister of Culture), Stephen Shennan, Tatjana Cyjetičanin, a representative of the Embassy of Germany, Dušan Šljivar and Ben Roberts.



Geographical locations of the sites in Serbia.

finds (slags and a slagged sherd) discovered in the trench situated in the newly excavated area in 2011. The Belovode 2012 campaign yielded thus far sufficient information on site formation, and the UK-Serbian team will continue to investigate this settlement further in 2013.

The excavated area in the site of Pločnik was located between two attested copper workshops, discovered in earlier campaigns. Both of the structures had been termed workshops by the excavators and had revealed finished metal artefacts (made of pure copper but also of tin bronze!), together with lumps of malachite, fragmented tools and ornaments made of copper metal. This single-



Excavations in Pločnik revealed a dwelling structure with a dozen malachite fragments.

occupation Vinča culture settlement is traditionally considered to be the consumption site, given that more than 40 heavy copper implements were discovered but no production evidence thus far. The team discovered a large dwelling structure (c. 6 x 4 m), with numerous remains of lithic production, followed by finds of copper minerals with significant concentrations of iron in them. Next to the house structure, an ephemeral construction with blocks of stone and ceramic sherds was uncovered, together with a copper metal earring adjacent to it. It is possible that the ephemeral structure was related to the processing of the earring, but this question had to be left to be resolved in the 2013 season. Geophysical survey of Belovode and Pločnik revealed promising results in terms of the organisation as well as the vast scale of these settlements. Both sites are estimated to cover c. 60 hectares, but further investigation will reveal more



1cm

A metal earring from Pločnik.

precise dimensions. At the site of Jarmovac, the team surveyed the area for ancient mines, and will continue the earlier excavations started in one of the shafts where Vinča culture pottery has been discovered.

It remains to be seen how much more we will learn about the sequence and organisation of activities at the three sites. The UK-German-Serbian team will continue to work in 2013 on different aspects of the metal production, including the analytical work that is currently being done at the UCL Institute of Archaeology and the University of Tübingen. In addition, the PhD research within this project (conducted by Silvia Amicone) is attempting to explore the frequently speculated technological relationship between pottery and metal making, testing the traditional theory of their interdependence.



Archaeological team prospecting for copper ores in the Jarmovac mining area.

After a promising first year, the next two years will hopefully continue to offer new data which will help us understand how and why pyrometallurgical activity emerged in western Eurasia.



Arts & Humanities
Research Council

*Miljana Radivojević
Benjamin Roberts*

HISTORICAL METALLURGY SOCIETY

50TH ANNIVERSARY CONFERENCE

14TH TO 16TH JUNE 2013

FRIENDS HOUSE, LONDON

SEE BACK PAGE FOR DETAILS

OR

WWW.HIST-MET.ORG



MEMBERSHIP, PUBLICITY AND PROGRAMMES COMMITTEE REPORT

The 50th Anniversary of The Historical Metallurgy Society is now drawing to a close, and we will be finishing our anniversary year with a bang. Just to remind all of you, there has been a slight change of dates and a change of London venue, so the details for your diary are the 14th-16th June 2013 at Friends House, near Euston Station. There will be wine, a pyrotechnical cake, a fantastic range of talks on topics spanning the globe, book stalls and a poster session. The Friday evening AGM and wine reception is free for all HMS members, but booking is essential. The booking form and programme are available on the website <http://hist-met.org/agm2013.html>.

2013 is the year of anniversaries, so to mark the centenary of stainless steel the HMS annual conference will return to Sheffield on the 19th-20th October to celebrate the 100th year of stainless steel with a meeting based at the Cutlers' Hall. A call for papers is included in this issue of *The Crucible* and more details will be on the website soon.

It has never been easier to run a HMS event, as the MPP is completing its very own 'how to run an event' guidelines. The events officer and MPP are happy to assist members who are interested in setting up their own Historical Metallurgy meetings or conferences. We are keen to hear from members about meetings you would like to see happen.

The MPP committee will hopefully launch the new website, providing improved facilities such as online payment, links and new events pages. The Journal and Occasional Publications Series are also being rebranded but plans for these are less advanced.

We are also developing a range of Historical Metallurgy Society merchandise, so you will soon be able to purchase HMS mugs, T-shirts and pens. All proceeds raised will go into the Anniversary Fund to support research into all aspects of historical metallurgy.

As always MPP is currently concentrating on publicity and raising awareness of HMS internationally so we are looking to recruit new members to our committee. It's not a huge commitment and we can accommodate corresponding members using email or Skype, so if you are creative, or have any ideas about what HMS should be doing or just would like to help HMS develop, we would love to hear from you – particularly if you are a historian or work in the metallurgical industries.

STAINLESS STEEL 100TH ANNIVERSARY CALL FOR PAPERS

HMS Annual conference, 19th-20th October 2013, Cutlers' Hall, Sheffield

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. 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.

Papers are welcomed on topics covering all aspects of stainless steel, or other modern alloys. Abstracts for papers should be submitted by 27th April 2013. For more information or to submit an abstract please contact HMSannualconf@hist-met.org or post to Eleanor Blakelock, Conservation and Scientific Research, British Museum, Great Russell Street, London WC1B 3DG, UK.

Abstracts should be no longer than 250 words. Please include the name and affiliation of all authors and indicate the presenting author in bold letters.

Booking forms will be available on the 14th of April. For more information and for the booking form visit www.hist-met.org.

HMS REMINDERS

E-MAILS

We feel honoured that many of you have been members of HMS for a long time – so long, that you didn't have an email address when you joined. We are now trying to update our records to include email addresses for everyone. So please, take a minute and email our Subscriptions Secretary, Lesley-Ann Cowell, with an update of your contact details at: lesley@mcowell.flyer.co.uk. Please note if you are happy for us to use this as the primary means to contact you. You'll help us save time and trees.

WEBSITE

We would like to remind all of those who perhaps haven't visited the website (www.hist-met.org) in some time that a number of reference works are freely available online. These includes the *Metal and Metalworking* framework for archaeometallurgical studies in the UK, all past issues of the *HMS Newsletter*, and a number of relevant datasheets on various sub-topics of archaeometallurgy.

AN UPDATE ON HMS PUBLICATIONS EVENTS OFFICER REQUEST

The Publications Committee is working towards making current and back issues of *Historical Metallurgy* available online. There are a number of options for this but final decisions have still to be taken. The recent move towards Open Access publishing of publicly-funded research, in the UK as well as in many other countries, is just one of the issues we have to consider. Updates on progress will appear in future issues of **The Crucible**.

We regret the delay in publishing *Historical Metallurgy* but are expecting to produce the four issues of Volumes 46 and 47 during the next twelve months. The first of these will be with the printer (and possibly with you) by the time this newsletter is sent out. The next two issues will be sent to you in the summer and autumn this year, and the last one early in 2014.

There are also two Occasional Publications in production – we expect both will be published this summer. The first is *Accidental and Experimental Archaeometallurgy*, edited by David Dungworth and Roger Doonan, containing 18 papers mostly arising from the HMS conference held at West Dean in 2010. The second is *Iron and Ironworking*, edited by Paul Belford, Justine Bayley and David Crossley, containing 15 of the papers on ferrous subjects that were presented at the HMS meeting held in Bradford in 2009.

IAMS SUMMER SCHOOL 2013

The Institute for Archaeo-Metallurgical Studies will be hosting its annual two-week training course in archaeometallurgy in London following the HMS 50th Anniversary Conference. With topics covering theoretical, practical, and technological approaches to the study of ancient metals, it is a great opportunity for anyone interested in learning more about conducting research in this field. Speakers include Professor Thilo Rehren, Dr. Simon Timberlake, Dr. Anna Feurbach, Dr. Brigitte Cech, Dr. Eleanor Blakelock, and Dr. Marcos Martín-Torres.

Date: 17th – 28th June 2013

Location: UCL Institute of Archaeology, London, UK

Number of places available: 20

Some limited funding available

Website: <http://www.ucl.ac.uk/iams>



One of the benefits of the new website is that the events officer will be managing the events pages, keeping them up to date. Conference pages will remain on the server after the event has taken place, along with abstract books. There will also be a new page where relevant metallurgy conferences or other events of interest to our members can be advertised. If you know about an event please let the events officer know so that it can be included, and also that potential clashes are avoided.

As a long term project, the events officer intends to create pages for past events, so if you have any photos of past conferences send them to the address below. I would also be interested in any comments or feedback about past conferences, or if organisers still have digital or scanned versions of abstract books for these pages.

Eleanor Blakelock
eleanor.blakelock@blueyonder.co.uk

THE POST HOLE

We have been asked to circulate this message from the student-run archaeology journal, *The Post Hole*. It publishes on a wide range of archaeological topics, from prehistory to the present day, giving readers the latest news, research and events in the world of archaeology, heritage and archaeological science. Issues are published via their website at the start of each month during the academic year and are available to anyone.

The primary aims of the journal this year have been to rectify the lack of publishing opportunity which is presented to the majority of young archaeological scholars, and create an established and respectable platform from which they can have their research and voices heard within the wider academic community.

If you are interested in writing for *The Post Hole*, or know any students who may be interested in learning of this opportunity, information and guidance for authors can be obtained by visiting their website at <http://theposthole.org/> or through contacting their submissions editor (Alison Tuffnell) at submissions@theposthole.org. In addition, if you are interested in working directly with them to help in sharing this opportunity with an even larger academic community, please email editor@theposthole.org.

METAL DETECTING AND ARCHAEOLOGY: A TALE OF TWO METHODOLOGIES

Cris G. Cumberpatch, Archaeologist

The long running debate between archaeologists and metal detector users took an unexpected turn recently in the form of the decision by the Society for Historical Archaeology (SHA) to accept sponsorship for their conference in Leicester from a company retailing metal detectors. The company in question, Minelab, make no secret of their commitment to metal detecting as a potentially lucrative hobby, as a glance at their website clearly shows. Indeed there is no reason why they should be secretive or apologetic for it, the activity being (within prescribed limits) an entirely legal one which has been enthusiastically endorsed by politicians of both major political parties, notably David Lammy and Ed Vaizey, former and current ministers at the Department for Culture, Media and Sport respectively.

As a professional archaeologist working mainly in the field of historical archaeology I felt it necessary to challenge the SHA on their decision, believing it to be a misguided one which would give Minelab and their clientele a claim to be supporting archaeology in Britain and thus a degree of legitimacy alongside more conventional funding bodies. An exchange of e-mails followed in which valid points were made on both sides but which, perhaps inevitably, left the main issues unresolved.

When I was invited to write this piece for [The Crucible](#), I felt that it would be useful to present the arguments that I used in my dialogue with the SHA as a means of revisiting a debate the main outlines of which are probably well-known to the majority of readers. Rather than focussing on issues such as the theft of material from Scheduled Ancient Monuments, the looting of sites under excavation, the difficult question of the funding of the rewards offered to successful artefact hunters under the Treasure Act or the frighteningly high cost of maintaining the Portable Antiquities Scheme (PAS) (see <http://paul-barford.blogspot.co.uk> for discussions of these aspects), it seemed to me that it might be more valuable to focus on the question of the incompatible methodologies employed by archaeologists and by artefact hunters.

There is little doubt in my mind that Minelab will use their presence at the SHA conference to represent themselves as an equal and responsible partner in archaeological investigations. This is despite the fact that the methodology employed by artefact hunters bears almost no relation to archaeological methodology as developed over the last century and a half. We have spent many years and a great deal of effort in developing the means of understanding and recording archaeological sites, the formation processes responsible for their existence and the intricacies of the

stratigraphic record in ways that allow us to draw robust inferences from archaeological data. These techniques allow us to make statements about the past that are both internally coherent and consistent with other archaeological and historical data.

Accepting artefact hunting as a comparably legitimate means of knowing the past means setting these methodologies aside in favour of one which ascribes primary importance to a tiny proportion of the artefactual record while seemingly disregarding anything that does not fall into the category of 'metal with a perceived aesthetic or financial value'. This, to my mind, is not archaeology and in terms of method, it does not even approach anything that can be judged to be archaeologically acceptable. While the PAS records and publishes the details of finds that are reported to them, the contrast between what is recovered from archaeological excavation and what is reported after artefact hunting expeditions suggests that much is either not reported or is not recorded by the PAS staff and in consequence does not enter the archaeological record. Where, one might ask, are the many objects and fragments that form the greater part of archaeological assemblages; the shapeless but informative scraps of metallic production waste, the nails, the animal bone, pottery, worked stone and so on? Where are the opportunities to take environmental samples? The absence of any recording of the archaeological strata from which the objects came or of the relationships between these strata indicates a degree of collateral damage to archaeological deposits that is at odds with the most basic principles of archaeological investigation.

On these grounds I have to reject the claim made by artefact hunters and their supporters to be carrying out legitimate investigations into our past. The results, notwithstanding the occasional spectacular find that attracts media attention and the admiration of poorly informed politicians, are not comparable with the results of conventional archaeology which allow us to reconstruct the detail of past lives in all their richness and diversity and so cannot be considered to be legitimate in archaeological terms.

There is no real excuse for the artefact hunter's approach to the past. The UK has and has had for many years a network of local and regional archaeological and historical societies who carry out archaeological survey and excavation of a very high standard. Recent access to funding from the National Lottery has allowed an unprecedented expansion of such activities. This has involved the development of productive collaborations between people who have a genuine interest in the past of their communities and are keen to learn and to deploy tried and tested methods of archaeological investigation and professional archaeologists. Such groups are, in my experience at least, keen to welcome new members. It is their activities (survey, documentary research, test pitting,

excavation, finds analysis etc) that I would wish to see encouraged by bodies such as the SHA and the British Museum, home of the PAS. It is, in my view, extremely regrettable that in an effort to salvage something from the essentially antiquarian approach represented by artefact hunting, we seem to have lost the capacity to question the efficacy and intellectual legitimacy of the artefact hunting methodology. In surrendering the methodological high ground to artefact hunters I would suggest that we have severely weakened our capacity to provide a reasoned critique of artefact hunting practice and the damage that it undoubtedly inflicts on our dwindling archaeological assets.

RESPONSE

Peter Barker, Detectorist

The main thrust of this article appears to be a comparison between the applied approach of archaeology and metal detecting and that there is criticism that the latter approach does not apply the same methodical approach to achieve the same outcome e.g. recording archaeological strata and taking environmental samples. Clearly these methods can only be reasonably undertaken by archaeological excavation, over a long period, and with the requisite expertise. They are beyond the scope of metal detectorists and this criticism is unfair.

Archaeology and metal detecting are two distinct approaches to enriching our knowledge of the past. It has to be said that the illegal looting of scheduled sites and digs currently being undertaken is indefensible. Unfortunately there may always be a criminal fraternity operating in such a manner, and whilst this article does not mention a stop to metal detecting, there is a strong inference, however, a ban on metal detecting in the UK would be unlikely to prevent such incidents of illegal looting and may actually increase the problem if a wholesale ban was introduced.

So what can metal detecting do to increase our knowledge of the past and what benefits can it bring? It is clear that many new sites have been discovered by responsible detectorists i.e. those who record with PAS which would otherwise have remained undiscovered indefinitely. These sites may have a few metal artefacts and few (if any) surface finds to indicate former occupation and/or never be field walked by a local society.

The discovery of these sites and large tracts of land where there is 'background noise' e.g. stray finds made by detectorists, but not actual occupation areas, are significantly enhancing our view of migration and settlement in Britain, and Roman coin-usage to name only a small number of examples. The Test Valley in Hampshire would be a good example, where a number of detectorists recording with the scheme are active and regularly bring along finds to their Finds Liaison Officer (FLO) for recording. These finds can never be reasonably expected to be found within

an archaeological context, everyone would understand that it is impractical and completely uneconomically viable to excavate vast tracts of the countryside where only a few finds will be expected to be discovered; only responsible metal detector users can ever achieve the recovery of these items.

In my experience FLOs will almost always record all finds at least 300 years old. It is perhaps inevitable that some detectorists will consciously grade their better finds and bring them to their local FLO leaving aside the lead pot mends, pottery sherds and nails and in that sense the actual objects recorded are skewed to certain groups of items. However, with better education and encouragement from those within the archaeological community this situation could improve.

The spectacular detecting discoveries e.g. the Frome Hoard, the Hoxne Hoard and the Staffordshire Hoard of recent years, to name just a few, have aroused the interests of the wider UK public in history and Cumberpatch does not appear to disagree with this. In my view these big discoveries that arouse much media attention help to enlighten those with little or a partial interest in history, provide academics with much more information on sometimes little understood areas of British history and years of enjoyment for the public to view the objects when they are eventually displayed in museums. This latter benefit is immeasurable.

The financial reward for these and treasure cases appears to also be under question. However, the alternative is rather less palatable. If finders are not given adequate reward for treasure items that are not disclaimed there will be plenty of dealers/collectors who will be willing to purchase such items and they will disappear from the record forever, and this was clearly happening before the introduction of PAS.

The depth recovery of most machines is largely a myth made by metal detecting manufacturers— it is just one way of selling more machines. Most coins and artefacts can only be found in the first few inches of plough soil and stratigraphic layers should be left largely intact.

Archaeologists and responsible detectorists should aim to work together, and clearly are in more and more situations; they can never hope to achieve the same results as both are distinct activities and whilst it would be foolish to pretend there aren't problems with illicit metal detectorists and those that do not record objects, there needs to be a sensible balance. Few could argue that metal detecting hasn't done much for the greater good of understanding our past in Britain, especially since the introduction of the renowned PAS scheme just over 15 years ago.

*What's your opinion? **The Crucible** is happy to see your further comments on this issue. Please email to thecrucible@hist-met.org*



DAVID KILLICK

Professor David Killick is one of the world's foremost archaeometallurgists and Africanist. He has revolutionised the study of African iron smelting, and has also worked on copper smelting in Peru, tin smelting in South Africa, and on 19th-century bloomery furnaces in New York. He is also a rare kind of archaeological scientist in that he combines anthropological and archaeological theory in his works, along with extensive fieldwork experience. Professor Killick was born and raised in the British colony of Nyasaland, which became the independent nation of Malawi in 1963. He received education in boarding schools in Rhodesia (now Zimbabwe) and then at the University of Cape Town in South Africa. He started out in Geology, with his fellow archaeometallurgist Duncan Miller as a classmate, but switched to African history and archaeology after two years. His Professor of Archaeology, Nikolaas van der Merwe, was a Yale PhD, and on his recommendation David Killick was offered a scholarship to Yale. After Professor van der Merwe was appointed to an endowed Chair at Harvard in 1989, David was hired to equip the Harvard archaeometry laboratories while he finished his PhD. In 1991 he was hired at the University of Arizona by David Kingery, for the new Culture Science and Technology program. Killick initially taught the history and sociology of technology to engineers while teaching archaeometry and African studies in the Anthropology Department. From 2003 to 2008 he directed the National Science Foundation/University of Arizona graduate training program in archaeological sciences, which has so far produced 22 PhDs. He runs a well-equipped laboratory in Anthropology for optical

techniques, and collaborates with isotope geochemist Joaquin Ruiz to use heavy isotopes for provenance of non-ferrous metals, turquoise, glass and glazes. David Killick's recent interests span across two continents, Africa and the Americas, and include iron, tin, bronze, and pottery provenance. He is a member of the Editorial Boards for the *Journal of Archaeological Science*, the *Journal of African Archaeology* and *Ethnoarchaeology*.

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

DAVID KILLICK: My family consider me the poster child for Attention Deficit Disorder, and although I've never had an official diagnosis, that would explain a lot! I'm interested in almost everything except mathematics, astronomy and biochemistry. I read widely and pick up new techniques readily. I've had to do so, as there is little support in the USA for laboratory-based archaeological science. I've never been able to employ a laboratory technician and so do almost everything myself, from raising the funds to drafting the figures. This has obvious disadvantages with respect to productivity, but the advantage is that I have acquired an unusually broad range of skills and perspectives, and am never bored. The first half of my research career was narrowly focussed on African ethnoarchaeology and archaeometallurgy, but I found this too restrictive, and so in the second half I expanded into a much wider range of archaeological sciences, and especially into provenance studies of materials like pottery, turquoise, glasses and metals, using petrography, chemistry and isotopes.

THE CRUCIBLE: What is your most memorable professional moment?

DAVID KILLICK: I think that it would have to be when a lion roared very close to us while we were excavating a site in tall grass in Malawi. There was a panicked rush back to the truck, and - after a moment of relief - another panic when we realized that the keys were back at the excavation! Fortunately the lion lost interest and wandered off.

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

DAVID KILLICK: I pick Paul Craddock – with apologies to Duncan Miller and Thilo Rehren, both of whom have also been major influences. I don't know Paul very well, but his ability to integrate history, archaeology, chemistry and metallurgy strongly influenced my own approach. He was also almost unique among European archaeometallurgists of his generation in having an interest in African metallurgy, and his broad comparative knowledge and perceptive suggestions were extremely valuable to me.

THE CRUCIBLE: What is your main current project?

DAVID KILLICK: I don't have one. As usual I have about a dozen projects in various degrees of disarray. All of them are collaborations with other colleagues, or with current or former students. These include tin mining and smelting in South Africa, lung-powered copper smelting in Peru, technology transfer in the early Spanish colonial period in the Americas, turquoise in the American Southwest and Mexico, trade across the Indian Ocean in the Islamic era, and ceramic petrography studies in New Mexico, Botswana and New Caledonia.

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

DAVID KILLICK: There is no chance of a multi-million dollar project in archaeological science in the USA, where public support for science in general is declining. But I can at least dream of a well-funded international collaboration to tackle the question that Jim Muhly raised forty years ago – where are the sources of ancient tin? He was thinking of the sources of tin for the Near Eastern and Mediterranean Bronze Ages, but I would like to expand the question to the whole of Eurasia, and Africa too. Two recent advances in techniques make this a good time to return to this problem. The first is the development by Ernst Pernicka's group of tin isotope ratios for provenance. This is not a general solution, as the natural range of tin isotope ratios is small, but tin isotopes can be used in combination with lead isotopes. Our group at Arizona has shown that tin from older ore deposits (>200 million years) can be "fingerprinted" by lead isotope isochrons, and that these isochrons can sometimes still be recognized after the tin has been alloyed with copper to form bronze. These

techniques would be combined with a systematic search for, and excavation of, tin mining and smelting sites in all potential source areas.

THE CRUCIBLE: Which publication should every HMS member read?

DAVID KILLICK: I think that every archaeometallurgist should read Donald Wagner's volume on ferrous metallurgy in Joseph Needham's series *Science and Civilization in China* (Volume 5, part 11, 2008). The breadth and depth of his research offers a silent rebuke to the current tendency in Anglo-American archaeological science, which is to carve research results up into as many publishable slices as possible. This book is the magnum opus of a superb scholar, and all the more remarkable for the fact that he was never offered a permanent position in a university.

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

DAVID KILLICK: Try not to specialize too narrowly. As far as careers are concerned, that path often leads to a dead end. And always try to situate your work within some larger intellectual context, so that you can show others – historians, engineers, archaeologists, funding agencies, or the literate public – why your work is interesting and even (sometimes, maybe) important.

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

DAVID KILLICK: Archaeometallurgy has come a long way in the last fifty years. Back then it was a hobby (and/or therapy) for a small group of talented people with other careers. Although avocational scholars still make important contributions, archaeometallurgy has evolved into a distinct field of academic study of almost unmanageable complexity, best done by teams of professional scholars, each with a distinct package of skills. Our current challenge is how to steer the transformation of archaeometallurgy from a hobby to a profession. I certainly worry about how my students will make a career out of it.

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.

JUSTINE BAYLEY

My involvement with HMS goes back to the 1980s. My first real memories of HMS were when Ronnie Tylecote asked me to talk about Iron Age metallurgy in Wessex to the annual conference held in Southampton in 1983, and the following year I put together a display about the Tudor Mint at the Tower of London for the HMS Spring meeting there – a project I’m still trying to complete nearly 30 years later!

When I was invited to join the HMS Council I replied saying I didn’t think I was the sort of person they wanted as I wasn’t interested in dead blast furnaces. The reply came: that’s why we want you – and I’ve been on Council ever since, first as an ordinary member, then as Treasurer for five years, and since 1990 as joint Honorary Editor. Becoming Editor was not something I’d planned to do, but a few weeks before Ronnie Tylecote, the founder Editor, died he summoned me and David Crossley to see him and told us we were to edit the Journal. No question of whether we wanted the job or were able to do it, and of course the precedent is that you die in office!!

In my years working for HMS I’ve run several conferences (in York, Portsmouth and Dublin) and a short trip to Normandy to visit metalworking sites there. I’ve also served on various committees, most particularly the Archaeology Committee, where I’ve helped draft guidelines and datasheets, edited the research framework, and run many ‘Slag Days’ that introduced archaeologists across the country to the joys of archaeometallurgy.

In HMS’s 50th anniversary year the temptation is to look back, and I have lots of good memories – of people and places – but one certainty is that things will continue to change. This affects not only HMS but the whole discipline of which it is part. So much more is now known than when I started – and some of that knowledge is things I’ve discovered, or at least demonstrated, which gives me a real buzz. However, despite all the advances there are still so many knowable unknowns that archaeometallurgy remains an exciting subject in which to work.

I’ve worked through an exciting time when so much has changed. The first XRF system I used filled a whole room, but now I can pack a portable machine in my hand luggage. The quality and quantity of research has grown out of all recognition, as has *Historical Metallurgy*. My first issues were set with movable type, but now it’s all computerised – and soon I’m expecting it to be accessible to all in digital format, though quite how we do that while maintaining HMS’s financial viability is this year’s main conundrum. I may no longer be a young upstart; perhaps I’ve become part of the Society’s ‘old guard’ but I’m not going to take a back seat while there’s still so much to do. I may have to begin to grow up, but I’m not going to admit I’m growing old!

Justine Bayley



Justine Bayley wielding the replica South Cave sword during a HMS workshop.

IRON SMELTING TRIALS AT FORT ST. GEORGE, MAINE, 1607-1608

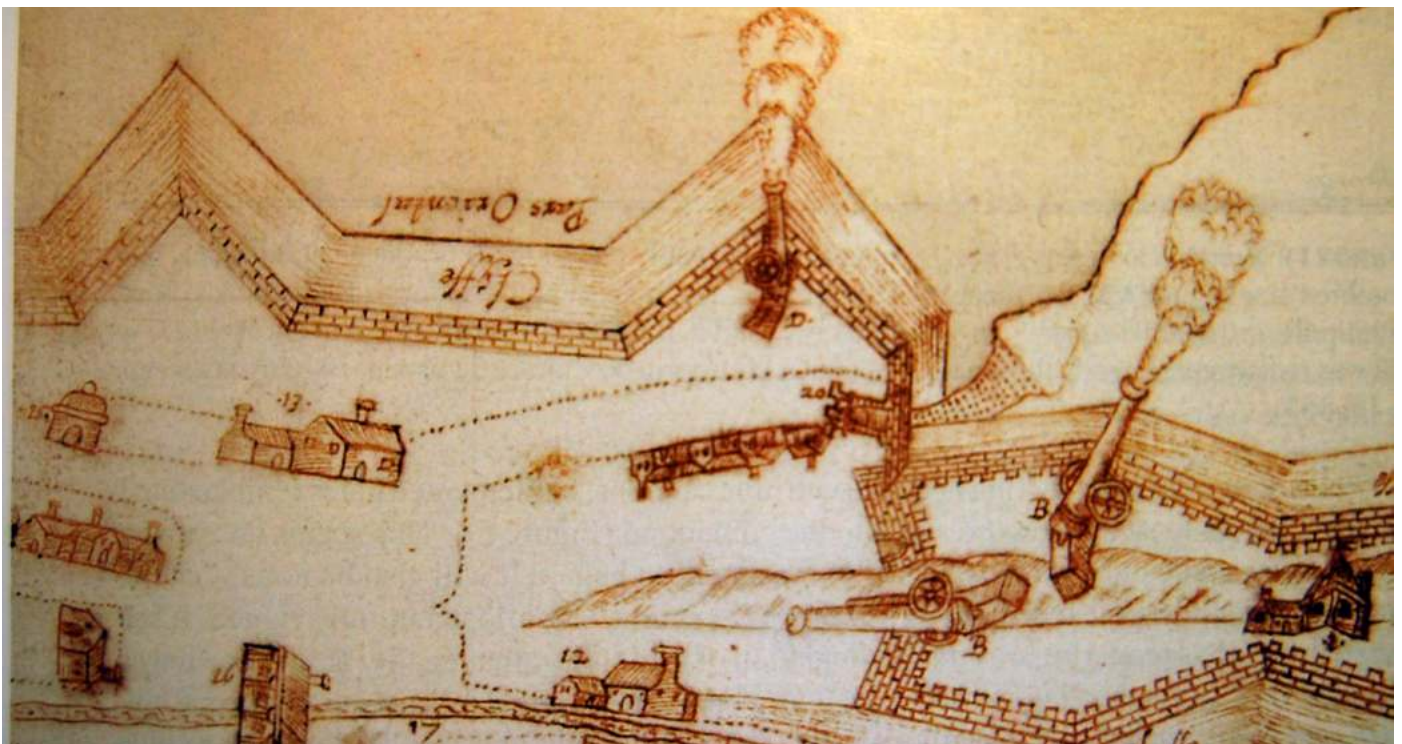
Analysis of slag excavated at the site of the first attempt to plant an English colony in North America shows that exploitation of mineral resources was one of the aims of the seventeenth-century colonial adventurers. The Virginia Company chartered by James I aimed for both a southern and a northern colony in eastern North America. Sir Fernando Gorges, commander of the Plymouth Fort, and Sir John Popham, Lord Chief Justice of England, dispatched some 120 men under the leadership of George Popham and Raleigh Gilbert in the spring of 1607 to found the northern colony. (The southern one, launched later, would become Jamestown.) Upon arrival in August the colonists selected a site on the coast of present-day Maine, and set about constructing a fort that would enclose dwellings, store-houses, and workshops. Building was well along by December, when some of the colonists returned to England with their ship; the rest settled in for the winter. George Popham died in February and in the spring the returning supply ships brought news that made Raleigh Gilbert, now heir to substantial estates due to the death of his half-brother, want to return home. Leaderless, the colonists abandoned their enterprise in 1608 and returned to England.

We would not even know for sure where the Popham colony was but for the Spanish ambassador to England, who in 1608 acquired and sent off to Philip II of Spain John Hunt's plan of the colony drawn the previous August. Discovered some three centuries later in a Spanish archive, the plan shows the colony's fortification and buildings. Jeffrey Brain's fourteen

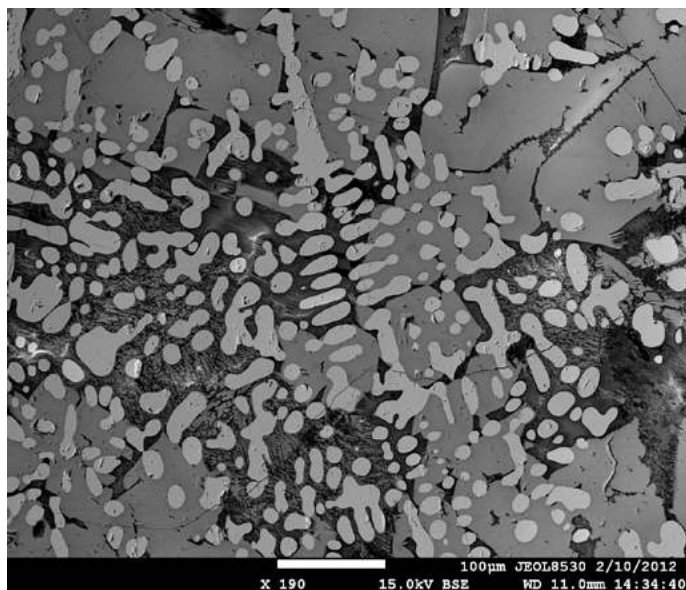
seasons of excavations at Popham Beach on the mouth of the Kennebec River uncovered features that exactly match Hunt's plan (Brain 2007).

Included in the Hunt's plan is a sketch of the smith's house showing an attached structure fitted with a stack. Excavations during the thirteenth field season revealed the stone bases of three hearths about 600 mm diameter and 200 mm high within this structure. Daub recovered from the layers above the hearths suggests that clay domes or stacks surmounted the hearth bases. Charcoal and nearly a kilogram of slag were found (Brain 2010). The microstructure of the slag shows that it is composed of fayalite crystals and wüstite dendrites in a glassy matrix that contains a fine precipitate of fayalite and droplets of iron. Microprobe analyses confirm the identification of constituents based on their appearance, and show that in addition to Fe, O and Si the slag contains only trace amounts of other elements, principally Al, Ca, and Mg. Notably absent are Mn and hercynite. Two microstructural features prove that the slag originated in iron smelting: the droplets of iron arrested in the process of coalescing together, and large masses of wüstite that were dissolving in the slag at the time of solidification.

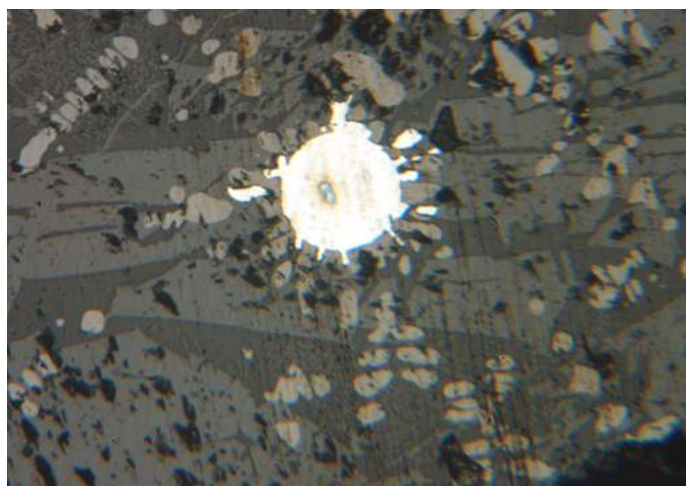
The Popham adventurers expected their colony to be a place for restless Englishmen the authorities found troublesome at home, and a source of wealth to be derived from American natural resources. Since iron ore in a location with abundant wood fuel would be a valuable mineral resource, test smelting would have been expected of the colony's smith.



Section of Hunt's plan of the Popham colony showing the smith's house, No. 13.



BSE image of slag found in a hearth at the site of the smith's house.



Newly-reduced iron agglomerating within the slag.

Only bog ore is found along the Maine coast, and is abundant near the Popham site. Slag from other New England sites where bog ore is known to have been smelted typically contain manganese and hercynite derived from included organic matter and clay minerals. Their absence shows that the ore tested by the Popham smith was remarkably pure. Nevertheless, as shown by the failure of John Winthrop Jr.'s Saugus ironworks in 1652, seventeenth-century colonists in New England found it easier and more profitable to exploit the region's timber and fisheries than its ores.

*Jeffrey Brain
Robert Gordon*

References

- Brain, Jeffrey. 2007. *Fort St. George*. Augusta: Maine State Museum.
- Brain, Jeffrey. 2010. *Fort St. George XIII*. Salem: Peabody Essex Museum.

WORKSHOP ON THE RISE OF IRON TECHNOLOGY IN EAST AND WEST ASIA, HARVARD UNIVERSITY

On October 11th-13th 2012, an international workshop focused on the spread of iron technology in Asia convened at Harvard University.

The workshop had a dual purpose. First, it aimed to bring together scholars working on topics related to the dissertations of two Harvard graduate students, Lam Wengcheong and Nathaniel Erb-Satullo, in order to provide helpful critiques and advice on their research design and preliminary results. The second purpose was to provide a forum for the discussion of methodological approaches, new data, and current models of metal production and technology, with a focus on the rise of iron production on the Asian continent. Presentations and discussions revolved around three major issues: the regional variation and chronology of iron adoption, archaeometric methods for identifying technical practices and technological choices, and the underlying socio-technic conditions that led to the increased use of iron. The discussion not only benefited the two dissertations, but also highlighted other potential archaeological methods in the study of ancient metallurgy.

Participants came from universities and research institutes in China (Chen Jianli, Mei Jianjun), Taiwan (Chen Kwangtzuu), Korea (Park Jangsik), United States (David Killick, Rowan Flad, Jason Ur, C.C. Lamberg-Karlovsky, Nathaniel Erb-Satullo and Lam Wengcheong), United Kingdom (Brian Gilmour, Mark Pollard), Denmark (Donald Wagner), and South Africa (Shadreck Chirikure). Other participants included Zhang Changping (Wuhan University), Heather Lechtman (MIT), and graduate students and research fellows at Harvard and other institutions in Boston area.

The presentations of participants varied widely, from broad methodological questions to specific regionally focused studies. However, they can be loosely grouped into two categories, both of which focused on the main themes of the conference. The first group focused on 1) the methodological challenges of investigating and interpreting iron production sites and 2) the use of archaeometric data to address key anthropological questions of technology transfer, social organization, and materiality. Particular attention was paid to the kinds of questions that geophysical prospection, chemical analysis and microscopic investigations can address. Participants argued that such investigations can not only aid in technological reconstruction, but can also illuminate patterns of economic organization, identify recycling practices, and even address questions of ancient perception



Workshop participants discussing after a presentation (photograph by Yining Xue).

of metal. Additionally, a significant topic of discussion was the relationship between copper-alloy and iron production, and the degree to which iron production depended technologically, socially, and economically on copper production. Participants argued that thermodynamic and geological constraints strongly suggest that the discovery of iron smelting occurred within the context copper smelting tradition. However, it remains an open question to what extent iron and copper-alloy metallurgy remained intertwined economically and socially after the period of initial invention.

The second group of presentations brought attention to the development of iron technology in various regions of the Asian continent, especially those with limited or difficult-to-access publications. Several talks discussed recent discoveries and analyses of early iron artifacts in central China, while others focused on less intensively examined regions such as Xinjiang, a possible key area for understanding the spread of iron technology from west to east. Other talks covered regions such as South Korea, Mongolia, India, and Southeast Asia. These presentations highlighted the limit of current knowledge about the chronology and mechanisms for the introduction of iron into many regions of Asia.

The presentations of the two graduate students, with a focus on the regions of Shaanxi, China (Lam Wengcheong) and the Republic of Georgia in the Southern Caucasus (Nathaniel Erb-Satullo), bridged these two

groups, examining continuity and change in the social and economic organization of metal production through archaeometric methods.

Overall, the workshop provided a useful forum for discussing theories and refining methodologies for approaching the rise of iron production. The workshop was exceptional in that it brought together scholars from four continents, yet had a relatively small number of participants, thus offering a rare opportunity for in-depth discussion on an international scale. The wide-ranging and enthusiastic discussion will undoubtedly have a substantial influence over future research on the rise of iron technology.

On the last day of the workshop, participants visited the historic Saugus Iron Works, the 17th century site of one of the earliest cast-iron foundries in the U.S.

For more information about the conference and its attendees, please visit <http://www.fas.harvard.edu/~chinaarch/therise.html>.

*Nathaniel Erb-Satullo
Wengcheong Lam*

IRON AGE EAST YORKSHIRE: ARCHAEOLOGY COMMITTEE SPRING WORKSHOP

In March some HMS members braved snow and icy winds to attend the Archaeology Committee Spring Workshop which had been organised by Peter Halkon and Yvonne Inall from the University of Hull. A combination of museum visits and field trips was arranged to illustrate the theme of Iron Age ironworking.

The meeting began with a Friday evening reception at the aptly-named Treasure House in Beverley. This combined library, archive and museum building opened in 2007 and holds the archaeological collections of the East Riding Museums Service. Here, delegates were able to see the very impressive cache of Iron Age swords from South Cave, discovered by metal detectorists in 2002. Some members of the group also took advantage of the opportunity to wield a replica sword, made in 2009 by Roland Williamson.

After the reception, delegates repaired to the accommodation in Hull, at the delightful Endsleigh Centre. This was built in 1901 as a Convent of the Sisters of Mercy and included a training College. The College closed in the 1970s and since 1995 the Endsleigh Centre has been a retreat and conference centre – still run by the very friendly and welcoming Sisters.

Overnight snowfall greeted delegates the following morning. Undeterred, the group boarded the minibus to explore some Iron Age sites and landscapes under the expert leadership of Peter Halkon, who has known this landscape since childhood and has been involved in many of the most important excavations. Some delegates took a while to get accustomed to the East Yorkshire definition of ‘hill’; however the icy Russian wind and drifting snow encountered at the famous Arras burial ground convinced most people that this was indeed high ground.

The trip then moved into the relatively low-lying area surrounding the River Foulness, which in the Iron Age was a much larger body of water feeding into the Walling Fen and thence to the Humber. The group investigated two sites, on either side of the former Fen. The first of these was at Moore’s Farm, Welham Bridge, the scene of substantial bog-ore smelting – indeed this was the site of the excavation of the largest slag heap ever found in Iron Age England. Weighing a massive 5338kg, this represented the production of up to between one and two tonnes of bloom (Halkon 2011, 139). Undeterred by the snow and freezing temperatures delegates enthusiastically began fieldwalking, returning to the minibus proudly bearing bits of slag.



Peter Halkon describes the landscape and excavations at the Welham Bridge smelting site.

The second site was at Hasholme. Famous for its log boat excavated in 1984, the trip explored an adjacent enclosure and again discovered various lumps of slag and bog-ore – along with a very nice decorated greyware rim-herd. A recent scheme has restored a small area of adjacent wetland to very much its Iron Age appearance, so there was a vivid impression of the former shoreline of the Walling Fen. The farmhouse kitchen provided a welcome warm break during which delegates were able to inspect an impressive collection of portable antiquities discovered by the farmer over the years.

After lunch at the Red Lion in Holme-upon-Spalding Moor, the workshop returned to Hull where an enjoyable afternoon was spent in the East Riding Museum. Peter led a tour of the galleries. Although the focus on the Iron Age meant inevitable enthusiasm for items such as the North Grimston Sword, there was also an impressive collection of Roman and medieval metalwork. The Museum also houses the Hasholme boat, although sadly the conservation programme was stopped in 2009 leading to some deterioration in its condition.

A quick pint at the Black Boy was followed by a very nice dinner at Princes Quay, and some delegates followed this with further drinks at the George.

Sadly the trip planned for the following morning was cancelled, due to snow and flooding. Some delegates made their way to Beverley, for a pleasant morning inspecting the Minster and various items of cast-iron street furniture.

This was a hugely enjoyable meeting, despite the weather; many thanks to Peter and Yvonne for organising it.

Paul Belford

Reference

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THIS WORKING LIFE: STEEL A CENTURY OF STEELMAKING ON FILM

In February 2013, the British Film Institute (BFI) launched a twin box set DVD containing a collection of 21 films featuring the UK's steel industry.

Some of these are documentary, others animations, and some fictional stories taking place in steelworks and others showing the use of steel. They span the period 1901 to 1985.

Featured on the DVD is a rare colour record made in 1945 called 'Steel' which was filmed by Oscar-winning Jack Cardiff. Other gems are 'Men of Consett' (1959), 'Woman of Steel' (1984) about steelmaking in wartime Sheffield, 'Parkgate Iron & Steel Co' (1901), 'Song of the Builder' (1936); and the animation, 'River of Steel' (1951).

The collection is being launched with screenings of many of the films across the country from February – BFI Southbank London; Sheffield Showroom; Glasgow Film Theatre, Tyneside Cinema, Newcastle; and the Chapter Cinema, Cardiff.

The DVD set is the third in a series recording the past industries of Britain following the release of 'King Coal' in 2009 and 'Tales from the Shipyard' in 2011.

The price of the DVD box set is £24.99 and it is available from BFI bookshop www.bfi.org.uk/shop.



'Men of Corby' tapping a blast furnace

ALSO SHOWING

For those who are fortunate enough to be close enough to visit one of the BFI 'Mediatheques' which provide free access to the BFI film archive (some 500 plus films) there are already several steel films available which I have listed below.

The BFI assure me that eventually additional films on steel will be added from the DVD collection. Sadly, no non-ferrous film is listed in the catalogue.

Mediatheques are located at BFI South Bank, London; Discovery Museum, Newcastle; the QUAD, Derby and Wrexham Library.

STEEL IN THE BFI MEDIATHEQUES

The Building of the New Tyne Bridge (1928 | 40 min)
Extraordinary footage of the construction of Tyneside's iconic landmark.

From Raw Material to Finished Product (1932 | 26 min)
Descend into the Eston mines as coal and ore are gathered to make iron and steel products.

The Iron Dale (1964 | 25 min)
Life at Stanton and Stavely Ltd. Ironworks.
Collection: Heartlands

A Century in Stone (2004 | 114 min)
The forgotten history of the ironstone miners of Eston, south of Middlesbrough.

Men of Corby (1961 | 30 min)
Rabbie Burns transplanted to the East Midlands.

Men of Steel (1932 | 71 min)
A young steelworker rises to the company board in this drama partly filmed at a Middlesbrough steelworks (a corny plot but excellent clips of open hearth steelmaking).

Pattern for Progress (1948 | 47 min)
Early documentary from John Krish touring an Ebbw Vale steelworks, with animation from Halas and Batchelor.

A Question of Leadership (1980 | 52 min)
Ken Loach interviews those involved in the 1980 steelworkers' strike.

Steel Goes to Sea (1941 | 15 min)
'Hitler is a B*****' – Shipbuilding at the height of WWII.

The full index to the mediatheques is available at and includes some remarkable archive film of past British industry. <http://www.bfi.org.uk/archive-collections/introduction-bfi-collections/bfi-mediatheques/all-mediatheque-films>

Tim Smith

‘RIBBON OF FIRE’ HOW EUROPE ADOPTED AND DEVELOPED US STRIP MILL TECHNOLOGY (1920-2000)

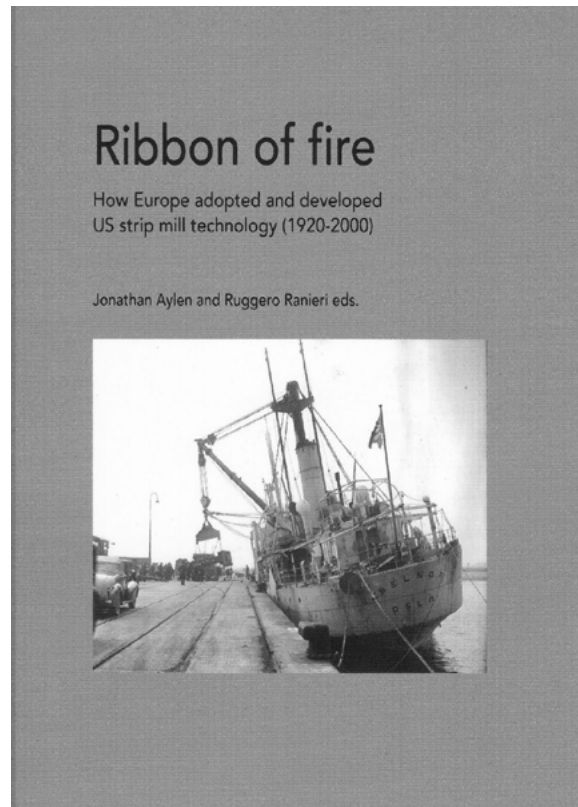
The title of this long awaited book refers to the red hot strip snaking through the many stands of the wide hot strip mill, a technology first introduced in the USA in 1924 but not arriving in Europe until 1938. It is taken from a poem by an anonymous author pinned on an office wall at Inland Steel’s Indiana Harbor 80” hot strip mill which opens with:

‘There is a Ribbon of Fire running around the World
It runs Day and Night
It runs out of the Past and into the Future.....?’

For the rest, you must get hold of a copy of this excellent book which is an elaboration of the Proceedings of a conference held ten years ago at the University of Manchester, UK and organised by the editors of the book, Jonathan Ayles, Senior Lecturer, Manchester Institute of Innovation Research, and Ruggero Ranieri, formerly of Manchester University and now Visiting Professor at the Universities of Padua and Perugia, Italy.

Divided into three parts, Part I reviews economic and technological developments in two papers by the editors showing how the wide hot strip mill evolved in the USA from narrow (max 3” wide) hot strip mills rolling ‘hoop’ in the 19th century, through wider (4”) mills rolling skelp to 7” wide mills rolling 100 ft (30.5m) lengths by 1890. Widths and lengths rolled slowly progressed – 24” wide and 500-1000 ft long (152-305m) – and then a breakthrough was made in 1923 by John Butler Tytus, an engineer at Armco. Armco had purchased the plant of the Ashland Iron & Mining Company of Kentucky which included a pilot hot strip mill. With a budget of just \$10M, Tytus, with a band of 100 skilled workers all sworn to secrecy, travelled from Armco Middletown works to put this into operation. The task took nearly a further three years but in January 1924 the first 36” wide strip (914mm) was rolled in the multi stand mill down to a thickness of 0.065” (2mm). This was soon followed by an improved 36” mill at the Columbia Steel Co at Butler, Pennsylvania which soon was widened to 48” (1219mm). The main innovation of this mill was a four-high finishing stand using a small diameter work-roll supported by a larger back-up roll, this enabling greater reductions between passes. It was from this mill design that all future wide hot strip mills developed. The importance of producing wide strip was to meet the demands of the growing automobile industry which was calling for ever wider steel sheet for body panels.

The authors develop the related history with a short section on the cold strip mill and coating (tinplate and galvanising)



Book cover. Technology transfer – offloading mill housings from Mesta, USA at Birkenhead docks UK in 1939 bound for Shotton works.

but essentially the book addresses only the wide hot strip mill dividing these into five generations as the technology evolved.

The first pioneering wide HSMs to arrive in Europe were in Germany, USSR and UK in the late 1930s to early 1940s, but the more successful mills arrived after WWII. In Germany, the first HSM was installed by Vereinigte Stahlwerk at Dinslaken and started operations in August 1937. This was the first wide HSM in Europe. In the USSR, a mill was built at Zaporozhy, Ukraine in 1938 supplied by United Engineering of Pittsburgh. It is still in operation today, largely unaltered, and is Europe’s oldest continuous hot strip mill (Fig 1). A second mill was supplied to Russia in 1942 at Novosibirsk Metallurgical Plant in Siberia. In the UK, two pre-war mills were installed in 1938 and 1939, respectively by Richard Thomas at Ebbw Vale in South Wales and the other by John Summers & Sons at Shotton, North Wales. With the exception of the Dinslaken mill, all these early mills were of American design and manufacture, the German mill being built by Demag of Germany, but the evidence suggests the finishing train to be largely of US design.

Part II of the book occupies the bulk of the pages and consists of case studies and developments of the wide HSM from the earliest days to 2000. The 13 papers are taken from the conference presentations with, sometimes, major additions and revisions. Papers describe mills in the UK (Ebbw Vale and Shotton), the early mills of the



The wide hot strip mill at Zaporozhy, Ukraine was supplied by United Engineering of Pittsburgh in 1938 and is still in operation today making it Europe's oldest continuous hot strip mill.

USSR and Europe's first mill at Dinslaken in Germany. Other mills described are post-war. The first mill in France came much later in 1951 at Denain in northern France, following the merger of the FADA and FANE companies to form Usinor. In 1953 a second mill was built by Sollac at Hayange, in the Lorraine district. In Italy, the first wide HSM was installed at Genoa by Cornigliano, and later a generation 2 mill at Terni in 1964.

These post-war mills proliferated with further mills in the UK (Port Talbot 1951 and a generation 2 mill at Llanwern, Newport). Under the Marshall Aid European recovery plan, a mill was built in Austria (Linz 1953). Other mills were constructed in the Netherlands (IJmuiden 1952), Belgium (Liège 1950 and 1954) Luxembourg (1951) and not least in Germany (Duisberg 1955, Bremen 1958, and Dortmund 1942 and 1958). Section II concludes with a useful appendix listing the so called First Generation mills including technical details.

Part III is devoted to plant suppliers, automation and users. The use of computers to control ferrous metallurgy was pioneered in the UK from 1953 when a Ferranti computer at Manchester University was used by the British Iron & Steel Research Association (BISRA) for statistical analysis of blast furnace behaviour. In the USA, computer control of processes was first introduced in the 1960s. By 1964, computer control was being used in many control situations including five hot strip mills in the USA, at Port Talbot and Llanwern in the UK and Hoesch and Bochumer Verein in Germany.

While the book tends to focus on the earlier strip mills, a useful table divides installations into five generations starting with 1926 to 1958 with the earliest semi-continuous mills where initial reduction was carried out on a single reversing rougher stand rather than a train of synchronised stands as in a continuous mill. The evolution follows through to the Generation Five thin slab casting and rolling lines post-1988 such as SMS's very successful Continuous Strip Processing (CSP) mills, which use a tunnel furnace to buffer output between the thin slab caster and mill and 'Endless Rolling', to-date illustrated only by the Arvedi mill at Cremona where the speed of the caster is sufficiently high to enable direct rolling without the need to crop the thin slab as it exits the caster, a short induction heater ahead of the mill serving to equalise the as-cast temperature.

The book is 410 pages long, softback and includes extensive references, an index of people involved in the development of the wide HSM, a glossary of steelmaking and rolling terms, and a list of definitions of acronyms.

A number of tables summarise data, and while graphics are few and far between, a selection of 21 archive photographs are presented on high gloss paper in the middle of the book.

'Ribbon of Fire' – How Europe adopted and developed US strip mill technology (1920-2000) edited by J. Aylen & R. Ranieri Published by Pendragon ISBN 978-8865982389 Price €45.00

Tim Smith

FORTHCOMING EVENTS

Title	Date	Location	Description	Website/Email
HMS Archives and Slag Collections Open Day	27 April 2013	Coalbrookdale, UK	This is a unique opportunity to gain an insight into the work of the ACC and the breadth of the Tylecote archive	http://hist-met.org/OpenDay.html mejbirch@aol.com lbacon@horniman.ac.uk
Butser Experimental Metallurgy Course 2013	31 May-3 June 2013	Hampshire, UK	An exciting chance for anyone interested in ancient smelting practices to get their hands dirty to learn and experience how our ancestors extracted metal from ores around the beginning of the Bronze Age	simon.timberlake@btinternet.com fergus@fingerbuster.com
HMS 50th Anniversary Conference and AGM	14-16 June 2013	London, UK	This international academic conference is the culmination of a series of events marking the 50th Anniversary of the Historical Metallurgy Society and will provide a high-level 'state of the art' profile of current and future developments in the various disciplines which HMS represents.	http://hist-met.org/agm2013.html eleanor.blakelock@archaeomaterials.co.uk
IAMS Summer School in Archaeometallurgy 2013	17-28 June 2013	London, UK	Two weeks of classes for those interested in the archaeology of metallurgy. The course covers a diverse range of topics, including mining, metal production, experimental reconstruction, field methods, to the analysis of metallic artefacts.	http://www.ucl.ac.uk/iams/iams-events-publication/iams_summerschool_2013 Pira Venunan: trcnpve@live.ucl.ac.uk
Rust, Regeneration and Romance: Iron and Steel Landscapes and Cultures	10-14 July 2013	Coalbrookdale, UK	This conference seeks to engage in an open multi-disciplinary analysis of iron and steel landscapes and cultures, from the ancient to the modern.	http://ironandsteel2013.wordpress.com/ Caroline Ashton: ironbridge@contacts.bham.ac.uk
Bronzekongress 2013 Bronze 2013	3-7 September 2013	Zurich, Switzerland	The main aim of the conference is to provide an up-to-date overview on the many different areas that bronze research has dealt with in recent years.	http://www.prehist.uzh.ch/bronzekongress2013.html bronze2013@bluewin.ch
The 8 th International Conference on the Beginnings of the Use of Metals and Alloys (BUMA VI)	10-15 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 the Asian region.	http://buma8.wiki.fc2.com/ buma.2013@gmail.com
International Conference on Metals Conservation 2013	16-20 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, including presentations on topics of the conservation and preservation of historic metals.	http://www.metal2013.org/
100th Anniversary of Stainless Steel HMS Annual Conference 2013	19-20 October 2013	Sheffield, UK	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.	http://hist-met.org/AC2013.html HMSannualconf@hist-met.org



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