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COLCHESTER, ESSEX.

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Summary

A group of radiate coins dating to the late third century AD found at the Angel Yard site were analysed. Qualitative analysis using X-ray fluorescence showed a range of compositions for the coins which could be related to the numismatic groups from the Central and Gallic Empires. The analyses are compared to barbarous copies of the radiates from the same site which have been analysed previously.

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ANALYSIS OF RADIATE COINS FROM COLCHESTER, ESSEX

Introduction

Radiate coins, or antoniniani, are dated to the 270s and 280s AD (Davies 1987) and were produced in both the Central Empire and the breakaway Gallic Empire. A group of radiate coins were found during excavations at the Angel Yard site in Colchester. Previous analyses of a group of barbarous radiates from the same site suggested that there were compositional differences between the coins from the two Empires. It was thought that analyses of the original radiates might also follow this pattern.

Analytical Method

All the coins were analysed qualitatively by energy-dispersive X-ray fluorescence (EDXRF) using a Link Systems Meca 10-42 machine. The primary radiation source was an X-ray tube with a rhodium target run at 35 kv and the fluorescent X-rays were detected by a Si(Li) detector. The elements recorded were copper (Cu), zinc (Zn), lead (Pb), silver (Ag) and tin (Sn).

The method of analysis used only looks at the surface of the coin and as no surface preparation was carried out on the objects the results will have been affected by surface contamination, corrosion and the depletion of elements from the surface this can produce, as well as any variations in surface topography. However the area analysed is an average across the whole coin surface and should give a reasonable indication of the alloys used in the production of the objects.

It is particularly difficult with this type of analysis to identify surface platings unless they are obvious visually. The plating of coins is undertaken using noble metals such as gold or silver in order to enhance the value of the coin. The majority of coins from Colchester had no visible surface platings. Other than the coins of Postumus, which were of very different composition to the rest, only one coin (SF No. 1186) was obviously plated (though only on the reverse) and this was confirmed by analysis. It is possible that other techniques such as pickling were carried out on these coins which would have altered the composition of the coin surfaces but there is no definite evidence of this from the analyses.

There were a number of surface treatments which could have been applied to the coins, though it is often difficult to be certain whether any analytically distinct surface was originally intended or whether it is the result of "selective chemical corrosive and surface enrichment processes" which have taken place since the object was buried (Cope 1972, 261). The coin surface treaments known to have been used in the Roman period include plating where a copper alloy core was surrounded with silver sheet-metal, silver washing where, after striking, the coins were covered with a thin applied wash of silver, and blanching where low-purity silver coins were boiled in a citrus fruit acid or vinegar which caused the leaching of copper from the alloy on the surface giving a whiter (more silvery) appearance (Cope 1972).

Results

A selection of radiates from the Angel Yard site were chosen for analysis from both the Central and Gallic Empires. The coins chosen could all be identified with specific Emperors as follows:

Number of coins analysed divided by Empire and Emperor

Gallic Empire Coins		Central Empire Coins	
Postumus	3	Gallienus	8
Tetricus I	9	Claudius II	10
Victorinus	9	Divo Claudio	3
Tetricus II	4		
Total	25	Total	21

There are clear differences in composition between the coins of the two Empires, particularly in the tin content which is not detectable in most of the Gallic Empire coins. The exception are the coins of the Emperor Postumus which have high silver contents and also contain some tin which is probably an impurity in the silver. The coins from the Central Empire in general contain much higher levels of lead and tin, the two elements being highly correlated which would suggest that they were added to the metal melt together. The analyses suggest that both tin and lead are present in the Central Empire coins at levels above 5%. However there is some variation in the composition of coins in each Empire group (and also within each Emperor group) which makes any further interpretation of the data problematic.

Average element ratios for each Empire and Emperor Group
(See table 1 for definition of element ratios)

	Zn	Pb	Ag	Sn
Central Empire				
Gallienus	5.5	56.9	17.1	10.6
Claudius II	6.7	69.8	8.1	13.7
Divo Claudio	6.0	79.3	8.7	12.0
Average	6.1	68.7	11.3	12.1
Gallic Empire				
Postumus	3.3	3.0	61.3	2.3
Tetricus I	3.8	14.0	3.3	0.0
Victorinus	3.8	19.6	5.1	0.0
Tetricus II	3.8	14.0	2.0	0.3
Average (excluding Postumus)	3.8	16.3	3.8	0.0

The three coins of the Emperor Postumus contained higher levels of silver than the other coins of both Empires. It is known from earlier analyses that the coins of Postumus contained over 15% silver until about 268 AD when there was a debasement to about 7-8% silver (Besly & Bland 1983). Imitations of the radiates of Postumus contain much lower silver levels. The three Postumus radiates analysed here contain high silver levels which suggest they may date from before the debasement in 268 AD.

Comparison of the analyses of the regular radiates with those of irregular copies from the same site (Heyworth 1988) show a similar but not identical pattern. The barbarous radiates of the Central Empire contain similarly high levels of lead and tin, in comparison to those of the Gallic Empire, but the barbarous radiates have generally higher lead levels than the regular coins. The barbarous radiates of the Gallic Empire have lower lead and tin levels, but these metals are present in the majority of coins, whereas tin is absent in nearly all the regular radiates.

All the regular radiates have very low zinc levels, in contrast to the barbarous versions which generally had higher levels and some of which seemed to have been made from brass.

Conclusions

The analyses of the regular radiates found at Angel Yard suggest that the two Empire groups can be distinguished compositionally. The radiates seem to be made from fairly pure alloys with high levels of lead and tin in the Central Empire coins distinguishing them from the Gallic Empire coins. The barbarous copies of these coins show the same broad pattern but had much higher 'background' levels of other metals, such as zinc. This may suggest that the regular radiates were produced using fresh metal sources whereas the irregular copies were made with a less pure alloy which may have contained scrap metal deliberately added to the alloy.

There was no evidence for the coins of specific Emperors having different compositions except for the radiates of Postumus which had much higher silver levels. Previous analyses of coins of Postumus have found similar high silver levels.

References

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Davies,J.A., 1987 "The Barbarous Radiates", in The coins from excavations in Colchester 1971-9, Colchester Archaeological Report 4, N.Crummy (Ed), pp.44-49.

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TABLE 1

Analytical Results for Colchester Radiates

The results of the X-ray fluorescence analysis of the radiates from Colchester are given in the following table. XRF peak heights were recorded for the following lines in the spectrum: Cu K_a, Cu K_B, Zn K_a, Pb L_a, Ag K_a and Sn K_a. It was assumed that the copper contents of the coins were approximately constant and the figures given in the table are therefore ratios to copper which were calculated as follows:

zinc = (Zn K_a/Cu K_B) x 100

lead = (Pb L_a/Cu K_B) x 100

silver = (Ag K_a/Cu K_a) x 1000

tin = (Sn K_a/Cu K_a) x 1000

The peak heights for each element cannot be directly compared between elements as the height bears little relation to the proportion of that element present. Different elements are excited with varying efficiencies by the primary X-rays, eg tin is excited far less than zinc so the peak height will be a lot lower even when the amounts involved are similar. The use of ratios is an attempt to make the data more meaningfully comparable so that it is possible to roughly compare the proportion of each element present. This is achieved by using copper, which is assumed to be present at about the same level in each analysis, as an internal standard and using a different multiplication factor for the lower energy elements (zinc and lead) to that for the higher energy elements (silver and tin).

Central Empire Radiates

Emperor	SF No	Zn	Pb	Ag	Sn
Gallienus	983	5	152	9	8
Gallienus	1051	3	6	12	4
Gallienus	1086	8	5	80	8
Gallienus	1139	11	61	6	15
Gallienus	1167	4	107	12	14
Gallienus	1352	4	50	5	10
Gallienus	1417	4	21	9	8
Gallienus	1437	5	53	4	18
Claudius II	1227	4	30	11	7
Claudius II	736	6	116	18	24
Claudius II	1008	6	20	5	6
Claudius II	1044	8	193	0	35
Claudius II	1050	11	79	0	13
Claudius II	1106	5	39	9	8
Claudius II	1140	10	80	3	12
Claudius II	1363	9	70	14	17
Claudius II	1379	4	33	15	4
Claudius II	1408	4	38	6	11
Divo Claudio	903	5	46	1	4
Divo Claudio	1235	8	111	13	19
Divo Claudio	1424	5	81	12	13

Gallic Empire Radiates

Emperor	SF No	Zn	Pb	Ag	Sn
Postumus	567	3	4	66	3
Postumus	1228	4	1	64	2
Postumus	1360	3	4	54	2
Tetricus I	745	6	21	4	0
Tetricus I	1150	4	8	1	0
Tetricus I	1185	4	16	4	0
Tetricus I	1226	4	19	2	0
Tetricus I	1233	3	9	3	0
Tetricus I	1238	3	24	5	0
Tetricus I	1240	3	7	3	0
Tetricus I	1241	4	15	5	0
Tetricus I	1413	3	7	3	0
Victorinus	974	5	24	9	0
Victorinus	1032	4	20	8	0
Victorinus	1107	5	12	3	0
Victorinus	1147	4	5	3	0
Victorinus	1186	6	26	3	0
Victorinus	1186 rev	8	39	104	4
Victorinus	1200	4	13	3	0
Victorinus	1242	3	55	7	0
Victorinus	1414	3	18	6	0
Victorinus	1508	0	3	4	0
Tetricus II	1110	4	3	1	0
Tetricus II	1143	4	22	2	0
Tetricus II	1201	3	6	3	0
Tetricus II	1252	4	25	2	1