A Western Iberian Cassiterite Survey 1992-96

This article is a short review of the archaeo-metallurgical survey work which formed the basis of my PhD thesis presented at the Institute of Archaeology, University College London in January 1996.

I decided on tin as the subject for my PhD field survey work in 1992 since tin was a metal used in antiquity which had not been properly dealt with compared to the amount of research and fieldwork that had been invested in the provenance and production techniques for gold, silver, lead, copper and iron within the Iberian Peninsula.

The geographical and geological region I chose to work in was Mid Central-Western Iberia, including cassiterite ore sites in Spain in the provinces of Badajoz, Caceres and Salamanca and ore sites in Portugal in the provinces of Beira Alta, Beira Baxia and Upper Alentejo.

Cassiterite, the major tin ore used in antiquity in the Iberian Peninsula, appears almost exclusively within the Centro-Iberian Zone granites. The Centro-Iberian Zone granites run in a curved arch from the north-west corner of the Iberian Massif in the province of Galicia down to the Andalusian province of Jaen. The Central-Iberian granite zone contains important mineralizations of Sn, W, U, Cu, P, Li, Zn, Sb, and Au. The major deposits of Iberian cassiterite ores appear mostly within the central and northern regions of the granites. The field survey work which I undertook included only the central region granites.

A total of 42 sites were visited, some of the sites were visited only once, others were revisited each year as the survey work progressed.

A reference for choosing sites to visit was the geological listing of cassiterite mines that were still working or had recently ceased to work (Dallmeyer, Garcia, eds, 212-19). I visited primary vein mines where possible since alluvial worked sites would not really provide much identifiable archaeo-metallurgical surface evidence.

During the survey, I soon realised that it would be very difficult to locate some of the mines as they had not been worked for years and local knowledge of the location of what were very small mine workings was very meagre.

The sites were visited with the hope of locating remains of cassiterite ore veins or fragments of ore samples, archaeo-metallurgical surface remains such as mining or crushing implements, furnaces, casting or mould fragments, metal objects or fragments, slags and pottery.

The most important sites were:

No 4. El Cerro de San Cristobal, Logrosan: hammers, crushers, grinders, large amounts of Late Bronze Age pottery, and a small amount of flint and metal.

No 6. Tres Arroyos: a few fragments of iron slag and Roman pottery.

No 14. Mina Telba: pottery, undateable, a possible hammer fragment.

No 16. Mina Golpejas: a tin/copper mineral.

No 20. Torre Romana Centumcellas: Roman pottery and tin slag.

No 29. Minas Valdeflorez: two fragments of iron slag and cassiterite mineral samples.

No 38. Mina de San Expedito: a small amount of undiagnostic pottery and a small amount of iron slag.

No 42. La Mina de Berrocal: hammers, crushers, flint fragments and Copper Age pottery.

No 4. El Cerro de San Cristobal, Logrosan, proved to be the most rewarding of all the sites visited, for both its archaeometallurgical and Late Bronze Age settlement remains. Vicente Sos Baynat, a geologist working in the Logrosan area in 1950 to 1960, made a collection of archaeological artefacts which he presented to the National Roman Museum, Merida. Some of these artefacts strongly infer that El Cerro de San Cristobal was also settled in the Iberian Copper Age approximately 2000 BC.

No 42. La Mina de Berrocal, also was a site with numerous probable mining surface remains (hammers and crushers) and Copper Age settlement pottery.

No 16. Mina Golpejas produced a mineral containing both Cu and Sn. In a series of laboratory experiments I was

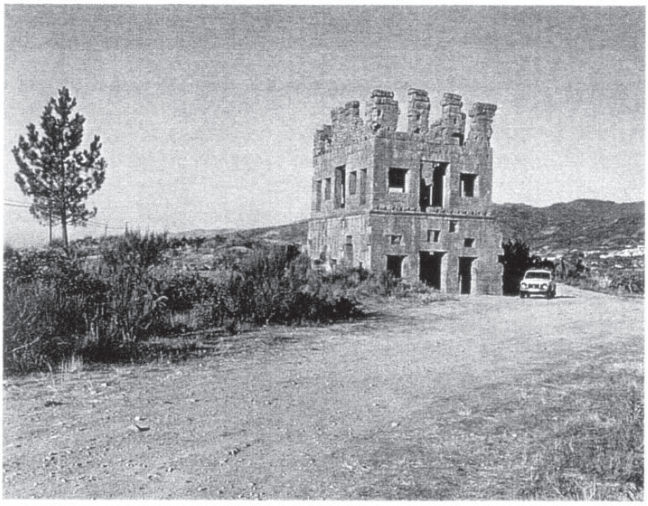

Fig. 1. View of Torre Romana Centumcellas, Belmonte, Portugal, looking south-west. The Roman tin slag, 1st to 3rd century AD, both surface and excavated, was found where vehicle is parked. Site No. 20.

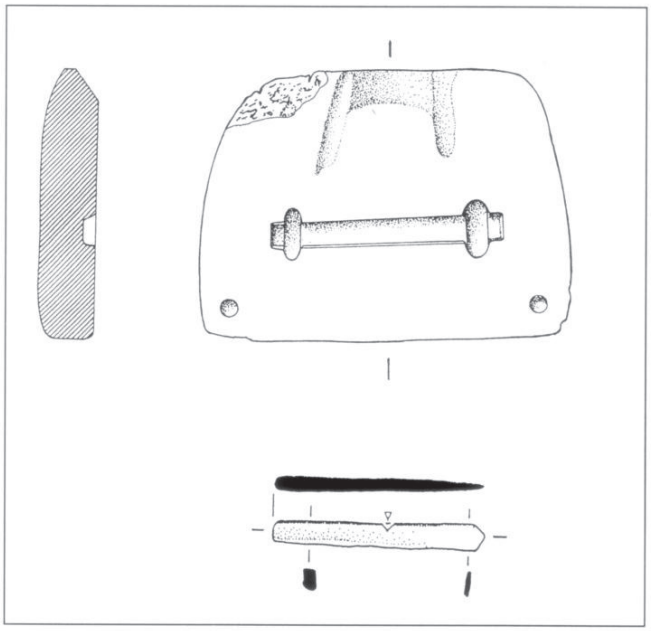

Fig. 2. El Cerro de San Cristobal, site No. 4. Casting mould fragment, part of Sos Baynet collection, found in the 1950s-60s. National Roman Museum, Merida. Bronze chisel, surface find by Anthony Bridgeman, 1995. The chisel fits perfectly into the casting mould. Scale 1:1.

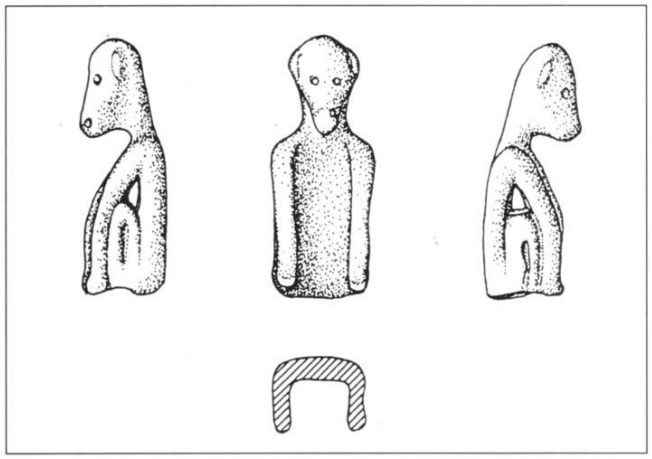

Fig. 3. El Cerro de San Cristobal. Site No. 4. Bronze monkey or dog (?). Sos Baynat collection National Roman Museum, Merida. Scale 1:1.

able to melt this unique mineral into a very small natural bronze prill. A Spanish geologist (Felix Garcia, Minas de Rio Tinto) informed me that small ore veins of mixed copper/tin minerals were quite common in the past at the western side of the Iberian Peninsula. The majority of these deposits would most probably have been worked out in antiquity.

No 20. Torre Romana Centumcellas produced a small amount (about 15 pieces of surface and excavated Roman tin slag dated 1st to 3rd centuries AD). Iron slag fragments were also collected and analysed. The excavated tin slag of Torre Romana Centumcellas is only the third example of ancient tin slag that has been found and recorded within a archaeological context.

The Torre Romana Centumcellas tin slag, analysed in the laboratory of the Institute of Archaeology (SEM/EDS) not only contained tin in amounts varying from 2.2% to 20%, but also contained varying percentages of the elements Niobium (Nb), Titanium (Ti), and Tantalum (Ta). These three minerals appear almost always with or alongside cassiterite in the granites of the central Iberian Peninsula.

The settlement and mining area of **El Cerro de San Cristobal** was planned (features and contours, 1:500 scale) during the 1994-95 survey seasons. It is hoped in the near future to enlarge the Logrosan planning survey to include the worked out mines on the lower north side of the Cerro and to plot in greater detail the cassiterite veins, mining shafts and galleries within the Late Bronze Age settlement area of the west Cerro.

The **Extremadura** tin survey project will be an on-going project involving the Prehistoric Department of the University of Caceres and it is hoped in the near future it will be possible to make some small excavation trenches at El Cerro de San Cristobal and at Mina de Berrocal.

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High-Tin Bronze Mirrors of Kerala, South India

High-tin bronze (copper with 20-30% tin) has been used in various ancient cultures to make mirrors. This alloy, also known as speculum, has a bright reflective surface when polished. In Ancient China, decorated mirrors were widely made from the Chou dynasty onwards for cosmetic, decorative and other uses. Typical Han Chinese mirrors were often cast from leaded high-tin bronze with about 25% tin and 5% lead (Meeks, 1993). There are examples of mirrors from the Roman world which were also leaded high-tin bronze. A variation during Roman times utilized low-tin bronze alloys, but with a tin coating on the reflective surface. Mirrors in antiquity represent a special class of metal object requiring specific metallic properties. In addition to technical studies of ancient mirrors, observations of traditional metallurgical crafts may also be used to increase our understanding of mirror production using high-tin bronze alloys.

A distinctive traditional process for making cast, high-tin bronze mirrors exists in several small villages in South India. The process received little attention from archaeologists, anthropologists or metallurgists, until the first publication of the process by Mukherjee (1978). There are, however, many aspects of this specialized traditional craft which were not considered at that time. As this traditional craft may yet vanish, the opportunity was taken to observe and document the process recently in the Allepey district of Kerala. There still remain several small, specialised groups of metals craftsmen utilizing the distinctive material properties of high-tin bronze to produce mirrors as well as bells, musical instruments and wrought vessels. Such utilitarian objects of high-tin bronze also appear to have been commonly used in Ancient India, so study of the traditional craft adds an additional perspective for the archaeological mirrors.

The metals craftsmen at the village of Aranmula in the Allepey District of Kerala, about 15 km from Changanur on the banks of the Pambiyar river, were visited on several occasions in 1992-93. Most helpful was a Mr A. Gopalakrishnan (Fig. 1), one of the few artisans who still carries on this traditional craft, which he claims has been in danger of dying out altogether. Economically, it was the interest of foreign tourists at a nearby *ashram* (religious commune) which has helped revive the craft. Mr Gopalakrishnan makes polished high-tin bronze mirrors mounted in brass handles. The high-tin bronze mirrors,