A study of Hellenistic gilding practice and manufacture of funerary wreaths

Eleni Asderaki & Thilo Rehren

Abstract

A number of fragments from four Hellenistic wreaths were studied in order to better understand their manufacture and to identify suitable conservation treatment (Asderaki 2001). They were excavated during rescue work by the 13th Ephorate of Prehistorical and Classical Antiquities at the cemetery of ancient Demetrias in Magnesia, Central Greece. Three of the wreaths studied date to the early 3rd century BC, and one to the late 2nd century BC. Sampling was governed by the availability of fragments remaining from the conservation process, and analytical methods were chosen to provide as much insight as possible into the production and corrosion of these wreaths. In this paper, we concentrate on the gilding practices as well as manufacture techniques identified in the samples.

The wreaths were made to a high standard of craftsmanship, using often high quality material: ample gold leaf, cinnabar pigment and a pure kaolinite gesso. This use of high quality raw materials matches the relative scarcity of the wreaths among the overall number of tombs excavated: only about one percent yielded remains of these ornamental items. However, despite their relative scarcity, they appear to have been made on a regular scale, using standardised methods and primary raw materials rather than merely recycling circulating metal and working on a semi-skilled ad-hoc level of craftsmanship.

Introduction

Gilded wreaths are relatively common items of personal adornment in Hellenistic graves, particularly in Macedonia proper (Robinson 1941; Makaronas 1965; Despini 1980, 1996; Andronikos 1984; Vokotopoulou 1990). However, finds of Hellenistic wreaths spread from Thessaly in central Greece as far as southern Italy in the west (de Juliis 1984: Cat. Nr. 20), Rhodes (Oddy *et al.* 1979) and Asia Minor in the east, and Cyprus in the south-east (Karageorgis 1973). The wreaths are generally imitating those made from a range of natural plants such as myrtle, oak, daphne, olive, etc. These particular wreaths studied here are representing myrtle, which is probably related to the worship of Demeter, Persephone and Aphrodite (Nikolaou, pers. com.), all goddesses adored in the area of ancient Demetrias and linked to the myrtle plant.

Despite this wide distribution, and the potential symbolic importance as a prestigious grave good, few technical studies are published concerning the manufacture of these, or indeed the type and quality of materials used to produce them. Here, a first attempt is made to rectify this situation.

General layout of a Hellenistic wreath

The majority of Hellenistic wreaths consist of a trephine as the central piece, which holds together the various attached decorative items. Probably, the trephine band stretched only partly around the skull, with an opening in the front part above the forehead. According to the literature, a range of materials was used to build the trephine, including bone, wood, and metal. Of the four wreaths studied here, three had a leaden trephine, and one was made from wood. Attached to the trephine were tufts comprising of leaves and fruits. The tufts were attached to the trephine in regular intervals of about two centimetres, fixed through holes punched into the soft trephine material. Each tuft consisted of a bunch of copper wires, which at their outer ends then either hold the ceramic fruits or the copper-made leaves. A thin thread of organic fibre, wound around them and securing them safely, held the wires together (Fig. 1, see also Fig. 6). The majority of the individual items of the wreaths from ancient Demetrias were gilded with gold leaf, while only a few of the ceramic fruits were coloured by a red pigment. In the following, we will focus on the metal used to produce the wires, leaves and trephines, and the gilding technique applied in these wreaths.

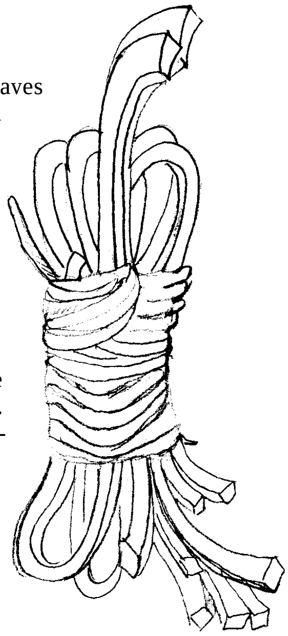

Fig. 1: Scetch drawing of a linnen thread securing a bunch of copper wires tightly together (drawing G. Kiassas)

Methodology and results

Since the major research questions in this study were concerned with the manufacture of the wreaths, the gilding techniques used, and the corrosion of the material, it was decided to use primarily image-based analytical methods. Although this required some sampling and sample preparation, it offered in return a detailed insight into the composition, treatment history and current situation of the metal. In addition, chemical analysis was done on the majority of the samples, using the already prepared metallographic mounts. Thus, the two main instruments used were the metallographic microscope and the Secondary Electron Microscope with attached Energy-Dispersive Spectrometer (SEM-EDS). In addition, some X-ray diffraction analyses were done to verify the nature of corrosion products. The samples were selected based on the ethical considerations necessary in any conservation and restoration work; thus, only tiny fragments, which were already separated from the main pieces, were sampled. This resulted in some limitations as to the extent of information gained, but this compromise was clearly necessary to minimize the adverse effect on the preservation of the archaeological material. The actual analyses then were done non-destructively, *i.e.* the mounted samples are still existent and available for any further investigation.

The metal

The wires and leaves were found to be both made of the same type of technically pure copper metal with a fair amount of copper sulphide inclusions throughout the body of the metal (see front page of this issue). In the majority of samples, the metal was totally corroded to form copper chloride, copper oxide and other corrosion products (see Asderaki 2001 for full details). Where preserved, this metal showed upon etching an annealed, recrystallised texture of equiaxed copper grains with no preferential orientation. The distribution and shape of the copper sulphide inclusions, however, were evidence of an earlier severe and directed deformation of the metal, most likely through hammering (Fig. 2). The copper leaves appear to have been cut into shape by chisels or scissors; in rare i

Figure 2: Copper metal etched with alcoholic ferric chloride. Twinned crystals and elongated copper sulphide grains are clearly visible. Optical microscope, magnification 200X. Copper leaf from tomb 393, 3rd century BC.

nstances of good preservation of the metal texture in the corrosion products one can still see the characteristic distorted flow of the metal where it was cut.

Similarly, the wires were apparently made from copper metal hammered into a thin sheet, cut into strips, which were then hammered into a 'G'-shaped wire (Fig. 3). This is in good accord with wire-making techniques throughout the pre-medieval world, and rules out the use of a drawing plate for their manufacture (Oddy 1987; Redfern 2000).

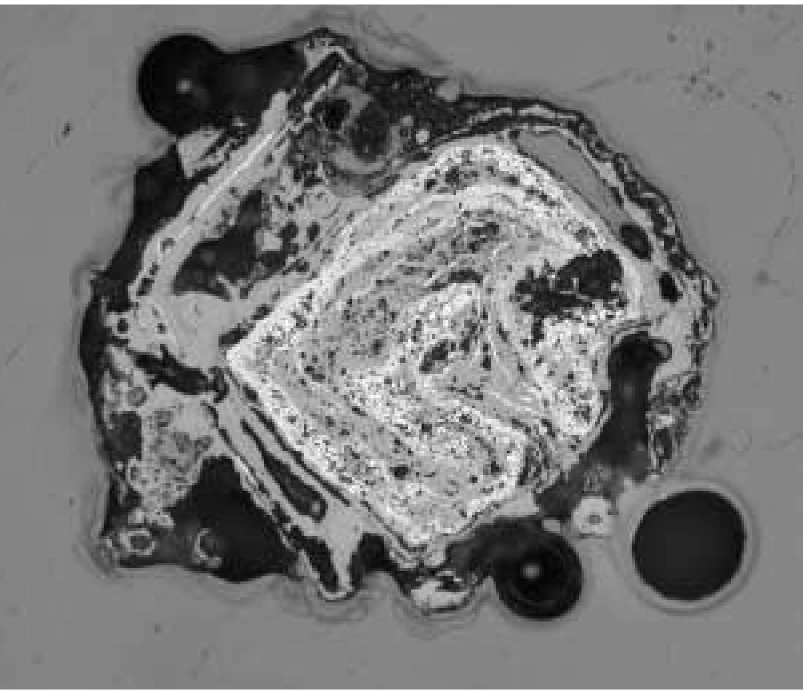

Figure 3: Cross section through a gilded wire, showing the hammered shape of a 'G'. Magnification 200X, optical microscope. Copper wire, tomb 924, 3rd century BC.

SEM-EDS analysis found no alloying elements in the copper metal, beside the before mentioned ubiquitious sulphide inclusions. This indicates that the metal used was most likely not taken from circulating metal stock, which would probably have been dominated by recycled bronze scrap, and would possibly have been more highly oxidised due to repeated remelting. Instead, we assume that the metal was received directly from a primary smelting site, processing sulphidic copper ore. No further investigation towards the possible provenance of this metal was made. However, during the Hellenistic period, a number of copper sources in mainland Greece, especially in the Fthiotida area near Demetrias, were providing ample copper supplies to the urban centres of manufacture and consumption.

The metal strips of the lead trephines are 2 mm thick and 1.6 cm wide. Even though they are extensively corroded to cerussite, hydrocerussite and litharge (as determined by XRD analysis), they preserve enough metal in their core to judge its original composition. They were found to be made of almost pure lead. Optical microscopy, XRF and SEM-EDS analysis indicate the presence of some minor amounts of copper and silver, in the range of half a percent, as well as a trace amounts of arsenic and antimony. From these results, it appears that the metal was not subjected to desilvering (Rehren & Prange 1998) prior to its use here. The possible provenance of this metal was again not investigated; the most productive source of lead at that time, Laurion, is not far away from the area of ancient Demetrias, so it could be a possible origin of the used metal. Although very badly corroded, we can identify the shape and the way of their manufacture; the trephines were apparently made from lead metal hammered into thin sheets and cut into strips. Then holes were punched (Fig. 4) in regular intervals of about two centimetres, where the bunches of copper wire and leaves were attached. In a couple of samples, gilding is preserved. From optical microscopic observation we can assume that the gold leaf was applied straight to the metal surface either by burnishing it or by using a kind of glue to adhere it on the metal surface.

Fig. 4: Detail of lead trephine with holes punched in the centre. The holes would have held the bunch of copper wire secured by an organic fibre. Magnification ca. 10X through stereomicroscope. Tomb 924, 3rd century BC.

Gilding

Despite the badly corroded state of most samples, we were able to identify either by careful observation of the unmounted samples in the binocular microscope or – more rarely – in the mounted sections hidden underneath the corrosion layers remains of the original gilding. In the three wreaths from 3rd century BC graves, the gilding was always applied on top of a layer of siliceous material covering the metal core (Fig. 5). This gesso layer was identified by SEM-EDS analysis to consist either of pure kaolinitic material, indicated by the sole presence of alumina and silica in the EDS spectra, or as a calcareous clay, when the EDS spectra indicated in addition the presence of minor amounts of potash and calcium and iron oxide.

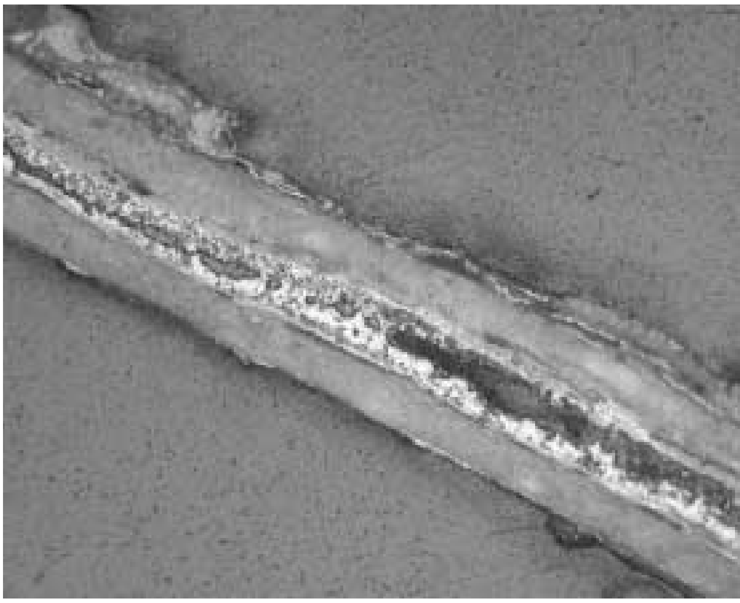

Figure 5: Gesso layer applied between the completely corroded copper body and the gold leaf. Magnification 100X through optical microscope. Copper leaf, tomb 924, 3rd century BC.

The gold leaf was found to be about one micrometer thick and to consist of technically pure gold; the levels of silver and copper were always found at or below the detection limit of the instrument, estimated to be in the range of half a percent in this heavy metal matrix. Thus, the gold was refined and parted prior to being hammered into gold leaf.

In the gilded copper leaf from the wreath from the 2nd century BC grave, the gilding was applied directly to the metal surface by burnishing the gold leaf straight to the clean metal surface. As in the other examples, the gold leaf was found to be about one micrometre thick and to consist of pure gold. The wire from this tomb, though, had the same gesso layer between the copper metal and the gold as the earlier samples.

Non-metallic materials

In addition to the various ornamental pieces made from metal, we identified ceramic beads and some organic fibres as integral parts of the wreaths. The beads came in two different sizes, and were identified to represent myrtle beads, matching the leaves. Some of them were gilded as well, others were coated with a red pigment. In at least one case we were able to identify cinnabar as the red pigment. As with the gilded metal, both the gilded and the pigmented beads were first covered with a layer of gesso onto which the final surface decoration was then applied.

The copper wires which formed the tufts were best preserved near the holes in the lead trephines. Here, the corrosion of the copper had preserved among a group of three to four wires a central thread of organic fibre (Fig. 6), which apparently was both running parallel to the wires along their length, and then was wound round the lower ends of them, securing them by a knot. According to Sandra Bond and Liz Pye, both Institute of Archaeology UCL, these fibres are most likely from plants, not from animals, and may be linnen. The tiny quantity of material preserved prevented any further research on this question.

Conclusion

Only about one percent of the 927 tombs found in the cemetery of ancient Demetrias preserve gilded wreaths, made of composite materials. They represent the myrtle plant. From these wreaths four were selected for analysis, three of which dated to the early 3rd and one to the late 2nd century BC.

Several instrumental techniques were used to analyse minute fragments. The selection of the samples was made according to conservation codes of ethics, using only material which had already become detached from the major remains by corrosion.

The metal used for the manufacture of the leaves and wires was technically pure copper; the majority of this was corroded to form copper chloride, phosphate and oxide, malachite *etc*., preserving in many cases the ghost-like primary structure of the object. The residual metal after etching showed that it was hammered and annealed. The copper leaves have been cut into shape by chisels or scissors. To produce the wires, copper metal was hammered into thin sheet and cut into strips, which then where rolled or hammered to form a "G"-shaped wire.

Remains of the original gilding can be identified in most of the samples. In the wreaths of the 3rd century BC, gilding of the leaves and wires is invariably preserved on top of a gesso layer, which consists either of pure kaolinite or of calcareous clay. The gold leaf used is about one micrometre thick. It consists of pure gold containing less than half a percent of silver. In the one leave studied of the wreath from the tomb dated to the 2nd century BC, the gilding was applied straight to the metal surface using the burnishing technique, while the wires had the same gesso layer as the earlier ones. Unfortunately, this being a unique sample, we can not identify whether this difference in the gilding technique represents a general change in craftsmanship from the early 3rd to the late 2nd century BC, or just a coincidental change in practice in this one piece. Clearly, further research is necessary here to answer this interesting question.

The lead trephines are made of almost pure lead which had probably not undergone any refining or desilvering. The lead metal was probably cast and hammered into sheets and then cut into strips, into which holes were punched so that the copper leaves and copper wires could be attached. The trephines

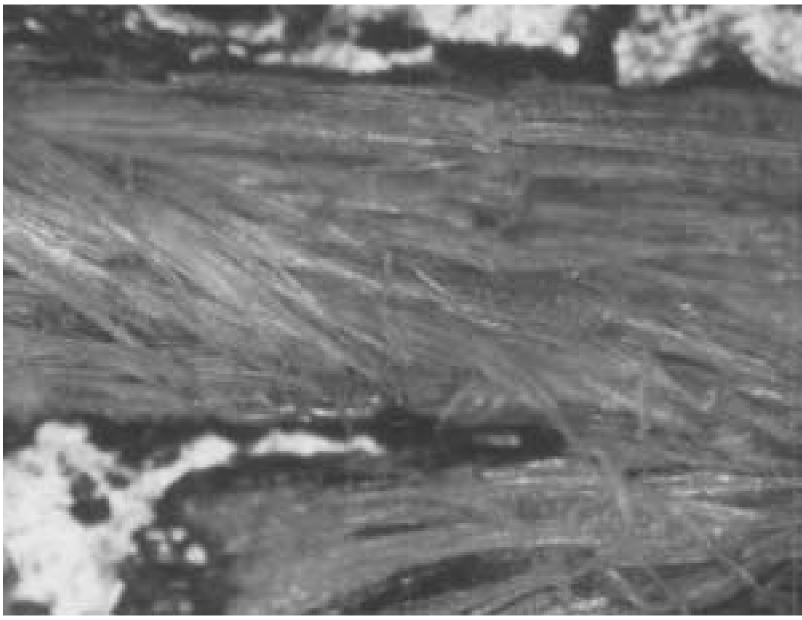

Fig. 6: Organic fibre, probably linnen, preserved by copper salts. Magnification ca. 200x. Tuft of copper wire, tomb 393, 2nd century BC.

were gilded as well. From all the above we see a consistently high standard of craftsmanship, which is indicated by the quality of the material used, such as the use of primary raw materials instead of recycled metal.

Acknowledgement

This work was done as part of a master thesis in partial fulfillment of the requirements for the degree of MA in Principles of Conservation at the Institute of Archaeology UCL, under the supervision of Professor Clifford Price. We are very grateful to him and the other members of staff involved in this research for much advise and support during the study. E. Nikolaou most kindly provided the material for restoration, and allowed the sampling to take place in order to enhance the technological knowledge and to further the conservation treatment of these fragile and often badly damaged objects. We are particularly grateful to her for her support and patience.

References

Andronikos, M. 1984. *Vergina*. Ekdotiki Athinon A.E.

Asderaki, E. 2001. Hellenistic gilded wreaths found in Magnesia, Greece: Material study and conservation. Unpublished MA Dissertation, Institute of Archaeology, UCL, London.

Despini, A. 1980. The tomb of Katerini (in Greek), *Archaeoligika Analekta Athinon* XIII, 2, 198-209.

Despini, A. 1996. *Greek Art: Ancient Gold Jewellery* (in Greek). Athina: Ekdotiki Athinon.

De Juliis, E. 1986. *Gli Ori di Taranto in Eta Ellenistica*. Arnoldo Mondadori Editore S.p.A., Milano (4th ed).

Karageorgis, V. 1973. *Excavations in the Necropolis of Salamis III*. Salamis, vol. 5. Republic of Cyprus, Ministry of Communications and Works, Department of Antiquities.

Makaronas, Ch. 1965. Antiquities and Monuments in central Macedonia (in Greek). *Archaeologiko Deltio* 18 (1963), Part B-2 (chronika), 193-196, plates: 223-234, Athina.

Oddy, A., Padley, T. & Meeks, N. 1979. Some unusual tech-niques of gilding in Antiquity. *Archaeo-Physika* 10, 230-242. (= Proceedings of the 18th International Symposium of Archaeometry and Archaeological Prospection, Bonn).

Oddy, A. 1987. Does ‘strip-drawn’ wire exist from antiquity? *Masca Journal* 4, 175-177.

Redfern, D. 2000. A technical examination of the Scythian gold hoard from Vettersfelde / Witaszkowo. *Eurasia Antiqua* 6, 405-418.

Rehren Th. & Prange M. 1998. Lead metal and patina: a comparison. In: Th. Rehren, A. Hauptmann & J. Muhly. (eds), *Metallurgica Antiqua*, 183-196. Der Anschnitt, Beiheft 8, Bochum.

Robinson, D. 1941. *Excavations at Olynthus, Part X: metal and minor miscellaneous finds. An original contribution to Greek life*. Oxford.

Vokotopoulou, I. 1990. *The tombs of Aineia*, (in Greek). Archaeologiko Deltio 41, Greek Ministry of Culture, Athina.