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Summary

Two gold pendants from Grave 459a were examined in the scanning electron microscope and analysed using energy-dispersive analysis (EDX). Their compositions were compatible with the suggested mid-seventh century date, based on the compositions of contemporary gold coinage.

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Catherine Mortimer

Two pendants were found in context 459a, a seventh century woman's grave, possibly as part of a necklace constructed from silver wires (Malim 1993, 19). Other finds in the grave were a necklace of glass beads and fragments of a bone comb.

There is a generally held opinion that gold purity is closely linked with date, during the early Anglo-Saxon period. This is because gold artefacts are thought to be made with melted-down Merovingian gold coins and the purity of gold coinages declined from the late sixth to eighth centuries, from in excess of 90% gold to often less than 50%, with substantial variation between the issues of different regions (*eg* Kent 1972, reproduced here as Figure 1). Analyses of typologically-dated Anglo-Saxon gold artefacts (*eg* Hawkes *et al* 1966; Brown and Schweizer 1973) indicate that the purity of the gold used does indeed decline overall during this period but that significant variation may be expected within the products of a period or even within one artefact, where it is made of more than one part. Hence the correlation between purity and date is not exact.

The gold alloys of the pendants from context 459a were analysed using energy-dispersive X-ray (EDX) analysis in the scanning electron microscope (SEM), in order to determine their compositions and to establish how they fit into the pattern discussed above.

Although archaeological gold alloy artefacts appear on excavation to be untarnished and therefore may seem not to be corroded, gold contents are normally enhanced on the surface, compared to the interior content, because the more chemically active elements of the alloy, silver and copper, have been depleted during burial. This effect can be observed visually, as freshly scraped areas are brighter and more golden than other areas and there may be as much as a 2% increase in gold content at the surface (*eg* Mortimer 1984). Analysis of the Barrington gold was performed on the artefacts as received. No surface preparation, *ie* cleaning or scraping the top layers, was possible. This probably means that the values obtained are not those which would have been discovered had a cut or drilled sample been available. These analyses and the results of X-ray fluorescence analysis, which has commonly been carried out on gold artefacts (*eg* Hawkes *et al* 1966; Brown and Schweizer 1973), should be compared with caution since XRF penetrates deeper - information from the enhanced/depleted zones of the metal surface is more important in SEM-EDX results than in the XRF results. The coin 'fineness' (gold purity) which is to be used as dating evidence was determined by density which, as only a small proportion of the whole coin will have suffered depletion, is likely to give a reasonably accurate overall value. Furthermore, EDX analysis is ideally carried on flat, solid samples and few of the analysed areas conformed to this. Three gold-silver and three gold-copper standards were analysed using the same method, showing that the technique tended to produce under-estimates of both silver and copper; the results from the standards were used to calibrate the 'unknown' values from the Barrington artefacts. Because of these problems, although the EDX analyses are given to the nearest 0.1%, they should be thought of as having large 'error bars' (*c.*0.2% absolute for copper and *c.*0.5% for silver) and are normalised. Only gold, silver and copper were detected in

significant amounts. The results below (table) are the average of three areas in most cases.

Results

Nine areas were analysed on Δ7 and four on Δ43 (see Figure 2). The results from Δ7 suggest that the two 'vertical' wires, numbers 2 and 4, were made of the same alloy, with a rather high silver content. The 'horizontal' wires are rather less silver-rich and their compositions are comparable with those of the alloys used to make the wires which frame the outside of the piece, with those around the central setting, and perhaps with the alloy used to make the suspension loop. The back plate is even less silver-rich. Little can be said about the copper contents as they do not vary very much, although it is noticeable that the silver-rich wires 2 and 4 also have some of the highest copper contents.

The copper contents of the alloys of Δ43 are much higher in all cases and the silver contents are comparable, or even a little higher, than those of the high-silver alloys used in Δ7.

Table: Weight percent compositions of gold pendants, by SEM-EDX analysis

Artefact	Area	Weight % normalised		
		Cu	Ag	Au
459a Δ7 Pendant	suspension loop	1.5	14.4	84.1
	back plate	1.7	9.6	88.7
	wire 1	1.4	13.2	85.4
	wire 2	1.8	24.4	73.8
	wire 3	1.0	10.2	88.8
	wire 4	1.6	21.6	76.8
	outside wire	1.4	11.8	86.8
	wire around setting	1.8	12.8	85.4
	plain wire around setting	1.0	12.8	86.2
459a Δ43 Pendant	knot	4.1	26.0	69.9
	loop	4.4	22.2	73.4
	band 1	3.5	26.0	70.5
	band 2	4.8	23.0	72.2

Discussion

The lowest gold contents of these two pieces would conventionally give dates for them of 'after 610AD' based on Kent's (1972) data on the gold contents of 'extra-Provençal' coinages, which are thought to be more-frequently available in Anglo-Saxon England than the Provençal coinages, on the basis of coin hoards at Sutton Hoo and Crondall (*eg* Brown and Schweizer 1973, 183). The lowest gold values are taken because these would presumably relate to the latest gold alloys used in the artefacts and therefore to the *terminus post quem* for manufacture. Hence, despite all the potential problems in using gold contents to estimate date of manufacture, the items from context 459a have compositions which fall within the 'expected' range.

However it is widely appreciated (*eg* Brown and Schweizer 1973) that Anglo-Saxon

goldsmiths may also have had access to some coins from the higher-purity gold coinages of the time (*ie* the Provençal high or Provençal low standards) or to still-circulating early gold coins which had higher purities. Hence the gold content of artefacts might be expected to be rather higher than the gold contents of contemporary extra-Provençal coinages and the estimated dates for artefacts, deduced on the basis of their composition, may be misleadingly early. The analytical problems mentioned above would only exacerbate this situation.

References

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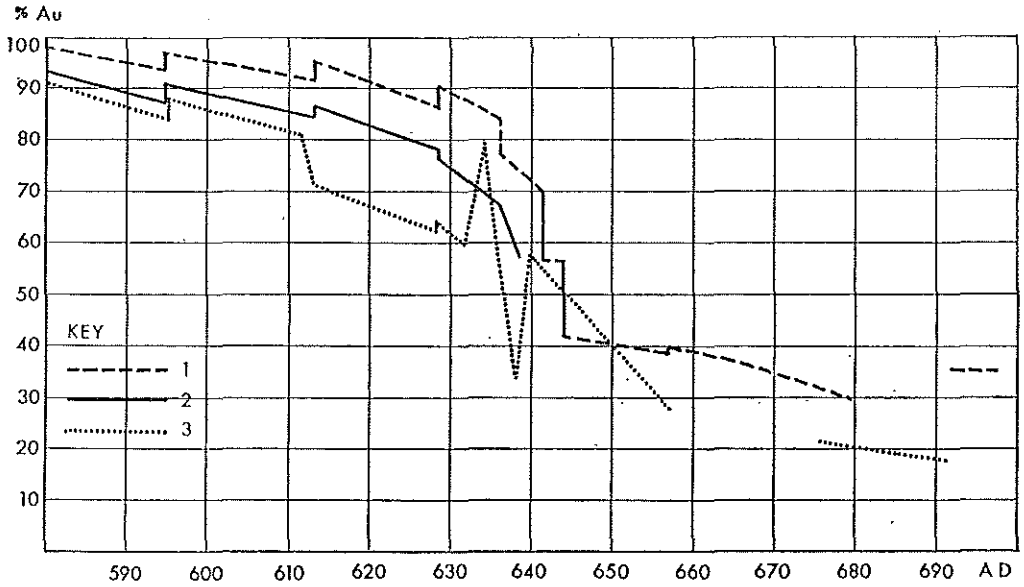

FIG. 1. The fineness of the Merovingian gold coinage, 580–700. Key: 1 and 2, Provençal standards; 1, high standard; 2, low standard; 3, standard outside Provence. This diagram is based exclusively on dated coins and on the results obtained by W. A. Oddy.

Reproduced from Kent 1972

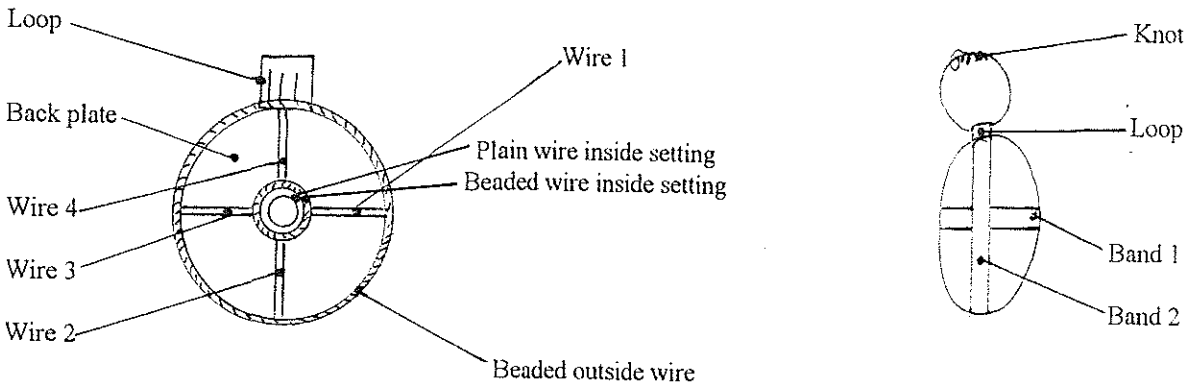

Figure2:Sketches of gold pendants from 459a Δ7 (left) and Δ43 (right), showing positions of analyses