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New finds from an old treasure: the archaeometric study of new gold objects from the Phoenician sanctuary of El Carambolo (Camas, Seville, Spain)¹

*Nouvelles trouvailles pour un ancien trésor :
l'étude archéométrique de nouveaux objets en or du sanctuaire phénicien
de El Carambolo (Camas, Séville, Espagne)*

Alicia PEREA* and Mark A. HUNT-ORTIZ**

Abstract: In this paper, we present the results of an archaeometric study by SEM-EDS, carried out on six gold objects originating from the historical site where, 50 years ago, an important gold treasure, belonging to the Orientalizing-Tartesian period, was found. The new finds came to light recently, during rescue excavations that unearthed a monumental complex described as a Phoenician sanctuary.

Résumé : Nous présentons les résultats d'une étude archéométrique par MEB-EDS effectuée pour six objets en or provenant du site historique où, 50 ans auparavant, un trésor important, appartenant à la période orientalisante-tartésienne, a été trouvé. Les nouvelles découvertes ont été mises à jour récemment, pendant des fouilles de sauvetage qui ont exhumé un complexe monumental décrit comme un sanctuaire phénicien.

Keywords: Archaeometry, archaeometallurgy, goldwork, SEM-EDS, Orientalizing period, Southern Spain, Tartesian archaeology.

Mots-clés : Archéométrie, archéométaballurgie, Travail de l'or, MEB-EDS, période orientalisante, Espagne méridionale, Tartésienne, archéologie.

1. INTRODUCTION

On 30 September 1958, a treasure of gold objects was found by workmen refurbishing a public building at the top of a hill overlooking the fertile Guadalquivir river valley. The

Carambolo gold hoard consists of two sets of objects, representing a total of 21 ornaments, including 16 rectangular plaques, two pendants, a pair of bracelets, and a pendant necklace. They have recently been dated to a period around the 8th century BC, except for the necklace, which is prob-

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1. This paper is part of the Research Project entitled: "Grounds for an archaeometric and technomic research on metallurgy during Prehistory and Antiquity. The Iberian Peninsula" (Ref. n° HUM2006-06250), within the Programme CONSOLIDER INGENIO 2010 (CSD-TCP), funded by the Ministry of Science and Innovation, Spain.

Figure 1: Loop-in loop chain.
Figure 1 : Chaîne en loop-in-loop.

ably Cypriot in origin and of a later date, around the 6th century BC, the period when the treasure was concealed. From a technological point of view, it has been interpreted as the joint production of two different workshops, one indigenous and the other of Mediterranean origin, suggesting a peaceful coexistence between local people and the Phoenicians, although no evidence for technological transmission has been detected (Perea and Armbruster, 1998). Rescue excavations at the time brought to light some structures that were interpreted as a 'pit dwelling'. The pottery was said to be found in mixed archaeological levels containing both local and Phoenician types (Carriazo, 1973).

For many years, El Carambolo was the only site to produce a stratigraphy for the period when natives and Phoenician colonists first came into contact. Years later, a bronze statue of Astarte, the Phoenician goddess, was found nearby. This and other finds alerted archaeologists to the possibility that the site may have been more than a simple settlement, and that it might have had a religious function.

Rescue excavations carried out at this site from 2002 to 2004, due again to building works in the expanding city of Seville, unearthed a monumental sanctuary, dated to a period between the 8th and the 6th centuries BC. The complete stratigraphic sequence of the site extends from the final Bronze Age to the end of the Orientalizing period in the 6th century BC, when the site was abandoned (Fernández and Rodríguez 2005; 2007). The discovery of new gold objects during the most recent excavation has reopened the old debate on native versus Phoenician workshops.

Figure 2: Cylindrical lining.
Figure 2 : Revêtement cylindrique.

2. THE NEW FINDS AND THE METHOD OF RESEARCH

The new find consists of six gold objects:

- a 42 cm long fragment of a double *loop-in-loop* chain. It displays the marks of an ancient repair and several broken links.
- a 1.3 cm long cylindrical bead or lining made from grooved sheet, misshapen and incomplete.
- four identical discoidal appliques, 0.2 cm in diameter, each with a central hemispherical boss and a wire looped attachment on the back.

These objects were sent to the *Laboratorio de Microscopía Electrónica* CENIM, CSIC, in Madrid, for topographic examination using a Scanning Electron Microscope (SEM), and were initially analysed by Energy Dispersive X-ray Spectroscopy (EDS) in order to determine the elemental composition of the alloys, and also the type of solder used, if any.

3. TOPOGRAPHIC STUDY

The cross-section of the wire employed for making the chain links is circular, with traces of a helicoidal line that has largely disappeared due to wear. These features indicate, firstly, a prolonged use, and also the fact that the wire was manufactured by twisting a thin strip of gold (also known as strip-twisting). It also shows the marks of an ancient repair. At the midpoint of the chain, an interconnected link appears which could represent the beginning of a second branch of the chain, or a link for suspending a pendant.

Figure 3: Discoidal appliqué (left) with the wire loop at the back (right).
 Figure 3a, b : Applique discoïde (gauche) avec la boucle sur le revers (droite).

The cylindrical piece seems to be the lining of a cord or thick wire, rather than a separate bead. It is made from grooved foil rolled into a tube, which is considerably worn at the edges.

The four discoidal appliqués are real miniatures made by stamping small circular pieces of sheet, and had a wire loop soldered onto the back so that they could be sewn onto cloth. The wire loop was made by the same system of twisting as the one used for the chain. They are so small that the soldering process which had to avoid fusing the tiny objects was difficult. Traces of these problems can be seen in the dendritic structures throughout the surface.

4. MICROANALYTICAL STUDY

Table 1 records the complete results of the analysed areas. The chain is made from an alloy of 12% silver and 1% copper. The cylindrical lining has a silver content of 16% and about 1% copper. We cannot provide an approximate composition for the four appliqués, because all the measurements are affected to a greater or lesser extent by the process of soldering the loop to the back. However, they seem to be of fairly pure gold, with a silver content that cannot have exceeded 8%. In the case of the solder, we think it was carried out using a ternary alloy as a soldering material, with a silver content of around 20-25% and about 2% copper. There is no indication that an autogenous welding method or a bonding using copper salts was used, since the curve of the silver and copper measurements increases notably at the interfaces.

5. THE IBERIAN DISCOIDAL GOLD APPLIQUÉS

The objects that provide most information for interpreting this find are the discoidal appliqués. We are aware of a small but significant number of these objects, which always appear in relatively numerous sets. All the finds are distributed in the southwest of the Iberian Peninsula, and their chronological contexts point to the final Bronze Age / Early Iron Age transition period, which encompasses the so-called Orientalizing period.

The hill fort (*castro*) of Ratinhos (Moura, Portugal) presents signs of continuous occupation from the Final Bronze Age to the 6th century BC (Silva and Berrocal-Rangel, 2005). In the higher part of the *castro*, a large building, described as a palace, was located, where a set of seven discoidal appliqués with a diameter of about 0.8 cm was found. The edges of the appliqués were decorated with a square cross-section twisted wire. EDXRF and PIXE analyses (Valerio *et al.*, 2007) showed that the fabrication material was a gold alloy with 10% silver. The authors think that solid phase welding was used to attach the loop to the back by heating below the melting point without using a solder.

A second set of two appliqués, with a diameter of approximately 1.6 cm, is currently on display in the Lisbon Museum. It originates from Outeiro da Cabeça (Torres Vedras, Lisbon, Portugal) and was associated with earrings, beads and double spiral pendants, but it has no contextual data (Pingel, 1992: 295-296, n° 277).

A third set consists of 39 items from Fortios (Portalegre, Portugal), again lacking an archaeological context, and is also held in the Lisbon Museum (Pingel, 1992: 298,

Item & analysis N°	Area	Au	Ag	Cu	Others
CRB01 201 Chain	Link	88.91	11.09	-	
CRB01202	Link	86.06	13.94	-	
CRB01203	Link	87.44	12.56	-	
CRB01204	Repair	75.67	22.55	0.66	Fe, Ca
CRB01205	Repair	77.97	19.09	0.70	Fe, Ca
CRB01206	Repair	72.90	24.42	0.67	Fe, Ca
CRB02 201 Lining	Sheet	83.14	16.17	0.70	
CRB02202	Sheet	82.45	16.70	0.85	
CRB02203	Sheet	65.44	17.09	0.71	Si, Al, K
CRB02204	Used edge	92.26	7.25	0.48	
CRB03 201 Discoid	Sheet	100	-	-	
CRB03202	Sheet	90.34	8.81	0.85	
CRB03203	Sheet	99.19	-	0.81	
CRB03204	Sheet back	90.88	9.12	-	
CRB03205	Sheet back	89.69	9.76	0.55	
CRB03206	Sheet back	88.91	10.68	0.41	
CRB03207	Loop	87.59	11.38	1.03	
CRB03208	Loop	89.69	10.31	-	
CRB03209	Loop	80.61	18.41	0.98	
CRB03210	Solder loop/sheet	75.14	22.63	2.23	
CRB03211	Solder loop/sheet	73.52	24.27	2.20	
CRB03212	Solder loop/sheet	76.10	22.10	1.79	
CRB04 201 Discoid	Sheet back	87.41	12.35	-	Fe
CRB04202	Sheet back	71.26	26.99	1.76	
CRB04203	Sheet back	74.65	23.27	2.08	
CRB04204	Loop	84.60	14.97	0.43	
CRB04205	Loop	81.60	17.01	1.39	
CRB04206	Loop	90.38	9.62	-	

Item & analysis N°	Area	Au	Ag	Cu	Others
CRB04207	Solder loop/sheet	73.10	24.96	1.94	
CRB04208	Solder loop/sheet	72.70	25.25	2.05	
CRB04209	Solder loop/sheet	74.40	23.23	2.37	
CRB05 201 Discoid	Sheet back	80.39	19.27	0.34	
CRB05202	Sheet back	92.50	7.03	0.48	
CRB05203	Sheet back	79.86	19.23	0.91	
CRB05204	Loop	83.08	16.78	0.13	
CRB05205	Loop	87.84	11.10	1.05	
CRB05206	Loop	91.50	8.14	0.36	
CRB05207	Solder loop/sheet	72.88	26.01	1.11	
CRB05208	Solder loop/sheet	72.25	26.24	1.51	
CRB05209	Solder loop/sheet	72.64	25.45	1.65	Fe
CRB05210	Sheet	100	-	-	
CRB05211	Sheet	88.46	11.03	0.52	
CRB05212	Sheet	89.44	10.56	-	
CRB06 201 Discoid	Sheet back	75.46	24.16	0.38	
CRB06202	Sheet back	81.93	18.07	-	
CRB06203	Sheet back	80.37	19.48	0.15	
CRB06204	Loop	82.67	17.33	-	
CRB06205	Loop	77.55	22.19	0.27	
CRB06206	Loop	77.17	22.83	-	
CRB06207	Solder loop/sheet	73.07	25.82	1.11	
CRB06208	Solder loop/sheet	73.57	25.91	0.51	
CRB06209	Solder loop/sheet	74.38	25.18	0.44	
CRB06210	Sheet	82.81	16.74	0.45	
CRB06211	Sheet	77.10	22.90	-	
CRB06212	Sheet	78.22	21.19	0.59	

Table 1: Elemental spot composition (SEM-EDS, wt%).
Tableau 1 : Composition élémentaire ponctuelle (MEB-EDS en %).

n° 287). The objects have a diameter of about 2 cm, wire loops on the back, and are decorated with concentric circles. This is the largest set of such artefacts, and it also contains the largest examples known to date.

Other comparable objects have been found, rather different morphologically from those under discussion here, but which could have been used in a similar manner to decorate garments, although they do not have the loop on the back, the defining feature of the sets described earlier. These are the appliqués from São Martinho (Alcácer do Sal, Setúbal, Portugal) and El Castañuelo (Huelva, Spain), which have holes on the outer edge, probably for sewing or fixing. The association of the find of São Martinho (Armbruster and Parreira, 1993: 188-191) with spirals, and the context of the items from El Castañuelo – a cist necropolis (Schubart, 1975: 95-96, lám. 54; Perea, 1991: 107) – seem to indicate

an earlier date than that of the items with a loop on the back instead of holes (Perea, 2005). They could be dating to the Final Bronze Age of the southwest.

As a hypothesis, we propose that these ornaments originated from garments belonging to the local elites of the Final Bronze Age. The subsequent adoption of the new Mediterranean technology brought by the Phoenician colonists included soldering. This enabled the wire loops to be attached to the back, so that they could be sewn onto cloth – something which had been previously accomplished by using holes. Soldering also enabled the appliqués to be adorned with twisted wires around the edges.

6. CONCLUSION

The great treasure of El Carambolo and this new find must be compared. The first one was hidden intentionally so that the jewels could be recovered. The objects were in a perfect state of preservation and showed few signs of wear. The new find, however, consists of fragmentary, incomplete objects that display traces of having been used for a long time, an aspect which seems to reflect an unintentional loss.

As we can observe from the finds of discoidal appliques that appear from the Final Bronze Age onwards, the adornment of garments with gold must have been relatively common in the southwest of the Iberian Peninsula. This represents new evidence for the same process, i.e. the coexistence of native and Phoenician workshops, or the presence of goldsmiths with different technical knowledge. This is an interesting case of technological transmission: the Atlantic *versus* the Mediterranean.

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