

THE CRUCIBLE

Historical Metallurgy Society News

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Lapphyttan Medieval Blast Furnace

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*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.*

The Crucible

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The **HISTORICAL
METALLURGY**
Society

SOME OBSERVATIONS ON THE TECHNIQUE OF LUTED CRUCIBLE METAL CASTING

Luted crucible casting is a lost wax metal casting process in which the crucible is joined to the mould. Unlike many pre-Industrial Age processes this method is still in use today in parts of India and West Africa. The following is based on my work with the technique as I learned it from the Gharuas of Bastar, Chhattisgarh, India and is intended to add to the overall knowledge of the process from a practitioner's point of view. After a short description of the process, I will highlight a few points that I find particularly interesting.

Briefly, a clay mould is created around a wax object and joined to a clay cup containing metal. The resulting mould/crucible object is placed in a fire and heated until the metal is molten at which point the mould/crucible is taken out of the fire and inverted allowing the molten metal to pour into the mould.

There has been no concerted effort to give the technique a specific name. It has variously been described as “the cire perdue method” (Reeves, 1962), and “the lost-wax technique” (Postel, 1999) both of which lack specificity. The “Bastar technique” (Mukherjee, 1966) and “Ashanti Casting” (Sias, 2005) suggest a geographical limitation that does not exist. Others simply use a description such as “enclosed mould and crucible” (Hurst, 1996).

While the term “luted crucible” is found in numerous documents from the 19th century it is not used to describe this particular technique until it is used by Katherine Hacker in her article “Traveling Objects: Brass Images, Artisans, and Audiences”. She states: “images created by the lost-wax technique are typically fired while a separate crucible of metal is heated in an adjacent kiln. In contrast, the images under study are produced by a “luted-crucible” technique. (Hacker, 2000). She then describes the same process as written about and/or witnessed by all of the aforementioned authors.

The verb “to lute” means: “to seal or cement with luting” and the noun “luting” means: “any of various readily molded substances for sealing joints, cementing objects together, or waterproofing surfaces.” Finally, the word “lutum” is latin for mud, or clay. Thus sealing the joint between a clay based crucible and a clay based mould with a clay based and “readily molded substance” makes sense and Luted Crucible would therefore appear to be the appropriate name for the technique.

Various authors have highlighted the quality of the clay used in mould making as instrumental in re-producing the finest details of the wax model. However, the results of my field tests on samples of the investment layer used by



the Gharuas, showed that it contained a higher sand than clay content. Having reproduced this mix I found it to be successful in a number of ways. First, if the sand is fine, it will take the impression of fingerprints on the wax. Second, by using only just enough clay to bind the sand together the investment has the potential to dry rapidly without cracking. Third, silica sand has a higher fusion point than most clay enabling a sand based mould to resist the high temperatures of the fire better than a clay based mould.

The use of dung in pre-Industrial casting is wide spread. I have not been able to find convincing evidence or articles detailing why it is incorporated. It may have refractory properties, or perhaps the digested fibers aid in helping the clay to dry without cracking. In any case after extensive experimentation I have stopped using dung completely and am getting excellent results by adjusting the qualities and quantities of clay, sand and rice hulls accordingly. It makes one wonder if the Gharuas would be able to change their social status if they were to stop using dung.

To avoid cracking, melting, and/or exploding, the exterior or refractory layer of clay around the mould and crucible needs to have certain qualities. All of these are achieved with the addition of rice hulls to the clay body. Mixing substantial amounts of rice hulls into the clay opens up the clay body making it porous. This porosity allows for the refractory layer to dry without cracking and once dry and in the furnace it allows for the gases generated by the melting and burning wax to escape without causing an explosion. The gases are escaping not being absorbed by the clay as stated by some authors. The rice hulls also act

as a refractory material substantially altering the melting point of the clay body. "Rice husk ash is a major source of silicon dioxide [2]. The ash contains 80% to 95% silicon dioxide..."(Onojah p.246)

The Luted Crucible process offers a number of efficiencies. Because the mould is attached to the crucible, only one fire is needed, helping to save on fuel. During the firing process the wax is burnt out of the mould, the mould is pre-heated and the metal is melted. No venting for gas in the mould is needed and there is no discernible loss of metal to oxidation making it possible, for instance, to cast sterling silver using no flux whatsoever.

I am continuing to research this process both physically and through published material, if anyone has suggestions of where to look or what to read, I'd be extremely grateful.

Piers Watson

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Reeves, Ruth, 1962 *Cire Perdue Casting In India*, Crafts Museum: New Delhi

Mukherjee, Meera, 1966, "Gharuas of Bastar, Images and Image Makers". In M. S. Randhawa (ed.) *Roopha-Lekha, Vol XXXV Nos. 1 & 2*, All India Fine Arts and Crafts Society: New Delhi

Postel, Michel 1999, *Bastar Folk Art, Shrines, Figurines and Memorials*, Project for Indian Cultural Studies, Publication VIII,: Mumbai

Sias, Fred R. Jr., 2005 *Lost - Wax Casting, Old, New and Inexpensive Methods*, Woodsmere Press: Pendleton, South Carolina

Hurst, Steve, 1996, *Metal Casting, Appropriate technology in the small foundry*, Intermediate Technology Publications: London, UK

Hacker, Katherine F., 2000, "Traveling Objects: Brass Images, Artisans, and Audiences", *The President and Fellows of Harvard College, Peabody Museum of Archaeology and Ethnology, Anthropology and Aesthetics*, No. 37, Spring

Onojah, A. D., Agbendeh N. A., Mbakaan C. 2013 "Rice Husk Ash Refractory: The Temperature Dependent Crystalline Phase Aspects", *International Journal of Research and Reviews in Applied Sciences* 15 (2) May

DARTMOOR TIN RESEARCH GROUP CONFERENCE

6-11 May 2016

To mark the 25th anniversary of the founding of the Dartmoor Tin Research Group (www.dtrg.org.uk) an international conference, "A Celebration of the Tinworking Landscape of Dartmoor in the European Context – Prehistory to the 20th Century" is to be held. This six day event will consist of a three day conference followed by three days of field trips.

Based in the stannary town of Tavistock on the western part of Dartmoor, the venue is ideally located for visits to the numerous tin and copper mining sites dating from pre-historic times to the 20th century. Special evening visits are planned to the Victorian copper exporting port of Morwellham on the river Tamar and the notorious Lydford castle where stannary law was enforced.

The conference will celebrate the diversity of Dartmoor's industrial landscape, and compare its features and technologies with those of contemporary tinworking areas of continental Europe – Czech Republic, Germany, France and Spain, as well as that of Cornwall.

Lecturers already confirmed include Dr Tom Greeves, Dr Peter Herring, Dr Phil Newman, Henrietta Quinnell, and Dr Petr Rojik (Czech Republic). An exhibition will be held and proceedings published.

See www.dtrg.org.uk/press.htm for further details and current participants list. Costs to follow in 2015.

INTERESTED IN OPERATING A MEDIEVAL BLAST FURNACE THIS SUMMER?

Between the 27th June and 11th July a replica of a 12th century blast furnace will be in operation. We need volunteers for various tasks, including running the water dam, water wheel, leather bellows, blow pipes and the iron tuyere to distribute the air blast. Other tasks are charging charcoal and roasted hematite ore every second hour, tapping liquid pig iron and slag every 4-5 hours. In between that, preparing all the raw materials will be the other duties you will have on a shift. The furnace will be operated 24 hours a day and we work in shifts of 8 hours. No real experience is needed and we have a foreman/woman on each shift. The furnace is located in Norberg, Sweden (about 150 km from Stockholm). For more information or if you're interested please email using the contact below. Read about the project on our website (<http://www.jarnetpalapphyttan.se/>) or see our Facebook page (Föreningen Järnet på Lapphyttan).

Bo Sundelin

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PROFESSOR BENO ROTHENBERG MEMORIAL LECTURE: IZUMI SHIMADA

The Institute for Archaeo-Metallurgical Studies cordially invites you to the Professor Beno Rothenberg Memorial Lecture, which will take place at the UCL Institute of Archaeology on Tuesday 16 of June at 6pm

The lecture, delivered by Professor Izumi Shimada (Southern Illinois University, Carbondale), will be entitled “*Obsessed with Metal: Manufacture, Use and Significance of Metals in the Thousand Year-Old Sicán Culture of South America*”. It will be followed by a wine reception at the Leventis Gallery.

Professor Beno Rothenberg (1914-2012), acclaimed photographer of the emerging state of Israel, self-taught scholar and founding father of archaeo-metallurgy, was one of only a handful of scientists who between them revolutionised the way in which we study and understand the production of metal prior to the Industrial Revolution. He pioneered the fusion of traditional archaeological and science-based approaches which later came to be known as archaeometry, with a strong emphasis on painstaking data gathering and photographic documentation in the field, chemical and mineralogical analysis of the archaeological remains unearthed, and visionary, if sometimes contentious interpretation of his observations. While his interests went well beyond the beginnings of mining and metallurgy, these are where he left his strongest legacy, not least through coining the very term ‘archaeo-metallurgy’, now used world-wide for the study of ancient metals and their production using scientific methods, and through establishing, directly and indirectly, two of the leading academic schools in this field. He was the founder of the Institute for Archaeo-Metallurgical Studies in 1973. For further information, see: http://www.ucl.ac.uk/iams/iams-news-publication/rothenberg_obituar

Izumi Shimada is a Professor of Anthropology and Distinguished University Scholar at Southern Illinois University, Carbondale (SIUC), with research interests in the archaeology of complex pre-Hispanic cultures in the Andes, ancient technology and craft production, mortuary practices, and culture-environment interaction, among other topics.

Born in Kyoto, Japan, he studied anthropology at Cornell and obtained his doctorate from the University of Arizona in 1976. Since then, he taught at University of Oregon (1977-8), Princeton (1978-1983) and Harvard (1984-1992) before moving to SIUC in 1994. From 1978 to the present, he has directed the interdisciplinary Sicán Project focusing on metallurgical and ceramic production, religion, and other aspects of the pre-Hispanic Sicán culture (ca. A.D. 800-1400) on the northern coast of Peru. The project results formed the foundation of the Sicán National Museum in

Ferreñafe, Peru that he largely designed (opened in 2004).

He has authored or edited over 200 publications. Sixteen books include *Pampa Grande and the Mochica Culture* (1994), *Craft Production in Complex Societies* (2007), *Cultura Sicán: esplendor preinca de la costa norte* (2014), and *The Inka Empire: A Multidisciplinary Approach* (2015). He has received awards and medals of honors from the government and other institutions in Japan and Peru. For further information, see: <http://cola.siu.edu/anthro/facultyandstaff/faculty/archaeology/shimada.php>

Obsessed with Metal: Manufacture, Use and Significance of Metals in the Thousand Year-Old Sicán Culture of South America

The northern coast of Peru in western South America with its rich mineral resources and abundant fuels was the setting of what is arguably the most sophisticated metallurgy of pre-Hispanic New World. Striking gold and other metal objects that often grace the covers of popular books on ancient cultures of Peru were looted out of rich tombs of this region, limiting our ability to illuminate on people and technology that produced them. This lecture discusses knowledge and understanding gained over the past 35 years on manufacture, use and significance of



Izumi Shimada with a Sican Tumi

diverse alloys of the millennium-old state-level Sicán culture, one the cultures responsible for these objects. Interdisciplinary and international teams of the Sicán Archaeological Project have investigated many workshops where varied alloys, primarily of arsenical bronze and tumbaga (arsenical bronze-silver-gold alloys) were produced and worked. Our approach is based on a belief that understanding of what, how and why specific objects were produced is most effectively achieved by focusing our attention on the primary production loci. Concurrent examination of residential, ceremonial and funerary settings also has afforded us insights into the usage and the social significance of diverse products. Sicán metallurgists produced many alloys with a remarkable range of material performance and visual qualities to suit correspondingly varied purposes and products, including household tools, personal ornaments and thin sheets to cover textiles. Metals permeated many aspects of Sicán life. Differential access to different alloys served as social status markers and a large segment of the society appears to have been involved in at least some facet of the metallurgy. At Sicán, emphasis was on production by the masses, rather than efficiency-based mass production. Overall, the lecture offers a technological and social analysis of the Sicán metallurgy showing how it was intertwined with many critical aspects the culture. For further information, see: <http://sican.org/>

For more information about this event, or IAMS generally, visit www.ucl.ac.uk/iams



IAMS SUMMER SCHOOL IN ARCHAEOMETALLURGY

Save the date! The IAMS Summer School in Archaeometallurgy will take place at the UCL Institute of Archaeology in London from 29 June to 10 July. The first week will be devoted to bloomery iron smelting, and will include seminars and handling sessions as well as an experimental iron smelting campaign. The second week will cover the field archaeology of mining and smelting as well as introductions to the scientific analysis of archaeological metal objects. Tutors will include Brigitte Cech, Michael Charlton, Jake Keen and Marcos Martín-Torres. Programme and registration details are available from www.ucl.ac.uk/iams

PREHISTORIC METALLURGY AT BUTSER (EXPERIMENTAL ARCHAEOMETALLURGY) COURSE

3rd July – 6th July 2015

Butser Ancient Farm, near Petersfield, Hampshire, UK

This is a practical and theoretical short course on the use of experimental archaeology in examining the production of metals at the beginning of the Bronze Age. Through lectures on prehistoric archaeometallurgy and daily practical workshops, the course will provide valuable experience for anyone working in this field or interested in it (either at undergraduate or postgraduate level). During the practical sessions students will work in small groups to build, operate and record smelting hearths and then use these to produce metals (principally copper and tin). In addition, these groups will make much of the ancillary equipment such as the bellows, tuyeres, crucibles and moulds used in the production of metals from ores. Students will finish with the casting of small objects such as bronze or copper axes.

During the course there will also be two iron smelts for the entire group to participate in, with one of them taking place during an optional evening stay at the Farm.

The course will be held at the world-famous Butser Ancient Farm in Hampshire and the tutors will be Dr Simon Timberlake of the Cambridge Archaeological Unit (University of Cambridge) and Fergus Milton of Butser Ancient Farm.

For registration, and further details on costs and accomodation see <http://www.fingerbuster.com/>

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THE SWORD - FORM AND THOUGHT

19th-20th November 2015

Deutsches Klingmuseum Solingen

Call for papers for a 2 day conference. Possible themes include material characteristics, decoration and symbolic value, and additionally the use of the sword as a weapon and as a cultural object; of central interest is how these aspects are interwoven. To highlight the interactions between the different aspects of the sword at a given age, the 4 panels will be structured chronologically from Bronze age to the Present, with an additional 5th panel for discussion of international swords. A sword practical session is also arranged for the 21st November. Abstract deadline 30th April 2015. Click [HERE](#) for a pdf with more details.

DUNCAN HOOK

I am shortly coming to the end of my second period on Council, but I will be able to leave knowing that it is in good health, is full of talent, and has a healthy balance of experienced and newer members who together represent the many diverse interests within the HMS!

I have my father to thank for introducing me to metallurgy – he was a mechanical engineer who worked for a West Yorkshire company that made large machine presses for the production of a wide range of products, from coinage to car bodies. I spent two summers working there before the decline of British manufacturing industry forced my father to lay off 300 out of the 400 employees who worked there. Sadly this was not an uncommon scenario across the UK, with many factories closing, but one that planted a belief in me that our industrial heritage should not be forgotten.

In fact my interests in practical metallurgy actually date even earlier – I was casting tin alloy heraldic badges by the age of 12, and casting aluminium into greensand moulds at 17 (About this time I also made a metal detector and thus began an interest in Treasure!). I went on to do a chemistry degree at York University and started a PhD in medieval metallurgy under Ernie Pitt and Roger Brownsword before being lured to London, joining the analytical section of the ‘Research Lab’ at the British Museum in 1982. There I benefitted greatly from working with Mike Cowell and Mike Hughes, using a wide range of techniques including AAS, XRF and NAA, and of course, working closely with and learning from, the metals section led by Paul Craddock. Over the years I have worked on many kinds of museum and archaeological material, including ceramics, stone and glass, dating from the Stone Age to the 20th century, although my main interest remains in all things metallic, especially of copper alloys and precious metals.

Soon after joining the BM I was able to return to my early love of Treasure—for many years I analysed precious metal items (found largely by metal detectorists) on their way to the Coroner’s Court, including the large hoards from Snettisham and Hoxne.

The 1980s to the early 2000s were certainly an exciting time to be involved with archaeometallurgy, with many conferences being organised at the BM and seeing our understanding and knowledge greatly increasing – truly a ‘Golden Age!’

Teaching and mentoring have always been important to me. Whilst at the BM I have had input into the teaching of a succession of students from Bradford University and other researchers, and it has given me great pleasure whenever they have gone on to great things elsewhere! This experience facilitated me giving numerous lectures on archaeometallurgy, from Cairo to the Canaries (of course



it was hard work...). Whilst teaching, I have always tried to impart my belief in the importance of high standards in all things, but especially in the production of reliable data, properly published and not over-interpreted. And talking of standards, I have been very pleased to have been part of a number of consortia that have recently produced reliable copper-, silver- and gold-based standards: these can only help with the essential exchange of archaeometallurgical data.

What is the future of the HMS? There is the great challenge of balancing the ‘academic’ with the joy and fun aspects of the HMS, such as the traditional conference, yomping through areas of outstanding natural beauty, all the time learning from others how to interpret these landscapes, and thus bringing the past to life – something that is a very important part of my day job. I am also very much looking forward to the increasing internationalisation of the HMS, so that it becomes ever more recognised as the world-leading organisation for the study and preservation of our metallurgical heritage. I promise I will try to continue to support the HMS even when I am no longer on Council (which should surely be an aim of all members!).

EXARC9 JANUARY 2015 DUBLIN, IRELAND

This year's Experimental Archaeology Conference was hosted by University College Dublin. EXARC9 was a collaborative effort between UCD, the Irish National Heritage Park, and EXARC. EXARC is an umbrella organisation dedicated to experimental archaeology and produces both print and online journals featuring projects in experimental archaeology. In addition, EXARC runs an annual conference where, in addition to papers and posters, experiments and demonstrations of archaeological technology are conducted.

The conference was held at UCD's Clinton Auditorium and the UCD Centre for Experimental Archaeology and Ancient Technologies. The event boasted over 200 delegates, 20 papers, and 31 posters. Because of UCD's strong programme in experimental archaeology, hosting EXARC9 was a natural fit. Students here are active in a wide range of experimental projects that include building houses and boats, making pottery, and experimenting with ancient metal technologies. The programme recruits experts from beyond the archaeology department to include professionals such as foresters and architects in order to incorporate a broad range of skills to support student projects.

The conference was kicked off with a demonstration of the remarkable range of sound produced by replica Irish Bronze Age horns by Billy Mag Floinnand Holger Lönze.

The first day of the conference included sessions on constructing houses, food technology, and communicating knowledge. The second day started with *Forged in the Fire: Aspects of Hot Technologies*, a session with topics that ranged from cremation to steel carburisation. Rather than have the usual poster meet and greet session, short presentations were given with posters broadcast on the conference room screen. These included Jiří Hošek, Ryszard Kaźmierczak, Paweł Kucypera & Maciej Tomaszczyk (Nicolaus Copernicus University) presentation on steel carburising in a small shaft furnace and Yuri Godino & Lorenzo Teppati Losè (University of Florence) presented a poster on their experiments on cupellating galena to produce refined silver. The presentations that discussed metal began with Giovanna Fregni speaking on inverse segregation and its influence on chemical analysis of objects cast in the Bronze Age. Padraig McGoran of Umha Aois presented a poster on his experiments that included problems and solutions in casting into open one piece moulds.

On Sunday was Barry Molloy & Mariusz Wisniewski (UCD) described their project combining 3D visualisation and kinaesthetic methods for understanding use wear on prehistoric metalwork.



During the conference, exhibitors had active displays of experimental work in the main hall, and during lunch others set up workshops at the outdoor centre for experimental archaeology. This centre boasts a Mesolithic house, along with metalworking furnaces in varying states of decay. There are separate areas set aside for flint knapping, firing pottery, and active metalworking projects. In addition to the students and staff of UCD's experimental archaeology programme, the members of Umha Aois were also demonstrating metalworking and casting. Umha Aois (Irish for Bronze Age) is a group that has worked together for 20 years experimenting with ancient metalworking techniques. Projects have ranged from smelting ore and casting bronze horns to constructing sheet metal cauldrons. The group organises annual symposia in which members gather from around the globe to experiment with ancient casting technology and metalworking. In addition, two members of Umha Aois presented at the conference.

The members of Umha Aois had a variety of furnaces set up for casting that included ones heated from below, from one side, and another with a tuyere that had a 90 degree bend that blew the air directly onto a flat, pan-shaped crucible. The day was spent casting axes, jewellery, tools, and other objects, while finished projects were on display, including swords and stone moulds. The casting events continued during the day and into the evening. Some of the conference delegates chose to stay and participate while others were taken on a pre-booked tour of the Irish National Heritage Park in Wexford.

Both EXARC and UCD's experimental programme have lively FaceBook pages and invite interested persons to join them in discussions about experimental archaeology. If you want to keep up to date for next year's EXARC conference, please check their website at experimentalarchaeology.org.uk.

Giovanna Fregni

DON WAGNER



Most readers of *The Crucible* will know Donald Wagner as a leading authority with encyclopaedic knowledge in Chinese archaeometallurgy, as well as a friendly regular of many conferences. He is equally famous in other fora, however, for his contributions to Chinese mathematical philology. Others may recognise his face from TV, as he recently showed further talents by playing a part in the international drama series *Borgen*!

Born in 1943 in Sudbury, Ontario, where his father was a chemist at International Nickel Company (now called Inco), he moved to the US when he was an infant, and grew up in New Jersey. Don moved again in 1968 (“for reasons Americans of my age won’t need to ask about”) and found a new home in Denmark, where he would later earn a PhD and a higher doctorate. He formally became a Danish citizen in 1999. He keeps a thoroughly curated list of his numerous publications on his website: <http://donwagner.dk>

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

Don Wagner: No, not in a couple of sentences. I got my SB degree in mathematics at MIT in 1965, but didn’t have the necessary grades to get into graduate school. I worked as a computer programmer for the Multics project at MIT for a couple of years; Multics was at the time the most advanced computer system ever, and the direct predecessor of Unix, Linux, and Mac OS X. From 1968 I was a programmer for the Danish company Regnecentralen, but that job was unsatisfactory coming from the cutting edge of computer

systems development, and I looked around for something else to do.

It turned out to be easy to enter the University of Copenhagen, with no tuition fees, and for some reason I decided to study Chinese. Chinese has a tendency to grab you, and I soon saw that my career was now here. I did an MA thesis on a Chinese mathematical text of the 3rd century, and there I solved a famous philological problem. It was published in 1979 and immediately translated into Chinese, and that accomplishment has opened a number of doors for me in China.

I got interested in iron after a conversation with Noel Barnard in 1978, and wrote an article – fortunately never published – about the iron industry in the Han dynasty. What I learned from that experience was that I had to ‘get my hands dirty’, so I attended an HMS meeting in Newcastle (was that in 1981?). There I met Vagn Buchwald, lecturer in metallurgy at the Technical University of Denmark, and I asked him how I was ever going to learn metallurgy. He said: ‘Take my course!’. Not only did he let me take his course, but he gave me free run of his laboratory, and I did some fun work attempting to reproduce the morphology of temper carbon in ancient Chinese malleable cast iron.

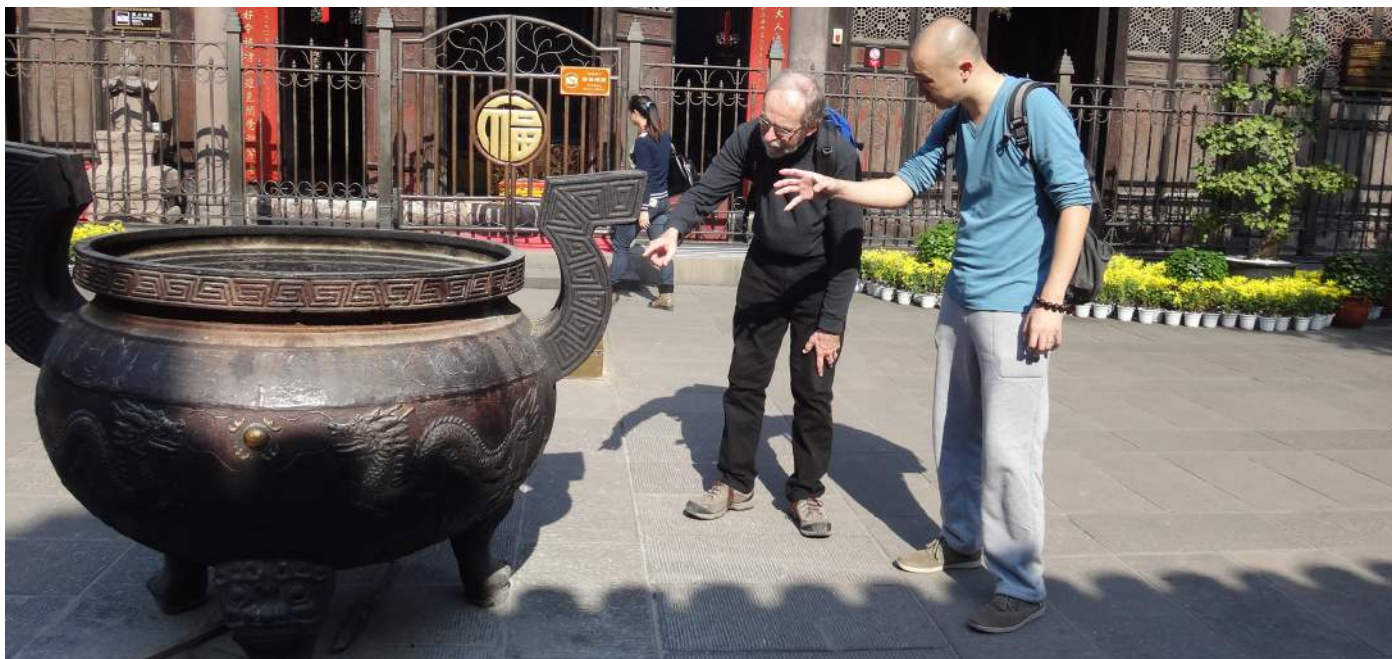
At some time in there (1980?) Joseph Needham asked me to write his volume on Ferrous Metallurgy for Science and civilisation in China, and that determined the greater part of my research activities for the next 25 years. A sidelight here: At some point I discovered that Vagn was being seriously criticized for letting this outsider use institute resources, so I went to Joseph Needham and told him I needed £1000 for laboratory expenses. He wrote a cheque straightaway, and saved my bacon.

I have never had a tenured academic position, but have had various short-term positions and have often been unemployed and on the dole. This has been inconvenient, but has also meant more research time than most academics have: no administration, and teaching only what I like to teach – mainly Classical Chinese. Retirement at 60 meant for the first time a steady income without the necessity of applying for grants or satisfying the dole authorities that I really – really – was looking for a job, any job, yes really. The teaching, by the way, had as a by-product the publication of four textbooks.

After finishing the SCC volume I have continued working on iron, but have also gone back to Chinese mathematical philology, and have recently published two articles with one of my former students, Tina Lim.

THE CRUCIBLE: What is your most memorable professional moment?

Don Wagner: In my bifurcated career there have been



two:

In mathematical philology, the discovery that substituting ‘2’ for ‘1’ at two points in a famous text suddenly made it understandable.

In metallurgy, something I have never properly published: observation of the effect of very low Si content and very thin section on the morphology of temper carbon in malleable cast iron, partially explaining the microstructures seen in ancient Chinese cast iron artefacts. Much more needs to be done before this is publishable, and since Vagn Buchwald’s retirement I no longer have access to a laboratory. I have tried to interest solid-state physicists in the problem, without any luck.

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

Don Wagner: In archaeometallurgy, Vagn Buchwald, who taught me what I needed in order to get started and continued to give practical help, encouragement, and good advice throughout my career.

THE CRUCIBLE: What is your main current project?

Don Wagner: Again this is bifurcated:

In mathematics, a book on the mathematician Wang Xiaotong, 6th–7th century, again with Tina Lim.

In metallurgy, a textbook based on a course of lectures I gave at Sichuan University in 2013, ‘Introduction to the archaeometallurgy of iron’. The purpose of the course was to give archaeology students the necessary background to read site reports and metallographic studies, with the warning that doing serious research in archaeometallurgy will require more extensive studies. Strong emphasis on the Chinese side, of course.

THE CRUCIBLE: What multi-million project would you like

to develop?

Don Wagner: I wouldn’t know what to do with millions. All of my research has been done on shoestrings and ‘a little help from my friends’.

THE CRUCIBLE: Which publication should every HMS member read?

Don Wagner: A tough question! Of all the books out there, maybe Percy’s Metallurgy (1861ff). Percy was an admirable Victorian polymath, and in his book he summed up what was known of the science and technology of metallurgy in his time as well as their history world-wide. He wrote at a time of great change, but the older technologies were still alive, and he was able to describe them in useful technical detail.

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

Don Wagner: To students of history I would say, ‘Get your hands dirty!’, but that is hardly necessary to say to archaeologists and metallurgists. Otherwise the usual banal advice: open your eyes, think things through, don’t accept easy answers, don’t believe anything your teachers tell you.

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

Don Wagner: I love you all. The archaeometallurgists are surely the most cheerful, friendly, and helpful body of academics I have known.

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.

PROF. PHDR. RADOMÍR PLEINER, DRSC.

Magister ferrariarum

1929 – 2015

Radomír Pleiner was born on 26 April 1929. His father Vladimír was a painter and a member of the famous Czech Legion; his mother originated from Russia. He studied prehistory and history at the Faculty of Philosophy of the Charles University in Prague, graduating in 1952. From 1953 to 1955 he carried out postgraduate work at the Institute of Archaeology of the Czechoslovak Academy of Science, for which he obtained the degree of CSC (equivalent to PhD). An equally significant event in this period was his marriage to fellow archaeologist Ivana Hnízdová in 1955. He was able to continue his researches at the Institute, into the earliest production of iron and smithing techniques, writing his first three monographs in 1955, 1958 and 1962. He developed considerable skills in metallography, which led to the creation of the laboratory at the Institute in 1963.

From this time onwards Radomír took part in many excavations and experimental work both in Czechoslovakia and abroad, in countries such as Poland, Russia, England, Scandinavia, Austria, Germany, and France, as well as contributing widely to symposia and conferences. In 1966-68 he participated in American expeditions to Iran and Afghanistan, and three years later he spent six months in the USA on an internship, at M.I.T. and the Universities of Chicago and California. These experiences led to the publication of studies of iron-making in Persia, Assyria and India and his 1969 monograph on Iron Working in Ancient Greece. These works formed the basis of a dissertation for his second doctoral degree, Doctor Scientiarum, DrSc., awarded in 1981.

In 1966 the Comité Pour la Sidérurgie Ancienne (CPSA) was founded, under the auspices of the International Union of Prehistoric and Protohistoric Science (UISPP), with Walter Guyan as President and Pleiner as Secretary. He held this position for the next forty years, creating a network of international and inter-disciplinary contacts with scholars engaged in study of the archaeology and the archaeometallurgy of iron, most of whom became corresponding members of the CPSA.

During this period he played a vital role in the rapid development of the discipline by collating new research, abstracts of publications, information on conferences and work in progress, published twice-yearly in *Archeologické Rozhledy*. These CPSA Communications comprise several thousand items, forming a crucial source of information in the pre-internet age. Key factors in this were Radomír's linguistic skills, enabling him to act as a bridge between the (old) east and the west, combined with his enormous energy. The contacts which he made and encouraged

through this work resulted in him being a guiding light for several generations of scholars.

Radomír maintained his connections with the Charles University in Prague: in 1968 he was appointed docent (Associate Professor) of prehistory and in 1992, after the so-called 'Velvet Revolution' he was appointed Professor. Unfortunately he had to retire in 1993, along with other colleagues, due to the reduction in the Institute's budget. Although he was no longer in full-time employment his research continued unabated and his output of publications remained prodigious, with more than forty papers and books since 1963, in several languages, including his three classic works, representing the fruits of his many years of research - *The Celtic Sword* (Oxford, 1993), *Iron in Archaeology: The European Bloomery Smelters* (Prague, 2000), and *Iron in Archaeology: Early European Blacksmiths* (Prague, 2006). The latter volume was produced under particularly difficult conditions due to the loss of his archive of samples and notes, and the library in the basement of the Institute of Archaeology, during the disastrous floods of 2002. This would have destroyed the spirit of a lesser man, but the fact that Radomír was able to complete this volume with little delay is a tribute to his determination and to his thorough knowledge of the source material.



Radomír Pleiner (right) with Boris Kolchin during experiments in Russia, around 1962. Photo from the Institute of Archaeology RAS Moscow, courtesy of Vladimir Zavyalov.



The first conference of the CPSA at Schaffhausen, in 1970. Photo from Robert Thomsen's archive, courtesy of Henrietta Lyngström. 2 W. Guyan, 3 K. Bielenin, 4 R. Thomsen, 5 O. Voss, 6 R. F. Tylecote, 9 G. Bauhoff, 10 R. Pleiner, 11 B. Osann, 12 Inga Serning



Delegates at the Sandbjerg, Jutland, conference 1999, with Pleiner 4th from the left in the front row, next to Olfert Voss. Photo courtesy of Lars Christian Norbach.

In total Radomír wrote 12 books and a remarkable 250 papers, in Czech, German, English and French, an average of nearly 5 per year. Many of these papers were published in the proceedings of conferences held all over Europe, some of which were organized under the auspices of the CPSA. Despite the travel and currency restrictions, at least before 1992, Radomír managed to attend a remarkable number of these conferences, sometimes 3 or 4 per year. His continual presence acted as a bridge across several generations as well as a means of attracting new members of the CPSA.

He was a member of The Historical Metallurgy Society from the 1960s, an Honorary Fellow of the Society of Antiquaries of London, a corresponding member of the Deutsches Archäologisches Institut, Berlin and a member of the Unité propre du CNRS, Sevenans.

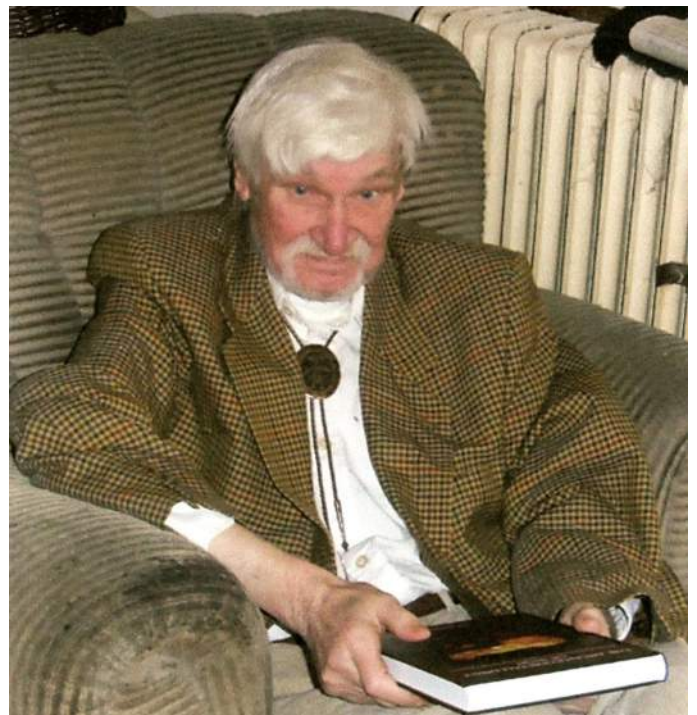
In recognition of his life's work, which made a valuable contribution to the development of European science, Radomír was decorated in April 2005 with the 'Knight's Cross of Merit', by the former President of the Republic of Poland, Aleksander Kwaśniewski, for his co-operation with the Polish Republic in the field of science.

It would be no exaggeration to say that the high level

of esteem which the study of ancient iron-working now commands is due in large part to the work and influence of Radomír Pleiner. His research and the dissemination of the results of that research were exemplary, through which he has inspired many young archaeologists to enlarge and refine our knowledge of the making and working of iron in antiquity and to demonstrate its immense significance in the development of human societies. At the same time he has been the most generous of scholars, willing to share his ideas and his results with colleagues and students alike. Above all Rado was the warmest, most welcoming, steadfast, and entertaining friend. It was a conceit of his for many years to complain lugubriously and sonorously that "I am an old man" - often described by his family and friends as proof of his Russian genes. This was, of course, nonsense: even at eighty he was as young in heart and mind as ever.

In 2011 *The Archaeometallurgy of Iron: Recent Developments in Archaeological and Scientific Research* was edited by Jiří Hošek, Henry Cleere and Lubomír Mihok, with papers from many of Radomír's friends, colleagues and admirers. The volume was dedicated to Radomír and was presented to him for his 80th birthday.

Radomír is survived by his wife prof. PhDr. Ivana Pleinerová, CSc. and his daughter RNDr. Johana Prokop Brokešová, CSc. We shall never see his like again.



Radomír Pleiner in 2011, presented with the volume for his 80th birthday. Photo courtesy of Jiří Hošek

Henry Cleere, Peter Crew, Jiří Hošek, Janet Lang, Věra Souchopová, Brian Scott

FORTHCOMING EVENTS

Conference, Date and Location	Description	Website, Email and Prices
Archives and Slag Collections, Study & Work Day 11th April 2015 Ironbridge Museum	A HMS Archives and Collections Committee (ACC) organised study/work day at the Long Warehouse, IGMT, Coalbrookdale. There will be hands on sessions dealing with the cataloging and protection of the photographic and slag collection. All are welcome.	http://hist-met.org/
Society for American Archaeology 15-19th April San Francisco, USA	A major international archaeological conference with 3800 presentations in 250 sessions, several with metal themes.	http://saa.org/AbouttheSociety/AnnualMeeting/tabid/138/Default.aspx
Archaeometallurgy in Europe IV 1st-3rd June 2015 Madrid	The most important forum for scientific discussion on early metalworking this year. The conference aims to bring together interdisciplinary knowledge and regional studies to permit the field to face future challenges.	http://www.congresos.cchs.csic.es/aie4/conference
HMS Annual Conference 2015 - Celebrating Street Furniture 12-14th June Stratford-upon-Avon	Conference themes include manufacturer, technology, design choices and trade patterns along with the social and economic considerations. We also discuss the needs for recording and preservation of these slowly diminishing objects. Two days of presentations will be followed by a tour of Stratford-upon-Avon which boasts a unique display of lamp posts	http://hist-met.org/meetings/hms-annual-conference-and-agm.html
Rothernbery Memorial Lecture - Shimada 16th June UCL, London	Organised by the Institute for Archaeo-Metallurgical Studies, this years lecture will be delivered by Professor Izumi Shimada (Southern Illinois University, Carbondale), and entitled " <i>Obsessed with Metal: Manufacture, Use and Significance of Metals in the Thousand Year-Old Sicán Culture of South America</i> ".	www.ucl.ac.uk/iams
IAMS Summer School 29th June - 10th July UCL, London	Two week summer school on the theme of metallurgy. Topics of smelting, metal objects and extractive metallurgy which include seminars and handling sessions, as well as an experimental iron smelting campaign to be held in Dorset.	www.ucl.ac.uk/iams
Butser Experimental Archaeometallurgy Course 3rd-6th July Butser Ancient Farm, UK	A short course on the use of experimental archaeology in examining the production of metals at the beginning of the Bronze Age. Through lectures on prehistoric archaeometallurgy and daily practical workshops, the course will provide valuable experience for anyone working in this field or interested in it	http://www.fingerbuster.com
European Association of Archaeologists 2015 2-5th September Glasgow, UK	A major international conference, main themes include Science and Archaeology with sessions on the " <i>Social Context of Metallurgy</i> ", " <i>Metallurgical Crafts in the 1st Mellenium AD Europe</i> " and " <i>New Approaches to Metals Trade and People Mobility</i> "	http://eaaglasgow2015.com/
THE SWORD - Form and Thought 19th-20th November 2015 Solingen, Germany	Two day conference to be held at the Deutsches Klingmuseum discussing the material characteristics, decoration and symbolic value of swords, and its use as a weapon and a cultural object.	www.klingmuseum.de
DTRG Conference 6-11 May 2016 Tavistock, Devon, UK	An international conference entitled " <i>A Celebration of the Tinworking Landscape of Dartmoor in the European Context – Prehistory to the 20th Century</i> "	www.dtrg.org.uk

