Reuse of Glass, Pottery and Copper-Alloy Objects in the Late to Post-Roman Transition Period in Britain

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ABSTRACT

This paper documents in depth reuse or repair of a selected range of Roman artefacts: reworked glass fragments (including both bases and body sherds), samian sherds reworked into spindle-whorls, and penannular brooches with replacement iron pins. All are predominant in late Roman or later levels. Samian spindle-whorls and reworked glass sherds are found to be particularly associated with military sites, while penannular brooches with iron pins are found most often in Anglo-Saxon cemeteries. The overall evidence suggests that particular types of reuse flourished as durable materials became scarcer in the late to post-Roman transition period, yet there is also considerable variation in the uses and values that can be associated with the different artefact types.

INTRODUCTION

In the paper presented to the A.D. 410 conference, I considered evidence for the reuse of Roman bracelets. It was found that bracelets cut down into smaller rings, and also otherwise distorted, fragmentary, or flattened bracelets, are particularly found in late fourth- and early fifth-century contexts. While rings made from Roman bracelets also occur in Anglo-Saxon cemeteries, the dates of deposition, which are generally not in the earliest Anglo-Saxon phase, and the nature of the reuse, suggest that there is no direct continuity between late/post-Roman reuse and Anglo-Saxon reuse. We can see here a profile of reuse and recycling in which the meaning of the artefacts clearly changes over time. Earliest reuse may have had personal associations and seems also to have been an attempt to prolong Roman cultural behaviour (for instance, child-sized bracelets made from cut-down adult bracelets as part of children's grave assemblages, following the fairly widespread late Roman habit of burial with jewellery), while the latest reuse, in bags at the waist in Anglo-Saxon graves, shows complete transformation, in which the artefacts probably had an amuletic function.

This paper has since been published elsewhere (Swift 2012), yet it raises interesting further questions about the extent of reuse and recycling of everyday artefacts in the late Roman period and what it tells us about aspects of the late to post-Roman transition. In this contribution, therefore, I take the opportunity to investigate the evidence of some other reused objects and to make some overall comparisons.

Reuse is part of object biography — the life cycle of an object from production, through use, reuse and recycling, to final discard or loss (Appadurai 1986, 14–15; Kopytoff 1986, 66–8) — in which the meaning of the object may change considerably, and from anthropological studies it is evident that reused objects themselves can have a wide range of meanings. They may have been curated as still-practical objects; they may also possess more esoteric significance in relation to cultural value, personal inheritance and collective memory, and status display. These meanings may co-exist alongside one another. Value can be created in many ways, and different kinds of value may develop over a period of time.

What we might term 'functional curation', primarily the reuse of objects for practical purposes,

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has been considered by Schiffer and others (Deal and Hagstrum 1995; Schiffer *et al.* 1981; Schiffer 1996; Wilson 1995). In a cross-cultural anthropological study, reuse (in this case, of pottery) was shown to be a widespread behaviour as a part of daily living. Reused objects had a different, lower-status function compared to their original use; most often this was connected to small-scale domestic production activities (Deal and Hagstrum 1995, 113–14). Examples from historical archaeology show rates of reuse linked to shortages and that poorer socio-economic groups tend to reuse more, although it can also be a profitable, organised activity on a larger scale (Schiffer *et al.* 1981, 119; Wilson 1995, 127).

Anthropological studies also show that reused objects can be linked to personal networks and gift-exchange (Schiffer *et al.* 1981, 108) and that they can have symbolic or ritual uses (Deal and Hagstrum 1995, 117–18); this illustrates not only that objects have a different economic value to different users, but also that other types of value, especially those connected to personal relationships, may accrue. Graeber notes that the initial object biography approach of Appadurai tended to play down non-commoditised meanings (Graeber 2001, 31–2), however these have been considered further in more recent scholarship (Haug 2001; Lillios 1999; see also McCracken 1988, 44–53). Lillios, for instance, discusses heirloom objects where circulation for several generations is likely to result in the replacement of personal associations with collective memory — perhaps representing family longevity (Lillios 1999, 243).

A number of types of artefact reuse have been suggested to be associated with the late to post-Roman transition period. These were noted briefly in my previous paper (Swift 2012, 191) and include: riveted pottery (Barker *et al.* 1997, 218; Cool 2006, 232–3); spindle-whorls made from samian sherds (Cool 2000, 53); collection for recycling of increasingly smaller pieces of glass indicated by increasing glass fragmentation in late assemblages (Price, J. 2010, 48); replacement iron pins for copper-alloy penannular brooches, since Roman penannulars were made with the pin and ring of the same material (White 2007, 21); and, in precious metals, clipped *siliquae* (Guest 2005, 110–15) and hacksilver (Hunter and Painter 2013). These last two have been the subject of extensive research already and thus will not be treated further here.

Riveted pottery will also not be investigated in detail as this would be a major study in its own right. Some studies of riveted samian exist, and riveting in other pottery types has also been noted at individual sites, for instance, grey sherds in fourth-century contexts at Frocester (Price, E. 2010, 131 no. 9 (A101a)) and Catsgore (Leech 1982, 126 no. 3). In the studies of samian, riveting has been shown to be over-represented at sites with poor access to durable material goods such as Welsh rural sites (Longley *et al.* 1998; see also Willis 2006, 11.5). One might therefore suppose that the same would be true of very late/post-Roman levels, since these also show a paucity of durable material culture. Proportions of riveting do increase in the latest levels at one very late/post-Roman site, Wroxeter (Barker *et al.* 1997, 218; Cool 2006, 232–3). A site-specific study at Binchester, however, which examined context dates in which riveted pottery occurs, suggests that at this site riveting does not show a bias to the late Roman period (Evans and Ratkai 2010, 115). Riveted samian in particular has been shown to be a phenomenon that occurs consistently in proportion to samian supply, thus peaking in the second century A.D. (Marsh 1981, 227–8; see also Willis 2006, 11.3), though it should be noted that this is based on production dates of samian, not dates of deposition, thus perhaps obscuring any patterning in which samian survived complete until the fourth century, and was then broken and mended with rivets. While there are some indications, then, of the prolongation of the life of pottery vessels through riveting in the very late Roman period, currently the evidence is scarce apart from at Wroxeter, and riveting is in general a multi-period phenomenon.

Glass fragmentation is hard to evaluate, since measurements of individual fragments are not consistently recorded in site reports. Although some glass reports do mention in general terms that the sherds of glass in the assemblage are considered to be extremely fragmented (e.g. Allen 1998, 94; Allen 2009, 568; Barford and Shepherd 1985, 191; Charlesworth 1982, 132), there is not sufficiently detailed and objective information across enough sites to make a wider study viable.

In many glass reports, reuse through the retouching or 'grozing' of broken sherd edges is documented, and, according to Price, is quite a common phenomenon (Price 1994, 135). Cool,

meanwhile, notes that the reworking of glass vessel bases at Piercebridge is late Roman (Cool 2008, 262–3). It was therefore decided to collect data on grozed material rather than on glass fragmentation.

The material chosen for further study, then, was reworked glass sherds, samian spindle-whorls, and penannular brooches with iron pins (see Swift 2013 for a wider discussion of reuse in Late Antiquity that includes some other material). As with the previous investigation of bracelet reuse, as wide a range of sites as possible was investigated, including sites dating to the early Roman period; the majority were occupied throughout the whole of the Roman period. Anglo-Saxon cemeteries and settlements, and the PAS database, were also checked for relevant material.

Each category of material will be discussed separately and then overall comparisons will be made.

PENANNULAR BROOCHES WITH REPLACEMENT IRON PINS

Care is needed with this category of material since penannular brooches were produced in the Iron Age, Roman period, post-Roman West, and in Anglo-Saxon England. The material collected comprises types which have a principal date range in the Roman period, although for those types found in both Roman and Anglo-Saxon contexts, we need to evaluate the likelihood that the brooches could still have been in production in the later fifth century, as should this be the case, they do not necessarily represent the curation of Roman or sub-Roman material. Fortunately, Mackreth's published corpus of brooches (Mackreth 2011) contains a very useful and detailed study of penannular brooch typology, which has been used to assign a stylistic date to the material where possible. Dates that extend beyond the end of the Roman period are seen for some types, and others remain essentially undatable; however, a more specific range is suggested by Mackreth in a few cases. Items which could not be classified within Mackreth's typology have not been included.

Relatively few Roman-style copper-alloy penannular brooches with iron pins were identified (22 in total), suggesting that they were not originally manufactured in this format and that the iron pins are indeed repairs. The majority come from Anglo-Saxon cemeteries, with large towns the next most productive category (FIG. 1). The overall site-type profile of the material is very different to that of other fourth-century objects and similar to that of early fifth-century objects (such as Quoit brooch style belt-fittings, also found mainly in Anglo-Saxon cemeteries).

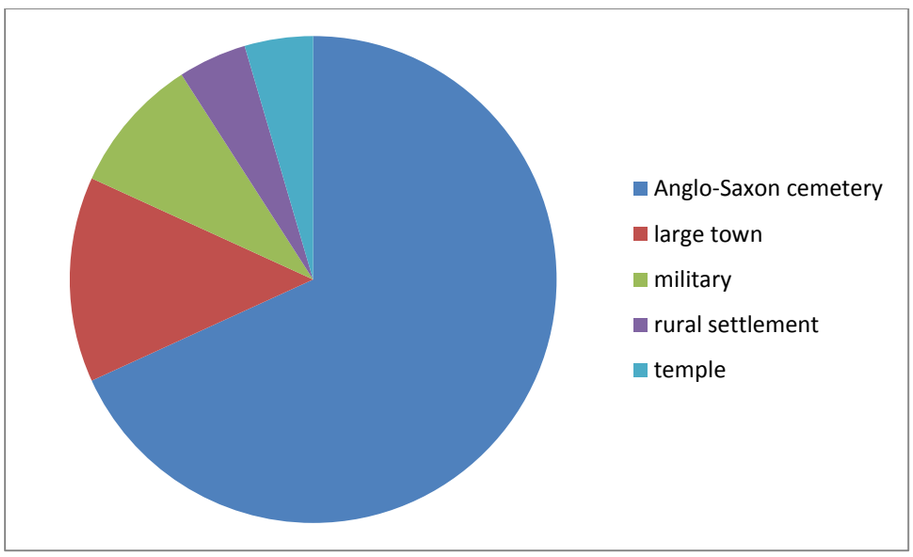

FIG. 1. Number of Roman-style penannular brooches with iron pins by site-type. (*Copyright Ellen Swift*)

FIG. 2. Distribution of Roman-style penannular brooches with iron pins.
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Overall distribution is mainly in southern England, probably reflecting the density of combined Roman and Anglo-Saxon occupation in the South (FIG. 2). Further details of the brooches and their contexts are given in Table 1. A wide range of types is represented, within Fowler's types A, C, D, and E, to use the more established terminology. There is one example in a late first-century A.D. context from Castleford, showing that repairs using iron pins are not only found in the late period. The others are from late or post-Roman contexts, or from Anglo-Saxon contexts in the earlier phase — mid-fifth to sixth century. The examples from Castleford and Caernarfon are types which can be given stylistic dates in the first to third centuries (k3a and k2a). Their deposition dates, in the later first century and the late third to mid-fourth century at Caernarfon, fit well with the hypothesis that these brooches have been curated. The examples from Canterbury and Lankhills are not closely datable types but were deposited in late Roman contexts. Each of these examples was probably given a new iron pin when the original pin broke, and thus their lifespan was extended.

It is difficult to evaluate whether the presence of penannular brooches of Roman style in Anglo-Saxon cemeteries represents the continued production of these brooch types in the fifth century, the curation of extant late Roman material, or the later collection of material from Roman sites (on the wider phenomenon of Roman objects found in Anglo-Saxon graves see Eckardt 2003; Swift 2012, 194–202; White 1988). In order to address this, the brooches with iron pins were compared against Mackreth's data (Mackreth 2011, 206–33). Mackreth includes dated contexts for each brooch type, and lists the presence of the type in Anglo-Saxon cemeteries, although the specific context dates of Anglo-Saxon graves are not given. (Most of the Anglo-Saxon material listed is taken, in turn, from White 1988, which was consulted for further information about dating and details of grave assemblages.) One can also take into account the lengths of the pins compared to the size of their rings; it has been noted that pins increase in relative length in the post-Roman period (see extensive discussion in Mackreth 2011, 223–8). For many types, evidence was not conclusive; those examples with clearer evidence are discussed below.

TABLE 1. Roman-style penannular brooches with iron pins

Site	**Ref.**	**Typology**	**Mackreth stylistic date (A.D.)**	**Context date (A.D.)**	**Context description**
Apple Down	White 1988, fig. 7 no. 5	Mackreth f1d Fowler Type D6	Not closely datable	-	Grave- no further details
Barrington A	White 1988, fig. 2 no. 4	Mackreth c2d1 Fowler Type C	Fourth century or later		Grave- no further details
Blacknall Field	Annable and Eagles 2010, gr. 102 no. 1	Mackreth f1a Fowler Type D	Not closely datable, though Youngs suggests this example is early medieval (Annable and Eagles 2010, 36-40)	450-500	Female grave, worn on chest on left side, as one of pair, the other worn on right side
Broughton Lodge	Kinsley 1993, gr. 14 no. 1	Mackreth c2b Fowler Type C	LPRIA or Late Roman	6th century or later	Grave, part of multiple burial, with horse and 3 people, position of brooch not given
Butler's Field Lechlade	Boyle *et al.* 1998, gr. 81/3 no. 2	Mackreth k1a Fowler Type A	Mostly LPRIA, though Mackreth notes examples in Anglo-Saxon contexts might be later (Mackreth 2011, 212)	mid-late fifth to early sixth century	Grave context, child, worn at burial on left shoulder

TABLE 1 (cont.). Roman-style penannular brooches with iron pins

Site	Ref.	Typology	Mackreth stylistic date (A.D.)	Context date (A.D.)	Context description
Caernarfon	Casey and Davies 1993, cat. no. 21	Mackreth k2a Fowler Type A2	First to fourth century (but mostly late first to third century)	late third to early/ mid-fourth century	-
Canterbury Marlowe	Blockley *et al.* 1995, cat. no. 122	Mackreth c2a Fowler Type C	Not closely datable	350/75-400	Layer in Building R23, sealed by dark earth layer
Castleford	Cool and Philo 1998, cat. no. 142	Mackreth k3a Fowler Type A3/4	First to fourth century (but mostly first to second century)	late first century	Midden deposit in fort area of site
Fairford	White 1988, fig. 4 no. 9	Mackreth c2d2 Fowler Type C	Fourth century or later	-	Female grave, worn at throat
Girton	White 1988, fig. 5 no. 1	Mackreth c2d2 Fowler Type C	Fourth century or later	-	Grave- no further details
High Down	White 1988 Type D no.3	Mackreth f1b Fowler Type D	Not closely datable	later fifth or sixth century	Grave context, child, no further details
Holywell Row	White 1988, fig. 4 no. 2	Mackreth c2a Fowler Type C	Not closely datable	late fifth to early sixth century	Grave context, penannular brooch on each shoulder with beads between (Lethbridge 1931 gr. 83 p. 37)
Holywell Row	White 1988, fig. 3 no. 6	Mackreth c2d1 Fowler Type C	Fourth century or later	early sixth century	Grave context, penannular found near waist; bead string nearby (Lethbridge 1931 gr. 39 fig. 10 no. 3)
Keston	Philp *et al.* 1991, cat. no. 99	Mackreth 6 Terminal Ears c Fowler Type E	Fourth century or later	after 400	Demolition layer over domestic building
Lackford	White 1988, fig. 7 no. 3	Mackreth 6 Terminal Ears c Fowler Type D	Fourth century or later	-	Stray find
Lankhills 2000-2005	Booth *et al.* 2010, gr. 780.1	Mackreth f1b Fowler Type D4	Not closely datable	Fourth century	Grave context, position implies fastening a cloak
Long Wittenham	White 1988, fig. 7 no. 1	Mackreth f1b Fowler Type D4	Not closely datable	-	Female grave, in bag at waist with fragment of mount
Lowbury Hill	Atkinson 1916, pl. x, 56	Mackreth f1c Fowler Type D	Not closely datable	-	-

TABLE 1 (cont.). Roman-style penannular brooches with iron pins

Site	Ref.	Typology	Mackreth stylistic date (A.D.)	Context date (A.D.)	Context description
Pewsey	White 1988, fig. 8 no. 6	Mackreth f1a Fowler Type D	Not closely datable	-	Female grave, worn in pair on shoulders with another penannular brooch
West Overton	White 1988, fig. 7 no. 4	Mackreth 6 Terminal d no ears Fowler Type D5	Fourth century or later	Fifth or sixth century	Female grave, worn at shoulder
Wroxeter Baths Basilica	Barker *et al.* 1997, cat. no. 11	Mackreth 8 Fowler Type D8	End fourth to fifth century	-	General layer

EVIDENCE FOR LATER COLLECTION OF ROMAN MATERIAL

Type f1b with a fragmentary iron pin from Long Wittenham was found in a bag group in an undated grave (the cemetery dates from the fifth to the seventh century, see White 1988, 208–9). Although the brooch type is not closely datable, only two of thirteen dated examples were cited by Mackreth as from Anglo-Saxon cemeteries: this example and another, from High Down, Ferring (with pin length virtually the same as the diameter of the brooch), which White suggests may have originally come from the Roman fort (White 1988, 15). It appears unlikely that production of this type continued into the post-Roman period. The iron pin may have been attached to the brooch in a late/post-Roman phase of continued use, as we see with another example of the same type worn at burial in the Lankhills cemetery at Winchester. It is then likely to have been lost and rediscovered, this is suggested by its final deposition in a bag group. Roman objects found in bag groups include both early and late Roman material and it is clear that these objects were mainly collected later by scavenging of Roman sites (see Swift 2012, 194–202 for a detailed discussion of evidence relating to reused Roman bracelets from Anglo-Saxon graves).

EVIDENCE FOR CONTINUED PRODUCTION IN THE POST-ROMAN/EARLY ANGLO-SAXON PERIOD

Type c2d2 has a date range of fourth century or later and, according to Mackreth, half the known examples of the type come from Anglo-Saxon cemeteries. We can perhaps see evidence of continued production in typological change, such as the widening of the ring of this type, and I agree with Mackreth and others (Leeds 1945, 44; White 1988, 25) that it is likely to have developed into the distinctively Anglo-Saxon series with wider, flat rings. The Girton brooch with an iron pin was analysed qualitatively by XRF and its composition was found to be gunmetal (Appendix 2), which is more common in the Anglo-Saxon than the late Roman period for copper-alloy objects (Blades 1999, 130; Bayley and Butcher 2004, 183–7). We can conclude that examples with iron pins at Fairford and Girton cannot be used as evidence of the extended life of late/sub-Roman objects.

EVIDENCE FOR REPAIR AND EXTENDED USE IN THE POST-ROMAN PERIOD

Types c2d1 and 6 Terminal d No Ears have date ranges of fourth century or later, and occur in significant numbers in Anglo-Saxon cemeteries (Mackreth 2011, 208, 219), and so are perhaps more likely to represent either continued production or survival above ground, rather than later collection. It can be noted that where data are available, pins for these types are similar in length to their ring diameter or only extend slightly beyond their rings, so there is no evidence in this respect of a continuing fifth-century developmental sequence (in contrast to some other late zoomorphic types, see Mackreth 2011, 215). The three examples with iron pins found at the

Anglo-Saxon cemeteries of Holywell Row, Barrington, and West Overton (see Table 1), possibly show the curation and survival above ground of late Roman objects.

Anglo-Saxon period production can probably be ruled out for types f1c, f1d, k2a, k3a, Type 6 Ears c, and 8, which occur in very low numbers in Anglo-Saxon cemeteries. A brooch of type f1c found at Lowbury Hill has no context date, but given the post-Roman activity at the site (Fulford and Rippon 1994, 201) a deposition date within the first half of the fifth century is possible. For Type 6 Ears c and Type 8 there is some further evidence of extended use beyond A.D. 400.

Type 8 brooches are probably late and post-Roman in manufacturing date, but not Anglo-Saxon (see also Mackreth 2011, 231; Snape 1992). The example of this type with an iron pin was found at Wroxeter, notable for its post-Roman strata, although it was not in a closely dated layer (Barker *et al.* 1997, 193). The pin was similar in length to the ring diameter, so arguably it was relatively early in the post-Roman series. It probably had an extended lifespan through repair. A fifth-century context for another repaired penannular of type 8 can also be noted here, at Piercebridge, though in this instance it is a silver brooch repaired with a copper-alloy pin rather than a copper-alloy brooch repaired with an iron pin (Cool and Mason 2008, no. 42[1516], 261–2).

Five examples of type 6 Terminals Ears c from dated contexts are listed by Mackreth, three from Roman sites (Caernarfon, early to mid-fourth century; Brancaster, fourth century to the end of occupation; Wroxeter, fifth to seventh century) (Mackreth 2011, 219). Mackreth notes two from Anglo-Saxon cemeteries: Lackford (a cemetery of the mid-fifth to mid-sixth century) and Brighthampton (a mid-fifth- to late sixth-century cemetery). Another example of the same type, with an iron pin, occurs in a destruction deposit over end-of-fourth-century levels at Keston (not in Mackreth's list; see Table 1). Investigating these 'Anglo-Saxon' contexts more closely, the item from Lackford (with an iron pin) is a stray find and probably comes from the earlier Roman settlement on the site (Lethbridge 1951, 3, 8). It was analysed qualitatively by XRF and was found to be leaded bronze (Appendix 2) — a composition more common for late Roman copper-alloy objects than for Anglo-Saxon objects, although leaded bronze is not very common for Roman penannular brooches in particular (Blades 1999, 130; Bayley and Butcher 2004, 183–7). The example from Brighthampton was found reused as a bracelet worn on the left wrist in an (undated) child's grave (White 1988, 17; 177). Burial of children with bracelets made from reused objects is seen in very late Romano-British contexts (see Swift 2012, 181). Parallels may be noted from Krefeld-Gellep, where a Romano-British penannular brooch probably reused as a child's bracelet (suggested by its position in the grave) came from a grave context dating to the first half of the fifth century (Swift 2010, 257–60), and Wattle Syke, where a penannular worn at burial as a bracelet occurred in a grave dating at the earliest to the last quarter of the fourth century and judged more likely to be early fifth century (Cool forthcoming). It may be, therefore, that the Brighthampton grave should be dated earlier than A.D. 450. We can conclude that type 6 Terminal Ears c is not likely to have continued in production in the Anglo-Saxon period and repairs with iron pins may be early in the post-Roman period.

EVIDENCE OF DRESSED BURIAL

Nine penannular brooches with iron pins came from grave contexts with information on the position of the material in the grave. Virtually all were worn at burial, the only exception was the Long Wittenham example in a bag group noted above. This forms a noticeable contrast with reused Roman bracelets from Anglo-Saxon cemeteries. The latter were mostly found in bag groups, were not concentrated in the earliest phases, and occured in graves with other randomly dated Roman material, and were thus concluded to represent later collection of Roman material (see Swift 2012). Considering the exact positions of the penannular brooches worn at burial, four were worn singly on the upper body (one of these in a Roman period grave at Lankhills), one was worn singly at the waist (it was associated with beads, and so perhaps had fallen with these from a higher position), and three were worn on the shoulder as one of a pair with another brooch, which we can note is a Germanic dress style. Brooches worn singly at the shoulder

are known from late Roman, post-Roman West, and Anglo-Saxon contexts (Collins 2010, 68; Walton-Rogers 2012, 184; White 1988, 25), although penannular brooches specifically worn in this way have been suggested to be particularly associated with post-Roman status display (Collins 2010, 68).

DISCUSSION

The best evidence for very late Roman or post-Roman repairs comes from Canterbury, Wroxeter and Keston. At Lankhills, the grave with the repaired penannular worn at burial is broadly dated to the fourth century, although there are some very late fourth- and early fifth-century burials from Lankhills (Booth *et al.* 2010, 461–2), so it is possible that it belongs to the very late phase, especially given the wider trend towards dressed burial in very late Roman graves (Swift 2010, 268–70). A number of other mainly Anglo-Saxon contexts, as discussed above, are suggestive of curation above ground, though the evidence is rather circumstantial. We can say, at least, that later rediscovery and collection is unlikely for some types on the evidence available.

In the cases where curation of extant Roman material seems probable, value for the item is demonstrated through the repair, which, given the crash in durable material culture production in the post-Roman period, is likely to indicate scarcity value. Penannulars produced in the late Roman period that survived beyond it might also be valued for their personal resonance as dress items associated with individuals, and/or as heirloom items, representing collective memories. In terms of the criteria proposed by Lillios for heirlooms (Lillios 1999, 242, 252), they are 'portable' and 'conservative in their general form over time', and some of those finally deposited in Anglo-Saxon graves could have been in circulation for several generations. In these contexts they could represent, then, family memories and descent (Lillios 1999, 243). It is important to note, however, the wider context of the general fashion for penannular brooches in the post-Roman/early medieval period (Collins 2010, 68). Older material may have been incorporated within this wider trend, superseding connotations of value that might have related to an 'heirloom' identity. Reused penannulars might therefore show, mainly, emulation of a prestigious dress style among those with poorer access to metal dress accessories, possibly in some instances alongside more personal meanings.

REWORKED GLASS SHERDS

The identification of reworked sherds is based on the observations of glass specialists, who have noted the presence of individual grozed or reworked fragments in site reports. It is likely therefore that more examples exist which have not been specifically noted in catalogued reports — especially as glass reports do not always contain detailed descriptions of each sherd. 93 reworked sherds were identified, which fall into two broad categories: firstly, roundels, made from reworked bases or, less commonly, from body sherds (about two-thirds of the total); and secondly, other fragments where one or more edges have been reworked — in most cases perhaps to create a sharp-edged tool, though there were also a handful of examples where a fragment including a handle had been reworked around the edges, as if the handle section was itself intended to be reused in some way. One of the roundels, from a first-century context at Old Winteringham, was pierced, perhaps for use as a spindle-whorl (Stead 1976, 245 no. 7). If we consider reworked sherds from dated contexts (Table 2), there are some from first- and second-century contexts, showing that reworking existed throughout the Roman period; numbers increase from third- and fourth-century contexts, including 15 from contexts dated more specifically to the mid-fourth century onward, plus a similar amount from Piercebridge which, although they did not have specific context dating, Cool observed were from deposits of the fourth century or later (presumably because of their site distribution and the occupation period of each Piercebridge site) (Cool 2008, 263). The production dates for the original glass vessels are mostly second to third century or first to third century, but as we will see below, an early production date does not by itself indicate an early date for reworking and reuse. The general distribution of the material is show in FIG. 3 and is widespread, with much material from the North-East.

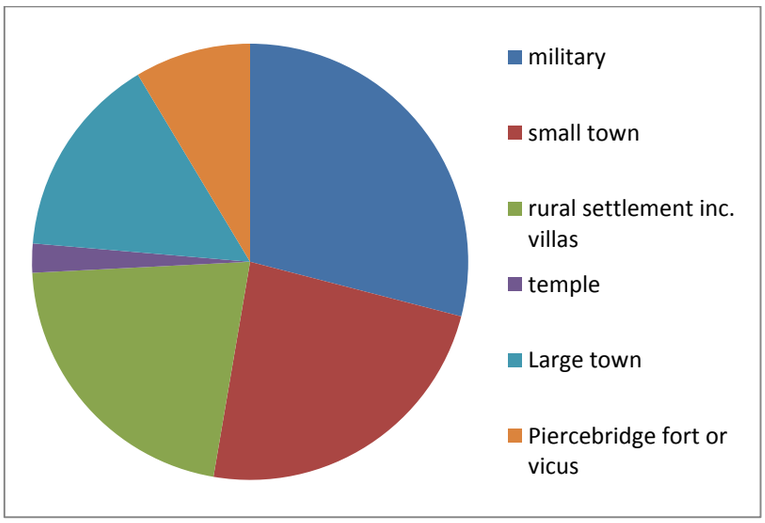
FIG. 3. Distribution of reworked Roman glass sherds. (*Copyright Ellen Swift and Lloyd Bosworth*)

Overall, the site-type distribution shows a bias to military sites and small towns (where sites encompassed both military areas and *vici*, objects could usually be assigned to one or the other by reference to the findspot, although this was not possible for all of the Piercebridge sites, and so unassigned Piercebridge sites have been indicated in a separate category) (FIG. 4a). Nine different military sites are represented. Of the small towns, Catterick and Piercebridge have been described as 'military towns' (Wilson 2002, 527). Most of the Piercebridge sherds whose exact location could be identified came from the *vicus* areas of the settlement. The example at the Caerleon *canabae* site came from a context which post-dated the military occupation of the adjacent site. The military sites are biased to the northern frontier zone, but other areas are also represented, for instance York and Caernarfon. Although there are examples of Roman glass sherds in Anglo-Saxon graves (e.g. Evison 1987, graves 15, 48 and 49; see also Harrington and Brookes 2008), none were described as grozed or reworked in Anglo-Saxon site reports. Large towns, usually the most prolific site-type, produced relatively few reworked sherds — fewer than the numbers at rural settlements. If the sherds are divided up into two categories — firstly, roundels made from bases or body sherds, and secondly, other reworked sherds — it can be seen that the reworked sherds that are *not* roundels are much more likely to come from a rural settlement than from any other site-type (FIG. 4b). Roundels made from bases or body sherds are correspondingly much more likely to come from a military or small town site, with Piercebridge in particular being strongly represented (FIG. 4c).

DISCUSSION OF REUSED GLASS SHERDS

Recycling of glass by collection and melting of scrap is well-known throughout the Roman period, and the decision instead to save and rework individual sherds shows a divergence in the way that broken material was valued, the sherd being valued not because it could be transformed again into a new vessel as is the case with collection and remelting, but because it could become a new artefact — from the evidence considered here, usually either a cutting tool, a handle, or a roundel (of arguable function, discussed further below). The notable bias to rural sites in the non-roundel material, taking into account the general scarcity of durable material culture on rural sites, points to the scarcity value of materials suitable for the making of cutting tools on these sites. The prosaic appearance and practical function of the reworked object, while not excluding a possible sentimental value attached to knowledge of its previous life, perhaps makes it less likely. The daily use of an item will cement its new, rather than former, identity in the user's mind.

Military sites and small town sites, by contrast, apparently valued not the sharp edges of glass fragments but the flat discs that could be made most easily from vessel bases. They may have had the same function as the similar pottery roundels (some made from bases) found throughout the Roman period on many sites. A variety of uses has been suggested for these, for instance smoothers for textile work, gaming counters, lids, or palettes (see e.g. Marsh 1981, 229; Ward 2008, 192). Price suggests use of glass bases as counters (Price 1994, 135); however, reworked glass roundels (and sometimes their pottery counterparts) are much bigger than the plano-convex gaming counters made specifically for this purpose. They seem to have had domestic uses, to judge by their presence within contexts from domestic buildings at Piercebridge, Dorchester Bypass and Birdoswald (Cool and Mason 2008, ID no. 598; Smith *et al.* 1997, 112 no. 4; Wilmott 1997, nos 66.304 and 4.635.37). The bias to military sites among the glass examples may be something to do with the choice or availability of material rather than the function of the object *per se*. Many were made from glass bottle bases, and one can envisage that commodities would have been transported in glass bottles to military sites on a larger scale than at many other site-types. The bottles themselves would have been reused many times as containers before breakage and reuse in other ways. The bias to military sites in reworked glass bases might also reflect particular military habits of collection and recycling of broken objects, and this seems likely, since recycling habits such as the collection of glass fragments for melting and recycling (cullet) can be particularly associated with the Roman army (Keller 2005, 66–7). Military habits of recycling are also suggested by the profile of our next object type, samian sherd spindle-whorls.



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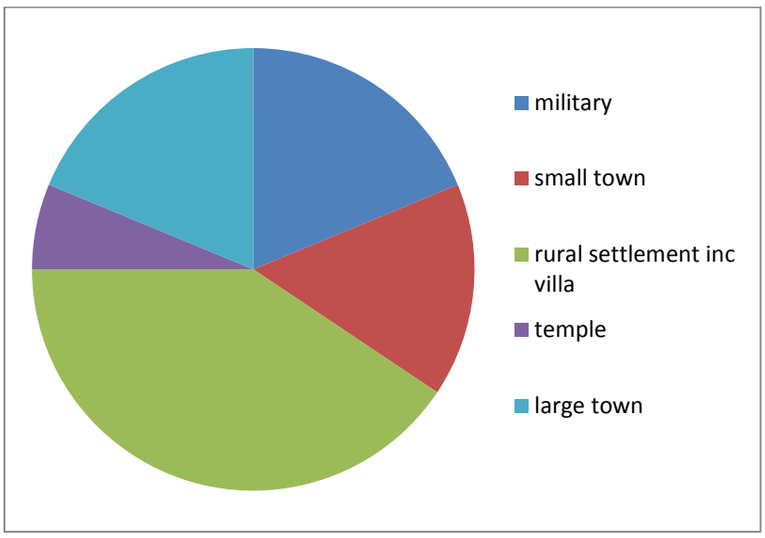

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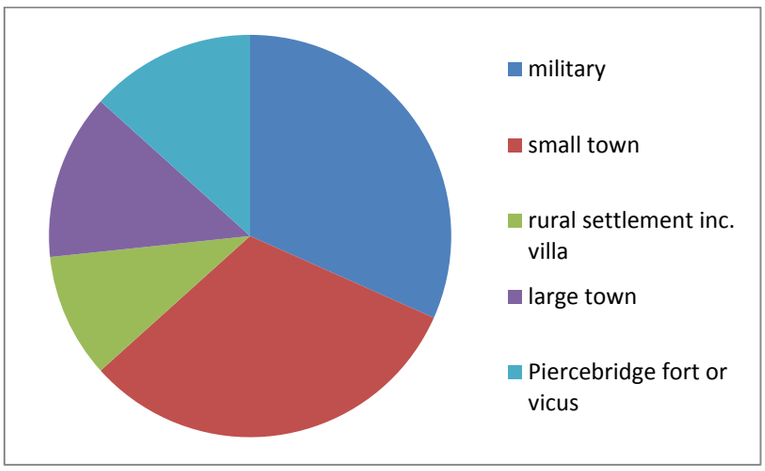

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FIG. 4. (a) Number of grozed Roman glass sherds by site-type; (b) Number of grozed Roman glass sherds by site-type excluding roundels. (c) Number of grozed Roman glass roundels made from base or body sherds by site-type. (*Copyright Ellen Swift*)

TABLE 2. Reworked Roman glass sherds from dated contexts

Site	**Reference**	**Context date (A.D.)**
Alcester extramural	Booth *et al.* 2002, no. 26	mid/late third to early fourth century
Binchester	Ferris 2010, no. 462	80-90
Binchester	Ferris 2010, no. 223	110/20-120/30
Binchester	Ferris 2010, no. 325	very late fourth to mid-fifth century
Birdoswald	Wilmott 1997, no. 4.635.77	350-400+
Birdoswald	Wilmott 1997, no. 66.304	350-400+
Birdoswald	Wilmott 1997, no. 82.1560	350-400+
Caerleon *canabae*	Evans 2000, no. 132	early fourth century or later
Caernarfon	Casey and Davies 1993, no. 66	late fourth century
Catterick Bypass	Wilson 2002, 20.2.2 no. 106	125 to later third century
Catterick Bypass	Wilson 2002, 20.2.2 no. 87	350/5-380+
Catterick Bypass	Wilson 2002, 20.2.2 no. 43	350/5-380+
Catterick Bypass	Wilson 2002, 20.2.2 no. 109	350/5-fifth century
Deansway	Dalwood and Edwards 2004, no. 23	Early second to mid-third century
Deansway	Dalwood and Edwards 2004, no. 21	Early second to mid-third century
Deansway	Dalwood and Edwards 2004, no. 6	post-Roman to early/mid-Anglo-Saxon
Dorchester Bypass	Smith *et al.* 1997, fig. 112 no. 4	third to fourth century
Frocester	Price, E. 2000, no. 74a	third century or later
Frocester	Price, E. 2000, no. 39	third to fourth century
Frocester	Price, E. 2010, no. 98(A201)	late third to fourth century
Frocester	Price, E. 2010, no. 46(A489)	mid-late third to fourth century
Housesteads	Rushworth 2009, no. 43	300-fifth century
Housesteads	Rushworth 2009, no. 49	300-fifth century
Lincoln defences	Jones *et al.* 1999, no. 88	late second to third century
Lincoln defences	Jones *et al.* 1999, no. 85	mid-late third century
Lincoln defences	Jones *et al.* 1999, no. 41	mid-fourth to early fifth century
Lincoln defences	Jones *et al.* 1999, no. 98	350-early fifth century
Lincoln defences	Jones *et al.* 1999, no. 96	350-early fifth century
London 1 Poultry	Hill and Rowsome 2011, fig. 33 no. 3789	45-53
London 1 Poultry	Hill and Rowsome 2011, fig. 93 no. 1093	*c.* 95-125
Old Winteringham	Stead 1976, no. 7	Neronian-early Flavian
Piercebridge	Cool and Mason 2008, ID no. 483	second century
Piercebridge	Cool and Mason 2008, ID no. 480	third to fourth century
Prestatyn	Blockley 1989, no. 20	70s-160
Prestatyn	Blockley 1989, no. 15	later third to fourth century
Prestatyn	Blockley 1989, no. 19	later third to fourth century
Prestatyn	Blockley 1989, no. 16	later third to fourth century
Prestatyn	Blockley 1989, no. 18	later third to fourth century
Prestatyn	Blockley 1989, no. 17	later third to fourth century
Uley	Woodward and Leach 1993, fig. 159 no. 5	mid-fourth century
Vindolanda	Bidwell 1985, no. 11	235-250/60
Wroxeter legionary fortress	Webster and Chadderton 2002, no. 221	Hadrianic

TABLE 2 (cont.). Reworked Roman glass sherds from dated contexts

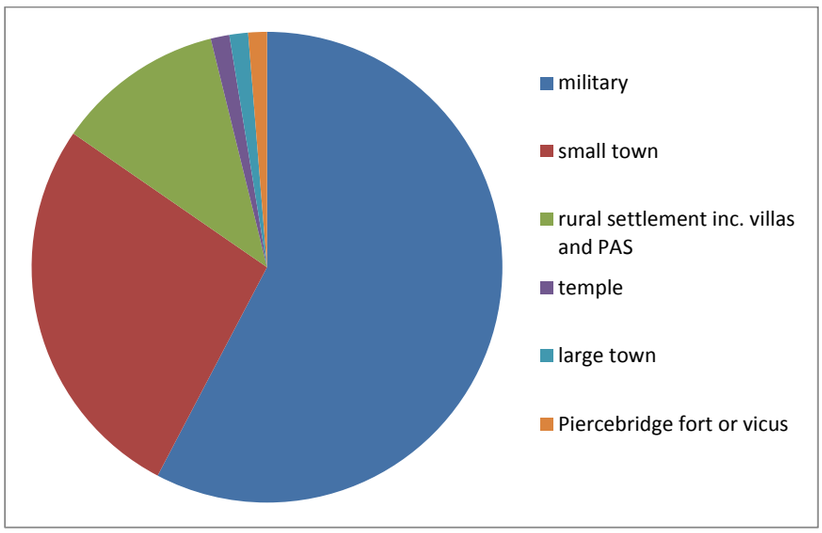
Site	Reference	Context date (A.D.)
Wycomb	Rawes 1980, no. 3	late Roman
York Blake Street	Cool *et al.* 1995, no. 6231	160-400
York Blake Street	Cool *et al.* 1995, no. 6233	after 280
York Blake Street	Cool *et al.* 1995, no. 6119	after 280
York Blake Street	Cool *et al.* 1995, no. 6092	360/400 to post-Roman
York Swinegate	Cool *et al.* 1995, no. 6449	late to post-Roman

SAMIAN SHERD SPINDLE-WHORLS

This category of material was first noted as a late phenomenon by Cool, in a paper that considers a range of objects characteristic of very late/post-Roman deposits in Britain (Cool 2000). In her table 7, Cool lists 17 examples in samian, along with a further 8 examples in orange-coloured fabrics, from well-dated contexts. Most of these, particularly the samian examples, are shown to be fourth-century, with a preponderance toward the late fourth (Cool 2000, 52–3, 60). To these can be added, mostly from site reports published since Cool's paper, a further 61 samian examples, including many additional instances from well-dated contexts, which further confirm the chronological pattern established by Cool (to be consistent with Cool's data collection methodology, an inclusive approach has been taken to categorisation, see Cool 2000, 52–3 commenting on Crummy's classification (Crummy 1983, 67)). Those from well-dated contexts are shown in Table 3.

At Piercebridge, although there are problems with establishing specific contexts and they have therefore not been included in the table, it is notable that four samian spindle-whorls came from the inner ditch, whose fill was deposited from the very late fourth to the fifth century at the earliest (Cool and Mason 2008, 308; samian table ID nos 44, 1144, 1185, and 967). Although there is a bias to late fourth- and early fifth-century contexts, for instance at Binchester (Ferris 2010, no. 25), very little evidence was found of samian spindle-whorls in later post-Roman or Anglo-Saxon contexts. There is one example from Cannington in a later sixth- to seventh-century layer. Although spindle-whorls made from reused Roman potsherds sometimes occur in Anglo-Saxon graves or at Anglo-Saxon settlement sites (e.g. Buckland Dover (Evison 1987, grave 60); Mill Hill Deal (Parfitt and Brugmann 1997, grave 18); West Stow (West 1985, 138, table 58)), none were found to be samian. One might also note that the context dates of Roman potsherd spindle-whorls from Anglo-Saxon sites do not cluster in the earliest phases of these sites (e.g. at West Stow they are found across the chronological range of SFBS, from early fifth to late sixth century or later, with more examples from the later buildings than the earlier ones (West 1985)). This suggests that Anglo-Saxon instances of reuse are from rediscovered objects rather than indicating a continuity of practice from the latest Roman cultural practices. Other types of Roman potsherd reuse at West Stow, such as that suggested by the high proportion of Roman pot bases found at the site, also increase in the sixth century and Plouviez suggests that the proportions indicate selection of already broken material (Plouviez 1985, 85).

The additional examples of samian spindle-whorls collected for the present paper also make it clear that there is a strong regional and site-type bias in the overall distribution of these objects (FIGS 5–6) towards military sites and especially those in the North. Combining Cool's data on samian spindle-whorls with new data, 58 per cent come from ten different military sites, while one might also note that the next most prolific site-type, small towns, with 27 per cent, constitutes four sites of which three also have military associations: the Caerleon *canabae* site, which produced a spindle-whorl from a deposit within the *vicus* contemporary with the occupation of the related legionary fortress (where sites encompassed both military areas and *vici*, objects could usually be assigned to one or the other by reference to the findspot); Piercebridge *vicus*, associated with the military site; and Catterick *vicus*, which has been suggested, on the basis of excavated evidence for a late military presence, to be a 'military town' (Wilson 2002, 527). Piercebridge alone produced 15 examples, more or less evenly distributed between the fort and



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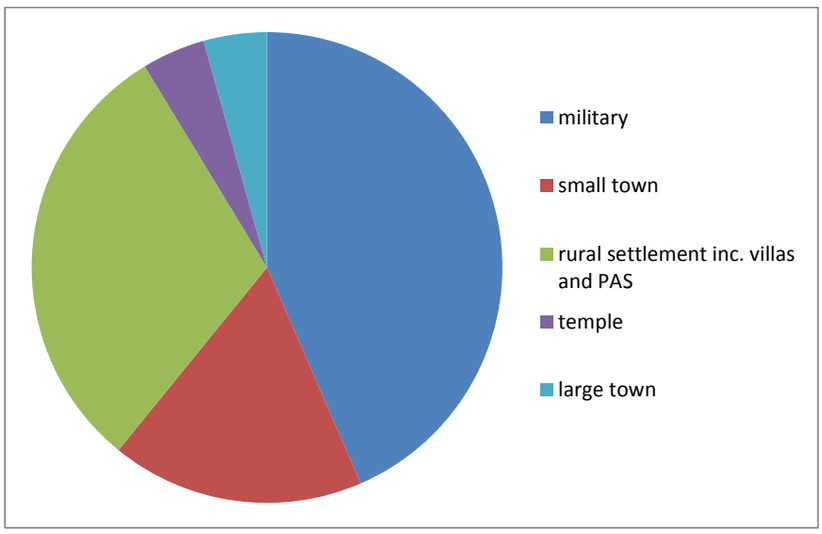

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FIG 5. (a) Number of samian spindle-whorls by site-type; (b) Proportions of the different site-types represented. (*Copyright Ellen Swift*)

vicus areas of the site. By contrast, only one samian spindle-whorl came from a large town site, which normally produce an abundance of all kinds of material and at which samian is relatively common (Willis 2006, 7.2.8). The military sites are mostly in the northern frontier zone, but the presence of Caernarfon and Caister-on-Sea illustrates that the trend extends to other military sites beyond this area.

DISCUSSION OF SAMIAN SPINDLE-WHORLS

Cool notes that on the basis of her collected evidence, it is difficult to say whether, in the late Roman period, the disproportionate occurrence of samian spindle-whorls (especially noteworthy considering the first- to third-century production period of samian) is due to choice of colour or choice of material (Cool 2000, 54). Non-samian examples in red fabrics, however, are shown in her table 7 to be of mostly early date. Although systematic data collection of sherd spindle-whorls in orange-coloured fabrics has not been undertaken for the present paper, other early examples could also be cited, such as three spindle-whorls made from orange-coloured sherds

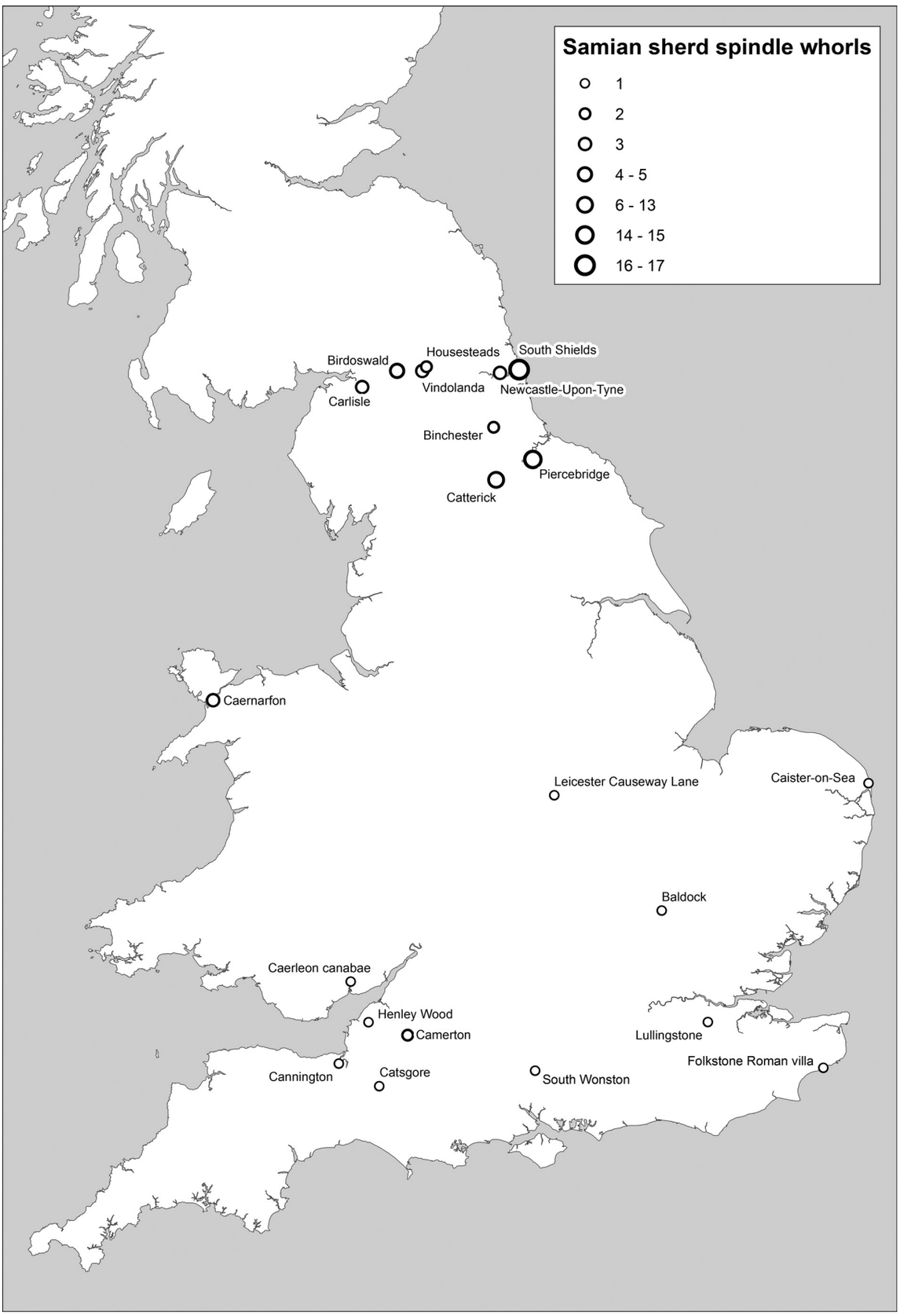

FIG 6. Distribution of samian sherd spindle-whorls. (*Copyright Ellen Swift and Lloyd Bosworth*)

TABLE 3. Samian sherd spindle whorls from well-dated contexts (also incorporating data from Cool 2000, table 7)

Site	**Reference**	**Context date (A.D.)**
Binchester	Ferris 2010, cat. no. 25	very late fourth to mid-fifth century
Binchester	Ferris 2010, cat. no. 21	350s-60s
Birdoswald	Wilmott 1997, no. 115.916.1496	290-350
Birdoswald	Wilmott 1997, no. 150.975.1403	after 350 to 400+
Birdoswald	Wilmott 1997, no. 116.917.1489	*tpq* 350
Birdoswald	Wilmott 1997, no. 118.2115.1521	350-400+
Birdoswald	Wilmott 1997, no. 111.633.84	350-400+
Caerleon *canabae*	Evans 2000 cat. no. 6	late second century
Caernarfon	Casey and Davies 1993, cat. no. 501	early-mid-fourth century
Caernarfon	Casey and Davies 1993, cat. no. 499	late fourth century
Caernarfon	Casey and Davies 1993, cat. no. 502	late fourth century
Caister-on-Sea	Darling and Gurney 1993, cat. no. 322	*tpq* early third century
Camerton	Wedlake 1958, cat. no. 9	180-350
Cannington	Rahtz *et al.* 2000, cat. no. FC127	later sixth to seventh century
Carlisle	Howard-Davis 2009, fig. 293.2	early third to late third/early fourth century
Catsgore	Leech 1982, 175, from feature 401	after 320
Catterick Bainesse	Wilson 2002, 19.2 no. 5	200/220-400+
Catterick Bypass	Wilson 2002, 19.1.4 no. 35	350/5-380+
Catterick Bypass	Wilson 2002, 19.1.4 no. 34	380+ to fifth century
Catterick Bypass	Wilson 2002, 19.1.4 no. 39	350/5-380+
Catterick Bypass	Wilson 2002, 19.1.4 no. 38	125-later third century
Henley Wood	Watts and Leach 1996, fig. 93 no. 102	after 364
Housesteads	Rushworth 2009, no. 540	?late fourth century
Housesteads	Rushworth 2009, no. 541	mid-late fourth century
Newcastle-upon-Tyne	Snape and Bidwell 2002, no. 160	late third to mid-fourth century
Piercebridge	Cool and Mason 2008, samian table ID no. 3776	first quarter of second century
Piercebridge	Cool and Mason 2008, samian table ID no. 3157	third to fourth century
Vindolanda	Bidwell 1985, MF1:G9 no.1	*c.*235
Vindolanda	Bidwell 1985, MF1:G9.no.4	*c.*275-300
Vindolanda	Bidwell 1985, MF1:G9 no.3	mid-fourth century

in first-century contexts at Keston (Philp *et al.* 1991, nos 48, 49 and 50). The strong military associations of the later samian examples, documented above, suggest that the occurrence of samian spindle-whorls in late contexts stems instead from something very specific concerned with military use of or access to samian fabrics in particular in this period. Willis (2006, 7.2.8) shows that in general samian is more frequent on military sites and military *vici* than any other site-type. Ward suggests, based on extensive evidence for repair and reuse (not only samian spindle-whorls, but also counters, bases, cut-down vessels, and riveting), that there was a workshop for the repair and reworking of samian in the *vicus* associated with the military site at Piercebridge (Ward 2008, 193) and this might be a more widespread phenomenon at military and *vicus* sites where samian was relatively abundant. Wallace studies the general phenomenon of samian

occurrence in phases later than the period of manufacture, and he cites four examples of sites where samian occurs even though the site was founded after the end period of manufacture of samian: Lympe, Portchester, Filey and Corbridge — all military sites, Corbridge later becoming a small town. At Corbridge, an assemblage of samian vessels was found in association with a fourth-century coin hoard. Although the context dating has been debated (see e.g. Forster 1908, 250–1; Haverfield 1910), this 'pottery shop' is now accepted to show the likely survival of complete second-century samian vessels into the fourth century (Wallace 2006, 266). It seems likely that more samian was extant at military/former military sites than at other types of site in the fourth century, and it is also possible that there might have been more systematic arrangements for recycling samian at military and military *vicus* sites. If that was the case, the evidence would represent not individual, personal decisions to curate particular, valued objects, but collective behaviour because the reworked objects had an externalised value independent of the particular object from which they were made. Their economic value would be lower than that of the original object and it is likely that the objects would be circulating among a different user-group, who might nonetheless value the wider social or cultural connotations of the material itself. The occurrence of samian and samian objects on military sites in the late Roman period may have led to a shift in associations in which samian items were mainly perceived and valued as culturally 'military', alongside any externalised value attributed to them as new objects with a practical function. Possibly coincidental, but rather suggestive of military connotations, a sherd fragment decorated with a figure of Victory had been selected for one of the samian spindle-whorls from Piercebridge (Cool and Mason 2008, ID no. 4181).

CONCLUSIONS

We can see from the evidence assembled above, and from my previous work on reused bracelets, that certain reused objects, although not exclusive to the late to post-Roman transition period, can be particularly associated with it. The site at Piercebridge is particularly significant, as here we see combined evidence of all the types of artefacts discussed: samian spindle-whorls, reworked glass vessel sherds, and a repaired penannular brooch; and in addition, many fragmentary and distorted Roman bracelets (see Swift 2012, 186–8). Although there are problems with reconstructing context details at this site, some of this activity at least can be associated with very late/post-Roman levels and the apparently intensive nature of the recycling can most readily be associated with the scarcity value created through a collapse in the availability of durable material culture in this period. This tallies with wider suggestions that reuse as a phenomenon on archaeological sites is typical of prolonged site abandonment phases (Deal and Hagstrum 1995, 124). Yet it is also apparent that, taking all the sites and material into account, there is widespread diversity in the nature and duration of reuse and the possible meanings that can be attached to it. Reworked glass and pottery objects have been completely transformed in function and may have been valued mainly as new objects, although the cultural associations of the material from which they were made may have been significant. Scarcity value for reworked glass sherds other than roundels may stem from the poor availability of certain materials on rural sites instead of, or in addition to, late Roman collapse. Reworked glass roundels and spindle-whorls made from samian are a particular feature of military sites, especially in the Roman North, and may be related to particular regional and social practices of curation. The reworking of samian, in particular, may have been systematically organised workshop production, suggesting the obliteration of the personal associations and memories connected to individual objects, and reworked samian objects might instead have developed culturally 'military' associations. There seems very little evidence of the survival of reworked glass bases and samian spindle-whorls above ground beyond the late to post-Roman transition phase. As the use of similar functional objects is still seen at this time — spindle-whorls, for instance, are a common Anglo-Saxon artefact — they may have been discarded following a gradual erosion of any cultural meanings rather than because of changes in practice.

By contrast to the glass roundels and samian spindle-whorls, in general reused bracelets — whether smaller rings or distorted and flattened material — are not common on military sites

or in the northern military zone and apparently have a more dispersed distribution with many on rural sites (though the smaller quantity of PAS data for the non-metal categories makes distributions less easy to compare). As dress accessories associated with the body, they can be suggested to have possibly been significant for the personal and collective memories attached to them. Those repaired penannular brooches that can be suggested to be curated objects surviving from the late Roman period, show slight indications of being a later phenomenon than reused bracelets and thus a possible heirloom status could be considered, though they must also be seen within the continuing traditions of penannular brooch-wearing in the post-Roman period which confers on them a double identity, simultaneously 'old' and 'new'.

APPENDIX 1

Complete list of reworked Roman glass sherds and samian spindle whorls (the complete list of penannular brooches is given in Table 1).

REWORKED ROMAN GLASS SHERDS

Alcester, Booth *et al.* 2002, no. 26; Beadlam, Neal 1996, nos 25, 46 and 99; Binchester, Ferris 2010, nos 223, 298, 325, 462, 463 and 464; Birdoswald, Wilmott 1997, nos 4.635.77, 26.846.1338, 42.205, 43.1, 66.304 and 82.1560; Caerleon *canabae*, Evans 2000, no. 132; Caernarfon, Casey and Davies 1993, no. 66; Caldecote, Zeepvat *et al.* 1994, no. 155; Catterick Bypass, Wilson 2002, 20.2.2 nos 43, 87, 106 and 109; Deansway, Dalwood and Edwards 2004, nos 6, 21, 22 and 23; Dorchester Bypass, Smith *et al.* 1997, fig. 112 no. 4; Exeter, Holbrook and Bidwell 1991, nos 65 and 66; Frocester, Price 2000, nos 39, 74a and 82 and Price, E. 2010, nos 25(18), 46(A489), 62(A2) and 98(A201); Housesteads, Rushworth 2009, 43 and 49; Lincoln defences, Jones *et al.* 1999, nos 41, 85, 86, 88, 96 and 98; London 1 Poultry, Hill and Rowsome 2011, fig. 33 no. 3789 and fig. 93 no. 1093; Lullingstone, Meates 1987, fig. 55 no. 358; Old Winteringham, Stead 1976, no. 7; Piercebridge, Cool and Mason 2008, ID nos 46, 47, 48, 126, 145, 227, 307, 340, 383, 384, 386, 480, 483, 582, 598, 616, 618, 619, 630, 671 and 707; Prestatyn, Blockley 1989, nos 15, 16, 17, 18, 19 and 20; South Shields, Allason-Jones and Miket 1984, no. 4.20; Uley, Woodward and Leach 1993, fig. 159 no. 5; Vindolanda, Bidwell 1985, nos 11, 26a and 84; Wanborough, Anderson *et al.* 2001, no. 59; Wroxeter legionary fortress, Webster and Chadderton 2002, nos 15, 194, 135 and 221; Wycomb, Rawes 1980, no. 3; York Blake St., Cool *et al.* 1995, nos 6092, 6119, 6231 and 6233; York Swinegate, Cool *et al.* 1995, nos 6437 and 6449.

SAMIAN SPINDLE-WHORLS

Baldock, Stead and Rigby 1986, no. 702; Binchester, Ferris 2010, nos 21 and 25; Birdoswald, Wilmott 1997, nos 111.633.84, 115.916.1496, 116.917.1489, 118.2115.1521 and 150.975.1403; Caerleon *canabae*, Evans 2000, no. 6; Caernarfon, Casey and Davies 1993, nos 499, 501 and 502; Caister-on-sea, Darling and Gurney 1993, no. 322; Camerton, Wedlake 1958, nos 9 and 19; Cannington, Rahtz *et al.* 2000, no. FC127; Carlisle, Howard-Davis 2009, fig. 293 nos 2, 10 and 11; Catsgore, Leech 1982, p. 175 from feature 401; Catterick Bainesse, Wilson 2002, 19.2 nos 4 and 5; Catterick Bypass, Wilson 2002, 19.1.4. nos 31, 32, 33, 34, 35, 36, 37, 38, 39, 40 and 41; Folkestone, CAT and CCU 2012, labelled 'Samian Spindle Whorl'; Henley Wood, Watts and Leach 1996, fig. 93 no. 102; Housesteads, Rushworth 2009, nos 540 and 541; Leicester Causeway Lane, Connor and Buckley 1999, no. 133 SF4529; Lullingstone, Meates 1987, fig. 29 no. 39; Newcastle-upon-Tyne, Snape and Bidwell 2002, nos 160, 167 and 168; Piercebridge, Cool and Mason 2008, samian table ID nos 31, 44, 967, 1144, 1183, 1185, 1212, 2021, 2445, 3157, 3776, 3991, 4181, 4514 and 4587; South Shields, Allason-Jones and Miket 1984, nos 9.10, 9.11, 9.12, 9.13, 9.14, 9.15, 9.16, 9.17, 9.18, 9.19, 9.20, 9.21, 9.22, 9.23, 9.24, 9.25 and 9.26; South Wonston, Worrell 2003 PAS HAMP2952; Vindolanda, Bidwell 1985, MF1.G9 nos 1, 3 and 4.

APPENDIX 2

XRF analysis results for two Roman-style penannular brooches with iron pins are listed below. The analysis was carried out by the author using a Niton XL3T XRF analyser on the unprepared surfaces of the brooch. Although numerical values are given below for completeness, results should be treated qualitatively rather than quantitatively as surface corrosion products can affect accurate recording. Alloys were categorised according to table 5 in Bayley and Butcher (2004, 14). Only the major alloying elements for copper alloys are given.

Reference	Cambridge Museum of Archaeology & Anthropology accession no.	Cu %	Sn %	Zn %	Pb %	Alloy type
Girton: White 1988, fig. 5 no. 1	Z242322	73.74	12.45	9.20	2.20	Gunmetal
Lackford: White 1988, fig. 7 no. 3	1950.241.2	70.22	18.44	0.11	9.85	Leaded bronze

ACKNOWLEDGEMENTS

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