THE FENNY STRATFORD HOARD

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Towards the end of summer 1990, during the course of roadworks at Galley Lane, Fenny Stratford (Roman Magiovinium), just south of Milton Keynes, a local metal 'detectorist' discovered what appeared to be the 'raw materials' for the production of unofficial Roman coins. The find comprised three ceramic vessels containing three groups of material and two iron dies for striking the coins.

The discovery of such material, although not quite unique, is certainly very rare and, indeed, these are the first iron dies found in Britain. Coin blanks and pellets have occurred in association with struck unofficial coins, such as those in the Sprotbrough hoard (Mattingly and Dolby 1982) and the hoard from North Leigh Villa (unpublished - recently investigated at the British Museum Research Laboratories). However, no struck coins were found in association with the Fenny Stratford material. Consequently the only reliable avenue for dating lay with the identification of the ceramic containers, although the size and weight of the blanks suggested a late third century date.

The identification of the pottery was carried out by P.T Marney of the Milton Keynes Archaeological Unit. Unfortunately the vessels proved rather unusual, although both form and fabric fall within a wide range of dates. Marney concludes that the vessels are 'poor imitations of the BB1 miniature cooking pot' and goes on to say that '(the) vessels are not easy to date. Certainly a date of late second to fourth century AD would cover all possibilities, but is rather too generous. However, the use of 'wild arcs' as decoration, combined with the slenderness of the vessels, may *perhaps* indicate a date in the late third or early fourth century AD. (Marney 1990,unpublished pottery report).
This, of course, agrees with the date suggested by the size and weight of the blanks and pre-blanks, and, as shall be demonstrated later, is in agreement with the interpretation of the analyses.

Within each of the three vessels was a distinct group of material. One vessel contained 352 blanks, another 246 pre-blanks (partly hammered flans) and the last vessel contained some 1250 cut lengths of cast copper-alloy rod as well as a small number of waste off-cuts and swarf.

Metrical analyses of the blanks and pre-blanks suggest a degree of control had been exercised over the size and weight of the flans (see fig.1). The average weight of 2.47gm is in close agreement with what one would expect for official late third century base *antoninianii* (perhaps better called 'radiates') as is the range of flan sizes (12-21mm).

The group of pellets are less well defined, sizes ranging from 2 to 5mm in length and weighing anything from 0.2 to 0.85gm. However, the majority are around 3mm in length. Examination of these pieces showed that a number were suffering the effects of 'piping' - where trapped gasses and rapid cooling of the metal cause the desired solid rod to become a hollow pipe. This may account for the large variation in weights. The diameter of the rod from which the pellets were cut seems fairly constant, keeping to 4 or 5mm, suggesting that the diameter of the pellets was controlled.

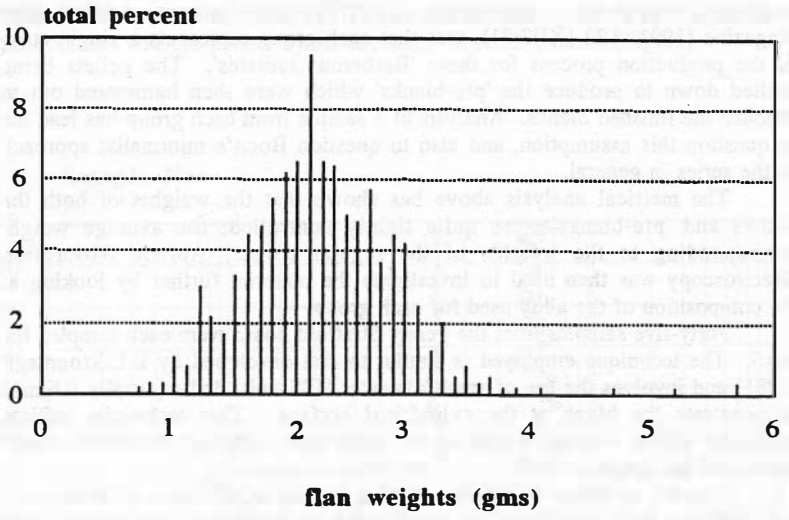

Fig. 1.

The coins that this material was intended to produce were copies of the officially produced 'radiate' or 'antoninianus', distinguished by the spiked crown worn by the emperor. These coins were produced in massive quantities during the period AD 274-286 (Reece 1987: 20) and are consequently very common as site finds and in hoards. Many questions remain to be answered about the series. However, the overall consensus of opinion is that they were issued in order to make up for shortages in official issues from the continental mints (Reece 1987: 20). By whom and from where they were issued remains controversial.

One of the most confusing aspects of these coins is the great variety of quality and size that appear to exist at the same time. Some copies are very well-produced and can only be distinguished by the trained eye, whereas others are produced on such small flans, and are of such vernacular workmanship, that they could never have been mistaken for official issues. Furthermore, although many types were produced from well cut-dies, many are by no means attempting to be exact copies of their prototypes. It seems, therefore, that there was no intent to deceive involved in the production of these copies, and this must presuppose at least some degree of official sanction.

George Boon in his paper on 'Counterfeit coins in Roman Britain' is of the opinion that the lack of exact copies was due to the 'carelessness with which the inhabitants of the Roman Empire were apt to regard the details of their coinage' (Boon 1988:114) and that the copiers' sole concern was in producing as many coins as possible out of whatever metal they could lay their hands on. The apparent decline in size of the copies over time is seen as evidence of this, although it is recognized that both large copies and small copies circulated together alongside the regular coins (Boon 1988:129).

The initial assumption for the Fenny Stratford material, as put forward in both the *Independent* newspaper (26/11/90) and *Current Archaeology* magazine (1991: 122 [XI]2:71), was that each group represents a single stage in the production process for these 'Barbarous radiates'. The pellets being melted down to produce the 'pre-blanks' which were then hammered out to produce the finished blanks. Analysis of a sample from each group has lead me to question this assumption, and also to question Boon's minimalist approach to the series in general.

The metrical analysis above has shown that the weights of both the blanks and 'pre-blanks' were quite tightly controlled; the average weight corresponding to the weights of the regular coins. Atomic Absorption Spectroscopy was then used to investigate the material further by looking at the composition of the alloy used for each group.

Forty-five samples from the Fenny Stratford hoard were each sampled for AAS. The technique employed is similar to that developed by E.L.Szonntagh (1981) and involves the use of small diameter HSS twist drills (usually 0.6mm) to penetrate the blank at the cylindrical surface. This technique inflicts minimum visible damage whilst at the same time sampling the entire cross-section of the blank.

In order to obtain as representative a sample as possible, an average of four drillings were made into the blank, each penetrating to the centre. The drillings were spaced equidistantly around the edge of the blank, usually in quadrants, although this was not always practicable. Approximately the first millimetre of drillings discarded in order to limit the effects of surface enrichment/depletion and contamination by corrosion products. The drillings extracted thereafter were carefully collected on analytical weighing papers which were changed after each sample. Furthermore, each specimen was held, during drilling, in a box-wood jewellers ring-vice, which was carefully brushed down after each sampling. The drills themselves were used for more than one sample, there being no danger of contamination from this source (Hughes et al. 1976:22). The resultant drillings from each blank or pellet were collected together and amalgamated thus creating a homogeneous sample collected from a number of reasonably equidistant areas throughout the specimen.

After each specimen had been sampled, the holes were then plugged using a two-part epoxy-putty, coloured with appropriate mineral dyes. By this process the sampling damage was rendered almost completely invisible to the naked eye.

Atomic Absorption Spectroscopy requires that the sample to be analysed is in solution. Thus the 20mg or so of drillings collected were digested in 2 ml of Aqua Regia (a mixture of hydrochloric and nitric acids) and the resultant liquids then made up to a standard volume with de-ionised water. The analysis then looked for twelve elements which had been decided upon by the results of earlier work, both by the author and from the literature. These were copper (Cu), tin (Sn), zinc (Zn), lead (Pb), silver (Ag), antimony (Sb), arsenic (As), gold (Au), chromium (Cr), cobalt (Co), iron (Fe) and nickle (Ni). However, the gold and chromium proved to be consistently below the detection limits of the instrument and so were left out of the final analysis.

Multivariate statistical methods were then used to examine the resultant data. It was immediately apparent that two very different groups of material are

represented here. These correspond directly to the blanks and pre-blanks on one hand and the pellets on the other. The blanks are distinguished by a significant zinc content and the pellets by an unusually high tin content (Fig.2).

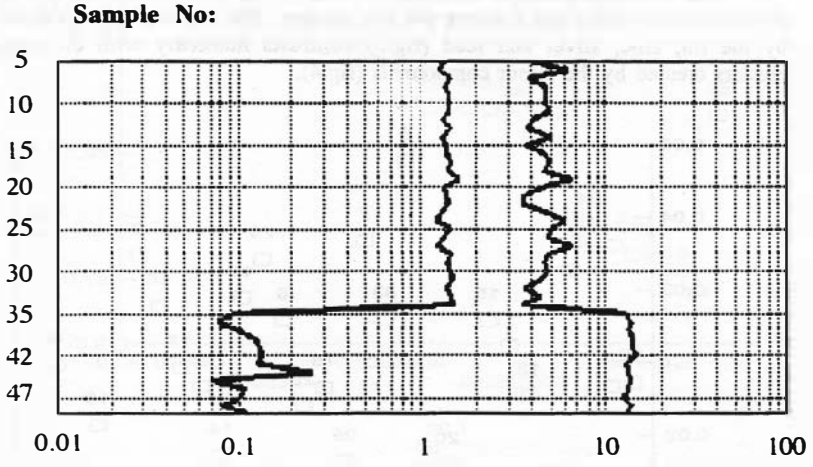

Fig.2. Plot of relative Zinc (left) and Tin (right) contents Blanks are sample Nos.5-34. Pellets are sample Nos.35-39.

Consequently it was decided to separate the two groups and treat them as separate data sets. Because the techniques to be employed assume that the data are normally distribute, and to stabilize their variability, the data were log-transformed. Where values detected were below the detection limits of the equipment a value of half the detection limit was ascribed, thus avoiding problems with zero values during the transformation.

Furthermore, it was felt appropriate to remove all copper values from the analysis in order to render the data no longer truly 'compositional'. By doing this Aitchison's (1989) objections to using standard multivariate statistical techniques on compositional data are avoided.

Ward's method cluster analysis was initially applied together with principle component analysis of the covariance matrix. The combination of these two techniques hinted at possibilities for further sub-groupings within the main material groups, although none were very clear cut.

It was therefore decided, on the basis of the archaeometallurgy, to divide the data into those components which were more likely to have been controlled in antiquity and those components which were present in such minute quantities that they can only have been present as impurities (from the ores and/or fluxes). Thus the tin, zinc, silver and lead form one group, and the nickel, iron, arsenic, antimony and cobalt form the other.

The resultant principle component plots of the blanks analyses clearly show a marked difference between the two groups. The random spread created by the tin, zinc, silver and lead (fig.3) contrasts markedly with the clear clusters created by the minor components (fig.4).

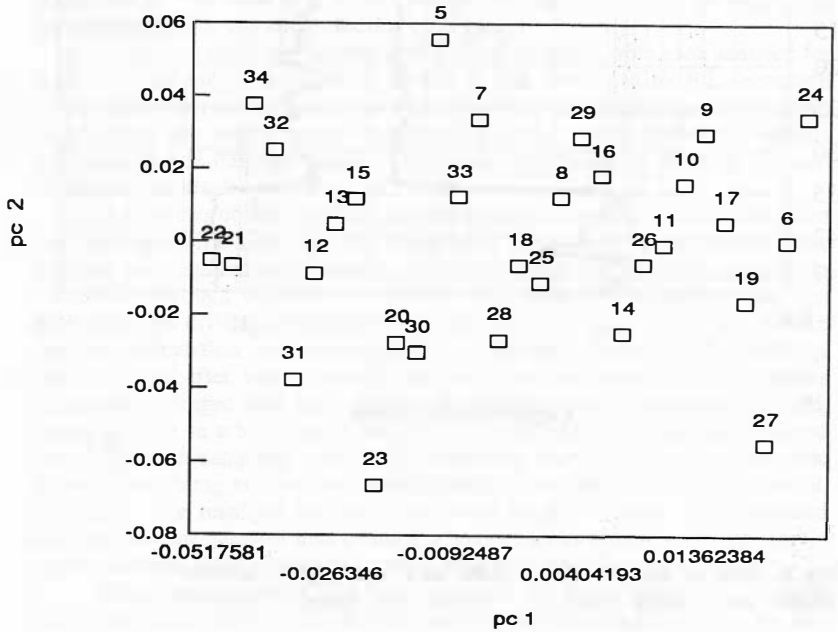

Fig.3.

It appears, therefore, on the basis of the minor components of the blanks and pre-blanks, that we have three possible 'batches' of alloy exhibiting different minor component profiles. However, the same pattern is not present when the controllable components are plotted, suggesting that an attempt was being made to maintain a consistent 'fineness' of these components across more than one mix of alloy. The same pattern is also apparent for the analyses of the cut-pellets, although the smaller data set makes the differences less profound. It is, however, the combination of Ward's method cluster analysis and the PCA which suggests greater structure in the minor components (fig.6) than in the major components (fig.5).

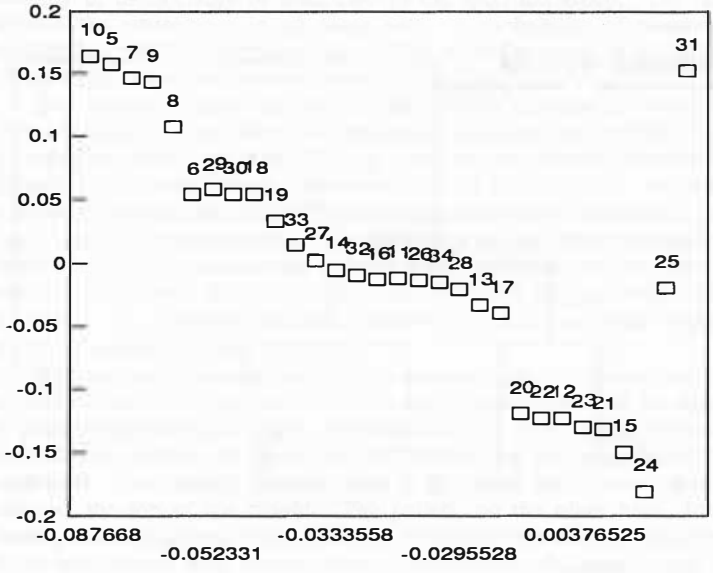
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.087668
-0.052331
-0.0333558
-0.0295528
0.00376525
pc 1
pc 2
10 5 7 9 8 6 29 30 18 19 33 27 14 32 16 1 12 26 34 28 13 17 31 25 20 22 2 23 21 15 24

Fig.4.

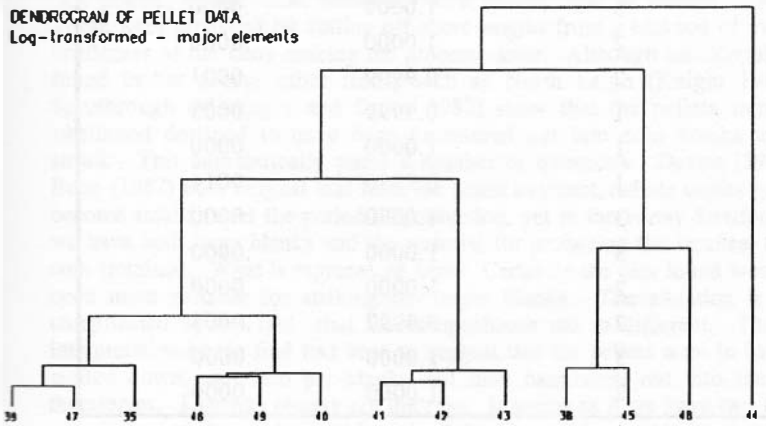
DENDROGRAM OF PELLET DATA
Log-transformed - major elements
39 47 35 46 49 40 41 42 43 38 45 48 44

Fig.5.

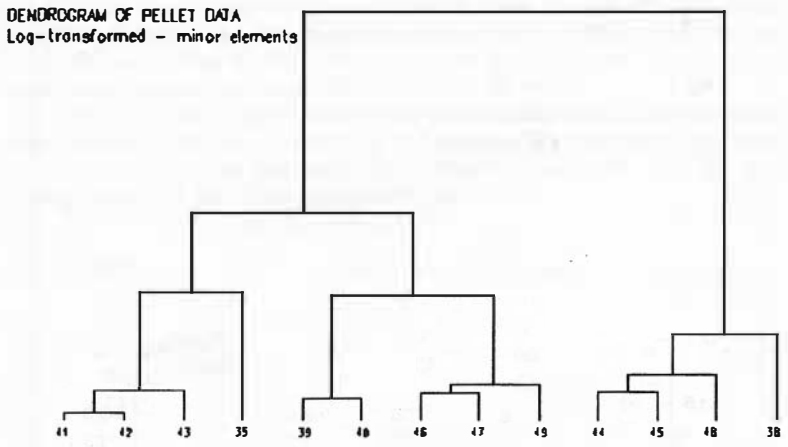

Fig.6.

Sample	Group	Highest group probability	Second highest group prob.
35	1	1.0000	.0000
38	3	1.0000	.0000
39	2	1.0000	.0000
40	2	0.9999	.0001
41	1	0.9999	.0003
42	1	1.0000	.0000
43	1	0.9986	.0014
44	3	1.0000	.0000
45	3	1.0000	.0000
46	2	1.0000	.0000
47	2	0.9997	.0003
48	3	1.0000	.0000
49	2	1.0000	.0000

Fig. 7.

In order to confirm that the compositional groupings encountered are significantly different and not just artifacts of the clustering procedure, the data were submitted to discriminant analysis. This process calculates the relative

probability of membership of each case to the specified group. The results confirmed the attributions in all cases with the probability of membership being less than 99% in only three cases. This is demonstrated in the table for the 'pellets' by minor components shown in fig.7.

Discriminant analysis can also indicate which variables are responsible for the clustering. The 'major',or controlled, elements responsible for the slight variation picked up in the 'blanks' group are tin and lead (F values of 30.34 and 183.5 respectively). However, the real groupings, by the 'minor', uncontrolled, elements are defined by the cobalt and nickel contents (F values of 841.0 and 28.05 respectively). The groupings of the 'pellets' are similarly defined; lead is again responsible for the groupings based on the controlled elements together with zinc (F values 2.30 and 39.99 respectively), and the iron content is confirmed as being responsible for the 'minor' element groupings (F value of 87.10) .

Metallographic examination of the polished edges of selected examples also supports the view that two very different groups of material are present. The visible structures strongly suggest that the pre-blanks were cast individually in moulds and then cold worked into the prepared blanks. Pre-blank No.25, for example, clearly shows a lip where the molten metal has overflowed the top of the mould. The pellets, on the other hand, form a different production group, being produced from cast rods of alloy which were then cut into pellets with a cold-chisel. The cuts can be clearly seen in a number of the pieces examined.

It is important to note that the two clearly different compositions of the blanks/pre-blanks and the pellets is matched by these two totally different production systems. The blanks/pre-blanks are of a gunmetal containing approx.1.4% zinc; these were cast individually and then hammered out, some being joined together, presumably to maintain a certain broad weight standard. The pellets, on the other hand, are of a leaded high tin bronze (13%+ tin). These were produced by cutting off short lengths from a cast rod of metal, the brittleness of the alloy making the process easier. Although no examples were found in the group, other finds, such as North Leigh (Knight 1984) and Sprotbrough (Mattingly and Dolby 1982) show that the pellets were in all likelihood destined to have been hammered out into coin blanks and then struck. This automatically poses a number of questions. Davies (1988) and Boon (1987) both suggest that from the hoard evidence radiate copies gradually become smaller over the period of production, yet in the Fenny Stratford group we have both large blanks and the material for producing the smallest types of coin (minims). What is represented here? Certainly the dies found would have been more suitable for striking the larger blanks. The situation is further complicated by the fact that the compositions are so different. The initial interpretation of the find had been to suggest that the pellets were to have been melted down, cast into pre-blanks and then hammered out into the blanks themselves. This was clearly not the case. It seems as if we have two types of copy represented here. It could be argued that the pellets would have been mixed with other metal not represented in the hoard to produce a similar alloy to the blanks/pre-blanks. Why then go to the trouble of casting rods and then cutting off such small lengths? Furthermore how would one explain the similarities with the other material mentioned above? Replication of the alloys used for

each group has shown that the differences in composition would have been sufficient to render differences in colour of the freshly struck coins. This feature would also support the suggestion that the compositions represent different values in terms of the component metals employed. Maybe the increased amount of tin in the pellets compensated for the reduction in size? Or perhaps we are just seeing material deposited at the time when large copies gave way to minims in that area?

The division of the compositions into major and minor components clearly demonstrates the existence of more than one batch of alloy being represented in the samples, and that the major components were quite closely controlled. These facts argue strongly for two distinct and controlled alloy standards being represented in the hoard and that these relate directly to two different size groups and production processes. This is in direct contrast to the accepted view of radiate copies, where it is generally thought that no alloying standards operated; any old metal being melted down for coins (Boon 1988:129).

There is a clear trait in the composition of the radiate copies which should be mentioned, and that is the presence of zinc. Apart from the earlier orichalcum issues (*sestertii* and *dupondii*) of the first two and a half centuries AD, zinc is only present as a trace (<0.1%) in official base-metal coins. Indeed, zinc is similarly lacking in both of the later outbreaks of copying discussed here. The radiate copies, however, seem to consistently contain about 1.5% zinc. This trait was confirmed recently by Mike Cowell of the British Museum research laboratories, who analysed two struck copies and three official radiates semi-quantitatively by XRF (Cowell pers. comm.). What is the significance of the 1.5% zinc, and is the amount purely fortuitous or, as its frequency suggests, a desired component? Certainly other Romano-British metalwork can contain similar amounts of zinc (Bayley 1986:384 for example) but it is the fact that the same amount is maintained over what appears to be, in the case of Fenny Stratford, three melts of metal. The same sort of figure occurs in Mike Cowell's analyses, the Sprotbrough Hoard and the Brauweiler Hoard (Ziegler 1983).

It may also be significant that the high tin pellets contain virtually no zinc. The results of the analyses (XRF) of the copies in the Brauweiler hoard show that copies with recorded zinc values of between 1.5% and 4.00% also tend to have low tin values (<2%) and that copies with higher tin values (>2%) have less zinc (<1%) (Ziegler 1983:76).

This analysis poses more questions than it answers. It has shown how trace element groupings can be of great value in work of this sort, and that it is always helpful to employ more than one analytical technique. On the archaeological level, more comparative analyses need to be done to establish the validity, or otherwise, of some of the suggestions put forward here. Nevertheless, the concrete facts remain that two types of copy are represented in the Fenny Stratford hoard, with significantly different compositions, metal colour and production systems. It can also be demonstrated that within the groups, remarkably tight standards of composition were in operation, presupposing a greater degree of organization that has previously been thought supportable (or desirable) for endemic copies in Roman Britain.

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