Archaeology & History in the Lebanon Issue Thirty Four-Thirty Five: Winter/Spring 2011/12. Pp. 60-67.

A CYLINDRICAL GOLD PENDANT FROM A MIDDLE BRONZE AGE GRAVE IN SIDON

DAFYDD GRIFFITHS

Description and discussion

A cylindrical rod-shaped gold pendant was found in the in the Middle Bronze Age grave of a female (burial 102) on College site. This grave also contained a gold and iron ring (see C. Doumet-Serhal & K. Kopetzky, p. 39 and D. Griffiths, p. 53).

1 Pendant from burial 102 made of gold alloy foil wrapped around a copper core. The copper core has corroded badly and shows as green corrosion products beneath the decorated gold foil covering which has been split open by the corrosion. The upper end of the pendant is on the right hand side of the photograph. It may be seen that the upper end cap has split open, showing that it encapsulates the upper part of the decorated gold foil wrapping.

The pendant is about 4.7 cm long and about 0. 6 cm in diameter. It is formed of decorated gold foil wrapped around a copper (or possibly bronze) core (fig. 1 and 2). As can be seen in these figures, the green copper corrosion products occupy more volume than the original copper core and the corrosion has split the decorated foil that encased it. Each end of the pendant bears a plain gold foil cap. One of the caps has part of the end missing (fig. 3). This is interpreted as the upper end of the pendant where a fixing (now absent) might have allowed the pendant to be suspended. Beneath where the gold is missing from the top part of the upper cap, there is what appears to be a small, central piece of green corroded metal, possibly the stump of a copper strip that might once have formed a loop for suspension. The narrow central piece of metal below the level of the top of the

2 A view of the pendant from the other side. Again the top of the pendant is on the right side of the photograph.

upper cap is surrounded by an off-white filler around which the upper gold cap was fitted. The filler is needed to fill the space between the thin central stump of metal and the gold foil cap. Given the extent of the corrosion that can be seen on the core, it is quite likely that the thin

3 An end view of the gold cap at the upper end of the pendant. The cap is about 0. 6 cm in diameter. Beneath the top end of the cap is a thin copper strip in the centre surrounded by an off-white filler

4 A side view of the gold cap at the upper end of the pendant.

strip that could have formed a loop for suspension may have been lost through corrosion.

3

In figures 1 and 2, the top of the pendant is on the right-hand side of the photographs. It can be seen that one side of the upper cap has split (fig. 1) and that on the other side of the upper cap (fig. 2) part of the lower margin has been torn upwards.

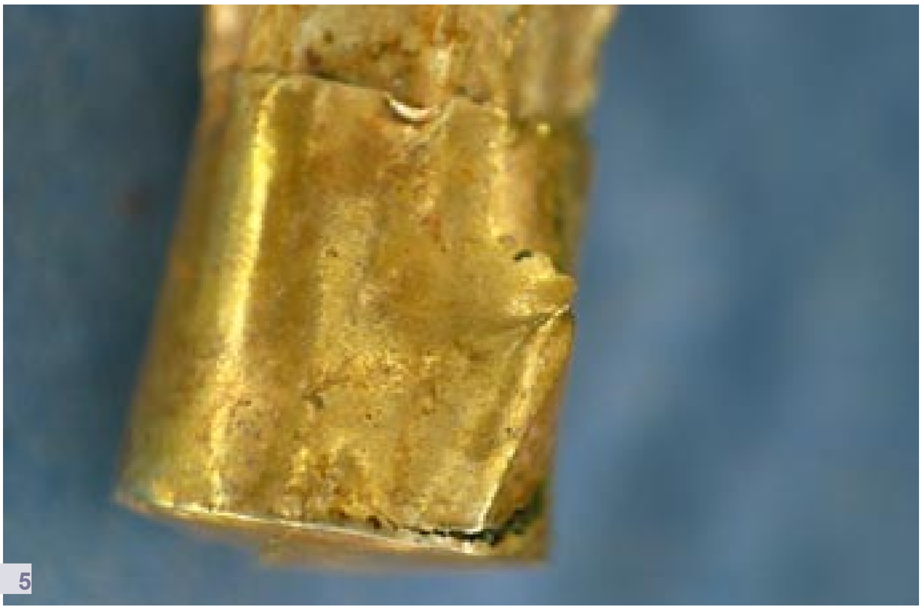
Although the interpretation as a pendant that has lost its supporting loop is very likely, it should be noted that Newman states that some cylindrical pieces of stone from Middle Kingdom female burials in Egypt have metal end caps but no sign of having been worn as pendants, appearing rather to be amulets [1]. The Sidon pendant is very similar in appearance to a pendant found at Tell el-Dab'a in the Nile delta (see p. 40).

4

Figures 2 and 4 show the upper cap from the side. The tear in the end cap shows that it encases and covers the upper end of the decorated foil.

Moving now to the lower end cap, the bottom end of this cap appears to have a very slightly greater diameter than its upper rim (see left-hand end of fig. 1 and 2). The lower end cap thus appears to form the base of a truncated gradually tapering cone rather that the base of a cylinder. This form of end cap widening slightly towards the end is also seen on a cylindrical pendant from Haregeh in Egypt, now kept in the Petrie Museum at University College London (UC 6482) [2].

Figures 5 and 6 show the lower end cap. As can be seen from the green corrosion under the tear in the lower cap (fig. 2, 5 and 6), the copper rod extends to the end of the lower cap and there is no need for filler. This difference in the upper and lower end of the core, with the upper end being thinned into a narrow strip, gives further support to the idea that the object was a pendant. The appearance of the join between the circular end piece of the lower cap and the side of the cap might suggest that the circular end of the cap was soldered onto the foil cylinder that constitutes the side of the cap [3] (see fig. 5 and 6). The appearance of the corresponding join on the upper end cap (fig. 3 and 4) also suggests that it also may have been soldered. The sides of the caps were probably made from strips of foil bent into cylinders. The join between the ends of the strips running down the sides of the caps were probably also soldered although the evidence for this is less clear. There is a more or less linear split along the side of the upper



5

5 The gold cap at the bottom end of the pendant showing a tear near the join between the edge of the end disc and the cylinder forming the sides of the cap.

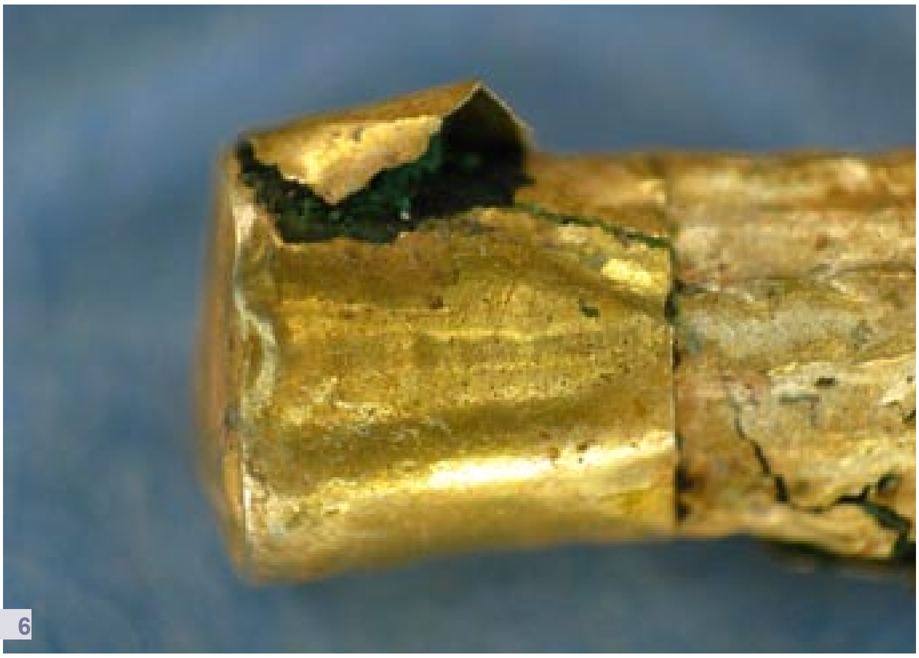
end cap that might correspond to the original join (see the right hand end of fig. 1). Further examination might clarify whether the side joins were soldered.

Scratches on the surface and signs of wear at the peripheries of the caps suggest that the pendant was worn in life rather than it being an object made purely for funerary adornment (fig. 3-6). The foil wrapped around the length of the pendant bears linear motifs running the length of the pendant. The motifs resemble garlands of leaves with the leaves hanging downwards towards the bottom of the pendant. This decoration was probably pressed into what is now the inner or

6 The cap at the lower end of the pendant showing a tear in the lower part of the side and the corroded copper rod beneath.

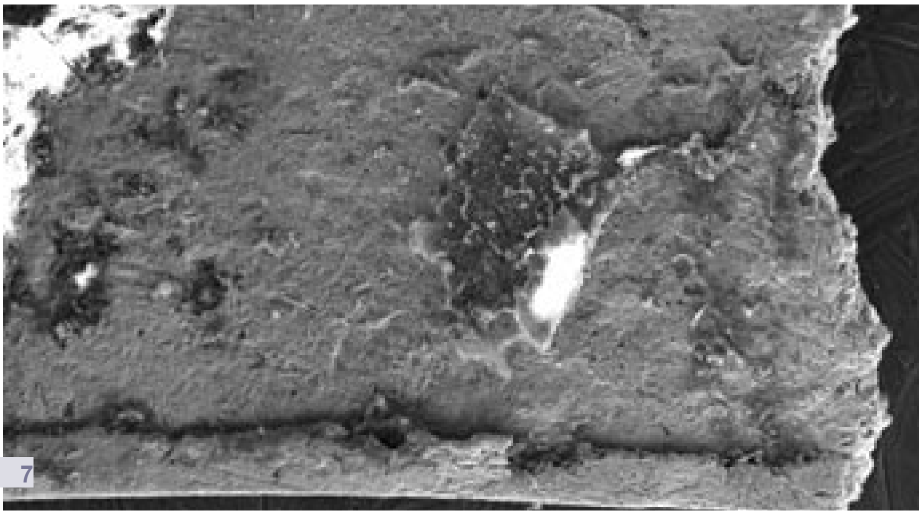
back surface of the gold foil before it was wrapped around the copper core. It is possible that the foil was pressed into a mould to form the decoration. The decorated foil may have been fixed in place with an adhesive. In discussing the overlaying of gold on the surface of other materials such as copper alloys, Ogden states that for "thinner foils and gold leaf the easiest procedure was to glue it to the substrate – either directly to the surface or over an intermediate gesso layer" [4].

As may be seen beneath the split in the upper (right-hand) end cap in fig.1, and again beneath the torn flap of the upper end cap in fig. 2 and 4, the end cap overlaps the decorated foil that sheathes the copper core. This overlap is also apparent at the open end of the lower cap (fig.1, 2, 5 and 6). The end caps thus help to keep the decorated foil in place. The decorated foil does not, however extend beneath the caps as far as their closed ends. The fact that the decorated foil extends only a little way under the end caps is apparent in fig. 1 in the split along the side of the upper cap and (in fig. 2 and 6) from the green corrosion visible under the tear in the lower end cap.


6

As can be seen in fig. 1, 2, 4 and 6, the end caps at each end of the pendant do not appear to have been tightly attached or soldered to the decorated sheet and may have been fixed in place with adhesive.

A tiny fragment of the foil had become detached and was loose in the sample container. Examination with scanning electron microscopy of the duller side of the fragment of foil (taken to be the inner side) showed that one edge of the foil had been folded under to make a straight edge to the fragment. (This is similar in principle to folding over the ragged cut edge of a piece of material to make a hem and a neat edge). The fold gave a far neater straight edge than the somewhat ragged cut edge of the foil still seen on the inner margin of the fold. This is very fine work as the strip folded under is only about 0.03 mm wide (fig. 7). This evidence would be consistent with the fragment being derived from the edge of one of the end caps. The flap torn upwards to reveal the inner surface of the upper cap (fig. 4) may have an edge that is folded under. The folded straight edge of the fragment showed no signs of soldering. The end caps have very straight open ends and appear not to be soldered to the decorated sheet (see fig. 1, 2, 4 and 6). It thus seems it is quite possible that the fragment comes from the open rim of one of the end caps. Further work might serve to place these hypotheses on a firmer basis.



7

7 A scanning electron micrograph of the inner side of the loose fragment of foil showing the narrow strip of foil (about 0. 03 mm wide) folded under to form a straight edge. The field of view is approximately 0. 5 mm from side to side.

Analytical results

The above fragment of foil was subjected to non-destructive elemental analysis using scanning electron microscopy with energy dispersive X-ray spectroscopy. The shiny surface of the fragment of foil, taken to have been the outer surface, gave normalized compositions from different analysed areas ranging from 61-88 weight % gold, 11-36 wt% silver and 2-3 wt% copper. In modern jewellery terminology this corresponds approximately to 15-21 carat gold [5].

It should be noted, however, that the analytical results given above were surface analyses taken on an unclean surface, not analyses taken from a polished cross-section of the foil. It is possible that the surface may have been subject to contamination and to variable degrees of preferential corrosion during burial. These processes might make the surface composition a little different from the original bulk composition of the gold foil. It should also be noted that the composition of the alloy used to form the end caps may be different to the composition of the alloy used to form the decorated foil.

Non-destructive analysis of the inner surface of the fragment of foil showed significant amounts of copper in the duller areas, quite probably derived from the visible green corrosion of the copper core of the pendant. In some areas of the inner surface of the foil, silicon, iron, aluminium and calcium were also found: these could easily originate from soil getting under the edge of the foil. In cleaner areas of the inside of the foil, the gold content of the foil was a little lower than had been found on the outer surface. Analyses of different cleaner areas of the inside of the foil (when normalized for a gold-silver-copper alloy) gave results ranging from 47-55 wt% gold, 41-47 wt% silver and 4-6 wt% copper.

As the analyses have been conducted on unclean surfaces, it is difficult to draw any firm conclusions from differences between the results obtained from the inner and outer surfaces of the foil fragment. Some of the copper found in the analyses of both the inner and the outer surfaces of the fragment of foil may have been contamination from the clearly visible corrosion of the core of the pendant.

The apparently higher gold lower silver content of the outer surface may have been due to loss of silver from the surface during burial but it might have been due to deliberate surface treatment during manufacture. The variability of the analytical results from different areas of the outer surface should be a warning against overinterpretation. The wide range of results from different areas of the surface may suggest that postdepositional processes (which might vary on a microscopic scale) might account for the differences in composition between different but closely positioned locations: the fragment is after all very small.

Despite the above cautions, the analytical results from the fragment are broadly consistent with what might be expected from native gold. In the Middle Bronze Age gold would probably have been available from the Eastern Desert of Egypt, from Nubia and from Anatolia [6]. Natural gold deposits often contain appreciable amounts of silver (5-45 wt% [7], most commonly 8-15wt% [8]) and a little copper. Ogden states that for Egyptian gold alloys, a gold content of 70-85 wt% is most typical. Copper may be present at up to 10 wt% but some of this may be deliberately added [9]. Bachmann lists analyses of about 160 natural, native binary and ternary gold alloys ranging in composition from 49-98 wt% gold, 2-42 wt% silver and 0-4 wt% copper[10]. (These figures exclude examples where associated copper or other minerals were suspected to have been present). Bachmann considers that gold artefacts with copper contents above about 2 wt% may have had copper deliberately added to the alloy, although the unintentional inclusion of copper minerals in the analysed sample may distort the analytical results [11].

No tin was detected in any of the analyses which may suggest that the core of the pendant was copper rather than bronze. It must be noted, however, that the green corrosion products have not been analysed directly so the possibility of the core being bronze remains.

Conclusions

Given the non-destructive nature of the elemental analyses, which were conducted on contaminated surfaces rather than on polished cross-sections, caution is necessary in drawing conclusions from the analytical results. It would be reasonable to infer, however, that it is likely that the fragment of foil was made from naturally occurring gold alloy. Deliberate addition of a small amount of copper is a possibility but the copper levels detected seem quite likely to arise from the openly visible corrosion products originating from the core. It should be noted that only one tiny fragment of foil has been analysed: the decorated foil may have an alloy composition different to that of the end caps.

No tin was found in any of the analyses so it may be that the core was made of copper, rather than bronze. This is not yet certain, however, as the core material itself has yet to be analysed.

The decorated foil covering most of the length of the core had its design worked from what was to be the inner side before the foil was applied to the core. The ends of the decorated foil were protected against damage and partly held in place against the core by the enclosing end caps which were probably held in place by adhesive.

The end caps appear to have been formed by soldering a disc of gold foil (a perforated disc in the case of the upper cap) to the edges of the foil cylinders which formed the sides of the caps. Each cylinder was probably formed by bending a strip of foil. The ends of the strips may have been soldered together to make the sides of the caps, though firm evidence for this requires further work.

Comparing the circular ends of the two end caps, it would seem that while one was complete, the other was perforated, perhaps to allow the passing through one end cap of the thin metal strip whose stump is seen at the centre of one end surrounded by whitish filler (fig. 2). The fact that the core extends to the end of the cap at one end and at the other is reduced to a narrow strip surrounded by filler is also consistent with one end being designed to allow suspension. This interpretation of the surviving material remains would be consistent with the object having been a cylindrical, gold-sheathed pendant.

We do not know the true significance of the pendant but signs of wear on the end caps suggest that it was worn in life and was not made purely as an object for burial. Those who buried the occupant of burial 102 believed that it was appropriate for the pendant to remain with the body in the grave after death.

NOTES

1 H. Newman, 1981, p. 89.

2 J. Ogden, 1992, p. 52.

3 H. Maryon, 1971, p. 5-9.

4 J. Ogden, 2000, p. 164.

5 H. Maryon, 1971, p. 6-7; M. Grimwade, 1985, p. 47-62.

6 J. Ogden, 1992, p. 28-30; J. Ogden 2000, p.161-162.

7 A. I. M. Seruya Cardoso Pinto, 1986, p.125-126.

8 M. Grimwade, 1985, p. 7.

9 J. Ogden, 2000, p. 162-164; see also J. Ogden, 1992, p. 28-32.

10 H.-G. Bachmann, 1999, p. 269-270, Table 1.

11 H.-G. Bachmann, 1999, p. 269.

BIBLIOGRAPHY

H.-G. Bachmann, 1999, "On the Early Metallurgy of Gold: Some Answers and more Questions", in A. Hauptmann, E. Pernicka, Th. Rehren and U. Yalcin (eds.) *The Beginnings of Metallurgy, Der Anschnitt,* 9, p. 267-275.

M. Grimwade, 1985, *Introduction to Precious Metals*, London.

H. Maryon, 1971, *Metalwork and Enamelling*, 5th edn., New York.

H. Newman,1981, *An Illustrated Dictionary of Jewelry,* London.

J. Ogden, 1992, *Ancient Jewellery,* London.

J. Ogden, 2000, "Metals" in P. T. Nicholson and I. Shaw (eds.), *Ancient Egyptian Materials and Technology*, Cambridge, p. 148-176.

A. I. M. Seruya Cardoso Pinto, 1986, *Ageing Processes in Ancient Gold alloys*, PhD dissertation, Institute of Archaeology, University of London.