THE CRUCIBLE

Historical Metallurgy Society News

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Crucible from an iron ore assaying experiment, Dorset

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

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The HISTORICAL METALLURGY Society

Editorial

The summer season has begun with a burst of brain feed for those of us with an interest in historical and archaeological metallurgy. The IV Archaeometallurgy in Europe Conference offered an international programme that was packed full of cutting-edge, inspiring research. Many members of HMS and colleagues alike thoroughly enjoyed the superb academic and social programme put together by Ignacio Montero and his team in Madrid. Among the many students presenting their research were Filipa Lopes and Rosa Vidigal, who attended the conference with financial support from HMS and have kindly produced the conference review included in this issue of The Crucible. Another benefitiary from HMS support to attend this conference was Omid Oudbashi, who sends *A Letter from Iran* summarising the work he presented in Madrid.

Also in June, the international Andean Technologies conference in London included an array of presentations and posters on metallurgical topics, as reported by Branden Rizzuto. A highlight of this conference was the Beno Rothenberg Memorial Lecture, organised by the Institute for Archaeo-Metallurgical Studies to celebrate the memory of this pioneer archaeometallurgist. This year, the lecture was delivered by Izumi Shimada, who used the captivating and fitting strapline "Obsessed with metal", and reported on four decades of archaeometallurgical work in Sican, Peru. Of course, we could not miss such an excellent opportunity to nail him down for a *One Minute Interview*.

Still in June, HMS celebrated its Annual General Meeting and Annual Conference in Stratford-upon-Avon, where attendees admired and discussed an extremely interesting domain of historical metalwork that we have the opportunity to enjoy every day: street furniture. A report on this meeting will appear in the next issue.

But there is more in this issue of The Crucible: our *Archaeometallurgical News* include current fieldwork in Ireland by Paul Rondelez, in Argentina by Carlos Angiorama and Florencia Becerra, and in Croatia by Nikolina Topić and Nikolina Drašković Vlašić. They cover a wide range of metals from prehistory to last century. There is also a note by Alan Williams on Leonardo da Vinci's steelmaking interests, and a report on yet another Bessemer converter by the indefatigable Tim Smith, who in the *Meet Your Council* section also shares much insight and advice based on his long career supporting HMS.

We are also particularly excited to inaugurate a short and hopefully useful section: *What are you up to?* Yes, we are asking you – please send us your answer!

We very much hope you will find something of interest in these pages, and once again thank our contributors for making this possible. We are particularly satisfied to note that the coverage of your newsletter keeps expanding chronologically and geographically, hopefully to provide a better reflection of the membership of HMS. And just as HMS and The Crucible evolve, so does your Editorial Team. Some may have noticed that a few new names have appeared on the cover page, whilst others disappeared. Siran Liu has just submitted his PhD and is getting ready to take up a position at USTB in Beijing; Miljana Radivojević has recently taken up a new job at Cambridge University. Both Siran and Miljana were part of the original team that turned the old HMS News into The Crucible, and we would never have reached this point without the ingenuity and effort they have generously devoted to this venture over the last three years. We are forever grateful to them, and now looking forward to chasing them for their own news! Their departure has allowed us to welcome some fresh blood into the team, with UCL doctoral students Carlotta Gardner and María Teresa Plaza enthusiastically taking on the challenge, and making their first contribution to the issue you are reading. Loïc Boscher, Matt Phelps and Marcos Martinón-Torres stay on board to provide some continuity and some additional energy. All five of us look forward to continuing to serve as your Editorial Team, and remain very keen to hear (and publish) your views, news, and reports.

The Editorial Team

Marcos Martinón-Torres

Loïc Boscher

Carlotta Gardener

Matt Phelps

María Teresa Plaza

THE FIRST YEAR OF THE SLIABH AUGHTY FURNACE PROJECT

Just over a year ago, in April 2014, a group of HMS members came over to Ireland for a two-day event with the theme 'ironworking in Ireland'. On the first day, a group of 17th- and 18th- century blast furnaces were visited in the Sliabh Aughty Mountains area in the counties Clare and Galway in the west of Ireland. At the end of that day, in the local pub (where else?), Gerard Madden, local historian, and Paul Rondelez, organiser of the trip, decided to formalise their research and conservation efforts related to the early modern ironworking in the area. The Sliabh Aughty Furnace Project was born.

The first event that was planned was a Furnace Festival, combining a conference with nationally recognised specialists and local researchers, 17th-century themed activities in the local park and a tour of the most important remains. This Festival, held in September of last year, greatly helped in spreading awareness of the Sliabh Aughty ironworks, with articles in the local press, a piece on national radio and talks at several other events in the area. Another result of that Festival was that a diverse group of people signed up as volunteers to the Project. These volunteers have since helped to clear some of the sites, unearthed previously unknown local information about the furnaces and have especially contributed to the historic research of the same.

Casting arch re-enforcement bar from Woodford, Co. Galway showing the date 1681 (upside down).

Since the HMS visit we have located the dam connected to what is likely the earliest of the furnaces (Ballyvannan, Co. Clare, c. 1610s?). Many more of the owners of the various ironworks have been traced down, including the scientist Robert Boyle (Scarriff, Co. Clare, 1683-5) and we have made good progress transcribing additional relevant material. At Glendree, Co. Clare, the entrance to an 18th-century iron mine, which was described in the 19th century, was re-discovered. The cast iron re-enforcement bar belonging to the Woodford, Co. Galway, cast with the date of 1681 and unique in Ireland, will in the very near future be put on public display by the local heritage society. The Project has provided this society with advice and historical background information.

Recently, the Project has also been awarded a generous grant by the Heritage Council towards the composing of Conservation Management Plans for each of the four surviving blast furnace remains. These Plans will consist of detailed measured surveys, structural assessments and the currently available historical information related to these furnaces. The Plans will then be used as a basis to apply for further grants for the actual conservation of these monuments. Our website (**www.furnaceproject.org**), which has more details on the Project, will have the Plans available for downloading once they are finalised. On the website you can also find a link to our Facebook page where any progress with this and any other aspects of the Project will be communicated.

Paul Rondelez

THE HMS RESEARCH IN PROGRESS MEETING – CALL FOR PAPERS

13th November 2015, Experimental Techniques Centre, Brunel University

This meeting is aimed at a wide variety of contributors, from historical and archaeological metallurgists to excavators, historians and economists. If you are working, or have just finished working, on a project related to archaeological or historical metallurgy, we would like to hear from you. We are particularly interested in bringing together contract and public sector archaeologists with academic researchers, and in fostering links between the different disciplines studying metallurgy and related activities. Whether you are a student, a researcher, an interested non-specialist, or a professional excavator, we invite you to meet others working in this field and present your research to an interested community.

For more information please contact Lorna Anguilano at **hmsRinPconf@hist-met.org**.

PRESERVED BESSEMER CONVERTERS – AN UPDATE

In the Spring 2014 issue of 'The Crucible' (No 85) I prepared a list of preserved Bessemer and Thomas converters known to me. In the following issue No 86 I added the ISCOR converter in Pretoria and two more Thomas converters in Palpala, Argentina bringing the total to 24.

10t Bessemer in Station Square, Pittsburgh, Pennsilvania USA. While in use it belonged to the A,M. Byers Company.

I have just received confirmation of a 25th converter at IJmuiden, The Netherlands from Rob Meijer of the Hoogovens Industrial Museum. It was in use in Utrecht in the Iron and Steel Works DEMKA (De Muynck Keijzer) and has been place near the (now) Tata Steel BOF Shop.

The present count is thus 25: ten in Sweden, seven in Germany, two in UK (including Bessemer's pilot converter), two in Argentina and one each in Austria, The Netherlands, USA and Canada.

If you know of others please let me know at **tjsmith560@btinternet.com**.

Tim Smith

HMS WEBSITE CALL FOR PHOTOS

As part of the website development HMS is building an online archive of past HMS events. If you have any photos from any of our past conferences please send them to **events@hist-met.org** for inclusion on the website. There will also be a digital archive of abstract books and space for thoughts and comments about events.

LEONARDO AND STEELMAKING

Leonardo da Vinci (1452-1519) was to achieve greater fame from the paintings by which he supplemented his income between engineering commissions, working in Milan and Florence. In fact, he was one of a long series of Italian artist-engineers (Gille 1966) such as Brunelleschi, Filarete, Taccola, who invented the differential gear, and Fioravanti, who fortified Moscow, albeit he was the most famous of these.

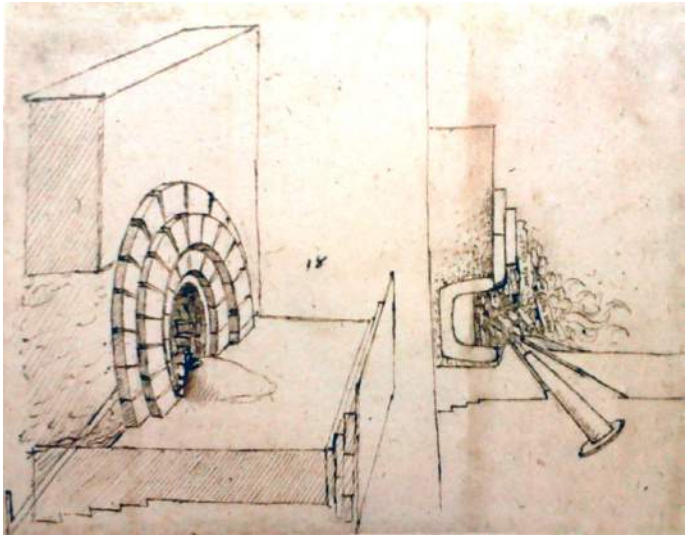
Leonardo da Vinci's 'Portrait of a man in red chalk', presumed to be his self-portrait, c. 1512.

His notebooks contain a large number of acute observations, not always related to one another, nor to any accompanying text. In one of these notebooks (Forster Collection, Victoria and Albert Museum), he describes a method of making steel, which would have been of considerable importance economically since 15th century. Milan was an important centre of the arms and armour industry, and its products were exported all over Europe. As well as the personal armour for individual commissions, the city maintained sufficient stores of ready-made armour to be able to equip a large army at short notice; for example, Milan was able to supply four thousand armours for cavalry and two thousand for infantry within a few days of the battle of Maclodio in 1427 (Thomas and Gamber, 1958). The majority of the armour with a Milanese origin in the 15th century was made of steel (Williams 2003, 68-202).

Leonardo's description of a steelmaking process is in somewhat vague terms:

"The steel is first beaten well for the length, and then broken in squares, and these are placed one above another and well covered with earth of Valenza[1] and powdered talc, and it is dried over a slow fire and gradually heated; and when it has been thoroughly heated both inside and out, the fire exerts its force and makes it become molten. But first insert flakes of iron, then have the earth gradually removed and beat it lengthwise, and this is good steel." (McCurdy 1954).

The starting material for making steel can scarcely have been steel, so a ferrous alloy, which can be "broken into pieces" suggests cast iron. This is covered with a refractory earth, presumably to resist oxidation, and is melted. At some stage, small pieces of iron were included. This might be a muddled description of a method of making steel by so-called "co-fusion" method of steelmaking which involved both liquid cast iron and lumps of wrought iron.



Two figures showing different views of the same steel furnace, from one of Leonardo da Vinci's notebooks.

Now, quite separate physically from this description, and in another part of his notebooks, there is a picture of a forge. This is to be found in the Codex Atlantico (reprinted 1975).

There are two views of the (same) furnace – a section and a three quarters view; without any separate text although there are two captions within the sketch.

The captions are [upper] "tutto caldo" (fully hot) and [lower] "mezzo caldo" (half hot), and the former is on top of a solid bar of some sort which seems to be melting.

This liquid then runs down, and appears to meet a jet of air from the tuyère[2].

The topics of the adjacent folios are not connected in any way with this folio. This was labelled as a "Catalan hearth" by Sherwood Taylor (1957, 65), and this nomenclature has been followed more recently by others (Bernadoni 2011, 118).

However, this seems to be very different to other depictions of the Catalan forge which was a high bloomery. This drawing shows a low hearth with no apparent means of tapping off slag at the base. If however, this were a finery of some sort, then the product would have been a solid removed from the surface of a liquid at the top or side of the hearth. So could this have been a furnace for making steel by "fining" (decarburising) cast iron? It does not seem to be related to his written description, but this was evidently a process that he had witnessed, rather than simply heard about.

Alan Williams

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Notes

[1] "terra di Valenza" – is a refractory earth, suitable for firebricks, according to: *Italian Dictionary* (Hoare, 1915).

[2] I am very grateful to Dr.Francesca Borgo (Harvard) for elucidating the captions for me.

ANCIENT MINING AND METALLURGY IN THE EXTREME NORTHWEST OF ARGENTINA

In the context of pre-Hispanic South Andes,the Argentinean Northwest became an important center of metalworking production and innovation. This development is reflected in the variety and quality of the metal objects produced there and in the technological solutions applied to produce objects with desirable characteristics.

The Puna of Jujuy, in the southern extreme of the South-Andes high-plateau and part of the current Argentinean Northwest, is an area of great interest for studying the particular characteristics of ancient mining and metalworking technology. Ores of the four metals employed during pre-Hispanic times, copper, tin, gold, and silver, were available in the area. Therefore, in 2004 we initiated a research project focused on generating new data on this subject by combining historical research on colonial documentation with intensive and large-scale archaeological surveys, excavations and records of pre-Hispanic and Colonial sites. To complement this, we have designed and implemented an archaeometric program to study furnaces, slag, minerals, and any metal found.

As a result of the work completed so far, we have recorded one-hundred sites that show evidence for mining and metalworking production in the area. We have identified pits and trenches for placer mining, adits to extract gold and silver ores, "canchas" (courtyards paved with cobbles), "marays" (grinding stones), furnaces for mineral processing and smelting, isolated shelters near the working areas and even small abandoned villages that were founded due to the mineral wealth of the area.

The evidence collected allows us to suggest that during the late pre-Hispanic period (ca. AD 900-1430), mining was not developed on a large-scale, however during this period the production of metal objects reached its peak in areas such as the Humahuaca Valley. The extraction of mineral ores, especially copper and tin, would have been carried out by herder-miners, who would have transported them to regional centers of metalworking, located in the lower valleys but, not in the current Argentinean high-plateau. In this scenario, Puna inhabitants were involved in mining but not metalworking activities.

Colonial era adit at Coyahuayma (Jujuy, Argentina).

Reverberatory furnace for silver smelting (18th century, Fundiciones 1, Jujuy, Argentina).

At the beginning of 15th century, the Argentinean Northwest was incorporated into Tawantinsuyu. Several researchers have pointed out the special interest of the Inca Empire on controlling the mines and workers of the Puna of Jujuy, however our investigation shows that the Inkas did not develop large-scale mining activities in this region, nor is there evidence of metalworking production in Inca contexts. The mineral ores, especially gold and silver, in this region were particularly attractive to the Spanish conquerors who arrived at Puna in AD 1535. Such was the will for searching and working these ores that this region, despite standing at 3700 amsl and having difficult weather conditions, had one of the highest population concentrations in Jujuy by the 18th century.

During the colonial period, the landscape of the Puna was structured around mining activity. European and Indigenous people worked the gold placers, labored the gold and silver ores and smelted minerals in reverberatory furnaces. Villages and towns grew up fast with the discovery of mineral sources but, they were also abandoned quickly as the resources depleted. Some of these towns are still inhabited today, and stand as landmarks that remind of the presence of the underground wealth and the gold and silver fever of the past.

Carlos I. Angiorama

Florencia Becerra

LATE MEDIEVAL TO POST-MEDIEVAL ARCHAEOMETALLURGICAL FINDS FROM SOKOL FORTRESS, KONAVLE

The area around Sokol fortress in Konavle, near Dubrovnik, was inhabited since prehistoric times. The fort played an important role during the transition from the late Roman to the early medieval period (as a significant point on Justinian's Limes in the coastal hinterland) (Topić et al. 2014a; Kapetanić 2013), as well as during the late Middle Ages (Grujić 1926; Beritić 1966; Živanović and Vuković 1954; Kapetanić 2013; Topić et al. 2014a). The fortress was an important control point of warfare and trade on the path from the Balkan mainland to the Adriatic Sea (Topić et al. 2014a).

This paper in short outlines the late medieval and post-medieval archaeometallurgical finds from the Sokol (Falcon) fortress (Figs. 1-2) in Konavle near Dubrovnik, Croatia. During conservation and restoration of the fort, a forge was found on the north side at the top of the fortress (Fig. 4). This forge is also mentioned in archival documents from the 15th century (Beritić 1966, 121). In an archaeological excavation carried out in 2013, a furnace was discovered along the western side of the fortress (Fig. 4), which operated from late medieval to early modern times (Topić et al. 2014a; Topić et al. 2014b).

Fig. 1 Sokol fortress.

The excavation included the area around the fortress, which revealed structures of diverse functions from various time periods (from prehistoric until post-medieval time), including a zone that consists of a large rectangular furnace and surrounding "rooms" that are situated along the western side of the fortress. The furnace (Fig. 4) was built of coarse and fine stones, bricks, and tiles bonded with greyish mortar. It is rectangular in shape (dimension 2.80 x 2 m) and is divided into two unequal parts by a wall. The bottom of eastern (bigger) part of the furnace consists of stones, sand and clay, while western part is made of

Fig. 2 Aerial view of the fortress (after Kapetanić, 2013, 80).

brown soil and small stones. It was most likely wood-fired. The furnace may have been used for different purposes due to the needs of the fortress. Just next the furnace, along its western side, a large fragment of a smashed iron vessel (probably a crucible) was found. There are traces of glassy slag on the walls of the vessel. According to the slag finds from excavation, it is clear that the iron objects were produced or repaired in much larger quantities than objects made of other metals. Inside and around the furnace small quantities of slag was found (Topić et al. 2014a).

The rocks that fell down from the fortress (which was built on a huge natural rock formation) during earthquakes on the western side were used to form the lateral sides of the surrounding "rooms." Room 2 is situated along the northern side of the furnace, and it was identified as a probable additional part of the furnace (Fig. 4). Several big rocks formed room 1, and it is situated north of room 2. Room 3 is situated south of the furnace. The south part of it was closed by huge rock and the north part was enclosed by the southern wall of the furnace. To the west of the furnace, there was some sort of pavement with small stones that was built in order to level the surrounding walking area with the huge decreasing rock that spreads south of the furnace (Topić et al. 2014a).

Large quantities of rough iron smithing slag (Fig. 5) was found along the northern and eastern sides of the fortress, while the same type of the slag was discovered in minor

Fig. 3 Reconstructed forge at the top of the fortress (exterior and interior) (after Kapetanić 2013, 84, 90).

amounts along the western side. The slag was thrown from the top of fortress where the forge (Fig. 3) was situated. The forge was positioned on the north side of the upper level of the fortress, and it served for minor production of cold steels and repairing of tools and armours. It was the closest way to get rid of the slag, to throw it down this side, which means that the slag mostly ended up along the northern side of the fortress. A small iron vessel (probably a crucible) (Fig. 6) was found beside the eastern side of the fortress (Topić et al. 2014a).

The slag finds are mostly products of iron castings, and minor amounts of bronze, copper and lead castings. Analysis will reveal more information on the technology applied and connection between the slag and the finds, as well as on the origin of the raw materials that were obtained from the mines located further inland. Metallurgical activity was present during the late Middle Ages when the fort was under Bosnian rule, which points to the Balkan inland mines as the source of raw materials. Well-known mines from that area were Ostružnica, Fojnica, Srebrenica, Rudnik, and Olovo. They mostly produced silver and lead, but also copper, bronze and iron. The ores were refined in the mining centres in Bosnia and exported further as metals. The main traders in metals were Dubrovnik merchants who also had mining colonies in Bosnia, Serbia and Kosovo in the late middle ages (14th-15th century) (Kovačević 1961; Hrabak 1984). Metal trade and export were very developed, and beside Dubrovnik merchants, there were also many Italian traders. Bosnian metals were exported to Venice, middle Italian cities, Sicily, the Ottoman Empire, Spain, Syria and Alexandria (Kovačević 1961, 161, 170). When the crisis halted European mining due to the wars, Bosnian mining reached its peak. Dubrovnik probably had an intermediary role in the export of Bosnian metals to Europe. That was an important time for Balkan mining products on the European market (Kovačević 1961, 142).

When the fortress came under rule of the Dubrovnik Republic (1419-1420), metallurgical activity continued until the fort became important for the new patrons. The Dubrovnik Republic needed metals for their own production but also for export across the Adriatic and the Mediterranean. The fort was abandoned in 1672.

Since the primary role of the fortress was defence, the products were mainly of a military nature; however, tools and materials used for buildings were also produced. Numerous iron nails (Fig. 5) and linchpins were discovered during excavation, which may point to extensive production of materials needed for clasping of the wooden architecture of the fortress. Many bolts/arrow-heads

Fig. 4 Furnace along the western side of the fortress.

Fig. 5 Iron slag, iron nails, tool, slabs with rivets and bolts (veretoni).

(veretoni), several spears and lead bullets, iron axe and gun fragments, iron armour (pieces of small metal slabs with rivets) (Fig. 5) and metal belt clasps bear witness to the military character of the finds. Among the finds, there are also blades, razors, knives and keys. Beside all these tools and arms, many fragmentary finds were unidentifiable due to their poor condition (Topić and al. 2014a). There are also many archival sources bearing evidence to steel and fire-arms at the fortress in the 15th and 16th century. The weapons were purchased from other production centres, but also produced in the fortress (Beritić 1966; Kapetanić 2013, 40-42).

Fig. 6 Small iron crucible.

Along with the metallurgical finds, in the context of the Medieval and early Modern layers fragments of glazed and rough pottery, tiles and bricks, glass, coins, stone cannon balls (for bombardas) were also found. The fortress is extremely abundant in finds of various types, origin and time periods, that also bear witness to its important position and function throughout history (Topić et al. 2014a; Topić et al. 2014b).

Along the western part of the fortress, the excavation was stopped on the late medieval layer (furnace level) to preserve the structures for presentation. The fortress has been restored, and a museum can be found on the upper level. The forge, situated on the northern part of upper level, is also reconstructed and equipped with tools. The area around the fort is currently in the process of being converted into an archaeological park, including the metallurgical zone.

Nikolina Topić

Nikolina Drašković Vlašić

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TIN BRONZE METALLURGY IN THE BRONZE AGE OF SOUTHWESTERN IRAN: THE DEH DUMEN GRAVEYARD

The importance of the Bronze Age in Iranian metallurgy has not been extensively studied and thus very little is known about the alloys used to produce metallic artefacts. Especially, because of the transition from arsenical copper in Chalcolithic/Early Bronze Age period to tin bronze during the third millennium BC of Iran (Oudbashi et al, 2012; Thornton, 2009), analysing metal artefacts from Early/Middle Bronze Age sites can help us reveal metallurgical events during this period.

In February-March 2013, a rescue excavation was done at a prehistoric graveyard near Deh Dumen village, a suburb of Dena Township, and about 70 km northwest of the city of Yasuj, the capital of Kohgiluyeh and Boyer-Ahmad province, in southwest Iran. This archaeological excavation was performed as part of emergency archaeological excavations of archaeological sites at risk due to the dam project over Khersan River. The Deh Dumen graveyard is located on a natural hill that is formed by river deposition. Many metal finds were found amongst the burial goods recovered. Based on the graves' form and structure and different archaeological finds, such as the metal objects and pottery, the site has been dated to the early/middle Bronze Age of western/southwestern Iran (third millennium BC). The graves and burial goods of Deh Dumen find many comparisons to Early/Middle Bronze Age graveyards excavated in Pusht-i Kuh of Luristan, western Iran such as Bani Surmeh graveyard (Haerinck et al, 2006).

View of the Deh Dumen site during archaeological excavations.

A research project was established at the Art University of Isfahan, funded by its research office, to study and analyse some of the metal objects found at the Deh Dumen Bronze Age graveyard. The emergence of tin bronze metallurgy in Iranian Plateau goes back to end of the fourth millennium BC. However, only a small number tin bronze examples have been found on the Iranian Plateau dating to the third millennium BC. For this reason, identification of alloy composition in these samples was the main aim of the research. Thus, in order to provide more analytical results for this period, this research performed the compositional and microstructural analysis on the metallic artefacts of Deh Dumen site to determine the types of alloys used and microstructural characterization in the metal samples, to identify the traditions of metalworking in Deh Dumen objects.

Two bronze vessels unearthed during excavations.

For this study, nine metal samples (from eight different broken vessels) excavated from different graves were examined. The microstructural observations and semi-quantitative chemical analyses were done by scanning electron microscopy coupled with energy dispersive X-ray spectroscopy (SEM-EDS) method. Also, the cross sections of the samples also were studied by optical microscopy method to characterize the microstructure and manufacturing processes.

The results of the chemical analysis indicated that the body of eight metallic vessels was made of tin bronze alloy with different amounts of Sn. Only in one sample was the internal bulk of the base of a vessel indentified as arsenical copper alloy. SEM-BSE observation of the microstructure of the samples showed many elongated dark inclusions and various light globules scattered in the copper matrix. EDS analysis on one of dark elongated inclusions showed that they are copper sulphide phases with some impurities. Analysis of the light globules showed that they are Pb-rich phases. According to the metallographic observation, it is clear that the microstructure consists of worked and annealed grains containing twinning and slip lines. It proves that the original cast bronze ingots were made by a cycle of cold-working and annealing to shape thin sheets that formed the bronze vessels. In some cases, the working and heat treatment was not able to remove all segregations which occurred during the solidification of molten alloy and some eutectoid phases may be observed in the microstructure (Scott, 1991).

Micrographs of two bronze samples after etching in alcoholic ferric chloride solution, including worked and annealed grains with twin and slip lines.

Based on analytical results, the bronze objects from the Early/Middle Bronze Age site of Deh Dumen are made from variable tin containing bronze alloys. These tin bronze artefacts with considerable tin amount are an important find in archaeometallurgy of the Bronze Age of Iran because of the lack of significant amounts of identified tin bronze objects in the Iranian Plateau from the third millennium BC. Further, the absence among these same samples of a significant amount of arsenic in the composition of copper/bronze objects is also important. Results of different studies on the prehistoric copper metallurgy show that the Chalcolithic and Early Bronze Age copper objects from Iranian Plateau have significant amounts of arsenic while Middle/Late Bronze and Iron Age tin bronzes contains arsenic as minor or trace element (Frame, 2010; Fleming et al, 2005; Fleming et al, 2006; Begemann et al, 2008).

The Deh Dumen metal objects could be considered as the stage of transition from arsenical copper to tin bronze on the Iranian Plateau during the third millennium BC. This is visible from apparent use of arsenical copper and tin bronze in the manufacture of a single bronze vessel. Interesting examples of the transition from arsenical copper to tin bronze may be observed in western Iran, where manufacturing different metals with arsenical copper in the Chalcolithic was changed to low tin bronze production alongside arsenical copper in Early and Middle Bronze Age, which include examples from Luristan and Godin Tappeh (Frame, 2010; Begemann, 2008). Due to the limited amount of metal finds from Deh Dumen and the limitations of sampling from complete objects, more data is required before further conclusions can be made on the nature of the arsenical copper and bronze alloy usage at this site. The next step of this research project is provenance analysis on the bronze samples to do some comparative studies and to characterize the probable origin of the tin bronze metallurgy in the third millennium BC in western/southwestern Iran.

Omid Oudbashi

Reza Naseri

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IZUMI SHIMADA

Izumi Shimada is a distinguished University Scholar and Professor of Anthropology at Southern Illinois University, Carbondale, as well as an internationally renowned example of how to lead interdisciplinary research in archaeology. His research interests include the archaeology of complex pre-Hispanic cultures in the Andes, the technology and organisation of craft production, and mortuary analysis. Cross-cutting all of these topics is the study of metals and metallurgical technologies, ranging from world-famous gold and tumbaga masks to more modest bundles of arsenical copper objects, always studied with scientific techniques but well-grounded in archaeological concerns.

He has excavated at many sites and continues to direct two archaeological projects in Peru. He has authored or edited over 200 publications including Pampa Grande and the Mochica Culture (1994), Craft Production in Complex Societies (2007), Cultura Sicán (2014), and The Inka Empire: A Multidisciplinary Approach (2015). He has received awards and honors from the government and other institutions in Japan and Peru. He founded the National Sicán Museum in Ferreñafe, Peru.

We caught him during a busy week at UCL, as he came to deliver the Beno Rothenberg Memorial Lecture for the Institute of Archaeo-Metallurgical Studies and to participate in a conference in Andean Technologies.

ThE CRUCi BlE : Can you summarise your career in a couple of sentences?

iZUMi ShiMADA : I am a Japanese, who lives and teaches in United States, but works in South America. I am very aware of this uniqueness, and I am trying to combine the different cultural perspectives and bring that to my research. So I am a not very easy person to classify. I was trained more as an ethnohistorian, but I am very much goal and issue oriented. So when I recognised the information potential of the area I am working in, I set a series of research aims that identify the key issues and I have been perusing those. So if you need to characterise me, I would say I am persistent. I have been doing that for almost forty years!

ThE CRUC iBlE: What is your most memorable professional moment?

iZUMi ShiMADA : The opening of the National Sicán Museum in the City of Ferreñafe, Peru that I designed and which exhibits the main results of over three decades of our research (by the Sicán Archaeological Project that I have directed since 1978).

ThE CRUCi BlE : Who has been your most influential colleague, and why?

iZUMi ShiMADA : Late Dr. John V. Murra, a renowned specialist of the Inka Empire at the Department

Experimental smelt in a well preserved Chimú-period furnace at Cerro Huaringa. Part of the holistic approach to Sicán metallurgy. From Shimada and Craig 2013.

of Anthropology, Cornell University. He inspired me to pursue the archaeology of complex societies in the Andes.

ThE CRUCiBlE : What is your main current project?

iZUMi ShiMADA : The excavation and analysis of the Middle Sicán (ca. AD 1000) precious metal workshop at the capital site of Sicán in Peru.

ThE CRUCiBlE : What multi-million project would you like to develop?

iZUMi ShiMADA : I would probably be doing exactly the same thing I have been doing, except on a larger scale. Because my idea of holistic understanding of technology really requires a regional approach as well as interdisciplinary collaborations. By regional approach I mean looking for multiple contexts on a different scale, starting from the individual artisans, group of artisans, to workshops and so on, building on a larger scale. It is only by setting a multi-scholar or a holistic context approach that you really get the understanding of how technology and its social contexts operate. This cannot be easily done by only one investigator or in a short time, you would require decades. So if multimillion funding is available, it would allow us to do this properly.

ThE CRUCiBlE : Which publication should every HMS member read?

iZUMi ShiMADA : I would recommend "The style, technology and organization of Sicán mining and metallurgy, Northern Perú: insights from holistic study" by Shimada and Craig 2013. [this article can be found online at **http://www.scielo.cl/pdf/chungara/v45n1/art01.pdf]**

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

iZUMi ShiMADA : Archaeometallurgy has a strong tendency to be technical oriented. If archaeometallurgy is to go beyond just technical studies, to really provide a better understanding of the social, cultural context it operates in, then it really has to have a broader outlook. Therefore, one piece of advise I would give to students in archaeometallurgy is to be conscious about the tendency to be technical and therefore to balance this, including the study of the social contexts, taking courses on social anthropology and constantly posing broader questions: more social, symbolic and so on. The importance to contextualise metallurgy or any technology is critical.

ThE CRUCi BlE : I would like to tell every reader of **The Crucible** that...

iZUMi ShiMADA : I am fundamentally an archaeologist and I began a long career in archaeometallurgy not by desire. It was really my recognition that the archaeological complex I was working had a tremendous potential to illuminate on ancient mining and metallurgy. And that is how I began the long term study of Sicán metallurgy. But it is a tremendous pressure, a responsibility, because after all these kinds of sites are rare. In that sense I feel we need to do the most we can do to make the information potential that these sites present. And like any other places where I work, there is constant pressure of preservation of these archaeological remains. The mines that I surveyed are no longer accessible, because they were taken over by modern mining companies and are essentially destroyed. This is a constant reminder that we have to do the most we can do to achieve the information potential of these sites.

Moreover, what we [archaeologists] are trying to do is so ambitious. That archaeologists in a rather short time span, want to able to reconstruct a "culture" is -if you think about it- an outrageous idea! We have just a few things to look at. As archaeologists, we have to recognise the difficulty and the challenge we face and we have to provide respect to the cultures we are studying deserve. And we do need to think in terms of long term investment, and not only investment, but also personal commitment to your research.

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**.

TIM SMITH

Well, this page seems to increasingly be 'Meet Your Ex-Council' as, like in the previous issue featuring Duncan Hook, I too have just retired from Council having completed two consecutive sessions which is the maximum the Constitution allows. Indeed, this is the second time I have served a double session as a Member of Council and I am happy to hand over to new blood to take HMS forward.

I found many changes between my two sessions as a member of Council (2002 - 2006 and 2009 – 2015) in particular the growth in the number of Committees which focus on the various aspects of historical metallurgy, the disappearance of a number of 'old faithfulls' but also there remained a fair proportion of Members I had known from the earlier days thereby ensuring a degree of continuity in the activities of HMS. I believe this to be very important to ensure that we do not keep 'reinventing the wheel'.

I served as Secretary to the History & Recent Metals Committee which may be the least successful of all the Committees, possibly because of too much overlap with the activities of some of the remaining six Committees. It proved difficult to find a common date and place for members to physically meet due to pressure of their work or distance to travel and we had to rely largely on e-mail communications to discuss matters. The introduction of different HMS digital discussion groups administered by Tim Young was a great help in this, as indeed has been the growth of the internet which has enabled much historical data to be accessed far more readily than in the past.

One of my aims on this Committee was to document as many films recording past metallurgical operations as possible and record preserved sites internationally. Where I have succeeded in doing this the information has been disseminated through the pages of 'The Crucible'.

This moves me on to publications. With 25 years of professional editorial experience on steel and aluminium trade publications I feel I am qualified to comment on this.

First the Journal: the pros are excellent content and print quality. The cons are late issues, limited use of colour and still no digital version. The latter I consider is the more serious failure and a matter of frequently discussion by Council but one so far not resolved. There is a simple solution – and one which I introduced in my own publications 15 years ago – place a pdf of the journal on a secure part of the website available to download by circulating a link to all HMS members. This is readily achieved as the past 10 years or more the journal have been sent to the printer in the form of a pdf, a lower res version of which should be hosted on the web site – and in colour. We still need to circulate the printed journal – indeed I still have all my back copies from Issue 1 - but the digital version has the advantage that it can be readily word searched – not just by issue but across all the issues stored as pdfs – just use the browse function in Acrobat to select the required folder. Once the easy part is done – uploading the existing past 10 years of journals – then we need to undertake the scanning of the older issues to build up a complete searchable archive. Of course, we should not forget the valuable work Brian Read has undertaken in creating a digital Index of Vols 1-38 and the Contents of Vols 1- 43, but technology has now moved – as have the number of issues since we are now on Vol 47 – and having the complete journal at your fingertips in searchable digital format is, I believe, the way to proceed.

Against this 'simple' solutions is the desire for the digital version to be available in academically recognised search engines so that professional contributors gain citations in a peer reviewed publication. I appreciate the quandary and propose the pdf solution for the general membership with investigations to continue to meet the needs of the professional archaeologists members.

Next 'The Crucible': previously 'Good', now 'Excellent' – particularly with the introduction of colour. Its frequency of publication, news, list of events, conference reports and profiles of personalities make it both very readable and valuable in informing the Membership. Congratulations to Marcos and the Editorial Team at UCL for the fine work.

And finally, and certainly not least, the web site which has grown in functionality as the technology has grown. This is our 'window to the world' and its professional design and frequently updated content is a credit to the Society.

Well, I have left saying anything about my background to the end so you can skip this bit if you wish and move onto the next article which I am sure will be of much greater use – but here goes.

My interest in Industrial archaeology arose from an early age as I was brought up on the southern slopes of Dartmoor and spent much of my youth exploring the remains of the old tin miners and clay workers on the moor. Indeed, I lived only a mile from the old wolfram works of Hemerdon mine which operated in WWI and again in WWII supplying the strategic metal, tungsten for the war effort. This mine is in the news again as Wolf Minerals are reopening it this year to produce tungsten and tin and say the reserves at over 400Mt at 0.13% WO_3 are the third largest in the world! I recall being chased away from the mothballed plant by the caretaker back in the 50s and climbing the spoil heap with its aerial ropeway. Further, I was within easy reach of the 18-19th century tin and copper mines of the Tamer Valley and further west in Cornwall.

This led me to deciding on a degree course in metallurgy which I undertook at Brunel University, Uxbridge. It was at this time I was introduced to HMS by Professor

Tim Smith while visiting Danieli & Co, Buttrio, Italy.

Bodsworth and I joined as a student member in about 1967. After graduating, I then spent two years in northern Somalia teaching chemistry and travelling around East Africa. The HMS journals were sea-mailed to me by my parents – most of which eventually arrived and some in my collection still bear the scars of the journey.

I returned to Brunel to undertake a PhD in 'kitchen sinks' (well really developing crystallographic textures to improve the formability of stainless steels). It was while on a Royal Microscopy course for TEMs that I met my wife who was a post office research engineer. We married while I was still studying – which gave us a great tax advantage. I sort of slid onto the staff at Brunel while writing up my PhD, lecturing in physical metallurgy (mainly ferrous) and was also in charge of the x-ray diffraction laboratories.

With two children on tow, we decamped to the copper belt of northern Zambia in 1981 where I eventually ended up running the mining department at the then technical college in Kitwe training technicians for ZCCM.

We returned to England in late '87 where I undertook a short course in Technical Writing which enabled me to obtain the job of technical editor on Steel Times & Steel Times International. Over the course of time I became editor of these two trade publications and later that of Aluminium International Today. International travel was a major part of the job which gave me the opportunity to visit many sites of industrial historic interest in Europe, USA and Asia.

I retired from this job in November 2013 which has given me more time to be active in various industrial archaeology societies that I have been a long term member of including the Trevithick Society and the Dartmoor Tin Research Group. I am also presently chairman of the Wealden Iron Research Group which undertakes field work on bloomery and blast furnace sites in the Weald of Kent, Sussex and Surrey. We also operate an experimental bloomery furnace using local siderite ore and local charcoal. In 2001, I organised the HMS Summer Conference held on the Weald.

I will keep in close contact with HMS during my 'retirement' and remain the liaison person with the Institute of Materials, Minerals and Mining (IoM3) as well as keeping a watching brief on the erstwhile History of Recent Metals Committee.

While I believe the Society to be in safe hands, in particular thanks to the expertise of the present Secretary and Chairman, I do urge Council not to forget its original aims to record, preserve and promote the metallurgical heritage of UK, and not to attempt to duplicate, but rather work with, other established national and international organisations preserving industrial heritage.

TECHNOLOGY: IDEOLOGY, ECONOMICS AND POWER IN THE ANDES

15th-17th June 2015, london, UK

With over a year's worth of dedicated planning, 24 paper and 14 poster presentations, and over 80 registered attendees, June 15th – 17th, 2015 marked the realization of the conference entitled Technology: Ideology, Economics and Power in the Andes at the UCL Institute of Archaeology. Organized by the Institute's very own Bill Sillar, Viviana Siveroni and Miguel Fuentes, and with an impressive array of conference presenters associated with academic institutions throughout Europe and the Americas, the conference boasted a tour de force of research on ancient and historical technologies in the Andes from metallurgy to textile production to rock art iconography. Specifically within the context of metallurgical technologies, Sillar, Siveroni and Fuentes' conference proved to be invaluable to both the student and researcher of archaeometallurgy, with well-recognized veterans of the field presenting what can be described as the product of over 100 years of ongoing research into ancient Andean metallurgical technologies. Among these veterans included Izumi Shimada (University of Southern Illinois Carbondale) who alongside John Merkel (UCL Institute of Archaeology) presented a paper entitled "Sicán Alloys: A Holistic Vision" concerned with the technological, social and symbolic dimensions of Sicán metal alloys. Additionally, on the second day of the conference, Shimada was invited by the Institute for Archaeo-Metallurgical Studies (IAMS) to deliver its 2nd Annual Professor Beno Rothenberg Memorial Lecture, in which Shimada detailed the archaeological work pioneered by himself and his colleagues over the last 30 years as part of his ongoing direction of the Sicán Archaeological Project.

The archaeometallurgical studies presented were not limited to the north coast of Peru however. Moving northward to Colombia, a paper titled "The 'material essence' of Muisca metalwork" (Colombia) was presented by María Alicia Uribe-Villegas (Gold Museum, Bogota, Colombia) and Marcos Martinón-Torres (UCL Institute of Archaeology) with a focus on critiquing current understandings of the intersection between technical and cultural traditions in the production of lost-wax castings of gold alloys among the historical Musica peoples. This brief investigation into Colombian archaeometallurgy was enhanced by a poster presentation by Juanita Sáenz Samper (Gold Museum, Bogota, Colombia) and again Martinón-Torres entitled "Pink, not yellow: depletion gilding and colour in Nahuange metalwork" (Sierra Nevada de Santa Marta, Colombia).

Meanwhile, in the southern Andes, the archaeometallurgy of Bolivia was represented by two papers entitled "Metal Production, Power and Religiosity in the Southern Andean Highlands" (Bolivia 15th to 16th centuries) and "Small-Scale Metallurgical Technology and the Value of Silver at Porco, Bolivia". The former paper, presented by Pablo José Cruz (CONICET/ Instituto Interdisciplinario Tilcara – FFyL-UBA, Argentina), aimed through investigation of historical sources and metallurgical sites to link together metal production, territorial jurisdictions, and ritual cults in the Bolivian highlands during the Inca and early Hispanic periods. The latter paper, presented by Mary van Buren (Colorado State University), engaged the more recent past by using ethnohistorical sources and an ethnographic case study from Porco to characterize small-scale household production of silver metal over the last half-millennium, situating its context within indigenous symbolic value systems, economies of scale, and the development of multinational corporations.

Mary Van Buren presenting about small-scale silver production in Porco, Bolivia.

Nearby, two paper presentations concentrated on the archaeometallurgy of the Atacama region of Chile. The first paper presentation, entitled "The organization of copper mining production before and after the Inkas in the Atacama Desert" presented by Diego Salazar (Universidad de Chile) detailed the environmental, technological, economic, social, and political contexts associated with a transformation in the organization of copper production in the Atacama after the Inca conquest. The second paper presentation, entitled "Mining communities and domestic metallurgy in the highlands of Arica and Parinacota" presented by Daniella Jofré (University of Toronto, Canada), Valentina Figueroa (Universidad Católica del Norte, Chile), and Thibault Saintenoy (Centro de Investigaciones del Hombre en el Desierto, Chile; CNRS, University of Paris 1) focused on characterizing the interactions between pre-Hispanic mining communities of the area using both

archaeological analyses and ethnographic research. Lastly, and fittingly, a poster presentation by María Teresa Plaza (UCL Institute of Archaeology), once more Martinón-Torres, and Valentina Figueroa-Larre bridged the archaeometallurgy of the southern Andes in a poster presentation entitled "Gold technology and the Tiwanaku culture in San Pedro de Atacama, Northern Chile (AD 400-1000)."

Handling session and open discussion at the British Museum to finish the conference.

While the research presented at the conference varies considerably within geographical and cultural contexts, all of the paper and poster presentations are united by a common theme, an emphasis that when it comes to studying technology and its relations to ideology, economics, and power, there is a need for the researcher of archaeometallurgy to strategically integrate together multiple dimensions of information in order to obtain a clearer picture; a theme emphasized in Shimada's presentations as the Holistic Approach to studying ancient and historical metallurgy. The conference Technology: Ideology, Economics and Power in the Andes reminds us as archaeometallurgists to investigate beyond the metallurgical materials themselves but also the social actors and cultural mechanisms integral to their narratives. Special thanks should be extended to all those individuals and institutions whose efforts allowed the conference to reach fruition and we should hope that students and researchers of the field can look forward to such stimulating and valuable dialogue on the topic of Andean technologies in the near future and onwards.

Branden Rizzuto

ARCHAEOMETALLURGY IN EUROPE IV

1st-3rd June 2015, Madrid, Spain

The Archaeometallurgy in Europe International Conference was held from the 1st to the 3rd of June in Madrid. This year's edition, organized by the Institute of History of the Spanish National Research Council (CSIC) in collaboration with the National Center for Metallurgical Research (CENIM-CSIC), the Autonomous University of Madrid (UAM), The National Archaeological Museum and the German Archaeological Institute (DAI-Madrid), had as main purpose "putting together all the interdisciplinary knowledge and regional studies we have been accumulating and negotiate a historical picture that will permit us to face future challenges". Therefore, during the conference, twenty sessions were organized covering a wide range of themes.

The first day started with an opening lecture in which William O'Brien presented the "Information flow and the early spread of metallurgical knowledge in Atlantic Europe". In this presentation, O'Brien focused in the copper spread from continental Europe to Ireland during the Chalcolithic and Early Bronze Age periods.

The morning presentations were dedicated to two different themes: the early metallurgy of the Iberian Peninsula and Gold. The first session started with a presentation from Roland Gauss concerning the "Copper and Bronze Age metallurgy at Zambujal and in South-Western Iberia and how it compares to metallurgical traditions in the Mediterranean and the Near East". After that, Mercedes Murillo-Barroso gave us an introduction to the SMITH project, devoted to investigate whether metallurgy was an independent innovation in Iberia, through the analysis of the whole chaîn opératoire from key Chalcolithic Iberian sites. Furthermore, the analysis of new findings of archaeometallurgical debris from Peñalosa gave us new data on scale production of copper in the Argar Culture; in addition, the new findings from the Early Bronze Age settlement of Santa Lucia (Spain) were also presented by Ignacio Montero-Ruiz.

During the afternoon, five different sessions were presented regarding: Ores and Mines; Gold; Experimental; and Early Metallurgy. The experimental archaeology session, which was opened by Georges Verly and Marco Romeo Pitone focused on smelting furnaces from Ayn Soukhna (Egypt). In addition, Elin Figueiredo presented an experimental approach for smelting tin ores from Northwestern Iberia. A promising archaeological and archaeometric approach to intentional patination on black bronzes was presented by Agnese Benzonelli. Santiago Cano González closed the experimental session with a study about an aesthetic and functional replica of Nariño copper and silver alloy.

After the coffee break the Ores and Mines session, started with an interesting overview of the history of the copper mine of Skouriotissa (Cyprus) lectured by Vasiliki Kassianidou, followed by a curious talk about Iron Age copper production in Timna Valley (Israel) by Erez Ben-Yosef. This session was concluded by Joseph Gauthier with a study of new evidences of washing ores in the Altenberg (France).

The second day opened with three different sessions concerning: Smelting Technologies; Provenance and Workshops. These sessions covered not only European cases but also, Israel, Peru, Chile, Roman Britain, Austria and Thracia studies. Johan Ling and Zofia Stos-Gale highlighted the hypothesis of an Iberian supplier to produce Scandinavian Bronze Age copper artefacts. New insights into Central Mediterranean copper trade during the Late Bronze Age were presented by Paolo Valera. Moreover, Moritz Kiderlen presented the use of neutron activation analysis for the provenance of artefacts cast in the lost wax technique of Early Iron Age Greek tripod-cauldrons.

The following sessions were related to Bronze Age; Out of Europe and Iron. In the Out of Europe session, Thomas Fenn presented the economic changes in Tanzanian Swahili Coast through the examination of non-ferrous metals and metallurgical technologies. In the Bronze Age session, Maikel Kuijpers presentation stood out when he presented an innovative view about scientific data of Early Bronze Age axes production in terms of metalworking craftsmanship. Peter Northover brought us an important lecture about the distribution of copper ingots from the British Late Bronze Age, in which he wondered why there is a gap of ingot finds until Roman times.

After lunch the conference took place at the Museo Arqueologico Nacional and started with a lecture by Ernest Pernicka in which he started to introduce the beginning of archaeometallurgy in the world and potential for future work. After this, two parallel sessions regarding Provenance and Trade, and Iron were taking place at the museum.

Conference at the Museo Arqueologico Nacional.

The provenance and trade session started with tin isotopes and the problem of the provenance of prehistoric tin with Gerhard Brügmann. Moreover, Yasser El-Rahman explored the provenance of iron ore in Egypt. The session ended with Marcos Martinón-Torres presenting tin ingots, lead pigs and 6-meter long iron bars recovered from a ship that sank in the Thames estuary. The day ended nicely with a free visit to the Archaeological Museum.

After the morning sessions, the poster session gathered 54 posters with interesting research works.

The last day started with Bronze Age; Iron and Roman Metallurgy. In the Roman Metallurgy session, Michael Bode talked about lead-silver mines from Iberian Peninsula through the combination of lead isotope analysis, archaeology and epigraphy of Roman ingots. Márton Benke brought special applications of X-ray diffraction on Late Roman silver artefacts as it is a suitable method for the measurement of crystallographic texture and residual stress. In this study, Benke showed that the examinations performed on silver artefacts proved that the type of manufacturing process can be determined through the developed techniques. Then, Arne Jouttijarvi talked about copper alloys in the Roman Empire and Germania Magna, in which he focused on Roman alloying traditions and the meaning of brass.

In the afternoon, the sessions covered lectures about Recycling and Medieval and Modern. The Medieval and Modern session started with a lecture about French bronze statues of the 16th-17th c. AD, in which Manon Coquinot and David Bourgarit showed a study of three prestigious royal commissions. This session ended with an interesting presentation about the Tudor (16th-century) mint in the Tower of London.

The closing lecture was given by Thilo Rehen. In this lecture, Rehen talked about the rise in publishing papers in this field, the importance of archaeometallurgy and how continuing work is needed. After that, the conference ended with the HMS prizes for the Best Student Oral Presentation and for the Best Student Poster. They went, respectively, to Julian Flament (CNRS) for his work on medieval cupellation remains from France, and Teresa Plaza (UCL) for her research on prehistoric gold from Chile.

Overall, the Madrid edition was a great success with fruitful discussions and presentations.

Filipa Lopes

Rosa Vidigal

ARCHIVES AND SLAG COLLECTIONS STUDY & WORK DAY

26th September 2015, Coalbrookdale, UK

This September an HMS Archives and Collections Committee (ACC) organised study/work day will be held at the Long Warehouse, IGMT, Coalbrookdale in collaboration with the Who cares? Project. This session will bring together two different groups, members of the HMS and the IGMT Young Archaeologists' Club (YAC) to work with the National Slag Collection in an interactive workshop. All are welcome to attend.

Please see our website for more inforrmation:

http://hist-met.org/

"WHAT ARE YOU UP TO?"

It often takes years from the moment a project starts until the results are reported, but it is always useful to know what other researchers are up to, even if they are only in early stages of their research. Don Wagner helps us inaugurate this new section of The Crucible where we invite anyone to tell us what keeps them busy (or awake at night!). Please share news of the site you are excavating, a particularly fascinating find, a highlight of a little-known furnace or museum exhibit, or just a couple of lines on your current thinking. Try to do it in up to 100 words plus a picture.

Please send contributions to: **thecrucible@hist-met.org**.

DON WAGNER writes: I'm busy now translating a report on a cast-iron bridge pier found in 2007 near Chengdu, Sichuan. It has an inscription stating that it was cast in 96 BCE and weighs what corresponds to 1.38 tons. 110 cm high, pearlitic grey cast iron. Nearby were found fragments of the mould in which it was cast. The report in Chinese will be published in September, and my translation sometime after that.

Forthcoming events

Conference, Date and location	Description	Website, Email and Prices
European Association of Archaeologists 2015 2nd-5th September Glasgow, UK	A major international conference, main themes include Science and Archaeology with sessions on the *"Social Context of Metallurgy"*, *"Metallurgical Crafts in the 1st Mellenium AD Europe"* and *"New Approaches to Metals Trade and People Mobility"*	http://eaaglasgow2015.com/
Archives and Slag Collection Study & Work Day 26th September 2015 Ironbridge Gorge Museums, UK	Held in partnership between the Ironbridge Gorge Museums and the Young Archaeologists' Club, this year's study and work day welcomes anyone interested in viewing, handling, and working on the National Slag Collection.	http://hist-met.org/
hMS Research in Progress 13th November 2015 Brunel University, UK	This yearly one-day HMS meeting is geared towards a wider audience than the regular conferences organised by the society. Any relevant metallurgical topic can be presented and contributions from both academic and professional sectors are encouraged.	http://hist-met.org/meetings/rip.html
ThE SWORD - Form and Thought 19th-20th November 2015 Solingen, Germary	Two day conference to be held at the Deutsches Klingenmuseum discussing the material characteristics, decoration and symbolic value of swords, and its use as a weapon and a cutural object.	www.klingenmuseum.de
DTRG Conference 6th-11th May 2016 Tavistock, Devon, UK	An internation conference entitled *"A Celebration of the Tinworking Landscape of Dartmoor in the European Context – Prehistory to the 20th Century"*	www.dtrg.org.uk