

HMS NEWS

Historical Metallurgy Society 60 Summer 2005

An Ongoing Research Project on Iron Production and Use in the Dogon Country, Mali.

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The indigenous production of iron in Africa was recognized by the first Europeans travelling through the continent. This industry was still flourishing at the beginning of the 20th century but collapsed soon after the First World War. Today, countless slag heaps and abandoned bloomery furnaces can be seen in many areas. Recent archaeological investigations have demonstrated the early use of iron going back at least to the beginning of the 1st millennium BC in some places. The numerous archaeological remains of iron production and the living knowledge of the African smiths and smelters, both on technical and social aspects, are very important parts of the historical and cultural heritage of Africa.



Figure 1: Map of Africa showing Mali in grey

The “Mission archéologique et ethnoarchéologique suisse en Afrique de l’Ouest” (MAESAO — E. Huysecom, Dep. Anthropology, University of Geneva), is leading the research project “Human population and paleoenvironment in West Africa”, started in 1997, with an interdisciplinary and international team. The project focuses on the development of the population from the Palaeolithic to the present days in the Dogon Country, Mali, classified as a UNESCO World Heritage site in 1989. Iron being a key material for warfare and agriculture, has a direct influence on the size and well-being of the population, at least during the last millennium.

In 1995, traditional iron production was revived in the area of the Bandiagara Cliff (see the movie “Inagina”, E. Huysecom). C. Robion-Brunner (Dep. Anthropology, University Geneva) has undertaken the study of the social group of smiths on the Plateau area, based on field survey and ethnohistorical enquiry. Sébastien Perret and Vincent Serneels (Dep. Geosciences, University of Fribourg) are involved in the archaeological excavations of bloomery sites, archaeo-metallurgical laboratory work and ethnoarchaeological study of the smithing techniques. Further research, both in the field and laboratory, are planned for the coming years. The aim is to describe the technical, socio-economical and environmental aspects of the local iron industry with a long term perspective. This work will also contribute to our understanding of the metallurgical remains from European archaeological sites. It is also important to highlight and protect the local heritage.



Figure 2: Crater-shaped slag heap near the village of Kakoli, Dogon Country, Mali.

At least five different groups of bloomery sites can be distinguished in the Dogon Country, located in different areas. They differ in the types of debris and slag, the architecture of the furnaces and in their general organization. During the last few years, we have concentrated our efforts on several very large slag heaps, up to 30,000t, in the villages between Mopti and Bandiagara. They are all organized in the same way, with several pairs of large furnaces, each of the pairs

surrounded by a crater of debris, up to 7m high (Figure 2). The slag assemblages look similar, mainly grey fayalitic tapped slag, associated with a few blocks with straw imprints and numerous plates of contaminated and vitrified soil. A huge number of clay tuyère fragments were found. In 2003, the upper part of two still standing furnaces, were seen in the slag heap of Kakoli. The excavations at Fiko in 2004, allowed the identification of two damaged furnace bases. During February 2005, a very well preserved furnace has been studied at the site of Koundioulé near the village of Kéma (Figures 3 and 4).

The furnace itself is surprisingly large: the internal volume can be estimated up to 3.5m³. The inner chamber is 2m long and 1.6m wide. The lower part is dug into the ground. At the ground level, the wall is pierced by 17 large apertures on the sides and the rear, for the tuyères. The total preserved height is 2.5m, probably not far from the original one. The lower part

of the walls were built using plates of vitrified soil and sandy clay mixed with straw as binder. For the upper



Figure 3: General view of the furnace excavated at Koundioulé near Kéma, Dogon Country, Mali.

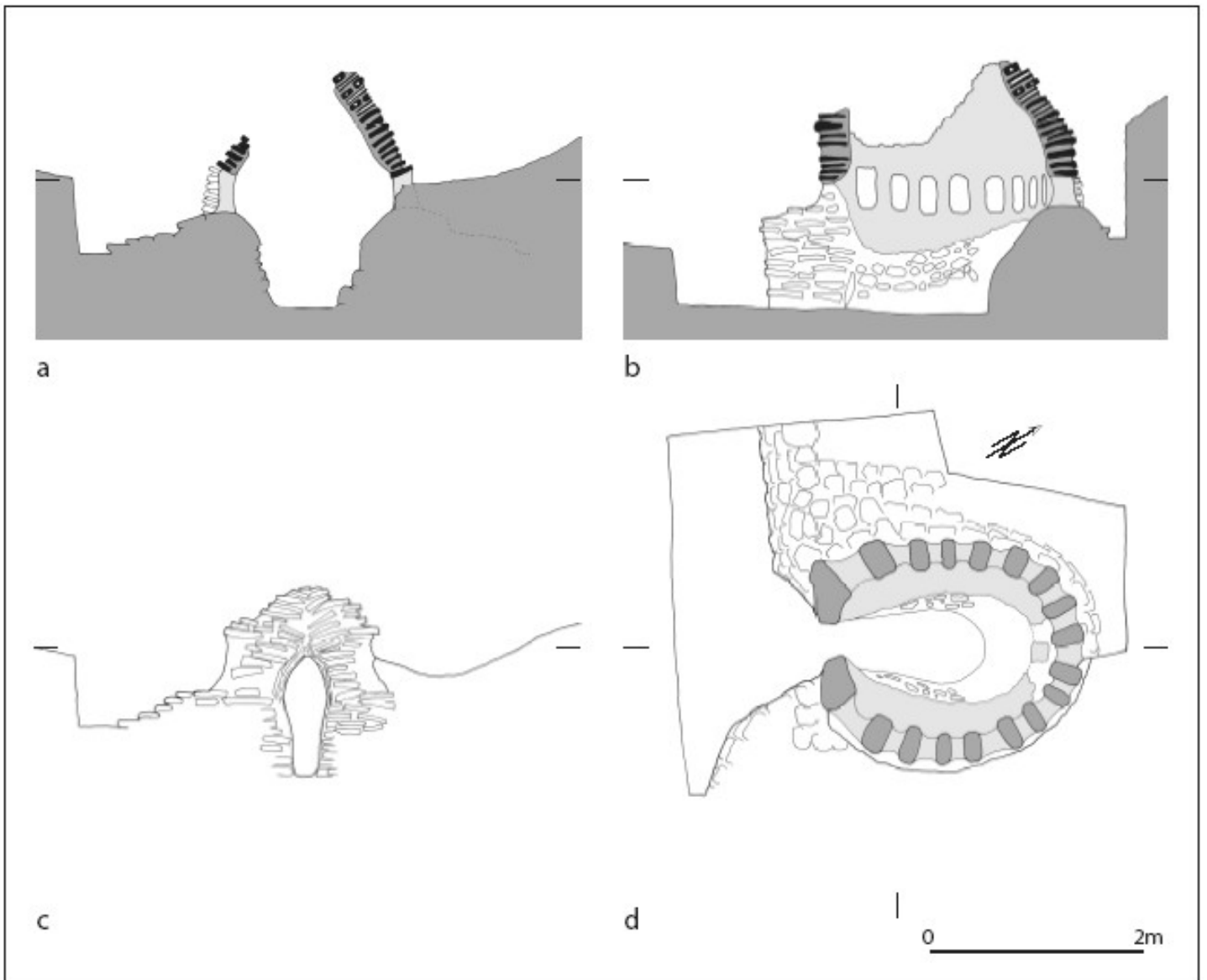


Figure 4 : The furnace of Koundioulé near Kéma, Dogon Country, Mali. Sections (a, b), front wall view (c) and plan (d).

part, broken tuyères were used. The inner surface is protected with a layer of clay. These very large furnaces were certainly using natural draft, as there is clearly no place for the bellows.

This group of sites, sharing a specific technology, were operated on a large scale. There are few, but the industry was active for at least for 500 years (AD1400–1900). They clearly played an important role in the production of iron for other parts of Dogon Country and probably also the Niger valley to the North where successive large kingdoms developed from the 11th century.

More information

Annual reports are published in the *Jahresbericht Schweizerisch-Liechtensteinische Stiftung für archäologische Forschungen im Ausland* (Zürich).

The official web site of the project:

<http://archo.unige.ch/ounjougou/>

A video of the 1995 bloomery smelting:

<http://archo.unige.ch/inagina/>

Archeometallurgy at the University of Fribourg:

<http://www.unifr.ch/geosciences/>

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Journeys in Search of Iron

Jake Keen

I want to tell you about two journeys. Firstly, I am planning to visit settlements in East and West Africa and central India so remote that traders carrying car springs to sell as scrap iron have not yet arrived in the markets. In consequence the ancient craft of smelting iron in small clay bloomery furnaces survives . . . just.

For decades anthropologists, archaeologists and archaeometallurgists have been recording surviving smelting traditions. There is a huge body of academic literature on the subject, but nothing for the general reader. My aim is to tell the story of the extraordinary transformation of rock into iron via this journey and a second one I embarked on in 1991.

At that time I was running the Ancient Technology Centre in Dorset, an outdoor education centre built on the premise that children learn best by doing, as in the old proverb,

“Tell me something and I’ll forget it;
Show me something and I’ll remember it;
Let me do something and I’ll understand it.”



Figure 1. School children building a furnace (1996)

Each day our visitors had the time of their lives getting very dirty turning bark into rope, clay into pots, flint into tools, chalk into cob, reed into thatch, wood into charcoal and so on. What could loosely be called experimental archaeology. As most of our structures and activities seemed to be focussed on the Iron Age (there was no National Curriculum then) it seemed natural to explore the technology that gave the period its name.

I’d been inspired first by Peter Reynold’s smelting failures at Butser and then by Peter Crew’s successes at Plas Tan Y Bwlch. Lacking any archaeological model, access to a laboratory or a sound education in chemistry, I thought the best bet would be to concentrate on the craft involved. Could we, through trial and error, with no master to guide us, learn how to smelt iron in less than a century or two?

We had irregular success; an excellent smelt might be followed by a failure even though we thought we had copied the first one in every detail. We discovered that the process is much harder than smelting tin or copper, both of which we had tried before. The puzzle of why the copper and bronze ages which needed very rare ores should have preceded iron, with its abundant ore, was partly explained. We also found out that when we lacked good scientific explanations for failure or success semi-magical ones clamoured for attention, e.g. “It must have been the banana skins that made the difference”. It gradually became clear that smelting iron in a pre-scientific age would:

- (i) encourage a conservative approach (if something works well, keep doing it)
- (ii) make it impossible to distinguish between the efficacy of propitiatory rituals (e.g. sacrificing a

chicken or donating a banana skin to the furnace) and the effectiveness of your bellows technique or ore charging procedure)

(iii) result in time in the entire smelting process becoming ritualised.

In 1994 I was invited to the World Archaeological Congress in India to give a paper on teaching children about ancient technology. I took the opportunity to look at the real thing by travelling south to Madhya Pradesh. Six family groups were gathered outside the modern steel works in Bhilai to demonstrate bloomery iron smelting. The families were from different villages each with a different design of furnace. To observe this craft being practiced with the assurance of people who had clearly been taught and then mastered their skills over a lifetime was even more inspiring than seeing Peter Crew's focussed, determined experiments. I have been trying to reproduce the quality of the best of their blooms ever since.



Figure 2. An iron smelting furnace at Bhilai, Madhya Pradesh, India in 1994. The husband is bottom left watching the slag tapping hole while his wife works the bellows. In the background can be seen various onlookers and the author taking notes.

The aim of the second journey has been to learn how to produce a good quality, well consolidated bloom, every time. In my dream, at the end of my smelting journey (and the book), three of the best storytellers in the land reveal the true story of the Sword in the Stone. They are accompanied, hour after hour, by the whoosh of three huge hand bellows. The wrapt faces of an audience of 200 are lit by the magenta and blue glow from the top of the furnace. Suddenly, a searing light illuminates the gathering who shrink backwards. I pull a sizzling bloom from the furnace and beat out a blade as arcs of luminous slag spray from my hammer. I reheat, hammer, reheat, fold, reheat, hammer until bit by bit I draw out the blade in the shape of a sword. The Lady of the Lake sings a finale of mesmerising beauty.

These two journeys, the geographical and the technological, are shadowed by another. The process of bloomery iron smelting, certainly the experimental variety, resembles alchemy: an endless series of procedures designed to refine something worthless or mundane into something very special. The same kind of transmutation is needed to turn the muddled ore of promising ideas and awkward doubts into the coherent, gleaming bloom of a book. Apart from the absurdity of trying to recreate a long forgotten and redundant skill and travelling to dangerous parts of the world to investigate an activity hardly anyone locally values any more, the difficulty of trying to distil meaning from what to many is a nerdish obsession is perhaps the hardest task.

Would you be interested in the book, joining me for a smelt (there will probably be several smelts over the next year or two in-between trips to India and Africa), or attending the story telling event (Drawing the Sword from the Stone)? Let me know.

Email: jakekeen@hotmail.com

Further results from Upper Forge, Coalbrookdale

Paul Belford

We have been continuing our excavations at the Upper Forge site in Coalbrookdale this summer. Last year we found the putative remains of a cementation steel furnace (see HMS News 59). This year we have found a second furnace, in a much better state of preservation. Both furnaces appear to have been in use from c.1620 to c.1680, and were built by the Brooke family as one of a series of investments in the Coalbrookdale complex.

Hitherto we had only found structural remains, but this year we have recovered metallurgical residues. These come from the demolition layer infilling one of the stokeholes at ash-pit level. These remains comprise burnt bricks and sandstone (presumably from the cementation 'chest'), as well as a fragment of arched brickwork (presumably from the roof of the reverberatory chamber) — all covered in an iron-rich residue reminiscent of that found on later cementation furnace remains (e.g. those excavated by David Cranstone and ARCUS). We also have a piece of what can only be described as 'crozzle' (to use a later Sheffield term).

This appears to represent the earliest metallurgical evidence for cementation steelmaking in England.

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CONFERENCE REPORT

Metallurgy — a touchstone for cross-cultural interaction 28th–30th April 2005

Duncan Hook

The conference ‘Metallurgy — a touchstone for cross-cultural interaction’ was held in the Clore Centre at the British Museum. It is the latest in a series of conferences on ancient metallurgy held at the BM spanning the last 30 years or so, but different in that it was organised in honour of Paul Craddock on his retirement, celebrating his enormous contribution to the study and understanding of metallurgy. His interest in metallurgy covers all alloys, stretching from their very earliest inception right through to the modern day, and from every corner of the globe. The conference was therefore potentially extremely wide in its remit, thus a theme was chosen which aimed to show how metallurgy was an indicator of cross-cultural interaction.



Figure 1. Delegates taking in some of the excellent posters

The ‘local’ BM organising committee of Susan La Niece, Duncan Hook and Nigel Meeks were supplemented by a number recent departees from the Museum who willingly came back to help — Janet Lang, Mike Cowell and Ian Freestone. Input and assistance from the Advisory Committee of Alessandra Giumla-Mair, Peter Northover, Thilo Rehren and Mike Wayman was also gratefully received.

The conference was opened by the Director of the BM, Neil MacGregor, who welcomed all the delegates warmly and reflected on Paul’s career, touching on the importance of research and international contacts.

The first day concentrated on early metallurgy from many parts of Europe and the Near East, and included studies on copper production, lead isotopes, trade and

the palaeo-pollution records preserved in peat bogs. The day finished with an evening lecture by Paul Craddock. The talk was introduced by Sheridan Bowman, who told us that Paul had joined the BM in the summer of 1966, and gained his PhD from the Institute of Archaeology on ‘The Composition of copper-alloys through Classical Antiquity’. He has since worked in many countries all over the world, and even in parts of Wales. Paul’s superbly entertaining lecture was entitled ‘The end of an old fraud: the story of Charles Dawson’s cast iron statuette’, and was followed by a wine reception.

The second day began with a session focussed on technology and innovation, and covered experimental archaeometallurgy, furnaces, crucibles, iron smelting and rotary motion techniques. Also included were papers on the uses of copper in the goldsmith’s workshop and copper in the industrial age.



Figure 2. Delegates enjoying the evening reception

The third session was entitled ‘Asian interactions’ with papers on the development of metallurgy and artefacts from Thailand, China, Japan, Korea, India, Russia and the Near East, covering many periods and a range of materials including iron, bronze and the precious metals.

The fourth session concentrated on African metal production and trade. The session included papers on tin and bronze in the Late Iron Age of southern Africa, technology transfer within an Islamic world system, copper-based technology at the time of the Mali Empire, the human factor in African iron slag, and tracing West African gold.

The conference wouldn’t have been complete without the final session on zinc and brass, which concentrated on the development of early brasses from many parts of the world and the early industrial-scale production in India and China.

Almost 70 posters were presented in two main sessions — once again a very wide range of topics were covered and provoked a lot of interest and debate. Some of the ‘posters’ were actually PC-based presentations shown in the IT suite, adding to the audio-visual variety introduced earlier by films on martial arts swords from India and on the discovery of zinc production in India.

The conference ended with an evening reception in the wonderfully appropriate setting of the ‘Enlightenment Gallery’.

All three days were packed with high quality oral and poster presentations, the entire event running smoothly due in no small measure to the hard work of a large number of Museum staff and the skill and the organisation of the projectionists. In addition, there was a terrific, friendly and positive atmosphere which was sustained over the whole three days.

The organising committee are pleased to say that Archetype books have agreed to publish a volume based on a selection of refereed papers presented at the conference. This volume will hopefully be a fitting record of the conference and will reflect just some of Paul Craddock’s interests and achievements over the past 40 years.

CONFERENCE REPORT

Pre-Industrial Iron Symposium, 2004

Skip Williams

The Pre-Industrial Iron Symposium was held in Cooperstown NY, 9th to 11th October 2004. The event drew in a diverse crowd of over a hundred; archaeologist, historian, smith, collier, and re-enactor. Oral presentations, given during lunch and in the evening, introduced us to development of the American iron industry, the technology of crucible steel (pulad) production, the ornamental use of iron through the Spanish Renaissance and a variety of other subjects. The audience had a selection of demonstrations to choose from during the morning and afternoon hours. Smelting in three furnaces types was demonstrated during the symposium.



Figure 1. Darrell Markewitz demonstrates a small Viking styles furnace to an appreciative audience

Darrell Markewitz is a blacksmith from Proton Station, Ontario who has participated in many Parks Canada Norse-related activities. Darrell arrived at the symposium expecting only to demonstrate Viking Age smithing techniques but, caught up in the excitement, by the end of the first day Darrell had put the finishing touches on the small Viking style furnace.

Michael McCarthy picked up his knowledge of Tatar steel making when he attended a workshop given by Mr. Akira Kihara at the University of Minnesota. Michael and his staff at the Framers Museum prefer to use only authentic materials for their smelts. The Tatar furnace was built using local clay and charged with magnetite sand harvested from the shores of nearby Lake Champlain.

Skip Williams and Lee Sauder of The Rockbridge Bloomery have been smelting iron since 1998 in a Roman shaft furnace built in the style of Ronnie Tylecote. Over the intervening years this furnace (in the background to the right) has produced nearly 1500lb (660kg) of bloom iron.



Figure 3. Paul as an Etruscan pendant

Fires were lit in the three furnaces in mid-afternoon on Sunday and smelting proceeded according to the whim and fancy of the individual furnace. The small Viking furnace was charged with ore and charcoal for 5 hours before smelting was stopped and produced a nicely shaped bloom containing several pounds of soft iron. The Sauder/Williams furnace continued to burn into the darkness of late evening and provided quite a show when the furnace was opened. With the crowding standing back a reasonable distance from the hot slag sprays, a 40lb (18kg) bloom was pulled from the tap arch, set upon an oak stump, and then drawn out and quartered by a team of sledge hammer wielding blacksmiths. The evening ended late with the pulling down of the Tataara where we found, nestled in the charcoal bed at the base of the vitrified and slagged furnace walls, a 25lb (11kg) bloom of steel known as Tama-hagane.

Metallurgical study of the blooms, ores and clay materials is being done by Elizabeth Hendrix at MIT. We are expecting her to present her results at the 2005 Symposium. Iron from the symposium smelts has been forged by Michael McCarthy at the Farmer's Museum and by Steven Mankowski at Colonial Williamsburg and the artifacts will be on display at the 2005 symposium.

The positive response from the attendees was overwhelming. We hope that this may become the first of a series of symposia on Early Iron. Thanks go to everyone who volunteered, especially the charcoal sorters! We hope to see you at the 2005 gathering (details below).

FORTHCOMING CONFERENCE

Early Iron II

8–10th October 2005, The Farmer's Museum,
Cooperstown, New York, USA

The EarlyIron II Symposium will be held at The Farmers Museum in Cooperstown New York, 8th to 10th October, 2005.

We again hope to attract folks from across the spectrum of interest in early iron-making processes: historical, archaeological, metallurgical, and artistic. Throughout the weekend there will be a variety of lectures, presentations, and smelting and forging demonstrations. On Saturday evening several bloomery furnaces will be run followed by a bloom smithing session.

In addition to the Symposium events, there will also be a hands-on workshop in bloomery smelting taught by Michael McCarthy, Darrell Markewitz, Skip Williams,

and Lee Sauder. Workshop participants will be organized in teams of 3–5 people each. On Saturday each team will build a Coated Tyle Furnace, a small clay bloomery based on a commercial terra cotta chimney tile (for details see: http://iron.wlu.edu/Bloomery_Iron.htm). The furnaces will be run on Sunday with Monday devoted to bloom smithing. The bloom will be divided among the team members as they see fit.

Cost for the symposium will be \$150 for the weekend, including breakfast and lunch. The cost of the smelting workshop is \$700 per team. The cost of the workshop includes Symposium registration, so participation in the workshop is only slightly more than the symposium.

For further info or registration call Karen Wyckoff of the Farmer's Museum at (607) 547-1410, or email Michael McCarthy at michael@hammerinhand.com

FORTHCOMING CONFERENCE

HMS Annual Conference,

9–11th September 2005,
Middleham, Yorkshire, UK

The conference will be held at the Key Centre, Middleham, near Leyburn in North Yorkshire and will focus on the mining and metallurgy of lead and silver but not to the exclusion of other metals. We are expecting presentations on work carried out as far afield as Bolivia and Greece as well as more local investigations on the early working of lead and iron.

Booking forms were circulated with the last newsletter and are available on the Internet at <http://www.exeter.ac.uk/~pfclaugh/mhinf/hmsbook.rtf> or by contacting
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FORTHCOMING CONFERENCE

Beautiful Measurement

24th November 2005, British Museum, London

The British Museum and the Worshipful Company of Scientific Instrument Makers join forces to celebrate the craft and the 50th anniversary of the founding of the Livery with a day of lectures and demonstrations which will appeal to the general public and the specialist.

Have you ever wondered what an Astrolabe is? What does a Nocturnal do? Who used an Armillary Sphere?

How does an Atomic Clock work and what is MRI? Who made these devices and how have they changed our world? Come to a one day meeting where the purpose, construction, use and social importance of Scientific Instruments from the early Islamic era to today will be unravelled. There will also be opportunities for handling some of these beautiful objects.

Attendance, which is open to all, is by ticket only (£40, concessions at £20) and includes coffee, lunch with wine and soft drinks and afternoon tea. Information and booking forms can be obtained from the British Museum, tel: 020 – 7323 8550 / 8510.

FORTHCOMING CONFERENCE

BUMA-VI, 2006

15–20th September 2006, Beijing, China

The sixth conference on the Beginnings of the Early Use of Metals and Alloys will be held from the 15th to the 20th September, 2006.

The general theme of this conference will be “Metallurgy and Civilisation” and discussions will focus on the impact of the emergence and use of metals on the development of human civilisations. There will be an excursion to Kunming, Yunnan Province.

The conference language will be English. The conference will be held at the conference centre of the University of Science and Technology, Beijing. Registration fees are US\$200, before 15 May 2006, and US\$240 after 15 May 2006.

Further details can be obtained from the Secretariat:

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FORTHCOMING CONFERENCE

Archaeometallurgy in Europe 2007

Grado and Aquileia, Italy

The organisers of the second international conference on archaeometallurgy in Europe (Associazione Italiana di Metallurgia, AIM) have issued a call for papers. The conference will deal with European archaeometallurgy from its origins to the first half of the 18th century AD.

Papers are welcomed on topics covering all aspects of archaeometallurgy. There will be a special session devoted to the archaeometallurgy of non-European countries. The conference language will be English and accepted papers will be published in a volume of conference proceedings. Titles and abstracts may be submitted via the AIM website:

www.aimnet.it/archaeometallurgy2.htm

The deadline for the submission of titles and abstracts is the 30th November 2006 with notification of acceptance by 15th January 2007.

Credit Card payments

Lesley-Ann Cowell

The NatWest Streamline have now changed the procedure for credit card payments. It is now a requirement to give the last three digits on the back on the signature strip, for authorisation. Would all members who pay via Visa or Mastercard only, please note that the subscription invoice will now ask for this detail following the credit card number.

I would also ask members who pay via Accounts Departments, or Agents, to advise them that the Membership Number is required on the remittance advice when presenting payment, either through BACS or cheque. This will ensure that payment is credited to the right account. There have been some anomalies in the past which have taken a great deal of time to sort out.

While submissions to the Newsletter are welcome at any time, if you want to have something in a specific issue of the newsletter then it needs to be with me by the following deadlines.

1st March,

1st July

1st November

Contributions can be sent in any format (hand-written, typed, email, floppy disk, CD-ROM, etc).

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