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Non-ferrous metal and glass working in Anglo-Scandinavian England : An interim statement

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Recent excavations in English towns and cities have produced much evidence for industries of the late Saxon period, roughly the 9th to 11th centuries. The sites referred to in this paper are shown in Figure 1. They can be divided into two groups; those in the area of Viking influence known as the Danelaw and those in Wessex, the southern part of England. The majority of the material discussed below, which refers only to non-ferrous metal and glass working, comes from the Danelaw area, mostly from York, Lincoln, Northampton and Thetford. The finds from these towns are all similar, those from Lincoln and York being the most alike. A question that this similarity poses is whether this is imported Scandinavian technology in England or English technology producing objects in Scandinavian styles.

Two years ago I was fortunate enough to be awarded a Winston Churchill Travelling Fellowship and spent six weeks in Scandinavia studying at first hand the comparable material from sites such as Hedeby, Ribe, Fyrkat, Kaupang and Birka. As a result of this I can say that some of the Scandinavian material is very similar to that from sites in the Danelaw but some is rather different.

The second area with which the Danelaw sites should be compared is southern England. Unfortunately no major metal-working site like that found at Flaxengate in Lincoln has yet been excavated in this area but smaller groups of material have been found eg. at Cheddar, Oxford, Southampton (Hamwih), Winchester and in London.

There is one important difference between the English sites, be they in Wessex or the Danelaw, and those in Scandinavia which is too fundamental to be overlooked. The Scandinavian sites were all new foundations so everything found on them is contemporary, or if it dates from an earlier period was

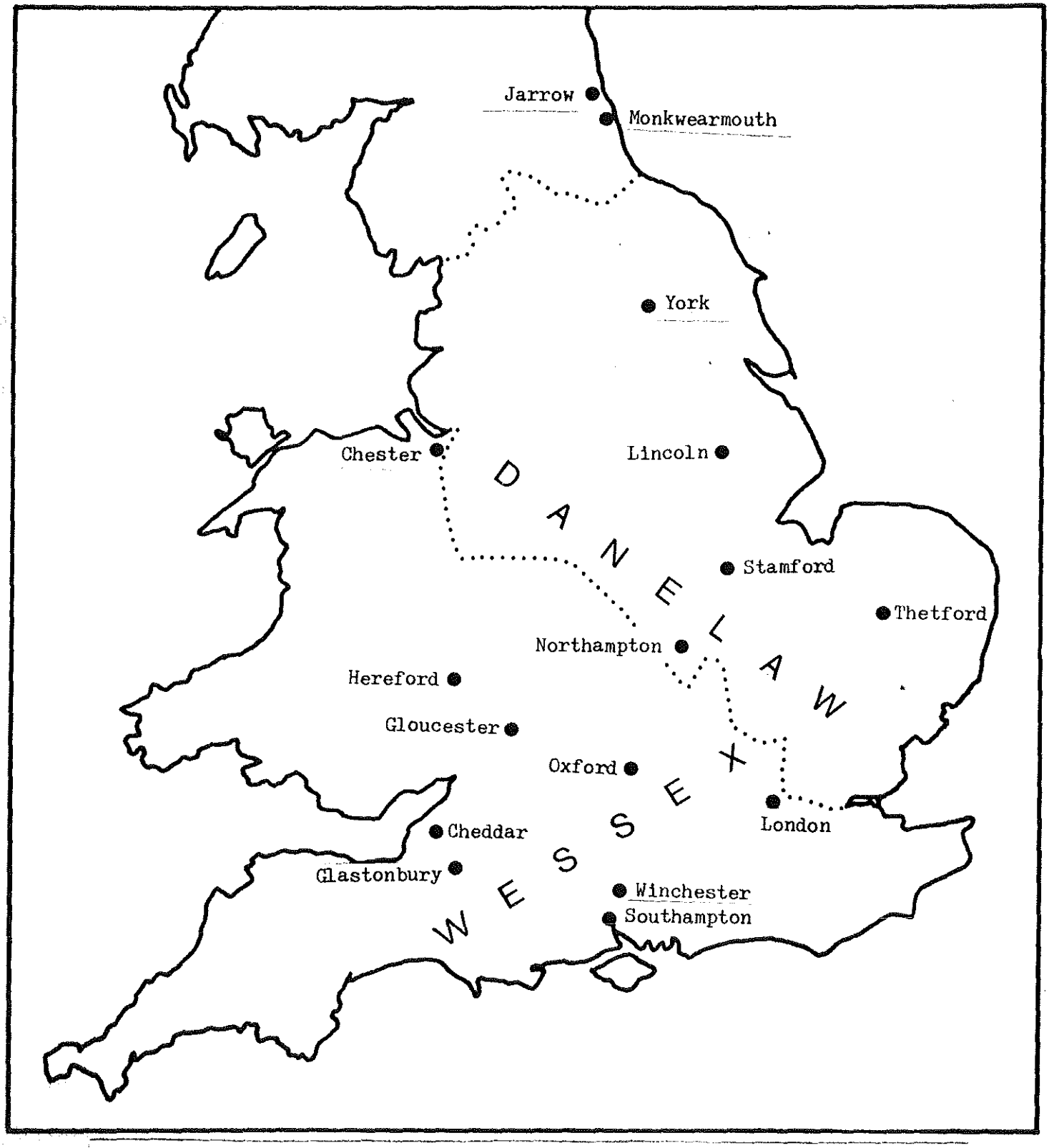

Figure 1 : Map of sites and areas in England mentioned in the text.

deliberately collected and brought to the site during its occupation. On the other hand, most of the English towns are on the sites of earlier, Roman settlements and there is therefore much residual material found in the Anglo-Scandinavian levels. Some of it, like pottery and decorated metalwork, is readily recognisable but some, much as scrap metal and small fragments of glass, is almost undateable so care and caution is needed in its interpretation.

It may seem a little surprising to treat non-ferrous metal and glass working together but there are reasons for their association. Not least of these is that crucibles containing glass have been identified in groups of finds thought by their excavators to be all metal working debris. As both technologies require a similar range of temperatures, a careful control of furnace or hearth atmosphere and an ability to manipulate red hot material, joint consideration is clearly justified.

Metalworking

The metals to be considered are copper alloys, silver and gold. As their melting points are similar they require similar working conditions and can be considered together, at least initially. The major evidence for metal working is the crucibles which were used to melt the metals being worked. They were not very robust and so had only a short life; in most cases there is no evidence that crucibles were used more than once and they therefore occur in quantity among the debris on metal working sites.

Most of the crucibles found on the Danelaw sites were bag-shaped and the majority appear to have had a pouring lip. Examples of the sizes and shapes found on the Flaxengate site in Lincoln are shown in Figure 2 and most of these could be paralleled from the Coppergate site in York. All these forms are of one fabric, Stamford-type ware, which is used for a wide range of domestic pottery as well as for crucibles (Kilmurray 1980). This is not surprising as for both sorts of use the ability to withstand high temperatures as well as sudden changes in temperature are necessary. Stamford-type ware is

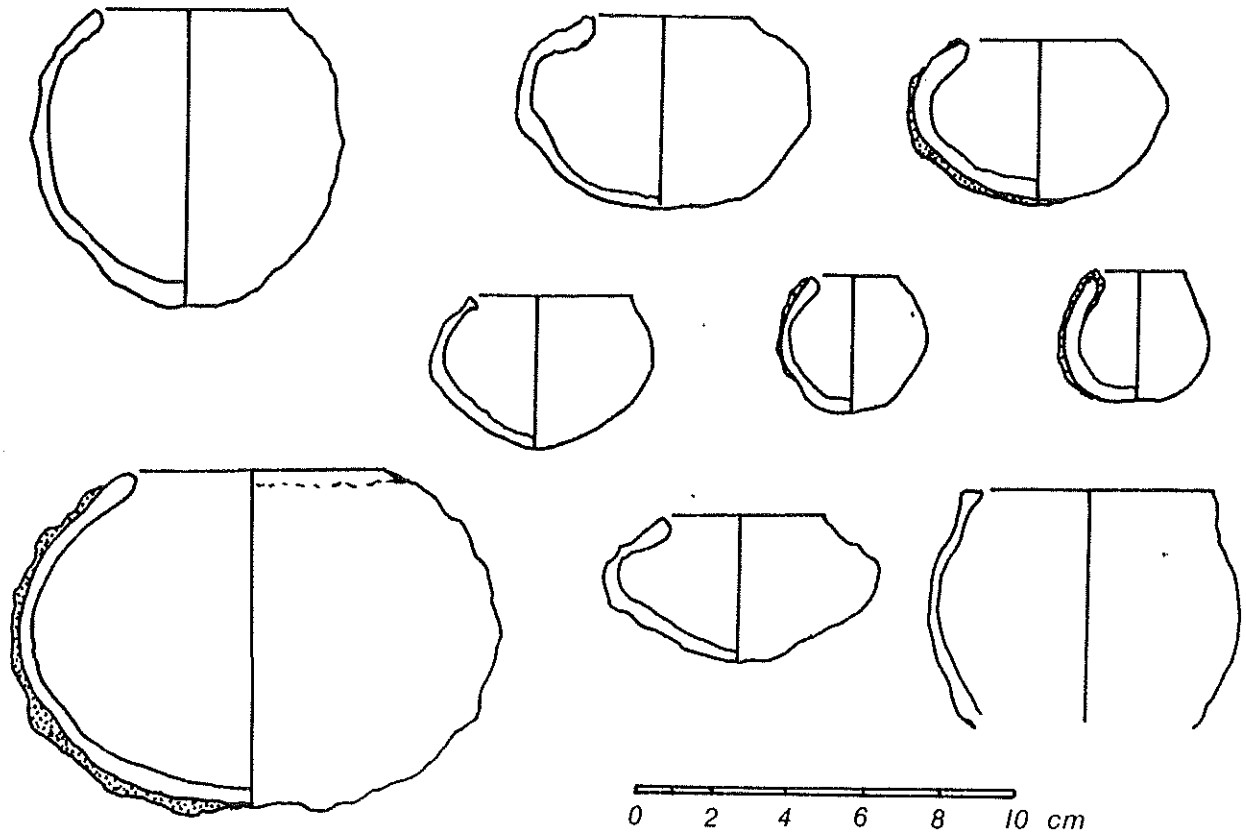

Figure 2 : Stamford-type ware crucibles from Flaxengate, Lincoln (after Adams and Young, forthcoming).

a fine, almost white-firing fabric but contains abundant fine quartz temper which makes it sufficiently refractory for metallurgical use. The crucibles were shaped on a wheel and the rounded base then pushed out by hand. Turning ridges can be seen on the upper parts of most of the crucibles but the bases have radial finger marks on the inside indicating how they were formed. The crucibles were thin walled (average thickness 2 - 4 mm) and they were often coated on the outside with a layer of less refractory clay before they were used. This would have protected them a little from thermal shock as they were lifted from the fire, reducing the risk of breakage and would also increase their thermal capacity so the molten metal they contained would not solidify quite so quickly. Even so their small size (maximum diameters mainly in the range of 4 - 8 cm) would have meant that pouring would have to be very rapid after they were removed from the fire as only a limited amount of superheating would have been possible.

The crucibles from Thetford, too, are mainly bag-shaped but are of a coarser sandy fabric which is also used for domestic pottery. They are thicker walled (3 - 6 mm) and of rather larger volumes (maximum diameters of 7 - 10 cm) than the Stamford-type ware crucibles. A range of other crucible forms in a variety of fabrics are known at this period. These include most of the crucibles from Northampton which are wheel-turned and of a Stamford-type fabric but of a nearly straight sided form with a narrow, almost pedestal base (see Figure 3.1) (Bayley, forthcoming). From Lincoln and Thetford have come a range of hand made 'thumb-pot' crucibles in a variety of sandy fabrics (eg. Figure 3.2 and 3.3) and from Coppergate in York there are very small, thin walled crucibles, apparently with a triangular mouth (Figure 3.4). In Wessex 'thumb-pot' crucibles were found at Cheddar in 10 - 11th century levels (Rahtz 1979) and at Southampton (Addyman and Hill 1969) while bag-shaped crucibles were found in Oxford in 10th or early 11th century levels (Jope 1952-3).

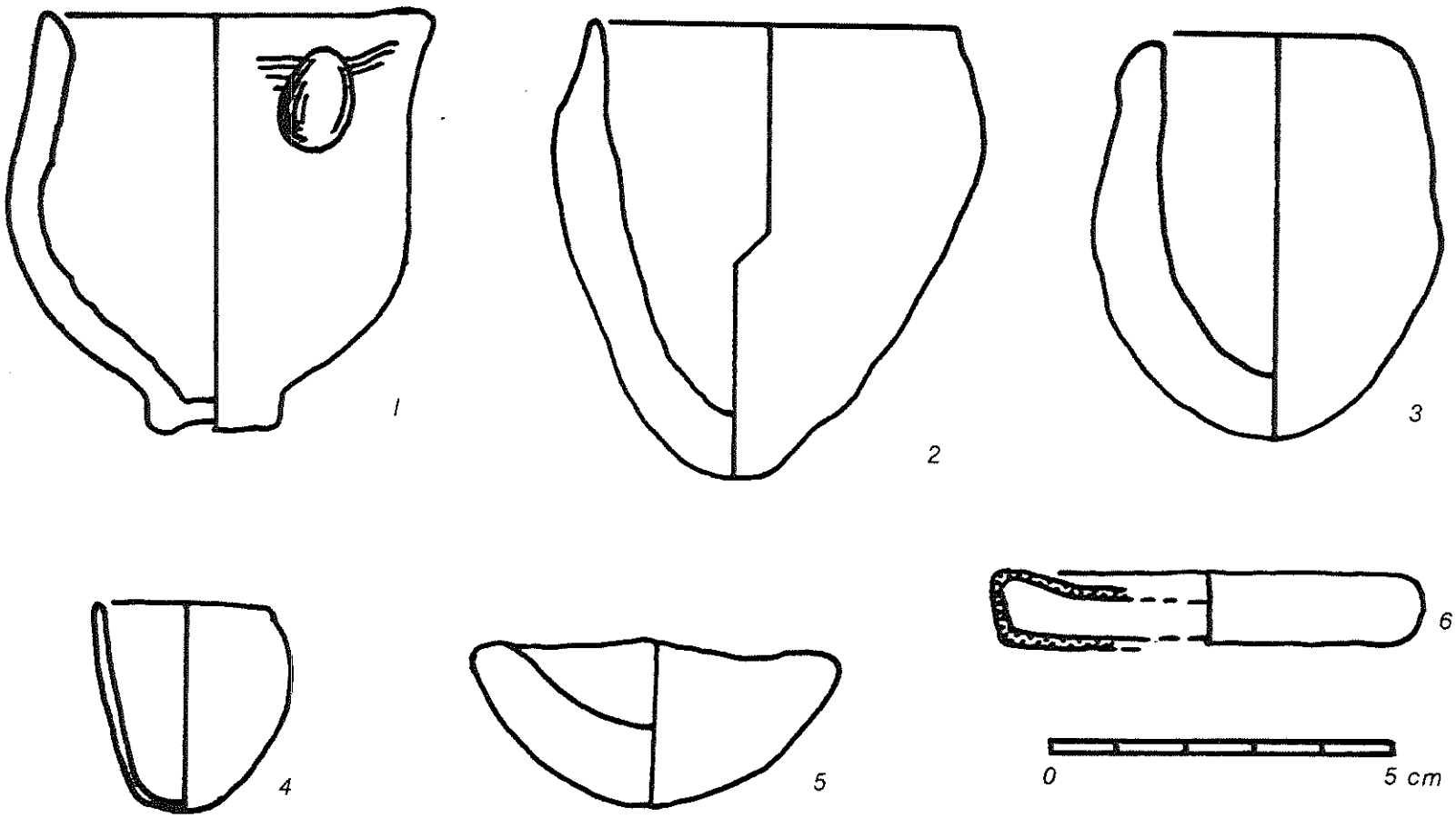

Figure 3 : Crucibles from various sites: 1- Northampton (after Williams, 1979), 2- Thetford, 3 and 6- Flaxengate, Lincoln (after Adams and Young, forthcoming), 4 and 5- Coppergate, York.

The Scandinavian crucibles by comparison are of a narrow range of forms, all usually described as 'thimble-shaped'. They are straight sided and round bottomed and are about twice as tall as they are wide. They range in size upwards from about 25 mm tall; fragments of the largest ones suggest they had a diameter of up to 10 cm. A few have knobs on their sides, presumably to act as handles and so make pouring the molten metal easier. Some are very well made and of highly refractory fabrics and others less so. These latter ones might be seen as 'home-made' copies of the better crucibles which may be imports, perhaps from the Rhineland (Drescher, pers. comm.).

All crucibles that have been used show some signs of vitrification, usually on their outer surfaces or near the rim. This is due to the silica-rich fabric being fluxed by the fuel ash at the high temperatures required to melt metals. Often small amounts of the metals being melted are absorbed by this vitreous surface, allowing the alloys that were being melted to be identified even where no droplets of metal survive. Crucibles were heated under reducing conditions to prevent the metal being oxidised and lost into a slag which means the traces of copper in the vitrified deposits colour them red, and can be readily seen with the naked eye. The presence of copper does not necessarily mean that pure copper or even one of its alloys (eg. brass, bronze) was being melted as it is also found in minor quantities in silver and gold. These two more noble metals do not produce strikingly coloured crucible slags in the way that copper does. Droplets of silver may be trapped in the vitreous surfaces and can corrode to give a waxy, dark brown or black blob, often with a powdery violet surface. Bright yellow metallic droplets are usually gold though in some soil conditions brass can survive untarnished and look very similar. The only sure test is chemical analysis which is most conveniently carried out by x-ray fluorescence (XRF) as this is a non-destructive surface analysis technique. Qualitative results, all that is required in this sort of application, are quickly and easily obtained.

The crucibles from Lincoln appear to have been used mainly for melting copper alloys. In some cases considerable quantities of metal were left behind in in the crucibles when they were discarded. Gold is found mainly in the smaller crucibles (eg. Figure 3.4 from York). Most of the crucibles from Northampton and many of those from Coppergate, York had been used to melt silver. In many cases the vitreous surface was coloured red in parts by traces of copper but silver too was detected by XRF even where no distinct blobs could be seen. Northampton is known to have been the site of a mint in the late Saxon period (Williams 1979) so it is tempting to see these crucibles containing silver as material evidence for the mint. York too was a mint and now the Coppergate excavations have produced two moneyers' trial pieces - lead sheet stamped with a coin die - as well as an iron die itself. Given these associated finds, the silver-containing crucibles are almost certainly part of the debris from the mint though it should be remembered that silver was not only used for coinage but for items of personal adornment too.

Metal, once melted in a crucible, was used in two main ways; either it was cast directly into objects or else into ingots or blanks which were then smithed into shape. Moulds for objects were usually made of clay. A number of fragments were found on the Flaxengate site in Lincoln but none were complete enough to indicate whether they were from part moulds or from investment moulds. From the same site came a casting sprue and many blobs and dribbles of spilt copper alloy. A clay part mould is known from 9 Blake Street, York (MacGregor 1978).

Ingot moulds are quite variable in both form and fabric. Most of the depressions in them are long and thin and would produce ingots half to one cm. across of triangular through semi-circular to square cross-section, varying in length from a few cm. up to about 20 cm. Other shapes are also known, eg. discs. Most of the ingot moulds from Lincoln are coarse sandy stones though two are of fired clay. In most cases only one ingot shape has been cut into each piece of

stone. The ingot moulds from Coppergate, York and that from Chester are rather different. The stone has been roughly squared, is finer textured, smaller and with several smaller ingot shapes cut into each piece. One of the York moulds is of soapstone which is widely used at this period throughout Scandinavia for ingot moulds, though it is not known if the York mould is of Scandinavian or Scottish soapstone. Traces of copper alloys, mainly brass, were detected in the depressions. Traces of impure silver were found in another ingot mould from Coppergate which was made of fired clay. Ingot moulds are also known from Oxford (Jope 1958), Southampton (Addyman and Hill 1969), Thetford and Whitby (Wilson 1976).

Some of the ingots were presumably cut up and remelted where smaller amounts of metal were required. Others were worked directly, bars, rods, wire and sheet being the products. These semi-manufactures, all of which were found in quantity on the Flaxengate site in Lincoln, were then further worked to produce such objects as folding scales or garment hooks (garter tags). The latter were found in great numbers in all stages of manufacture at Flaxengate.

One further group of finds connected with metal working comprises flat dish or disc shaped crucibles. These were originally thought to be connected with enamelling due to the high lead content of copper coloured vitreous upper surfaces (Biek and Bayley 1979) but further work has not confirmed this initial impression. Examples are known from Lincoln, York, Thetford and Northampton (see Figure 3.5 and 3.6) and also from Scandinavian sites such as Hedeby, Kaupang and Fyrkat where they were described as 'heating trays' (Roesdahl 1977). Most have droplets of silver and/or copper alloy in the vitreous surface. It was suggested by Roesdahl (1977) that they were used to hold fine metalwork while decoration such as filigree or granulation was attached. This is not a likely use as lead-containing solders were not usually used at this period for this type of work and the high lead levels present would interfere with a hard soldering process. Equally, the suggestion that the 'heating trays' were used

for small scale cupellation or refining of silver cannot be supported as they are all reduced fired, while cupellation needs strongly oxidising conditions. There are a few examples where the lead levels are very low and the trapped metal is gold, eg. from York and Birka. In these cases, holding objects while decoration is attached is quite a likely use.

The various types of evidence for non-ferrous metalworking have been described above. From this it can be seen that if metal working took place on any scale, crucibles, moulds of some sort and scrap metal are likely to be found. The scrap metal is universal with blobs and dribbles of metal, sprues (where objects were being cast) and pieces of rod, sheet and wire (where metal was being smithed) being found in all areas and at all times.

Moulds for objects, usually of clay, are also widespread but insufficient material has been found to show whether some areas or periods used only piece moulds while others used investment moulds or whether both technologies were widespread. Certainly piece moulds are known from York (MacGregor 1978), Ribe (Bencard et al 1978) and Helgö (Lamm 1980).

Ingot moulds are virtually unknown in England before the late Saxon period but are then found all over the country, usually being made of locally available stone though fired clay and exotic stone were also used. The Scandinavian ingot moulds are mostly of soapstone but this was widely used in the Viking period throughout the area even where it was not a strictly local stone. Some of these moulds are made from re-used sherds of soapstone bowls. The sudden upsurge in the use of ingot moulds in England in the Anglo-Scandinavian period may be more apparent than real as there is very little evidence for any sort of non-ferrous metalworking in the Migration Period. It may be that there was an increase in the use of wrought rather than cast metalwork, though there is plenty of wrought metal in Roman Britain and few if any ingot moulds to go with it. Crucibles and clay moulds for objects are known in Roman Britain as are ingots

whose size and shape roughly correspond to those produced in the Anglo-Scandinavian moulds. It may be that the idea of stone ingot moulds (as opposed to a groove in the ground perhaps) was imported in the Anglo-Scandinavian period but most of the moulds found in England appear to be of very local origin.

The variation of crucible type is quite marked, though all were obviously performing similar functions. Thimble-shaped (Scandinavian) crucibles are rare in England though one is known from an unstratified deposit, possibly of Anglo-Scandinavian date, in York. It is not known where this crucible was made, but the object itself or perhaps just the idea for its shape may have been imported from or via Scandinavia. The two main groups of crucibles found in England are the bag-shaped ones which are common in the Danelaw area but rare outside it and the thumb-pots' which are known in both north and south. It is difficult to say on present knowledge whether these variations in distribution are truly geographical or technological or whether they are due, in part at least, to differences of date between the various sites. Most are however not fully published so the necessary information is not available and the question will have to be left for future discussion.

The widespread identification of 'heating trays' is an interesting sideline but until a more convincing use can be suggested for them they will have to remain an enigma. Their present distribution, in England anyway, may be artificial as they are not generally known to exist and so may have gone unrecognised.

Glass working

Evidence for two major types of glass working has been identified in 9th or 10th century levels in Gloucester, Lincoln and York.

The first is the manufacture of trinkets such as finger rings, beads and gaming pieces from glass containing considerable quantities of lead (around 60-70% by weight lead oxide). The glass is transparent yellow or green, the colour being due to small amounts of iron and copper respectively. Objects made of this type of glass have been recognised in Hereford (Shoesmith forthcoming),

Lincoln and York while crucibles containing similar glass are known from Gloucester (yellow only) (Bayley 1979), Lincoln and York (green). The crucibles are shallow dishes of coarse, oxidised fired fabrics. They do not appear to be highly refractory but the relatively low softening point of the high-lead glass would make this unnecessary. A piece of frit (part made glass) was found with the Gloucester crucibles suggesting that the glass was being made there rather than just being melted, while Lincoln has produced at least one piece of cullet but no frit, so there the raw glass may have been melted and shaped (finds include a very poorly formed ring) though not necessarily made. The crucibles from York are represented by just two or three sherds containing dark coloured high-lead glass; where a colour is clearly visible it is green. I know of only one example of high-lead glass from Scandinavia; and that is a small fragment, possibly of a gaming piece, from the 'black earth' at Birka. Similar high lead glass is known in Russia from the 11th century (Besborodov 1957).

The beads made in Scandinavia at this period are rather different and the evidence for their manufacture is correspondingly so. Large quantities of material were found at Ribe (Bencard et al 1978) and considerable amounts are known from other sites such as Kaupang (Hougen 1969), Helgö and Paviken (Lundström 1976). Glass-containing crucibles are almost unknown but common finds are glass rods and tesserae. Scrap vessel glass is also found in some quantity but its relationship to the glass working is as yet unproved.

The Flaxengate site in Lincoln has produced several tesserae of green and blue glass and one small fragment of a rod of green glass as well as quantities of vessel and/or window glass sherds. However all of this material may be residual in the Anglo-Scandinavian contexts in which it was found. The tesserae for instance may have come from a substantial Roman building found near one end of the site.

The second major type of glass working is the manufacture of alkali glass suitable for making vessels or windows. The Coppergate, York excavations have

this year produced numerous sherds of large, wheel-turned pots containing glass as well as pieces of (? re-used Roman) brick and tile which appear to have been part of a glass furnace structure. An area set with tiles which had been very intensely heated was also found, and tentatively described as the base of the furnace; this has given a magnetic date of the end of the ninth century. It is hoped that thermoluminescent dating of some of the sherds containing glass will positively associate them with the ?furnace base and confirm the date of the industry. The debris found in association with the sherds suggests that glass was being made from batch (raw materials) rather than just being remelted from cullet (scrap). A small quantity of threads and dribbles of glass have been found near the ?furnace base. The closest parallels for this glassmaking industry are the furnaces and pots containing glass recorded at Glastonbury Abbey (Radford 1957, Harden 1971) which have unfortunately not yet been fully published but are thought to date from the 9th or possibly 10th century. There is also some evidence for glassworking at the monastic sites of Jarrow and Monkwearmouth, though this is mainly documentary (Cramp 1969, Harden 1971) and refers to their construction in the late 7th century. There is some evidence of glassworking at Jarrow in the 9th century but it is not apparently on a large scale (Cramp 1975). There is also mention of a glass furnace from Hedeby (Jankuhn 1963) but full publication is awaited there too.

In summary it should perhaps be said that the working of high lead glass appears to be an English rather than a Scandinavian industry with manufacturing sites dating to around the 10th century known in both Wessex and the Danelaw. The manufacture of other types of glass beads is well known in Scandinavia at this period and a little earlier but there is little if any concrete evidence from English sites. There are not many known sites for the manufacture of alkali glass on a large scale at any period and those dating to the Viking Age are few and far between. Until more of those known are published in detail, comparisons are tenuous and not very useful and the question of the origin of the technology cannot be discussed.

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Full details of the finds from Flaxengate, Lincoln are forthcoming in the series The Archaeology of Lincoln. The finds from Coppergate, York will be published in the series The Archaeology of York; both published by the CBA, London.