THE CRUCIBLE

Historical Metallurgy Society News

Issue 106 **Spring 2021**

1867advert (page 18)

Inside The Crucible

The HISTORICAL METALLURGY Society

The Lady Washington (page 14)

From the Editors

Little did any of us know in April 2020 that a year on we would all still be staying at home and keeping our distance from each other. But life has gone on and we all look forward to a new and brighter future, not least HMS. In this issue of ***the Crucible*** we have given considerable space to HMS News to bring you the latest announcements and updates from the Society. We hope readers will take time to study all the proposed changes, especially to the way we want to produce our Journal, and bring their thoughts and responses to the important meetings that will take place online on June 5th. In the meantime we hope you enjoy the rest of the content and please keep your contributions coming in, it's you and your work that makes ***the Crucible*** an absorbing and diverse read.

Gill and Lorna

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. Images should be sent as high resolution jpeg or tiff files. We accept a maximum of 5 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.

The Crucible
thecrucible@hist-met.org
c/o Lorna Anguilano
Experimental Techniques Centre
Brunel University
Kingston Lane
Uxbridge UB8 3PH
United Kingdom

FUTURE INTERVIEWS

Who would you like us to interview for the next issue of ***The Crucible****?*
Please let us know at thecrucible@hist-met.org

Archive films search

At the HMS conference at Ambleside in 1999 the late Mike Davies-Shiel showed some archive film of Backbarrow Furnace when it was still in blast in the 1960s. There were elements of the operation of the furnace which were relevant to earlier blast furnaces, and it would be fascinating to see it again. If it has survived perhaps a way could be found of making it more widely accessible, on YouTube for example. If anybody has any information on this film could they please let us know at thecrucible@hist-met.org

Dear HMS Members,

I am delighted to have the opportunity to greet you all and to say how much I am looking forward to meeting many of you again in the near future. I am, of course, referring to our upcoming Annual General Meeting on Saturday 5th of June. Being able to hold our AGM is a great improvement on last year, when the AGM was cancelled, but we will still have to be satisfied with meeting virtually online. It will be interesting to see if an online AGM will encourage more overseas members to join in, especially as the event will include an online conference.

The AGM meeting will follow a series of talks under the title of *A Metallurgical Miscellany,* starting at 10am. There is a wide range of papers and is bound to include something for everybody's taste (thankyou to Justine Bayley and Lorna Anguilano for arranging the conference). The programme, abstracts and joining info can be found on page 4 in this issue of ***the Crucible***. Please make sure you have got your time zones right if joining from outside the UK!

The AGM, at 2pm, promises to be more impactful than usual. Your Council will be presenting you with new members for Council; a long-needed revision of the Articles of Association and also nothing less than the future of our Society. As detailed by Tim Young on page 6, the most significant change we are proposing is to *Historical Metallurgy,* our Journal. Our plan is to move to publishing *Historical Metallurgy* digitally, as full Open Access, in colour and at no cost to the authors, in the very near future. Membership fees for those who want to continue receiving the *Journal* and ***the Crucible*** in the post would remain unchanged, but if you are happy to do your reading online, your membership fees will be considerably reduced.

With your continued membership you will not only be supporting your Council in producing our *Journal* digitally but also contributing to enhanced membership benefits, which is the second part of our suggested future for HMS. Discussions on how to shape these benefits are still in full swing but our aim is to create a stronger community for the membership. We would hope that this will work in two directions and that we will be able to attract some members to become more involved in the running of the Society.

And finally, you might not have noticed, but since the previous edition, ***the Crucible*** is now printed on recycled paper. We hope this will be a first step to making our Society more environmentally friendly. So, again, looking forward to meeting up in early June and hoping that your Council can continue to count on your support.

Paul Rondelez

The Historical Metallurgy Society Limited

Notice of Meeting

An ***Extraordinary General Meeting*** of the Historical Metallurgy Society Ltd will be held at 2.00 pm. on Saturday 5th June 2021 (using Zoom because the continuing problems with Covid-19 preclude holding meetings where members are all physically present).

Registration for the AGM and EGM will be made using Eventbrite https://www.eventbrite.co.uk/e/a-metallurgical-miscellany-tickets-144674909549

AGENDA

1. Apologies for absence
2. Motion proposed by HMS Council:

   "This extraordinary General Meeting of The Historical Metallurgy Society Ltd. approves the changes to its Memorandum and Articles of Association (previously published on its website and made available by other means). It instructs its Honorary General Secretary to submit these changes for approval by the Charity Commission and by Companies House."

Papers for EGM/AGM are available at: https://historicalmetallurgy.org/current-events/agm-2021/

The Historical Metallurgy Society Limited
Notice of Meeting

The 39th ***Annual General Meeting*** of the Historical Metallurgy Society Ltd will be held immediately after the EGM on Saturday 5th June 2021 (using Zoom because the continuing problems with Covid-19 preclude holding meetings where members are all physically present).

Registration for the AGM and EGM will be made using Eventbrite https://www.eventbrite.co.uk/e/a-metallurgical-miscellany-tickets-144674909549

AGENDA

1. Apologies for absence
2. Minutes of the 38th Annual General Meeting of the Historical Metallurgy Society Ltd held on Saturday 8th June 2019 at Reading Town Hall, RG1 1QH
3. Matters arising from these Minutes not covered by the following agenda.
4. Consideration of the Accounts of the Society.
5. Examiner's Report.
6. Report of the Council.
7. Appointment and Remuneration of the Examiners for 2021. The Treasurer proposes that SJ Tax Ltd. is re-appointed as examiner for 2021 and that Council be empowered to fix their remuneration.
8. Motion: This Annual General Meeting of the Historical Metallurgy Society resolves that, in order to maintain the due succession of officers and members of its Council, elections that fell due in 2020 shall be held in 2021, those due in 2021 be held in 2022 and those due in 2022 to be held in 2023.
9. Election of Officers and Members of Council in accordance with Article 24 of the Articles of Association of the Society:
    - President
    - Chair
    - Honorary General Secretary
    - Editor of *Historical Metallurgy*
    - Managing Editor of *Historical Metallurgy*
    - Web Manager
    - Up to 10 ordinary members of Council
10. Subscriptions for 2022. HMS Council proposes that the main subscription rates should not change but proposes that additional subscription rates for members receiving *Historical Metallurgy* and The Crucible partially or wholly online. (Concessionary members are mainly students and retirees.)

	Standard Membership	Concessionary Membership
Get Historical Metallurgy and The Crucible in print	£35 (the current subscription level)	£20 (the current subscription level)
Get Historical Metallurgy on-line and The Crucible in print	£27.50	£15
Get Historical Metallurgy in print and The Crucible on-line	£27.50	£15
Get both Historical Metallurgy and The Crucible on-line	£20	£10

11. Any other business that has been notified in advance.

A brief note about the elections to HMS Council

Any paid-up member can stand for any of the posts for which an election is due (see above). Any candidate must be proposed and seconded by two other members and must sign a declaration that they are a "fit person". These things can be done by emails to the Secretary. Fuller details can be found on the HMS website at: https://historicalmetallurgy.org/current-events/agm-2021/

Programme for on-line conference to precede the EGN and AGM meetings

Brunel University London

A Metallurgical Miscellany

Saturday 5 June 2021

The HISTORICAL METALLURGY Society

NOTE FOR THOSE JOINING FROM ABROAD: All Times below are British Summer Time (GMT + 1 hour)

The morning session will have a brief break midway through.

10.00-10.10	Welcome (Lorna Anguilano)
10.10-10.35	The bad side of recycling: The use of ancient coins as a source of material for counterfeits . . (Laura Perucchetti and A Dowler)
10.35 -11.00	Roman mould technology for small castings (Justine Bayley)
11.20-11.45	A very compleat paper trail (Peter Northover)
11.45-12.10	The context of the British Iron Act of 1750 (Peter King)
12.10-12.30	Bright sparks to engine blocks: The history of magnesium, the lightest of the structural metals . . (Chamini Mendis)
12.30-13.30	Lunch break

The afternoon session will start with a keynote lecture from the HMS Chairman that will be followed by an Extraordinary General Meeting and then the HMS Annual General Meeting.

13.30-14.00	The rising of the smith (Paul Rondelez)
14.00-15.00	HMS EGM followed by HMS AGM

To book free places for the conference and/or EGM/AGM go to:

https://www.eventbrite.co.uk/e/a-metallurgical-miscellany-tickets-144674909549

Conference abstracts will be available at: https://historicalmetallurgy.org/current-events/agm-2021/

Papers for EGM/AGM are (or will be) available at: https://historicalmetallurgy.org/current-events/agm-2021/

HISTORICAL METALLURGY
UPDATES ON OUR *JOURNAL*

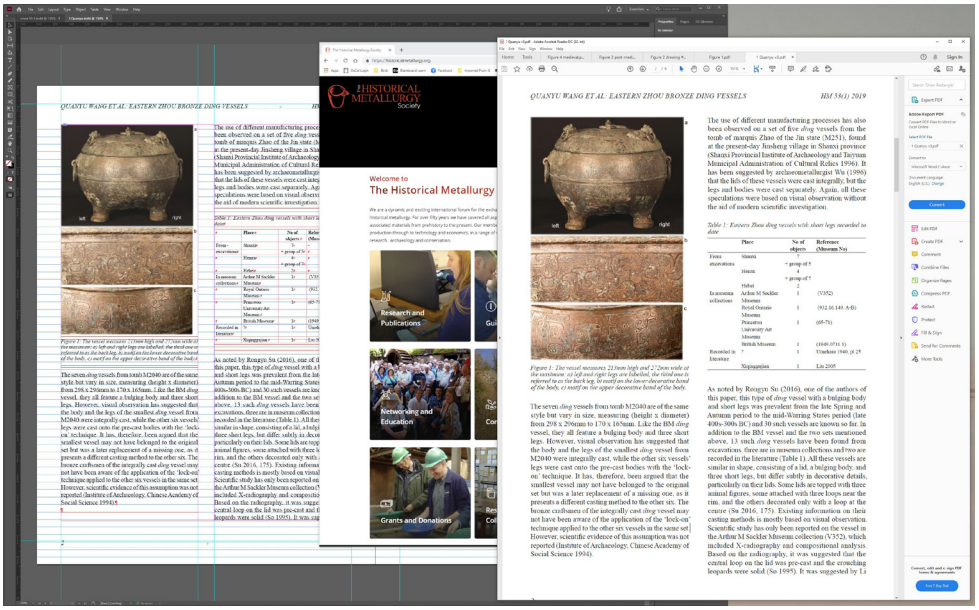

Fig. 1 Production of Historical Metallurgy has now switched to the use of full colour. All the article pdfs will be freely available from the website.

Over the last few years HMS Council has been developing an approach to allow the content of *Historical Metallurgy* to be available online. This has long been a request of our authors, who wish their work to be more widely accessible around the world, as well as of readers, who desire the simplicity of locating and accessing information that this would bring. Members of HMS will no doubt be aware that in recent years the landscape of academic publishing has changed beyond recognition, so attempts to develop an online presence for the journal over this period have been beset by the problems of reaching a moving target. This has meant that our desire to see *Historical Metallurgy* online has taken much longer to come to fruition than we would have liked. Recently, however, the 'futures taskforce' of HMS Council has been able to accelerate the planning for our digital future.

Council is now very excited to be able to commend to the membership a bold plan for *Historical Metallurgy* to become an accredited open-access journal. It is intended that from the start of 2022 the journal content, past and present, will be free to access and to download from the Society's website. For many journals, such a change has involved the shift of the burden of payment from the readers/members to the authors. We are, however, very aware of the Society' long history of publishing content from independent researchers and other authors for whom finding the expensive 'article processing charge' (APC) that normally accompanies open access publishing would be prohibitive. Uniquely in our field, *Historical Metallurgy* will have no APCs; authors will be able to publish in the journal free of charge, just as they do now, and readers will similarly be able to access the journal via the internet, from anywhere, without charge. The journal will maintain its high editorial standards and quality of its peer review process but it will have even greater reach.

Once the content of the journal (and of *The Crucible*) is available online, members will have the option of choosing no longer to receive the printed versions of the publications (with an appropriate reduction in the annual membership fee). For those wishing to continue to receive the printed materials as they do now there will be no change; we are fully committed to the continuation of a high-quality printed journal and newsletter.

One spin-off benefit of these changes that members will notice in the short-term is that *Historical Metallurgy* will shift to full colour production for both digital and printed versions from this summer.

A revised 'guidance for authors' will be available shortly. The editorial team will be requesting slightly different information from authors to ensure full compliance with open access standards. Work to digitise the back catalogue of papers from *Historical Metallurgy* is already underway, but this is a lengthy process because it entails HMS ensuring that all appropriate copyright consents are in place.

Such an undertaking is clearly a major financial challenge for the society, not least because it changes the perceived benefits of HMS membership. For HMS to produce a high-quality journal of international standing on the basis described above will need the continued support of the membership. Council very much hopes that members will feel a sense of pride in, and ownership of, what will be the only free to publish open access journal within our field of study. Members' subscriptions will effectively 'crowd-fund' the production of a journal that will benefit the whole historical- and archaeo-metallurgical community. Inclusivity has been one of the hallmarks of HMS since its inception and we hope that philosophy can be extended to a global readership and membership with this next phase in the evolution of the Society and of *Historical Metallurgy*. That inclusivity will also be fostered by a greater emphasis on electronic communication to enable a more responsive interaction with our members around the world. The open access project has the potential to lie at the heart of an expanded HMS community and Council is very keen to hear suggestions from members for any initiatives or activities that could enhance the society's provisions to members, particularly on an international basis.

Tim Young

Historic England's Draft Industrial Heritage Strategy

This consultation is on Historic England's draft Industrial Heritage Strategy. The Strategy sets out the key priorities for our internationally important industrial heritage to be delivered by Historic England usually in partnership with others.

It has been divided into four themes and nine issues with a series of priority activities listed under each heading. In some cases these have already been agreed and are being implemented, but for others this has yet to take place.

PDF Historic England's Industrial Heritage Strategy - consultation draft
406.10 KB

Responses to this draft Industrial Heritage Strategy are welcome particularly responses to the following:

- Comments on the identified priorities;
- Suggestions on any significant gaps or omissions in coverage;
- For those responding on behalf of external bodies or organisations to suggest how they might be able to work with us in its delivery.

The consultation is open for a period of three months and will close at midnight on **Monday 7 June 2021.**

Responses should be sent to governmentadvice@HistoricEngland.org.uk.

Elsecar Heritage Action Zone

Elsecar is a small rural village to the south of Barnsley with a surprising industrial past. The Elsecar Heritage Action Zone, a successful three-year partnership between Historic England and Barnsley Museums, has been researching the history and archaeology of this extraordinary village, helping to safeguard its important industrial heritage for generations to come.

Elsecar was developed as a model industrial settlement from the 1790s onwards by the Earls Fitzwilliam of Wentworth Woodhouse. The Earls created a new industrial community at Elsecar, building a canal, ironworks, collieries and workshops. They created attractive, high-quality cottages for their workers and provided a new school, a church, allotments, a cricket club, shops and pubs. Elsecar was a precursor to later model villages like Saltaire and was built as a showpiece – designed to impress royals and aristocrats, who were regular visitors throughout the 19th and early 20th centuries.

Elsecar is generally known as a mining village, however its early development was centred on iron. The village hosted two large ironworks, the Elsecar ironworks, built by Darwin and Co. of Sheffield in 1795, and the Milton Ironworks, established by Walker Brothers of Rotherham around 1798. Both

Fig. 1 Dr Rod Mackenzie inspecting the ha-ha at the Ironmasters House at Elsecar in 2018

Fig. 2 Calcining kiln base at Milton Ironworks excavation in 2018

sites were owned by the Earl Fitzwilliam and by the late 1830s were connected by a network of wagonways that ran between the Earl's ironstone mines at Tankersley and the canal basin at Elsecar, linking up with the Earl's collieries. Both ironworks operated until the 1880s, under the direction of various tenants, including the Dawes Brothers from Staffordshire who took over both sites in the late 1840s. They made significant changes, including creating a large new rolling mill at Elsecar, and in 1859 the Elsecar Ironworks produced iron plating for HMS Warrior, the Royal Navy's first ironclad warship.

The Heritage Action Zone has shown that significant parts of both ironworks still survive, including the furnace bank, former casting shed and rolling mill and ruined blowing engine house at Elsecar, and two of the four original furnace ponds at Milton (Fig. 1). A community excavation at the Milton ironworks in 2018 uncovered the remains of an early calcining kiln, and geophysics suggests that other parts of the complex survive as buried archaeology (Fig. 2). The research has also identified one of the former iron masters' houses, built in the late 1840s for the Dawes Brothers, complete with a decorative ha-ha made from blast furnace slag (Fig. 3).

Historic England published a new detailed report about Elsecar in February, which is available on their website (search Elsecar Historic Area Assessment). In October the Department for Culture, Media and Sport also announced 16 new and upgraded designations, to give some of the village's most important industrial sites further protection. This includes Hemingfield Colliery, built by the Earl Fitzwilliam in the 1840s,

and the Elsecar Ironworks, which have both been designated as scheduled ancient monuments, recognising them as rare survivals. The surviving ironworks buildings have all been listed grade II*.

The Elsecar HAZ finished in 2020, but legacy work is continuing, including a review of the Elsecar Conservation Area and planning for future conservation works. For more information about the Heritage Action Zone please contact ElsecarHAZ@barnsley.gov.uk

Tegwen Roberts

Fig. 3 Elsecar Ironworks furnace bank. © Barnsley Museums (photograph T Roberts)

A 'Mouse Proof Pedal'

Readers might appreciate a somewhat bizarre object that illustrates the inventiveness of 19th century cast iron founders. At a 'recycling fair' in Sussex some years ago, I noticed the small decorative cast iron plate amongst a pile of scrap iron. The plate reads 'PAT'D FEB 24. 1887. MOUSE PROOF PEDAL'. An internet search revealed it to be an ingenious devise to prevent unwanted rodents from taking up residence inside organs and harmoniums, via the open pedals. Mice apparently are responsible for frequent and costly damage to church organs. At the *RRS Discovery* exhibition in Dundee, I found on display a harmonium that had accompanied Scott and Shackleton on their first expedition to the Antarctic in 1901. This too had been fitted with mouse proof pedals - even in the severe Arctic cold, mice were a problem on board ship.

The mouse proof pedal was used on various models of organs and harmoniums manufactured during the second half of the 19th century, by companies that included The Bell Piano and Organ Co. of Ontario and by Wilcox and White of Connecticut. The inventors of the pedal were Alexander and Herman Marcy from Clinton, Ontario, who filed a patent application for a *'Mouse and Dust Proof Attachment for Organs'* in 1887. Perhaps what the pedal best illustrates is how in an age of increasing industrialisation, even the more functional metal components of machines still carried an aesthetic quality – in this case the arched decoration was neither functional nor particularly visible on the instrument. We see this aesthetic appreciation used frequently in cast iron of the period, from bridges to cooking pots, demonstrating the pride that manufacturers took in their products.

Jack Cranfield

ALESSANDRA GIUMLIA-MAIR

I studied archaeology at the *Alma Mater Rudolphina* in Vienna (Austria), where I also took optional exams in mathematics, chemistry and mineralogy. The chemistry laboratory definitely influenced my future. After my graduation from Vienna, I became Vice-Director of the Town Museum at Bolzano (Italy), but after one and a half years I decided that this was not my kind of activity, resigned from my job and went to London to study Archaeometallurgy at UCL. My Viennese professors were horrified and told me that I was never going to get another position like the one I had at the Bolzano museum. After university I moved to Salzburg (Austria) with my family and began working on a couple of projects. This led to more projects and then to teaching Archaeometallurgy and Archaeometry from 1991 to 2001, first at the University of Salzburg as a lecturer, then as professor by contract at the University of Trieste and the University of Udine in Italy. In 2000 I founded AGM Archeoanalisi, a company specialising in ancient metallurgy and archaeometry. More people commented that this was a crazy move and that I was not going to do any work without a university to support me. I happily survived until today, and have taken part in several international projects on objects and collections of several museums, excavations and institutions in Europe, the USA and Canada, India and Japan. Nevertheless, in the last couple of years, I have sometimes thought that I would like to do something really new in an exotic place, and this came by itself during this crazy Covid year: I was offered (and accepted) the position of head of a new research laboratory at the Institute of Archaeology of the Russian Academy of Sciences in Moscow. This will definitely improve my Russian.

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

I was a bored Vice-Director in a museum, then I was teaching at a university and enjoyed working with students, but not the endless (useless) meetings and bureaucratic tasks. And, much worse, I hated giving notes at exams. I have been a very happy independent researcher for the last 20 years and was invited to all sorts of places, from the USA to the Far East. From the 1st of January 2021 I will officially be at the Russian Academy of Sciences of Moscow. I'm sure I'll enjoy it.

THE CRUCIBLE: What is your most memorable professional moment?

As I have been in this field for years, it is difficult to pick one in particular. There were quite a few. A memorable moment was certainly when I first held in my hand the exquisite EBA gold cup from Montecchio (around 17th century BCE). There are only five such pieces in Europe and this is the only one found in Southern Europe. I was quite awed. Or perhaps the moment when I first realised that the magnificent silver rhyton at the Trieste Museum - the first silver rhyton I studied - had a decoration that should not have been there. It is dated to the 5th century BCE, the earliest example of niello identified up until now and the first I analysed of a group of superb niello-decorated silver objects, all from the area around the Black Sea. Perhaps that's where niello comes from. At least for the moment, all other niello examples are dated after the 1st century AD. But I also very much enjoyed working on the newly discovered and amazingly beautiful, inlaid Mycenaean dirk from Knossos that I am publishing now, together with Athanasia Kanta, who excavated it. This kind of object was not supposed to exist on the island of Crete, but for years I had been telling the colleagues who were digging there to look for something like this. Finally seeing it was magical too.

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

Certainly Paul Craddock, who was my Supervisor at university. With his immense knowledge and wide experience, he definitely provided the framework for all my subsequent projects. We are still working together now, on a Roman project. But I also would like to mention more very dear colleagues I have been working with for years, because they too have been teaching me a lot: the late Robert Maddin, Jim Muhly, Phil Betancourt and Fulvia Lo Schiavo. I also wish to mention Brian Gilmour, Susan La Niece and Duncan Hook. All of them are inspiring colleagues and good friends.

THE CRUCIBLE: What is your main current project?

In the last ten years I have been working as archaeometallurgist with the excavation teams of the Institute for Aegean Prehistory (INSTAP) of Philadelphia PA, USA, at Pacheia Ammos in Crete, in particular with Phil Betancourt, Susan Ferrence and Jeff Soles. We have a wide program of research on the metallurgy of Bronze Age Crete. I worked on all metal finds from the important sites of Petras, Mochlos, Halasmenos, Hagia Photia, Livari, Knossos and Chrissi, a pioneering and very exciting job, which still continues. We began publishing parts of it in the last couple of years. I am also working on an interesting 4 years project, which I am enjoying very much, with the Institute of Archaeology of the Ludwig - Maximilian University of Munich. The research is on lamps and candelabra - but not only - in the National Archaeological Museum of Naples and in Pompeii. And I do experimental work too, in collaboration with a Swiss foundry.

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

The one I shall actually develop, together with the colleagues of the Russian Academy of Sciences in Moscow, in the next few years. We will buy equipment and organise our new laboratory, which will be used for teaching and to study archaeological materials. And we will study the amazing finds from Novgorod, the ancient capital of Russia and UNESCO World Heritage Site. I am looking forward to it.

THE CRUCIBLE: Which publication should every HMS member read?

Ancient texts! *De re metallica* by Georg Bauer called Agricola, the *Probierbüchlein* by Lazarus Ercker, Vannoccio Biringuccio's *De la Pirotechnia* and, of course, Pliny's *Naturalis Historia*. Ancient writings are extremely important and greatly undervalued. But do not trust translations, they are never literal and create a lot of confusion, because they have been done by philologists, never by scientists. The only exceptions are the translations by Marcellin Berthelot. Read everything in the original language, if possible.

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

Read widely and on all periods and geographic areas, you never know what you will be confronted with in the future. Learn as many languages you can and especially the metallurgical terms: it makes a lot of difference when you talk to colleagues from foreign countries or,

in particular, when you want to know how artisans work. It helps greatly if you can communicate, even if it is only a little, without relying too much on a translator who normally does not know a thing about metallurgy. The best part of this job is meeting colleagues and people from all over the world and exchange knowledge with them.

I would like to tell every reader of *The Crucible* that…

There is such a huge amount of work to do in archaeometallurgy. We need more serious and dedicated people!

TRADITIONAL STEELMAKING IN SOUTHWESTERN ETHIOPIA: A METALLURGICAL ANALYSIS

Traditional steelmaking was practiced in some regions of Ethiopia until the early 20th Century. While the availability of cheap scrap steel in local markets largely negates the need for iron smelting in the modern age, such daily necessities as axes, hoes, and knives are still made by blacksmiths in local smithies.

In this study, indigenous steelmaking technology is discussed and analysed from a metallurgical perspective on the basis of the fieldwork among the Dime, in southwestern Ethiopia. Historically, an artisanal group in Dime, known as *Gitsi*, were exclusively engaged in iron smelting and forging. The fieldwork was conducted in 2004 with the support of two Dime blacksmiths in a restoration of local steelmaking. The steelmaking consisted of furnace construction, the mining of ores, charcoal production, smelting, and forging.

A shaft-bowl-shaped furnace with walls made from red-colored clay was constructed for smelting. The furnace did not have an outlet for slag-tapping. Six clay-pot bellows were placed around the furnace and long and short tuyeres were placed in the furnace. The blacksmiths mined three kinds of iron ore locally from a lateritic deposit: *balt, bullo, and gachi*.

Fig.1 Blowing bellows in smelting in Dime, Ethiopia (Photo: Isao Murahashi, 2004)

In a smelting operation called *girfe* meaning 'blowing', the blacksmiths, operated six-pot bellows covered with goat leather (Fig. 1). The temperature of the furnace base near the tuyere outlets reached 1100-1200°C. The blacksmiths were able to visually determine the timing of the end of smelting by the color and height of the flame. The large metallic mass dug out from the furnace base was a mixture of sponge iron and slag. The blacksmiths separated iron from the slag by hammering at elevated temperatures in the forge, utilising the ductility of iron and the slag. Finally, the iron was forged into a small knife. (Fig. 2).

Our metallurgical analysis of the sponge iron, slags, and iron ores revealed the characteristics of iron-making technology in Dime. The sponge iron contained no impurities, excluding iron and carbon, while the slag contained iron, silicon, aluminum, potassium, phosphorous, titanium, and manganese, indicating that the slag consisted of a FeO FeO-SiO_2-Al_2O_3-(CaO, K_2O, P_2O_5, TiO_2) matrix. The steel produced by this experimental restoration contained 0.31-0.48 mass% carbon, had a yield ratio of about 40%.

Among the three kinds of iron ores available to them, Dime blacksmiths preferred *gachi* to the others for steelmaking. We analysed the components of the three ores and conducted TG-DTA to clarify the mechanism of slag formation. While all three ores consist primarily of goethite [a-FeO(OH)] and kaolinite [$A1_2O_3$•$2SiO_2$•$2H_2O$], the white inclusions in *gachi* contained calciaum phosphate hydrate [$Ca_3(PO_4)_2$•xH_2O]. The results of TG-DTA suggest that *gachi* is the most appropriate ore for Dime steelmaking because the tricalcium phosphate hydrate in the white inclusions contributes to the formation of a low-viscosity slag.

As is well known, forming 'good slag' with a low viscosity in the steelmaking process facilitates the separation of the produced steel from the gangue

Fig. 2 Making a knife from collected sponge iron (Photo: Isao Murahashi, 2004)

component, prevents reoxidation, and insulates the steel. Despite not having scientific knowledge of the role of slag in steelmaking, the blacksmiths empirically knew which of the ores available to

Isao Murahashi [a] and Eiji Yamasue [b]
[a] Tokyo University of Foreign Studies
[b] Ritsumeikan University

A material investigation of Indigenous copper use on the Northwest Coast of North America

I began my archaeological career working on the Northwest Coast of North America 15 years ago, and it was there that I first became interested in the indigenous use of copper metal in the region. It is from this initial interest that I came to do my PhD at the University of Sheffield. My research focuses on how the technological practises of indigenous copper use developed and how they changed over time, particularly through the fur-trade and colonial periods spanning the late-18th to mid-20th century.

The Northwest Coast culture area stretches from the Columbia River located on the southern border of Washington State to the south Alaskan Coast. This region is comprised of multiple ethno-linguistic culture groups which are often combined into one 'study area' due to a collection of shared cultural practices. One of these is the way in which people valued and utilised copper, a material that naturally occurs in its metallic form as a usable metal in the region. This type of metal is referred to as 'native copper'.

Copper was and is considered a powerful and active material within indigenous animistic belief systems in the region and has been used in the creation of a wide range of objects, including bracelets, beads, ceremonial masks, daggers, and the famous 'Coppers' of the Northwest Coast. A process of hammering and annealing was utilised, alongside forming techniques such as folding, cutting, and repousse. There is no evidence that smelting or melting was ever practiced. However, there are multiple known sources of the

Fig. 1 Northwest Coast Culture Region with ethnolinguistic culture groups identified.

native copper across the region, particularly in the north, and evidence that the metal was manipulated using hammering and annealing processes in the south of region as early as 500CE (Blake 2004).

In my research I utilised a *chaîne opératoire* approach, studying the social actions and technical processes that were used to create indigenous artefacts of various types and styles. I considered the ways in which over three hundred of these objects were made, what tools were used, and what materials were chosen to produce these objects. This analysis included material characterisation using a hand-held portable XRF device, which identifies the chemical composition of the copper used to make each artefact. This allowed me to identify whether the metal was consistent with native material representative to the region, which is typically very pure copper, or manufactured metal from elsewhere, which generally contains trace amounts of alloying elements such as zinc, lead, tin and arsenic.

It is typically thought that, prior to the arrival of European and Russian explorers and traders during the fur-trade period beginning in the late 18th century, much of the copper used by indigenous communities on the Northwest Coast was native metal. Indigenous oral histories and primary accounts written by European and Russian travellers support the assertion that a large volume of trade metal was taken up by indigenous craftspeople early in this period, and it appears that the number of copper artefacts increased rapidly at this point. However, my research suggests the possibility that significant levels of manufactured copper and copper alloys were already present and being utilised by indigenous people to craft culturally significant artefacts prior to the fur trade.

There are several ways in which significant quantities of manufactured metal could already have arrived in the region prior to the late 18th century. For example, the currents in the Pacific Ocean washed drift metal and other material from shipwrecks onto the Northwest coast from Japan, China, and Russia. Japan and China had been manufacturing copper and copper alloys for hundreds of years prior to this time period, and the Chinese employed copper sheathing on their vessels from the 17th century (Callaghan 2003). In addition, trade metals are known to have been moving across the Bering Strait into North America by 1000AD and could have arrived on the Northwest Coast through the extensive Indigenous trade routes (Cooper *et al*. 2016).

Overall, my research demonstrates that manufactured metals were likely in use among indigenous craftspeople much earlier, and in larger quantities, than previously considered. However, my work also highlights a consistency within the traditional ways in which the metal was manipulated throughout the period, and the types of artefacts crafted from the material, suggesting that ideas such as colonial acculturation or assimilation during the fur-trade and subsequent colonial period are inappropriate and misleading. It is more likely that, as long as the metal could be worked using indigenous styles and techniques, the source of the copper and copper alloy material was not as important to Indigenous communities as the objects made from it. Furthermore, the traditions of making and use associated with these objects helped to reproduce and reaffirm Indigenous traditions, beliefs and practices into the modern era.

L Thompson

Fig. 2 (Front Cover). The Lady Washington trading with the Haida in the waters of Gwaii Haanas for sea otter pelts in 1791. It is thought that much of manufactured metal arriving on the Northwest Coast arrived through trade with Europeans from the late 18th century onward. My research suggests that although quite a lot of metal and other material was attained by Indigenous communities through such trade, there may have been a significant amount of the foreign metal already present in the area (Image by Gordon Miller, 2005)

Bibliography

Blake, M. (2004) Fraser Valley Trade And Prestige As Seen From Scowlitz. *In:* W.C. Prentiss, I. Kuijt, eds., *Complex Hunter-Gatherers; Evolution and Organisation of Prehistoric Communities of the Plateau of Northwestern North America.* Salt Lake: University of Utah Press, 103-112

Callaghan, R.T. (2003) The Use of Simulation Models to Estimate Frequency and Location of Japanese Edo Period Wrecks Along the Canadian Pacific Coast. *Canadian Journal of Archaeology,* vol. 27 (1), 74-94

Cooper, H.K., Mason, O.K., Mair, V., Hoffecker, J.F., Speakman, R.J. (2016) Evidence of Eurasian metal alloys on the Alaskan coast in prehistory. *Journal of Archaeological Science,* vol. 74, 176-183

Robert Walter Winfield (1799-1869) Birmingham Brass Founder

In between lockdowns in 2020 I went to a viewing at a local auction sale and bought an ivory locket enclosing a photograph of a Victorian gentleman with a lock of his hair and a pressed flower (Fig. 1). Written in pencil around the rim was the inscription R.W.Winfield. Having an active interest in genealogy I thought to research the name. Imagine my surprise when the only name that would fit the period was Robert Walter Winfield a brass founder of Birmingham who owned one of the largest brass works in Birmingham in the mid-19th century (Ramsey 2008: ii). A drawing of him in a book written by E. Edwards on his personal recollections of Birmingham and Birmingham men, confirmed Winfield's identity (Fig. 2) (Edwards 1877:120).

Early Career

Robert Walter was born on the 4th of April 1799 to John and Mary Ann Winfield in Birmingham. In a Baileys Birmingham trade directory of 1784, his father is cited as being a Factor (commerce). John Winfield came from a family of independent means but from about 1797 and until his death in 1804 he is listed in Pye's Birmingham Directory as a factor and a coal merchant involved in mining and quarrying.

Robert Walter was only five in 1804 when his father died, and his elder brother John Walter was eight. John Walter went into business on his own account from 1820 – 1842 as a gun and pistol manufacturer and maker of gilt and plated buttons, a factor, and military ornament contractor. His workshops were in Great Charles Street and later at Regent St., Birmingham. In the 1851 census he has retired to Wales. He dies in 1858.

According to Edwards, after his education his mother placed Robert Walter with the manufacturer Benjamin Cooke (Edwards 1877:122). It is quite difficult to identify Benjamin Cooke, as he has several guises and difficult to nail down purely from online information. There could be several Benjamin's or if it is the same one, he was diversified enough to be on the one hand a manufacturer of gilt toys, a jeweller and plated curb maker (mainly in Caroline St.), on the other hand he was a manufacturer of gas light apparatus and ran the patent brass rod company & Co of Baskerville House (he holds a patent in 1808 for barrels and ramrods for firearms. No.03122). He takes out a patent in 1811 combining metals and metals with wood (No.03460). He is also said to

Fig. 1 The ivory locket © Louise Bacon

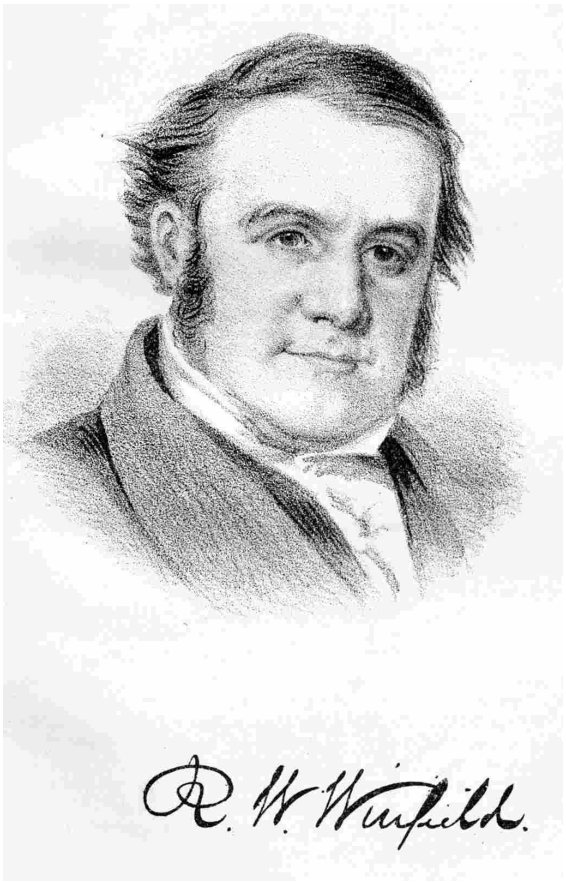

Fig. 2 Robert Walter Winfield (courtesy Edwards Project Gutenberg)

be the inventor of metallic bedsteads and this patent may have been the precursor for this invention (Shill 2006). Baskerville and Easy Row are named after Baskerville House, home of the printer John Baskerville, who built a house on eight acres of land which he called Easy Hill (now Row). The area encompassed Easy Row, Cambridge Street, Crescent Wharfs, St Martins Place and Broad Street, including the Union Rolling Mill.

Whatever the situation, it provided the young Robert Walter with all the grounding he needed in brass bedstead making and other items including gas light apparatus. He progressed so well at Cooke's that in 1820 at just 21 the Trustees of his father's money advanced him the capital to set up his own business at the Cambridge St. Works, Easy Row, Birmingham (Edwards 1877:122). According to Shill, however, his first premises were at The Crescent, beside Gibson's Canal Arm (Shill 2006). This canal arm connected to Baskerville Basin and the Easy Row Wharf. Roberts reports that in 1824 he was in partnership with the Ledsam brothers, Daniel and Joseph, and others, particularly with the Union Rolling mills, a partnership that was dissolved in 1864 (Roberts 2016: 22). To have been able to advertise the manufacture of a wide range of items as in Pigot's Directory of 1820/1, I feel he must have taken on a ready 'tooled' up workshop and he could have taken over Benjamin Cooks Baskerville House site and his patent. Patents can be bought or leased.

Pigot's Directory of Warwickshire 1820/21: Winfield Robert Walter Brass Founder, ornamental & patentee of metallic bedsteads, Brass mouldings etc. Tube makers brass & copper. Cambridge St Works, Birmingham.

Birmingham in the 18th and 19th centuries found itself in a unique position. As a 'new' town it enjoyed all the privileges of an unchartered town. Its location near to coal mines and the ever-developing canal system allowed the town to progress at a rapid rate. The rise of Birmingham in this period is striking but one has only to read Hamilton's 'The English Brass and Copper Industries to 1800', to discover how tortuous was the path to Birmingham's independence from external smelting Works. Birmingham finally set up its own smelting works in 1781. Although many manufacturers did set up their own smelting works, there is no evidence that Robert Walter did. He was probably initially using ingots made of cementation brass but later in the century the technology would have developed and changed to the direct method of making brass as smelters learned to smelt zinc from its ore (Bacon 2003: Chap.4). An ingot store is marked on a plan of Winfield's works in 1897. By the end of the eighteenth-century Birmingham had become the

Fig. 3 Winfield logo (courtesy IMLICO showrooms)

chief centre of English copper and brass manufactured goods,1000 tons of brass being used there in 1795 (Bacon 2003: 80).

At 21 Robert Walter was already showing his talents as an entrepreneur, inventor, and a great PR man. He believed in advertising and his first entry in 1821, sees him taking advantage of all the headings he possibly can in the trade directories compared to Gabriel & Co who barely had one line under brass founder (see Epilogue below). His progression can be seen yearly through trade directories (Wrightson's; Pigot's; Kelly's; Post Office). He was a coal merchant with his own wharf on the canal at Tindal St. ensuring that he had plenty of coal for his brass works. In 1835 he was employing 100 men and 700 by 1860.

His achievements

In 1835 he is listed in Pigots under seven categories: brass founder, coal merchant, ring maker, copper & brass tube manufacturers, wire manufacturers and drawers as well as patentee of the metallic bedstead & sofa and with a London Agent John Simms, Belle Sauvage Yard, Ludgate Hill.

Fig. 4. 1839 Advert with folding bed Wrightson's Directory

In about 1840 he opens up more showrooms in London and by 1849 has a full-page advert in the Post Office Directory, with all articles made by him at the Cambridge St. Works, 22 Easy Row, 141 Fleet St., London and 26 New Bond St., London. He is now a highly successful businessman, and in 1842 becomes a Freeman of the City of London by redemption.

But above all Robert Walter is well known for his metallic bedsteads. Early construction with metal led to problems with connections coming undone, consequently he devised and patented new methods for assembling brass and iron bedsteads and paved the way for a new industry for Birmingham (Shill. 2006. Chap. 3). His talent for technical inventiveness to create new models, improve productivity and manufacturing costs is impressive.

British Library Patents Collection

1827 No 5573; Winfield Robert Walter: "An improvement or improvements in tubes or rods produced by a new method of manufacturing…with various other improvements into parts of bedsteads and other articles".

1831 No. 06206: Winfield Robert Walter for metallic bedsteads etc.

1841 No. 8891: Winfield Robert Walter: his inventions consist of various improved modes of constructing the connecting joints of metallic bedsteads, and other framed metallic furniture.

And two more in 1848 when he also recognized the contribution (No.12268) by one of his workman John Ward in making improvements in the manufacture of tubes.

By 1847 he is adding chair making to his portfolio, in particular the reclining 'rocking' chair.

Slaters General & Classified Directory of Birmingham 1846/1847: Winfield Robert Walter: Bedstead Makers metallic & reclining chairs Cambridge St & Fleet St London (page 3), brass founder (page 6), chair makers (brass & iron reclining) (page 10), coal merchant (page 12, metal rollers (page 25), Cambridge St., Birmingham

The design allows the entire chair to be taken apart in a short timescale and could be transported whilst on campaign. The rocking feature, with stops at the front and back, was just a simple method of getting in and out of the chair given that it is essentially a lounging chair. The same armchair was later made in strap metal and decorated by a new process of brass inlay.

His awards

The 1851 Great Exhibition: along with a morocco leather rocking chair the metal bedsteads achieved popular recognition. They displayed his metallic

Fig. 5 'Rocking' chair courtesy VINterior.Co

military bedsteads, and several brass beds one in the French Renaissance style and described in Bed Bazaar as with figures foliage and scroll work, all swathed in green silk. The bed was deigned 'one of the best objects of its kind ever brought before our notice' by The Art-Journal. Their 'portable' bedsteads were advertised as ideal for use at home or abroad. They could adapt the bedsteads for use in a camp or for travelling, ideal for Officers in the Army and the Navy. They won the Council Award for a dismantling armchair in brass in recognition of ingenuity and innovation.

The 1862 London International Exhibition: They won a Medal for Excellence of Workmanship in Bedsteads and Ornamental Tubing.

And what of the Man?

Edwards, who knew Robert Walter and often walked with him from his home in Ladywood Lane along the canal to the Brass works, comments that 'he had a high sense of integrity and right' and 'his goods being always honestly made, of good materials well put together' and 'he was a good employer and probably paid higher wages and salaries than any manufacturer' (Edwards 1877:122) and by 1866 had a weekly pay roll of nearly £3,000 at an average of nearly £4 a worker. This shows that he used a very high proportion of skilled men. He was a philanthropist, opening a night school for his workers, as well as being a sponsor for the Birmingham Free Industrial Schools (called Ragged schools). He was a magistrate and also served as a juror, and as a landowner householder and merchant had the right to vote. Roberts describes in more detail all his philanthropic works, civic duties, and his political and religious allegiances (Roberts 2016: 29-34).

The Leicestershire Mercury reports on 16 October 1841 that the Clerks and Work people of the company, in recognition of all that he had achieved, presented Robert Walter with a collection of silver plate, the salver inscribed "…as a token of their high respect and attachment towards him, increased by his enterprising conduct in so largely extending his business and in admiration of his general desire to promote their welfare and happiness…". Robert Walter hearing of this immediately ordered a dinner for all 260 people of his work force, accompanied by fireworks, balloons and a band.

True to his spirit after his death and after the Great Chicago fire in 1871 when many people were made homeless, the Clerks and Work people of R.W.Winfeld and Co raised £25 for the relief fund, 'each man contributing according to his means'.

Later Career

Robert Walter married Lucy Fawkener in 1822 and had one son, John Fawkener Winfield. His death in 1861 struck Robert Walter a heavy blow as he had expected his son to carry on with the business. They worked together as Robert Walter Winfield and Son from 1855 until Johns death in 1861 at the age of 37 from 'Catarrhal' fever (an old term for a respiratory tract disease), no doubt brought on by the nature of the work he was employed in and as described in a Pigot directory 'the noxious effluvia of various metallic trades, and above all the continual smoke arising from the immense quantity of coal consumed'. By this time Robert Walter's health was also failing and in 1864 as Robert Walter Winfield & Co. he went into partnership with his Works Manager, James Atkins, and his wife's cousin, Charles Weston (Roberts 2016: 36). His death certificate in 1869 reports that he died of spinal fever which he had suffered for six years.

After his death Winfield & Co continued to win prizes at international exhibitions. At the Paris Exhibition in 1878 the firm received one bronze medal and three gold medals for a chandelier in wrought and gilded iron. However, they did not have Winfield's drive, his charisma and his close association with his employees and, in 1889, at a stormy annual meeting of shareholders reported by the Birmingham Daily Post, a vote of

no confidence in the accounts was passed. An interim committee which included Percy Gabriel was formed to investigate the affairs of the company (see Epilogue). The firm deteriorated after this, exacerbated by a fire that destroyed stock, tools and patterns, and coupled with a slump in trade. The receivers came in. The core metal rolling business was retained but in 1897 the Cambridge Street Works went into receivership and the various buildings were auctioned off. On the closing of R.W. Winfield and Company, Mr. Dugard and others formed in 1897 Messrs. Winfield's Rolling Mills, keeping the name. In 1900 the rolling mill was taken over by ICI Metals Ltd.

In 1918 the site of the Baskerville Wharf was chosen as the location for a civic complex and work began clearing the site in 1922. By 1936 the site was completely cleared (Ramsey 2008: 1) and part of it became a car park. In 2008 the car park formed part of the Library of Birmingham project, and the opportunity arose to examine the remains of the Winfield works. Birmingham Archaeology of the University of Birmingham carried out the archaeological excavation. The excavation identified remains of the Winfield brass works, platforms for heavy plant and the base of a tower as well as a part of the filled-in canal (Ramsey 2008: 3-5).

Epilogue

Robert Walter had two daughters, Sarah Hannah and Julia Ann. Julia Ann married a clergyman, Charles Busbridge Snepp, and had one daughter, Emily Fawkener Walter Winfield Snepp. Emily married Charles Edward Percy Gabriel in 1888. In 1884 he had founded the firm of Gabriel & Co. Originally a brass founder, by 1950 they had diversified to making stainless steel castings specialising in the manufacture of fittings for tramways, buses and railways and were exporting to Africa, Asia and South America. Gabriel & Co was a family firm until the last CEO Anthony Edward Gabriel died on 3 December 2017. However, the Company had suffered a decline and went into administration and was finally dissolved on 8 August 2014.

Acknowledgements

I would like to thank Steven Campion, Subject Librarian - Business and IP Research Services of the British Library, who patiently answered my enquiries about patents and provided me with copies of the patents.

I would also like to thank the internet! Apart from my PhD and personal library, in this second year of the COVID 19 pandemic and the lockdown of services such as record offices and libraries, I have managed to piece together this study of Robert Walter Winfield from the masses of data that has been inputted by individuals and institutions often accessible for free. I used the trade directories and genealogical databases such as *Ancestry* and *Findmypast* have also played a crucial role.

References

Bacon, L. (2003) *A Technical Study of the alloy compositions of 'brass' wind musical instruments (1651-1867) utilizing non-destructive X-ray fluorescence.* PhD dissertation, University of London.

Edwards, E. (1877) *The Project Gutenberg EBook of Personal Recollections of Birmingham and Birmingham Men,* pp 120-128. Released as an EBook July 13, 2006 [EBook #18821]. USA

Ramsey, E. (2008) *Project No. 1788 New Library Site, Cambridge Street, Birmingham an Archaeological Evaluation.* Birmingham; The University of Birmingham

Roberts, S. (2016) *Joseph Gillott and four other Birmingham Manufacturers 1784-1892.* Birmingham Biographies

Shill, R. (2006) *Workshop of the World Birmingham's Industrial Legacy.* Stroud: The History Press: ebook published 2013.

Forthcoming Events

Conference, date and locations	Description	Website and emails
Accidental and Experimental Archaeometallurgy 2.1 04/06/2021-06/06/2021. Dorset, United Kingdom	To celebrate the 10th anniversary of the hugely successful experimental conference at West Dean in 2010, and the subsequent volume of the same name, the Historical Metallurgy Society would like to invite submissions for both practical metallurgical experiments and oral presentations to be held over a two-and-a-half-day event at the Ancient Technology Centre in Dorset in June 2021.	https://exarc.net/events/accidental-and-experimental-archaeometallurgy-21
Iron in Archaeology, 29/06/2021-2/07/2021. Fribourg, Switzerland	For all things iron in archaeometallurgy, hosted by the CPSA Comité pour la Sidérurgie Ancienne – the Committee for Ancient Ironworking.	
EAA Annual Meeting 2021. 08/09/2021 -11/09/2021. The University of Kiel, Germany.	27th Annual Meeting of the European Association of Archaeologists	https://www.e-a-a.org/eaa2021
3RD Perspective on Balkan Archaeology- PeBA 2021 International Conference. Exact dates TBC (May 2022) Ohrid, Republic of North Macedonia	The theme of this conference is centred on "the mechanism of power in bronze and iron ages in south-eastern Europe"	https://pebasite.wordpress.com/peba-2020/ Email: pebaconference@gmail.com
43rd International Symposium on Archaeometry ISAS2020. 16/05/2022 - 20/05/2022. Lisbon, Portugal	The symposium aims to promote the engagement in the use of scientific techniques to improve the extraction of archaeological and historical information from historical sites.	https://www.isa2020-lisboa.pt Email:isa2020@isa2020-lisboa.pt
World Archaeology Congress WAC-9. 03/07/2022- 08/07/2022. Prague, Czech Republic	The World Archaeological Congress (WAC) seeks to promote interest in the past in all countries, to encourage the development of regionally-based histories and to foster international academic interaction. Its aims are based on the need to make archaeological studies relevant to the wider community.	https://www.wac-9.org Email: wac-9@guarant.cz
8th Balkan Symposium on Archaeometry. Dates TBC (2022). Vinča Institute of Nuclear Sciences, Laboratory of Physics, Belgrade, Serbia.		https://bsa7.uniwa.gr

Virtual Program	**Description**	**Website**
ICANMR 2021: 15. International Conference on Archaeometallurgy and Non-Metallurgical Residues 24/05/2021-25/05/2021 Barcelona, Spain	This conference aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Archaeometallurgy and Non-Metallurgical Residues, as well as practical challenges encountered and solutions adopted.	**https://waset.org/archaeometallurgy-and-non-metallurgical-residues-conference-in-may-2021-in-barcelona**