Section 4: Conclusions.

i. The coin mould still in the ground

The homogeneity of the retrieved mould through all the contexts of the Ford Bridge excavation suggests that the picture derived from it would not be altered by whatever remains in the ground. Further excavation, therefore, could do no more than yield the full size of the deposit: the majority of the questions which can legitimately be asked of the material have been answered.

ii. The manufacture of the Ford Bridge mould trays

All the evidence is that the overwhelming preponderance of the Ford Bridge coin mould was made in bowl moulds (although a small proportion appear to have been made in a box-mould, and some seem to have been cut to shape by hand), and that the holes were made with a single-pronged dibber after the tray had been turned out of the mould and while the clay was still wet.

All of the fragments that carry diagnostic signs of tray form are of the Verulamium type, pentangular trays which would have borne 50 holes in a 7 x 7 + 1 format. We can be sure that more than one mould was used to make these trays, as the angles on the pediment fragments retrieved were not identical.

However, there is some evidence to support the presence of a second tray form, the 'Puckeridge', a rectangular or sub-rectangular tray with 25 holes in a 5 x 5 conformation. Furthermore, it seems likely that the use of this tray form coincides with a demonstrable base diameter group, with holes with a base diameter greater than or equal to 16 mm.

A large proportion of the mould shows traces of chalk wash used to create and maintain a reducing atmosphere in the mould holes, in order to prevent fusion of the pellet with the fabric of the mould.

On balance, it would seem highly likely that the trays from which the Ford Bridge Assemblage derives were made by more than one person.

iii. What was made in the Ford Bridge mould-trays?

The work of Longden[1] on this assemblage, together with a single blob of copper-rich material adhering to one fragment, proves that the Ford Bridge moulds were used in a process involving molten metal, and that the metal involved was an alloy, predominantly bronze, but with a small fraction of silver. This alloy corresponds well with coin demonstrably local to the Braughing/Puckeridge area.

The variation exhibited by the mould holes is so great that it is certain that the holes could not have been used as measuring devices. The Sellwood[2]/Casey[3] hypothesis that the mould-trays were used to measure metals ready for alloying

therefore cannot apply to this material. Equally, metal could not have been introduced into the mould holes by pouring in the molten state if pellets of a consistent weight were required.

The metal was therefore introduced into the holes in a solid state. The object was to produce not cylindrical casts, but globular pellets, which would later be heated to cherry-red[4] before being struck with a design. The Ford Bridge mould is pellet-mould, rather than potin-mould, and tray-mould rather than sherd-mould. The distinctions are important, in that the first gives a general indication of period, for potin coins tend to be earlier, while the second confirms the scale of the operation, as the use of sherd-mould seems to have been reserved for very small-scale minting.

Although there is a clear break in the sequence of hole diameters, there is no way of telling from the mould itself what coin module was made in it. It is also clear that the diameter at the top of a hole is no more certain guide to 'module' than any other dimension of a hole, and is - as predicted – more variable than base diameter.

iv. The relationship between Ford Bridge and Puckeridge

The stylistic and technical parallels between these two very large deposits of coin mould are strikingly close, to the extent that is has been suggested[5] that they might be the dispersed halves of a single, vast minting episode.

Evidence which might be taken as supporting this idea is as follows:

- A similar range of hole base diameters, and a similar distribution pattern within that range.
- The likely presence in each assemblage of the same two tray forms.
- The vast preponderance in both assemblages of trays made by the same method.
- The frequent occurrence in both bodies of material of chalk wash, both inside mould holes and on the surfaces of fragments.
- The evidence from both finds that holes were made individually, rather than in multiples.
- The occurrence in both Ford Bridge and Puckeridge material of so-called 'incised guidelines' at very similar frequencies.
- The presence of 'band and lines' edge markings in both assemblages.
- The presence in each assemblage of trays fragments apparently originating from the same, distinctive, tray-mould.
- The occurrence in both of grain casts, suggesting manufacture in the same season of the year.

However, there are significant differences sufficient to suggest that, although the assemblages are closely related in both time and space, they are not part of the same minting episode. These significant differences are:

- Paucity of very large inclusions at Ford Bridge.

- Very infrequent appearance of shell/chalk temper at Ford Bridge.
- The complete absence among the Ford Bridge material of clay caps or luting.

Each of these differences, although small, is proof that the mould at each site was treated slightly differently both during manufacture and during use. On balance, therefore, it seems more likely that the two assemblages reflect two separate episodes of minting at the same time of year, and within a very short space of time.

v. Minting and society in Late Iron Age Braughing

The issuing of coinage is an act that must take place within a very complex context. Every chosen aspect of the process is the result of interaction between social, political and economic factors, from the precise composition of the coinage to the elements of the design on the finished coin.

The first point that must be noted is that minting in the Iron Age was not an activity that could be carried out on a whim. The process chosen to make coin at Braughing seems to our eyes absurdly inefficient and pointlessly convoluted, yet these master metalworkers must have had good reason for what they did. If a very complicated way was used to make coin, it was because it was felt that this complexity was required. It could be that the input of labour was felt to add worth; or it could be that, as the use and manufacture of coinage in this country was in its infancy, the natural tendency of humans to interpret a new concept in terms of familiar concepts meant that coins – even base metal issues – were seen as close kin to jewels and other items of display and craftsmanship.

Beyond the complexities of the pellet-mould method of making coin, forethought would have been required to assemble the materials required for an episode of minting. Chadburn[6] sets out well the web of planning and procurement that necessarily preceded an issue of coin. In particular, her consideration of the sourcing of the metals required is as relevant to a discussion of minting in the lands of the Catuvellauni as to Icenian minting. Clearly, the organizational aspect of coin manufacture becomes more significant the larger the scale of the operation, and the more likely it becomes that some sort of coordinating authority would have been required to oversee the operation. Her observation that it appears unlikely, given the absence of 'small change' denominations, that Icenian coinage was a fully-developed medium of exchange, serves to highlight that the territories of Tasciovanus and Cunobelin - and the Braughing/Puckeridge area in particular – were highly unusual in the degree to which their day-to-day economy had become monetized. Not only were enormous quantities of largely bronze coinage being produced here, but the rates of casual loss were exceedingly high[7].

Collis[8] has discussed the influence of political considerations on the scale of minting and the extent to which it might have been a decentralized process, pointing out that minting began in the Celtic world before the emergence of large proto-urban settlements. His prediction that many smaller sites would yield

evidence of flan production has been fully supported both in Britain and in mainland Europe.

This general finding, however, serves to highlight the exceptional nature of minting in the Braughing/Puckeridge complex. Not only has the area produced two of the three largest deposits of coin mould in Europe, but it has also yielded several discreet and distinct smaller assemblages. Unfortunately, without secure dating evidence for the deposition of a single find of coin mould in Braughing, it is possible to do no more than suggest that the political story here is one of increasing centralization, based on the assumption that only larger political units would be able to command the resources necessary for the largest issues of coin.

Haselgrove[9] examines the socio-political dimensions of Iron Age coin production, distinguishing three separate stages in the process (the casting of pellets; turning pellets into coin; the disbursement of finished coin), and emphasizing that there is no necessity for these processes to have been performed at a single location. In the absence of a recognized Braughing mint mark, and given the far from conclusive nature of distribution evidence[10], it is perfectly compatible with what is known to suggest with Longden[11] that Braughing/Puckeridge may have been a production centre for bronze coinage, which was exported to other centres for striking.

However, independent evidence that Braughing was at the centre of a substantial and wide-ranging trading network[12] involving expensive luxury goods, together with the evidence that both the Ford Bridge and Puckeridge Assemblages were made in the same season of the year, would seem to suggest a well-established local need for coinage in large quantities, whatever the mint-mark with which they were ultimately struck. Yet, if this was the case, why is it that the vast bulk of retrieved coin mould appears to have been used for the production of what, despite the apparently deliberate addition of a small fraction of silver, was essentially a bronze coinage?

The evidence obtained by excavation seems to show that, by the second decade of the C1$^{st.}$ AD, Braughing was no longer the pre-eminent trade destination that it had been. Haselgrove[13] has demonstrated that the circulation-pool in Braughing was, by the time of the issue of 'developed' Cunobelin coinage, not being replenished at the same rate as before. It is not unreasonable to suggest that the very large deposits of coin mould used for bronze coinage are consistent with this evidence of decline. Although the topmost rank of the elite might well have removed to another centre, be it Verulamium or Camulodunum, a local landowning class would have remained in the environs of Braughing/Puckeridge.

It would be entirely natural for them to try and maintain a lifestyle of conspicuous consumption for which they had developed a taste, and which was also an accepted means for demonstrating social standing. Perhaps the coinage made in the Ford Bridge mould represents a last attempt to eke out a very limited supply of silver in order to maintain a lifestyle which was actually beyond the ability of the local economy to support.

The presence of 'incised guidelines' on the top surface of around 10% of the mould from Ford Bridge seems to suggest that some coin mould needed an

identifying mark. It could be that this represents the share of a minor participant in the minting episode, or it could represent a tithe due to the owner of the mint, to an issuing authority (who controlled the dies used to validate coin), or to an overlord.

It seems highly unlikely that these questions can be resolved with any certainty. It is hard to imagine that, in the absence of written sources, there could be any evidence better than the coin mould itself, and it does not seem possible that any greater precision can be wrung from the mould than has already been achieved.

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[1] Op. cit.
[2] Op. cit.
[3] Op. cit.
[4] de Jersey, Philip; 2007: '*Some experiments in Iron Age coin production and some implications for the production of Gallo-Belgic E*'; in 'Essays in Honour of Simone Scheers'; ed. van Heesch and Heeren; Spink; pp.257 – 269.
[5] Isobel Thompson, pers. comm.
[6] Op. cit.
[7] Stead, I.M.; 1970: '*A trial excavation at Braughing, 1969*'; Hertfordshire Archaeology 2; pp. 37 – 47. He reports finding an average of one Iron Age coin per $5m^2$ of trench – a rate of loss far greater than this author has noted for coins of the last five hundred years during 10 years as a gardener in the Braughing area.
[8] Collis, J.R.; 1984: '*Oppida; earliest towns north of the Alps*'; cited in Collis, J.R.; 1985; Britannia XVI.
[9] Haselgrove, Colin; 1987: '*Iron Age Coinage in South-East England: the Archaeological Context, Part i*'; BAR British Series 174(i); Chapter IV.
[10] Both of these points are raised in Haselgrove, Colin; 1988: '*Iron Age Coins*'; in Herts. Archaeology Vol. 10, ed. T.W. Potter & S.D. Trow; pp. 21 – 29.
[11] Op. cit.
[12] Niblett, R.; 1995: '*Roman Hertfordshire*'; Dovecote Press; p. 16.
Partridge, Clive; 1979, 1981, 1982; op. cit.
Potter, T.W. & Trow, S.D.; 1988; op. cit.
Thompson, Isobel; 2002: '*Braughing Extensive Urban Survey Project Assessment Report*'; Hertfordshire Historic Environment Unit.
Webster, G.; 1980: '*The Roman Invasion of Britain*'; Batsford; pp. 55 -56.
This list is not exhaustive.
[13] Haselgrove, C.; 1988; op. cit.

Appendix 1: Synopsis of a report by Henrietta Longden, MA, on the testing of samples of coin mould from the Ford Bridge Assemblage.

This study, 'Coin Moulds from the Iron Age Oppidum of Braughing: An investigation of Celtic coinage production techniques.' (Unpubl., 2008), was commissioned and funded by Stewart Bryant of the Hertfordshire Historic Environment Unit on behalf of English Heritage, and carried out by Henrietta Longden of Liverpool University as part of her MA dissertation. Using Scanning Electron Microscopy in Secondary Electron Imaging mode, Back-Scattered Electron mode, and in conjunction with an Energy Dispersive Detector, Longden examines selected fragments of coin mould for metal traces and subtle variations in heat-induced changes in the fabric of the mould, with the intention of discovering the type of coin pellet manufactured and the finer details of the process of pellet manufacture.

She deals first with the vitrification commonly exhibited by mould which has been used. She notes that the clay from which the trays are made vitrifies at a temperature close to the melting point of the metals used in coin production, and is able to demonstrate both that heat was applied to the top of the tray rather than at the base, and that the effects of heating are not as uniform in their distribution through the body of the fabric as with mould from Verulamium. This she attributes to the lower melting point of the base metal smelted in the Ford Bridge assemblage compared with the melting point of the silver pellets produced in the Verulamium mould. She suggests that it might be possible to infer the type of metal smelted in a given mould sample from the degree of vitrification exhibited, but notes that extensive additional SEM examination of mould from several different sites would be necessary in order to verify this hypothesis. She notes also that the variation in the degree and duration with which heat was applied to the trays may indicate variations in the detail of the smelting process, which might be indicative of lower levels of centralized control of the minting process.

Next, Longden considers the ceramic of which the trays are made. She notes that they were fired in a reducing atmosphere, and that their low density confirms that they were subjected to furnace conditions. Although her report does not mention this, work carried out by Cottam and Gebhard et al. has shown that a reducing atmosphere is vital to the successful manufacture of a pellet in a clay tray. She notes the presence of voids in the sample examined which may be indicative of the use of an organic temper, and suggests that the vertical orientation of these voids is evidence that the trays were formed in a mould. She notes that the clay used is not refractory, citing the absence of high levels of aluminium in the material.

She then proceeds with the analysis, using SEM-EDS, of a metal prill large enough to be located with the naked eye. She reports a generally homogenous composition throughout the prill, which is a 1.6% tin bronze with a high level of copper purity and very slight traces of iron, manganese and sulphur. Noting the preferential degradation of certain elements, she emphasises the difficulty of associating the Ford Bridge mould with particular issues of coinage, although she states that the levels of tin fall comfortably within the ranges exhibited by the coinage of both Tasciovanus and

Cunobelin. She states that the homogeneity of tin concentrations through the sample is good evidence that the bronze was pre-alloyed before being placed in the mould, citing parallels with evidence from coin mould found at Manching, and hypothesizes that this results either from the use of recycled metal, or tight (centralized) control of the composition of coinage. She argues that such a degree of control would presuppose an ability on the part of the smiths to judge the composition of an alloy with great accuracy without access to modern techniques of analysis. In addition, she makes the point that the use of ready-made alloys manufactured to a predetermined recipe would add yet another complex operation to what – to us – appears an already complex, even needlessly convoluted, process, highlighting the likelihood that Iron Age concepts of money and worth were very different from our own. She concludes that it is entirely possible that different stages in the production of coinage were carried out at different sites.

In the fourth section of her report, Longden sets out the results of her analysis of what she terms a 'white residue' found in some mould holes. She states that this residue is almost certainly calcium carbonate, in the form of chalk, and that it was used as a mould-release agent to overcome the porosity of the clay (which is often exaggerated by the tendency of the clay to vesiculate under extreme heat), which might otherwise result in the loss of significant quantities of metal, and make more likely the fusion of the pellet with the fabric of the mould. She feels that the use of the chalk within the mould holes would explain why metal residues were found only on the top surfaces of mould fragments. The fact that this 'residue' has been noted on coin mould from Verulamium but not at other mint sites across the country she attributes either to local 'tradition', or as a practical response to the lack in this area of more refractory clays.

Next, Longden sets out the results of her analysis of metal residues on the material. She notes the presence of copper, and that it has been actively absorbed into the glassy phases of the clay, a phenomenon which could only have occurred at temperatures exceeding 1000^{o} C. She tells us that tin was found similarly embedded in the form of cassiterite (tin oxide) crystals, and that these crystals formed as a result of leaching from a pre-mixed alloy. Silver was also present, as discreet globules in the voids of the vitrified clay, but in very small quantities. She feels that this is not simply due to the higher specific gravity and melting point of silver compared with base metals, but could well result from the addition of the silver as a separate ingredient. She argues that the presence of silver in such small quantities does not indicate that a silver coinage was being produced, but that the silver might well have been included to affect the colour of the finished coin. In addition she notes the presence of iron, mentioning the work carried out by the University of Munich Archaeometry Group using iron phases in the fabric of coin mould to discover data about the temperature applied to the trays and the time during which the temperature was maintained. She concludes that similarities in the way silver was added to the metal mixture indicate a continuity in tradition between Continental Celtic minting practice and its counterpart in Britain.

In her concluding section, Longden first emphasises that the moulds from Ford Bridge were undeniably used to make metal pellets, which were then almost certainly made into Late Iron Age coinage, pointing to the similarity in composition between metal traces in the moulds and coins known to have been manufactured in the

Catuvellaunian territory. She confirms that the evidence from vitrification supports Tylecote's hypothesis that heat was applied to the top of the trays, charcoal being heaped up over the holes to help ensure a reducing atmosphere, rather than (as suggested by Castelin) burning charcoal being placed within each hole.

Her statement that production at Braughing and Verulamium was on a similar scale was correct when her report was written, but must be revised with the coming to light of the Puckeridge Assemblage. Citing coin loss patterns at both Braughing and Verulamium, she suggests that Braughing may have been a centre for the production of base metal coinage, while silver tended to be produced at Verulamium. From this she adduces the presence at Braughing of a 'thriving trade economy', while major state expenditure was focused on the tribal capital.

S6 Dia and Vol Spread

Larger hole size spread:	Largest hole base dia.	17.6 mm.
	Smallest base dia.	16.5 mm.
	Dia. spread:	1.1 mm.
	Largest vol.	2068.717 mm^3 (17.6 mm. dia.)
	Smallest vol.	1390.394 mm^3 (16.5 mm. dia.)
	Vol. spread:	678.323 mm^3
Smaller hole size spread:	Largest hole base dia.	12.357 mm.
	Smallest base dia.	8.400 mm.
	Dia. spread:	3.957 mm.
	Largest vol.	1005.295 mm^3 (11.2 mm. dia.)
	Smallest vol.	354.809 mm^3 (8.4 mm. dia.)
	Vol. spread:	650.485 mm^3