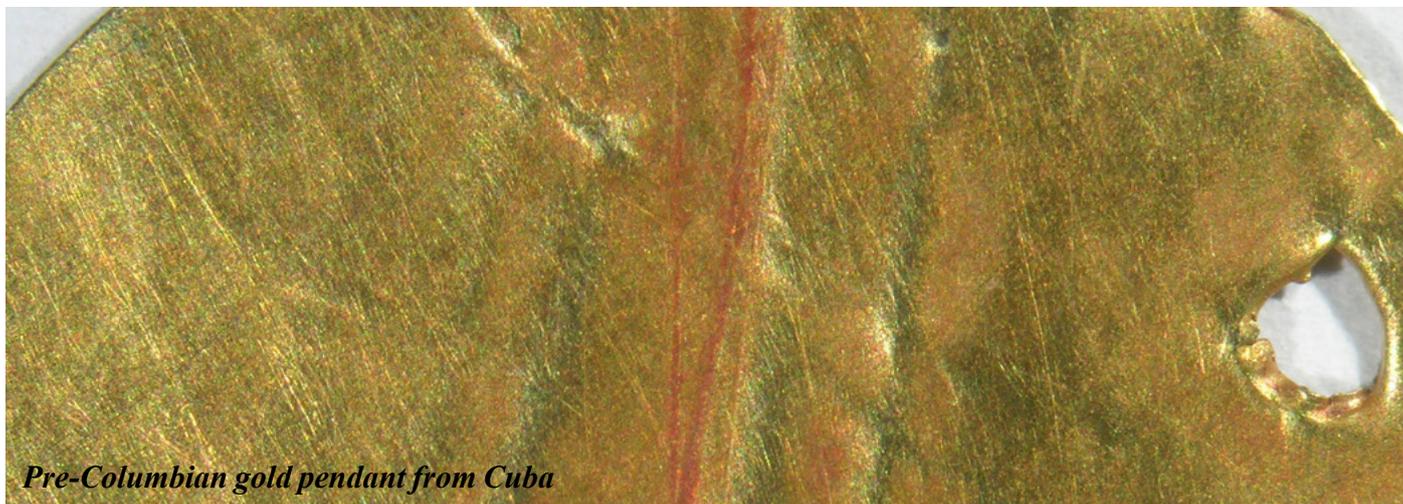


THE CRUCIBLE

Historical Metallurgy Society News
Issue 84

Winter 2013



Pre-Columbian gold pendant from Cuba

Editor

Marcos Martín-Torres

Assistant Editors

Loïc Boscher

Siran Liu

Matt Phelps

Miljana Radivojević

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.

The Crucible

thecrucible@hist-met.org

c/o Marcos Martín-Torres

UCL Institute of Archaeology

31-34 Gordon Square

London WC1H 0PY

United Kingdom

www.hist-met.org

INSIDE THE CRUCIBLE

- 2 **Editorial**
- 3 **Archaeometallurgical News**
- 8 **A Letter From... France and Chile**
- 10 **One Minute Interview - David Bourgarit**
- 12 **Meet Your Council - Peter King**
- 13 **Reviews**
- 20 **Forthcoming Events**



The **HISTORICAL METALLURGY**
Society

This year marked the 100th anniversary of the official discovery of stainless steel, and HMS celebrated the occasion with its annual conference in Sheffield, “the Steel City”. It therefore seems fitting that much of this issue of **The Crucible** concentrates on ferrous metallurgy, not only with a review of the Sheffield conference but also with reports of conservation work in important ironworks and relevant publications. Even the Meet your Council section has a strong ferrous flavour through the words of Peter King, who diligently helps us keep the HMS accounts in order, while continuing his extremely thorough research on the history of post-medieval iron in Britain.

The conservation of industrial metallurgical heritage, primarily blast furnaces, was a core concern of the founding fathers of our Society 50 years ago, as reported in revealing historical notes by Tim Smith. While this concern has not been abandoned, as shown by the report from Gunns Mill, HMS has continued to expand its membership and scope of action. It is perhaps significant that the editorial team of this very newsletter includes representatives from five countries and three continents! We are therefore very pleased to see this diversity of interests and approaches increasingly reflected in the pages of **The Crucible**. It is hard to think of something more diverse than a ‘A letter from...’ signed from both Chile and France, outlining an inter-continental comparative approach with very interesting implications for our understanding of the different developmental trajectories of copper metallurgy in both regions. Also from France, and with interests ranging from experimental archaeometallurgy through to Gaston Bachelard, David Bourgarit displays his usual combination of wit and insight in the One Minute Interview.

The issue is completed with further reports and conference announcements, including one sent from China about the recent BUMA conference in Japan. And Japan will be the destination of one of the first two beneficiaries of the HMS Anniversary Fund, which keeps growing thanks to your very generous donations and, in turn, helping others with their training and research on matters of historical and archaeological metallurgy. We are very keen to keep promoting the internationalisation of **The Crucible**, as a true reflection of the HMS base – so please keep them coming! We want to read your news, views and reports from around the world.

If you are reading these lines on a hard copy, don’t forget that you can also download a full-colour version from the HMS website (www.hist-met.org), where you will also find interesting features such as a growing number of Archaeometallurgy Datasheets and a brand new HMS Shop, as well as details of exciting HMS Conferences on the horizon. You can additionally join the HMS Facebook page (www.facebook.com/groups/histmet), which has recently welcome its 600th member, and follow HMS on [Twitter \(@histmet\)](https://twitter.com/histmet). It has never been easier to stay involved and up to date!

The Editorial Team



The impressive sight of copper smelting experiments in Serbia. Full article to follow in the next issue.

EMERGENCE OF LARGE SCALE COPPER PRODUCTION DURING THE EARLY BRONZE AGE IN SAINT-VÉРАН (FRANCE) AND IN PREHISPANIC NORTHERN CHILE: A COMPARATIVE RESEARCH PROGRAM

Recent research on the organisation of copper production tends to show that metallurgy has rarely developed on a simple and linear manner but rather along quite tortuous paths. A team of Chilean and French archaeologists, archaeometallurgists, and geologists are currently comparing different social and technological contexts surrounding the emergence and/or development of various copper metallurgies including domestic and large-scale types of productions. The latter are explored in both France during the Early Bronze Age and Northern Chile during Pre-Inca and Inca periods through a combination of field work, archaeometric investigation and metallurgical experimental simulation. The on-going work focuses on two Chilean mining and metallurgical areas, Miño and Ujina-Collahuasi, and on the Saint-Véran district in the French Alps. The French and the Chilean historical contexts are culturally independent, allowing us to conduct our studies according to a comparative method. The expected result of such an approach is to better understand and explain the different trajectories of development of metallurgy in the two regions.

Whereas a single model of copper extractive metallurgy has long been assigned to the Early Bronze Age Saint-Véran district, namely large-scale reduction of bornite thanks to very efficient smelting processes (Bourgarit et al, 2010), current fieldwork and slag investigation are putting into light a much less mature metallurgy (Figures 1 and 2). This alternative technology has yet to be phased in order to determine its place in the metallurgical activity of the district.

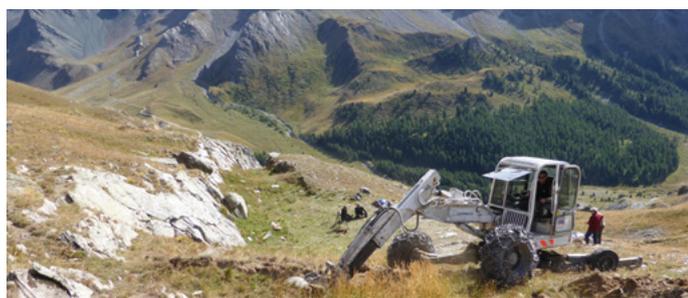


Figure 1 Saint-Véran, Hautes-Alpes, France. View from the copper mine 'La Tranchée des Anciens'.

In the Upper Loa in Northern Chile, the intensive production system brought by the Inca largely relied on pre-existing widespread copper extractive metallurgies practiced at smaller scale (multipolar development of metallurgy, *sensu* Mille and Carozza 2009). Traditionally, it has been assumed that Inca conquest introduced important transformation in local metallurgical traditions, including new types of furnaces, emphasis on specific alloys and/or the manufacture of specific types of objects. Our ongoing research in the mining

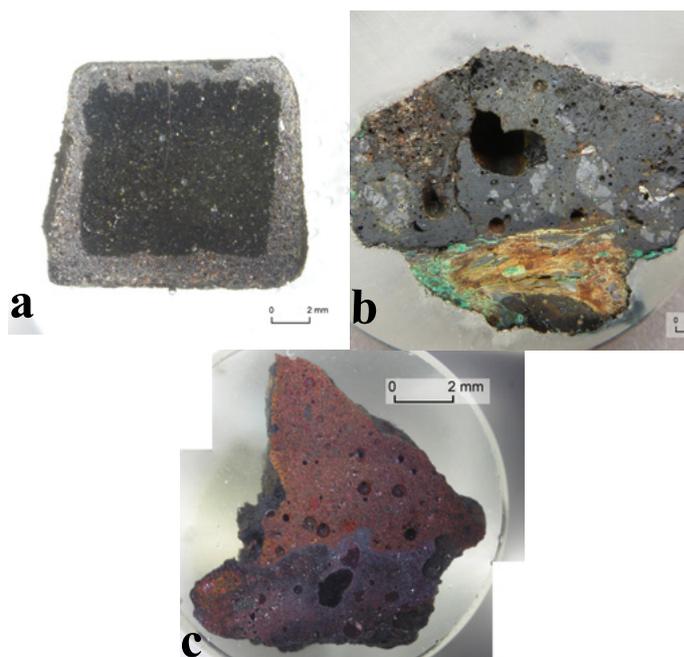


Figure 2 Comparison of EBA plate slags and undated conglomerate slags at Saint-Véran (a & b) with conglomerate slag at Miño (c); Dark-field optical Micrographs taken from polished sections.

and metallurgical districts of Miño and Ujina-Collahuasi seems to prove otherwise (figure 3). Even though there is an evident increase of production scale during the Inca period both in mining and metallurgical sites, this change appears to have been promoted more by a reorganisation of the activity — increase of human power, improvement of the mining settlements, development of transportation for both catering and production — rather than by any marked technological progress in smelting (Salazar et al, 2013a). Indeed, most local technological peculiarities are still to be seen during the Inca period, as exemplified by two aspects. First, conglomerate-like copper slags are produced in both Pre-Inca Miño and at Ujina-Collahuasi during the Inca period, thus pointing so far to few if any improvement of the copper smelting technology (figure 2). Second, at Ujina-Collahuasi, very peculiar large stone furnaces, which had not been reported previously in other metallurgical sites in the Andes, have been brought into light for both Pre-Inca and Inca periods (figure 4). These smelting reactors, always located on the top of small hills, are powered by wind, taking advantage of a strong airstream which has been proved by the local meteorological records to be very steady in both intensity and direction.

Although the research program is at its very beginning, several preliminary observations may already be pointed out. Interestingly, the Chilean case offers another nice example of multipolar emergence of metallurgy. This adds to the former proposition stated for Languedoc, France at the end of the 3rd mill. BC (Mille and Carozza 2009). Moreover, it enlightens how determinant efficient supplying system and mobilisation of manpower may be for the rise of a large-scale copper production in hostile environments. This may



Figure 3 View from the modern Rosario mine at Collahuasi, Chile.

offer new avenues of research at Saint-Véran where the working organisation underlying the Early Bronze Age copper massive production is not yet fully understood. Regarding technology, the exact role of the efficiency of the smelting process in the change of production scale has to be examined as well. In Northern Chile, the apparent absence of any clear technological improvement needs further investigation. At Saint-Véran a “Bronze-Age” technological revolution has clearly occurred, although the two types of metallurgies recognized so far, namely the non-slugging and the very efficient slugging process have still to be phased chronologically in relation to each other. Finally, the very question of the copper ore destination needs to be addressed. For example, in Prehispanic Northern Chile copper seems to have been traded more as an ore than as a metal. The huge disequilibrium between the mining production at the Tranchée des Anciens and the smelting activity obliges to reconsider this aspect at Saint-Véran as well.



Figure 4a Large stone wind-powered furnace at Ujina 8 (bench-shape type).

Despite the fact that considerably more fieldwork has been done in Europe, our understanding of ancient metallurgy in the Prehispanic Andes is more advanced than for the European Alpine Bronze Age. This is obviously related to both a better conservation of the Chilean sites and to the availability of ethnohistorical sources. Moreover social, political and economical contexts so far have been much more taken into consideration in South-America than in Europe in order to study the historical development of metal production. These may also be future prospects of research.



Figure 4b Reconstruction of an Ujina-Collahuasi bench-shape furnace for a smelting experiment; a 40 km/h⁻¹ wind was produced with an industrial fan.

At least, one parameter of paramount importance should be systematically recorded during fieldwork on prehistoric metallurgical workshops: the scale of production. And this variable should be addressed not only from the archaeometallurgical remains alone, but from the overall archaeological context where these are situated (Salazar et al., 2013b).

Benoit Mille, Diego Salazar, David Bourgarit, Valentina Figueroa, Catherine Perlès, José Berenguer, Laurent Carozza, Paulina Corrales, Florian Balestro, Pierre Rostan, and Albane Burens-Carozza

Acknowledgments

This work was supported by CNRS-CONICYT (2012, grant number 555) and by ECOS-CONICYT (2012-2014, grant number C11H02).

References

- Bourgarit, D., P. Rostan, L. Carozza, B. Mille and G. Artioli. 2010. Vingt ans de recherches à Saint-Véran, Hautes Alpes: état des connaissances de l'activité de production de cuivre à l'âge du Bronze ancien. *Trabajos de Prehistoria*, 67(2), 269-285.
- Mille, B. and Carozza, L. 2009. Moving into the Metal Ages: The Social Importance of Metal at the End of the Neolithic period in France. in: Kienlin, T. L. & Roberts, B. W. (eds.), *Metals and Society, studies in honour of Barbara S. Ottaway*. Bonn: Habelt, 143-171.
- Salazar, D., Berenguer, J. & Vega, G. 2013a, Paisajes minero-metalúrgicos incaicos en Atacama y el Altiplano Sur de Tarapacá. *Chungara*, 45(1): 83-103.
- Salazar, D., Borie, C. & Oñate, C. 2013b, Mining, commensal politics and ritual under Inka rule in Atacama, northern Chile, in: K. Vaughn, K. & Tripevich, N. (eds.): *Mining and quarrying in the ancient Andes: sociopolitical, economic and symbolic dimension*. Springer, 253-274.