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‘Well, Sextus, what can we do with this?’ The disposal and use of insect-infested grain in Roman Britain

David Smith and Harry Kenward

Beetle (Coleoptera) pests of stored products such as the granary weevil may have entered the archaeological record by various routes, including: (1) deliberate dumping, and usually burial, of spoilt grain with the aim of preventing further infestation of grain in storage; (2) the use of infested grain as human and animal food; (3) the incorporation of infested grain and living or dead grain pests into deposits by accident and by reworking. It is suggested that these routes, although outlined specifically for beetle grain pests, can stand as a model for the way other insects and biological remains became incorporated into the archaeological record. It also is suggested that the identification of these different depositional routes depends strongly on taking a multi-proxy (‘indicator group’ or ‘indicator package’) approach to the archaeological and biological record of urban sites.

Keywords: insect grain pests, archaeological deposition, site formation, taphonomy, disposal

Introduction

Many Roman deposits in Britain contain abundant insect remains, including a range of beetles (Coleoptera) which are common pests in grain stores today (e.g. Buckland 1978; Kenward 2009; Kenward and Williams 1979; Smith and Kenward 2011). These pests of stored products often account for 50–70% of the beetle remains recovered from deposits, and sometimes over 90% (Smith and Kenward 2011). Species such as the ‘granary weevil’ *Sitophilus granarius* (L.), the ‘saw-toothed grain beetle’ *Oryzaephilus surinamensis* (L.) and ‘the flat grain beetle’ *Laemophloeus ferrugineus* (Steph.) are typical of this fauna and often can be superabundant (as defined by Kenward 1978). A range of other beetle pests of stored products may also be recorded, but usually in much smaller numbers (Smith and Kenward 2011). Examples of such less frequent species are *Palorus ratzburgi* (Wissm.) (‘the small-eyed flour beetle’), *Tribolium castaneum* (Hbst.) (‘the rust-red grain beetle’), *Alphitobius diaperinus* (Panz), (the ‘lesser mealworm’) and *Tenebrioides mauretanicus* (L.) (the ‘cadelle’).

These grain pests seem to have arrived in Britain with the Roman occupation, then died out during the ‘Dark Ages’, starting to return in the very late part of the Saxon period. They then become gradually more prominent, but only become widely abundant again during the High Medieval, though often there is a more restricted range of species (Buckland 1978; Kenward 2009; Smith and Kenward 2011). Possible explanations for this distribution through time include differences in trade connections, changes in the political and economic control of grain, changes in storage technology, variations in the amount of grain grown and traded at various times, and just conceivably climate (Buckland 1978; Smith and Kenward 2011). The possible effects on grain production and supply during the Roman period have also been discussed by Buckland (1978) and the extent of the problem experienced by the Roman Army considered by Smith and Kenward (2011).

What has not previously been discussed systematically is how these beetles may have entered the archaeological record, and if this resulted from the continued use of grain despite infestation or was the result of deliberate disposal or accidental incorporation. The topic was touched upon by Smith and Kenward (2011), Kenward (2009) and

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Kenward and Hall (1997), and specific cases have been considered, for example, by Buckland (1982), Hall *et al.* (1980), Kenward and Williams (1979) and Smith (2012a). Although the present paper focuses on the deposition of grain pests, many of the routes and mechanisms that lead to their incorporation in the archaeological record stand as models for the ways in which insect and other biological remains enter archaeology in general. This discussion of grain pests also provides insights into some of the day-to-day issues faced by a range of people in the past, and the responses they made. Beyond Britain, most records of Roman grain pests are of rare charred individuals or pottery impressions, which contribute little to the issue of disposal with which we are concerned here.

The locations of the various sites discussed are indicated in Fig. 1.

Routes to deposition

The flow chart presented in Fig. 2 attempts to summarise some of the routes by which the grain fauna could have entered the archaeological record. This process normally starts in the grain store, where the initial infestation probably occurred, either from pests hiding in cracks and spilled grain, or as a result of contamination of imported grain or sacks. It then traces the routes along which this material may have passed until its eventual disposal or accidental deposition. The hatched lines separate the three main types of route. In the middle of the figure are two forms of direct, deliberate disposal of infested grain. On the left there are a number of possible routes by which grain, despite being infested with insects, was still used for human food, animal fodder and in malting before finally reaching the archaeological record. On the far right of the diagram two routes lead to the 'accidental' deposition of grain pests into the archaeological record in general waste and possibly in roofing thatch.

This model of is, of course, a simplification. There are sure to have been more routes to final deposition in the archaeological record than these, but we believe that they probably represent the main ones. This diagram does not include the reworking of material once the archaeological record has formed or, indeed, offer a full outline of the complex events that can lead to the formation of archaeological deposits. Fig. 3 is a more pictorial attempt to represent the same ideas. It owes a lot to the illustrations prepared by our colleague James Greig to outline the process by which plant materials may have entered cess pits and how pollen may enter urban deposits (Greig 1981; 1982).

Deliberate deposition for disposal

People may have made the decision to throw away the whole bulk of stored grain once it was seen to be infested by insects. It is likely only to have occurred once grain in storage had become so heavily infested or spoilt that it became unpalatable, or even unsafe to consume, for man and beast alike. Even if rejected by the upper social classes, their minions or livestock would probably have accepted grain which was lightly contaminated. Intolerance of insect contamination in developed countries is largely a matter of aesthetics, and there is no evidence that moderate levels of contamination are harmful (eg. Howe 1965).

If grain is completely spoiled or crawling with insects, disposal has to be complete, careful and well executed. It has to be done in such a way that the insect pests cannot escape during disposal, or the materials which subsequently enter storage in the original location would become reinfested. To prevent recontamination, the infested grain cannot even be left within tens of metres or more of the site of the original infestation (see below). Such disposal seems to have been a fairly common occurrence, as a number of Roman deposits clearly show evidence of the bulk disposal of rotten and infested grain. There seem to have been two main ways of achieving this in the Roman period: burial and burning.

Burial of infested grain

The insect remains from a number of pit deposits from 1st century AD Building 4 at the site of Poultry, London clearly suggested that the disposal of infested grain was an issue even in the pre-Boudiccan revolt settlement (pre-60 AD, Smith 2012a). In these samples grain pests accounted for between 56% and 73% of the whole insect fauna. This suggests deposition of a relatively large quantity of infested grain, along with other domestic waste into a sealed context. This pattern of deposition was seen again in a number of deposits from the same period at the adjacent site at Gresham Street, London, where several pit deposits contained insect faunas in which grain pests accounted for more than 50% of the beetles. This also seems to be a feature of deposition in the later 3rd or 4th century AD phases of the site at Poultry, where the fauna of one context, consisting of a dump associated with road levelling, was again dominated by grain pests (70% of the fauna), leading to the impression that any available pit or levelling deposit might be a suitable site for the dumping and sealing away of infested grain (Smith 2012a). A similar story was seen in the 15th century AD post-dissolution site of St Mary Spital, London, where a

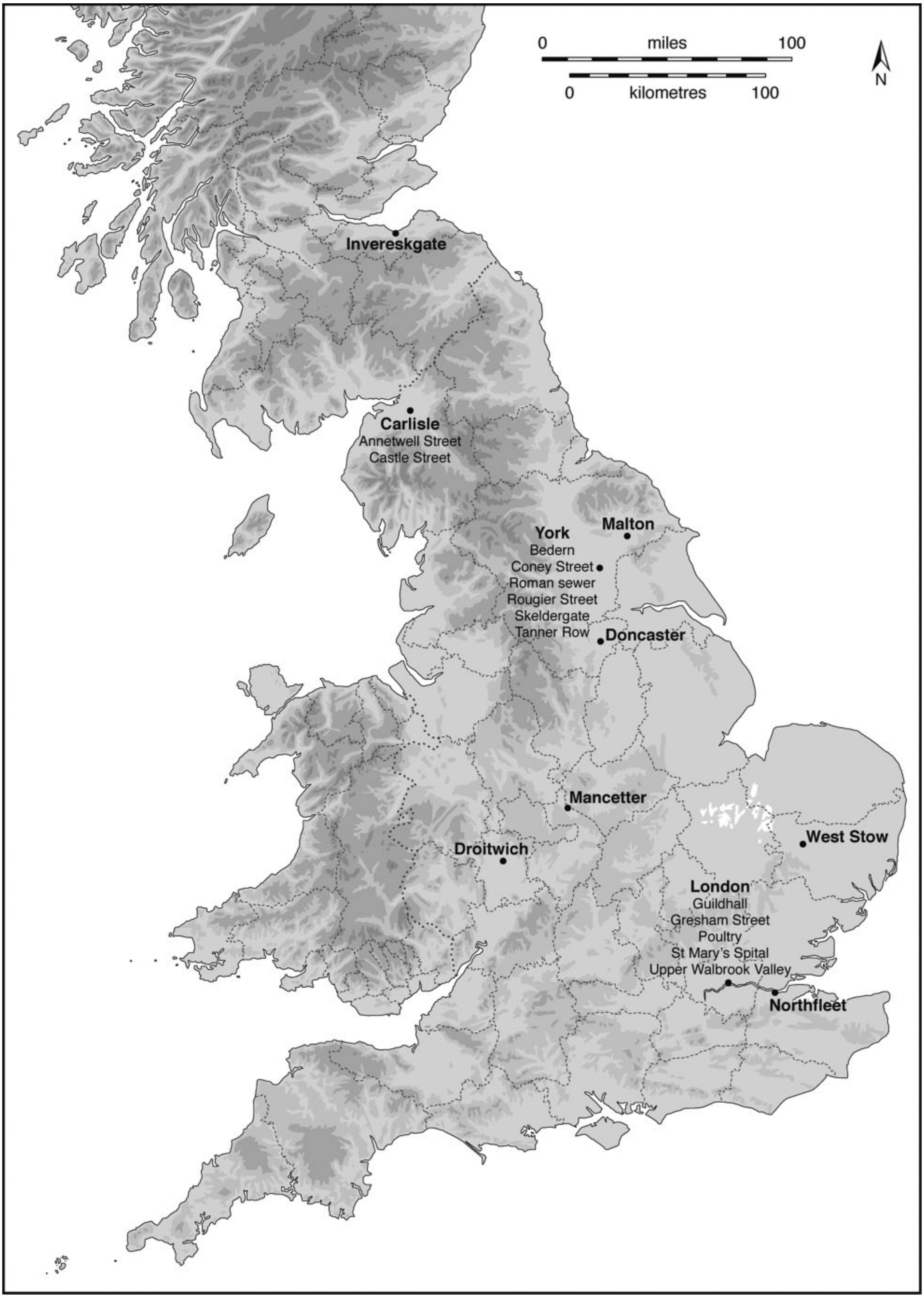

Figure 1 Location map of the sites discussed

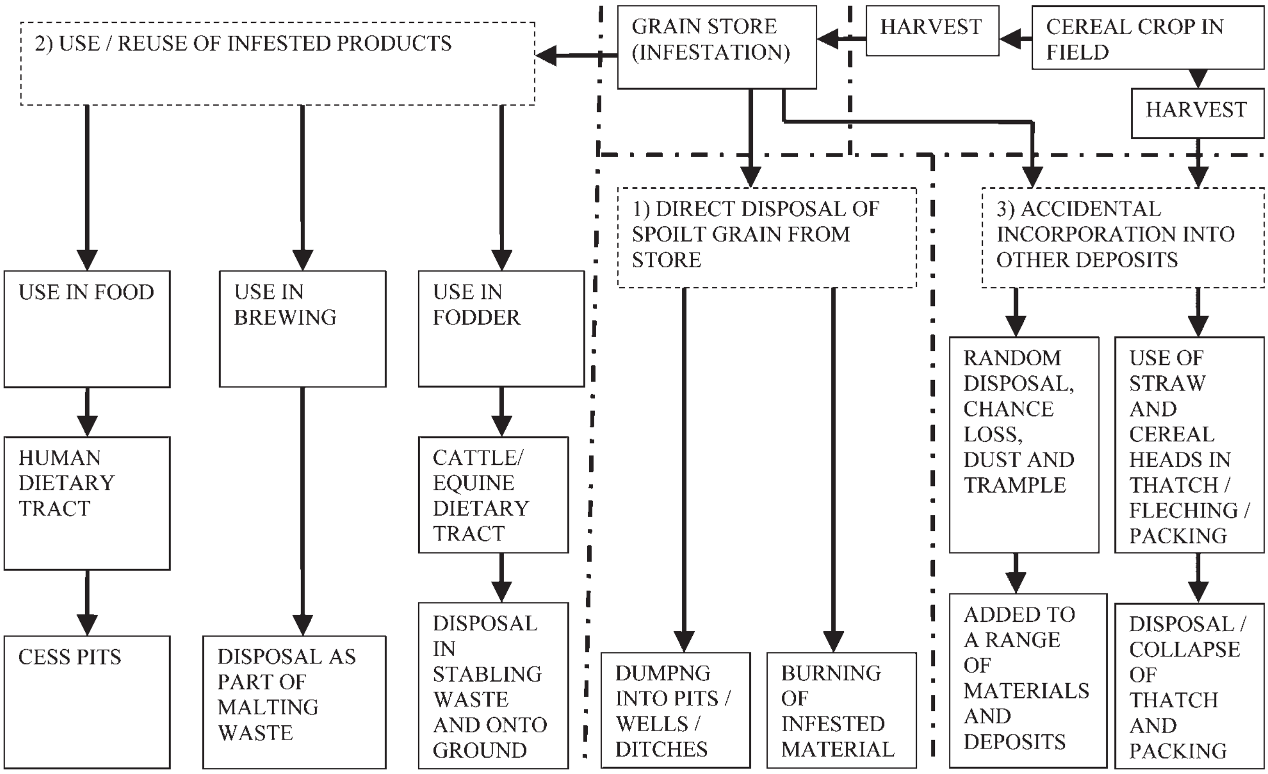

Figure 2 A flow diagram illustrating the various routes for the incorporation of grain pests into the archaeological record

number of pits excavated into the remains of the monastic gardens were filled with assorted rubbish from domestic and craft activities. These included one pit (268) where the insect fauna was again dominated by grain pests (69% of the fauna) (Smith 1997b).

The backfills of several Roman wells also seem to have contained very large amounts of spoilt grain, suggesting that these were recognised to be good places to get rid of contaminated material. This can be seen in backfills of the Bedern and Skeldergate wells in York, where grain pests often accounted for 40–60% of the beetles and bugs recovered (Hall *et al.* 1980; Kenward *et al.* 1986). There seems little doubt that the Skeldergate well in particular had received a large quantity of spoiled grain as one of its first fills. Another clear example of the use of a well as a convenient place for the disposal of infested grain is the 2nd century AD site at Invereskgate, West Lothian, where the lower backfill deposit produced a series of insect faunas in which 60–70% of the total fauna consisted of a range of grain pests (Smith 2004). The insect faunas from the Invereskgate well also contained the remains of a range of non-biting midges (Chironomidae), hinting that the water in the well may have 'soured', resulting in the abandonment of the well as a water supply and its adoption as a convenient place to dispose of waste, including infested grain. The disposal of rubbish into wells does seem to have been particularly common in the Roman period; another example is the well at the Roman fort at Mancetter in the West Midlands, which seems to have contained considerable quantities of stable waste in the backfill (Smith 1997a). Indeed, the plant, bone, and intestinal parasite remains from many wells clearly suggest that they had been used for the disposal of a range of other agricultural and domestic wastes in addition to spoilt grain (e.g. Bishop 2004; Hall *et al.* 1980; Kenward *et al.* 1986). In addition, various votive offerings, whole dead animals, and parts of human bodies also seem to have entered some, but certainly not all, disused wells as 'closing deposits' (Esmonde Cleary 2000, Woodward and Woodward 2004).

Despite the dominance of grain pests in the insect faunas, it is clear from other forms of evidence, such as the plant remains and bone, as well as the archaeology of these various deposits, that other kinds of waste products were also present in these deposits. For example, St Mary Spital Pit 268 also contained the seeds of sedge (*Carex* sp.) and spike rush (*Eleocharis palustris* L.), suggesting the incorporation of flooring (Davis 1997) and the skeletons of over 30 gulls, probably representing a discrete deposit of food waste (Pipe 1997). The Skeldergate and Bedern wells clearly contained a wide range of waste,

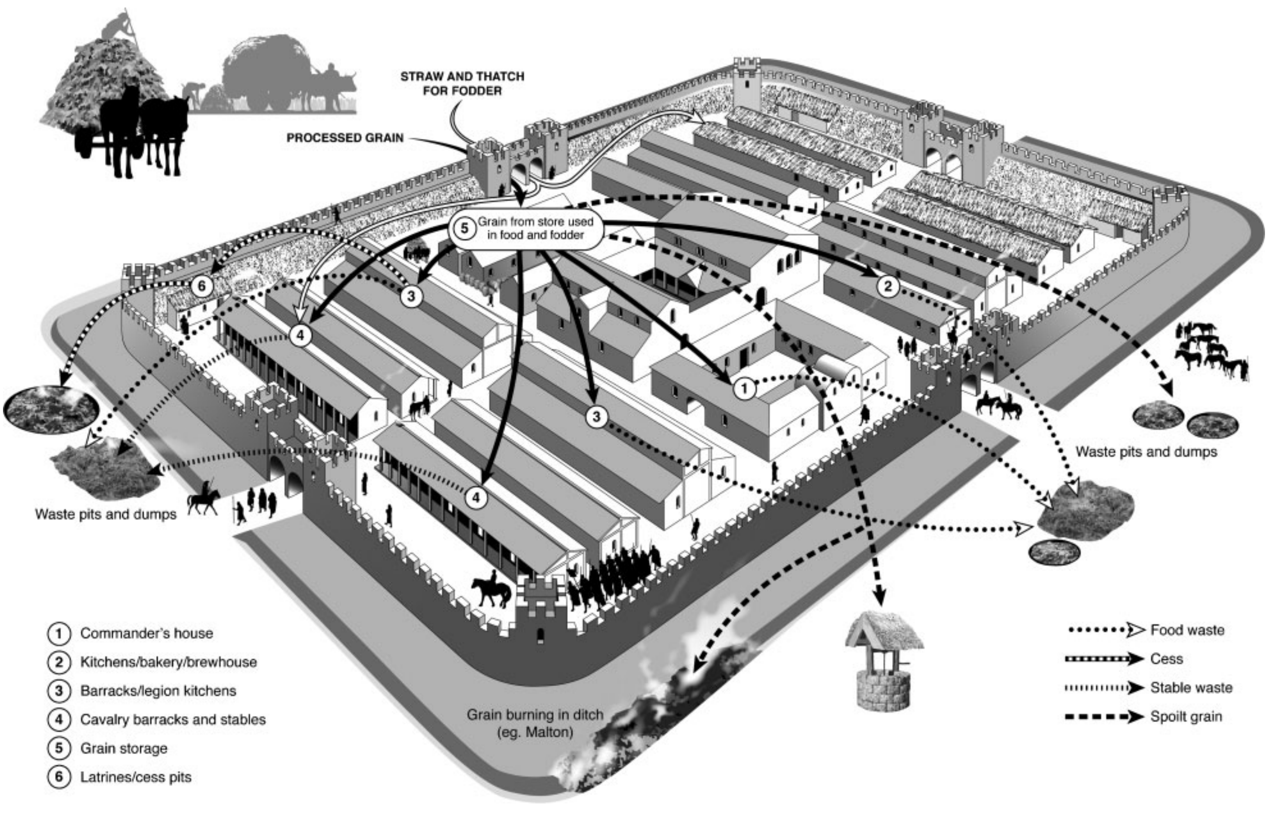

Figure 3 A diagrammatic sketch of the various routes to deposition for grain pests in a typical Roman fort

probably including material scraped up from surrounding surfaces. The impression gained is that considerable quantities of spoilt grain were entering these deposits as part of the more general pattern of disposal of occupation waste.

Finally, it is important to note that deposits where insect faunas have been interpreted as resulting from spoil grain disposal do not usually contain large amounts of immediately recognisable grain. This is not the problematic issue which it might at first appear to be. Cereal grain does not preserve well through waterlogging and therefore has often disappeared from deposits or become reduced to tatters of 'bran' as a result of differential preservation, the grain pests being more robust. This was clearly the case with the Bedern and Skeldergate wells. Although no 'grains' of cereals were recovered from the Bedern well, abundant bran fragments were preserved, suggesting the incorporation of considerable amounts of grain (Kenward *et al.* 1986, 62). This differential preservation leaves us with a problem: it is very difficult to determine objectively the degree of infestation or the relative contribution that spoilt or infested grain may have made to any single deposit.

It seems that the deliberate dumping of grain in order to prevent reinfestation might lead to grain pest insect faunas having a number of distinct characteristics. First, the deposits should contain a wide range of both primary grain pests such as *Sitophilus granarius* together with secondary pests and scavengers such as *Oryzaephilus surinamensis*, *Palorus ratzburgi*, and *Laemophloeus ferrugineus.* The presence of the latter species probably indicates that the grain infestation was prolonged and heavy. The additional presence of other more generalist 'mould' beetles, such as lathridiids and cryptophagids, may indicate that the grain also may have reached the point where it was effectively 'composting', perhaps representing old residues from corners and under floors rather than the bulk of the grain. Secondly, grain pests in this type of deposit should account for over 50% of the insect fauna recovered, indicating relatively large amounts of spoilt grain. Thirdly, both the archaeological finds and other 'environmental' remains recovered should indicate that settlement rubbish was also being dumped into these deposits, as well as the dumping of grain.

Another approach was to seal off severely infested grain where it lay. Perhaps the clearest example is the remains of the 2nd-century storehouse at Coney Street, York, where millions of grain pests were present in the silts associated with the beam slots of the foundations of a dismantled wooden store building (Kenward and Williams 1979). It seems quite likely that an overlying clay layer may have been put into place to seal off the infestation, since the existing surface was reasonably even.

Burning of infested grain

A number of Roman archaeological sites contain deposits apparently indicating that infested grain may have been burnt in an effort to prevent pests migrating from it and causing further infestation and to clean storehouses. This is mainly indicated by the occurrence of charred grain pests in amongst considerable bulks of charred grain. Given that fairly specific firing conditions are needed for insect remains to be preserved in this way and that charred insects are generally very fragile and easily broken or overlooked during recovery (Kenward *et al.* 2008 and unpublished) it seems likely that burning may have been a relatively common event and thus that it was probably seen as a solution to the problem of insect infestation in stored products.

Perhaps the best-known example of the occurrence charred grain pests in Britain is the burnt grain deposit from Malton, Yorkshire (Buckland 1982). Here, charred insect remains were present within a substantial deposit of burnt grain recovered from the 2nd/3rd century AD fort ditch. This find of charred grain pests led to the suggestion that the burning was not due to any rebellious act of the native Picts, but rather the quite mundane disposal of spoilt grain (Buckland 1982). However, Smith and Kenward (2011) have pointed out that the infestation appears to have been small and there was little sign of insect damage in the grain itself. In fact it is very difficult, given how poorly insects normally preserve through charring, to use such remains to establish whether there was a significant degree of infestation. Moreover, it is unclear whether what appears, at face value, to be a relatively low level of infestation would have been visible at the time. Quite large numbers of insects need to be present before they are at all obvious in bulks of stored grain. A more convincing argument for the deliberate burning of infested grain could be made for the charred remains of grain pests from 4th-century Droitwich, Worcestershire (Osborne 1977), especially as it was subsequently shown by examination of the charred plant remains that this grain was spoilt (Straker 2006, 22). Beyond Britain, a striking example of apparently heavily infested grain was provided by the Gallo-Roman granary in central Amiens, burned at the end of the 2nd century AD (Matterne *et al.* 1998). At this site there were abundant charred cereal grains, together with hundreds of fragments of charred grain pests, but also some which were ‘waterlogged’ and others which were part-burned (‘toasted’).

Not all bodies of charred grain represent deliberate destruction, of course. The thick layer of charred grain from the second phase of the store building at Coney Street, which overlaid the clay discussed above, did not contain pests, suggesting that accidental burning is as likely as deliberate destruction by fire (Kenward and Williams 1979). Such bulks of grain sometimes also contain uncharred insects; this should not be taken as evidence of infestation, since they may have strayed in after burning. For example, one of the samples from a thick mixed layer of charred and compressed uncharred grain at Rougier Street, York, produced an insect fauna which included decomposers and a few grain pests. These seemed likely to have invaded the rotting uncharred grain after burning (Hall and Kenward 1990, 383).

Food, fodder and other uses for infested grain

It seems that there are occasions when grain infested with insect pests may have been put to a constructive use, rather than just being disposed of by burning or burial.

Use in human food

There is considerable evidence that infested grain may have entered the human food supply. It is possible that the levels of insect infestation in the grain supply were usually quite low, and so not obviously visible to either store keepers or all but the fussiest of consumers. Certainly *Sitophilus granarius*, the granary weevil, occurs in grain which is relatively undamaged and palatable (Coombs and Woodroffe 1963; Freeman 1980). Also, since it spends most of its life cycle inside grains, it can easily pass unnoticed both to the eye and to the intestines. Equally, the consumption of spoilt grain, and the insects in it, may have been less of an aesthetic issue in the past than it would be today. This was probably especially the case for those people who could not afford or could not obtain better-quality provisioning — one thinks of the tales of sailors resignedly tapping the larvae of the biscuit beetle, *Stegobium paniceum* (L.), out of ships’ biscuits.

Perhaps the clearest archaeological evidence for this is that grain pests, usually *Sitophilus granarius*, are commonly found in small numbers in deposits that are interpreted as fills of archaeological cess pits (e.g. Hall *et al.* 2007; Osborne 1983; Skidmore 1999; Smith 1997b; 2002; 2006). These may have been strays or have been dumped in floor sweepings, but a route via the human intestine seems perfectly possible. The definition of archaeological cess pits has become much clearer over the last 10 years. A distinct 'indicator package' (*sensu* Kenward and Hall 1997) has appeared for these features. In addition to a number of distinct archaeological characteristics, cess pits usually contain a group of plant macrofossils that all appear to pass as food through the human digestive tract, as well as a range of distinctive fly puparia. Small numbers of grain pests (often less than 10% of the total fauna) are also a common component in this group (Smith unpublished). Osborne (1983) suggested that the occurrence of both grain pests and *Bruchus* 'pea weevils' in such deposits can be explained by the incorporation of infested grain and pulses into foods such as gruel, pottage, or unrefined 'horse' bread. These food stuffs then pass through the human gut and enter cess pits in faeces. Osborne (1983) proved the point in a now classic experiment in the 1980s, when he consumed various grain weevils and searched his own faeces to demonstrate that they survived the journey disarticulated but intact (sadly, a recent attempt by one of the authors to repeat and expand on this experiment was made impracticable by modern Health and Safety procedures). There seems little doubt that bean weevils (*Bruchus rufimanus* Boh.) were frequently eaten with pulses and entered pits in the same way (e.g. Kenward 2009).

Use in fodder

Spoilt grain, in the past as now, can of course be used as fodder for cattle and horses. This is a good use of this material since, in addition to feeding stock, it also makes sure that the material is disposed of in such a way that new infestations of clean grain in storage are minimised. There seems to be evidence that infested grain may have commonly featured in animal feed in the past. For this reason Kenward and Hall (1997) included both cereal grain and grain pests in their 'indicator group' for the identification of stable manure in the archaeological record. Grain pests have been found in a number of deposits identified as stabling material, for example at first century Castle Street, Carlisle, and Tanner Row, York (Allison *et al.* 1991a; 1991b; Hall and Kenward 1990; Kenward and Carrott 2006). This also seems to be the most likely explanation for the recovery of granary pests from a variety of channels and features below the buildings interpreted as barracks at the 1st century AD fort at the Carlisle Millennium site (Smith and Tetlow 2010). Similarly, this route offers the best explanation for the incorporation of grain pests into a number of medieval deposits interpreted as dumps of stabling material in London and Doncaster (Smith and Chandler 2004; Kenward *et al.* 2004), and in the north of England (Kenward 2009). Determining whether grain pests have entered the archaeological record as part of animal feed is certainly best approached by considering them as part of the indicator group for the identification of stabling material, rather than in isolation.

Grain pests eaten by horses often will have been evacuated in faeces onto roads and open ground, providing another route for their deposition; this may have occurred at the Annettwell Street site within the Roman fort at Carlisle (Kenward and Carrott 2006).

Use in brewing

Accidental preservation of clearly infested foodstuffs is exceedingly rare in the archaeological record. However, recently examined assemblages from the Roman Villa at Northfleet, Kent, appear to be an instance where cereals and grain pests have been accidentally preserved through charring (Smith, D. 2011). Four dump deposits, which included charred plant remains and charred grain pests, were recovered from an early Roman posthole, a middle Roman cistern, and early–middle and late Roman ditches. All of these assemblages were primarily composed of charred spelt glumes (the tough material encasing the grain) and detached sprouts. Such material from elsewhere (e.g. from Catsgore, Hillman 1982; Springhead Town, Campbell 1998; and the Mount Roman Villa, Robinson 1999) has been interpreted as a by-product of spelt malting, during which the surrounding chaff and sprouts were intentionally removed from the malted spelt grain before 'mashing' it for brewing. The absence, or rarity, of charred grain in this instance appears to reflect intention, as these deposits most likely represent an unwanted by-product. The preservation of cereal remains through charring appears to be related to the use of this waste material as fuel. Certainly, both the hypocaust system of the bath and deposits from the undercroft and/or flues of the corn dryer at Northfleet produced virtually identical material, except in these cases insect remains were not recovered, perhaps not surviving charring (Smith, W. 2011).

These chance finds from Northfleet suggest that infested grain may have been used in brewing (Smith, W. 2011). Deposits of charred germinated grain and malting waste from a range of archaeological features at the site suggested that malting, and the subsequent reuse of the by-product of malting as fuel, occurred on a large scale (Smith, W. 2011). Grain pests such as *Sitophilus granarius*, *Oryzaephilus surinamensis* and

Palorus ratzburgi were also recovered from this material in small numbers (10–20% of the total insect fauna) (Smith, D. 2011). Again, it is unclear what level of infestation such evidence represents, but the numbers of individuals, particularly of *Oryzaephilus surinamensis*, were substantial in some deposits. It may be that the level of infestation was relatively low or that the malters had selected out obviously infested grain. The extent to which this may have been visible to the Roman malters is not clear. Even quite recent malt houses which used traditional wooden bins to store malted grain seem to have supported a high level of infestation by grain pests (Hunter *et al.* 1973) and relatively large numbers of insects are tolerated in malt because they do not appreciably taint the flavour of the beer. The identification of insects reaching the archaeological record as part of malting waste is, of course, dependent on malting being identified from archaeobotanical remains, which is by no means straightforward (e.g. van der Veen 1989; Smith, W. 2011).

Accidental incorporation into other deposits

Many archaeological deposits from Roman and Medieval contexts contain relatively small numbers of grain pests. This appears to be a manifestation of the phenomena which Kenward (1975; 1978) identified as the incorporation of a 'background' of insects into archaeological deposits. In many settlements there surely was a degree of 'background radiation' of grain pests from infested stores, which subsequently entered archaeological deposits so that their presence was not the result of deliberate dumping of spoilt grain, or the use of infested material, but rather of chance. It is easy to envisage numerous ways in which small amounts of spoilt grain, or granary pests themselves, could enter the archaeological record as individuals or in small groups. The identification of deposits such as this is relatively straightforward (Kenward 1978) since, in addition to producing only a small number of grain pests, such assemblages that derive from a number of sources and materials yield insect faunas that are very diverse both in terms of the number of species present and of the ecology represented by the beetles recovered (Kenward 1978). This is also true of the plant and other biological remains from the same archaeological record, that equally tend to show a wide range of ecological preferences and origins. It is possible that, being abundant, dead grain pests were part of the 'dust' falling on sites as deposits formed, in the way postulated for woodworm beetles (*Anobium punctatum* (Degeer)) by Kenward and Large (1998). In addition, there is also fairly clear evidence from many archaeological sites for considerable redeposition and mixing of deposits which resulted in the dispersal or mixing of insect remains, grain pests included, between deposits.

The extent to which grain pests will 'wander' away from grain stores into other deposits is not clear. Some simple tests on *O. surinamensis* and *S. granarius* indicated that, providing locomotion was sustained, these species could travel many tens of metres in a day (Table 1). Three examples, suspected to represent this type of dispersive deposition for grain pests, will suffice. The drains that ran under the 2nd- and 3rd-century amphitheatre at the Guildhall London produced insect faunas and plant floras that were very diverse and therefore suggested that a range of materials, probably representing street wash, entered this deposit (Smith and Morris 2008; Grey and Giorgi 2008). This mixture included a small number of grain pests. Similarly, both the Poultry and Gresham Street sites contained contexts that, although including grain pests in small numbers, were not dominated by them (they accounted for less and 10% of the total insect fauna). Again, these appear to be deposits which contained a mix of materials from a range of sources (Smith 2012b). The situation may have been different at the 11th century AD site at the Guildhall, London. Here the insect faunas and the plant macrofossil materials were so mixed in deposits, and this 'mix' so ubiquitous among the deposits, that it seemed very likely that the archaeological record had been extensively reworked after deposition (Morris and Smith 2008). This reworking between deposits presumably included the small numbers of grain pests that occurred throughout the site.

One possible form of 'accidental' deposition of grain pests that has been suggested is from straw-thatch roofs. This is not as odd a suggestion as it seems. A recent survey of a range of medieval roofing

Table 1 Mobility of two common grain pests. The tests were carried out at 25·5 C, by placing insects in a group on a surface and recording individual times to reach a radial distance of 35 cm

Species	No. tested	No. reaching edge	Mean speed	SD	Comments
Oryzaephilus surinamensis	20	16	0·3 cm/sec (10·5 m/hr)	0·09	Four remained immobile
Sitophilus granarius (trial 1)	45	39	0·3 cm/sec (10·6 m/hr)	0·13	One wandered randomly, five remained immobile
Sitophilus granarius (trial 2)	20	16	0·3 cm/sect (10·6 m/hr)	0·13	Four remained immobile

thatch, including smoke blackened thatch, found that single individuals of *Sitophilus granarius* occurred in many of the samples examined (Smith *et al.* 1999; 2005). This suggests that either the processing waste used in packing between the layers of the roof or the whole sheaves used as the decorative 'flecking' on the interior surfaces of the roof contained grain, and that this had been infested by the granary weevil (Smith *et al.* 1999). The occurrence of *S. granarius* and other grain pests at modern reconstructions of Saxon buildings at West Stow, Suffolk, seems to have been the result of their importation with cereal straw (Authors, unpublished). As roofing material was reused, disposed of, or collapsed, or simply by straying, the grain weevils might consequently enter the archaeological record.

Conclusions

Our aim has been to demonstrate that there are a number of distinct ways that the insects associated with grain, and of course spoilt grain itself, can enter the archaeological record. It seems clear that the route leading to the burial of this material reflects numerous possible accidents as well as human decisions based on the degree that the material has been spoilt, the level of infestation present, social perceptions concerning food supply and the tolerance of spoiled food. Certainly, building conceptual models of the ways materials enter the archaeological record, and the conscious decisions that resulted in human actions, is a useful approach to the past. Although we have only been considering the beetle grain pests here, there is no reason why the same approach could not be applied to other kinds of urban insect communities and to a wider range of biological proxies.

It is evident that deducing past routes of deposition depends on the correct identification of archaeological deposits. This mainly depends upon using a combination of archaeological and biological approaches to the past. It certainly underlines the importance of using multi-proxy data or 'indicator packages' (biological indicator groups plus all of the other evidence, Kenward and Hall 1997) when interpreting the remains of past lifeways at occupation sites.

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