ARCHAEOOMETRY AND THE INTERNATIONAL EVOLUTION OF STUDIES ON METALLURGY: A BIBLIOMETRICAL PERSPECTIVE

Elías LÓPEZ-ROMERO GONZÁLEZ DE LA ALEJA and Ignacio MONTERO-RUIZ
Dpto de Prehistoria, IH, CSIC
C/Serrano 13, 28001-Madrid (SPAIN)
elopez@ih.csic.es imontero@ih.csic.es

1. INTRODUCTION

Analytical studies on prehistoric metals have their origins in the 19th century. Pernicka (1998) divided the history of archeometallurgy in three periods that we can labelled as: - formative (XIX century -1930), development (1930-1970) and expansion (1970-). The first one used wet chemistry, being the introduction of Optical emission spectroscopy (OES) in the 30ths the point of breaking-off. In this period the archaemetallurgical research mainly used OES developing projects of analytical corpusess aiming at solving questions of provenance and distribution networks of metals (Otto and Witter, 1952; Pittioni, 1959; Chernij, 1966; Junghans et al., 1960, 1968). At the same time, studies on the History of Technology were being developed, using complementary techniques such as metallography or hardness test. In the 50ths and 60ths new analytical techniques were available, for example Alan Walsh develops atomic absorption spectroscopy in 1955 or Harry Bowman and colleagues publish in 1966 first energy-dispersive X-ray fluorescence (EDXRF) results (Ryon, 2001: 366), although some time passed until their general archaeological application. From the 70’s onwards a high diversity of multielemental techniques were in use and instrumentation improvements added to the introduction of digital control and standardisation of the computer platforms, software, portable equipments etc (Jenkins, 1999), let the archaemetallurgy research explore all capabilities looking for more sensitive and precise results.

We will focus on the third period, trying to define the kind of materials analysed (metals, alloys and production residues), the analytical techniques and their evolution as well as the chronological distribution of those materials, by the study of scientific periodicals and publications from 1975 to 2000.
2. SAMPLING

The database created for the global project of bibliometrical analyses consists on 1440 records; 245 of them refer to studies on metals and are the basis for the present paper.

Articles have been classified following a seven-type structure according to their main general purpose: 1) “analysis of archaeological materials”, 2) “dating”, 3) “analysis of soils & geology”, 4) “statistics & computing”, 5) “descriptive and general review papers”, 6) “genetics”, and 7) “other”. Only types 1, 4 and 5 are represented in the current case of study.

Three have been the sources for our database collection: the journals *Archaeometry* (Oxford University) and *Revue d’Archéométrie* (CNRS), and the International Congresses on Archaeometry series, held every two years at different locations. Regarding to the latter, it must be said that they are unevenly published and they are not always easy to find; the first of those publications included in our database is the 16th International Congress on Archaeometry, held at Edinburgh in 1976, while the latest is the 30th Congress held at Urbana (Illinois) in 1996. However, only selected papers of all those presented were finally published in some Proceedings. Previous conferences remain unpublished or have not been available, but their absence in the current analysis is by no means essential for our basic aim was to show and identify the main trends in archaeometrical studies in the last 25 years; having this in mind, we considered setting the upper chronological limit in 2000.

As a general reference for the evolution of studies on metallurgy, we have also decided to analyse those papers presented to the 31st (Hungary) and 32nd (Mexico) ICA, though only abstracts of the sessions on metals have been available.

3. GENERAL TRENDS

Through the analysis of the previous data we can define some general trends and perspectives of research on metallurgy.

First of all, it comes out that the instrumental development of techniques is quickly applied to Archaeometallurgy, improving the capability and quality of analytical activities. Added to these improvements, a clear effort is being done to reduce the size of the analytical equipment, developing portable machines.

Several techniques are being complementarily applied for studying the archaeological material; we have documented up to six different physical and/or chemical techniques in the same paper. This is also a tendency in progress, and the multi-technique research will be probably increased in future in order to evaluate the accuracy of different techniques and to fulfil the definition of the metal objects and by-products.
In which respects to the techniques themselves (fig. 1), it is worth noting the prevalence of Elemental Analyses (82.4% of papers include this type of data) as well as the increment -in the 90’s - of Lead Isotopes due to the creation and availability of new laboratories, linked to the interest in research on provenance analysis on metals.

Dealing with elemental analyses techniques (fig. 2) SEM was the most used (25.9% of all registered techniques). It is from the second half of the 80’s when this dominance is apparent in concordance with the improvement of the equipments and its versatility for the interest of research. The chronological evolution of this and other main techniques can be seen in fig. 3, with the progressive decrease of NAA (including its instrumental implementation: INAA) in archaeometallurgy as another relevant trend, something that is not to apply to the general archaeometric research.

Papers dealing with the study of coins have shown the specificity of this field in the general context of Archaeometallurgy; techniques such as Proton Activation Analysis are almost exclusively used in the analysis of coins. Coins are, generally speaking, subject of less aggressive analyses; use of SEM has been nearly avoided until recent times. The historical, chronological and self-economical relevance of this kind of archaeological remain can be in the origins of such a behaviour.
Among the different types of metals (fig. 4), copper-based items are studied in near the half of the papers, while surprisingly iron is one of the least commonly studied; though the situation is once more changing in the last years, as we can note from the original program of the 34th Conference itself. We could define some reasons why this has been the dominating trend in the last 25 years,

There is a difficulty in the chemical characterisation of iron and its by-products

Iron gets easily corroded, and the state of preservation of iron-made objects is not always appropriate for undertaking analytical procedures

Third, but not least, iron-made objects refer most often to day-by-day activities (nails, etc.) and used to be at the eyes of researchers less attractive.

Finally, we can highlight the increasing concern on experimentation and study of ores, slags and smelting debris as reflection of the interest in the knowledge of production technology as a whole.

Figure 2. Elemental Analysis Techniques (percentages are based on the total number of techniques documented, not on the number of papers).
Figure 3. Chronological evolution of most used analytical techniques.

Figure 4. Percentage of metals studied in the papers sampled.

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