THE CRUCIBLE

Historical Metallurgy Society News
Issue 108 Winter 2021

Stone from a Roman washing table (©B. Cech) See page 15

Inside The Crucible

The HISTORICAL METALLURGY Society

St Manchan's Shrine (Photo: Kevin O'Dwyer) See page 17

From the Chairman

A new year and a renewed Historical Metallurgy Society

Dear Members,

Although nothing regarding Covid appears to be very predictable, the indications are that 2022 will be a more 'normal' year than the previous two. It is also the year that the Historical Metallurgy Society is taking a major step into the future as heralded in previous editions of ***The Crucible***.

Historical Metallurgy 53.2, which you received a while ago, was the last Journal issue to be sent out in hard-copy only. From now on, each Journal issue will be published online for all to access, read and download freely (Open Access). Members who wish can, of course, still receive printed copies of Historical Metallurgy and/or ***The Crucible*** by post.

In the very near future, the online versions of Historical Metallurgy will appear at https://hmsjournal.org. When the next issue is published online, in early 2022, it will be accompanied by all issues of Historical Metallurgy from Volumes 31 to 53, and older volumes will be added as they are processed.

Not only will Historical Metallurgy be freely available online, we will not be asking for Article Processing Charges from future authors. Publishing with us will remain free of charge (so-called Platinum Open Access). This will allow us to continue publishing papers regardless of an author's status, financial backing or location around the globe. We will continue to provide fully peer-reviewed articles with a high quality of publication, as you have come to expect from our Publications team. Prospective authors will also be able to use our new online submission system, which will allow future Journal issues to be published more efficiently. With all of these changes, the Society is pitching Historical Metallurgy to be the outlet of choice for all those working in the historical and archaeometallurgy.

We can do this as we are a non-commercial, dedicated Society, staffed by volunteers, and with relatively limited overheads. But the overheads are there, nonetheless. That is why we need your support. It is only the funding generated by membership that will permit the perpetuation of our journal in its new form. We ask you not only to remain a member of HMS but also to encourage colleagues, students and other enthusiasts for the history of metals and metallurgy to support us in our work by becoming members. It is only by the community coming together to support this project that it can be maintained as what we hope, will be a significant resource for all those around the world interested in the history of metals. Details of the various ways you can support us can be found on page 3 of this issue of ***The Crucible***.

Alongside opening-up Historical Metallurgy for the benefit of the whole community, we are working hard to create new resources and benefits for our members. Additionally, for more of the initiatives being developed, we will be requesting assistance and contributions from our membership. Further details of these will be announced during the coming year.

In particular, while we have held successful online conferences, meeting each other in person has been sorely missed these last two years. We hope that the easing of the pandemic will continue and permit renewed 'in-person' activities. We therefore invite you to join us both for an excursion to Killarney in Ireland in early May 2022 (more information on this outing on page 17) and for our Accidental and Experimental Archaeometallurgy 2.1 Conference in Dorset a month later (see https://historicalmetallurgy.org/current-events/agm2022/). Please keep an eye on the website and social media for the latest news on these and other events.

HMS Council

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.

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Renewing your HMS subscription online

Some members pay by standing order or make a direct transfer. This is just fine. You don't have to do anything about renewing. However, logging in will allow you to review your details and make choices about your membership plan. You may need to renew your password using the email address you joined HMS with.

The home-page of the HMS website (historicalmetallurgy.org) now features a function that will allow anyone to renew their membership on-line. The new system supports card, standing order, cheque and direct transfer payments. The link to this new function is at the top of the home page, towards the left. (1). New members can also enjoy a (more-or-less) painless experience joining. Existing members are strongly urged not to use the function that allows people to join for the first time. To renew, click on Join/Renew membership. Now log-in. Screenshot 2 shows you where to start renewing your membership. Work is in hand to streamline the renewal and joining processes, so please be aware that some of the details shown in the screenshots may change. The basic structure will not change. Also please be aware that you will not be able to renew your membership before the due date. (We plan to have a facility for early renewal in place soon.) You will, however, be able to review your membership details and see your renewal date. If your subscription has expired, you will see a button labelled "renew".

Existing members will also see that there is a new type of membership. This is called Patron membership. Patron membership is open to those who can afford to make an extra contribution to the costs of expanding the activities of the society, including the transition to platinum-grade Open Access publishing. Patron membership costs from £100 a year. There is an option to increase this amount using a button labelled "make an additional payment here". This button is on your "basket" page (3) and will appear after you have clicked "add to basket". (Please be assured that no-one's membership status will be disclosed unless they agree to that explicitly.)

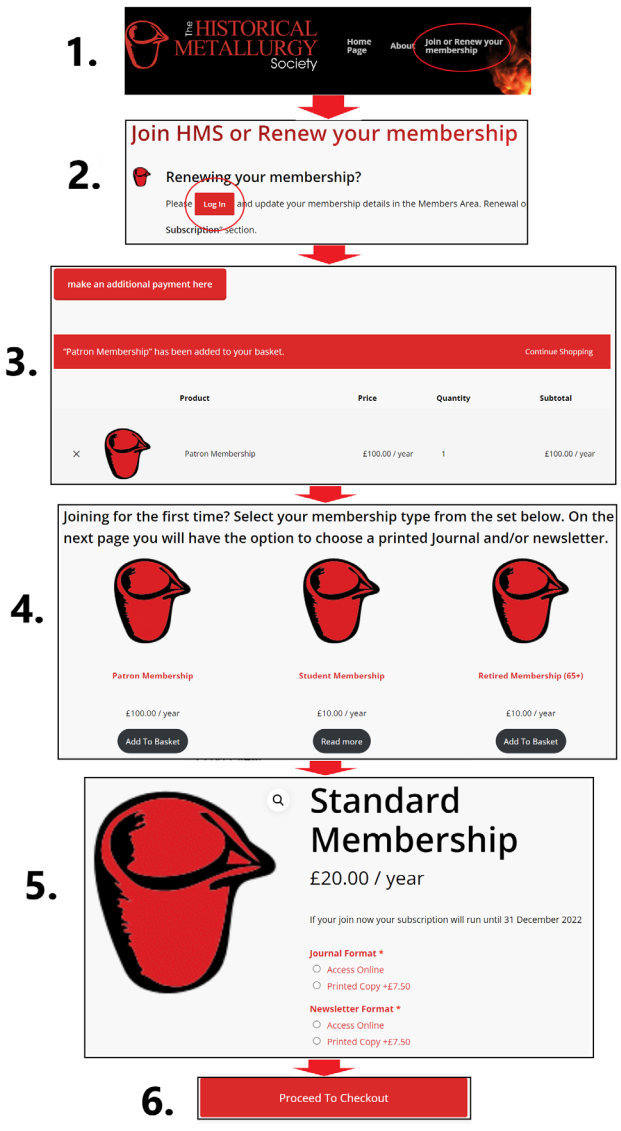
The facility to make an extra payment appears with the other membership types as well. If you want to contribute to the project, but cannot commit to Patron membership, you can specify a lower contribution. (You can set this amount to any value by increments of £5.)

New members should use the selection at the bottom of the "join/renew" page (4). From this point onwards joiners and existing members will have much the same experience. Once you have decided whether you are a student, retired, a library, perhaps a patron or a "standard" member you get a choice about which combination of printed and on-line material you want to receive (5).These choices reflect HMS's move to open access publishing. Members do not have to opt for printed material. Please remember that our working assumption is that other communications will be sent by email.

Once the selection has been made, click 'add to basket', double check that you are choosing the membership plan that you want and 'proceed to checkout' (6). Don't forget to tick the box (under your choice of payment method) agreeing that HMS may store your details. We cannot proceed without your consent to this. At checkout there are fields for your personal details that you will need to check.

Problems logging in? You may have forgotten your username and/or your password. You may never have had either. At the log-in points and on the "renew/join" page you will find password renew points (2). Provided that you can offer the email you provided to the society, you will be automatically emailed with a link to renew. We are aware that some members have never given the society their email address and that there are a few more whose email addresses are no longer current. If you have not got an email address that the website recognises, please email membership@historicalmetallurgy.org asking for new username and password.

If you pay be cheque that's just fine. Send it to HMS c/o Dean Farm Oast House, Rushlake Green, Heathfield, E. Sussex. TN21 9QU



GEORGE VAROUFAKIS

Members will be interested to read about the life of George Varoufakis and his contribution to our discipline, as written by his son Yanis Varoufakis https://www.yanisvaroufakis.eu/2021/09/30/george-varoufakis-1925-2021-english/ *Crucible Editors*

Shortly after midnight, on 29th September 2021, George Varoufakis died. He was born in Cairo, Egypt in June 1925 where he finished his high school studies at the Ambetio School. After graduating, he worked at a branch of a Greek bank in Cairo before coming to Athens in 1946 to enrol in the Department of Chemistry at the University of Athens

Shortly before the outbreak of the second Greek civil war (1946-9), he went to the Dean's Office, representing his students union, to protest against an increase in tuition fees at a time students were facing starvation. On his way out he was arrested by secret police. Refusing to sign the infamous 'declaration of denouncing communism', he was imprisoned in Athens and later exiled to the Makronisos prison camp – a massive, open-air torture chamber. There, on that barren rock, he had the good fortune of surviving alongside poet Giannis Ritsos, actor Manolis Katrakis and author Spyros Linardatos. When Makronisos was shut down, following an international outrage, he was exiled to the island of Ikaria, before finally returning to Athens and the University of Athens, where he met his life partner Eleni Tsaggaraki. Eleni was the first female student in the history of the Department of Chemistry who would later work as a biochemist. She would be active in the feminist movement and would be elected for many years municipal councillor (including a term as the Deputy Mayor) of Palaio Faliro. George and Eleni had two children – Yanis and Trisevgeni.

After the secret police effectively dissuaded potential employers from employing him as a chemical engineer, he managed to land a job in 1954 at Halyvourgiki, the country's first steel mill – which over the next few years he helped expand into a large-scale modern steel factory.

In 1961, he was appointed Director of the Quality Control, a position he cherished, until in 2003 when he was appointed Chairman of the Board of Directors of Halyvourgiki, a position he held until January 2020.

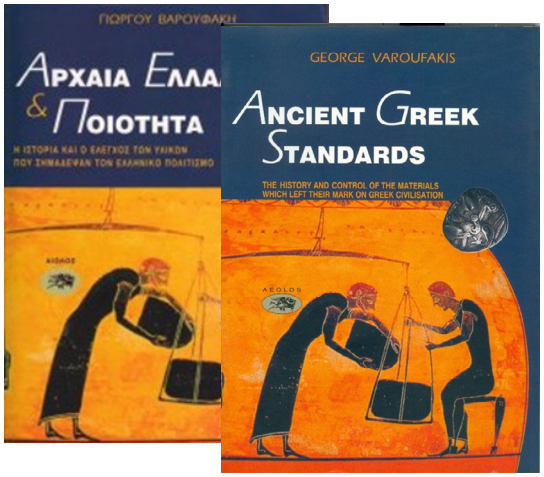
From 1959 until almost his life's end, in parallel with his demanding position at Halyvourgiki, he systematically began to study the erosion of the ancient bronze statues of Kouros and Artemis that are on display at the Archaeological Museum of Piraeus. Those metallurgical and experimental studies developed into a doctoral dissertation which he successfully defended at the University of Athens, where he was awarded him his doctorate in 1965.

From 1965, and with the collaboration of leading archaeologists, he continued to study ancient metal finds and to publish original works in Greece and abroad. Among them were:

- The Mycenaean Metal Finds of Perati – in collaboration with professor and member of the Athens Academy Spyros Iakovidis
- The Steel Spears of the Geometric Era – in collaboration with academician G. Mylonas
- The Study of Inscriptions Around the Quality Control of Metals and the Authenticity of the Silver Attic Coins of the 4th century BC – together with Ronald Stroud
- The Study of the Famous Derveni Crater – in the study of which he collaborated with renowned archaeologist Manolis Andronikos – and which he presented at the British Museum
- 45 Figurines of the Minoan Era of Crete
- Raw Materials for the Casting of Figurines in Kythira

In 1979, George Varoufakis submitted a dissertation entitled "Chemical and Metallurgical Research Around 19 Iron Tripods of the Geometric Era", which resulted in the award of the title of Lecturer, and in 1982, Honorary Associate Professor at the University of Athens.

George Varoufakis (left) with Yanis Varoufakis (right)



His research took another important turn when he focused on the steel rods holding the Parthenon and the Erechtheion together; rods that run through the large marble volumes of the cornice and the base of the temples. That study was published mainly in ***Historical Metallurgy*** Society and changed the way archaeologists appreciated the knowledge and skills of ancient technologists. He then researched the iron links of the temple of the Bank of Aegio and Epicurean Apollo in an attempt to assess the evolution of technology from the archaic to the classical era. It was at that time that scientific societies invited him to present his research works abroad, including in Cyprus, at the British Museum in in London, Prague, Zurich, Sicily and the USA.

During the 1980s, and then again in the 1990s, George Varoufakis also served as President of the Greek Standards & Standardisation Authority (ELOT). During this long tenure, ELOT grew in importance, expanding its activities in Greece's industrial and economic life. When his term ended, he was awarded the title of ELOT's Honorary President.

In parallel with his tenure at ELOT, in 1988, he was elected president of the Hellenic Archaeometric Society (EAE), which focuses on the scientific study of ancient technology. Combining his tenure at ELOT and EAE, he studied the history of quality control in antiquity. In 1996, he published a relevant book entitled *"Ancient Greece and Standards: The History and Control of the Materials Which Left Their Mark on Greek Civilisation"* (Aeolos Publications). The book was also published in English, in 1999. In 2005, he published a sequel, a book entitled *"The History of Iron from Homer to Xenophon: The Iron Findings and the Ancient Greek Literature through the Eye of a Metallurgist"* (Ellinika Grammata).

When asked by a foreign visitor a few years ago to summarise his life, he replied: "I am a boy from Cairo who was destined to fall in love with life, humanity and science in the prison camp of Macronissos."

Yanis Varoufakis

Angela Wallace BA, Msc., MIAI

I graduated from University in Galway (NUIG) with a BA (Hons) in Archaeology & English in 1994. I worked as a volunteer during college and afterwards on research excavations for the Discovery Programme (Dun Aonghusa, Inis Mor), the Royal Irish Academy (Rathlackan Court Tomb, the Ceide Fields and Ross Island Copper Mines, Killarney, Co. Kerry). From 1996 onwards, I have worked on archaeological elements of various road, gas and electricity infrastructure schemes along with private development projects throughout Ireland. This has led to many intriguing discoveries and enjoyable research on a wide variety of topics. I have given talks to local history groups and contributed to local and academic publications. I have also worked on archaeological excavations and research projects in Austria, France and Australia.

In 2005, I completed an MSc in Technology & Analysis of Archaeological Materials, Institute of Archaeology, University College London (UCL). My thesis was focused on metallurgical ceramics linked to Viking Metalworking in Scandinavia. Since then, I have carried out a lot of specialist reports on various aspects of Irish iron working from prehistoric – late medieval times and have published material on this topic for various TII (Transport Infrastructure Ireland archaeological publications).

In 2008, I founded my own Archaeological Consultancy (Atlantic Archaeology www.atlanticarchaeology.ie) in Enniscrone, Co. Sligo, providing advice and support on best practice in archaeology on a wide range of projects for Irish Water, ESB, Local Authorities, windfarms, residential developments etc. I am currently chairperson of the North Mayo West Sligo Heritage Group, a recent member of FAME (Federation of Archaeological Mangers & Employers) and a long-standing member of the Institute of Archaeologists of Ireland. I feel old when I say I am now almost 30 years working in Irish archaeology, I have built relationships with very supportive colleagues who have become dear friends during this time.

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

My career has been quite varied and I have enjoyed lots of adventures on excavations in different parts of Ireland and around the world. I have had the benefit of working within research and rescue excavations, and within local authority and private sector. I enjoy the freedom and variety of being self-employed. It is challenging in terms of job and financial security but no two days are the same from financial planning for projects, negotiations with clients, research, on-site work, report writing, community engagement and communications.

THE CRUCIBLE: What is your most memorable professional moment?

I have had many memorable moments for me personally. Working in the spectacular location at the cliff-edge promontory fort of Dun Aonghusa on Inis Mor back in 1995 was a fantastic introduction to excavation and I was very privileged to work with some very inspiring female field archaeologists: Clare Cotter, Georgina Scally and Helen Kehoe. Discovering a large previously unknown multi-phase landscape in Ratoath, Co. Meath in 2003 and excavating this site over 18 months led to my interest in ferrous and non-ferrous metalwork as there was lots of evidence for it on this incredibly interesting site. During this project, I discovered an MSc in Technology & Analysis of Archaeological Materials in UCL and was extremely lucky to receive a Marie Curie scholarship to study this course. This led me to the fantastic team at UCL under Prof Thilo Rehren.

More recently, I have worked on a 3 year infrastructure project in Ballinasloe, our work and discoveries on this project received local and national media attention. Alsom, myself and my colleague Fiona Maguire have been honoured to be nominated by Galway County Council for an Archaeology Achievement Award. I was also delighted to receive communication in the past year from Anders Soderberg of the Swedish Sigtuna Museum who felt my UCL masters research from 2005 was worthy of publication in next edition of their journal Sigtune Dei, he has been very encouraging and supportive and I am thrilled it is going to print.

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

It's so hard to pin this down, there have been so many wonderful colleagues over the years. I think the most long-standing influential colleague would have to be Clare Ryan, an incredible colleague and friend. She has taught me the value of creativity, resilience and a good sense of humour to survive in this very precarious profession. In terms of archaeometallurgy, I owe a huge debt to Prof Thilo Rehren, Dr John Merkel and all the fantastic team at UCL during my time there in 2005.

THE CRUCIBLE: What is your main current project?

I am currently juggling about five at the moment! Starting with, finishing off artefact submission procedures of finds to museum from our 3-year Ballinasloe project; co-ordinating specialists on other projects; working on two exciting community projects funded by National Monuments Service; proving archaeological field support on forestry and development projects; finalising a short article on the synthesising iron-working evidence from the N5 road scheme in Mayo for a TII publication; and researching potential funding options for further research on Irish early medieval and Viking non-ferrous metallurgical material. Any tips are more than welcomed!

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

I would like to help develop a large-scale research project on evolution of metallurgical technology and crafts in Ireland. Placing it within a wider European and International context by working within a team of experts at home and abroad. I would personally like to do more research and analysis on Irish early medieval and Viking craft. I would also love to support developing creative pathways for community and educational engagement with our rich metallurgical craft heritage.

THE CRUCIBLE: Which publication should every HMS member read?

This is difficult, there are members far more qualified than me to make this recommendation. I was very inspired in my interest of metalworking by Susan Young's British Museum publication, The Work of Angels, also Brian Scott's Early Irish Iron-working and Peter Crew's fantastic corpus of work. I also benefitted immensely from reading Justine Bayley's and Tim Young's many reports and publications. The fantastic guidelines produced by the Historical Metallurgy Society have also been invaluable to me. Next on my reading list is St. Manchans Shrine due to be published in spring 2022, see www.saint-manchans-shrine.com for some fantastic images.

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

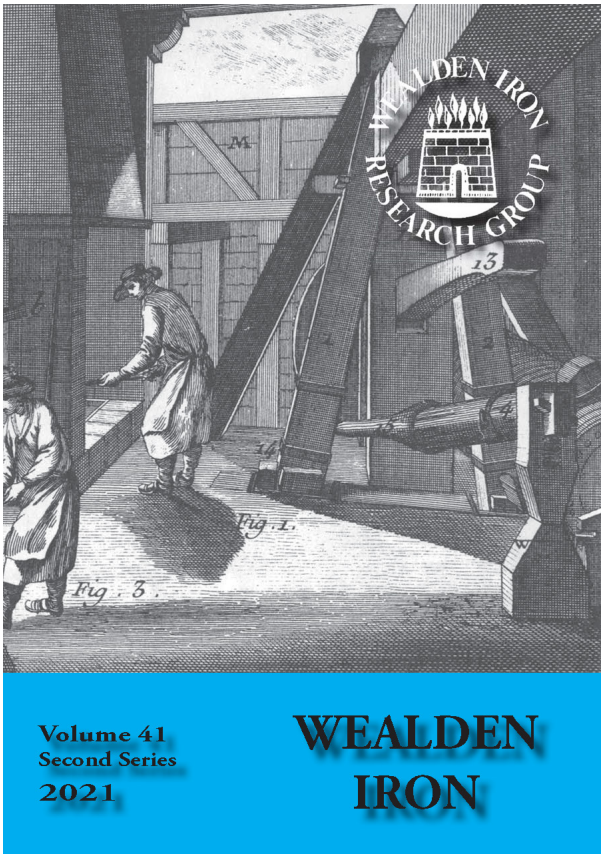
It's a difficult career choice in terms of job security but if you have the interest, creativity and determination to make it work, you will meet many wonderful and interesting people. You will never be bored as there is always so much to discover.

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

I am very grateful for the resources, events and expertise developed by the various committees of the Historical Metallurgy Society, it is invaluable in terms of a support network and sharing of knowledge.

WEALDEN IRON: BULLETIN OF THE WEALDEN IRON RESEARCH GROUP

Summary of Volume 41, 2nd series, 2021



A paucity of contributions has resulted in a slimmer volume this year. Field Notes record the discovery by Archaeology South-East of a bloomery furnace at Sidley on the outskirts of Bexhill in East Sussex. Set into a bank, its remains suggest it was of a domed construction and there was an apparent absence of tap slag. Samples have been obtained for dating, the results of which are expected when a report on the excavation is published in due course. Further to the west, an evaluation by Wessex Archaeology in Crawley, West Sussex, has produced a radiocarbon date from the mid-7th to mid-9th century for charcoal found in association with a small quantity of ironworking slag. The site of this find lies to the east of the centre of the town where abundant evidence has been found of iron production in the 13th to 15th centuries.

Two articles contain more substantial reports on the excavation of bloomery sites. In the earlier of the two, at Hawkhurst in Kent, a dig by Archaeology South-East revealed the plough-damaged remains of a furnace which radiocarbon has dated, at 74.6% probability, to the third century BC. Of interest is the presence of tap slag associated with a furnace of this early date, and the report draws a comparison with the excavation reported in the Bulletin last year of a bloomery near Haywards Heath, in West Sussex, of the same period, where evidence of slag tapping was not found.

The second excavation, by Chris Butler Archaeological Services, is of two bloomery furnaces, side by side, dated by pottery to the Late Iron Age or early Roman period. Located in a part of Brede High Wood in Sedlescombe parish in East Sussex, very little survived of any superstructure on either of them, only sub-circular depressions. However, it is likely that they were contemporary. Slag found in association with them indicated that these were tapped furnaces.

Finally, an article examines the trade in hammers, anvils and hursts (the pivoting collar on the hammer shaft or helve) that were being made at Robertsbridge Furnace in East Sussex in the early-17th century and shipped to Hull for onward transport to Rievaulx Forge in the North Riding of Yorkshire. Both works were owned by Roger Manners, the fifth earl of Rutland, Robertsbridge coming into his hands by marriage to Elizabeth Sidney, whose grandfather had built the furnace. The article goes on to speculate as to why it was found necessary to bring these castings such a long distance when accounts for Rievaulx Furnace have shown that the same items were cast there in the 1590s, and also to note production of them at Robertsbridge for other forges.

Jeremy Hodgkinson, Hon. Editor
www.wealdeniron.org.uk

ARCHAEOMETALURGICAL AND MANUFACTURING PROCEDURES: STUDIES OF TWO ANCIENT COPPER COINS 1851 AND 1853

Fig. 1 The Soho Manufactory

Introduction

The coins presented in this study belong to the Republic of Chile, Independence stage, and their values are One cent (1851) and Half cent (1853). The 1851 coin belongs to a private collector and the 1853 coin was rescued from the archaeological site "Historical Fort May 25 Village" and is currently exhibited in the Narciso Sosa Morales Museum in front of the actual site. Numismatic studies support the observation of the relationship between money and nations. Coins are a material testimony of the identity of a people, of an era and of the monetary policies that have animated the economy. Engravers and craftsmen have shaped in metal many of the most significant characteristics of the history of a nation, as well as its artistic development. The rich iconographic heritage allows us to read the historical symbols of our societies and recognise the identity of young American nations following their Bicentennial celebration. The creation of these new nations required a new image, hence new symbols derived from the local nature such as erupting volcanoes; the Andes Mountain range; the sun; the eagle and the condor; the Andean camelids, are added to more historical or political symbols such as hands swearing on the constitution; the figures of the Republic and Minerva. These latter are representations of freedom and the education of the people through the school, amongst others. In the 18th century, the idea of the nation began to slowly form as a group made up of individuals who associated freely and with the fragmentation of the old Spanish empire in America, the new nations required symbols that would give a homogeneous identity to these new countries. In the country of Chile, through the enactment of the law of January 9, 1851, the Chilean monetary system was transformed, moving from Reales and Escudos to Pesos and Centavos, with the following equivalence 1 Peso = 8 Reales. The aforementioned law, in article 4, states: "There will be two kinds of copper coins, called cents and half a cent of refined copper without mixing any other metal." And the law of March 19, 1851, established that: "The copper coins will bear on the obverse the central star of the shield with the inscription: Republic of Chile and year of issue; and on the reverse, the expression of its value, a bouquet of circular laurel, and the motto: “Economy is wealth”. Throughout the numismatic history of Chile, different versions of the coat of arms have been used on the coins. Initially, when Chile was a Spanish colony, the coats of arms of Spain were used. Later on, when independence came, Chile’s coat of arms showed a shield that depicted the Earth on a pillar. There were more simplified versions of this coat, in which only the central flat star was shown like in the case of the 1851 coin, however, in the case of the 1853 coin, the same shield is represented but with a five-pointed star possessing additional relief. These precise details are observed in Fig. 7.

In order to comply with this law, copper was commissioned from the Carlos Lambert smelter in Coquimbo (Chile). The plates produced were taken to Santiago where they were minted at the Casa de Moneda. The defects in the plates resulted in the coins having high variability in weight, which ranged between 8.388g and 9.400g.

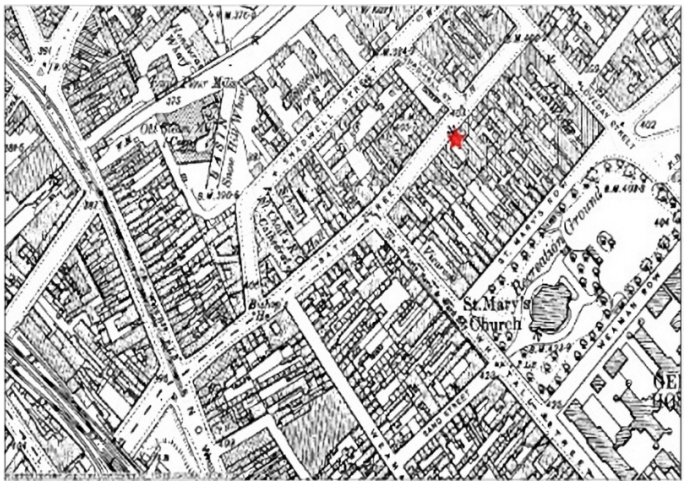


Fig. 2 Map location of Birmingham Mint, 71 Bath Street. ©Landmark Information Group Ltd. and Crown Copyright 2021. FOR EDUCATION USE ONLY.

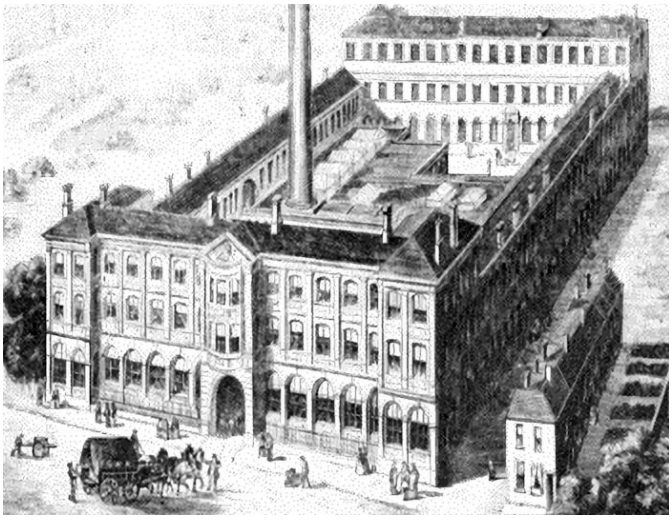


Fig. 3 Exterior view of Messes. Ralph Heaton and Son's Mint, Birmingham.

This added to the technical deficiencies of the mint for the minting of copper coins (it was the first time that such large quantities were produced), and it consequently led to halting the production of these coins in the country, and the production moved abroad. Except for the information presented below, there is no complete information on which variant was minted in which country. These historical coins have been catalogued as KM # 119.4 and KM # 126 and were minted by The Heaton & Sons' Mint, located in Birmingham, England.

Ralph Heaton II

Ralph Heaton II (1794 – October 1862) was the son of Ralph Heaton I, an engineer, inventor and businessman in Slaney Street, and later Shadwell Street in Birmingham. Ralph Heaton II was a die sinker operating in Shadwell Street independently of his father. On 2 December 1817, Ralph I conveyed to his son, land and buildings at 71 Bath Street (Fig. 1 and 2) to enable him to develop a separate company. Ralph II engaged in brass founding, stamping and piercing, examples of his products are brass chandeliers for the newly invented gas lighting and a patented "bats wing" burner.

Birmingham Mint

The Birmingham Mint, a coining mint, originally known as Heaton's Mint or Ralph Heaton & Son's Mint, in Birmingham, England, started producing tokens and coins in 1850 as a private enterprise, separate from, but in co-operation with the Royal Mint. On April 1, 1850, the auction of equipment from the defunct Soho Mint, created by Matthew Boulton around 1788, was announced. At the auction on April 29, Ralph Heaton II bought the four steam screw presses and the six plate presses for making blanks from metal strapping.

This information is very well described in a newspaper of the time, where it is reported that a complete set of presses, pneumatic pumps, and other machinery for minting, were acquired by Ralph Heaton and Son. In this news, it became obvious that Ralph Heaton & Son intended to move their attention to a long-term monopolized manufacturing branch of the Soho company (Heaton Mint 1850). The Ralph Heaton and Son's Manufactures were installed at the 71 Bath Street works (Fig. 2 and 3) and trade tokens were obtained that year for use in Australia. In 1851, coins were minted for Chile. The same year, copper plates were made for the Royal Mint to convert into pennies, halfpennies, farthings, half farthings, and quarter-farthings. In 1852, the Mint won a contract to produce a new series of coins for France. At this time, the Mint was a pioneer in the minting of bronze. In 1853, the Royal Mint was overwhelmed with the production of gold and silver coins. They even re-minted copper coins for Chile. The Birmingham Mint won its first contract to mint finished coins for Great Britain: 500 tons of copper, minted between August 1853 and August 1855, with another contract in 1856. During the peak of operation by their new owners in Birmingham, the four presses of the original Boulton screw and James Watt hit around 110,000 coins a day.

As overseas orders increased, particularly for Chile and India, the Mint added a new pressure lever and more equipment, filling the Bath Street facility. In 1860, the company purchased a 1-acre (0.40 ha) parcel on Icknield Street (the current site, since it was expanded) and built a three-story red brick factory, completed in 1862, where it employed 300 people. At that time, it was the largest private mint in the world. In 1861, a bronze coin contract was signed for the newly unified Italy, and the Mint sent blanks and equipment to Milan for its Milan staff to convert into finished coins.

Fig. 4 Birmingham Mint and its Façade on Icknield Street.

Experimental Cleaning method: Electrolytic Reduction

The coins under study were in good conditions and not only were their metallic cores well preserved, but the original surface was covered only with non-deforming corrosion products that could be easily reduced back to the metallic state via a simple cleaning procedure. It was decided to use electrochemical cleaning through electrolytic reduction (Aldaz et al 1986). This treatment consists in the creation of a galvanic reaction in which the metallic object to be treated acts as the cathode and a galvanized steel sheet (zinc) or an aluminium sheet act as the anode, with 1%M sodium hydroxide as the electrolyte. When the galvanic reaction takes place, the less noble metal (aluminium or zinc) loses electrons in favour of the more noble metal (copper), thus producing a reduction of some corrosion products back to the metallic state. At the same time, the reaction produces hydrogen, which when released forms bubbles that mechanically removed further corrosion products from the metal surface. The results obtained were very satisfactory: the treatment needed just a fraction of time (2 hours) usually required for metal cleaning; the degree of cleanliness achieved allowed the revelation of appreciable details on the copper coin surface. Different results can be obtained depending on the intensity of the applied current which affects the rate of reduction of the

Fig. 5 The before (5 a. and 5 b.) and after (5 c. and 5 d.) of the 1853 historical copper coin to electrolytic cleaning and macroscopic images.

Fig. 6 Inverse and reverse of 1851 historical copper coin after the electrolytic cleaning.

Table 1. 1853 Coin characteristics by Krause catalogue

Material	Copper
Weight	4.6-5.0 grams
KM#	126
Diameter	22mm
Edge	Smooth
Year	1853
Print	2.667.000
Coined	Heaton Mint, Birmingham, England

Table 2 1851 Coin characteristics by Krause catalogue

Material	Copper
Weight	10 grams
KM#	119
Diameter	30mm
Edge	Smooth
Year	1851
Print	no found data
Coined	Heaton Mint, Birmingham, England

Fig 7. Half a Cent Coin 1853 by Krause catalogue.

Fig. 8 One Cent Coin 1851 from Classical Numismatic Group.

corrosion products to the metallic state and mechanical cleaning by the action of bubbles of hydrogen on the surface. But in general, it is advisable not to work with very high currents, due to the complexity of the chemical reactions that could occur and affect the cleaning process sought (Birchenall 1977).

Figs. 5 a. and 5 b. show the state in which the 1853 copper coin was received and Figure 5c and 5d show the coin after cleaning. Figure 6 show the 1851 coin after cleaning. The clean and polished coins (Figs. 5c and 5d and 6) clearly show their origin, year of issue, monetary value, legend and two laurels.The material is primarily Copper (Cu), with alloying elements that do not play a major role in the chemical composition of this historical element.

Due to the calamine (green) patina formed on its surface, which behaves as a protective barrier over time and corrosion, the coins have maintained an almost perfect state of preservation. Coin minted in 1853, Republic of Chile, five-pointed star in relief, Value: Half a Cent, Legend: Economy is Wealth.

These coins (1851 and 1853), are mainly identified by:

Inverse: REPUBLICA DE CHILE, Star of five points and year of minting 1853 between two points. Numbers 1 of the date with straight top.

Reverse: ECONOMY IS WEALTH. Denomination in words surrounded by laurels. Four-pointed star on bottom. Letter 'Q' for "RIQUEZA" with short outer tilde for the 1853 coin. And for the 1851 coin the letter 'Q' with the

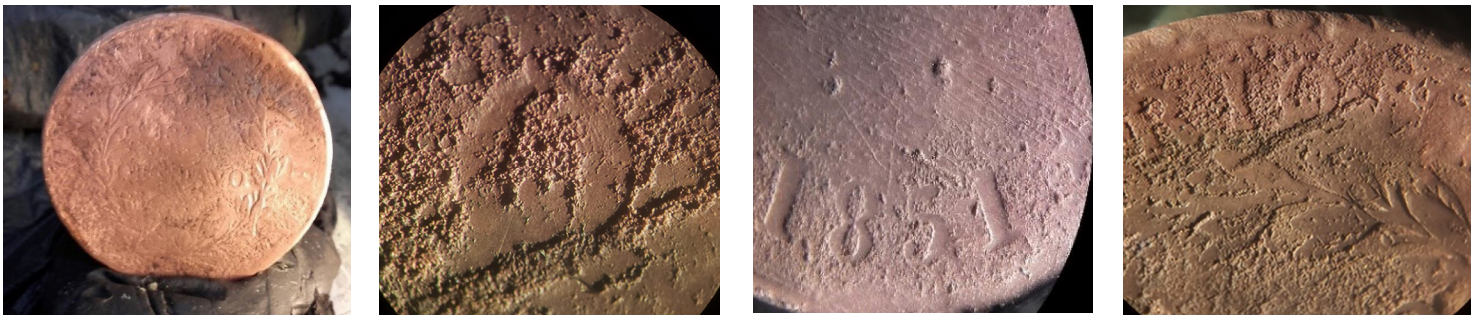


Fig 9. Historical coin macroscopy 1851; Value: One Cent.

Fig 10. Three images of the 1 Cent coins (1851) typified as (KM # 119.2; KM # 119.3 and KM # 119.4) on their back for the morphological comparison of the letter Q.

Table 3. Characteristics of the 1851 coins compared

Date	Mintage	Frequency	Characteristics
1851	100000	38%	**KM#119.1** (Pointed top-1 Single loop in wreath's knot; leg of "Q" like ~) Santiago Mint; rare
1851		42%	**KM#119.3** (no mintmark on left star; double loop on wreath's knot; short leg below "Q") Heaton Mint
1851		9%	**KM#119.4** (no mintmark in left star; flat star; leg traversing "Q") Heaton Mint; rare
1851 H	3300000	36%	**KM#119.2** (mintmark in left star; flat 5-pointed star; double loop on wreath's knot) Heaton Mint

Chemical analyses

Table 4 1853 Coin Chemistry Composition

% Zn	% Ni	% Fe	% Mn	% Cu	% Pb	% Si	% As	% Bi
<0.076	0.099	<0.090	<0.015	96.2	<0.10	<0.26	0.091	0.11

Table 5 1851 Coin Chemistry Composition

% Zn	% Ni	% Fe	% Mn	% Cu	% Pb	% Si	% As	% Bi
<0.063	0.069	0.062	<0.016	80.0	<0,066	0.48	0.10	0.079

Comparison of chemical compositions with other coins also minted in England in the same period.

Table 6 Coin: HMS Investigator, Country: Great Britain, Analysis: R4887/Mean

Date	Fe	Co	Ni	Cu	Zn	As	Sb	Sn	Ag	Bi	Pb	Au	S
1848	0.01	0.01	0.05	99.29	0.01	0.32	0.03	0.00	0.07	0.10	0.04	0.03	0.00

Table 7 Coin: Caduceus (bolt), Country Great Britain, Analysis: R3915/Mean

Date	Fe	Co	Ni	Cu	Zn	As	Sb	Sn	Ag	Bi	Pb	Au	S
1857	0.00	0.00	0.10	99.48	0.01	0.17	0.02	0.00	0.05	0.02	0.09	0.03	0.01

Table 8 Coin: Islay locomotive (steam pipe), Country: Great Britain, Analysis: NRM4

Date	Fe	Co	Ni	Cu	Zn	As	Sb	Sn	Ag	Bi	Pb	Au	S
1857	0.00	0.00	0.04	99.48	0.00	0.17	0.01	0.01	0.07	0.05	0.12	0.03	0.00

Table 9 Coin: Islay locomotive (steam pipe), Country: Great Britain, Analysis: LCul

Date	Fe	Co	Ni	Cu	Zn	As	Sb	Sn	Ag	Bi	Pb	Au	S
1857	0.00	0.01	0.04	98.77	0.01	0.32	0.03	0.01	0.02	0.09	0.63	0.01	0.03

Mechanical Testing

Table 10 1853 Coin, Vickers Microhardness

1º	146 HV	138.7 HBr
2º	132 HV	125.4 HBr
3º	121 HV	115.0 HBr
AVERAGE	133 HV	126.36 HBr

Table 11 1851 Coin, Vickers Microhardness

1º	137 HV	130.15 HBr
2º	109 HV	103.55 HBr
3º	101 HV	95.95 HBr
AVERAGE	116 HV	109.88 HBr

Macroscopic Observations of the 1851 Historical Copper coin.

For the Chilean 1 Cent copper coin of 1851 (Figs. 9 and 10) there are variants regarding the shape of the letter Q in the word WEALTH (RIQUEZA in Spanish). The first type (KM # 119.2 and KM # 119.3) has the Q leg only outside the letter (common) and in the second type (KM # 119.4) the Q leg crosses the letter (rare).

There is another variant, even rarer, with the Q leg ~ like to the letter Ñ (from the Spanish Alphabet).

In this case, the 1 Cent copper coin from 1851, the letter Q for the word WEALTH, it is seen that the Q leg crosses towards the inside of the letter Q [4], (Table 3).

The investigation of the coin's microstructure was performed after etching. For etching, alcoholic solution of 2% ferric chloride (FeCl3) was used.

The 1853 coin shows a grain structure typical of hot-working and consequent annealing with some visible twin grains, variable grain size, and some porosity seen as dark holes due to corrosion (Fig. 11). There is no evidence of second phases precipitation. Some intragranular fractures have also occurred due to copper corrosion.

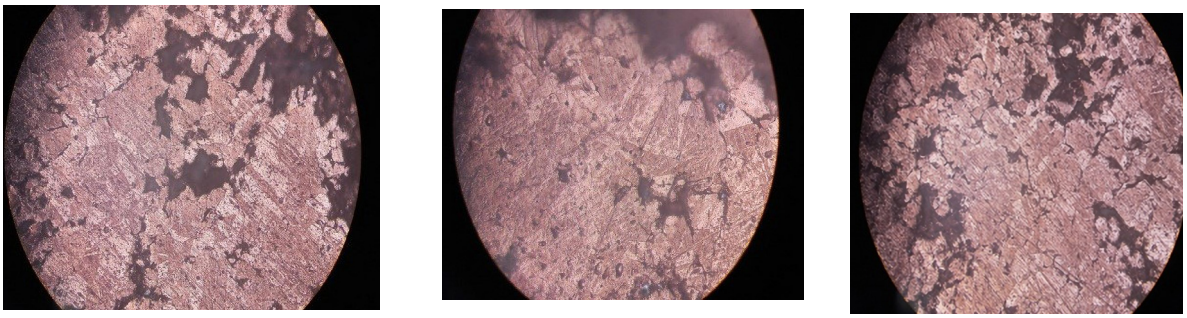


Fig. 11 Micrograph of the 1853 historical copper coin. Detail corrosion by pitting. Reagent: Alcoholic solution of 2% ferric chloride (FeCl3). Magnification: 100X

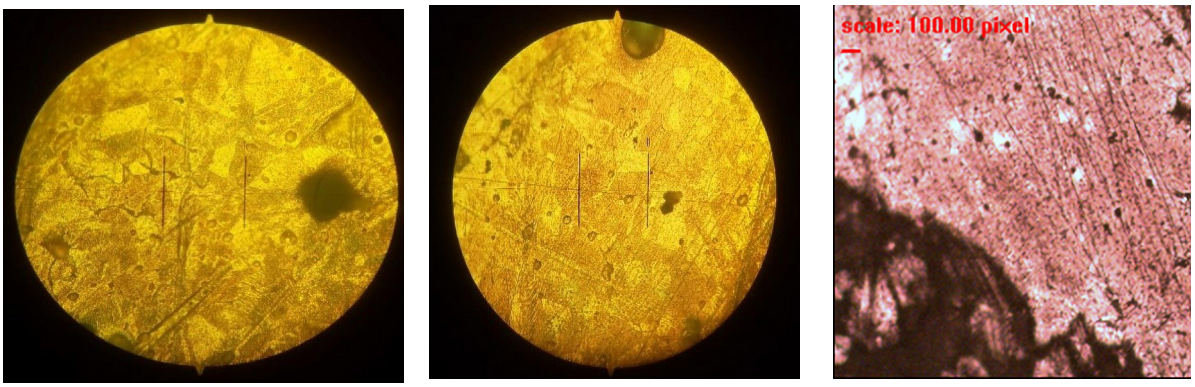


Fig. 12 Micrograph of the 1851 historical copper coin. Corrosion at the grain edge and detail of slight porosity. Reagent: Alcoholic solution of 2% ferric chloride (FeCl3). Magnification: 400X (a, b) and 100X (c).

The 1851 coin shows a structure with a well-formed recrystallized grain matrix, having straight twin lines and very little porosity present (Fig. 12). There is no evidence of a secondary phases. The X-ray fluorescence analysis for both coins confirms that only minor, trace-type alloy components are involved with Copper (Cu) being the majority component. The chemical data and the metallographic evidence both indicate that the alloy is of a single phase in line with the historical decree of January 9, 1851, when the Chilean monetary system was transformed from Reales and Escudos to Pesos and Cents, and this decree of law said: "There will be two kinds of copper coins, called cents and half a cent of refined copper without mixing any other metal."

According to the manufacturing method used at that time, a rail was prepared where the molten metal was poured, which was obtained from a coal furnace first and later with the passage of time, it was operated with gasoline, so the metal contained in the crucibles was melted and then it was moulded to obtain solid ingots, (Fig. 13).

Ingots that did not have the adequate thickness to obtain the blanks, needed to pass several times through the rolling mills, (two rollers that pressed the metal strip) to be stretched until it obtained the required thickness. When the rail hardened, it was necessary to anneal it to re-laminate it (Figs. 14 and 15). If the rail was too long, it would be cut into smaller pieces.

Once a thickness equal to the blanks was achieved, the rails were annealed to make it more workable. Since oxidation could be generated during annealing, the rails were put in the furnaces in sealed boxes to limit this effect.

In 1786/1788, the first automatic machinery appeared to drill the rail and obtain the blanks (Fig. 16). These machines were manually fed, and the operator had to move the metal strip forward following the rhythm of the machine. The freshly cut blanks then went through the press that created a pre-listel, which, amongst other things, favoured the minting of the listel into a coin avoiding wear. The press was formed by a conduit through which the flange passed and while the coin was pressed along its edge, the flange raised it creating the pre-listel and eliminating the burrs left by the cut of the coin. Afterwards the coin was annealed to soften it, eliminating internal tensions to facilitate its coinage. Rotary annealing furnaces for blanks appeared in the early twentieth century as seen in Fig. 17.The annealing of the blanks was followed by washing. Since rust forms on the blanks during the annealing, a cleaning procedure is required: first, a chemical solution and then a bath of soap and water resulted in a final shiny surface. The drying procedure used hot sawdust which eventually evolved into drying machines in later years (Muñiz García n.d.).

Fig. 13 The molten metal was poured into the rail, with moulds in the shape of ingots

Fig. 14 Rail laminators

Conclusion

The idea of a nation/territory meant the adoption of ones own emblems and symbols, this meant that new nations like Chile resorted to republican allegories: stars, tree of freedom, among others, which allowed the substitution of sovereign imagery by symbols that appealed to a new political order, thus becoming an effective vehicle for the visual construction of the nascent American republics. Not only were symbols required to identify themselves as a nation by referring to their former ruler. The symbols used were in line with the independence ideas, with clear inspiration from the French Revolution and the independence of the United States of America; for that reason, the inscriptions of freedom, union, force, and independence, represented the new order.

The result of the electrolytical cleaning using sodium hydroxide is highly recommended or suitable for cleaning pure copper coins, however the literature shows that for copper alloys and silver alloys, this method is not recommended. In this case, as the coins are virtually made of pure copper, all the products of corrosion (greenish layer of malachite) were separated in a time of around 60 minutes. After that, the entire surface could be seen in detail. In addition, the good state of preservation of these ancient coins was verified. Data from catalogues of coin collectors and numismatists were also used to verify the legitimacy of the currencies, numerical data of minting and the company in charge of manufacture were obtained. It was even verified that there are several models of coins of the same value. In this case, the half cent from 1853 can vary in the shape of the laurel loop that can be single or double ones, while other models of the one cent from 1851 differ in the form of the 'Q' of the word RIQUEZA (Wealth) in the Spanish language.

Patricia Silvana Carrizo and Peter Northover

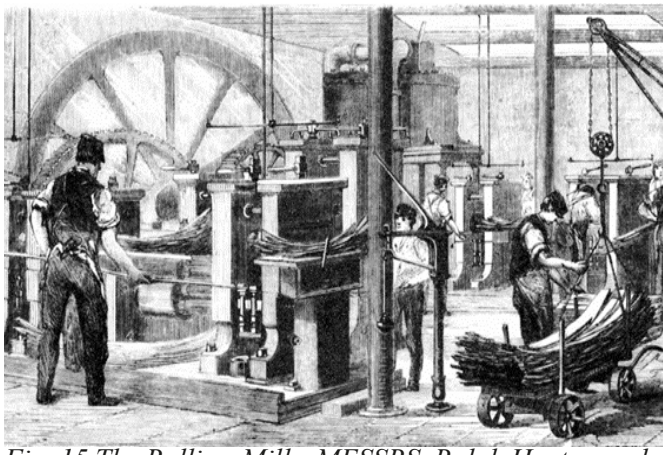


Fig. 15 The Rolling-Mills, MESSRS, Ralph Heaton and Sons' Mint. Image ©The British Library Board, All Rights Reserved.

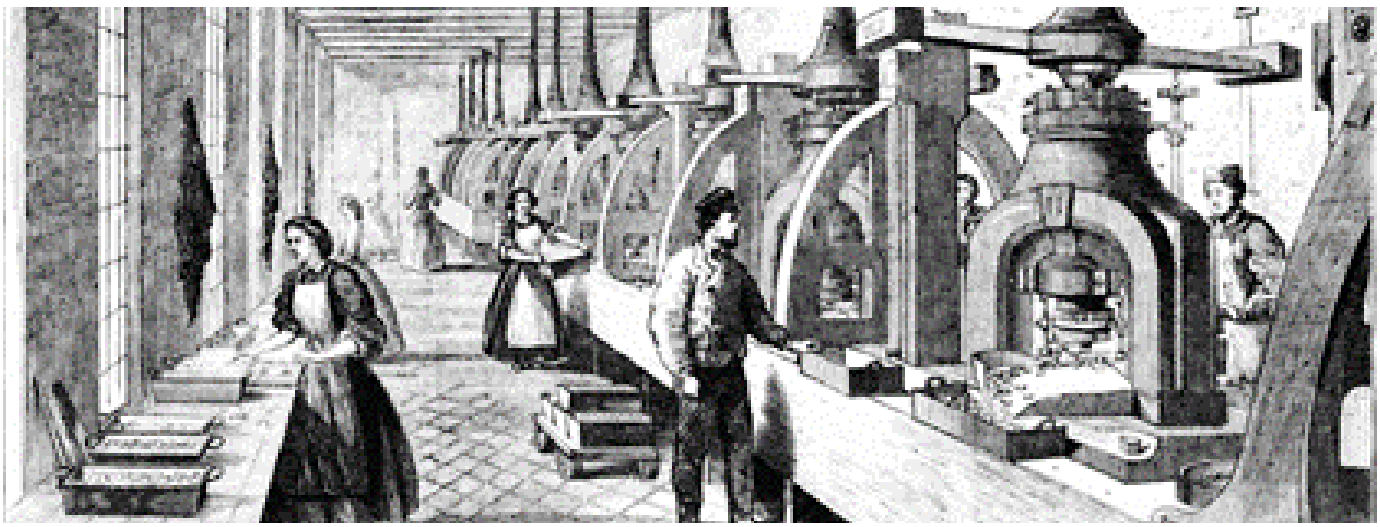


Fig. 16 The Coining - Presses, MESSRS, Ralph Heaton and Sons' Mint. Image ©The British Library Board, All Rights Reserved.

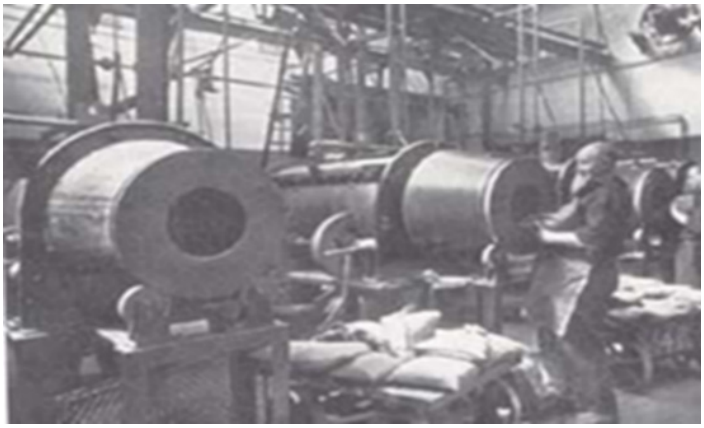


Fig. 17 Rotary annealing furnaces for blanks

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Images used for comparison: First type: courtesy of Classical Numismatic Group St. James 'Auctions Ltd. and Second type: courtesy of Heritage Auctions (www.ha.com)

Muñiz García, B. (n.d.). Manufacture of the currency through the times, version October 2005-2008.

FRAGMENTS OF STONE WASHING TABLES FROM ROMAN GOLD MINE IN CARINTHIA, AUSTRIA

The valley of the river Lavant (Lavanttal) in Carinthia is well known for its medieval and early modern gold-mining that is well documented in the contemporary written sources (Pichler 2003 and 2020). The remains from the mining of primary and secondary gold deposits are collapsed adits and shafts as well as pits. The only evidence of Roman settlements in the area are tombstones and spolia found near Bad St. Leonhard (Dolenz and Egger 1971, Piccottini 1973). There is also evidence of a Roman road in the valley of the river Lavant.

The Roman gold mine lies in a wooded area about 3 km to the northwest of Bad St. Leonhard (Roman province of Noricum). This is the only mine not mentioned in any of the medieval sources, which suggests that it dates to an earlier period. It is bisected by a modern road. The southern part (Area 1 on Fig. 1), where the actual mining took place, covers an area of about 0.18 km2 and the northern part (Area 2 on Fig. 1), an area of about 40,000 m2.

The deposit that the Romans mined is an alluvial cone consisting mainly of schist, pegmatite and quartz rock fragments (Pichler 2020, 253). The LIDAR scan shows features typical for Roman hydraulic mining (Fig. 1). The parallel channels are up to 8 m deep (Fig. 2). Large stones have been heaped onto the ridges between the channels. Water for ground-sluicing was supplied by the Mischlingbach, a brook to the north of the mine. No traces of the leat have survived. The reason for this could be agricultural activity or the fact that the leat consisted of a wooden channel supported by posts. Similar features are

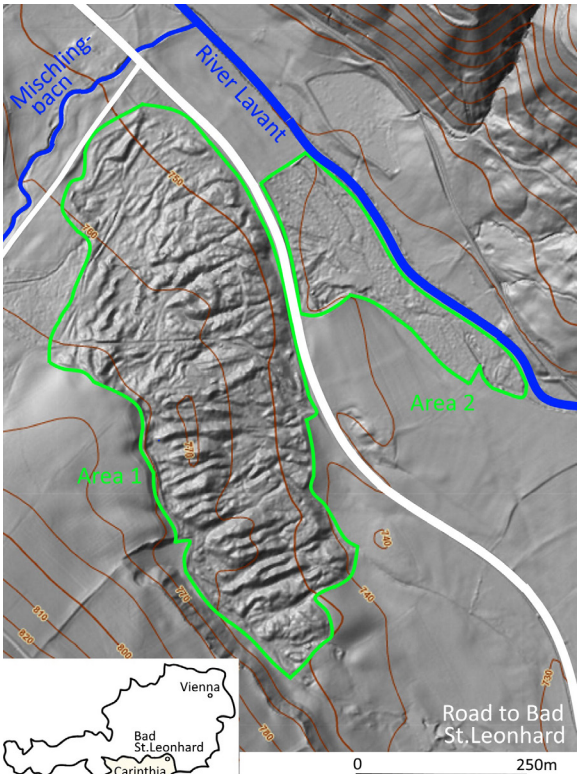

Fig. 1 LIDAR scan of the Roman gold mine near Bad St. Leonhard (LIDAR scan: Land Kärnten, mapping: B. Cech).

known from the Roman gold mine in the Karth, a landscape about 70 km to the south of Vienna. The latter mine is currently being researched in detail by the author and an interdisciplinary team of scientists (www.karthgold.com).

Fig. 2 Remains of hydraulic mining near Bad St.Leonhard (©B. Cech).

Fig. 3 Heavily eroded side of a stone from a Roman washing table at the gold-mine near Bad St. Leonhard, scale: 40 cm (©B. Cech).

Area 2 was the place where the heavy mineral concentrate (black sand) collected in Area 1 was washed for gold. Only a small part of Area 2 is preserved in its original state. Most of it was later converted into farmland. Several fragments of unusual stones made from compact gneiss boulders in the river Lavant were found in this area. They are characterised by numerous parallel grooves running transverse to a wider and deeper groove along the whole length of the stone. The image on the cover of ***The Crucible*** and figures 3 to 4 show the largest and best preserved of these fragments.

One stone shows these features on opposite sides (fig. 3 and 4). When the grooves on one side were ground down, the stone was turned over and new grooves were cut. Well defined edges and corners show that they had been inserted into a wooden construction to set them at the right gradient for the separation of gold from heavy minerals by washing. The only interpretation that comes to mind for these stones is that they were used as washing tables.

Water with black sand ran along the central groove and the heavier gold particles were deposited in the transverse grooves. So far, no parallels to these stones have been found in publications on Roman gold mining. If anybody knows of similar finds, please contact the author: b.cech@gmx.at

Brigitte Cech

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Fig. 4 The opposite side of the stone shown on fig. 3, scale: 40 cm (©B. Cech).

Historical Metallurgy Society excursion to Killarney, Co. Kerry, Ireland (6 to 8 May 2022)

Newly discovered copper smelting site along Lough Leane

Killarney in Co. Kerry is not only located in one of the most scenic areas of Ireland, it also has a varied metal producing history. Famous, are the Bronze age copper mines at Ross Island excavated by Prof. W. O'Brien. The same ore bodies were worked again in the Early Medieval period and in the 18th and 19th centuries. Less well-known are 18th century blast furnaces for smelting iron ore, two in the immediate area and more further afield.

The 3-day HMS excursion to Ireland aims to combine visits to these known and some newly discovered sites with talks on local metal production and aspects of prehistoric and medieval metal manufacturing processes. And especially, to meeting each other once again in a beautiful setting with potent Irish after-dinner entertainment.

Detail of St Manchan's Shrine (Photo: Kevin O'Dwyer)

Programme

Thursday 5 May

Arrive and check-in

Friday 6 May

Visit to the westerly Lough Leane copper mines

- newly discovered copper smelting sites along the lake shore
- 18th century copper mines and an unresolved structure.

This involves rather strenuous and extended walking (some might prefer to arrive on Friday and participate in the Saturday and Sunday activities only).

Saturday 7 May

Morning/early afternoon: bus tour to the Blackstones early 18th century blast furnace through Killarney National Park and other scenic areas.

Afternoon (4-6pm): lectures on early Irish metal production. Confirmed speakers:

- Dr. Brendan O'Neill (University College Dublin): Moynagh Lough Crannog and Making: detailing early medieval non-ferrous metalworking
- Dr. Griffin Murray (University College Cork): St Manchan's shrine: the manufacturing techniques of an early 12th century Irish reliquary
- Dr. Paul Rondelez (Independent researcher): The blast furnace iron industry in Co. Kerry (17th and 18th centuries)

Sunday 8 May

Morning tour around Killarney with traditional horse-drawn jaunting cars/minibus to:

- Easterly Lough Leane copper mines: Bronze Age, Early Medieval and 18th/19th century copper mines at Ross Island (includes an easy 45 minute walk)
- Muckross: mid-18th century blast furnace

Back home in the afternoon

Technical ceramic from Moynagh Lough Crannog (Photo: Brendan O'Neill)

	Room type	3 nights (Thu – Sat)		2 nights (Fri – Sat)	
		Euro	Pounds	Euro	Pounds
Hotel	Double/Twin room	€ 365	£ 310	€ 280	£ 240
	Single Occupancy	€ 550	£ 465	€ 420	£ 355
Hostel	Twin	€ 240	£ 205	€ 180	£ 155
	Dormitory	€ 210	£ 180	€ 160	£ 135

Accommodation

There are two accommodation options for which we have reduced rates, both are close to each other and the train and bus stations:

- Scott's Hotel Killarney
- Killarney Railway Hostel

Get there and away

Cork is the obvious airport to fly into to get to Killarney, but with longer travelling times, Dublin and Shannon can be used as well. From Cork Airport, a short bus ride needs to be taken into town to the main bus station where there are regular bus services to Killarney (c. 1h:45mins).

Costs per person

Included: accommodation, breakfast (light in hostel), mid-day lunch, transport in and around Killarney, talks.

Not included: transport to and from Killarney, evening meals, drinks.

These prices are for HMS members and their family/partners, non-members should add the cost of the annual basic Membership to the above.

Bookings and additional information

Bookings can be done at https://historicalmetallurgy.org/current-events/killarney. Bookings will be taken until the middle of March 2022.

If you have any questions, please contact Paul (prondelez@yahoo.com).

Published by Archetype Publications Ltd in association with the Arms and Armour Society of Great Britain.

This was prepared as a Festschrift for David Edge, who recently retired as head of Conservation at the Wallace Collection. The Wallace Collection is a national museum in central London which, inter alia, contains the largest collection of princely armour in London, and one of the finest collections of oriental armour outside the subcontinent.

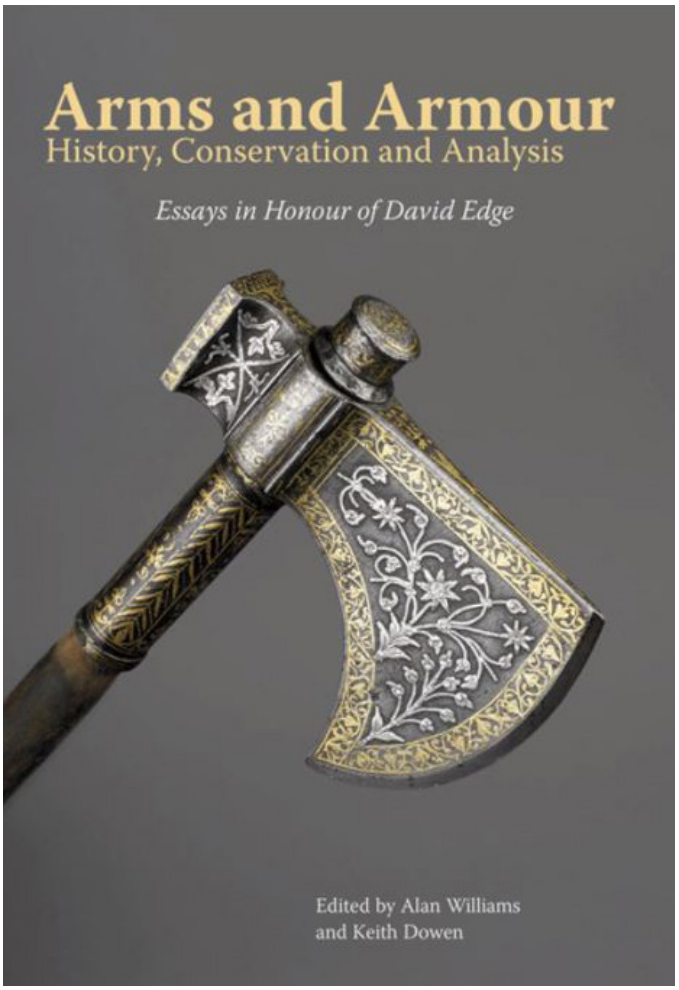
As well as essays on the history, conservation, and display of armour, there are seven articles which should be of particular interest to readers of ***The Crucible***, because they deal with the analysis of arms and armour.

Metallography is the technique employed in the study of an armour of King Henry VIII presently in New York, the large number of fakes discussed by Brian Gilmour, and the threaded screws used by the 18th century manufacturers of both furniture and flintlocks.

Neutron diffraction techniques have been applied to the Helmet of the Black Prince, now hanging over his tomb in Canterbury Cathedral, the dagger of Shah Jahan - the builder of the Taj Mahal, and al- Biruni's method for simulating wootz, together with numerous contemporary comparative examples.

Finally, Viking sword enthusiasts will find the CT scans of fifty sword hilts an invaluable reference.

Alan Williams



ISBN 9781909492820
Binding Paperback Dimensions 170 x 240mm
Pages 256 fully illustrated in colour throughout
Published September 2021 Price £49.50

Research in Progress Meeting 2021

On Saturday 13th November, Moesgaard Museum hosted The Historical Metallurgy Society's annual Research in Progress Meeting. The virtual online event took place on Zoom, starting at 09:30 UK time, with 17 presentations delivered (1 poster, 16 oral), closing at 17:30. The first morning session heard three talks on lead, the first on the circulation and provenance of Qi State Bronzes in Northeast Asia (Chen Wang), the second on Mycenae lead vessel rims (Stephanie Aulsebrook) and the third on recent archaeometallurgical investigations into the construction lead (and iron) from Notre-Dame de Paris after the fire (Maxine L'Héritier et al.). The poster presentation by Tim Greifelt (with Sabine Klein and David Wigg-Wolf) on the composition and provenance of Roman denarii provided new insights into patterns of debasement related to historical events and change in leaders during the Republic and Imperial Era. The second morning session, leading up to the lunch break, held talks focusing on iron; such as the history of Ironworks at Bradley (Peter King), a medieval iron production centre at Roffey (Jack Cranfield), archaeometric dating of smithing slag (Patrice de Rijk), and investigations into peat as an alternative fuel for smithing and smelting during the Scottish Iron Age (Paul M Jack).

The first afternoon session kicked off with a much-anticipated talk on the new Global Lead Isotope Database (GlobaLID) lead by the Sabine Klein and the Bochum group, presented by Gary (Yiu-Kang Hsu). He displayed the interactive and user-friendly components of the database through the use of the 'Shiny' app, promoting 'fair' principles and making this the start of a truly open, accessible and usable lead isotope database. All are encouraged to participate and upload their data. Omid Oudbashi (with Mathias Mehofer) presented new and extensive work on tin bronze metallurgy of Iran 3000-1500 BCE, followed by a second talk on experimental bronze casting of Bronze Age palstaves in soapstone and clay moulds to investigate serial production and variation using geometric morphometrics (Bart Cornelis et al.). Ivan Stepanov et al. presented recent work on ancient iron and copper production remains from the middle Trans-Urals in Russie (Irtyash Lake), followed by the last paper in the session by Don Wagner on graphite morphology and experiments to recreate ancient Chines malleable cast iron. Don encourages anyone who wishes to pursue his work further to contact him. The final afternoon session started with a talk by Braden Cordivari on copper production in the Niari Basin during the 15th-17th centuries CE in the Niari Basin (Republic of the Congo), for which HMS council awarded him the HMS student prize. A very informative and well-illustrated talk on iron-phosphorus prills in wootz crucibles from Telangana, India (Meghna Desai et al.) harked back to Iranian metalworkers, warmly picking up on Omid's earlier presentation. Amin (Mohammadamin Emami) with Christopher Thornton, presented new insights into copper-arsenic metallurgy from the 'Sheik-Ali' copper mine in Iran, followed by a final talk presented by the conference organiser Thomas Birch (et al.) on chemical and isotopic investigations of the Damhus Hoard – a hoard of 262 early Viking silver coins.

The conference went smoothly and kept to time, and despite the online format, the sheer plenitude of questions and engaging discussions stopped it simply being a screen-watching exercise. Most agreed that the format worked for such a meeting as it promoted the possibility for international attendance, as reflected in the wide range of countries represented in the presentations given by a variety of institutions. The rolling present attendance hovered around 60 participants on zoom with individuals coming and going, though 120 registered, leaving this to be the total number of attendees.

Thomas Birch

Conference, date & locations	Description	Website, emails and prices
The historical metallurgy of Killarney 06/05-08/05/2022 Kerry, Ireland	A 3-day HMS excursion to Ireland aiming to combine visits to these known and some newly discovered sites with talks on local metal production and aspects of prehistoric and medieval metal manufacturing processes. And especially, to meeting each other once again in a beautiful setting with potent Irish after-dinner entertainment.	https://historicalmetallurgy.org/current-events/killarney/ Email: prondelez@yahoo.com
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
Accidental and Experimental Archaeometallurgy 2.1 Conference. 03/06 - 05/06/2022 Ancient Technology Centre, Cranborne	Celebrating the 10th anniversary of the 2010 successful experiment conference at West Dean, the historical metallurgy society is hosting both practical experiments and oral presentation over two days.	https://historicalmetallurgy.org/current-events/agm2022/
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
9th International Conference on Mining, Material, and Metallurgical Engineering (MMME'22). 31/07/2022- 02/08/2022	The goal of this mining, material and metallurgical engineering conference 2021 is to gather scholars from all over the world to present advances in the relevant fields and to foster an environment conducive to exchanging ideas and information.	https://mmmeconference.com/ Email: info@mmmeconference.com
8th Balkan Symposium on Archaeometry Dates TBC (2022) Vinča Institute of Nuclear Sciences, Laboratory of Physics, Belgrade, Serbia.		

Virtual Content

Program	Description	Website
ICAPSP 2022: International Conference on Archaeometallurgy Processes, Standards and Practice 15/02-16/02/ 2022 in 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 Processes, Standards and Practice	https://waset.org/archaeometallurgy-processes-standards-and-practice-conference-in-february-2022-in-barcelona