

# THE CRUCIBLE

**Historical Metallurgy Society News**  
**Issue 112**

**Summer 2025**



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The **HISTORICAL**  
**METALLURGY**  
Society

*Visitors mine at the Mining museum in Bochum (left).  
Below: Experimental Iron Age domed furnace at the  
Open Air museum in Hagen. See page 3.*





## From the Editor

Dear all, Welcome to our Summer edition of *The Crucible*. There has been a number of exciting events and conferences organised by HMS this year including the Festival of Metals at Butser Ancient Farm that took place in May. This event was a great success with a range of fascinating talks and demonstrations. Our thanks go to Paul Rondelez for his hard work in organising this and to all the presenters and demonstrators. In November our annual Research in Progress conference is due to take place. This is always a great event and provides an insight into the many areas of research currently taking place in the field of metallurgy. Further details of this can be found on page 9. I also draw your attention to the Forthcoming Events page at the back of *The Crucible* for other conferences happening across the world. If you know of other events which you would like to advertise to HMS members, please get in touch using the contact details below. This edition of *The Crucible* also summarises some recent events including the very successful trip to the Ruhr Region in Germany and the face-to-face HMS Networking meeting in Sheffield.

In the Archaeometallurgical News section, we have two articles on the discovery of a Brass Sundial in Dolgun and a discussion on a new project characterising bar / wrought iron made by different fining processes - a project HMS members may be able to assist with. Thank you again to Jeremy Hodgkinson from the Wealden Iron Research Group for providing a summary of Volume 44 of Wealden Iron. We end with a few Out and Abouts that take us from central Portugal to a coffee shop in Eastbourne.

Thank you again to everyone who has written something for *The Crucible*, and I hope you enjoy reading it.

Jack

**Editor:** Jack Cranfield

### Submissions

Submissions to *The Crucible* are welcome at any time, but deadlines for each issue are 1<sup>st</sup> March and 1<sup>st</sup> September each year. Contributions can be sent in any format, but we prefer digital if possible. Images should be sent as high resolution jpeg or tiff files. We accept a maximum of Five Harvard-style references per article only.

For consistency, we tend to use contributor's names without affiliations and email contacts. Anyone wishing to contact a contributor not known to them is welcome to forward a message in the first instance to the editors who will facilitate the contact.

## A Message from the General Secretary

HMS is now using WebCollect to manage membership and administration. We use [hismetsoc@webcollect.org.uk](mailto:hismetsoc@webcollect.org.uk) to send you important information and news about events, some of which will be in-person, some online and some will not be in the UK. Look out for 'The Historical Metallurgy Society' in your inbox or junk.

All HMS members for whom we have an email address have been given an account in WebCollect <https://webcollect.org.uk/hismetsoc/member-home>. Your username is your email address. Please check it is correct. The password is of your choosing and to set it click the link 'Reset my password>'. You will be able to update your personal details e.g. address.

All members are invited to take an active role in the organisation by submitting an article to the HMS Journal and/or *The Crucible*, by volunteering time to one of the committees, or donating additional funds.

If you have some research that you've been working on, independently or with an institution, you can email an article to [editor@historicalmetallurgy.org](mailto:editor@historicalmetallurgy.org). Items of news or short articles can be sent to the editor of *The Crucible* ([crucible@historicalmetallurgy.org](mailto:crucible@historicalmetallurgy.org)) or, if you would like to present at some future event, let me ([secretary@historicalmetallurgy.org](mailto:secretary@historicalmetallurgy.org)) know. Ideas for events and activities, in person and/or online, are very welcome.

Your support of the HMS is invaluable and helps us to carry on our work. The Historical Metallurgy Society provides its journal, *Historical Metallurgy*, as a free to write, platinum Open Access publication. It is a Historical and Archaeometallurgy resource which is only possible with the support of its members.

Please let me know if you would like to volunteer in any area, such as membership development, event planning, grant applications, archives and collections, publicity (social media), website content creation or updating, helping with publications, technology (website, membership database), our virtual office, or anything else. We rely completely on the expertise and help of our members.

Vanessa Cheel

Hon. Gen. Secretary, Historical Metallurgy Society

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### The Crucible

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## HMS COLLECTIONS AND ARCHIVE

Are you currently looking after any collection items or archive material that belongs to HMS? If you are, please let Eddie Birch know as we are cataloguing our collections. Eddie can be contacted on [libertyship.eb@gmail.com](mailto:libertyship.eb@gmail.com) or phone 07983 526110.

It would also be of interest if you have copies of Council or committee minutes, or HMS conference papers, that we could borrow to copy to fill in gaps in our collections. Thank you.

*Eddie Birch*



## (BLAST) FURNACES, TORCHES AND MORE: A VISIT TO THE RUHR REGION IN GERMANY

What a great idea of Paul Rondelez to organise a visit to the Ruhr region. On a sunny Saturday morning in September a group of 15 people from Germany, Denmark, Norway, France, UK and the Netherlands gathered in Duisburg to start a tour through the decommissioned 20th century blast furnace of Duisburg which was turned into a recreational area with an open air cinema, vast parkland, diving in a gas cylinder, etc (Fig. 1). We could climb to the top (70 meters) of one of the blast furnaces (great view of the surroundings) and follow the route the ore and cokes took to the foundry hall where the pigs were cast (Fig. 2). Everything was still there, the cooling system, the dust collectors, the system to pull the carts with the mixture of ore, aggregates and cokes up to the mouth of the furnace.

That afternoon we listened in the old control room to a variety of very interesting talks highlighting current research in Germany on the history of metal production illustrated by case studies by Prof. Dr. Ernst Pernicka (Professor Tübingen University, Scientific and Managing Director Curt-Engelhorn-Zentrum Archäometrie), Prof. Dr. Sabine Klein (Head of Archaeometallurgy, Deutsches Bergbau-Museum, Bochum), Dr. Guntram Gassman (Mining



*Figure 1 (right): Blast furnace number 5.*





*Figure 2: Great view from Blast furnace number 5 to the ore bunkers.*



*Figure 3: Talks in the control room.*

Archaeology Specialist for the Heritage Service of Baden-Württemberg), Dr. Michael Farrenkopf (Department Head of the Mining History Documentation Centre, Deutsches Bergbau-Museum Bochum) and Dr. Bastian Asmus (Labor für Archäometallurgie, Herbolzheim) (Fig. 3). After a nice dinner we were given an evening tour of the blast furnace by a guide, all carrying torches which set the stage for a ghostly atmosphere (Fig. 4).

The next day we went by bus to the Open Air Museum in Hagen where we visited the experimental Iron Age domed iron smelting furnace which was about to be demolished to be re-excavated after several years (see cover image). Dr. Jennifer Garner (Scientific co-worker, Deutsches Bergbau-Museum Bochum) told us about the reconstruction which was done according to the excavated furnaces in the Heuneburg of which Guntram Gassman had told us the day before.

During the experiment the furnace started to have a good stable temperature when left alone for the night without using the bellows! Therefore they decided not use bellows at all and several nice blooms were produced using local hematite ore.

The museum housed many nice 18th and 19th century metal working mills like a brass stamp hammer, a zinc rolling mill, a cowbell forge, wire drawing mill, etc (Figs 5-6). So much to see and so little time since we were off to the largest mining museum in the world located in



*Figure 4 (left): Evening tour with torches.*



*Figure 5: Demonstration of the working of the mechanical hammer by Peter.*





Bochum, our last stop of the excursion guided by Dr. Thomas Rose (Scientific co-worker, Deutsches Bergbau-Museum Bochum). The museum's landmark, a large A-frame, was in scaffolding and invisible but the museum offered a lot more to see. A visitor's mine with a fun pit descent simulator. A good display of archaeological mining sites and again too big for only an afternoon's visit! The excursion was very inspiring, it is so nice to visit all these sites with people who have a great interest and knowledge of ancient metallurgy. Looking forward to the next HMS excursion!

*Ineke Joosten*

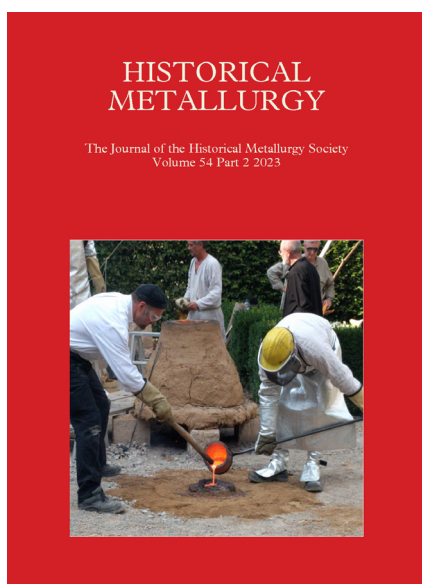
*Figure 6 (left): Kaffee und Kuchen at the Open Air museum, Hagen.*

## A NEW EDITORIAL TEAM FOR *HISTORICAL METALLURGY*

The editorial team of *Historical Metallurgy* has changed in recent months, following the vote at the Historical Metallurgy Society's General Assembly in May 2024. We bid farewell to Justine Bayley, who served as Editor-in-Chief of the journal for 34 years, and welcome María Florencia Becerra (CONICET, Argentina) as Editor-in-Chief and Florian Téreygeol (CNRS, France) as Managing Editor. Berber van der Meulen-van der Veen (University of Amsterdam, The Netherlands) joined the council and was recently incorporated as Assistant Editor. Thomas Rose (Deutsches Bergbau-Museum, Germany) continues in his role as Technical Editor.

The new Editorial Team wishes to deeply thank Justine Bayley for her many years of dedicated work, devoting much of her time to editorial responsibilities, carefully guiding authors through the process, and leaving her unique mark on the journal. Her dedication and thorough approach have greatly shaped *Historical Metallurgy* into the esteemed publication it is today.

We also want to recognise the efforts of other colleagues who have been instrumental in the journal's recent development. In particular, we acknowledge Tim Young's role as Technical Editor, who oversaw the transition of *Historical Metallurgy* to Platinum Open Access (i.e., no fees for publishing and reading), established the web system hosting the digital version of *Historical Metallurgy* (<https://hmsjournal.org>), and took on the monumental task of scanning and uploading many past volumes, now accessible on the journal website. We would also like to thank Paul Rondelez for his editorial work as the previous Managing Editor and the various



members of the Editorial Board in recent years, whose dedication has been invaluable to the journal's growth and continuity.

We would also like to take this opportunity to announce that the journal is now welcoming your contributions via the web system (<https://hmsjournal.org/index.php/home/about/submissions>). We have introduced some changes to the author guidelines to align them with current editorial standards, with the goal of applying for indexing in the coming years such as Directory of Open Access Journals (DOAJ), Scopus, Web of Science. Being a Platinum Open Access Journal, *Historical Metallurgy*

is a driver in making knowledge available openly in accordance with the FAIR principles. We are very proud to continue this endeavour and to support the community in making their research available to all.

We are grateful to the authors who have trusted the journal to publish their research, and we look forward to receiving new contributions!

**María Florencia Becerra:** Ph.D. in Archaeology from the University of Buenos Aires, she is a researcher at CONICET (National Council for Scientific and Technical Research of Argentina) in the Museum of La Plata, National University of La Plata. She is an assistant professor in the Anthropology program at the University of Buenos Aires and in the Archaeometry specialisation program at the National University of La Plata. Her research focuses on pre-Columbian and colonial mining and metallurgy in the Southern Andes. She is currently studying the use, circulation, and provenance of copper in Northwestern Argentina.



**Florian Téreygeol:** Ph.D. in Archaeology from Sorbonne University, he is a senior researcher at CNRS (Centre National de la Recherche Scientifique, France) in the institut pour la Recherche sur les ArchéoMATériaux (IRAMAT, UMR 7065). His research focuses on the archaeology of mining and metallurgy, mainly in the medieval period. On the site of the silver mines at Melle (France), he has developed a platform dedicated to palaeometallurgical experimentation, open to all researchers.

**Thomas Rose:** Ph.D. in Archaeology from Ben-Gurion University (Beer Sheva, Israel) and Sapienza – University of Rome (Rome, Italy), he is a researcher at the Deutsches Bergbau-Museum Bochum. He is currently implementing

TerraLID, the digital research data infrastructure for lead isotope data in archaeology. He gained expertise in ancient copper metallurgy with focus on the Chalcolithic Southern Levant and stable metal isotope systems, and is maintainer of the R package ChronochRt.

**Berber van der Meulen-van der Veen:** Ph.D in Archaeology from Cardiff University, she is a lecturer in archaeology at the University of Amsterdam within ACASA (Amsterdam Centre for Ancient Studies and Archaeology). Her research focuses on alloying practices and metallurgy in the Roman provinces and Free Germany.

*María Florencia Becerra*

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## ANNOUNCING THE IRON AND STEEL HERITAGE FORUM - SOCIETY FOR INDUSTRIAL ARCHEOLOGY

The purpose of the Iron and Steel Heritage Forum is to create and maintain a community interested in the heritage of iron and steel, as well as organisations that preserve artifacts, documents, and other items from the iron and steel industries.

Our individual members come from diverse backgrounds including (a) the academic community, (b) professionals in museum management, cultural resources management, environmental consulting, (c) managers and workers from the steel industry, and (d) anyone with an interest in iron and steel. ISHF has two types of members: individuals and organisations. Organisational members are primarily iron and steel museums.

The topics of interest include metallurgy, mining (iron ore, metallurgical coal, limestone); iron making technology (iron furnaces, Bessemer converters, open hearth furnaces, electric arc furnaces); steel processing technology (hot and cold rolling, continuous casting, casting, forging); transportation networks (railroads, fresh and salt water shipping); “interesting” users and uses of iron and steel; business history; labour and union history; art & photography; and steel and iron museums and historic sites. Our geographical range is North America: Canada, United States and Mexico.

Our initial activities are a mailing list and monthly talks on iron and steel. Our talks started in July 2024 and are scheduled through to early 2026. We are always looking for potential speakers. We are encouraging members and others to deliver papers on iron and steel related topics at the SIA’s annual conference.

A group of volunteers are developing an online database of all iron and steel sites in North America. It has grown into a database of industrial heritage sites of all types.

This will make it easier to discover industrial sites for researchers and travellers.

We encourage anyone interested in iron and steel to join our mailing list to receive announcements of monthly talks and other news. You can sign up for our mailing list by sending an empty email to Iron-Steel-SIG+subscribe@groups.io or by contacting our chairperson directly. For more information please contact the ISHF Chairperson, Anthony Meadow at tmeadow@ferrumwest.com.

### *About the Society for Industrial Archeology*

The Society for Industrial Archeology is the premier organisation for industrial heritage, history, and archaeology in North America. Since its founding in 1972, the SIA has built a dedicated community of people and organisations – our members and supporters - interested in these topics. This open, diverse, and distinguished group gathers regularly to share new information about the development, history, and preservation of industrial heritage sites at conferences and tours, through our publications, and as part of other types of programs.

SIA programs support new and original studies that advance knowledge in the field of Industrial Heritage, including the identification, documentation, analysis, interpretation, and preservation of cultural resources that are associated with the history and development of industrial society. The SIA encourages participation by both avocational and professional members, and by other people and organisations that are engaged in the stewardship of industrial heritage resources. Our activities include an annual conference, an annual tour, a newsletter and a refereed journal. For more information on the SIA please go to our website at <https://www.sia-web.org/>.

*Anthony Meadow*



## HMS NETWORKING WEEKEND, SHEFFIELD

3RD AND 4TH JUNE 2023



Figure 1. Blonk St. Bridge over the River Don.

What does everyone miss about “face to face” conferences? It’s not so much the presentations, it’s the connections we make! As an experiment, it was decided to have a networking weekend with visits to key sites, and plenty of opportunity to discuss historical metallurgy topics with others, both members and non-members. Despite the rather short notice 14 people booked, though unfortunately two overseas visitors had to drop out because of the uncertainty caused by the train strikes.

Everyone was responsible for their own travel, accommodation and meals – but some guidance was available. Despite some anxiety on the part of the organisers, at no point were there more lifts wanted than were offered, and nearly everyone ate together.

The weekend started with a pre-meeting get together at the Sheffield Tap (the Sheffield Railway Station bar) on Friday evening, from where the group went on to an Italian restaurant in the heart of Sheffield.

Saturday started with a visit to Abbeydale Industrial Hamlet. For some of us the focal point was the crucible furnace shop, for others the tilt hammer shop which had specialised in scythe blades. The volunteer guides here, as in the other museum visits were very welcoming and knowledgeable. We had lunch at the café on site before moving off to the centre of Sheffield for a walk along the River Don and the Sheffield and Tinsley Canal looking at relics and sites associated with the metal industry. Two walks were planned, to cater for levels of fitness.

We started at Blonk St. Bridge over the River Don. The bridge is close to the site of Sheffield Castle and as an archaeologist in our group had worked on the site he gave us a brief overview before we started the walks. As we are hoping to put the routes of the walks onto the HMS web site soon, we will only cover one or two highlights

here. Apart from some 70 metres all of the shorter walk was covered by the longer one.

The first highlight was Salmon Pastures on the River Don, as rural as the name suggests until about 1750, since when it has been the site of works and coal and coke stockpiles. Since about 1960 a lot of work has gone into reclamation, and the site now includes a small “nature reserve”. The other highlight is the Bacon Lane Bridge over the canal, one of two remaining original 1819 bridges (Fig. 1). It’s known as the “Eye of the Needle” because when the cut was full an empty barge would need ballast to

get under it. The buildings on the right of Fig. 1 are part of Baltic works, formerly an Integrated (cementation and crucible) Steelworks.

We finished with a very pleasant meal at another Italian Restaurant near the Crucible Theatre.

On Sunday morning we met upstream on the Don at Wortley Top Forge where we were given an excellent introductory tour. This heavy iron forge can be traced back to 1640 and today stands in very pleasant grounds.

On leaving Wortley, we returned to Sheffield and parked on Doncaster Road (named for the steel-working family rather than the town). This is the site of the Hoyle Street Cementation Furnace, under preservation, but somewhat overgrown. It was last fired in 1951 and is still topped by a shutter which could be closed in case of air-raids. The last metallurgical use of the site was as one of the BISRA Laboratories (closed c 1973).

A short walk took us to Kelham Island Museum where our table was laid for lunch in the restaurant. We had started to order when someone pointed out there was only a few minutes before a demonstration of the River Don Engine, a steam powered rolling mill engine in preservation. The staff were very understanding as we rushed to catch the ‘show’. The engine began its 70 year working life rolling armour plate for battleships, and finished it rolling shield plates for nuclear reactors.

After lunch, we dispersed around the museum and everyone found something to interest them from the Hawley collection of hand tools to a Bessemer converter.

The general feeling was that it had been an interesting and useful weekend with plenty of opportunity to network. The organisers learnt a lot of lessons for future events. Watch this space!

*Eddie Birch on behalf of OVC Committee*



## A BRASS SUNDIAL FROM DOLGUN, NEAR THE 18TH CENTURY BLAST FURNACE

This sundial was found in 2022 by Bryan Henshaw, as a result of systematic metal-detector searching in the fields around Dolgun, where he has a caravan on the Fronalchen site. The sundial was in the field to the north of the Dolgun blast furnace, across the Afon Clywedog, and quite close to the site of Dolserau Hall. The sundial is rather small, only 3½ inches square, made on a brass plate about 1mm thick (Fig. 1, left).

It has four holes in each corner, suggesting that it was originally mounted on a wooden post. A reconstruction of the sundial shows that it would have been mounted in a horizontal position, facing towards the south, with the hour lines all converging at the base on the gnomon (Fig. 1, right). At this latitude the (missing) gnomon would have been at an angle of about 54 degrees.

Considering the small size of the dial it has been very well and carefully prepared, though it is uncertain if it was engraved directly or perhaps etched through a scratched

wax coating. There are no initials or a name marked on the dial.

It is most likely that it was made by John Kelsall, who managed the Dolgun furnace in 1714-17 and from 1729-34 (Adamson and Crew 2022). In his diaries Kelsall records making three sundials and he mentions his great interest in “Mathematicks (sic), more especially in Geometry, Trigonometry and Dialling, the last of which I have more particularly practised.” The first of the dials in 1716 was for Dolgelley market place, the second in 1722 was for the forge at Dolobran and the last in 1729 was for Dolgun House, where he was then living.

This example is 18th century in style and is almost certainly the one from Dolgun, which was perhaps moved to Dolserau after Charles Edwards purchased the estate in 1872. Neither of the other dials has survived.

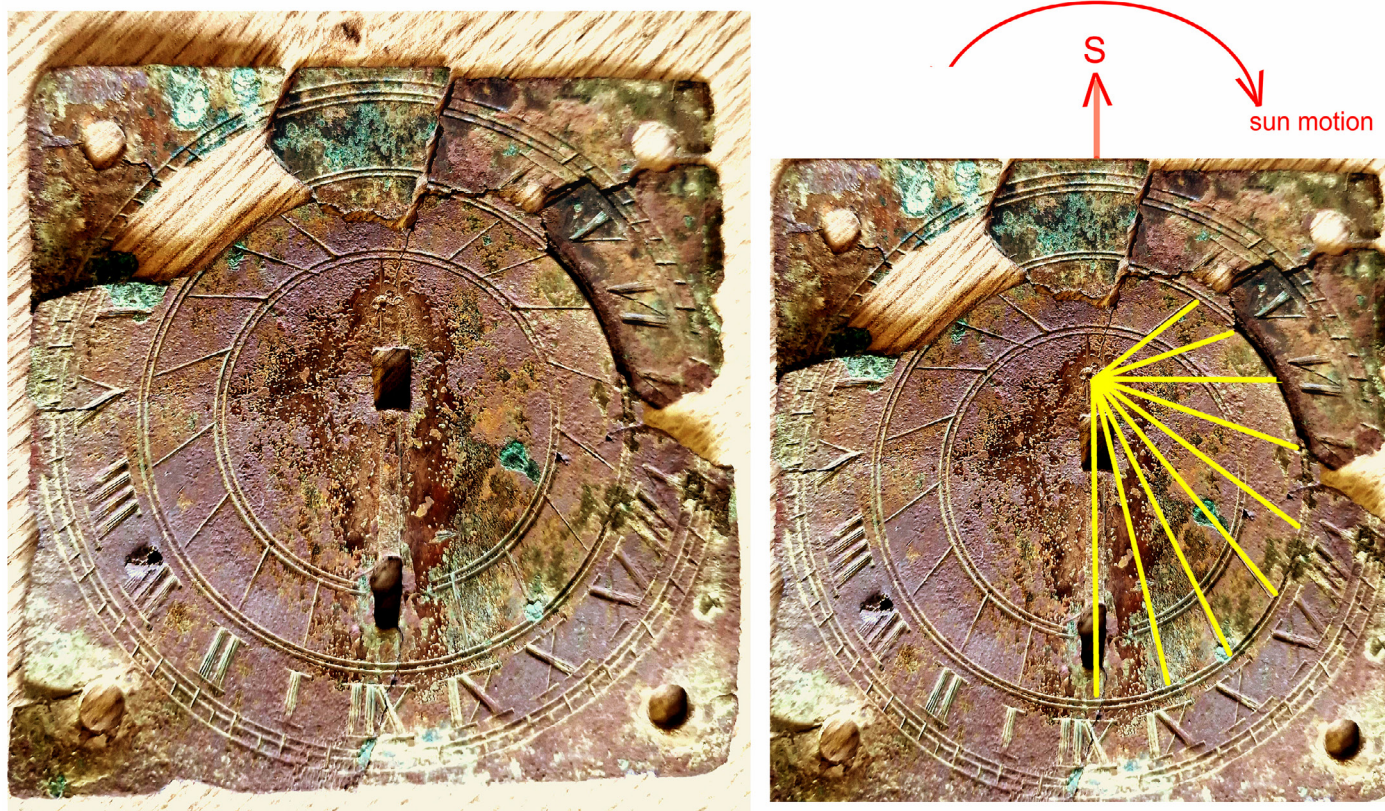


Figure 1: The sundial from near Dolgun. Left: the dial as found, at life size, 3½ inches square. Right: Reconstruction of the dial as a south facing horizontal dial, with the motion of the sun and shadow lines up to 12 noon.





Figure 2: The cast iron pig fragments. Scale 100mm

## Other relevant finds

Two short lengths of cast-iron pig were found near the top of the steps leading down to the barge loading point, about 250m west of Beudy Dolgun. This is the highest point where the Afon Wnion has sufficient depth for barges. On top of the bank is a large iron post driven into

the ground, which would have been used to moor the barges whilst being loaded.

Both pigs are around 200mm long and one has an extra piece corroded onto it (Fig. 2). It is unfortunate that the pigs are highly corroded with very little iron surviving. They were probably of very poor quality.

Near the top of these steps there was a shallow pit filled with a jumble of corroded iron slags and glassy slags, undoubtedly waste from the furnace, which seem to have been used to level up the ground.

A large number of coins have been found, only one of any relevance being an 1816 silver shilling. Although the Dolgun forge may have continued to c. 1817, this coin is very worn and so was deposited much later, possibly during the period when Plas Dolgun was in use before it burnt down in 1825 (Crew 2019).

Peter Crew and Bryan Henshaw

## References

Adamson, P. and Crew, P. (eds), (2022). *John Kelsall Diaries and Journal 1699-1743*. Privately printed. Available at: <https://www.academia.edu/42049360>

Crew, P. (2019). 'Dolgun Blast Furnace and Forge, 1715-1817' Gwreiddiau Gwynedd Roots. *Journal of the Gwynedd Family History Society*, 76. Available at: <https://www.academia.edu/50320314>

Daniel, C. (2023). 'Sundials'. Available at: <https://www.buildingconservation.com/articles/sundials/church-sundials.htm>

The British Sundial Society. <https://www.sundialsoc.org.uk>

## HMS RESEARCH IN PROGRESS

### 28 NOVEMBER 2025

The next Research in Progress Meeting of the Historical Metallurgy Society will take place online on Friday, 28 November. Participation is free of charge. The conference provides a forum for everyone working on topics related to ancient and historical metallurgical practices, the past use of metal objects, and related fields. We are keen to learn more about your ongoing or recently finished projects! The meeting aims to foster links between the different disciplines and geographical regions. Therefore, we particularly encourage submissions from early career researchers, contract archaeologists/conservators, and colleagues from outside Europe. There will be an HMS prize for the best student presentation.

Abstracts (up to 200 words) can be submitted between August 1 and October 1 through <https://archaeothommy.github.io/hms-rip-meeting/>. Presentations can be either 6 min or 15 min long (with time for questions added).

The programme and any updates will be announced on the meeting's webpage.





## CHARACTERISATION OF BAR/WROUGHT IRON MADE BY DIFFERENT FINING PROCESSES

### A CALL FOR HELP!

I have just started an MSc by research at the University of Warwick, with the aim of looking at the different microstructures, analyses and slag contents of indirect process irons used in England between 1500 and 1900 AD.

I identify five different fining processes, albeit with complications. The main issue is whether the pig iron fed into each process was high or low in silicon.

1. Simple Walloon/French charcoal fining of low silicon irons, without iron oxide additions.
2. The German fining process for pig iron with higher silicon contents, involving the addition of iron oxides (in some form or another).
3. Potting and stamping, where silicon was removed from high silicon coke pig in a prior treatment process.
4. Puddling, using a white pig iron, or a high silicon coke-iron that had been prior treated, in a 'refinery'.
5. The wet puddling process, where high silicon iron was fed in on top of an iron oxide- rich hearth.

The complications are chiefly that there were many half-way, hybrid, arrangements, where iron oxide additions were made during the operation in smaller quantities.

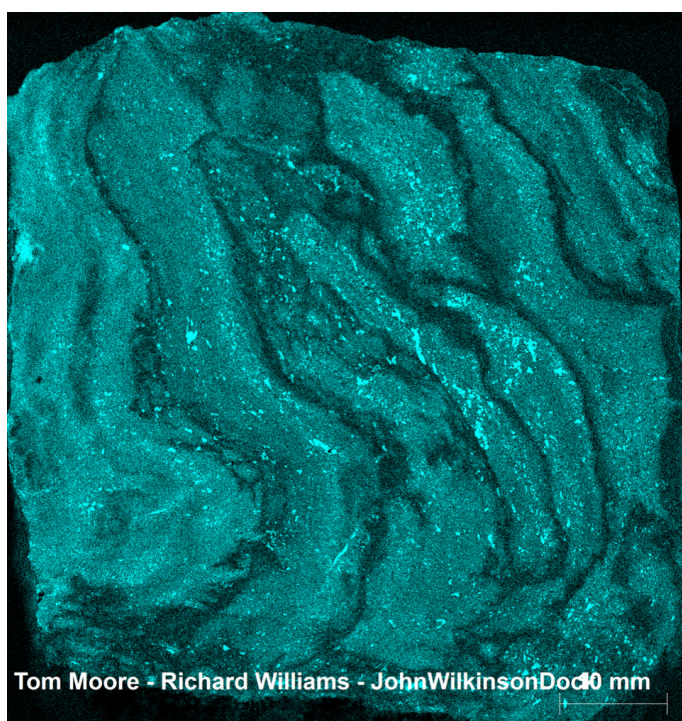


Figure 1. Micro XRF phosphorus map of a bar from New Willey, showing the individual 'stamped' pieces of iron that were placed in the crucible. Cross section approximately 50mm square.

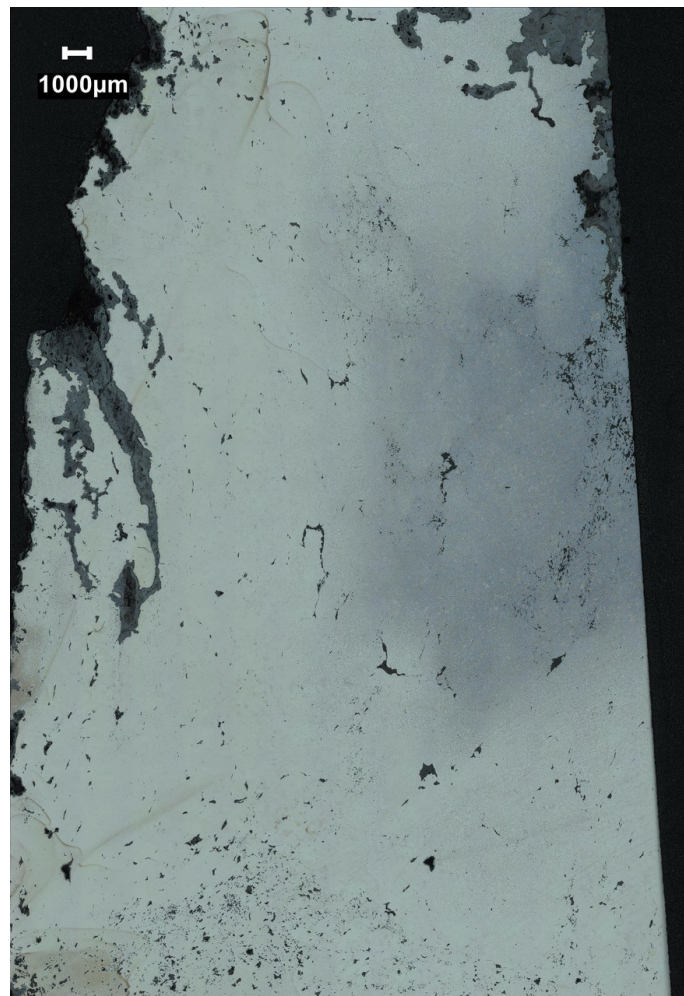


Figure 2. Optical microscopy of iron from Bjork Boda in Finland, 1770. Dark area is pearlitic, light areas ferritic. Note relatively small amount of slag.

I will be looking at slag analyses, but also at slag quantities and the relationships between matrix and slag chemistry, i.e. the partitioning of elements between matrix and slag.

Malleable iron is an enormously variable material, within bars, between bars and from place to place, and I need as many samples of iron in each category to analyse as possible.

So my plea is for samples of iron with some provenance. This is not as difficult as may be thought perhaps. Any iron, in the form of any manufactured object or merchant bar, that can be dated to the 16th, 17th and first half of the 18th Century and was manufactured in England, will have almost certainly have been made using the Walloon process. The German process only became necessary in England after 1750, when coke iron first began to be used in the forges.



All puddling was a two stage process up until 1820 or so, thereafter wet and dry processes were used side by side.

Potting and stamping was only used in earnest between 1770 and 1800, and then in relatively few, well-known, places.

Imported iron is a complication, because Swedish irons were sometimes made using iron oxide additions, ie the German process, and sometimes not, when some variant of the Walloon one was used. It depended on whether the iron was made from torrsten ores or from quicksten ones, the former being a form of hematite with a high silica:lime ratio that naturally produced a grey iron. The strategy here will be to go back to source and try to obtain irons from areas where the particular ores were found. I have no strategy as yet for understanding the Russian irons that were imported in some quantity over the same period.

I already have some very interesting specimens to look at. Being sent a sample of bar iron found near John Wilkinson's New Willey works at Broseley was pivotal in my starting the project. It was very clearly made by potting and stamping (Fig. 1). Very quickly thereafter I was asked to look at some iron bars that had been found off the coast of Holland. They were well documented.



*Figure 3 (left). Cross section of a nail from the Weald c.1650. Note the enormous amount of slag and the dark areas of high carbon content.*

They had been on their way from Finland via Stockholm when the boat sank, destined for a particular merchant in Birmingham, who was to receive them via Bristol. The registration of the particular stamp mark in the Jernkontoret noted the iron

to be of second quality, specifically produced for the English market (Fig. 2).

I have since been given bar iron from the Weald (17th century) and from North Wales (late 16th century). I am making a random collection of 19th century irons looking to see if they can be filed into two groups. My surmise is that dry puddled iron should have less overall slag and lower phosphorus contents than wet puddled material.

Can you help me? Do you have any early bar/wrought iron samples at home that you would like to know the composition of, or know where some might be found? A classic location is dismantled old buildings, or, of course, finds in old industrial areas.

My research is a part-time project, destined to take three years, so there is time for searching!

*Richard Williams*

## METAL ESPAÑA 2025

**M**etalEspaña2025 IV Congress on Conservation and Restoration of Metallic Heritage will take place between October 23-25, 2025 at the University of Cadiz. The dissemination of scientific research and conservation of cultural heritage is essential to ensuring access to knowledge, promoting the value of metallic heritage as an educational and tourist resource, and strengthening social commitment to its preservation. Furthermore, they constitute a responsibility towards society, which provides the necessary resources to make this work possible.

It is within this context that MetalEspaña2025, the IV Congress on Conservation and Restoration of Metallic Heritage, is framed. This event highlights advances in applied research, technological innovation, and conservation projects involving metallic objects and works. Spain has a long tradition of metalworking dating back to ancient societies, which reinforces the relevance of this congress in protecting and promoting its rich cultural heritage.

MetalEspaña2025 will be the fourth edition of this congress, following the successful meetings of MetalEspaña08 (Autonomous University of Madrid), MetalEspaña2015 (Royal Mint of Segovia), and MetalEspaña20 (Autonomous University of Madrid). The congress will feature a diverse and enriching programme structured into five major thematic areas:

1. Science and technologies applied to metallic heritage.
2. Archaeological metallic heritage.
3. Underwater cultural heritage (dedicated plenary lectures).
4. Historical, artistic, and religious metallic heritage.
5. Scientific, technological, industrial, and urban metallic heritage.

For registration information and the conference program please see: <https://eventos.uam.es/128242/detail/iv-congreso-de-conservacion-y-restauracion-del-patrimonio-metalico-metalespana2025.html>



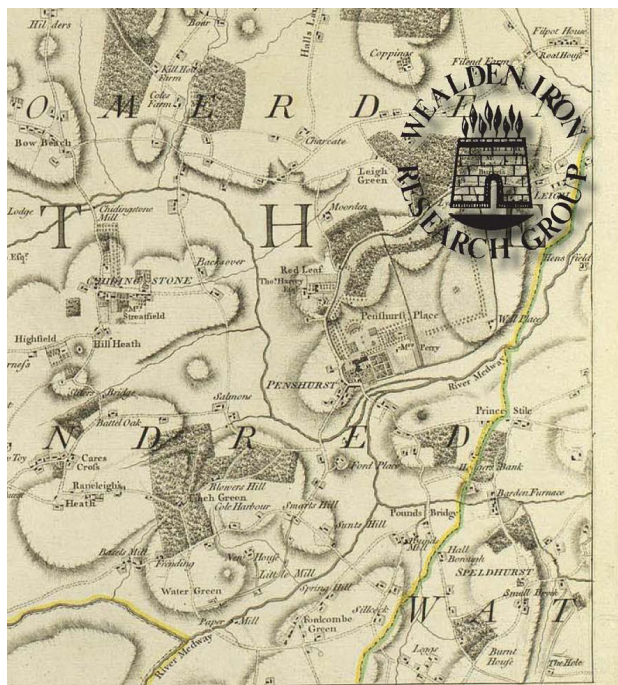
## WEALDEN IRON, SECOND SERIES, 44, 2024

### BULLETIN OF THE WEALDEN IRON RESEARCH GROUP

With the exception of the current issue, all of the Bulletins of the Wealden Iron Research Group – 17 in the First Series from 1969-80, and 43 so far in the Second – are available for download from the group's website – [www.wealdeniron.org.uk](http://www.wealdeniron.org.uk) – together with all the newsletters received by its members since 1980. And there is much more of interest to read about the group's other activities, past and present.

In the latest Bulletin seven newly-discovered bloomery sites are recorded in the Field Notes. At Speldhurst in Kent bloomery slag and other furnace waste have emerged from a domestic garden. Both Romano-British and medieval pottery finds have made dating uncertain so far. Remains of a Middle Iron Age bloomery in Newenden, also in Kent, were discovered in the last year or so, radiocarbon dating having a range of 364-175 BC. In East Sussex, near Wadhurst, scatters of bloomery slag reported in last year's Bulletin have been confirmed as four bloomeries. It is hoped that it may be possible to date some of them, a substantial number of other sites having previously been discovered in the area, although none has been dated so far. Finally, a widespread scatter of bloomery tap slag across two fields near Reading Street, south of Tenterden in Kent, has been found with more than 70 sherds of Romano-British pottery, furnace lining and three coins, one of which dates to the reign of Marcus Aurelius (c.AD 171-2). This site lies a short distance to the east of the recently identified RB site at Small Hythe where tiles of the *Classis Britannica* have also been found.

In the 1970s the late David Crossley excavated the site of Chingley Forge, in advance of the flooding of the Bewl valley on the Kent-Sussex border, to form a reservoir. Remains of a probable forge dating to the 14th century were found and a possible association with the Cistercian abbey at Boxley, north of Maidstone, was posited, the abbey having a grange at Chingley. An article describes the abbey's estate and the evidence for its purchases of iron horseshoes and nails and of steel.



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In the Weald the sites of 112 blast furnaces and 106 forges have been identified as operating between 1490 and 1827. In a small number of cases no written records have been found to corroborate the field evidence. However, in a reversal of that, a furnace and forge called Cowden Paddock, named in Chancery documents as operating in the mid-16th century, have yet to be associated with a site on the ground. An article sets out the evidence.

George Browne's career as gunfounder to the Commonwealth government was elaborated in an article in Volume 43 of Wealden Iron. His subsequent business for the Crown following the Restoration of Charles II in 1660 forms the subject of the second part of this brief series and describes the

considerable demands placed on Browne and his partner, Alexander Courthope, to maintain the supply of guns to the navy during the Second Dutch War.

A useful source for documenting the final years of the iron industry in the Weald are the newspapers of the time and in particular the advertisements placed when furnaces and forges came up for sale or lease. The closure of the furnaces at Barden and Cowden, for many years operated by William Bowen of Tonbridge, and of the forges at Birchden and Robertsbridge, and the late occupancy of those sites, forms the subject of the last article in the Bulletin. Additional information about the late tenancy of Birchden Forge has been extracted from the records of the Medway Navigation where shipments of iron along the river were recorded until 1783.

Jeremy Hodgkinson



## THE *EMBRECHADOS* OF THE CONVENTO DE SANTA CRUZ DO BUSSACO, PORTUGAL

During recent fieldwork researching iron mineralisation in the Bussaco Syncline, central Portugal, and associated early iron smelting sites, our attention was drawn to the wonderful *embrechados* that adorn many historic buildings in the Bussaco National Forest.

*Embrechados* are coarse mosaics, formed from the setting of irregular fragments (20mm to 100mm) of various found, natural and waste materials in mortar. They became a prominent feature of Portuguese rustic architecture in the 17th century, showing influences both from the grottos of the enlightenment period in northern Europe and from Renaissance gardens in Italy rooted in classical mosaics. At the Convento de Santa Cruz do Bussaco, a '*deserto*' of the Discalced Carmelites founded in 1628, *embrechados* form a significant decorative element not only of the main convento building (Fig. 1, right), but also of the shrines, hermitages, springs and gateways ranging in date from c1630 to c1700 distributed through the forest. In 1834, the male religious orders were suppressed and their monasteries dissolved, but after that date the enclosed forest was managed as an arboretum and its structures preserved. Plans to create a royal palace within the forest were abandoned, but a fantastical neo-Manueline structure, The Palace Hotel, was built (c1887-1908), with much of the convento being demolished. Although most of the hotel does not reflect the architectural style of the former convent, one building, the *Casa dos Embrechados* (c1897) was embellished with *embrechado* detailing (Fig. 1, left), as was a subsequent building (c 1922) linking it to the main body of the hotel. *Embrechados* were also applied to several new gateways and forestry buildings during the 19th and 20th centuries. The Bussaco National Forest thus contains *embrechados* constructed over almost three centuries, both as primary panels and as secondary repairs, reconstructions and replacements.

Over this long period, the materials employed for *embrechados* varied. The early Carmelite work emphasised the local and the coarse, and was almost

monochrome. The pale components of this period were drawn from two rock units outcropping at the site – Ordovician quartzites and Carboniferous quartz conglomerates. Later works also incorporated non-local materials, with the youngest examples using a wider colour palette, including white, grey, blue, yellow, brown, orange and red, formed from sandstones, quartzites, vein quartz and tile. Throughout the history of the site, however, the darkest materials were provided by metallurgical waste (often misidentified as basalt, dunite or simply "little black stones").



Figure 1: contrast between the almost monochrome *embrechado*-covered façade (c1628, but restored) of the entrance to the convento church and the *Casa dos Embrechados* (c1897; left) with its polychrome *embrechado* detailing.

In the surviving 17th century *embrechados* this component was provided by bloomery tapslags (Fig. 2). Later examples show an increased proportion of blacksmithing waste. The youngest identified primary example (the connecting range of c. 1922) shows a mixed (and actively corroding) assemblage of smithing slag, clinker, coal-shale and iron particles, resembling that of the dump outside the forge building to the east of the hotel.

It is not yet known where the Carmelites gathered the tapslags. There is haematite mineralisation associated with a fault system in the southern part of the forest but, so far, we have not located evidence for smelting there. Three kilometres to the south lies a more likely source, where mineralisation occurs as the faults pass through





Ordovician volcanic rocks and where there are smelting sites using both tapping and non-tapping technologies. Tapslags can also be found 2 to 4 kilometres west of the forest near Vacariça. We hope that future research will clarify the age and origin of the slags in the early *embrechados*, but they remain a striking witness to the ethic of poverty of the Discalced Carmelites.

*Tim Young & Sofia Pereira*

*Figure 2 (left): detail of the coarse, grotto-like, embrechado interior of the entrance to the convento church (c1628, but possibly repaired). Large tapslag fragment c100mm across.*

## PRESSED METAL CEILING TILES - BACK IN FASHION?

Following on from the article on pressed metal ceiling tiles in issue 110 of *The Crucible*, it was wonderful to see their present-day incarnation in the interior decoration of a coffee shop in Eastbourne on the South Coast of England. Unlike their 19th century predecessors, which were painted to imitate the more expensive plaster counterparts, these tiles celebrated the use of polished metal in a mix of neoclassical and gothic designs. A quick internet search shows that metal ceiling tiles are still available on the market and come in a range of traditional and contemporary designs. Perhaps we will see a resurgence in their popularity in commercial premises? However, would you instal them in your home?



## A 13TH CENTURY COPPER CANDLESTICK IN BRISTOL



In a recent trip to Bristol Museum and Art Gallery, it was great to explore a gallery dedicated to silver, glass and ceramics that had many fine examples of metalwork from throughout the centuries. One particularly beautiful object was a copper candlestick with enamel decoration. According to the museum, this candlestick, dating to the 13th century, had been made in Limoges in France and had more recently resided in St Thomas the Martyr Church in Bristol. After the Reformation and the founding of the Protestant Church in England in the 16th century, many valuable items of church plate were melted down across the country. The museum attributes the survival of this candlestick to its manufacture in copper which had little in the way of scrap value compared to its silver counterparts. It is interesting to reflect on the fact that so many of the wonderful metalwork artefacts found in museum collections have survived because of their perceived value and yet this is an object whose survival is due more to its lack of value at a time when many other significant pieces were lost.

*Jack Cranfield*



## REUSED IRON SLAG IN THE GARDENS AT STANDEN

One of the most impressive features of Standen, a wonderful Arts and Crafts House at East Grinstead, West Sussex, is the Quarry Garden, a rock garden created within a former quarry where stone used for building the adjacent house was excavated from 1891 (Fig. 1). Today this tranquil garden features fine examples of native fern species that grow amongst the sandstone. The garden also incorporates features that hint to the earlier use of the landscape when the area was a site of iron production. Large fragments of tap slag, the by-product of smelting, have been incorporated into the paths and steps that run throughout the garden. The tap slags have the characteristic runnels where the slag was released or 'tapped' from the furnace and solidified in lava like flows (Fig. 2).

These slags were presumably unearthed during the excavation of the quarry or found locally and subsequently incorporated into the garden (Fig. 3).



Figure 1. Standen House designed by Philip Webb in the Arts and Crafts style.

The Weald of Kent, Sussex and Surrey was a centre for iron production during the Roman and Medieval periods. A Roman bloomery site was recently investigated 0.6km to the South-east of Standen House by Ethan Greenwood (2021) and it is possible that there were other small scale iron production sites within the area.

Standen House, which was designed by Philip Webb for the Beale family, incorporates the ideals of the Arts and Crafts movement that emphasised the importance of traditional skills and crafts. Heritage was at the forefront of this movement and is demonstrated at Standen by the preservation and incorporation of an ancient barn and Wealden farmhouse into the layout of the later house.



Figure 3. slag tapped from a furnace.

The tap slag therefore represents the industrial history of the landscape that, like the farmhouse and barn, were important to preserve within the creation of the gardens.

Standen is now in the care of the National Trust and is open to the public.

Jack Cranfield



Figure 2. Tap slag, possibly Roman, reused in the later Quarry Garden at Standen. Here it has been incorporated into steps leading into the former quarry.



# FORTHCOMING EVENTS & VIRTUAL CONTENT

Conference, date & locations	Description	Website, emails and prices
31st EAA Annual Meeting 2 - 6 September 2025 Virtual Online Conference	Conference registration for the 31st EAA Annual Meeting, Belgrade, is now open and the Scientific Programme is available to download on the website.	<a href="https://www.e-a-a.org/ea2025">https://www.e-a-a.org/ea2025</a>
BUMA XI 24 -28 September 2025 Quanzhou, China	The international conference on “the Beginnings of the Use of Metals and Alloys” (BUMA) is an interdisciplinary gathering of scientists, engineers, archaeologists and historians with a focus on production and use of metals, and an emphasis on cultural interactions and evolutions over time and space especially between the West and the Asian region.	<a href="https://archaeology.pku.edu.cn/info/1042/5120.htm">https://archaeology.pku.edu.cn/info/1042/5120.htm</a>
MetalEspaña2025 23-25 October 2025 University of Cadiz, Spain	MetalEspaña2025 IV Congress on Conservation and Restoration of Metallic Heritage will take place at the University of Cadiz. See page 11 of <i>The Crucible</i> for further details.	<a href="https://eventos.uam.es/128242/detail/iv-congreso-de-conservacion-y-restauracion-del-patrimonio-metalico-metalespana2025.html">https://eventos.uam.es/128242/detail/iv-congreso-de-conservacion-y-restauracion-del-patrimonio-metalico-metalespana2025.html</a>
SMEIA II 28-30 October 2025 Leibniz-Zentrum für Archäologie, Mainz, Germany	The 2nd International Symposium on the Metallurgy of the European Iron Age. The conference Programmecan be downloaded from the website.	<a href="https://www.leiza.de/forschung/forschungsfelder/zusammenleben-in-komplexer-werdenden-sozialen-gefuegen/international-symposium-on-the-metallurgy-of-the-european-iron-age-ii-smeia-ii">https://www.leiza.de/forschung/forschungsfelder/zusammenleben-in-komplexer-werdenden-sozialen-gefuegen/international-symposium-on-the-metallurgy-of-the-european-iron-age-ii-smeia-ii</a>
UISPP Archaeometry Conference on stone, glass and metals 6-8 November 2025 Chania Archaeological Museum, Crete, Greece	The UISPP Commission on the Archaeometry of Prehistoric and Protohistoric Inorganic Artefacts, Materials and their Technologies is organising an Archaeometry Conference on Stone, Glass, Ceramics and Metals at Chania Museum. It welcomes contributions on topics related to the materials listed above, and participants from other UISPP commissions and from other institutions working on related topics.	<a href="https://uispp.net/index.php/en/news/2024/archaeometry-conference-stone-glass-ceramics-and-metals-chania-crete-greece-6-8-november">https://uispp.net/index.php/en/news/2024/archaeometry-conference-stone-glass-ceramics-and-metals-chania-crete-greece-6-8-november</a>
HMS Research in Progress 28 November 2025 Virtual Online Conference	The next Research in Progress Meeting of the Historical Metallurgy Society will take place online on Friday, 28 November. Participation is free of charge. The conference provides a forum for everyone working on topics related to ancient and historical metallurgical practices, the past use of metal objects, and related fields.  Abstracts (up to 200 words) can be submitted between August 1 and October 1 through <a href="https://archaeothommy.github.io/hms-rip-meeting/">https://archaeothommy.github.io/hms-rip-meeting/</a> . Presentations can be either 6 min or 15 min long (with time for questions added).	<a href="https://archaeothommy.github.io/hms-rip-meeting/">https://archaeothommy.github.io/hms-rip-meeting/</a>

For the latest conferences and events please see the HMS Website at <https://historicalmetallurgy.org/events/>