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Chapter 6

Sewers, Cesspits and Middens: A Survey of the Evidence for 2000 Years of Waste Disposal in York, UK

Allan R. Hall and Harry K. Kenward

Introduction

In a paper now over 20 years old, Peter Addyman[1] addressed the question of public health through the two millennia of York's history, drawing on an accumulating body of evidence from archaeological excavations in the city from the 1970s onwards. Our aim in this paper is to update Addyman's account, at least with respect to sanitation and waste disposal more generally, using information gained during the investigation of hundreds of samples of archaeological deposits from dozens of sites during the life of the Environmental Archaeology Unit (1975–2003) at the University of York. Working within an integrated team, it was possible to study macroscopic plant remains (fruits and seeds, fragments of leaf and moss and so on), insects and other macroscopic invertebrates, the microscopic eggs of intestinal parasites, and the remains of vertebrates of all kind, including humans. We recognise a characteristic set of plant and invertebrate remains as constituting an 'indicator group'[2] for faecal material, although most of the individual components could have other origins; only the eggs of intestinal parasites (Table 6.1) necessarily originated in faeces of some kind, although identification of the host is not always certain and these tiny eggs were liable to be redeposited easily. The results are exemplified by publications

[1] Addyman, P.V., 'The archaeology of public health at York, England', *World Archaeology* 21(1989): 244–64.

[2] Kenward, H., Hall, A., 'Enhancing bioarchaeological interpretation using indicator groups: stable manure as a paradigm', *Journal of Archaeological Science* 24 (1997): 663–73; Kenward, H., Hall, A., 'Dung and stable manure on waterlogged archaeological occupation sites: some ruminations on the evidence from plant and invertebrate remains', in R.L.C. Jones (ed.), *Manure Matters* (Farnham: Ashgate, 2012), pp. 79–95.

dealing with material from Roman levels at 24–36 Tanner Row (Hall et al. 1990)[3] and from Anglo-Scandinavian deposits at 16–22 Coppergate and other sites.[4]

Roman York

Like Addyman, we shall follow a chronological path, beginning with the foundation of the Roman city of *Eboracum* in AD 71. Most striking for much of the Roman town is the lack of survival of evidence for organic occupation waste: in the greater part of the city for which we have explored Roman levels, waste has either simply not survived (through decay since deposition or levelling during development during the Roman period), or it was never there in the first place. Dobney et al.[5] have reviewed the nature of the evidence from bioarchaeology for Roman York, emphasising this problem. Our view of the Romans as having well-organised waste disposal is borne out by the excavation of an impressive stone-lined sewer under Church Street, within the Roman fortress (see plates in[6]). However, in other parts of the settlement where such large-scale sewerage did not extend, waste must have been removed by other means as there is no evidence that it was left near to habitation in significant amounts or for long periods. We do not, for example, have a single convincing example of a well-preserved organic deposit in a cesspit from the first four centuries of York's past. A single pit fill from a site on the fringes of the Roman town, in Peasholme Green, stands as evidence for faecal material in the form of mineral-replaced and concreted plant remains including fruit stones such as *Prunus* (for example plums and sloes; Figure 6.1) and corncockle (*Agrostemma githago* L.) seed fragments.[7] It

[3] Hall, A.R., Kenward, H.K., *Environmental Evidence from the Colonia: General Accident and Rougier Street*. The Archaeology of York series 14(6) (London: Council for British Archaeology, 1990).

[4] Hall, A.R., Kenward, H.K. 'Setting people in their environment: plant and animal remains from Anglo-Scandinavian York', in R.A. Hall, D.W. Rollason, M. Blackburn, D.N. Parsons, G. Fellows-Jensen, A.R. Hall, H.K. Kenward, T.P. O'Connor, D. Tweddle, A.J. Mainman and N.S.H. Rogers, *Aspects of Anglo-Scandinavian York*. The Archaeology of York series 8(4) (York: Council for British Archaeology, 2004), pp. 372–426 and references pp. 507–21; Kenward, H.K., Hall, A.R., *Biological Evidence from Anglo-Scandinavian Deposits at 16–22 Coppergate.* The Archaeology of York series 14(7) (York: Council for British Archaeology, 1995).

[5] Dobney, K., Hall, A., Kenward, H., 'It's all garbage … A review of bioarchaeology in the four English Colonia towns', in H. Hurst (ed.), *The Coloniae of Roman Britain: New studies and a review*. Journal of Roman Archaeology Supplementary Series 36 (Gloucester: Journal of Roman Archaeology, 1999), pp. 15–35.

[6] Whitwell, J.B., *The Church Street Sewer and an adjacent Building*. The Archaeology of York series 3(1) (London: Council for British Archaeology, 1976).

[7] Hall, A., Kenward, H., Jaques, D., Carrott, J. (2000), 'Technical Report: Environment and industry at Layerthorpe Bridge, York (site code YORYM 1996.345)', *Reports from the Environmental Archaeology Unit, York* 2000/64.

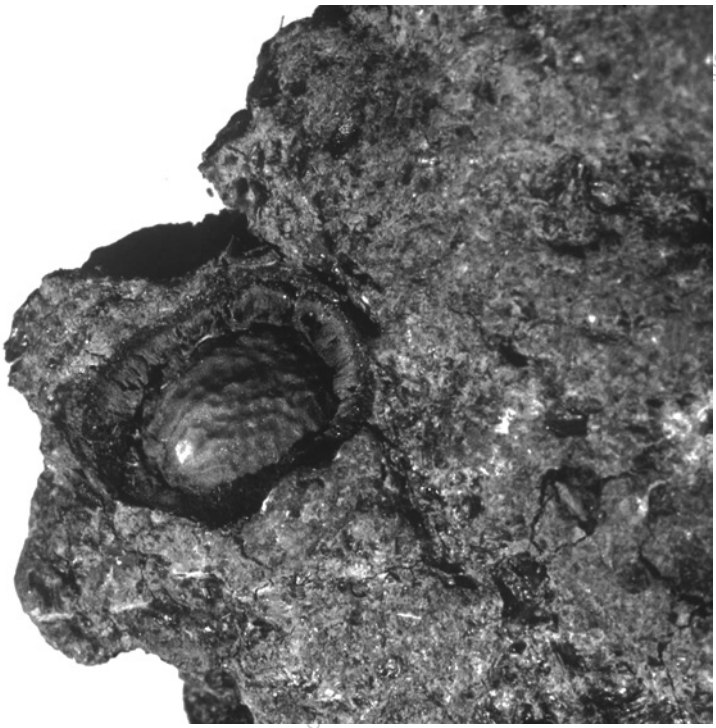

Figure 6.1. A sloe (*Prunus spinosa* L.) fruitstone embedded in a faecal concretion from Anglo-Scandinavian 16–22 Coppergate. The 'flesh' (mesocarp) of the stone is also preserved in this case. The stone is about 10 mm in length. (Photograph: Philippa Tomlinson)

must, however, be said that few excavations have revealed substantial remains of domestic dwellings of the period.

Where there *are* surface accumulations of organic material from the Roman town, these have been shown largely to comprise of stable manure, as at 24–30 Tanner Row, within the civilian settlement (Colonia) SW of the Ouse,[8] and more recently at a site in Spurriergate, at the edge of the fortress on the NE bank (unpublished). Obviously the waste from the stabling of equines – which are the animals presumed to have produced the material in question – was much more tolerable than the equivalent waste from human occupants, and certainly it had somewhat different (but at the time apparently unappreciated) health implications in terms of transfer of harmful bacteria and of endoparasites. No Roman dumps are known outside the urban area of York or on the riverfronts, the latter in contrast with London and Lincoln. The

[8] Hall and Kenward 1990. See Figure 6.2 (beetle head) as an example of the remains of a beetle typical of herbivore dung.

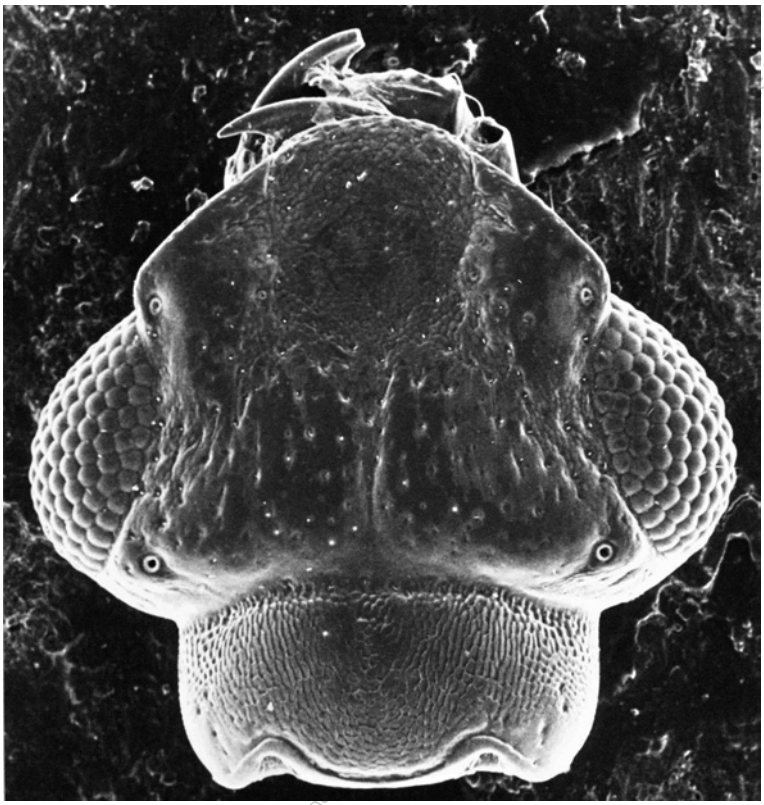

Figure 6.2. Head of the rove beetle *Oxytelus sculptus* Gravenhorst from Roman 24–30 Tanner Row: a common denizen of stable manure and cesspits in York. Width across eyes about 0.6 mm. (Photograph: Enid Allison and Harry Kenward)

substantial organic deposits at Tanner Row may have been dumps on the edge of the occupied area, perhaps serving as landfill to raise the ground.

In reviewing records of eggs of human intestinal parasites (the whipworm, *Trichuris trichiura* and the roundworm, *Ascaris lumbricoides*), we were surprised by the paucity of records for Roman York. As for the post-medieval period (below) it seems more likely that this is a result of a combination of often poor preservation and rarity of analyses, and not just simply a low level of infestation.

Returning to the sewer, it must be remarked that its potential as a source of evidence for waste from the inhabitants using it has not been sufficiently realised. Buckland[9] reported a wide variety of remains preserved in samples of its fills, but

[9] Buckland, P.C., *The Environmental Evidence from the Church Street Roman Sewer System*. The Archaeology of York series 14(1) (London: Council for British Archaeology, 1976).

the presence of some Australasian insects, which certainly arrived in Britain in the early modern period, casts frustrating doubt on the dating of the remains as a whole. It may be that the extensive unexplored parts of the Roman sewer system will prove to contain uncontaminated deposits that can be investigated in future.

After the Romans

For the Anglian period, between the end of Roman York towards the end of the 5th century AD and the coming of the Vikings in the mid-9th century, the archaeological record is tantalisingly sparse, and with it the record for many kinds of biological remains. Fortunately at an excavation at 46–54 Fishergate, away from the Roman and medieval centre of the city, a number of pit fills (and fills of some other features) can be shown to have contained remnants of plant foods preserved by mineral replacement, in which some of the soft tissues had become impregnated by calcium phosphate. This kind of preservation is very typical of cesspits, where high concentrations of calcium and phosphate occur: see[10] for studies of the processes involved. Every gradation can occur from the presence of small amounts of mineral replacement within material that is essentially preserved by anoxic waterlogging, through the formation of 'concretions' of waterlogged material bound together by calcium phosphate into more or less amorphous lumps ('faecal concretions', commonly encountered towards the edges of cesspits), to assemblages of plant material preserved by mineral replacement alone. At Fishergate only the most extreme case was observed. This may relate to ground conditions in which continuous waterlogging did not occur,[11] although another variable to consider is the rate at which waste was deposited. If this site was occupied only seasonally, for example, as a trading settlement, or was simply not very densely settled, it is possible that conditions were hardly ever suitable for mineral replacement to take place. At any rate, the amounts of mineral-replaced plant material were small. The study of insects, too, offered little evidence for foul matter. However, some of the assemblages of bones, especially those of fish, gave rather clearer evidence of faeces, in the form of remains likely to have been ingested and subsequently voided.[12]

[10] McCobb, L.M.E., Briggs, D.E.G., Evershed, R.P., Hall, A.R., Hall, R.A., 'Preservation of fossil seeds from a 10th century AD cess pit at Coppergate, York', *Journal of Archaeological Science* 28 (2001): 929–40.; McCobb, L.M.E., Briggs, D.E.G., Hall, A.R., Kenward, H.K., 'Preservation of invertebrates in 16th century cesspits at St Saviourgate, York', *Archaeometry* 46 (2004): 157–69.

[11] Allison, E.P., Hall, A.R., Jones, A.K.G., Kenward, H.K., Robertson, A., 'Report on plant and invertebrate remains', in R.L. Kemp (ed.), *Anglian Settlement at 46–54 Fishergate*. The Archaeology of York series 7(1) (York: Council for British Archaeology, 1996), p. 85–105.

[12] O'Connor, T.P., *Bones from 46–54 Fishergate*. The Archaeology of York series 15(4) (London: Council for British Archaeology, 1991).

Viking Age York

The contrast between the evidence from Fishergate and that from the mid-9th to late 11th century (Anglo-Scandinavian or 'Viking') occupation at 16–22 Coppergate[13] could hardly be greater. Here, very many of the pits contained fills rich in organic material preserved by anoxic waterlogging, much of which was human faecal waste – to judge from the characteristic assemblages of wheat/rye 'bran' (and other plant foods), weed seed fragments (from the milling of grain contaminants), intestinal parasite eggs (Table 6.1), and a wide variety of insects characteristic of foul matter, especially the puparia (resting stage) of flies and a suite of foul-matter beetles. Cesspits were common towards what is supposed to be the street frontage along the north edge of the site during the earliest phase of occupation,[14] though exactly where the inhabitants using those cesspits lived is unknown. Later, when a series of four contiguous tenements was laid out and the street front was formed by two ranks of wooden buildings, cesspits were located towards the rear of the buildings in an area of yards.[15] No obvious evidence survives for superstructures around these cesspits so it is possible they were open to the skies with perhaps just wicker screens; the suite of beetles found in them rather suggests this.[16]

To give an idea of the prevalence of cesspits – or at least of pits that served as cesspits at some stage in their life – we can note that a total of 50 layers from Anglo-Scandinavian Coppergate were recorded as containing large concentrations of wheat/rye bran. Of these, all but three were pit fills, and represented a total of 30 pits. Of the 50 layers rich in bran, 22 also yielded abundant seed fragments of corncockle (see below). Analysis of eggs of intestinal parasitic worms from the same samples showed that in almost all cases the whipworm (*Trichuris*, Figure 6.3) was present, often in large numbers and, in more than two-thirds, eggs of the roundworm *Ascaris* were also present (though, as is usually the case in material thought to represent human faecal waste, in very much smaller concentrations).

Most of these pits contained puparia of flies, including the house fly (*Musca domestica* Linnaeus), which are known to carry disease organisms, and it is quite probable that the beetles, too, would have been minor agents of disease dispersal.[17] A common fly in cesspits of this period and later was *Thoracochaeta zosterae*

[13] Hall, A.R., Kenward, H.K., Williams, D., Greig, J.R.A., *Environment and Living Conditions at Two Anglo-Scandinavian Sites*. The Archaeology of York series 14(4) (London: Council for British Archaeology, 1983); Kenward, H.K., Hall, A.R., *Biological Evidence from Anglo-Scandinavian Deposits at 16–22 Coppergate.* The Archaeology of York series 14(7) (York: Council for British Archaeology, 1995).

[14] Kenward and Hall 1995, Figure 130.

[15] Kenward and Hall 1995, Figure 141.

[16] Carrott, J., Kenward, H., 'Species associations among insect remains from urban archaeological deposits and their significance in reconstructing the past human environment', *Journal of Archaeological Science* 28 (2001): 887–905.

[17] Kenward, H., Large, F., 'Insects in urban waste pits in Viking York: another kind of seasonality', *Environmental Archaeology* 3 (1998): 35–53.

Figure 6.3. Whipworm (*Trichuris*) egg within a leaf-margin tooth of leek (*Allium porrum* L.) from an Anglo-Scandinavian cesspit deposit at 16–22 Coppergate. The egg is about 50 µm in length. (Photograph: Philippa Tomlinson)

(Haliday), now usually found in stranded seaweed and originally misidentified as a species more likely to be found in faeces, the latrine fly *Teichomyza fusca* Macquart.[18] As an aside, isotopic analysis of material from medieval Oxford has shown that *T. zosterae* was exploiting organic material locally, and had not been imported with seaweed;[19] the same is undoubtedly true for the vast majority of inland archaeological sites.

A topic of endless fascination in relation to the use of all these cesspits is the nature of materials used as 'sanitary wipes'. The most likely candidates are textiles, on the one hand, and moss, on the other. We are not convinced – given the lack of any high concentrations of textile fragments in pit fills – that they served this purpose on a regular basis and, indeed, Walton[20] seems to regard textile scraps at the Coppergate site as casual discards. Moss, by contrast, is regularly recorded in these pit fills, sometimes in very high concentrations, and is surely there because it was brought into Jorvik (Viking York) for wiping bottoms. The species concerned

[18] Belshaw, R., 'A note on the recovery of *Thoracochaeta zosterae* (Haliday) (Diptera: Sphaeroceridae) from archaeological deposits', *Circaea* 6 (1989): 39–41.

[19] Webb, S.C., Hedges, R.E.M., Robinson, M., 'The seaweed fly *Thoracochaeta zosterae* (Hal.) in inland archaeological contexts: $\partial^{13}C$ and $\partial^{15}N$ solves the problem', *Journal of Archaeological Science* 25 (1998): 1253–57.

[20] Walton, P., *Textiles, Cordage and Raw Fibre from 16–22 Coppergate*. The Archaeology of York series 17(5) (London: Council for British Archaeology, 1989).

are typical of woodland floors and tree trunks,[21] and a similar suite is recorded from pit fills from this and later medieval periods across Northern Europe.

There were various gullies or drains at Anglo-Scandinavian Coppergate, some of them originating within buildings,[22] but there is no good evidence from the plant and animal remains in their fills that they carried human waste; most seem to have been backfilled with an assortment of waste material such as the dyebath residues mentioned below. These drains, some tentatively identified as 'open sewers' by Addyman,[23] almost certainly carried rainwater or groundwater away; those within buildings were situated in basements that were surely liable to seepage.

There were also small patches of filth on floors and external surfaces, on the evidence of localised concentrations of fly puparia or occasionally intestinal worm eggs. These puparia usually seem to have been *in situ* but the worm eggs are perhaps as likely to have resulted from redeposition of material from earlier cesspits through the digging of new ones. Floors and external surfaces at sites such as Coppergate were constantly built up by the informal deposition of waste, much of it a potential source of infective agents. Among this material were some substantial accumulations of waste from dyebaths at Coppergate and other Viking Age sites in York, likely to have been most unsavoury – though, like some cesspit fills, some may have been sufficiently toxic that even flies would have been unable to breed in them! We might suspect that a large proportion of waste in most areas in the Anglo-Scandinavian period – and in at least some areas in all periods – ended up on surfaces and decayed into the general build-up that became York's exceptional archaeological archive.

From the Neolithic period onwards, organic waste produced in small settlements was almost certainly transported to agricultural land as fertiliser, but this may have been impracticable for a town of thousands of inhabitants such as Jorvik (Viking York), explaining the abundance of cesspits and their fills. Indeed, there seems to be no evidence of any formal waste disposal system in Anglo-Scandinavian York, although if 'town dumps' existed they may have been overlooked or, if close to one of the rivers, flushed away. An example that may represent disposal of waste into the river at this period comes from excavations by Layerthorpe Bridge, where several organic deposits proved to be rich in very decayed tree bark. This, and the remains of a beetle with a predilection for stored skins, have been interpreted as indicative of tan-bath waste, a very noxious kind of effluent.[24] It is worth noting that, while this disposal site was downwind of the town (leather tanning being an

[21] Kenward and Hall 1995, p. 745.

[22] Kenward and Hall 1997: 663–73, see Figure 159.

[23] Addyman 1989, pl.3.

[24] Hall et al. 2000; Hall, A., Kenward, H. 'Can we identify biological indicator groups for craft, industry and other activities?', in P. Murphy and P.E.J. Wiltshire (eds), *The Environmental Archaeology of Industry*. Symposia of the Association for Environmental Archaeology 20 (Oxford: Oxbow, 2003), pp. 114–30; Hall, A., Kenward, H., 'Plant and invertebrate indicators of leather production: from fresh skin to leather offcuts', in

especially noisome business), the waste was being dumped upstream of the town centre, contributing to the likely pollution mentioned below.

Many other (much smaller) excavations of Viking Age deposits in the centre of York have revealed further examples of cesspits with the same suites of organisms occurring repeatedly (discussed as a group by[25]; records of parasite eggs from these sites are listed in Table 6.1). Good examples have been examined at 2 Clifford St,[26] and 28–9 High Ousegate.[27] At a further site in this group, at 4–7 Parliament St, two of the four samples examined were rich in the classic 'faecal' suite of remains but also contained quantities of uncharred cereal chaff, perhaps pointing to the presence of faeces from livestock, most likely pigs.[28] There are substantial difficulties in distinguishing the eggs of the *Trichuris* and *Ascaris* species that infect pigs and humans, as they are of very similar size and shape to one another.[29]

Unlike nearby Coppergate, an early excavation of Anglo-Scandinavian deposits at 6–8 Pavement[30] yielded no evidence for pits containing waste – the deposits excavated here seemed primarily to have formed as floors. Even at Pavement, though, there were occasional concentrations of insects indicating rather foul conditions. Intriguingly, an object formed of concreted faecal material was recovered from one of these layers and appears to represent a single (large) human stool.[31] Unlike the usual faecal concretions recovered from cesspits, this object offered the opportunity to explore the diet and worm burden of a single individual rather than a potentially 'averaged' sample of faeces from a random concretion or unconcreted fills from a pit.

One of the constants – or nearly so – of faecal concretions and 'unmineralised' parts of faecal deposits from Anglo-Scandinavian York (and indeed many other sites of this period and the Middle Ages in York and elsewhere) is the presence of

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R. Thomson and Q. Mould (eds), *Leather Tanneries: The Archaeological Evidence* (London: Archetype, 2011), pp. 9–32.

[25] Hall and Kenward 2004, pp. 372–426 and references pp. 507–21.

[26] Hall, A.R., Kenward, H.K. (2000), 'Technical Report: Plant and invertebrate remains from Anglo-Scandinavian deposits at 4–7 Parliament Street (Littlewoods Store), York (site code 99.946)', *Reports from the EAU, York* 2000/22.

[27] Kenward, H., Hall, A., Jaques, D., Carrott, J., Cousins, S. (2003), 'Assessment of biological remains from excavations at Waterstones bookshop, 28–29 High Ousegate, York (site code: 2002.475)', *Palaeoecology Research Services Report* 2003/50.

[28] Hall and Kenward 2000; Hall and Kenward 2004, pp. 407–8; Kenward and Hall 2012, pp. 79–95.

[29] Kenward, H. (2009), 'Invertebrates in archaeology in the north of England', *(English Heritage) Research Department Report Series* 12/2009 (available online at http://services.english-heritage.org.uk/ResearchReportsPdfs/012_2009WEB.pdf), p.24–5.

[30] Hall et al. 1983.

[31] Jones, A.K.G., 'Report on a coprolite from 6–8 Pavement', in A.R. Hall, H.K. Kenward, D. Williams and J.R.A. Greig, *Environment and Living Conditions at Two Anglo-Scandinavian Sites*. The Archaeology of York series 14(4) (London: Council for British Archaeology, 1983), pp. 225–9.

milled weed seeds, as mentioned above. These are from seeds unavoidably mixed with the cereal crop and evidently ending up in the flour-based products whose bran forms a large part of the surviving material (virtually all of it has been identified as 'wheat/rye', these two not being distinguishable microscopically). There are at least two implications concerning past health from these observations. The first is that the diet – insofar as it is represented by the large bulk of bran – contained plenty of insoluble fibre. At the time these deposits were first being studied in the late 1970s, the vogue for a high-fibre diet to combat what were perceived as a variety of diseases consequent on the large-scale consumption of refined foods lacking dietary fibre was being taken seriously by the medical profession and filtering into the popular consciousness. It is perhaps difficult now to remember, for example, how rare it was at that time to find bread on the supermarket shelves that was both brown and contained a good quantity of fibre. Brown rice was still very much the preserve of a relatively few people, regarded as eccentrics. People in Viking Age York certainly seem to have had a high-fibre diet, perhaps essential in easing the passage of the fish bones and fruit stones which are common in faecal deposits from the period and clearly were regularly swallowed.

By contrast with the evidence from the ground, the presence of milled weed seeds is something that is extremely rare in even the most rustic of modern 'granary' loaves. Many of the seeds were probably of little consequence to the consumers, or may even have been nutritious, but one particular species, corncockle (*Agrostemma githago* L.), was probably injurious.[32] The large black seeds of this plant must at least have made brown flour grey and imparted a disagreeable odour;[33] but more significantly corncockle seeds contain considerable quantities of saponins, a group of substances that are injurious to cell walls and therefore toxic when eaten by mammals. What is not entirely clear – the now very old (mainly mid-19th century) literature is ambivalent on the subject – is how far the poisonous effects were mitigated by baking, or boiling in the case of foods like porridges and frumenty. Certainly at times corncockle has been used as a famine food,[34] though seemingly after treatment with steam, which presumably made it less harmful. It has also been suggested that consuming corncockle in bread and other flour-based products may actually have counteracted some of the effects of an intestinal worm burden; certainly Foster and Duke[35] refer to the use of powdered corncockle seed (albeit uncooked) as a vermifuge in North America – where the plant, and presumably its use for this purpose, was brought from Europe.

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[32] Hall, A.R., '…The cockle of rebellion, insolence, sedition…', *Interim: Bulletin of the York Archaeological Trust* 8 (1981): 5–8.

[33] Long, H.C., *Plants Poisonous to Livestock* (Cambridge: Cambridge University Press, 1917).

[34] Maurizio, A., *Die Geschichte unserer Pflanzennahrung von den Urzeiten bis zur Gegenwart* (Berlin: P. Parey, 1927).

[35] Foster, S., Duke, J.A., *A Field Guide to Medicinal Plants and Herbs of Eastern and Central North America.* 2nd edition (Boston: Houghton Mifflin, 1999).

On the topic of vermifuges, we might in theory hope to be able to detect their use in the past through examination of the contents of cesspits. In practice, however, the actual use of any of the wide range of plants mentioned in the literature of herbal medicine as having been employed thus would be very hard to detect. The parts used or the way in which they were used (typically leaves, prepared as powders, or as decoctions) simply would not leave a trace in the ground recognisable by the methods of low-power microscopy currently routinely used to study macroscopic plant remains in cesspit fills. The growing application of biomolecular analyses of archaeological organic residues may eventually cast some light on this and various other questions regarding diet and disease.

After the Norman Conquest

Our knowledge of the cesspits of post-Conquest York comes from a variety of sites, although most studies have been on a small scale (for example, the medieval levels at Tanner Row and Rougier Street).[36] To judge from the lack of structures other than wicker or barrel linings, these earlier post-Conquest cesspits continue the tradition of the Anglo-Scandinavian period. There are several examples of the seats from latrines of the early part of this period (Figure 6.4), although they are sometimes incorrectly referred to as if they were Anglo-Scandinavian.[37] Through time, stone- and brick-lined (external) cesspits and (internal) garderobes became more common and eventually the norm. In one case where a large quantity of material was examined, from excavations of the College of the Vicars Choral in The Bedern, dating to the 14th–17th centuries, brick-lined latrines[38] were rich in food plants, especially seeds and fruit stones of fig, grape, wild strawberry, coriander, and fennel, as well as 'bran', and generally yielded at least a few intestinal worm eggs. In contrast to this evidence for faeces, many of the pits had an insect fauna predominantly of beetles likely to have lived within buildings – these pits were, after all, associated with buildings of good quality – and only occasionally yielded more than a few fly puparia or significant populations of foul-matter beetles.[39] Pits

[36] Hall and Kenward 1990.

[37] Murray, H., *Where to go in York: The History of the Public Conveniences in the City of York* (York: Voyager, 2000), p. 1.

[38] Addyman 1989, pl. 11.

[39] Hall, A.R., Kenward, H.K., Robertson, A. (1993a), 'Investigation of medieval and post-medieval plant and invertebrate remains from Area X of the excavations in The Bedern (south-west), York (YAT/Yorkshire Museum sitecode 1973–81.13 X): Technical report', *Ancient Monuments Laboratory Report* 56/93; Hall, A.R., Kenward, H.K., Robertson, A. (1993b), 'Investigation of medieval and post-medieval plant and invertebrate remains from Area IV of the excavations in The Bedern (north-east), York (YAT/Yorkshire Museum sitecode 1976–81.14 IV): Technical report', *Ancient Monuments Laboratory Report* 57/93; Hall, A.R., Kenward, H.K., Robertson, A. (1993c), 'Investigation of medieval and post-medieval plant and invertebrate remains from Area II of the excavations in The Bedern

of this period sometimes yield larger numbers of puparia, including *Thoracochaeta zosterae*, mentioned above. Another example, from the late 14th century, was a stone-lined cesspit from a site in Low Petergate. Its fills contained the usual mélange of plant foods, including bran, with milled weed seeds, but there was also evidence from the insect fauna for the disposal of floor sweepings from the adjacent building.[40] As for Anglo-Scandinavian York, infestation by *Trichuris* and *Ascaris* seems to have been very common, eggs having been found in a substantial proportion of the deposits investigated.

There seems to have been some dumping in the open air as well as in pits. William the Conqueror caused the damming of the River Foss by the building of one of his two castles in York, leading to the formation of the 'King's Pool', a large shallow lake on the SE side of the city. This seems to have become a focus for waste disposal throughout the medieval period and later, and it seems that the shore adjacent to the core of the city gradually extended into the lake through the dumping of urban ejectamenta. We cannot determine how much of a health hazard this dumping represents, although it must have led to significant water pollution (a point to which we return later). Similarly, we are not sure if it was officially sanctioned to make new ground, the defensive pool now being redundant, or represents 'fly tipping'. There is no bioarchaeological evidence for dung in the streets heaped against houses as described by King from documentary sources for early post-medieval Prescot in Merseyside, [41] and implicit in the presence of garderobes within the city walls of medieval York, including the bars,[42] but how might we ever detect it? It is most unlikely that waste of this kind would ever be sealed into an archaeological sequence in a form where studies of plant and animal remains would give an unequivocal identification, though biomolecular analyses might reveal concentrations of coprosterols or bile acids.[43]

(north-east), York (YAT/Yorkshire Museum sitecode 1976–81.14 II): Technical report', *Ancient Monuments Laboratory Report* 58/93.

[40] Hall, A., Kenward, H., Girvan, L., McKenna, R. (2007), 'Investigations of plant and invertebrate macrofossil remains from excavations in 2004 at 62–8 Low Petergate, York (site code 2002.421)', *Reports from the Centre for Human Palaeoecology, University of York* **2007/06**.

[41] King, W., 'How high is too high? Disposing of dung in seventeenth-century Prescot', *The Sixteenth Century Journal* 23 (1992): 443–57.

[42] Murray 2000, p. 2.

[43] Bethell, P.H., Goad, L.J., Evershed, R.P., 'The study of biomarkers of human activity: the use of coprostanol in the soil as an indicator of human faecal material', *Journal of Archaeological Science* 21 (1994): 619–32; Dickson, J. H., Brough, D.W., 'Biological studies of a Pictish midden', in U. Körber-Grohne and H. Küster (eds), *Archäobotanik.* Dissertationes Botanicae series no. 133 (Berlin: J. Cramer, 1989), pp. 155–66.; Knights, B.A., Dickson, C.A., Dickson, J.H., 'Evidence concerning the Roman military diet at Bearsden, Scotland, in the 2nd century AD', *Journal of Archaeological Science* 10 (1983): 139–52.

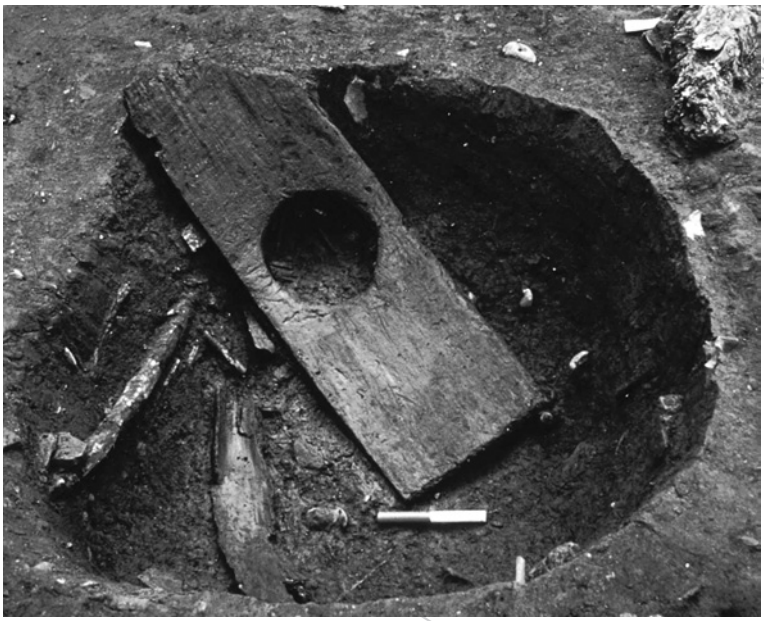

Figure 6.4. 12th century wooden toilet seat from 16–22 Coppergate. The scale is 20 cm long. (Photograph: York Archaeological Trust)

There were at least some communal 'facilities' in York from the later Middle Ages onwards,[44] which demonstrates that the community was attempting to put a stop to *al fresco* defecation and urination. Sabine[45] refers to a medieval 'great well' or cesspool in London but there does not seem to have been an equivalent on such s scale in York, perhaps because most of the town was close to one or other of the rivers running through it.

While there is effectively no documentary evidence that reflects on mundane details of life – and health – in pre-Conquest York, the rise of bureaucracy following the Norman settlement led to the creation of an ever-growing documentary trail. York does not have the richest archive, but there is plenty that has a bearing on the topic at hand. We will not review this – or the documentary evidence for plagues – as we are concerned with biological evidence that has been recovered from archaeological deposits, but useful sources include compilations by Palliser[46]

[44] Murray 2000.

[45] Sabine, E.L., 'Latrines and cesspools of mediaeval London', *Speculum* 9 (1934): 303–21, see p. 305.

[46] Palliser, D.M., 'Epidemics in Tudor York', *Northern History* 8 (1973): 45–63; Palliser, D.M., 'Civic mentality and the environment in Tudor York', *Northern History* 18 (1982): 78–115.

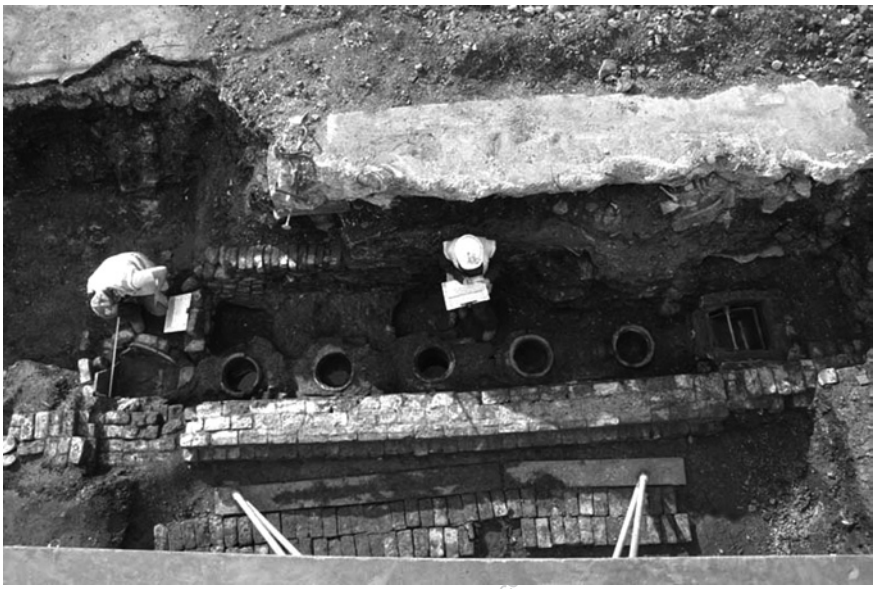

Figure 6.5. Remains of a Victorian system of tipping-flush communal toilets at Hungate. (Photograph: York Archaeological Trust)

and Cooper.[47] Although only peripherally concerned with archaeological evidence, Murray's very readable account of the history of public conveniences in York also deserves further mention here.[48]

The Recent Past

Recent excavations in York at Hungate have given us the opportunity to explore sanitation in the city in the much more recent past. Within a block of badly made mid-19th terraced brick houses lay a yard with a communal latrine, serving five households, immediately behind the back wall of the houses. Later, by the time the houses were 'accommodating' 11 households with perhaps as many as 50 people, the cesspit was replaced by a system in which a row of large metal buckets on pivots became filled with rainwater and, when full, tipped and flushed the effluent.[49] In the absence of piped water, this cannot have been very efficient much of the time in an area of predominantly low rainfall – the smell must have been revolting

[47] Cooper, T.P., 'The medieval highways, streets, open ditches and sanitary conditions of the City of York', *Yorkshire Archaeological Journal* 22 (1913): 270–86.

[48] Murray 2000.

[49] Hunter-Mann, K., 'Scratching the surface of Early Modern York: the Block E excavation, Hungate', *Yorkshire Archaeology Today* 12 (2007): 12–14, see Figure 6.5.

and disease transmission by flies rife. There are almost no records of intestinal parasite eggs from the post-medieval period (Table 6.1), but we suspect that this is not because infestation levels dropped significantly, but because preservation is generally poorer and rather few deposits have been examined for worm eggs.

Some General Issues

One of the most important sources of human disease is contaminated water. Unfortunately we know very little about water supplies in York's more remote past. We do know that there were excellent deep wells in Roman York,[50] and there has been speculation concerning the existence of an aqueduct to the city.[51] Addyman illustrates one of the Roman water pipes recovered from the city.[52] For later periods, up till the installation of piped water in the 19th century, wells and the rivers appear to have been the only water sources, although rainwater may have been collected in cisterns. The last of these may have provided water of moderate potability, but at least some supposed wells of the Anglo-Scandinavian and medieval periods seem to have been located worryingly close to cesspits, and the quality of river water may usually have been questionable, bearing in mind the discharge from sewers in the Roman period and the likely dumping of foul waste at this and later periods. There are hints of a decline in water quality in the Ouse from studies of fish bones and bivalve molluscs,[53] but this is an area in need of a good deal of further study. That the Ouse was badly polluted by human waste from 'privies and jakes' along its margins within the city seems certain; Murray[54] refers to ordinances in 1579 to have them removed. York's other river, the Foss, has a more limited flow and there is archaeological evidence for waste dumping into it at some period (see above), so it was surely severely polluted. There is certainly evidence from the Foss for Anglo-Scandinavian or early post-Conquest flax retting,[55] which generates extremely foul water. Again, there is room

[50] Carver, M.O.H., Donaghey, S., Sumpter, A.B., *Riverside Structures and a Well in Skeldergate and Buildings in Bishophill*. The Archaeology of York series 4(1) (London: Council for British Archaeology, 1978); Hall, A.R., Kenward, H.K., Williams, D., *Environmental Evidence from Roman Deposits at Skeldergate*. The Archaeology of York series 14(3) (London: Council for British Archaeology, 1980); Kenward, H.K., Hall, A.R., Jones, A.K.G., *Environmental evidence from a Roman well and Anglian pits in the Legionary Fortress*. The Archaeology of York series 14(5) (London: Council for British Archaeology, 1986).

[51] Buckland 1976.

[52] Addyman 1989, pl.4.

[53] Hall and Kenward 1990, p. 386; Kenward and Hall 1995, p. 780; O'Connor, T.P., *Bones from Anglo-Scandinavian levels at 16–22 Coppergate*. The Archaeology of York series 15(3) (London: Council for British Archaeology, 1989), p. 198.

[54] Murray 2000, p. 3.

[55] Hall et al. 2000.

for further study of the margins of the Foss around the King's Pool through the post-Conquest period.

We mentioned above the contamination of bread by weed seeds, but it is quite likely that, in the Roman and post-Norman Conquest periods, contamination by grain pests was prevalent (the typical grain pests seem to have been very rare or more probably absent in Anglo-Scandinavian times[56]). There are records of abundant grain weevils (*Sitophilus granarius* (L.)) and other grain pests in deposits interpreted as the remains of stored grain as well as more generally through occupation layers. In the latter case, the most likely explanation for their presence is that they arrived in stable manure, infested grain having been fed to horses (the importance of the grain pests in the Roman period in Britain is discussed by Smith & Kenward[57]). Grain pests are sometimes found in cesspit fills, but it is not clear whether they had been through the human digestive tract first – it has been shown by Osborne[58] that insects are not significantly damaged by such a journey. On the other hand it seems fairly certain that most of the bean weevils (*Bruchus rufimanus* Boheman) *had* been swallowed inside pulses; indeed, some of the fossils are of individuals whose cuticles had not hardened so that they were certainly still inside their host seeds when they died. Species association analysis suggested that *Bruchus* tended to occur with a group of insects found especially in cesspit fills at Anglo-Scandinavian Coppergate.[59]

Although somewhat peripheral to the topic of waste disposal, it is worth mentioning that there are numerous records of human ectoparasites from Roman, Anglo-Scandinavian and later York.[60] These include large numbers of human fleas (*Pulex irritans* Linnaeus), the larvae of which develop in accumulations of filth. As an example, *P. irritans* was consistently present in and around the Anglo-Scandinavian buildings at 16–22 Coppergate, while *Pediculus humanus*, the human louse, was found in over 50 layers.[61] The comparative rarity of *P. humanus* in the ground probably reflects differential preservation rather than a difference in levels of infestation of people. Both of these ectoparasites are implicated in disease transmission, of course, and both must have been almost inevitable companions of people in the past.

[56] Kenward 2009.

[57] Smith, D., Kenward, H., 'Roman grain pests in Britain: implications for grain supply and agricultural production', *Britannia* 42 (2011): 243–62.

[58] Osborne, P.J., 'An insect fauna from a modern cesspit and its comparison with probable cesspit assemblages from archaeological sites', *Journal of Archaeological Science* 10 (1983): 453–63.

[59] Carrott and Kenward 2001: 887–905.

[60] Kenward 2009, p. 339ff.

[61] Kenward and Hall 1995, pp. 488–91 and 700–3.

Bones of food animals are a major component of the archaeological build-up in York as in other towns.[62] Most of these probably represent cooked 'post-consumer' waste that would not generally have been a significant health hazard – and was clearly tolerated, given the frequency with which bones occur in floors and other surface-laid deposits. More serious may have been various components of butchery and skin processing. These will have attracted a range of specialist scavengers that could subsequently disseminate disease organisms, although only gut contents and skin scrapings may have generally been discarded, everything else ending up as glue or stew. We have yet to recover convincing evidence of such vile material.

The remains of animals were not the only organic 'waste' likely to have been recycled. Many other materials will have had a secondary use, for example as food for livestock, absorptive litter in stables, make up for roads and other surfaces, manure, or fuel. In some of these cases the material will have been effectively lost to the bioarchaeological record of the occupation site – manure taken out to fields, for example, is evidenced only by potsherds and other durable material, or possibly through biochemical markers, in cultivated soils. Stable manure is a special case deserving a little further consideration. As noted above, while foul and produced in enormous quantities at some periods, it is much more tolerable close to human occupation. It must be for this reason – and the fact that it may often be 'self-preserving' – that its remains are so often found in urban deposits. This is fortuitous, since the numerous materials it may contain and their diverse origins can provide many insights into wider aspects of the past than just the stabling of equines.[63]

We have mentioned above that much of the organic waste deposited on surfaces, but also in cuts into well-drained substrates, will have decayed so as to leave only residues that are not easily identified. In consequence, we can rarely be sure that absence of evidence of filth in the archaeological record is truly evidence of absence in the past. However, it seems very probable that some parts of York at most periods did not have more than traces of decaying organic matter exposed to the air. Much of the core of Roman York, with its technologically advanced sewer system, surely falls in this category. But would any filth have survived if it were deposited on metalled surfaces? Unless very large quantities were deposited quickly, most would surely have dispersed naturally, even if not swept up. There is a hint from within the Roman fort at Carlisle that there may have been horse

[62] O'Connor, T.P., *Bones from the General Accident Site, Tanner Row*. The Archaeology of York series 15(2) (London: Council for British Archaeology, 1988); O'Connor 1989; Bond, J.M., O'Connor, T.P., *Bones from Medieval Deposits at 16–22 Coppergate and other Sites in York*. The Archaeology of York series 15(5) (York: Council for British Archaeology, 1999).

[63] Kenward and Hall 1997: 663–73; Hall, A., Kenward, H., 'Disentangling dung: pathways to stable manure', *Environmental Archaeology* 1 (1998): 123–6; Kenward and Hall 2012, pp. 79–95.

manure on surfaces, from the strong statistical association between grain beetles (which probably arrived within faeces) and dung beetles,[64] though it is uncertain for how long such dung lingered. We have yet to discover parallel evidence from York.

People living in clean zones of towns and, in the Roman period, in military establishments, may not have been immune to the effects of the filth exposed in less salubrious areas nearby, however. Apart from the smell, their homes and barracks would certainly have been invaded by the abundant flies emerging from cesspits and middens. Thus even the occupants of the religious houses with drains and an inherent regime of cleanliness were probably subject to fly-borne disease.

We have very briefly surveyed 2000 years of the disposal of organic waste in York, but what of future studies in this area? We are not optimistic that the archive of organic material under the city will survive or be studied. Many of the deposits rich in delicate biological remains such as plant tissues and insect fragments are not within stable water-tables, which would favour their continued survival, but in deposits that appear to have perched water-tables or that hold water like sponges.[65] Changing groundwater regimes are suspected to be leading to the decay of these richly organic deposits.[66] At the same time, the nature of British archaeology has changed radically, from a regime under which there were often intensive studies of large corpora of material to one in which there are numerous but usually very superficial and unpublished studies of small excavations.[67] There are rays of hope, however. The many small excavations do, at least, offer a more or less random sample of 'keyholes' into the past and, with pressure from local planning offices, some property developers are still prepared to fund large-scale excavations with a research component. Recent excavations at Hungate, York, represent just such a case.

[64] Kenward, H., Carrott, J., 'Insect species associations characterise past occupation sites', *Journal of Archaeological Science* 33 (2006): 1452–73.

[65] Kenward, H.K., Hall, A.R., 'Easily decayed organic remains in urban archaeological deposits: value, threats, research directions and conservation', in O. Brinkkemper, J. Deeben, J. van Doesburg, D. Hallewas, E.M. Theunissen and A.D. Verlinde (eds), *Vakken in Vlakken. Archeologische Kennis in Lagen*. Nederlandse Archeologische Rapporten 32 (Amersfoort: Rijksdienst voor het Oudheikundig, 2006), pp. 183–98.

[66] Kenward, H., Hall, A., 'Decay of delicate organic remains in shallow urban deposits: are we at a watershed?', *Antiquity* 74 (2000): 519–25; Kenward, H., Hall, A., 'Urban organic archaeology: an irreplaceable palaeoecological archive at risk', *World Archaeology* 40 (2008): 584–96.

[67] Hall, A.R., Kenward, H.K., 'Development-driven archaeology: bane or boon for bioarchaeology?', *Oxford Journal of Archaeology* 25 (2006): 213–24.

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Table 6.1 Representative records of presumed human intestinal parasites from archaeological deposits in York.[68] Many records for the medieval/post-medieval transition could not be included because dating was too broad.

Date	Site	Parasites	Deposit type
Roman	24–30 Tanner Row (pre-buildings)	traces T, A	ditch fills
	24–30 Tanner Row (Colonia)	abundant T, A	drain fills
	The Bedern (Fortress)	traces T, A	well backfill
Anglian	Blue Bridge Ln	traces T	pit fill
	36–54 Fishergate	traces T, A	various deposits, including dog coprolites
Anglo-Scandinavian	6–8 Pavement	abundant T, A	human coprolite
	16–22 Coppergate	abundant T, A	pit fills and various other deposits, including traces in floors
	4–7 Parliament St	abundant T, A	?pit fills
	2 Clifford St	traces T, A	pit fills
	28–9 High Ousegate	sometimes abundant T, A	pit fills
	118–126 Walmgate	sometimes abundant T, A	various
	7–9 Aldwark	sometimes abundant T, A	pit fills
	NCP Car Park, Skeldergate	sometimes small numbers T, A	pit fills
	1–9 Micklegate	sometimes abundant T, A	pit fills
Norman and later medieval	7–9 Aldwark	some T, A	pit fills
	The Bedern	some T	pit fills
	Davygate	some T, A	concretions
	former Presto supermarket (George Hudson St)	some T, A	pit fill

[68] Kenward, H. (2009), 'Invertebrates in archaeology in the north of England', *(English Heritage) Research Department Report Series* 12/2009. (available online at http://services.english-heritage.org.uk/ResearchReportsPdfs/012_2009WEB.pdf)

Date	Site	Parasites	Deposit type
	62–8 Low Petergate	abundant T, some A	pit fills and other layers
	Merchant Adventurers' Hall	some T	levelling/dumps
	50–2 Monkgate	some T	pit fill
	44–5 Parliament Street	sometimes abundant T, traces A	pit fills
	17–21 Piccadilly (Reynard's Garage)	traces T, A	pit fill
	5 Rougier St	traces T	pit fill
	St Andrewgate	some T, ?A	dump
	9 St Saviourgate	abundant T, some A	pit fills
	Swinegate area	traces T, A	various deposits
	NCP Car Park, Skeldergate	some T, A	layers, pit fills
	7–15 Spurriergate	sometimes abundant T, A	pit fills and other deposits
	24–30 Tanner Row	traces T, A	pit fills
	47–55 Tanner Row	traces T	pit fill
	1–2 Tower Street (Castle Garage)	traces T, A	fills of large ditch/ moat
	41–9 Walmgate	traces T, A	pit fill
Post-medieval to modern	9 St Saviourgate	abundant T, some A	pit fills

(Copies of the unpublished *Reports from the Environmental Archaeology Unit, York* and *Palaeoecology Research Services Report* series are available as pdfs from http://www.york.ac.uk/inst/chumpal/EAU-reps/eaureps-web.htm and *Reports from the Centre for Human Palaeoecology* are available at http://www.york.ac.uk/inst/chumpal/CHPReps/CHP-reps-web.htm)