Historical Metallurgy Society 2017 AGM

The Metallurgy of our Portable Heritage

Saturday the 17th June, 2017
Institute of Archaeology,
University College London

The HISTORICAL METALLURGY Society

Portable Antiquities Scheme
www.finds.org.uk

The story of Iron Age brooch manufacture from ADS to PAS.

Sophia Adams
University of Bristol

More than 730 Early and Middle Iron Age bow brooches have been found in England, Wales and Scotland (c.450–150 BC). About 30% of these were recorded by Rex Hull and Christopher Hawkes and published in their *Corpus of Ancient Brooches in Britain* (1987). c.25% are finds reported to the Portable Antiquities Scheme (PAS). The majority of the remainder are excavated finds, many discovered through developer-funded excavations. A number of these sites are published but others are lodged as unpublished reports with the Archaeology Data Service (ADS). From these collections of data it is has been possible to revise our understanding of the manufacture, use and deposition of bow brooches (Adams 2013; 2014; 2017). This paper explores how the different data sources have enhanced and restricted our knowledge and presents the latest hypotheses on the manufacture of these small objects. From the combined evidence we can discuss matters of technological change, organisation of production and the influence of creativity over conformity.

References

Adams, S. A. 2013. *The First Brooches in Britain: from Manufacture to Deposition in the Early and Middle Iron Age.* PhD Thesis: University of Leicester http://hdl.handle.net/2381/28593

Adams, S. 2014. Iron in a time of change: brooch distribution and production in Middle Iron Age Britain. In Hornung, S. (Ed.) *Produktion, Distribution, Ökonomie - Siedlungs- und Wirtschaftsmuster der Latènezeit.* Universitätsforschungen zur Prähistorischen Archäologie.

Adams, S. 2017. Personal Objects and Personal Identity in the Iron Age: the case of the earliest brooches. In Martin, T.F. and Weetch, R. (Eds) *Dress and Society: Contributions from Archaeology.* Oxford: Oxbow Books.

Hull, M.R. & Hawkes, C.F.C. 1987. *Corpus of Ancient Brooches in Britain: pre-Roman bow brooches.* Oxford: British Archaeological Reports British Series 168.

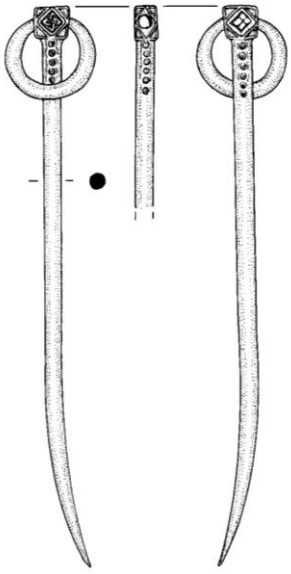
Converted Medieval jettons (accounting tokens) as dress accessories in East Anglia and beyond.

Alex Bliss
Finds Liaison Officer for Suffolk

The inception of the Portable Antiquities Scheme and its continuation in England and Wales since 1997 has facilitated the recording of over one and a quarter million archaeological objects as of 2017, virtually all found by members of the public. Some of these objects are of types completely unknown from or very rarely found in the course of archaeological excavation, with datasets solely provided in some cases by un-stratified metal-detecting finds recorded on the initiative of their finders. With the latter in mind, this paper will focus on the primarily East-Anglian phenomenon of converting Medieval jettons (accounting tokens) for use as dress accessories; analysing these objects from the points of view of their manufacture, use, and possible social significance to the people who wore them. In addition to this their spatial distribution will be interpreted, this element of study in particular drawn heavily from the PAS database.

How did they make those beautiful things? Base-metal manufacturing in the first millennium AD.

Justine Bayley



Just looking carefully at Roman and early medieval base metal finds can reveal a lot about how they were made and decorated. There is little major technical innovation over the millennium but the designs of the objects produced changed significantly. Some were cast, others wrought, and both were often decorated in a wide range of ways. Further evidence for manufacturing processes comes from part-made objects and the tools and debris that can be found in abandoned workshops – things such as scrap and waste metal, moulds and crucibles. Scientific investigation often adds additional information. This talk will provide insights into the ways craftsmen worked in the past and how they made the metal objects we study today, whether they are reported under the Portable Antiquities Scheme, displayed in museums or found in the course of archaeological excavations.

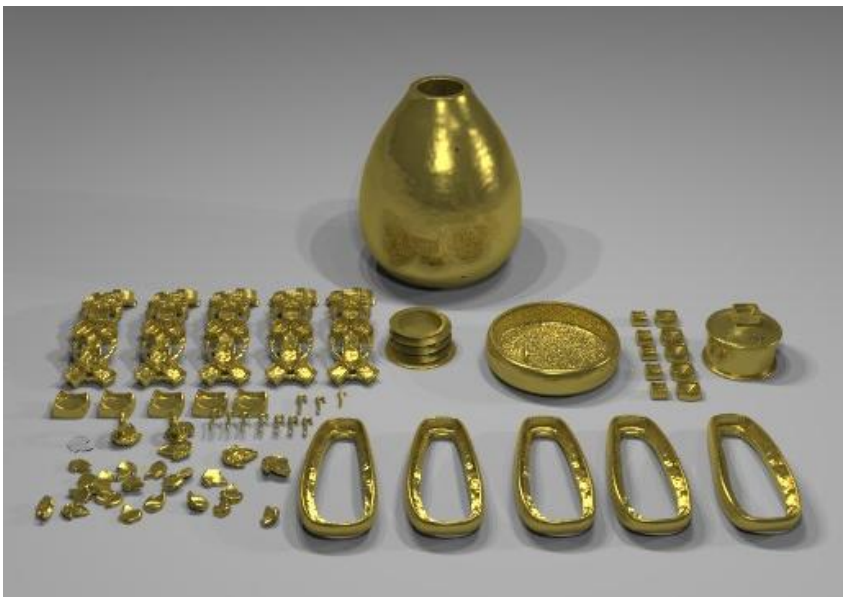
Secrets of the Anglo-Saxon goldsmith: Analysis of the gold from the Staffordshire Hoard
Eleanor Blakelock

The discovery of the Staffordshire Hoard in 2009 led to the development of a cross-disciplinary programme to conserve, research and disseminate the find. The Hoard consists of the largest assemblage of Anglo-Saxon gold and silver objects, most of which is battle regalia. Many different raw materials were brought together to create the objects in the hoard, including; precious metals, garnets, glass, organics and other inlays. Most of the material belongs to the sixth to seventh centuries and much is richly decorated with intricate interlace patterns carried out using a variety of techniques including cloisonné garnet and filigree.

As part of the wider research project studying the Staffordshire Hoard a ground breaking study of the gold was carried out. The work has revealed more details about workshop practice and from this it is possible to outline some of the decisions made by the goldsmiths in the Anglo-Saxon period to enhance the appearance of the objects.

Reconstructing objects from the Cheapside Hoard
Ann-Marie Carey

We have recently been working on two artefacts from the Cheapside Hoard, (i)Scent bottle gold and precious stones which we have deconstructed and recreated to understand the manufacturing processes involved and (ii) Ferlite watch guilt brass – we have just recreated the casing and interestingly the internal bell which we have struck, the peal is amazingly clear and beautifully pitched. It is quiet unusual to associate museum artefacts with sounds and to recreate that sound to what it might have been when in use, It's been a unique experiment.



The changing of gold production from gold dust to gold ore in the Japan's 16th century

Takahiko KUTSUNA
Department of Science and Engineering, National Museum of Nature and Science, Japan

In Japan, Gold dust has been used from discovering the gold for a long time. *The Zipangu's Gold* in *"The Travels of Marco Polo,"* also means gold dust. It is believed that gold production started in the mine from the 16th century, and it is believed that there was progress in smelting technology to produce gold from ores. In particular, the cupellation was brought to the *Iwami silver mine* from oversea in 1533 (from records). Japanese researchers are taking notice of the relation between spread of cupellation and increase production of gold and silver from ores, from 16th to 17th century in Japan.

In the 16th century, development of gold mine was thought to have started around the Yamanashi prefecture in central parts of Japan. The two gold mine ruin sites in Yamanashi were excavated around 1990. In recent years, I performed reinvestigation of excavated artifacts, and confirmed new items with having small gold particles related to the gold's smelting of metallurgy. By the nondestructive analysis using X-ray Radiography, XRF and SEM-EDX, relics that were used for smelting of gold ores were clarified.

But, I could not find evidence of using cupallation from relics of Yamanashi's mines. Cupallation was definitely drawn as one of most important and famous techniques at *Sado Gold and Silver Mine Picture Scrolls* in Edo period. So, we might have misunderstood by the Mine Picture Scrolls.

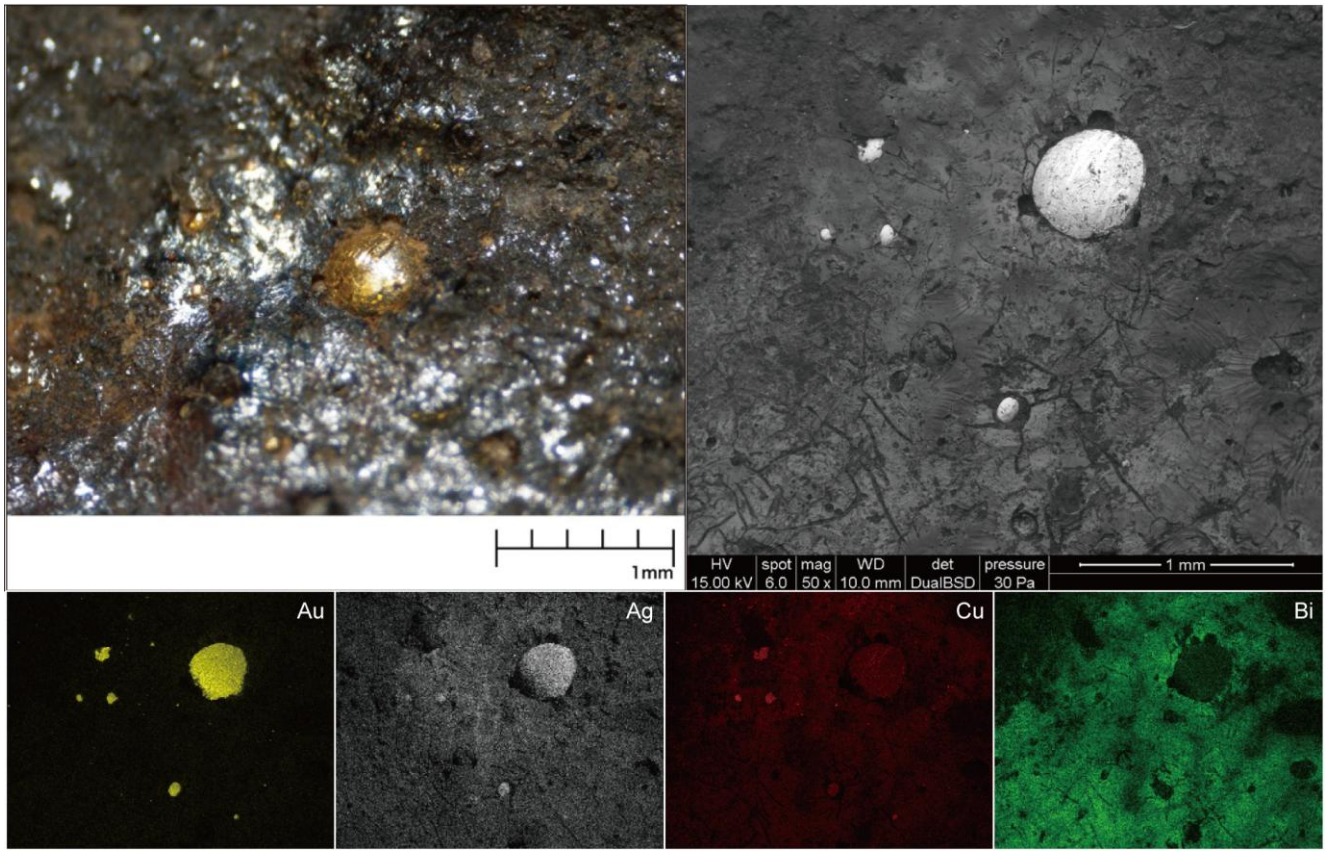


Fig. Gold particle's micrographs and element mappings.

Scientific Examination of the Jewellery from the Colchester Hoard

Matt Phelps

Excavations within Colchester in 2014 uncovered a hoard of objects deposited within a small hole scraped into the floor of a house destroyed during the Boudican revolt. These objects were likely buried in haste prior to the sacking of the Roman colony in 60/61 AD. They include 12 pieces of high-quality gold jewellery consisting of rings, earrings, bracelets and armlets, and three silver military awards. A selection of these objects were analysed using a range of scientific techniques (pXRF, SEM-EDS, digital microscopy and x-radiography) with the aim of identifying alloy compositions and metalworking processes. The results demonstrate the application of a wide range of production methods. These include diffusion bonding and hard soldering; wire production by hammering and rolling; details on the setting of emeralds within the gold rings; and information on the fabrication of the silver medallion. In addition, the jewellery was recognised to be of a high-grade gold alloy typical of Roman compositions. This analysis extends the body of knowledge concerning Roman jewellery production in the 1st century AD.

Detail of a dolphin engraved onto the bezel of one of the gold rings.

Trendy fashion jewellery from Phoenician Motya

Francesca Oliveri
Soprintendenza del Mare, Palermo, Italy,

The study of precious pendants and earrings found on the Phoenician island of Motya in Sicily has offered the opportunity for reflection on fashion habits of the Phoenician of the West Mediterranean. Jewels are special artefacts: these small metal objects, probably born with the will of embellishment, possess a much deeper meaning than that, upgrading the simple material object with symbolic, magical and religious values or making it an instrument of prestige and ostentation, thanks to the various and accurate manufacturing techniques that since ancient times reveal the abilities and the special role played by the goldsmiths in ancient society

This complexity leads toward two substantive aspects related to the duration of use and the geographic distribution of some ornaments.

It is important to remember that even on the occasion of discovery in a perfectly datable archaeological context, a jewel could always be much older, representing, for example, a family inheritance.

Similarly, some particularly welcome and fashionable productions enjoy wide circulation capable of overcoming regional boundaries and are found all over the Mediterranean sea.

Scientific Examination of a Middle Bronze Age gold 'belt-torc' from East Cambridgeshire.

H. White and N. Wilkin
The British Museum, Great Russell Street, WC1B 3DG

The 'East Cambridgeshire' four-flange twisted bar torc.

An exceptional example of a Middle Bronze Age four-flange twisted gold bar torc was discovered by a metal detectorist in East Cambridgeshire on the 26th September 2015. Weighing 732 grams, measuring 126.5 cm in length and finished with 11 cm long 'trumpet' terminals, it is one of the largest found in Britain, Ireland and the near Continent. It adds to the small group of 'belt-torcs' comparable both in weight and length which include the recently discovered Corrard torc, Co. Fermanagh, and the Saint Helier torc, Jersey. Scientific analysis was undertaken to investigate its composition for the Treasure process and to give some clue to its morphology at the time of discovery following modification of the torc by the finder. The opportunity was also taken to carry out a technical examination to investigate manufacturing methods and wear, and to compare these results with other Penard period bar torcs, including examples held in the British Museum collection as well as new discoveries reported through the *Treasure Act (1996).*

Mis-cast and Moulds: Evidence for Metalworking from the Portable Antiquity Scheme

Kevin Leahy

The Portable Antiquities Scheme has now recorded over a million finds which presents us with an unparalleled data set. This talk will look at some of the evidence for metal working presented by these and try to put it into its context. In addition to moulds, metal working dies and tools will be considered and the evidence presented by the objects themselves reviewed.

Modelling tribological processes to examine the use-intensity of Bronze Age metal objects.

Miriam Andrews[1], Stephen Monaghan[1], Tomas Polcar[1], Alistair Pike[2], Jo Sofaer[2].
1 National Centre for Advanced Tribology, Faculty of Engineering and the Environment, University of Southampton, S017 1BJ.
2 Department of Archaeology, Faculty of Humanities, University of Southampton, S017 1BJ.

Historically, wear on metal artefacts has not received as much attention as other material types, e.g., lithics and bone. This is reflected in the slow development of materials science approaches, quantitative analysis, and robust systematic methodologies, in the field of metal use-wear investigation. Furthermore, research has been focused, almost exclusively, around the functionality of objects.

This project is a response to the gaps that exist within the experimental protocol of the aforementioned field, investigating a new dimension of use – the sum amount sustained by the artefact – which has been termed the 'use-intensity'. To test this new directive, replica Bronze Age palstave axes were subjected to systematic wear in laboratory settings by repetitive wood-cutting in an 'impact tower'. An algorithm in the rig was used to assess the optimum sharpening interval, at which point the axes were resharpened, and the experimental phase repeated. Sequential and quantitative examination by Vickers hardness testing demonstrated an incremental increase in hardness of the axe blades due to both use and sharpening.

The results of the project may be used to estimate the overall degree of use of prehistoric axes and the number of sharpening phases. More generally, the project represents the potential for establishing artefact-specific methodologies to evaluate use-intensity.

Metallurgy of Portable Sundials Found by Detectorists

John Davis
Independent scholar, British Sundial Society

As part of an ongoing study of medieval scientific instruments, the portable sundials reported to the PAS are being monitored and assessed alongside the limited corpus of museum examples (which have often come from archaeological sources a century ago). Dials from the late 13th to the 18th/19th centuries are found, of many different types but usually made from engraved copper-alloy sheets. The earliest dials (before c.1350) measure time in the old unequal-hour or seasonal-hour system whereas later dials use the modern or equal-hour system. Dial types include quadrants, ring dials, naviculae, equatorial dials, compendia, horizontal dials and nocturnals.

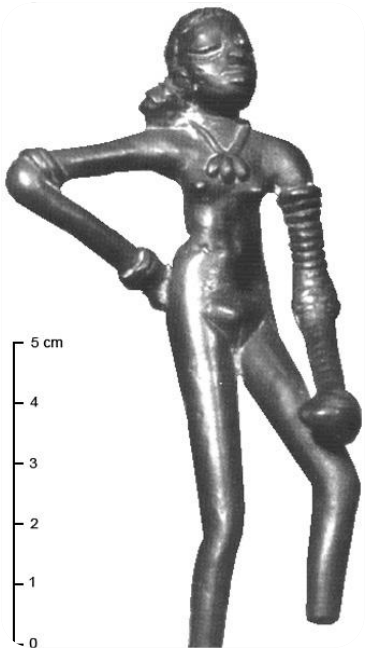
The compositions of the alloys are being measured by XRF and the metallurgy has been investigated by selective etching of embedded sections. When exposed to damp soil for extended periods, copper-alloys suffer from the well-known problem of 'dezincification' which can seriously distort XRF results as it is a surface-sensitive technique and it is usually not permitted to perform aggressive surface preparation of archaeological specimens. An experiment has been performed on a scrap piece of a 17th century 'poke' or ring dial to quantify and profile this loss of zinc, as well as other common elements in the alloy. Other long-term experiments with buried test specimens are also ongoing.

Eventually, it is hoped that some light may be shone on the locations of the workshops producing these early 'mathematical instruments' and on their sources of materials and the techniques employed.

A compendium, c. 1450, made from copper-alloy and comprising a magnetic compass, an equatorial sundial and a simple nocturnal, now in the Oxford Museum of the History of Science. (Photo: J Davis)

Understanding the Lost wax Technique through an Ethnographic Study

Diya Mukherjee
Department of A.I.H.C & Archaeology, Deccan College Post Graduate & Research Institute, Pune



The anecdote of Lost wax model in India goes back to Harappan cultural times and the finest example is the dancing girl. The tradition is still continued even today in various parts of India. The traditional ways and the modern ways (used in industries termed as investing casting) co-exist side by side.

For understanding the Lost wax technique I have selected Manner, Kerala, India since they use the traditional method of lost wax technique. Even through in some parts of India like West Bengal and Tamil Nadu metal now use modern crucibles but metal craftsmen of Manner they still use clay crucible. My aim is to study the Lost wax technique through ethnography which will help to understand the probable technique followed by the Harappan metal craftsmen. The methodologies adopted for this paper are to review archaeological and literary sources as well as ethnographic investigation.

The manufacturing technique, workshop area, tools used for manufacturing, et cetera will be discussed during the presentation

Analysis of some Late Bronze Age ingots from Cornwall

Tim Young

A Late Bronze Age (Ewart Park phase) hoard of fragmentary artefacts and casting debris (including twenty-four fragments of copper ingots) was discovered on St Michael's Mount, Cornwall, in 2009. As part of a project to investigate and display parts of the hoard, the National Trust commissioned analysis of the ingot fragments, together with analysis of two other ingot fragments previously recovered from the same area, and this was conducted in several phases during 2013-15. Analysis by pXRF was conducted prior to sampling, with approximately half the collection having undergone some prior cleaning and half not. Selected pieces were afforded the rare luxury of being sliced to expose a broad, fresh cross section, which was then re-analysed by pXRF. Samples were also taken for polished blocks for investigation using an ASEM with microXRF. In addition, drilled samples were taken for lead isotope analysis and for further chemical characterisation by ICP-MS. The analytical data proved extremely problematic, with the coarse dendritic microstructure and the strong concentration of weathering products towards the surface of the ingots meaning that representative elemental analyses were not obtainable from the drilled samples. Although budgetary constraints meant that all the problems could not be pursued as rigorously as desirable, the most useful elemental data were those obtained with the pXRF on a cut surface, with multiple analysed areas, each of approximately 8 x 10mm. The microXRF on similar-sized areas also showed great potential, but the need for an overnight run for a single analytical area meant this approach was prohibitively expensive. The analyses tentatively suggested a possible Welsh Borders source for the copper. Possibly the most important outcome of the project was that unless historic analyses of ingots can demonstrate very large sampling volumes, representing large areas of the cross section, their elemental analyses should be considered of dubious utility. Such doubt therefore exists for the elemental composition of essentially the whole corpus of British Bronze Age copper ingots.

Historical Metallurgy Society 2017 AGM

The metallurgy of our portable heritage

Saturday the 17th June, 2017
Institute of Archaeology, University College London

9.20-9.50	**Registration with tea/coffee**	
9.50-10.00	***Introduction & welcome***	
10.00-10.30	Sophia Adams	The story of Iron Age brooch manufacture from ADS to PAS.
10.30-11.00	Alex Bliss	Converted Medieval jettons (accounting tokens) as dress accessories in East Anglia and beyond.
11.00-11.30	Justine Bayley	How did they make those beautiful things? Base-metal manufacturing in the first millennium AD.
11.30-11.50	Eleanor Blakelock	Secrets of the Anglo-Saxon goldsmith: Analysis of the gold from the Staffordshire Hoard
11.50-12.10	Ann-Marie Carey	Reconstructing objects from the Cheapside Hoard

Lunch 12.10-13.00

HMS AGM 13.00-13.30

13.30-13.50	Takahiko Kutsuna	The changing of gold production from gold dust to gold ore in the Japan's 16th century
13.50-14.10	Matt Phelps	Scientific Examination of the Jewellery from the Colchester Hoard
14.10-14.30	Francesca Oliveri	Trendy fashion jewellery from Phoenician Motya
14.30-14.50	Harriet White and N. Wilkin	Scientific Examination of a Middle Bronze Age gold 'belt-torc' from East Cambridgeshire

Tea and coffee break 14.50-15.20

15.20-15.50	Kevin Leahy	Mis-cast and Moulds: Evidence for Metalworking from the Portable Antiquity Scheme
15.50-16.10	Miriam Andrews	Modelling tribological processes to examine the use-intensity of Bronze Age metal objects.
16.10-16.30	John Davis	Metallurgy of Portable Sundials Found by Detectorists
16.30-16.50	Diya Mukherjee	Understanding the Lost wax Technique through an Ethnographic Study
16.50-17.00	Tim Young	Analysis of some Late Bronze Age ingots from Cornwall
17.00-17.05	***Final Words***	