Copy or authentic? Analysis of a Phoenician gold ring from the National Museum of Archaeology, Valletta, Malta

Copie ou authentique ? Analyse d'une bague phénicienne en or du Musée national d'archéologie, La Vallette, Malte

Daniel Vella*, James Licari**, Nicholas Vella***, Sharon Sultana**** and Vanessa Ciantar****

Abstract: The present work is a study of a Phoenician finger ring from the collection of the National Museum of Archaeology, Malta. The item was first described by the museum's director Themistocles Zammit in 1925, and is believed to date to the 6th century BC. The ring consists of two stirrup-shaped hoops, which can be worn separately or fitted together and worn as a single piece. Inscribed on the bezel surface is a seafaring vessel. Zammit described the artefact as manufactured in pure gold, quoting its mass as 9.65 g. The ring in the collection fits Zammit's description but differs significantly in weight. The aim of this paper is throw light on the authenticity of this ring using documentary sources and non-invasive scientific techniques of analysis. Optical and electron microscopy allowed a thorough description of the manufacturing technique, while the material analysis was conducted via energy dispersive spectrometry. As a result of these analyses, it was concluded that the ring is not authentic, but is most probably a copy, possibly commissioned by Zammit himself.

Résumé : *Ce travail décrit l'étude d'une bague phénicienne appartenant à la collection du musée National d'Archéologie de Malte. Cet objet a été décrit pour la première fois en 1925 par le Directeur du musée, Themistocles Zammit, et est attribuée au VIe siècle av. J-C. La bague se compose de deux anneaux en forme d'étrier pouvant être portés séparément ou pouvant être assemblés pour être portés ensemble. Le chaton est inscrit d'un vaisseau. Zammit décrit l'objet comme étant fabriqué en or pur et indique un poids de 9,65 g. La bague de la collection correspond à cette description mais diffère considérablement en ce qui concerne son poids. Le but de cet article est de jeter un jour nouveau sur l'authenticité de la bague à partir des sources documentaires et des analyses scientifiques non-destructives. Les microscopies atomique et électronique permettent une description approfondie des techniques de fabrication alors que l'analyse des matériaux a été réalisée par spectrométrie à énergie dispersive. Nous avons conclu que la bague n'est pas authentique, mais probablement une copie, peut-être commandée par Zammit.*

Keywords: Gimmal ring, iconography, Phoenician, gold, authentication.

Mots-clés : *Bague gimmal, iconographie, phénicien, or, authentification.*

* *Department of Metallurgy and Materials, Faculty of Engineering – University of Malta, MSD 2080. (daniel.vella@um.edu.mt)*
** *Objects Conservation Laboratory, Conservation Division, Heritage Malta, Bighi, Kalkara KKR 9030, Malta. (james.licar@gov.mt)*
*** *Department of Classics and Archaeology, Faculty of Arts, University of Malta, MSD 2080, Malta. (nicholas.vella@um.edu.mt)*
**** *National Museum of Archaeology, Heritage Malta, Republic Street, Valletta, Malta. (sharon.sultana@gov.mt), (vanessa.ciantar@gov.mt)*

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1. Introduction

Historical background

The National Museum of Archaeology (NMA) in Malta holds a small collection of gold artefacts, of which a 'gimmal' finger-ring (NMA Object ID: 866) merits particular attention. The artefact was first described by the museum's director Sir Themistocles Zammit in a short article published in 1925, and is thought to date to the Phoenician-Punic period (Zammit, 1925; Bonanno, 2005: 31). The ring consists of two stirrup-shaped hoops, which can be worn separately or fitted together and worn as a single piece (cf. Smith, 1803). The hoops fit to form an elliptical bezel of circa 20 x 10 mm, divided horizontally by twelve indentations on each side. When the complete ring is assembled, a rowing vessel appears inscribed on the bezel surface (Fig. 1). Although this finger-ring is a unique piece and no similar examples are mentioned in the literature dealing with ancient jewellery that we have consulted (e.g. Culican, 1986; Higgins, 1961; Pisano, 1974; 1987), rings with oval bezels with engraved devices set within a rim are in fact known from Punic sites in the western Mediterranean, and are believed have been produced until the 5th century BC (Boardman, 2003: 12; Quillard, 1987). Even the representation of the galley, redrawn in order to rectify some errors in Zammit's line drawing (compare Fig. 2e with Fig. 2d), would find parallels in ship representations from the 7th-6th centuries BC (Morrison and Williams, 1968).

Figure 1: Photograph of the NMA ring, showing bezel surface under raking light conditions.
Figure 1 : Photographie de la bague du NMA, montrant le chaton sous lumière rasante.

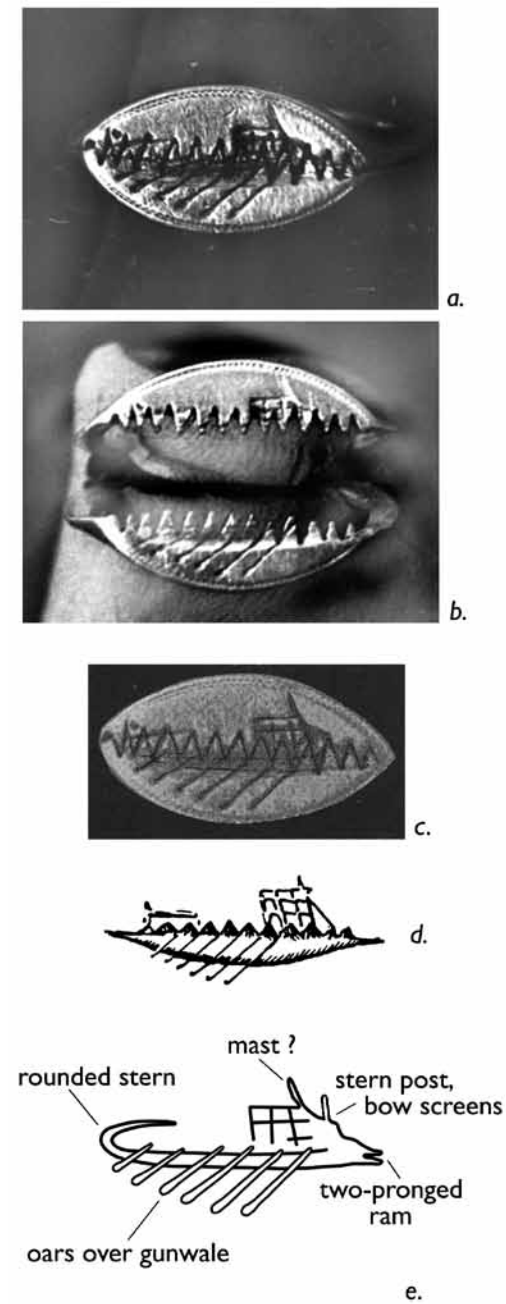


Figure 2: (a, b) Scanned digitized positive images of two glass plate negatives believed to have been used in Zammit's 1925 publication; (c) Zammit's published photograph (1925: Fig. 1b) of the ring, clearly retouched to emphasize the engraved lines; (d) a mirror image of Zammit's published line drawing (1925: Fig. 3) of the details on the bezel; (e) reconstruction drawing of the features visible on the bezel photographed in (a).
Figure 2 : (a,b) Images numérisées de deux négatifs sur plaques de verre dits avoir été utilisées par Zammit dans la publication de 1925 ; (c) photographies de la bague publiées par Zammit (1925 : fig 1b) ; (d) image en miroir du dessin publié par Zammit (1925 : fig. 3) montrant des détails du chaton ; (e) dessin reconstituant ce qui est visible sur le chaton photographié en (a).

In his paper, Zammit described the artefact as manufactured in 'pure gold', quoting the mass of the ring at 9.650 g (Zammit, 1925: 266). The ring was shown to Zammit by an undisclosed owner. From Zammit's publication we are led to believe that the owner was reluctant to supply details about the discovery, but did indicate that the ring was passed on to him by a farmer, who had found it himself (Zammit, 1925). In a subsequent note, recently retraced in Zammit's field notes, the identity of the farmer who found the ring is disclosed, and Zammit specifies that the ring was discovered in a rock-cut tomb at Ghajn Klieb in Rabat, Malta (Zammit, 1926: 1923). He also adds that this was the same tomb from which he had unearthed a gold amulet in 1906 (Vella *et al.*, 2001: 12; Sagona, 2002: 794-795). Nevertheless, it is not known when the ring was removed from the site. The current ring, which is part of the NMA collection, fits the physical description of Zammit, but differs substantially in weight. The current ring weighs 4.418 g, about half the mass of Zammit's ring.

A thorough search in the NMA archives for notes describing the acquisition of the NMA ring for the museum collection was inconclusive. The recent discovery of five gelatine dry plate negatives of the ring published by Zammit has raised hopes that further documentation may still exist. Two of the gelatine plate negatives portraying the ring (Figs. 2a and 2b) are believed to be the same photographs included in Zammit's 1925 paper. The photographs were however edited, perhaps to enhance specific features appearing on the ring bezel (Fig. 2c). The glass plate negatives were used to help authenticate the NMA ring.

The presents study is meant to answer two important research questions: is the NMA ring the same object described by Zammit in 1925? If the NMA ring is not authentic, what further information can be obtained from a non-invasive examination of the artefact?

2. Methodology

Given the uniqueness of the artefact, a non-invasive examination was undertaken. The manufacturing technique was observed both visually and through optical and electron microscopy. The material of the ring was characterized by elemental X-ray analysis using an energy dispersive spectrometer attached to the electron microscope.

Gelatine dry plate negatives

The gelatine dry plate negatives were digitally recorded by scanning, and the digitized negatives converted into positives using Adobe Photoshop CS Version 8. Two of the more informative images (the same ones used for Zammit's 1925 publication) are presented in Figure 2 (a, b). The representation of the vessel obtained from the gelatine plates was visually compared to the one currently visible on the NMA ring (Fig. 1) for authentication purposes.

Optical Microscopy

The NMA ring was observed at low magnification using a Nikon SMZ 2T stereomicroscope at 1x and 3x magnification. Optical fibres (Fibre Optic Source GLI-156P) were arranged in such a manner that light reflects off the surface of the metal at 45°. This angle reduces diffuse reflection off the metal to a minimum and permits a good observation of the surface. Where necessary, a polarizing plate was placed between the light source and the ring in order to minimize surface reflections. Digital photographs were recorded directly through the microscope via a Leica PFC290 digital camera. The digital images were processed using the Leica IM 500 software, Version 5.

Electron Microscopy

Observation at higher magnification was performed using an Oxford Link 1430 Scanning Electron Microscope (SEM). Electron imaging was carried out in both secondary emission and backscatter modes. The secondary emission detector creates topographic images of the surface and was used to visualize manufacturing marks and other decorative features. The backscatter (BS) detector is designed for elemental contrast. In BS mode, the higher atomic weight elements appear white or light grey, and contrast with the lower atomic weight elements, which appear dark grey or black. The elemental X-ray analysis of the NMA ring surface was carried out using the energy dispersive spectrometer attached to the electron microscope.

3. Results and Discussion

Gelatine dry plate negatives

The digitized positives, corresponding to Zammit's photographs (Figs. 2a and 2b) were compared to the image of the NMA ring (Fig. 1). A number of differences are evident: the galley mast projects into the edge decoration motif in Zammit's photograph, while a gap exists between the mast and the edge decoration in the current ring. The stern post projects between the 3rd and 4th serration from the right in Zammit's photograph; it projects between the 4th and 5th serration in the NMA ring. The thickness of the first oar, far right of the galley, constricts at its middle in the NMA ring. This is not the case in Zammit's photographs. A surface loss occurs adjacent to the first oar on the right of the NMA photograph. Again, this is absent in Zammit's record. This photographic evidence suggests that the original ring was used as a model onto which the NMA ring was cast. The loss of fine decorative detail and the introduction of new surface defects would seem to confirm this hypothesis.

Manufacturing technique and surface decoration

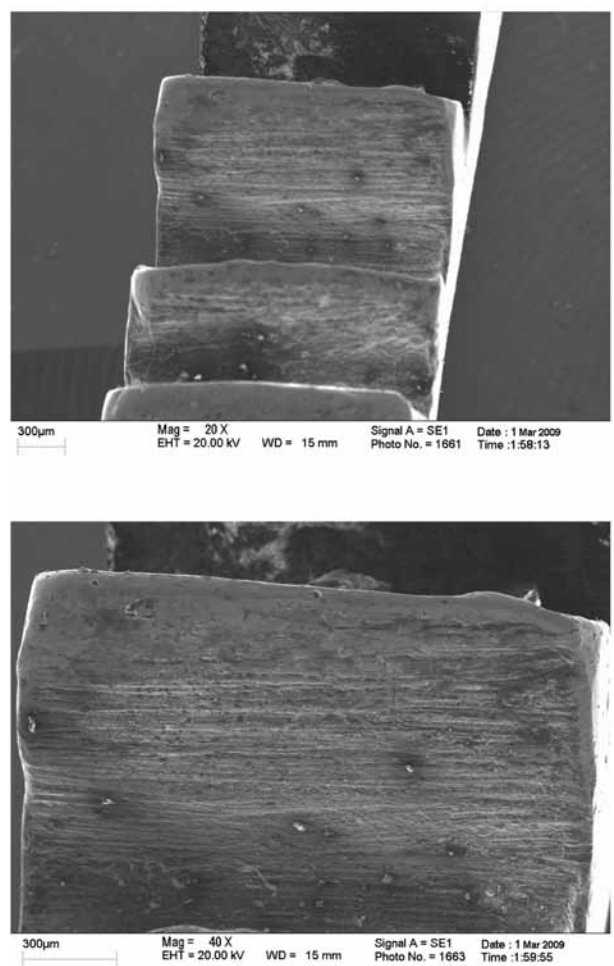
It appears that the ring hoops were cast as single pieces and decorated to produce the final object (pers. comm. J. Aquilina, 2009). Tool marks were examined and recorded in an attempt to identify the technique used to decorate the ring and to shed light on its authenticity. Tool marks were categorized into two types, i.e. decoration marks (for example, a decorative motif along the edge of the bezel, oars and bow screens), and manufacturing marks (for instance, filing and shaping marks).

Decoration marks

The circular decoration around the bezel was produced by chasing. Chasing is carried out by tapping the metal surface with a small flat chisel having a rounded tip and building up a continuous ridge from a series of individual indentations (Craddock, 2009: 173). No metal is removed from the object during this process, but the dislodged material is pushed up and protrudes from the surface. The indentation marks observed on the NMA ring are circular, with an average diameter of 250 µm. The oars and bow screen structure were also chased into shape. The width of the marks forming the sea galley also measure around 250 µm; it appears that the same tool was used to produce all the decorations on the bezel. In another area of the edge decoration, the indentation marks are missing, although a palimpsest of the original decoration is still evident. If the NMA ring were indeed cast off an original ring, the smith would have had to emphasize the decoration motif by chasing or engraving over. We believe that this particular area of the ring was overlooked.

Manufacture and shaping marks

The serrated edges were finished using a very fine file. The file marks are barely visible under the stereomicroscope, but are well defined under the SEM, even at low magnification (Fig. 3a). At higher magnification, the file marks appear evenly spaced and measure between 5 and 10 µm in width (Fig. 3b). The even spacing of the filing marks and their small width suggest that they were made by a modern implement. Filing marks were also observed on the depressed surface forming the hull of the galley. The average width of these marks is 5 µm. The curved geometry of the surface indicates that a file with a circular cross-section was used to shape this area. A coarser file was used to finish the flat underside of the two hoops. The average width of these marks is 60 µm. It is probable that the goldsmith was not concerned about the quality of the surface finish here, knowing that these roughened surfaces would be hidden when the ring is worn or, indeed, when exhibited as a single piece.



a.

b.

Figure 3: (a) Electron micrograph of serrated edges showing horizontal filing marks and (b) magnified image of the surface of one of the serrations. The width of the grooves is approximately 5-10 microns.

Figure 3 : (a) Image au MEB des bords en dents de scie montrant les marques horizontales et (b) image amplifiée de la surface d'une des dents. La largeur des rainures est d'environ 5-10 microns.

The underside of the bezel piece with the sail decoration exhibits a number of parallel grooves running along the horizontal length. The irregular width of the grooves and their disconnected nature excludes their deliberate manufacture. The marks probably resulted from a defective mould surface.

Spherical shaped cavities also occur on this surface and are prominent on the serrations (Fig. 4). The entrapment of air bubbles between the molten metal and the surface of the mould during casting can explain these odd features, and their presence confirms the hypothesis of the NMA ring being a cast artefact. The fact that these defects are located on the back of the bezel might explain why the goldsmith spared their removal.

Material Analysis

Close examination of the NMA ring under the stereomicroscope revealed a number of inconsistencies. A dark grey discoloration was observed in some areas along the ring edges, suggesting the presence of gold plate rather than a solid gold artefact. Indeed, if a gold plate were applied, the edges of the ring would be most at risk of material wear through handling and cleaning. A green coloured deposit was observed between the serrated edges of the ring. The green colour of this material suggests the presence of copper corrosion products, an unusual finding on gold items.

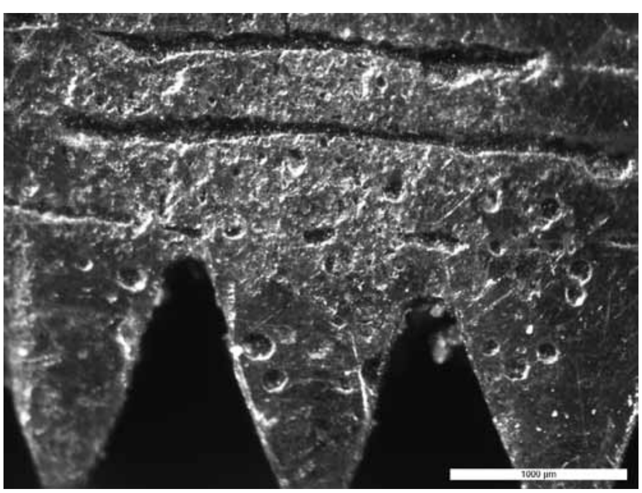


Figure 4: (See colour plate) Photomicrograph of the underside of the bezel exhibiting the oar decoration. Note the horizontal grooves and the spherical cavities.
Figure 4 : (Voir planche couleur) Image MEB du dessous du chaton montrant la décoration en forme de rames. Remarquons les rainures horizontales et les cavités sphériques.

SEM backscattered images of the flat underside of the hoop exhibiting the bow screens decoration presented white areas with some dark grey along the outer edge of the ring. This difference in grey contrast suggests the presence of two different materials. X-ray point analyses were performed on the separate areas. White areas consisted of elemental gold (major element) accompanied by some silver and copper. Elemental silver (major element) and copper formed the grey areas. Sulphur was also detected over silver rich areas and indicates the presence of a silver tarnish. The absence of a gold signal on silver rich areas supports the hypothesis of a silver cast ring that was plated with gold.

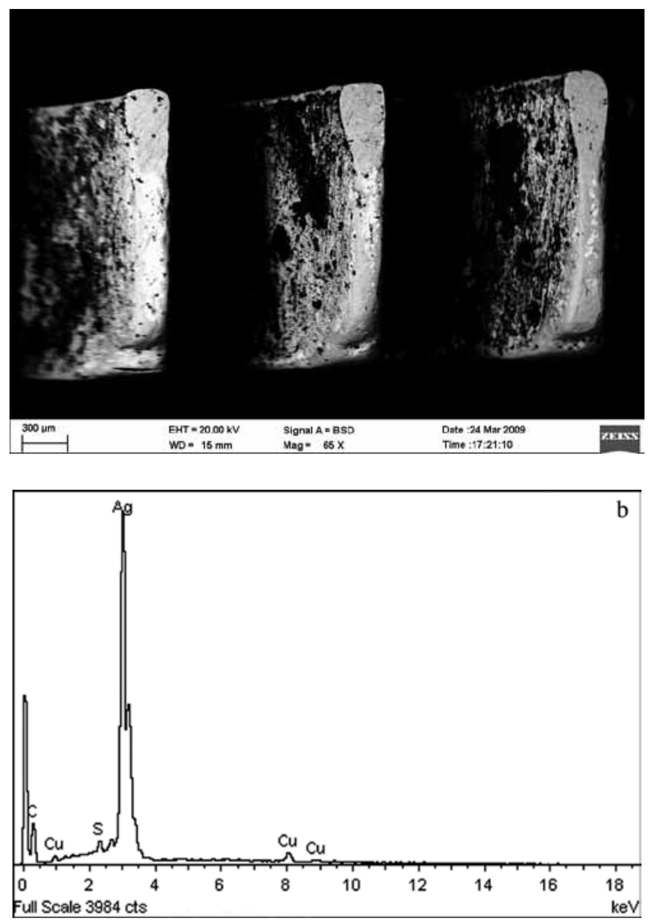


Figure 5: (a) Back scatter electron micrograph showing the three adjacent exposed serrations; (b) corresponding EDS X-ray spectrum of the exposed surface. The exposed material is composed of silver (main element) and copper.
Figure 5 : (a) Image en électrons rétrodiffusés de trois dents de scie adjacents ; (b) spectre de rayons X correspondant à la surface exposée. Le matériau analysé est constitué d'argent (élément principal) et de cuivre.

Unequivocal evidence for a silver cast ring is presented in Figure 5a. Three of the serrations on the hoop exhibiting the bow screens were apparently filed down, exposing the underlying silver. This was performed *after* the ring was plated. Perhaps the fabricated copy required some adjustment for the hoops to fit properly. The exposed material consists of silver and copper (Fig. 5b). The weight percentage of copper was determined semi-quantitatively at 10.2 ± 1.3 wt%.

Elemental X-ray analyses performed on the green material revealed the presence of copper, carbon, oxygen, and sodium. The occurrence of copper corrosion products was therefore confirmed. Sodium is probably present as carbonate; this compound could have been used as a mild abrasive agent in polishing products. It is possible that in the early years following the introduction of the ring into the museum collection, the artefact was cleaned using abrasive polishing products. Indeed, the ring surface exhibits fine scratch marks that suggest it was polished, perhaps in preparation for exhibition.

The determination of the thickness and composition of the gold layer requires destructive analyses of the ring. This, of course, was not possible. If the ring was plated in the mid-1920s, then this was very probably carried out by an electrolytic process – electroplating was introduced in the mid-19th century, about seventy years prior to the presumed manufacture date of the NMA ring (Hunt, 1973).

4. Conclusion

The results presented above confirm that the NMA ring is most probably a copy of the original ring seen and published by Zammit in 1925. The salient evidence supporting our conclusion is summarized below:

– the clear differences between the representations seen on the glass plate negative images (Zammit's ring) and the representations on the NMA ring;

– the evenly spaced filing marks observed on the serrated edges and bezel surface of the NMA ring;

– the presence of copper corrosion products on the NMA ring.

The SEM-EDS data established that the NMA ring was in fact composed of silver that was plated with gold. The silver alloy was found to contain about 90 wt% silver and 10 wt% copper. The NMA ring is thus not an authentic artefact. Nonetheless, it represents a very important piece of evidence in itself. Together with Zammit's 1925 publication and the recently discovered dry gelatine glass plate negatives, it is one of the three surviving records for the existence of this important archaeological find. Not only is the NMA ring considered important for its historical value, but it is now the only remaining copy of an original ring, very probably Phoenician. The likelihood that the NMA ring was commissioned by Zammit to serve as a copy of the original ring holds much ground. This suggestion, however, can only be confirmed once more evidence comes to light.

Finally, the weight discrepancy between the NMA ring and Zammit's published gold ring can be explained. For simplicity, we consider the gold plate on the NMA ring to have a negligible mass and Zammit's published ring to be made entirely of pure gold. The density of gold is 19.32 g/cm^3 (Lide, 2004, Part 4: 59), which is almost twice that of the NMA silver, at 10.31g/cm^3, calculated from the semi-quantitative compositional data and the densities of the pure elements (Callister, 2000: 71-73). If indeed the NMA ring was modelled on the original ring, the volumes of the two rings should be very similar. Hence, a pure gold ring with this volume should weigh about 1.874 times the weight of the NMA ring, i.e. 8.280 g. This value comes close to the original mass measured by Zammit. The remaining discrepancy in mass can be explained by factoring in material losses resulting from the manufacture of the NMA ring, especially in shaping the ring serrations by filing.

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