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Charting the effects of plough damage using metal-detected assemblages

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Many thousands of metal objects are retrieved from arable fields every year, by casual discovery or by treasure-seekers with metal-detectors. What is the status of this material? Here a senior archaeologist and a metal-detectorist get together to demonstrate scientifically the hostile context of the ploughsoil and the accelerating damage it is inflicting on the ancient material it contains. Their work raises some important questions about the 'archive under the plough': is it safer to leave the objects there, or to take advantage of a widespread hobby to locate and retrieve them?

Keywords: metal-detecting, ploughzone, Anglo-Saxon artefacts

Introduction

The exceptional quality and wealth of the Staffordshire hoard (see Editorial in *Antiquity* 84: 295–6) has highlighted the importance of the Treasure Act in facilitating the reporting of finds of portable antiquities in England and Wales. We should not ignore, however, the more mundane objects reported on a day-to-day basis which can also throw light on past societies and, as this paper seeks to demonstrate, on the depositional history of artefacts.

The archaeology of the ploughzone is an important area of study (e.g. Schofield 1991) and archaeologists are well aware of the damage done to stratified archaeological deposits by modern agricultural practices (e.g. Lambrick 1977, 1980, 2004; Hinchliffe & Schadla-Hall 1980). Most mitigation strategies, however, have focused on lessening the damage to monuments rather than assemblages (e.g. Oxford Archaeology 2006; Oxford Archaeology & Cranfield University 2010). There has been some research into the effects of plough disturbance on artefacts, although most previous studies of such attrition have been concerned with mechanical or chemical damage to pottery (Reynolds 1988, 1989; Boismier 1997) and, in a few cases, bone, while for metalwork most work has started from the issue of how arable agriculture has resulted in changes in the chemical stability of objects and has not looked at mechanical damage (Fjaestad *et al.* 1997; Scharff & Huesmann 1997; Wagner *et al.* 1997; Gerwin & Baumhauser 2000; Pollard *et al.* 2004; Ullén *et al.* 2004).

McLean and Richardson (2007) have discussed whether detected Anglo-Saxon brooches are accidentally lost or represent deliberate deposition, based on the composition of the detected assemblage over southern England in comparison with the excavated assemblage.

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Chester-Kadwell (2009: 76–7) has compared excavated and detected brooches in Norfolk and reviewed the literature on aspects of ploughzone taphonomy as it relates to metal-detected artefacts.

Metal-detecting is often portrayed as an activity which destroys archaeology (Dobinson & Denison 1995; Oxford Archaeology 2009; Thomas & Stone 2009). However, comparison of the condition of stratified excavated and metal-detected artefacts recovered from the ploughsoil allows us to chart the effects of plough damage on portable antiquities. Instead of being a cause of damage to archaeology, metal-detecting has the potential to provide new data to help us understand the processes at work in the agricultural destruction of the archaeological record.

Anglo-Saxon pins and strap-ends

Copper-alloy artefacts comprise the majority of finds made by detector users although they are frequently recovered in a fragmentary state. The VASLE project identified that 85 per cent of Anglo-Saxon finds recorded in the Portable Antiquities Scheme database were copper alloy (Richards *et al.* 2009: 3.2, fig. 61). In the present study, attrition to two groups of Anglo-Saxon copper-alloy dress fittings, namely pins and strap-ends, was quantified and demonstrated to result largely from farming practices. The choice of pins and strap-ends rests, on the one hand, from them being ubiquitous and numerous finds on Middle Saxon sites across the country and also through the availability of comprehensive records of long-standing detector surveys of several sites of the period in the East Riding of Yorkshire and one in West Yorkshire.

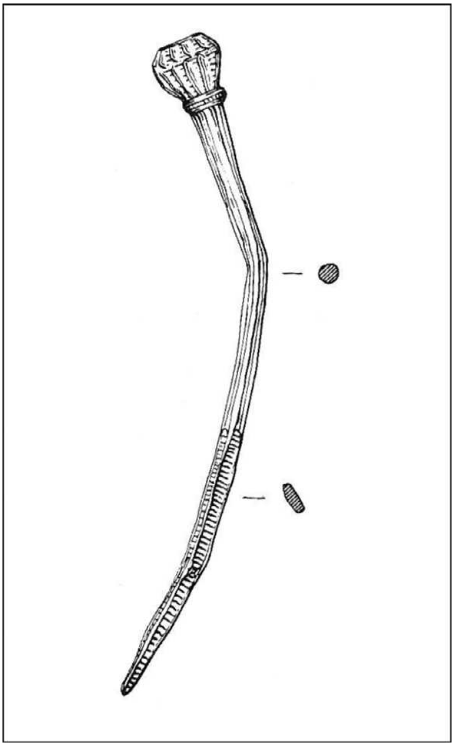

Figure 1. Cottam B Anglo-Saxon pin, bent as a result of plough damage (length: 76mm).

In the case of the pins, the process was found to be observable on two sites over two to three decades. The pins studied here date from the later Middle to Late Anglo-Saxon periods (*c.* AD 800–1000), and divide into the following broad categories of head form: faceted, biconical, globular and flat (largely disc or rhomboid) (Haldenby & Richards 2009). Other groups of Anglo-Saxon pins are not included, each predating the study group and being far less numerous. These comprise those from early burials, often with plain disc or spiral heads, and the large eighth-century chip-carved and gilded forms. Suggestions as to the function of Anglo-Saxon pins largely derive from the presence of the earlier types around the upper torso of early Anglo-Saxon female inhumation burials and include their possible use in the pinning of veils, lightweight scarves, shawls and headbands, or for holding up plaited hair (Figure 1).

Table 1. Pin condition: comparison of detected and excavated sites.

Detected	Number	% complete	Excavated	Number	% complete
Cottam A	21	10%	Hamwic	155	83%[2]
Cottam B	79[1]	15%	Winchester	11	100%
South Newbald	144[1]	14%	York (Fishergate)	21	91%
Cowlam	23	17%	Cottam B	7	86%
'Near Pocklington'	41	26%	Flixborough	238	77%[2]
TOTAL	**308**	**16%**	**TOTAL**	**432**	**81%**

[1] Based on finds for which images were available
[2] Estimated where unclear from published report

The strap-ends studied are widely considered to be ninth century and all share certain features, including: a double-pierced split end to receive the strap; a leaf motif below this; a decorated central panel; and a modelled animal head at the terminal (Figure 2). Function is again uncertain and, as Thomas (2003) summarises, uses probably included the terminals of girdles and garters or bag and satchel straps.

To establish the overall degree of any damage to material in the ploughzone requires reference to undisturbed deposits. Five excavated assemblages: Hamwic (Hinton 1996), Winchester (Biddle 1990), Fishergate, York (Rogers 1993), Cottam B (Richards *et al.* 1999) and Flixborough (Evans & Loveluck 2009), were compared with five metal-detected assemblages: Cottam A and B (Richards *et al.* 1999, in prep), South Newbald (Leahy 2000), Cowlam (Richards *et al.* in prep) and a fifth site whose location is currently being kept secret to preserve it from unauthorised nighthawks, and which will simply be described as 'Near Pocklington'. Since data is available on strap-ends (but not pins) from a further metal-detected site, 'Near York' (also unidentified for the same reason), this is included in the comparison of strap-end condition, along with information on a sixth excavated site, 'York (other)' which in fact includes strap-ends from a number of excavations in that city.

Loss or breakage?

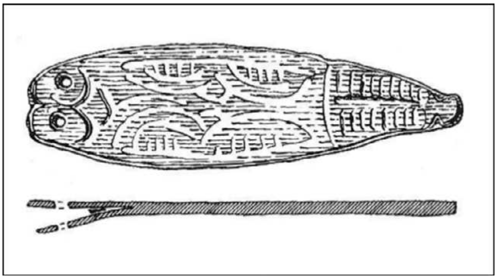

Figure 2. Cottam B Anglo-Saxon strap-end (length: 50.5mm).

Table 1 compares the number of pins with complete shanks from metal-detection and excavation, and shows that most damage to pins occurs following entry into the ploughzone. By virtue of their slender shanks, pins are highly susceptible to mechanical disturbance and this leads to failure as a result of accelerated chemical corrosion in the increased aerated environment. By contrast, pins from excavated contexts are relatively complete, which demonstrates that, more often than not, deposition occurred as a result of accidental loss or the discard of complete objects, rather than being thrown away due to breakage. Although metal-detectors were used to enhance

Table 2. Bent pins: comparison of detected and excavated sites (complete pins only).

		No.	% with > 10° bend	Average %	Average bend	Overall average bend
Detected	Cottam B	11	46%		90°	
	South Newbald	18	78%	64%	59°	81°
	'Near Pocklington'	13	62%		127°	
Excavated and in context	Hamwic[1]	47	21%		47°	
	Flixborough	120	32%	34%	45°	47°
	(York) Fishergate[1]	17	76%		52°	
	Cottam B	6	67%		31°	

[1] Measurements based upon published illustrations rather than actual pins or photographs

Table 3. Strap-end condition: comparison of detected and excavated sites.

Detected	Number	⩾95% complete	Excavated	Number	⩾95% complete
Cottam A	11	55%	Hamwic	12	83%
Cottam B	37	53%	Winchester	10	90%
South Newbald	31	33%	York (Fishergate)	4	75%
Cowlam	8	50%	York (Other)	12	75%
'Near Pocklington'	11	73%	Cottam B	3	100%
'Near York'	27	16%	Flixborough	14	50%
TOTAL	**125**	**42%**	**TOTAL**	**55**	**76%**

recovery levels at two of the excavated sites (Cottam B and Flixborough) this will only have increased the recovery of smaller broken pieces, rendering the comparison even more striking.

During early ploughing episodes pins may become bent as a prelude to snapping. Therefore there is a higher proportion of bent pins and a greater degree of bending in complete detected pins compared with complete excavated examples (Table 2). In the case of many of the metal-detected examples, cracked patina at the bend further points to modern damage which, due to metal fatigue, represents a point of weakness at which breakage is more likely to occur upon subsequent agricultural disturbance.

Strap-ends are more robust and the results are not as clear-cut, although as Table 3 demonstrates they also show varying degrees of plough damage, as evidenced once again by the relatively intact nature of the excavated material. Since it is clear from repaired examples that strap-ends sometimes remained in use following damage, the comparison here between detected and excavated finds was of the percentages of examples that were at least 95 per cent complete. As with the pins, it would appear that the frequently intact nature of excavated strap-ends is evidence of their loss, more often than discard due to breakage.

One can easily envisage the loss of large numbers of pins having resulted from their insecure means of attachment but the mechanism by which, consistently across Middle Saxon sites, the loss of large numbers of securely attached strap-ends occurred is less obvious. This is unless, as Hinton envisaged (1996: 37), many were in fact stitched, perhaps following the loss or removal of the rivets (after strap breakage probably at the junction with the strap-end) or even from the outset. Evidence of this can be seen in the majority of strap-ends,

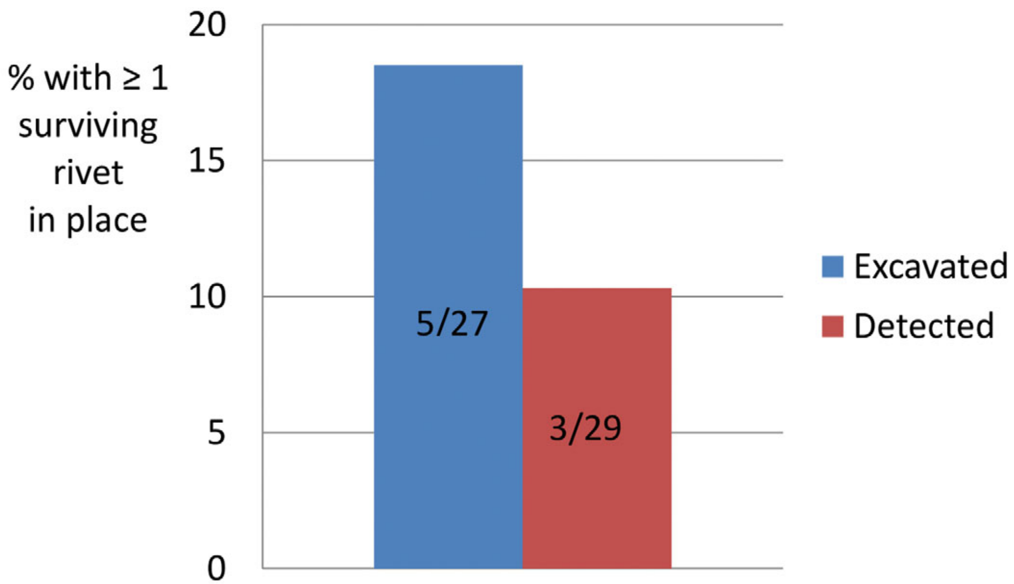

Figure 3. Strap-ends: the presence of rivets.

Table 4. Detected sites: average pin shank length and strap-end % completeness.

	Pins		Strap-ends	
	Number	Average shank length	Number	Average % completeness[1]
Cottam A	21	167mm	11	77%
Cottam B	90	192mm	37	75%
South Newbald	147	147mm	31	74%
Cowlam	23	250mm	8	79%
'Near Pocklington'	41	251mm	11	87%

[1] Estimated proportion based on nearest 10% for each strap-end

whether detected or excavated, having no rivets (Figure 3). This scenario would make the loss of a strap-end no less understandable than that of a button whose gradually loosening stitching was not attended to in time.

The degree of fragmentation of the pins and strap-ends on each site surveyed by detector was also examined. This was undertaken for pins by calculating the average remaining shank length and for strap-ends by calculating the average completeness in percentage terms.

As Table 4 demonstrates there are variations in levels of plough damage between sites, no doubt depending on various factors including a site's soil type or particular agricultural history, and these will be explored below. On individual sites these factors appear to have affected both the pins and strap-ends to a similar extent. Hence, for example, we find that at 'Near Pocklington' and Cowlam both artefact groups show relatively less damage whilst at South Newbald both groups show more damage.

Irrespective of agricultural circumstances, the process of post-depositional artefact attrition can, on occasion, be seen to begin as soon as loss has occurred (Lambrick 1984;

Table 5. Flixborough: excavated pins.

Where found	Number	% complete[1]	Average shank length[1]
In context	162	83.3%	494mm
Unstratified	76	64.5%	415mm

[1]Estimated where unclear from published report

Needham & Spence 1996). Immediate breakage may result from trampling by people or larger domestic animals, as well as when an object is displaced from its original context (by subsequent habitation; the action of burrowing animals, wind or water action etc.), whether in antiquity or more recently. When the unstratified pins from Flixborough (Evans & Loveluck 2009) are compared with those recovered in context the latter are seen to be, on average, more complete with significantly longer surviving shanks than the unstratified pins. The unstratified finds include those recovered from the spoilheap and the ploughsoil and the proportion of complete pins reflects a position which is partway between a stratified and a metal-detected assemblage (Table 5).

Damage through time

So far this study has drawn on total numbers within groups of objects and does not rely on the sequence in which they were recovered. Full finds records, including approximate dates of recovery, exist for sites Cottam B and South Newbald, surveyed for 23 years and 30 years respectively. For these sites it is therefore possible to observe whether fragmentation has increased over time. In both cases the same detector users, using the same machines, have been involved from the outset, removing one possible source of bias, as there will have been no increase over time in the ability to find smaller fragments. It might still be argued, however, that strong signals are more easily discerned and at greater depth than smaller ones and so larger, complete artefacts are generally found before fragments. This could, mistakenly, give the impression of incremental plough damage but cannot easily be separated out.

Perhaps uniquely, one class of object, once again the humble dress pin, does make this possible by virtue of the fact that the pin shank which, as we have seen, is a sensitive indicator of plough damage, does not greatly add to a pin signal which is produced largely by the head with its relatively concentrated mass. This arises out of the fact that slender copper alloy rods (i.e. shanks) emit a very weak signal in the case of most detectors. Personal experience of detector users and the recovery of very few detached pin shanks demonstrates this well, although there has been no quantified published study into this and other related phenomena. Various people have investigated (Crowther 1981; Barber 1990; Garrett 1991) or speculated about (Gregory & Rogerson 1984: 180; Pestell 2005: 171, n. 22) the efficacy of different detector machines and the experience of metal-detectorists in picking up particular sizes and shapes of object at different depths. Metallic artefacts from wet-sieved topsoil have also been compared with those from metal-detecting (Watt 2006: 145) to inform an understanding of the processes of recovery, but there is a pressing need for more up-to-date and comprehensive research into recovery bias.

With the above collecting bias in mind only pin heads of a similar order of size were included in this part of the study. Disc headed and flattened faceted head forms (mallet

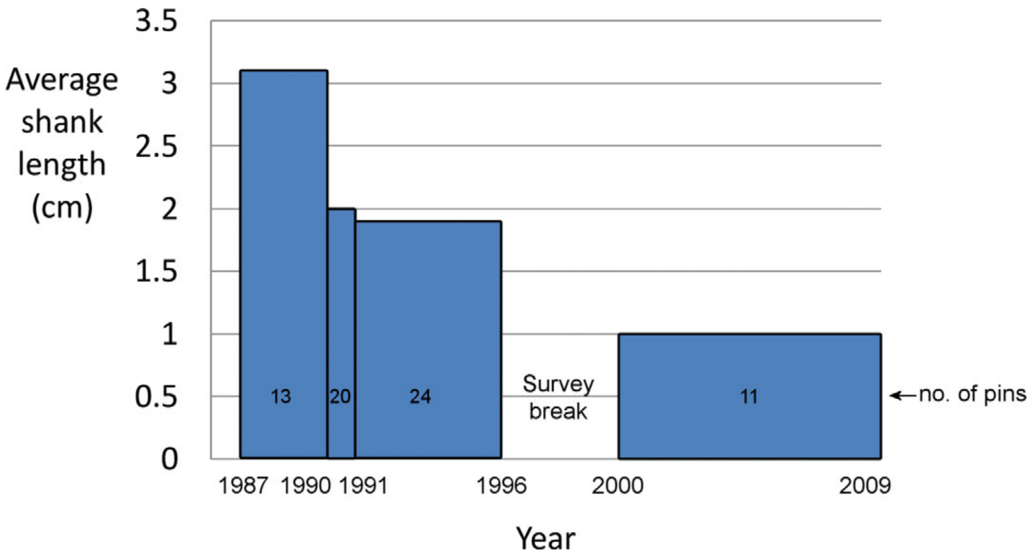

Figure 4. Cottam B: average pin shank length over time.

Table 6. Cottam B and South Newbald: average shank length.

	Pins		Large heads excluded		Large heads only	
	Number	Average length	Number	Average length	Number	Average length
Cottam B	90	192mm	68	202mm	22	166mm
South Newbald	147	147mm	137	151mm	10	95mm

heads) were omitted as it was observed that their larger head size had indeed led to most of these being found earlier in the recovery sequence. Their inclusion would have meant that we were not comparing 'like with like' and it could have been assumed that larger heads would have stouter and so better surviving shanks, interfering once again with, and inflating, any indications of plough damage.

In fact, as Table 6 demonstrates, pins with larger heads at Cottam B and South Newbald have shanks that are, on average, shorter than the remainder. Whilst these remain relatively intact up until entering the ploughzone, from this moment on they probably experience greater mechanical stresses due to their larger heads presenting more resistance and so preventing the pin from moving through soil experiencing ploughing and/or compaction. This is taken as evidence that, not surprisingly, as artefacts increase in size so too do the mechanical forces which they experience and increased fragmentation results.

It follows that any observable reduction in average pin shank length over time has resulted from plough damage. Figures 4 and 5 illustrate this at both Cottam B and South Newbald although a reversal in decline in phase 2b at South Newbald is apparent (albeit average shank lengths do not return to original levels). An increase at South Newbald during the final survey phase in the number of shanks with slightly less damage (20–40mm), rather than of complete pins, is the cause of this rise and suggests an episode of deeper ploughing

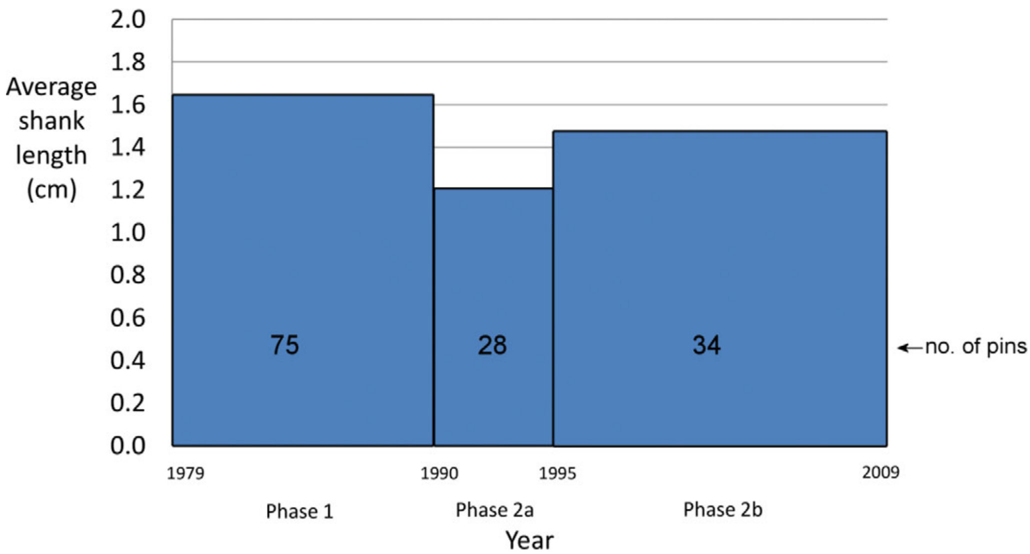

Figure 5. South Newbald: average pin shank length over time.

down into levels previously disturbed, albeit less frequently than the uppermost layers. The initial pin lengths at Cottam B suggest that at this site an even deeper ('para ploughing') episode disturbed archaeological deposits not long before survey began.

That ploughing on parts of the Yorkshire Wolds might only as late as the mid 1980s have disturbed large amounts of material from archaeological deposits is not surprising. The historical avoidance there of deep-ploughed potato crops and a shallow ploughing tradition (around 150mm) will have left much of the archaeology of the region relatively undisturbed well into the twentieth century (Harwood Long 1969: 32).

Despite the high initial figure at Cottam B the average pin shank length on this site during the final survey phase is significantly lower than at South Newbald and since there is no obvious difference between how each has been continuously cultivated the explanation is likely to have more to do with varying soil types. Pins moving during ploughing in the sandy soil of South Newbald would certainly experience less resistance and consequent leverage than those in the chalk-laden boulder clay of Cottam B and greater fragmentation on the latter site is the likely outcome. Although this paper has focused upon mechanical damage one might also note, however, that an acid sand is more likely to attack metal than an alkaline chalk.

Table 7 summarises the main factors, including those mentioned above, that have affected the extent and rate of fragmentation of pins and straps-ends on the detected sites included in this study.

Conclusion

With the recent burgeoning of studies into metal-detected artefacts in Britain, Scandinavia and elsewhere, there is a need for work on how metal artefacts enter the ploughsoil from archaeological deposits, and how changes in composition, condition and movement

Table 7. Comparative ploughing histories and geology.

	Pins: average shank length	Strap-ends: average % completeness	Location & topography	Soil	Ploughing history	Recent events
Cottam A	167mm	77%	High Wolds; flat and adjacent to deep valley	Boulder clay; thin; uniform depth; chalk beneath	Long duration; historically ploughed <150mm	Excavated 1996; deep ploughing damage visible in dig; frequent potato crop in recent years
Cottam B	192mm	75%	High Wolds; flat and adjacent to deep valley	Boulder clay; thin; uniform depth; chalk beneath	Long duration; historically ploughed <150mm	Excavated 1993–95; deep ploughing damage visible in dig; frequent potato crop in recent years
South Newbald	147mm	74%	Lowland; S of Wolds; flat & adjacent broad stream & village	Sandy; depth unknown; plough brings up gravel	Long duration; probably not restricted to 150mm	Unexcavated; intensively farmed
Cowlam	250mm	79%	High Wolds; gently undulating & adjacent to deep valley	Boulder clay; variable depth; chalk beneath	Recent; first ploughing early 1970s; historically ploughed <150mm	Excavated 2003; some plough damage visible; auger survey showed variable soil depth
'Near Pock-lington'	251mm	87%	High Wolds; valley bottom; on village outskirts	Boulder clay; depth unknown; chalk beneath	Long duration; historically ploughed <150mm	Unexcavated

occur. These and other aspects of attrition in the ploughzone have long generated a considerable literature for pottery and flint, but there is a dearth of artefact analysis and experimental research for metal finds. This paper has attempted to make a contribution to the quantification of attrition caused by ploughing.

We have demonstrated that quantitative comparison of metal-detected and excavated assemblages of Anglo-Saxon pins and strap-ends can illuminate depositional, post-depositional and recovery processes. It is evident that these artefacts suffer most damage in the ploughzone, which suggests that rather than having been deliberately discarded because they were broken, they were lost when intact and still functional. In the case of strap-ends this indicates that they were commonly stitched to clothing and belts, not riveted. This does not necessarily mean that a similar depositional biography applies to all artefact types, as other objects may have been less prone to casual loss, although it is likely that a similar process applies to Roman or early Saxon dress artefacts which are of a similar function and form. Furthermore, this methodology could be applicable to other periods and places in the world where ploughing and metal-detecting occur, in order to establish if the same patterns arise.

We have also quantified damage in the ploughzone and shown that differences in damage are dependent upon the soil type and agricultural history of the individual sites included in the study. Crucially, the results show that the level of fragmentation of recovered artefacts increases through time. Ploughing eventually causes metallic artefacts to degrade completely, and therefore recovery by metal-detection (although considered by some to be destruction) is preferable to the alternative of doing nothing.

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