"34th International Symposium on Archaeometry: Archaeometallurgy", Zaragoza, Spain, 3rd-7th May 2004

Marcos Martinón-Torres
Institute of Archaeology, UCL

The "34th International Symposium on Archaeometry" was held in Zaragoza (Spain), 3rd-7th May 2004. The local committee, led by Josefina Pérez-Arantegui (University of Zaragoza) and Marius Vendrell-Saz (University of Barcelona), should be commended for their excellent organisation, which allowed nearly 200 international delegates to enjoy a wide-ranging scientific programme as well as an exciting social agenda, including guided tours and many opportunities for informal discussion.

Some 90 oral presentations and 190 posters were featured, covering many aspects of the technology and provenance of metals, ceramics, glass, glazes, stone and pigments, as well as field archaeology, dating and biomaterials. Almost 20 oral presentations and over 30 posters concerned archaeometallurgy. These provided a fine picture of the breadth of current research on past metallurgy worldwide, presenting modern research trends, new discoveries and reassessments of past topics in the light of new analytical data and theories. These also suggested new research questions and strategies for the future. Only a few of these presentations and posters can be mentioned here.

Several papers in the field of ferrous metallurgy may be highlighted. In his poster, V. Serneels addressed a type of metallurgical remains frequently found in archaeological workshops, the informative potential of which is normally not exploited in full: the plano-convex bottom (PCB) or smithing slag. He classified PCBs into three types, each of them representing a different process and having diagnostic external and microstructural features. Furthermore, he presented a method for calculating iron loss during smithing, which may allow systematic comparisons of the extent of production and skill of different workshops.

Another poster presenting promising analytical developments was that by M. Charlton and A. Reid on iron smelting slag from Uganda. By processing the bulk chemical composition of slag samples using multivariate statistics (principal component analysis), they could differentiate distinct slag types based on the variable influence of ore, fuel and furnace lining in slag formation. The identification of these 'positive constraints' provides a sound basis for the discussion of technological variability and could be applied to any remains of iron metallurgy.

It was encouraging to notice that the contribution of fuel-ash and metallurgical ceramics to slag formation – and thus to metal production – is increasingly considered in the interpretation of analytical results. Also in this vein, H. A. Veldhuijzen and Th. Rehren presented evidence from the earliest known iron smelting site in the Levant – Tell Hammeh in Jordan, dated to the early first millennium BC – and demonstrated the crucial technical role of the tuyères, which melted during the smelting process, thereby increasing the fluidity of the slag.

Papers from the Institute of Archaeology 15 (2004): 106-109

P. Dillmann and P. Fluzin presented an analytical study of the metallurgical remains from Glinet (16th century AD), the earliest iron refinery excavated in France. Their research showed the use of low-phosphorus (≤1%) ores for the production of cast iron, which was subsequently dephosphorised in a refining process with the addition of lime. Unfortunately, no hypothesis was presented as to the form in which this lime was added. The authors also categorised different types of refining cakes from consecutive refining steps.

Those interested in non-ferrous metallurgy had the chance to learn and discuss the results of varied and interesting research. B. Mille *et al.* presented the results of a large-scale project on the development of copper metallurgy in Balochistan, Pakistan. They traced the origins of metallurgy back to the first half of the sixth millennium BC, and documented the use of lost-wax casting as early as the fifth millennium BC, amongst other examples of a surprisingly skilled Chalcolithic metallurgy. The presentation by R. Muller *et al.* confirmed the long suspected practice of crucible smelting of arsenical copper in Chalcolithic southeast Spain, and posed the possibility of fahlore smelting. Experimental fahlore smelting in a one-step process controlled by oxygen partial pressure, carried out by D. Bourgarit *et al*., demonstrated the feasibility of such a technique for early metallurgy. This questions traditional assumptions in the interpretation of archaeometallurgical remains, such as the need for a furnace for smelting, or the necessity of roasting fahlores.

Also focusing on the Iberian Peninsula, S. Rovira *et al.* discussed a peculiar lead smelting technique documented in several sites from the Phoenician period (early first millennium BC), which involved the generation of 'free silica' slag. This was probably due to an insufficient combustion of the charge in the top of the furnaces. Given the relatively widespread occurrence of this type of slag in the southwestern Iberian Peninsula and its absence from the rest of the Mediterranean basin, it would be extremely interesting to investigate the particular technical and socio-cultural reasons behind this technological choice.

Valuable research presented by M. Georgakopoulou revealed the first evidence of small-scale Early Bronze Age copper (and possibly lead/silver) smelting within a settlement in the Cyclades, Greece, contemporary with known larger-scale smelting sites at remote locations. This discovery compels a wider review of inter-site relationships and a reassessment of the organisation of early metal production in this region.

N. Eniosova *et al.* presented systematic analyses of Alanian mirrors from medieval southeastern Europe. They illustrated how the standard, simple casting technique remained unchanged, while alloys evolved over time from typical high-tin mirror bronzes to more variable tertiary and quaternary alloys, thus revealing the loss of an original recipe and/or recycling of scrap metal. In this poster, advanced digital maps were effectively used to present the directions and intensity of culture and metals flow.

J. Bayley and K. Eckstein addressed the variability of the archaeological litharge cakes, the characteristic features formed at the bottom of silver cupellation hearths. They

identified two main types: those lined with bone ash and those lined with marl. Their formation mechanisms and functions were explained and the relative efficiency of the slightly different cupellation processes was assessed. Significantly, a different type of cupellation hearth lining – plant ash – was documented by Th. Rehren *et al.* in their ethnoarchaeometallurgical study of traditional lead/silver smelting in Bolivia. This study showed many variations of the 'canon' that are often not considered in the interpretation of archaeological remains, such as the direct reduction of galena in a process with substantial metal losses, and where the availability of fuel appeared as a major constraint. Observations such as these further stress the danger of applying modern industrial economic systems to the interpretation of past technologies.

Numerous litharge cakes, as well as copper smelting remains, have also been found in fourth millennium BC contexts in central Iran, during an exhaustive archaeometallurgical survey programme reported by Z. Hezarkhani *et al.* In a different context, E. Asderaki and Th. Rehren investigated the use of fresh, desilvered lead in Hellenistic Greece and showed that part of it was still coming from Laurion at such a relatively late date, a discovery for which written evidence is scarce.

The author also presented and discussed some research carried out with Th. Rehren. This included a presentation on the potential of scientific analyses of laboratory remains as a complementary approach to the traditionally confusing world of Renaissance alchemy, and a comparison of the material properties and performance characteristics of the main crucible types used in the post-medieval world: the well-known Hessian wares and the little-known black Obernzell crucibles, both produced in Germany and widely traded.

Another area where archaeometallurgical research showed significant developments was in the provenancing of metals by isotope analysis. For example, M. Haustein *et al.* reported current advances in the measurement of tin isotopes, although this technique still needs further refining. P. Degryse *et al.* presented successful work on lead, strontium and osmium isotopes aimed at provenancing iron artefacts excavated in Turkey. Where the attempted provenancing of metals was achieved, however, researchers sometimes failed to explore the archaeological significance of their findings. It is hoped that future research on the provenance of metals will be more clearly related to wider archaeological questions.

Many other interesting archaeometallurgical studies were also presented covering the metallurgy of Pre-Columbian America (namely N. Schulze on technological choices in the production of Aztec bells, and L. Limata *et al.* on a Peruvian nose filigree). Details of surface treatments, such as a previously unknown cuprite-based black patina, were documented by F. Mathis *et al.* in a Roman artefact.

Overall, archaeometallurgical research presented at the 34th International Symposium on Archaeometry showed an encouraging trend to ground analytical data in archaeological contexts and questions and a refreshing consideration of cultural aspects in metallurgy. Increasing attention was paid to the role of ceramics in metallurgy and to

the potential contribution of a combination of written and archaeometric information. Such a stimulating meeting provided an excellent environment to celebrate the ever-inspiring work led by Professor Michael S. Tite, on the occasion of his formal retirement later this year. The conference proceedings, which will be published electronically, are eagerly anticipated.

As a note of local interest for the readership of *PIA*, it may be mentioned that the symposium also served as an international forum for the presentation of research carried out at the Institute of Archaeology (IoA), UCL. Four oral presentations and five posters, most of them by current and former research students, reported on work carried out at the Archaeological Science Laboratories, and they were awarded four different prizes. This establishes the IoA at the forefront of archaeometric research worldwide.

Acknowledgements
I am very grateful to the Historical Metallurgy Society R. F. Tylecote Fund, the Institute of Archaeology Awards and the Graduate School, UCL, for their financial support to attend this symposium.