Section 2 – Recording coin mould: aims and methodology.

Aims.

To attempt to establish by supra-microscopic examination; classification using a standardized protocol; and comparison of coin mould:

a. The details of the process in which coin mould was used
b. The way in which the coin mould was made
c. The possible scale of coin manufacture at Ford Bridge
d. The possibility of local variations in the manufacture and use of coin mould, and the existence of local or regional traditions of minting
e. The way in which minting at Ford Bridge may have been organized[1]
f. The social and economic structures within which the manufacture of coin took place.

Methodology.

Unless it is possible to characterize a particular piece of mould in a standardized format, it will be impossible without the physical juxtaposition of the samples to compare one fragment with or differentiate it from any other fragment of mould. This lack of a standard procedure has been the single greatest obstacle to progress in the field of pellet mould studies during the last fifty years.

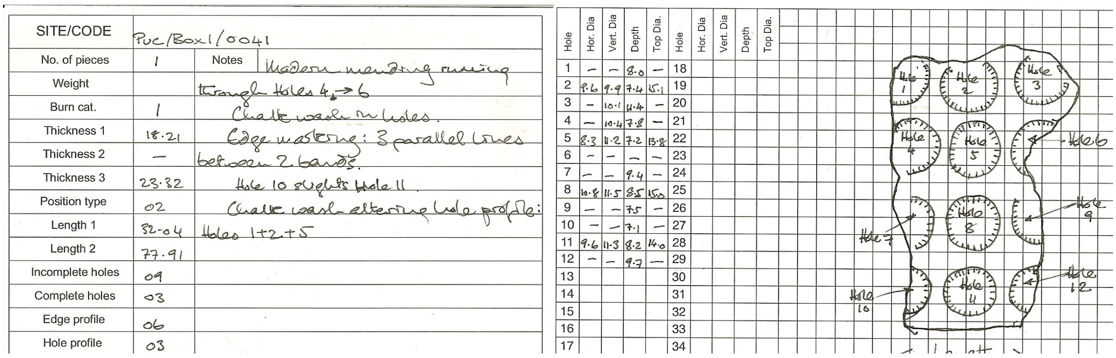
The evolution of a useful recording protocol for pellet mould could be characterized by the two phrases ‘chicken and egg’ and ‘feedback loop’. Until a deal of mould has been examined, it is not possible to say which physical parameters should be measured – but without some decision as to which parameters to measure, it is difficult to make any meaningful examination of mould morphology.

The basic criterion adopted was that as little as possible should be based upon assumption, and that primacy should be accorded to the data. Until its validity was demonstrated, reasoning by analogy would not be acceptable: uniformity of practice cannot be assumed, it must be demonstrated.

After some trial and error, it was decided that the best approach was to collate the various claims made for pellet mould, its manufacture and function, and to attempt to resolve as many as possible of these theories into hypotheses that could be tested against morphological data. In addition to these, the current researcher had additional propositions to test, and more questions arose during the course of data collection.

Early in the process it was realized that one of the theories central to the idea that pellet mould was used in the production of coin, the ‘intermediate process’ theory, could not be addressed by means of mensuration or observation. Rather, this is a question which can only be answered by a programme of experimental minting.

The methodology devised is non-destructive, and requires no equipment more sophisticated than digital callipers, a strong desk lamp and a x8 handlens. The numerical data is retrieved according to the protocol set out below; additional features are listed of each fragment using a standardized terminology, as explained in the 'Notes' section of the protocol. Data from each sample of coin mould was listed on a pre-printed record card; specimens with more than five holes were drawn schematically on the record card, and the holes numbered. Fragments with no retrievable data beyond Burn Category and incomplete holes without measurable diameter or depth were bagged together according to the number of incomplete holes, and the number of fragments in each 'bulk bag' noted on a record card.



SITE/CODE	Puc/Box1/0041		
No. of pieces	1	Notes	Modern mending running
Weight		through Holes 4 → 6	
Burn cat.	1	Chalk wash in holes.	
Thickness 1	18.21	Edge weathering: 3 parallel lines	
Thickness 2	—	between 2 bands.	
Thickness 3	23.32	Hole 10 sleights Hole 11.	
Position type	02	Chalk wash altering hole profile:	
Length 1	82-04	Holes 1+2+5	
Length 2	77.91		
Incomplete holes	09		
Complete holes	03		
Edge profile	06		
Hole profile	03		

Hole	Hor. Dia	Vert. Dia	Depth	Top Dia.	Hole	Hor. Dia	Vert. Dia	Depth	Top Dia.
1	—	—	8.0	—	18				
2	9.6	9.9	7.4	15.1	19				
3	—	10.1	11.4	—	20				
4	—	10.4	7.8	—	21				
5	8.3	11.2	7.2	13.8	22				
6	—	—	—	—	23				
7	—	—	9.4	—	24				
8	10.8	11.5	8.5	15.0	25				
9	—	—	7.5	—	26				
10	—	—	7.1	—	27				
11	9.6	11.3	8.2	14.0	28				
12	—	—	9.7	—	29				
13					30				
14					31				
15					32				
16					33				
17					34				

Plate 2: A completed record card, front and back.

Resolving the theories into testable propositions.

i. Tray forms.

The deduction from a fragment of mould of the original form of the parent tray is can be carried out by observing first, the angles of tray corners; second, the relationship between tray edges; third, the relationship between tray edges and the rows and columns of holes on the fragment; fourth, the number of holes in rows and columns.

While this is a relatively simple process, it will only be possible to carry it out either if these features are to be found on the fragment, or if the features are sufficiently distinctive. A right-angled or rounded corner is a feature which could be possessed by several, entirely different, tray forms, and cannot therefore be considered diagnostic of a particular form, whereas the oblique corners of the pentangular Verulamium tray form can be distinguished with ease from both right-angled corners and from the less oblique angles one would expect from a hexagonal tray. The single hole one finds at the apex of the Verulamium form is also distinctive; however, if this is missing from a fragment which has one edge and no corners, the angle between the edge and the hole-row will enable the researcher to decide with confidence that the parent tray was not rectangular, if the hole-row and the edge diverge significantly from the parallel.

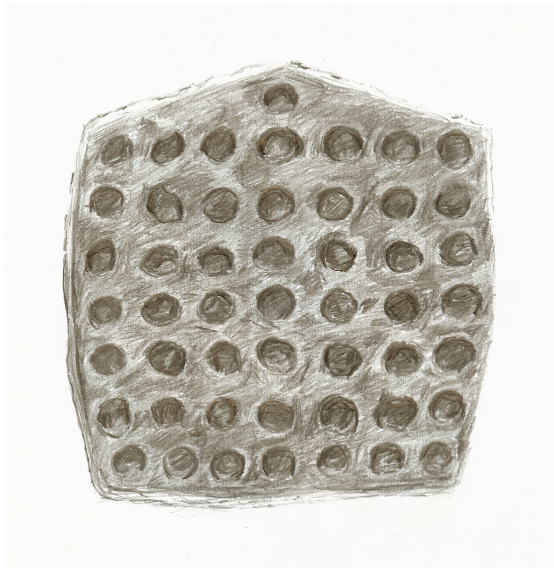


Plate 3: 'Verulamium' form tray.

The Puckeridge form, a rectangular tray with five rows of five holes, is more problematic. Both of the diagnostic examples of this type have holes with a diameter greater than 15 mm., and no corner fragments from the Puckeridge Assemblage with holes of this diameter exhibited oblique corners or apex holes that one would associate with a Verulamium form tray. It is therefore suggested that the Puckeridge form was reserved for larger diameter holes, but this cannot be demonstrated with absolute certainty.

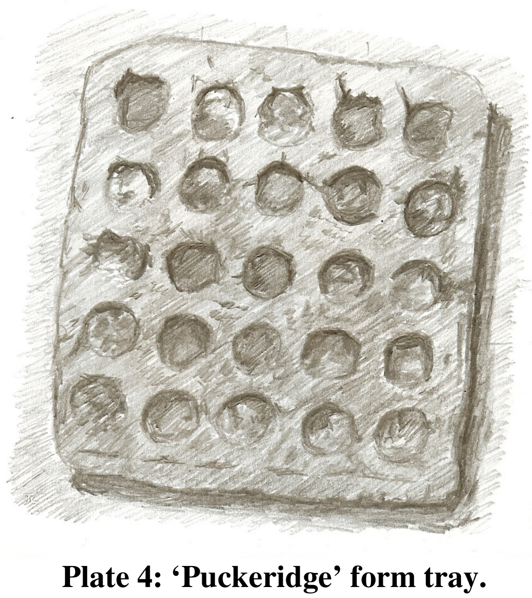


Plate 4: 'Puckeridge' form tray.

ii. Tray Profiles

Elsdon[2] refers to the bowed profile of trays, although she advances no reasons for this characteristic. It has been noted that this is by no means universal, so it would seem unlikely that there is any processual imperative for bowing. Instead, it should perhaps be viewed as either an accidental effect of a particular method of tray manufacture, or the personal taste of the tray-maker.

While this occasional feature may not have been of great significance to the contemporary users of pellet mould, in cases where it does occur, bowing can serve as a good indicator of the location and orientation on the parent tray of fragments without edge profiles.

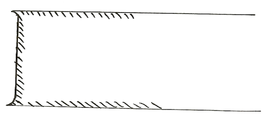
iii. Methods of tray manufacture.

There are five possible ways in which a tray might be made:

a. Using a box-mould, as with tile-making.
b. Using a bowl-mould, like a very shallow jelly-mould
c. By cutting the desired shape from a larger sheet of clay rolled to the appropriate thickness, like cutting pastry.
d. Freehand, without any device.
e. By beating to shape using a paddle.

Experiment has revealed that some of these methods will produce a distinctive signature on a finished tray. These are all related to edge characteristics, involving the edge profile and markings on the side-face. However, it should be pointed out that these experiments assumed that an edge profile was the product of a single process. In fact, it seems possible that some profile forms result from two intentional processes, moulding and hand-finishing; others represent accidental modification of a profile during either the later stages of manufacture or during use.

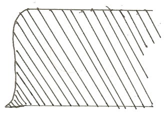
Fig. 1 – Edge characteristics: 'I-Section' Profile.



The 'I-Section' profile indicates that a box-mould has been used to form a tray. Its distinguishing features are the 'burring' on both top and bottom edges, and result from the use of a mould open at both top and bottom.

Plate 5: An experimental 'box-mould' with one open end.

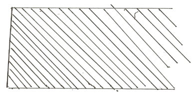
Fig. 2 - Edge characteristics: 'Lazy S' Profile.



This profile is consistent with the use of a bowl-mould. The features which distinguish it from profiles produced by other methods of manufacture are the smoothly rounded upper edge and the 'burring' at the base only. This 'burring' is caused when the clay is smoothed flush with the top of the mould.

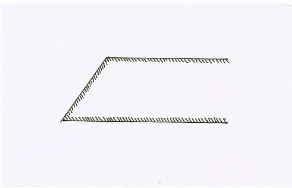
Plate XX: An experimental 'bowl-mould' with one open end.

Fig. 3 – Edge Characteristics: 'Straight-Section' Profile.



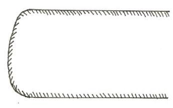
This edge profile is suggestive, but not diagnostic, of a cut edge.

Fig. 4 – Edge Characteristics: 'Angled Section' Profile.



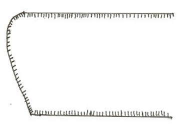
Again, this profile is suggestive, but not diagnostic of a cut edge

Fig. 5 – Edge Characteristics: 'Rolled-Edge' Profile.



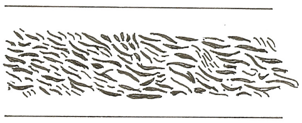
The tapering of the slab as it approaches this type of profile, and the distinctive 'rolling' of both upper and lower edges seems to indicate that the edge was not formed in a mould or by using a paddle. On fragments retaining more than one edge, this form of profile may appear in conjunction with any of Profiles 1 – 3. For Profiles 1 and 2, this possibly indicates the use of a mould with one open end. However, it should be noted that experiment has not been able to resolve this point beyond doubt. The form of rolled edge noted on some material from Old Sleaford seems to have been produced by the intentional modification of a Type 2 profile while the clay was still wet.

Fig. 6 – Edge Characteristics: 'Overhang' Profile.



Although this profile seems to have been produced using some type of mould, it has proved impossible to generate this distinctive signature using a single process, and the suspicion is that this type represents the modification of another profile type, probably a 'Lazy S'. Some examples are clearly the result of expansion of the top surface and edge of a fragment through vesiculation caused by heating, but others may have been caused by the displacement of clay during the hole-making process.

Fig. 7– Edge Characteristics: 'Cut and Tear' Banding on Side-Face.



Experiment has shown that this distinctive marking – smooth bands at the top and bottom of the face, with a band of rough, torn clay in between - on a side-face is produced by cutting the clay with some sort of blade.

iv. Edge markings.

A number of markings of uncertain import have been noted on both the Ford Bridge and the Puckeridge material, the most striking of which has been termed 'band and lines'.

Plate XX: 'Band and lines' edge marking

Since this marking is not prominently displayed, and since it is often very faint and fragmentary, it should perhaps be concluded that this is not a decorative motif, and ought rather to be considered as a minor variant in the tray manufacturing process. It was noted during the experimental manufacture of mould trays that when using a wooden bowl-mould without modification the clay tended to adhere to the mould, resulting in serious malformation of the tray during extraction from the mould. The solution adopted in the experiments was to grease the mould, which worked very satisfactorily; however, the use of a mould-lining would also be a practical way of dealing with the problem. The 'band and lines' marking is very similar to the impression caused in wet clay by a length of Iris pseudocorus leaf, and the occasional occurrence of sections of 'band and lines' terminating in a clear diagonal cut would seem to support this interpretation.

v. Evidence of elaboration.

This refers to features such as the 'cleavage grooves' noted in the Sleaford material by Elsdon[3], and the 'incised guidelines' observed on a very small proportion of the fragments from Ford Bridge. They are noteworthy in that they reveal a degree of attention and care during manufacture beyond the norm, but closer study is required before it can be assumed that these features reveal any further information.

With regard to the 'cleavage lines' found at Sleaford, Elsdon[4] suggests that they represent improved functionality, by enabling the cleaving of trays along the rough line of the base of the mould holes, which she claims would have enhanced the retrieval rate of pellets. On the face of it, the benefits of this practise would seem to have been minimal: cleavage lines have not been noted at Verulamium, and have been found on none of the material from Braughing, yet only three in situ pellets have been found at Verulamium, as opposed to one at Sleaford – and none at all have been found at Braughing. It is for this reason that the present survey classes them as 'elaboration'.

Concerning 'incised guidelines', it should first be noted that these features have so far firmly been identified only on material from the Braughing/Puckeridge Complex, with a single possible example from Turners Hall Farm near Verulamium. Furthermore, they occur almost exclusively on proved or very likely 'Verulamium' tray form fragments: only a single instance of an 'incised guideline' has been noted on a fragment of a probable 'Puckeridge' form tray.

These lines were made using a point and some sort of straight edge on the upper surface of the tray while the clay was still wet. To date, they have been found in two places on the upper surface: lateral, between the outer column of holes and the side edge of the tray, running more or less parallel to the edge;

and – much more rarely - horizontal, below the apex hole, and close to, and roughly parallel with, the top hole row.

The precise purpose of these lines is not yet clear. They have been termed ‘guidelines’, yet were they essential to the placing of holes on a tray, then one might reasonably expect their presence on a much higher proportion of the recovered material. Moreover, experiment has shown that it is perfectly possible to position holes in rows and columns with sufficient accuracy to enable all 50 holes to fit onto a tray without the use of any guidelines at all, using the apex and the two oblique corners of the ‘pediment’ as reference points. For a fuller discussion of possible methods of controlling hole spacings and alignments to enable the inclusion of the desired number of holes on a tray, see below, ‘Methods of Hole Making’.

Furthermore, for horizontal guidelines at least, the evidence is ambiguous as to which came first – the top hole-row or the guideline. Slighting has been observed, but it has not proved possible to discriminate priority.

Taken together, these observations would seem to show that ‘incised guidelines’ were not essential to the successful completion of a tray, and that they should therefore be classed as elaboration.

vi. Methods of hole manufacture.

A word first about terminology: Elsdon[5] has used the word ‘matrix’ for the implement used to make the holes. Since ‘matrix’ means ‘womb’, it seems a wonderfully inappropriate term for a tool that is essentially a blunt prong, and which operates by piercing. The term ‘dibber’ is therefore to be preferred as much more apposite and accurate.

It has been claimed (Elsdon[6]) on the basis of Continental examples[7] that the mould holes in a tray were made in multiples, but this has never been tested against British material; nor has consideration been given to the two possible alternative methods of hole-making: that the holes were made all in one go, using a sort of pegged board; or that they were made one at a time using a single point.

To modern minds, conditioned by two hundred years of Industrial Revolution, effort expended on the means of production offers clear benefits in terms of speed, ease and standardization. However, it must be remembered that the savings offered by this approach to mass-production in time and effort are often only apparent if the production process in question is carried out regularly and on a large scale. If production is episodic or spasmodic, and relatively small-scale, then it is perfectly possible that such savings will be insufficient to justify any great outlay of labour on complex or 'sophisticated' manufacturing systems.

It should also be remembered that 'standardization' operates on all the different parameters of an object: one may have a 'standard diameter' without a 'standard depth'. The notion that the mass-production of a type of object should result in examples which are physically identical is not the only approach which will yield acceptable results. An alternative concept would be 'functional identity' – the mass-production of objects which are capable of fulfilling the same function, while not being physically identical. An example of this would be the production of pottery in the Late Iron Age: this was produced in quantity, but pots of the same type are never exactly identical. The height of the shoulder will vary slightly from pot to pot, as will the thickness and profile of the rim and the thickness of the wall, but these variations did not prevent the pots from fulfilling the same function.

So long as the pellets are identical in the parameters that affect their functionality, precision in other parameters is actually unnecessary.

The determination of whether mould holes were made all at once, in multiples, or singly, can be made irrefutably of a given fragment under certain circumstances using morphological data.

If a peg-board has been used to make the holes in a fragment, then one would not expect to find instances of one hole slighted by another, nor evidence of 'abortive' holes; and all holes would have the same angle of insertion.

If a dibber with more than one prong has been used, then this will result in repeated patterns of spacings between holes, in either rows or columns, depending on the orientation of the dibber. One would expect to find an identical angle of insertion in that axis, and any hole slighting would similarly take place only in a single axis.

Conversely, if a single-pointed dibber has been used, then one would expect to see instances of hole-slighting, abortive holes, and random spaces between holes. It is also likely that holes would exhibit different angles of insertion.

It has been suggested by David Parker[8] of ULAS, who is working on the material from Merlin Works in Leicester, that it might be possible to track the path of the dibber across a fragment by taking a second top diameter measurement at right angles to the first. The orientation of the longer axis on each hole, relative to the orientation of the longer axis on the other holes on the fragment, would show the orientation of the dibber when each hole was made, and therefore might also show the order in which both holes and hole rows were made.

It was felt that this idea was good, certainly good enough to warrant investigation, and so five of the larger fragments were selected on which to test the theory. However, two out of the five fragments generated results for dibber orientation that looked almost random. It was realized, after much thought, that while the research design had modelled dibber orientation during the process of hole-making with a single variable, angle of insertion, there were in fact three, independent, variables affecting top diameter: angle of insertion; angle of extraction; shape of dibber. It was decided that this rendered the technique too undependable to justify its employment.

These considerations also affect the validity of the 'angle of insertion' method of determining the way in which holes were made, and therefore this technique has not been pursued.

However, instances of hole-slighting and abortive holes have been noted, and the measuring of hole-spacings on fragments large enough to be able to provide reasonable evidence of repeated patterns of spacing has taken place.

Slighting introduces another source of unintentional distortion, producing both D-shaped and 'squarish' (Clifford[9]) outlines. D-shaped outlines are informative, in that they can be used to discern the order in which holes were made: the slighted hole will undeniably have been made before the 'slighting' hole.

Observed variation in hole profile across single fragments is so great that it is clear that there is very little relationship between dibber profile and hole profile.

Experiments in hole making have demonstrated that if holes are made in wet clay with a single-pronged dibber, a characteristic pattern of variation arises. If the data retrieved from a fragment of coin mould agrees well with this pattern, then this is strong evidence that the holes in that fragment were also made with a single-pronged dibber.

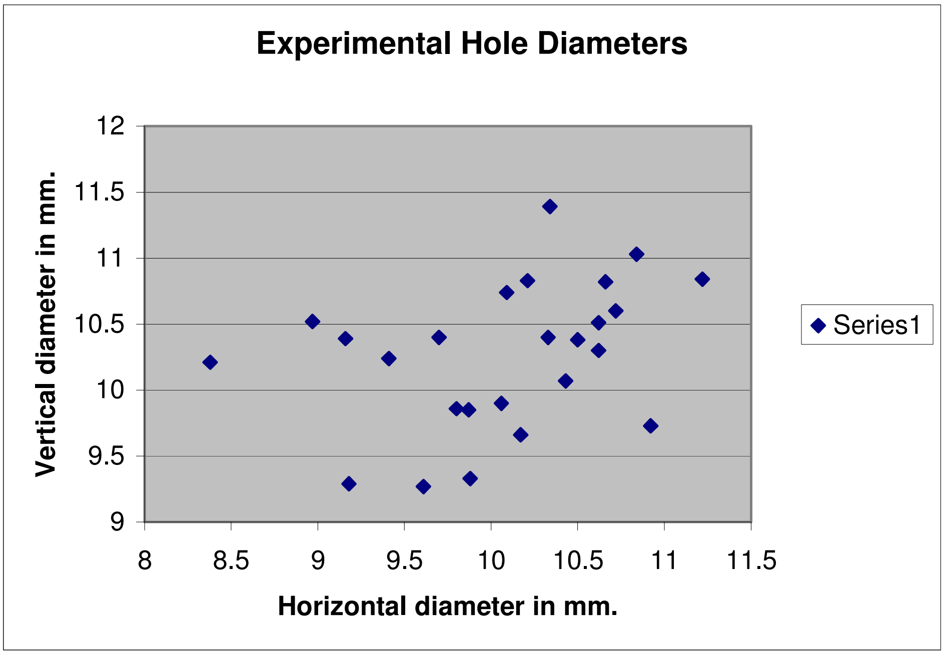


Table 1: Diameters of 25 holes made experimentally with the same single-pronged dibber.

vii. Number of pellets in a tray.

It must be accepted that, in many cases, it will not be possible to answer this question. If trays can be proved to be of the Verulamium form, then the matter is simple enough. It is very likely that all trays of this form contained fifty pellets in a 7 x 7 + 1 conformation. As well as the famous near-complete example from Verulamium, this is supported by a fine specimen from the Merlin Works excavation in Leicester[10], as well as a nearly-complete example formerly part of the Puckeridge Assemblage, now in the hands of a private collector[11].

In other cases, involving other tray-shapes such as the Sleaford and Bagendon presumed rectangular forms, the matter cannot be settled in the absence of more complete specimens than have been found hitherto. As has been noted above for the Puckeridge tray form, even when a rectangular form is fully known, it does not possess sufficiently distinctive features to enable attribution with any certainty if the fragments are too small to define row and column size.

viii. Predictable relationship between base and top hole diameters.

Some writers[12] have felt that it is sufficient to measure the diameter of the mouth of a mould-hole in order to ascertain the diameter of the pellet it would have produced. However, without concrete date to support it, this idea would seem to be unsound for a number of reasons.

First, one should consider that the metal was melted – or poured – in the bottom of the mould-hole. This entails that, if any inference about pellet-size is to be drawn from measurement of the top of a hole alone, there must be a predictable relationship between the diameter at the top and the diameter at the bottom of a mould hole.

Second, it should be remembered that Clifford[13] noted the presence of 'tapered' holes among the Bagendon material. This means that a predictable relationship between top and bottom diameters cannot be assumed, but must be demonstrated by measurement.

Third, it should be pointed out that, in the light of basic mechanical principles, it is most likely that unpredictable and irregular variation in diameter will occur at the mouth of a mould-hole. Any obliquity in the angle of insertion or removal of the implement used to make the hole, whether as part of a single or as part of a multiple 'dibber', will cause the greatest variation at the hole mouth. Any 'wobble' during insertion will similarly be greatest at the hole mouth.

On balance, it would seem that it is more likely that the relationship between base and top hole diameters will not be predictable. However, since a uniformity of practice in pellet mould manufacture across the country cannot be assumed, both measurements should be taken in order to put the matter beyond doubt.

ix. Predictable relationship between hole diameter and coin denomination.

It has been assumed by many[14] that there is a direct and predictable relationship between the diameter of a mould hole and the denomination of the coin derived from it. The argument behind this assumption would seem to run thus:

'In a given assemblage, the smallest hole diameter is y mm. and the largest hole diameter is (y + z) mm., therefore the hole diameter range within the assemblage is z mm. If there are x no. denominations of coin known in the vicinity of the assemblage, then the diameter range for each denomination will be (z ÷ x) .'

The most obvious problem with this approach is its circularity: there are three denominations of coin locally, therefore there are three groups of hole diameters, which means that three denominations of coin were manufactured at this site. However, we can never be certain that all, or some, or just one denomination of coin was being manufactured at a given site, unless this can be demonstrated on the material from the site itself. Until that demonstration has been made, any reference to actual coinage is misleading and irrelevant.

How might one prove a predictable relationship between hole diameter and coin denomination? Few writers[15] since Clifford[16] have mentioned, let alone considered, the irregularity and variability of the material, and no-one since Clifford has considered the effect that this variability will have on the relationship between hole diameter and coin denomination. Therefore, in assigning diameter-ranges to denominations, there has been no appreciation of the possibility of overlapping diameter-ranges, nor of the possibility of 'general purpose' mould, where any diameter of hole will do, so long as the depth is sufficient to accommodate the metal. Were either one of these hypotheses to be true, there would be, to echo Clifford's words, no direct or simple relationship between hole and coin – and any attribution of denomination based on the contrary assumption would be of very little value indeed.

Assuming that the sample be large enough to give a valid reflection of the distribution of the original population, the easiest way to eliminate these possibilities would be to measure the diameter on two axes of each hole on every fragment, noting intra-fragment diameter variation (a difference in diameter between holes on the same fragment) and intra-hole variation (the difference in diameter on two axes across a single hole) on fragments with more than one measurable hole. If the hole-diameter series were not continuous, and the discontinuity were greater than the greatest intra-fragment and intra-hole variation found in the assemblage, then it would be less likely that either 'overlapping groups' or 'general purpose' mould were present in the assemblage. Instead, it would become more possible that a direct relationship between diameter and denomination could be inferred.

However, it should always be remembered that the behaviour of the molten metal within the hole (where it coalesces into a globule, rather than being cast as a sub cylindrical pellet), and the need to minimize contact between metal and hole wall in order to avoid the fusion of metal with clay (as observed in the pellets retrieved at Verulamium and Old Sleaford) means that, while some holes would be too small for certain denominations, no hole can be considered too large for even the smallest size of pellet. In practice, this means that conclusions drawn from an assemblage exhibiting the full hole diameter range, or a diameter range restricted to the larger hole sizes, about the denominations being manufactured and their relative proportions within the assemblage will be much less secure than similar conclusions drawn about an assemblage with a diameter range restricted to the smaller hole sizes.

x. Control of hole volume.

The idea that mould-holes were in some way measuring devices lies behind both the Sellwood[17]/Casey[18] hypothesis that pellets were used in alloying rather than coin manufacture, and the idea that metal was introduced into the holes in molten state by pouring, rather than in weighed amounts of solid metal which was then melted in situ.

Since we know from van Arsdell[19] and Chadburn[20] that the technology existed in the Late Iron Age for the very accurate determination of weight, to ±0.05 g., better than or equal to 1 in 250 (Talbot (pers. com.) is able broadly to confirm this figure, with important provisos, for certain Icenian silver unit issues)[21], the Sellwood/Casey hypothesis must demonstrate that it offered some sort of benefit of ease or accuracy over weighing. The consistent composition of various types of coinage indicates that Iron Age smiths were capable of reproducing with great accuracy particular alloys, so the Sellwood/Casey hypothesis must also demonstrate that it is capable of that accuracy.

If it is argued that the metal was weighed before being placed in the mould, then the production of pellets offers no advantage over simple weighing – rather it adds a wholly unnecessary stage between 'pure' metal and alloy. If, on the other hand, it is suggested that the metal was introduced by pouring, then it is a necessary corollary of this that the volume of the mould hole was controlled sufficiently to produce pellets 'of uniform size and weight', and this is also true of the 'pouring' hypothesis.

The best method for demonstrating that the volume of mould holes was controlled is to measure the depth of every hole on each fragment with more than one measurable hole depth, and note the intra-fragment depth variation. It is then possible to work out a rough volume for a given hole, using the formula: 'Vol. = $\pi r^2 \times h$', where r = the radius of that hole, and h = its depth. Since 1 cm^3 of silver weighs 10.49 g., then 1 mm^3 will weigh approximately 0.01 g. The increase in weight per millimetre increase in depth will therefore equal ($\pi r^2 \times 0.01$) g.

Three examples will suffice to show the relative magnitudes of variability that this would entail for pellets at the lowest, middle and upper points of the known hole diameter range.

For a 4 mm. diameter pellet, $\pi r^2 \times 0.01 = 0.15566$ g. per millimetre of depth, which is more than three times greater than the variability observed in the Icenian 1.25 g. silver coin.

For an 11 mm. diameter pellet, $\pi r^2 \times 0.01 = 0.66405$ g. per millimetre in depth – very nearly the half the weight of the same Icenian coin.

For an 18 mm. pellet, $\pi r^2 \times 0.01 = 2.54502$ g. per millimetre of depth, which is more than twice the weight of the Icenian 1.25 g. silver unit.

From these examples it is possible to see that, if a degree of accuracy in any way approaching that achieved by contemporary weighing technology were required, depth would have to be controlled to within fractions of a millimetre, and that this control of depth would have to become ever more stringent as the diameter of the pellet increased.

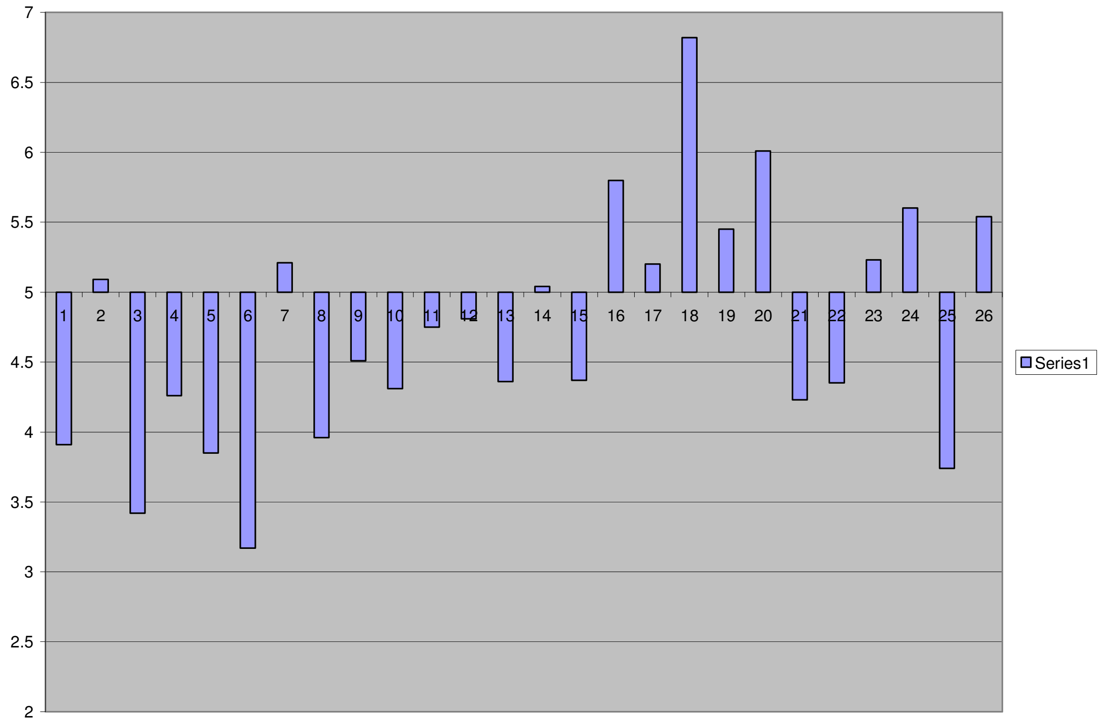


Table 2: Results of an experiment to produce 26 holes with a controlled depth of 5 mm.

xi. Calcium carbonate traces.

Van Arsdell[22] notes the presence in some of the mould from Verulamium of 'particles of calcium carbonate, probably from powdered chalk', which he interprets as a 'mould release agent', although Robbins and Bayley in Elsdon[23], state that 'wetting' would not have taken place were the moulds being used for the casting of noble metals. Tylecote[24] points out that 'wetting' occurs when a layer of oxide is allowed to form on the surface of a pellet, which then fuses with the clay. He shows that Iron Age smiths were well aware of the need to exclude oxygen from the casting process by demonstrating that mould fragments from Old Sleaford were originally fired under reducing conditions, and surmises that this was achieved by adding charcoal to the clay.

The fact that calcium carbonate, when heated, emits carbon dioxide tends to suggest that it was used by some Iron Age smiths to create and maintain reducing conditions within the mould hole, thus overcoming the potential oxidizing effect of the blast of air from a tuyère.

This means that the presence of calcium carbonate traces in mould holes is capable of more than one interpretation. If the application of calcium carbonate was a routine procedure at those sites where its presence is noted, regardless of the metal intended to be smelted in it, it could be seen as a process intermediate between the manufacture of a tray and its use. As noted earlier, if unused fragments with and without calcium carbonate are found, one might reasonably speak of the stockpiling both of fired trays, and of trays ready for use. If the application of calcium carbonate to mould holes was related to the metal intended to be cast in them, we may see its presence or absence as an indication that particular fragments were intended for the casting either of base, or of noble, metals. This question is, in fact, one that can only be resolved by means of testing for metal residues.

The question of how the calcium carbonate was applied to holes is, however, capable of resolution by simple observation. It has been surmised (van Arsdell[25]) that powdered chalk was pressed into the wet clay, but the feasibility of this has never been considered.

How would the chalk have been introduced into the hole? How would it have been pressed into the wall and base of the hole? Remembering that some mould holes are very tiny indeed, 5 mm. and less, it is clear that a human finger would not be able to do the job. The use of a stick might be posited, but experiment has shown that this would cause observable and distinctive irregular distortion of the hole, leading to a very large increase in intra-tray variation in hole diameter, depth, profile and plan.

The inference to be drawn would seem to be that the calcium carbonate was applied as a liquid wash, using either a brush or the simple expedient of pouring a small quantity of the wash into each hole and then agitating the tray with a swirling motion to coat the walls of the hole.

Brush marks have been observed, both inside holes and on the tray surface. In other cases, drips, splashes and dribbles have been observed on the tray surface, as well as swirl-marks on the chalk coat at the base of a hole. These differences in process are significant, in that they provide evidence of different 'hands' at work within a particular assemblage.

Chalk wash also has consequences for the measurement of other hole parameters. The coat is typically at least 0.5 mm. thick on the wall of a hole, and more than 1.00 mm. thick at the hole base. Not only are the diameter and depth significantly affected by this, but the profile of a hole can be changed from straight-sided, narrow taper or broad taper into tassiform.

When one considers the extreme fragility of the chalk coating – since it does not always bond well to the clay, it can peel away in sheets, leaving no trace behind it – this means that, in the words of the well-worn apothegm, the absence of evidence is not evidence of absence. The fact that chalk wash is not observable on the mould is no indicator that chalk wash was never present. It may reflect only that conditions have not favoured its preservation. As well as destruction during use, or by weathering and abrasion following deposition, acid soil conditions could also result in the total disappearance of calcium carbonate from an entire assemblage.

This adds an entirely new dimension of uncertainty to the problem of whether it is possible to deduce from the dimensions of a mould hole the size of pellet produced in a given specimen of mould. If it cannot be said with certainty of the large proportion of mould so far examined that does not show traces of chalk wash that it never contained chalk wash, then – bearing in mind the variable thickness of chalk wash – the hole dimensions obtained from such mould cannot be related to the hole dimensions of the mould in use, except in very broad terms.

xii. Introduction of metal into holes.

The debate about the introduction of metal into the mould hole, whether this was achieved by melting solid metal in situ in the hole, or whether it was achieved by pouring in metal melted elsewhere, has been touched on in Section viii. above, where it was treated in terms of the control of the volume of a mould hole.

However, there is another observable trace that might be expected to occur were metal to have been poured into the holes in a tray. It is inconceivable that this operation could have been performed many times without showing some evidence of splashing or spillage. These would involve prills on the surface of the mould surrounding the mouth of a hole, and would be quite distinct from the metalliferous staining noted on many fragments of used mould, which is caused by the condensation of metal-rich vapour[26] spread by the blast from a tuyère, and the occasional droplets of metal found adhering to the lip of a hole.

xiii. Proportions of used and unused pellet mould.

Collis[27] states firmly that 'while some have proved negative, the majority (*of analyses of trace elements in the moulds*) have produced some traces of metal'. This might be taken to imply that the majority of pellet mould found has been used, but this is not necessarily the case. At Bagendon and at Old Sleaford, by far the greater proportion of the mould retrieved apparently shows no signs of use at all. This may also be seen as further evidence of the stockpiling of mould, which in turn may be taken to imply that pellet manufacture was carried out at a given site on a sporadic basis and in unpredictable quantities.

This would seem to suggest that the occasions for making pellet were governed by specific need, rather than as part of the routine maintenance of a monetized economy: we might posit the linking of pellet manufacture to the payment of taxation or tribute, to a need to pay manpower hired from outside the territory of the issuing authority, or to the advent of seasonal trading opportunities.

For these reasons, it would seem important to record of each fragment whether or not it has been used.

However, this may not be as straightforward a matter as might be supposed. While some fragments show undeniable traces of use, such as vitrification, vesiculation and slumping, and it has been presumed by many authorities that these are the diagnostic signs of use, by no means all fragments which have yielded positive results under metal trace analysis exhibit any of these characteristics.

Writing of the Henderson Collection material, Craddock and Tite[28] state that none of the six samples examined showed signs of vitrification, yet all tested positive for metal residues, mainly silver. Instead, they note that the fragments tested all show 'signs of strong heating, being red on the base from oxidization, but quite black on the top around the depressions actually containing the metal, showing that the metal had been covered in charcoal to prevent its oxidization whilst molten'.

They surmise that this could be because the vitrification point of clay is higher than the melting-point of silver (960^{o}C). Yet Elsdon states that the vitrification of clay takes place at around 950^{o}C, a statement largely supported by Gebhard et al[29].Although Gebhard and colleagues are careful to say that vitrification is the 'usual' effect of use, it is hard to reconcile this acknowledgement of occasional exception with the complete absence of the phenomenon on the material tested by Craddock and Tite.

It is beyond credence that the basic physics of the process could be at fault: the melting point of silver is invariant under normal conditions, and so is the vitrification point of ceramic, except in the case of certain rare types of clay with an unusually high refractive index, such as the bentonite used for gas mantles. There can be no doubt that the clay used to make the Henderson mould is utterly unexceptional, and the presence in the Collection of two fragments exhibiting vitrification would seem to provide irrefutable confirmation of this.

This apparent conundrum may be resolved by close examination of the variables in the process. First, there is the question of how heat was applied to the trays. Many examples show reddening (and even vitrification) of the base, and this has always been assumed to be evidence that heat has been applied by placing trays in a furnace preparatory to the actual smelting process. We know from Gebhard that temperatures at the base of mould holes in the Manching material rarely exceeded 700^{o}C, well below the temperature required to vitrify clay, so there is no need to assume that heat applied to the whole tray would have exceeded this. Gebhard has also demonstrated that the fusion of metal granules occurs relatively quickly, requiring the maintenance of a temperature high enough to melt the metal for between three and five minutes. However, the results given in the paper for Mössbauer spectroscopy and the alteration in iron-bearing species during heating show that the experimental samples were maintained at temperature for between 3 and 48 hours.

It seems possible that this lack of vitrification in the Henderson assemblage could simply be an indication of how efficient the pellet makers had become, in that they had learned not to prolong intense temperatures beyond the bare minimum required to smelt metal granules or powder, and that this time was not long enough to initiate vitrification in the solid mass of the mould.

Tournaire and Henderson[30] state firmly that vitrification will occur only in the presence of an alkali, either from wood-ash or from alkaline earth metal compounds present in the clay of the mould. It should be noted that calcium is an alkaline earth metal. However, Tylcote[31] notes only that a ‘well-fired layer’ would have been produced by the ‘fluxing action’ of wood-ash; while Tite, Freestone, Meeks and Craddock[32] make no mention of alkali or wood-ash, citing only temperature as the cause of vitrification.

A further factor to be considered is the fragility of the vitrified layer on used mould. This layer is often very thin and, given the often friable nature of the mould fabric, is extremely susceptible to removal by both abrasion and weathering processes such as frost.

Vitrification has been observed on fragments with little or no signs of vesiculation or other heat-induced surface alteration, so the loss of this layer would result in a fragment without any obvious signs of use.

Unfortunately, this merely serves to complicate the attribution of use on the basis of supra-microscopic evidence alone, as exemplified in the recording protocol by the ‘Burn Category’ classification. It has been noted on material from Ford Bridge that blackening can occur simply because the mould has been deposited in close contact with charcoal, and reddening can be caused during the firing of ceramic by a failure to exclude oxygen from the kiln, and requires no exceptional heat. Add to this the fact of differing degrees of reddening on various examples, ranging from complete reddening, top to bottom, through reddening of one or other surface, to very slight and localized reddening, and it becomes clear that these are at best equivocal signs of use.

As a result, it was felt necessary to supplement the ‘Burn Category’ classification with a standardized system of verbal description of heat effects on coin mould, yet it must be emphasized that attributions of use can only be made without the use of SEM-BSE and SEM-EDS[33] if prills of metal exist on the sample large enough to be detected with the use of a handlens.

Braughing Archaeology Group

Coin Mould Database Key

Site Code:

Enter the site code, followed by

Context:

The context number from which the find came, followed by

ID Number:

If the piece has an individual find number, otherwise enter ‘*’

Number of pieces:

How many bits are in the bag?

Weight:

Weight of bag contents in grams.

Burn category:

0 Unquantifiable
1 No trace of burning
2 Yellowing
3 Partly reddened
4 Fully reddened

5 Vitrified

Thickness 1:

Taken at one end of Length 1 (in millimetres). If the fragment lacks one or both surfaces, then enter '*'.

Thickness 2:

Taken at other end of Length 1 (in millimetres). If the fragment lacks one or both surfaces, or if Length 1 is too short for variation in thickness to occur, then enter '*'.

Thickness 3:

Taken on the longest axis at 90^o to Length 1, (in millimetres). If the fragment lacks one or both surfaces, or if it is too short along this axis for variation in thickness to occur, then enter '*'.

Position type:

00 Unquantifiable
01 Middle of slab
02 Straight edge
03 Curved edge
04 90^o Corner
05 Oblique corner
06 Curved corner
07 Corner

Length 1:

If the fragment is an edge, then this measurement is taken along the edge. If the fragment is a corner, then this measurement is taken in millimetres on the longer side. If it is a middle fragment, then measure the longest axis in millimetres.

Length 2:

If the fragment is an edge or middle, then measure the longest axis at right angles to Length 1. If the fragment is a corner, then enter the shorter side measurement in millimetres.

Lengths greater than 2:

In the rare event that a fragment has more than two edges, these should be labelled upon the diagram 'Length 3'; 'Length 4', and so on. They should be measured in the same way as Length 1 and Length 2, and the measurements included in the Notes.

Incomplete holes:

Enter the number of incomplete holes on the fragment. If there are no incomplete holes, then enter ‘00’.

Complete holes:

Enter the number of complete holes on the fragment. If there are no complete holes, then enter ‘00’.

Hole measurement:

A diagram of the fragment should be made, indicating both complete and incomplete holes. These should be numbered for ease of reference.

Four measurements of each hole should then be taken, and listed in tabular form using the individual hole reference numbers:

i. Horizontal diameter (taken at the base of the hole on the axis of the hole row)
ii. Vertical diameter (taken at the base of the hole on the axis of the hole column)
iii. Depth
iv. Top diameter

If it is not possible to obtain a particular measurement for a given hole, this should be represented in the table by ‘*’.

Edge profiles:

If the fragment has a Position Type code of 00 or 01, enter Edge Profile code 00.

If the fragment has a Position Type code of 02 or greater, please enter the appropriate Edge Profile code:

00 No edge profile
01 I-section
02 Lazy S
03 Straight section
04 Angled section
05 Rolled edge
06 Overhang
07 Cut and tear
08 Other (supply profile diagram in notes)
09 Uncertain

If two Edge Profile characteristics are exhibited by a single edge, for example Angled Section and Cut and Tear, then both codes should be entered, lower code first, thus: ‘04+07.’

If a single fragment has more than one edge, then Edge Profile codes for each edge should be included, the code for Length 1 first, thus: '04+07; 05'.

Hole profile:

00	None
01	Straight
02	Narrow flare
03	Broad flare
04	Other/Indeterminate (Include diagram in Notes)
05	Tassiform
06	Circle and swirl

Notes:
Set out below is a comprehensive list of all the features observed on coin mould which are not covered in the protocol above, together with the abbreviations used in the database compiled for the Ford Bridge Mint Assemblage.

Note in Longhand	Abbr.
Abraded	AB
Abraded base	ABB
Abraded edge	AE
Abraded top	AT
Angle of insertion, skewed	ASK
Apex	A
Apex edge (LH)	AL
Apex edge (RH)	AR
Apex hole, entire	AH
Apex hole, part	AHP
Base mostly gone	BMG
Base all gone	BAG
Base only	BO
Base partly gone	BAP
Bast marks, presumed. face Length 1	BML1
Bast marks, presumed. face Length 2	BML2
Black blotches/black spotting	BB
Blackened base	NB
Blackened core	BC
Blackened top	BT
Blowhole on top	BOT
Boustrophedon dibbing pattern	BD
Break, ancient	BA
Breaks sealed by melting, some	BSS
Brick/tile in matrix	BTM

Brown layer, base	BLB
Brown staining on top	BST
Brush mark in chalk wash in hole	BMH
Bulk bag, should be in	BUG
Burring of Length 1 as it meets Length 2: possible sign of mould lining	BL1L2
Burring of Length 2 as it meets Length 1: possible sign of mould lining	BL2L1
Burring, bottom edge, Length 1	BBEL1
Burring, bottom edge, Length 2	BBEL2
Burring, top edge Length 1	BTEL1
Burring, top edge Length 2	BTEL2
Cap, entire	CE
Cap, most	CM
Cap, partial	CP
Cap, possible, trace	CPT
Chaff cast on top	CHT
Chaff marks on base	CMB
Chalk wash on top	CWT
Chalk wash on top, green stained	CWTG
Chalk wash splashes on top	CWST
Chalk wash on all side faces	CWS
Chalk wash on face, Length 1	CWL1
Chalk wash on face, Length 2	CWL2
Chalk wash on face, Length 3	CWL3
Chalk wash on base	CWB
Chalk wash on broken edges	CWF
Chalk wash in holes	CWH
Chalk wash in holes, all	CWHA
Chalk wash in holes, most	CWHM
Chalk wash in holes, some	CWHS
Chalk wash, possible	CWP
Chalk wash, right-angled line on top.	CWRL
Charcoal casts	CC
Charcoal cast on base	CCB
Charcoal cast on top	CCT
Clay blob in hole	CH
Clay, blob, in hole: possible cap	CHPC
Clay blob, face Length 1	CL1
Clay blob on top	CBT
Clay blob on top, vitrified	CBTV
Conjoining fragments; ancient break	CFAB
Conjoining fragments; ancient break; conjoins with (Code)	CF/Code
Conjoining fragments: found on return by Henrietta Longden	CF
Conjoining fragments, modern break	CFMB
Coppery blob	CB
Cracked and very fragile	CVF

Crazing on base	CRB
Crazing, face Length 1	CRL1
Crazing on top	CRT
Crust adhering to hole wall	CAW
Dark brown base	DBB
Deformation all surfaces	DA
Deformation of base, extreme	DB
Deformation of Length 1	DL1
Deformation of Length 2	DL2
Deformation, pre-firing, Length 1	DPL1
Deformation of top	DT
Deformation, unspecified	DU
Dimple on base coincides with hole above	DCH
Edge bevelled	EB
Edge markings: band	EMB
Edge markings: band, wide	EMBW
Edge markings: band and lines	EMBL
Edge markings: band and lines, Length 2	EMBLL 2
Edge markings: band over parallel lines over band	EMBPB
Edge markings: band over unclear	EMBU
Edge markings: diagonal striations	EMDS
Edge markings: diagonal striations above horizontal striations	EMDHS
Edge markings: grass mould lining, possible	EMGL
Edge markings: groove above foot serif	EMGF
Edge markings: groove midway on face	EMG
Edge markings: 2 parallel bands	EMPB
Edge markings: 2 parallel grooves	EMG2
Edge markings: groove parallel top over diagonal striations	EMGDS
Edge markings: horizontal striations	EMHS
Edge markings: line, single	EMLS
Edge markings: parallel lines, Length 1	EMPLL1
Edge markings: near-vertical striations, Length 1	EMVSL 1
Edge markings: wood grain cast, possible	EMWG
Fabric, very hard – conchoidal fracture	FHCF
Fingertip impressions, face Length 1	FIL1
Fingertip impression on base, possible	FIB
Fingertip impression on top, possible	FIT
Fired deposits in holes	FDH
Foot serif, burred	FSB
Fragment missing: old card only	FM
Fragments of superimposed tray adhering to top	FAT
Fragment exceptionally thin	FET
Freehand manufacture, possible	FMP

Fused fragments of mould, two	FFM
Grass stalk cast on base	GB
Grass stalk cast on base. possible	GSB
Grass marks on base	GMB
Grass marks, face Length 1	GML1
Grass marks in hole, possible	GMH
Grass marks on top	GMT
Grain cast on base	GC
Grain cast on base, possible	GCP
Grain cast in body of fabric, possible	GCF
Grain cast in hole	GCH
Grain cast, face Length 1, possible	GCPL1
Grain cast on top, possible	GCTP
Grey core	GRC
Grit on base	GTB
Grooves in top	GIP
Heat-affected surface flaking off	HFO
Heated beyond use	HBU
Hole, abortive	HA
Holes arranged in a very irregular chequerboard pattern	HIC
Hole base only	HBO
Hole base, odd fracture of	HOF
Holes larger than 15 mm.	HL
Holes small	HK
Holes occluded	HO
Hole mouths standing proud of top surface, possible	HPT
Holes oval, possible	HOP
Holes purposively oval	HPO
Hole slighting	HS
Holes very shallow	HVS
Hole has wide flare at mouth	HWF
Impression on top, possibly another tray	IT
Incised guidelines, double, Length 1	IGDL1
Incised guideline, orientation uncertain	IG
Incised guideline parallel apex edge	IGA
Incised guideline parallel Length 1	IGL1
Incised guideline parallel Length 1, double	IGL12
Incised guideline parallel Length 1, possible	IGL1P
Incised guideline parallel Length 2	IGL2
Incised guideline parallel Length 2, possible	IGL2P
Incised guideline parallel Length 3	IGL3
Incised guideline parallel Row 1	IGR
Incised guideline parallel Row 1, possible	IGRP
Incised guideline at 45^{o} to Row 1, possible	IG45R
Incised guideline, right angled	IGRA

Incised line (more cut than guideline)	IL
Incised line on base	ILB
Incised lines, double, on top	ILD
Inclusion cast	ICAS
Inclusions, chalk	IC
Inclusions, flint	IF
Inclusion, grog	IG
Inclusion, large, flint	ILF
Inclusion, large, organic, burned out	IO
Inclusion, large, pebble	ILP
Inclusions, massive	IM
Inclusion, massive, shell	IMS
Inclusion, quartzite	IQ
Inclusion, soft, dark red	IR
Irregular holes and spacings	IHS
Irregular rows	IRO
Irregular rows and columns	IRC
Luting, possible, in hole	LP
Marks on base, matting or cloth	MBM
Marks on base, unspecified	MBU
Mitred corner	MC
Modern break	MB
Modern repair	MR
Modern repair, possible	MRP
Moulded line parallel Length 1	MLL1
Moulded platform for holes	MP
Moulded ridge on top parallel Length 1	MRT
Mould lining traces, Length 1	MLTL1
Mould lining, possible, Length 1	MLTL1P
Mould lining traces, Length 2	MLTL2
Mould lining, possible, Length 2	MLTL2P
Not coin mould	NCM
Old card only: fragment not returned by Henrietta Longden	OC
Orange glass in hole	OGH
Parallel striations on base: matting marks?	PSB
Parallel striations on top	PST
Pellet detachment, possible scars of in hole	PDP
Poorly made	PM
Pot fragment included in bag	POB
Puckeridge tray form: 5 holes in a row.	PF
Purple staining	PS
Reddening on base	RB
Reddening in core	RC
Red cortex	RCX
Reddening in holes	RH

Reddening on Length 1	RL1
Red staining on base	RSB
Red staining on top	RST
Reddened surfaces	RS
Red deposit in hole	RDH
Red top	RT
Ridging on base	ROB
Rumex cast on base	RCB
Sagging on base	SGB
Sagging on top	SGT
Sagging, Length 1	SGL1
Sectioned by Henrietta Longden. See old card for original dimensions.	SHL
Serif, foot, moulded	SFM
Shallow-peaked Verulamium form tray	SPV
Shell, crushed, on base	SCB
Shell temper	ST
Shell temper, sparse	STS
Slag, blob, on base	SBB
Slag blob in hole	SBH
Slag, blob, on top	SBT
Some slumping in holes	SH
'Splatch' marks on hole base	SMH
'Stepping' in holes	STH
Striations on hole base	SHB
Silvery globules	SG
'Squidge' mark in hole	SM
Straw cast, possible, Length 1	SCPL1
Surfaces mostly gone	SMG
Temper, crushed chalk	TCC
Temper, crushed flint	TCF
Temper, grit	TAG
Temper, grog	TGR
Temper, shell	TS
Temper, waterworn grit, coarse	TWC
Tested by Henrietta Longden	THL
Too cracked and fragile to measure in any aspect	TFM
Top gone	TG
Top mostly gone	TMG
Torsion marks in holes, possible	TMP
Concave tray profile, possible	CTPP
Twig cast on base	TCB
Vesiculation, all surfaces	VESA
Vesiculation on base	VESB
Vesiculation in core	VESC
Vesiculation in holes	VESH

Vesiculation, Length 1	VESL1
Vesiculation, Length 2	VESL2
Vesiculation, Length 3	VESL3
Vesiculation, slight	VESS
Vesiculation on top	VEST
Vesiculation on top, possible	VESTP
Vesiculation, unspecified	VES
Vitrification, all surfaces	VS
Vitrification on base	VB
Vitrification in holes	VH
Vitrification, face Length 1	VL1
Vitrification, face Length 2	VL2
Vitrification, internal	VI
Vitrification on top	VT
Vitrification, minute traces on top	VMT
Vitrification, unspecified	VU
Void, large	VOLE
Wash, possible, in hole	WPH
Whitened base	WB
Whitened face, Length 1	WL1
Whitened top	WT
Wipe marks on base	WMB
Wipe marks, face Length 1	WML1
Wipe marks on top	WMT
Yellowing, all surfaces	YA
Yellowed base	YB
Yellowing in holes	YH
Yellowed side	YS
Yellowed top	YT

[1] Chadburn, Amanda; 1999: '*Tasking the Iron Age: the Iceni and Minting*'; in 'Land of the Iceni: the Iron Age in Northern East Anglia', ed. Davies and Williamson; Studies in East Anglia History 4; Centre of East Anglian Studies; pp. 144 – 149. Her statement '...I want to briefly examine the range of tasks which might be required to make an Icenian coin, and in doing so try to illuminate the society which produced these objects' encouraged the basic assumption behind the present study that the way in which a complex and socially-rooted task like minting is organized will reveal much about the structure and ideation of the society in which it takes place.

[2] Elsdon, Sheila M.; 1997: '*Old Sleaford Revealed: A Lincolnshire settlement in Iron Age, Roman, Saxon and medieval times; excavations 1882 – 1995*'; Oxbow Monograph 78, Nottingham Studies in Archaeology 2; pp. 51 – 67.

[3] Op. cit.

[4] Op. cit.

[5] Op. cit.

[6] Op. cit.

[7] Tournaire, J.; Buchsenschutz, O.; Henderson J. and Collis J.; 1982: '*Iron Age Coin Moulds from France*'; Proceedings of the Prehistoric Society 48; pp. 417 – 435. The almost complete tray from Saintes (Pl. 31b.)

has undeniably been made using a dibber with six prongs in a row: the repeated patterns of spacing in one axis are plainly visible, as are variations in the orientation of each row and irregularities in the alignment of columns.

[8] Pers. comm.

[9] Clifford, Elsie M.; 1960: '*Bagendon: a Belgic Oppidum, Appendix VII: The Coin Moulds*'; Heffer & Sons, Cambridge; pp. 144 – 149.

[10] Kipling, R. & Parker, D.; 2008; '*An Archaeological Excavation on the site of the former Merlin Works, Bath Lane, Leicester (NGR SK 580 045)*'; University of Leicester Archaeological Services.

[11] Cottam, G.; *pers. comm.*

[12] Elsdon, op. cit.

Tournaire (op. cit.) goes even further, claiming that the 'coin module' of a given tray is defined wholly by top diameter. However, not only does he offer no evidence in support of this extraordinary claim, it is further undermined by his own (incomplete and unsystematic) data set, which shows that variation between top and base hole diameter is actually greater than he claims in the text.

[13] Op. cit.

[14] van Arsdell, R.D.; 1989: '*Celtic Coinage of Britain*'; Spink, London; pp. 46 – 48

Cowell & Tite in Partridge, Clive; 1982: '*Braughing, Wickham Kennels 1982*'; Hertfordshire Archaeology 8 (1980 – 82); p. 57

Elsdon, op cit.

Frere, S.S.; 1983: '*The Belgic Mint*'; Excavations at Verulamium Vol. II; pp. 30 – 32

Tournaire, op. cit.

This list is not exhaustive.

[15] Bayley, Justine; 1979: '*Rochester: Belgic Coins and Associated Finds*'; Ancient Monuments Laboratory Report N. 2811

Wilthew, Paul; 1985: '*Examination and Analysis of Coin Pellet Moulds from Rochester, Kent*'; Ancient Monuments Laboratory Report No. 4541.

[16] Op. cit.

[17] Sellwood, D.G.; 1980; Numismatic Chronicle XX (1980); iii – vii.

[18] Casey, J.; 1983; Britannia xiv; pp. 358 – 60.

[19] Op. cit.

[20] Op. cit.

[21] The provisos are: first, that the ±0.05 g. figure is a statistically derived average, and should not be regarded as a constant standard; second, that in order to minimize the downward distorting effect of wear and damage, he adopts a convention of excluding the lower 30% of the range of values, as well as excluding the upper 5% to remove anomalous excess coin weights.

He provides data for all known examples of each of three series: ECEN silver units ('all die linked and therefore likely to be from one continuous production sequence'); ANTED units ('from a single die linked sequence'); ECE B units ('from a number of die groups and therefore these may have been minted at separate locations').

[22] Op. cit.

[23] Op. cit.; pp. 60 – 61.

[24] Tylecote, R.F.; '*The Method of Use of Early Iron-Age Coin Moulds'; Numismatic Chronicle, Seventh Series, Vol. II; pp. 102 – 109.*

[25] Op. cit.

[26] Opinion is divided as to whether the purple staining noted on many fragments of mould is a compound of the copper cast in it, or of the manganese occurring naturally in the clay of which the tray is made.

[27] Collis, J.; 1985: '*Iron Age 'Coin Moulds"*'; Britannia 16; pp. 237 – 238.

[28] In Partridge, Clive; 1981; '*Skeleton Green: a Late Iron Age and Romano-British Site*'; Britannia Monograph Series, 2; pp 323 – 356.

[29] Gebhardt, R.; Große, G.; Riederer, J.; Wagner, F.E.; Wagner, U.; 2007; '*What Mössbauer Spectroscopy Can Tell us About Precious Metal Working in Celtic Times*', University of München; pp. 1 - 5.

[30] Op. cit.; p. 432.

[31] Op. cit.

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