# Setting People in their Environment: Plant and Animal Remains from Anglo-Scandinavian York

By Allan Hall and Harry Kenward

## Introduction

For the past millennium, the inhabitants of the centre of York have, whether they knew it or not, been living on top of a compost heap in which are preserved all kinds of remains of Anglo-Scandinavian and early post-conquest life. The preservation of this mass of organic matter has come about because, for reasons which are not fully understood, the deposits show anoxic waterlogging — in other words they have remained moist, and decay has been inhibited by lack of free oxygen. Later citizens must often have encountered these 'peaty' deposits and wondered about some of the more recognisable biological remains, as well as the numerous artefacts, surviving in them. However, it was not until the early 20th century that the value of all this material in investigating the past started to be appreciated (see p.294).

## Early observations

There are a few early allusions to plant and animal remains from Anglo-Scandinavian York, as well as to the nature of the deposits containing them. Over a century ago, it had become clear that the centre of York was the repository for an important archive of plant and animal remains from the early medieval period. Benson (1902) observed deposits at 25, 26 and 27 High Ousegate, some of which — to judge from their character and from the evidence of later excavations — were surely of Anglo-Scandinavian date. He wrote (p.64) that 'the material [exposed] was a black warp deposit, matted with brushwood, pieces of leather, bones and horns of cattle, sheep, pigs, goats, etc., tusks of boars, cut antlers of red and fallow deer, and occasionally oyster shells. A thin light-coloured strawy band, two inches deep, occurred here and there, and gave out a strong odour that savoured of manure. The deposit was very compact and could be cut vertically, and on digging into it vapours were emitted similar to steam.' By analogy with the 16–22 Coppergate excavation, such deposits accumulated in the 10th–13th/14th centuries.

Benson's comments also embody an early attempt to interpret the formation of the deposits (p.65): 'the site of the excavation has been subject to floods, warp being deposited, and vegetation growing between times to be entombed by warp with recurring floods. The district was a swampy one; the leg bones of a stork or heron were found. The area has been raised by warp deposits and in later times the road was heightened five feet, may be as a barrier between the two rivers when in flood. The depth of this warp deposit has not been reached, although penetrated three feet below present level of digging.' Ramm (1971), evidently influenced by these early comments, perpetuated the 'warp' theory when he wrote at some length on the supposed evidence for late and post-Roman flooding. In particular, he cites (ibid., 183) a late 19th-century account of finds of Viking (and Anglian) date at the Friends' Meeting House between Clifford Street and Castlegate: 'under the finds "was heather and ling" indicating an open site in what had been the middle of the closely packed civilian area south of the fortress. Heath is the vegetation that might be expected to grow over silt left behind after the floods had receded.' Sadly, this last statement is untenable: heath is almost the *last* kind of vegetation to colonise such deposits and it is very much more likely — given all subsequent studies in the city — that the sequence at the Friends' Meeting House included heather (ling is the same plant!) imported by the Anglo-Scandinavian inhabitants of the area for one or more of many purposes. It is worth mentioning here that vegetative remains of heather, *Calluna vulgaris* (L.) Hull, have been recorded from as many as 173 contexts at 16–22 Coppergate, sometimes in considerable quantity, and from twelve layers at 6–8 Pavement; a 20–30 mm thick layer of heather was also recorded at 21–33 Aldwark (Seaward and Williams 1976; *AY* 10/2). That there is no clear evidence for flooding in York in the Anglo-Scandinavian period will be argued below.

## History of biological analyses

The earliest report on plant or animal remains from Anglo-Scandinavian York that was more than anecdotal in nature was that by Godwin and Bachem (1959) on plant material from Richardson's excavations in Hungate . They studied plant macro-fossils from a pit fill and five 'levels' (layers), dated as 'Late Anglo-Saxon' or 'Anglo-Danish' from a brushwood and clay bank; in all, eight samples were examined, though no details of their size were published. The samples contained a wide range of uncharred material including wetland taxa and weeds of cultivation, especially cornfield weeds and nitrophiles, but also some *Prunus* stones and several grassland plants. Hop and ?flax were both present, but the tentative identifications of seeds of 'vegetables' are rather suspect. Indeed, a number of the taxa were not regarded by the original authors as necessarily satisfactorily identified at the level of species and this, and the lack of accurate dating, makes this early work of rather limited value, other than as a demonstration of potential.

The 'rescue' excavations of the 1970s–1980s can be seen as the period in which the study of plant and animal remains from archaeological deposits in York evolved from a marginal to a central role. Much of the stimulus for this came from Peter Addyman and Paul Buckland during the earliest years of York Archaeological Trust's work in the city, and by 1975 there was sufficient momentum for the Ancient Monuments Laboratory of the then Department of Ancient Monuments and Historic Buildings to establish and core-fund the Environmental Archaeology Unit at the University of York to undertake the routine analysis of a wide range of biological remains and archaeological sediments from York's extensive excavations. Anglo-Scandinavian material figured prominently in these early projects, starting with 6–8 Pavement but mainly through the large-scale investigations at 16–22 Coppergate in the period 1976–81. This was a time when techniques for sampling, for processing, and for analysis were all being developed and it is for this reason that Kenward and Hall wrote in 1995 (*AY* 14/7, 437) 'the ill-formed theoretical base for work on biological remains from urban deposits in existence ... meant that the investigations ... were essentially an exercise in exploratory data gathering with *post hoc* "interpretation". Only when a substantial proportion of the work had been completed ... [could] the authors ... begin to construct hypotheses...'. Urban environmental archaeology is a discipline which still requires a great deal of fundamental research.

Since the advent of 'developer-funded' archaeology in the 1990s, opportunities for studying biological remains from the usually rather deep-lying Anglo-Scandinavian levels in York have become extremely limited. Indeed, it is something of an irony that the city's (and for that matter the nation's) policy with regard to preservation of its below-ground heritage was in part born out of the problems encountered at a site where there happened to be excellent waterlogged preservation of Anglo-Scandinavian occupation deposits (but an inadequate provision for sampling and post-excavation analysis), viz. at 1–9 Micklegate. As Table 6 shows, interventions in the last decade have generally yielded at most only one or a few samples of Anglo-Scandinavian date, the most important being those from St Saviourgate, Layerthorpe Bridge and 4–7 Parliament Street (preservation of delicate plant and invertebrate remains at the last-named site was as good as or better than anything observed at 16–22 Coppergate). The fall-off in numbers of samples from Anglo-Scandinavian deposits subjected to biological analysis over the past three decades has been dramatic: there have botanical analyses of over 500 contexts from sites excavated in the 1970s, but only 50–60 from both of the two succeeding decades. However laudable the policy of in-ground preservation, the failure to collect samples when opportunities arise is, in academic terms, reprehensible, especially if there is a long-term threat to at least some of the deposits (Kenward and Hall 2000c; Kenward and Hall forthcoming).

## What are the deposits made of?

As the passages from Benson and Ramm quoted above indicate, the question of how these thick organic occupation deposits dating to the Anglo-Scandinavian period in York formed and subsequently survived the vicissitudes of a millennium of burial is an important one. That the deposits were, in most cases, clearly not laid down in water or by the agency of flooding means that they formed subaerially (although some pit fills must have been saturated as they formed). Parallels in nature are accumulations of peat in fens and bogs where ground water conditions or levels of precipitation are such that plant and other organic matter steadily builds up because deposition rates are faster than rates of decay. It is not surprising, therefore, that the more richly organic deposits at sites like 16–22 Coppergate were commonly termed 'peats' during the earlier stages of excavation. A better analogy, though, is with a garden compost heap which has been poorly constructed and is consequently insufficiently well drained and aer-

**Table 6** Sites with Anglo-Scandinavian deposits in York for which some analysis of plant and/or invertebrate remains has been made. References marked * are archaeological reports with passing references to biological remains but no detailed account of results concerning their study

| Site name | References | Nature of site | Size of corpus of samples |
|---|---|---|---|
| Hungate (1949) | Godwin and Bachem (1959) | one pit fill and five 'levels' (layers), dated as 'Late Anglo-Saxon' or Anglo-Danish, and coming from a 'brushwood and clay bank' | very small |
| 6–8 Pavement (1972.21) | *AY* 14/4 | ?floors associated with wattle structures | modest |
| 21–33 Aldwark (1973–4.6) | Seaward and Williams (1976); Greig (1983); *AY* 10/2* | layers of brushwood and moss | very small |
| 58–9 Skeldergate (1973–5.14) | Tomlinson (1989a) | mostly pit fills, but phasing not certain | small |
| 5–7 Coppergate (1974.8) | *AY* 14/4 | deposits of uncertain nature associated with wattle; probably Anglo-Scandinavian | modest |
| site adjacent to 1–5 Aldwark (1976–7.15) | Kenward (1986); Kenward and Robertson (1988); Hall (1988); *AY* 10/2* | ?Anglo-Scandinavian bank deposits and pit fills | small |
| 16–22 Coppergate (1976–81.7) | *AY* 14/7 | various deposits associated with post-and-wattle and plank buildings and their surroundings | very large |
| 118–26 Walmgate (1978–9.8) | Tomlinson (1989b); Kenward and Hall (2000b) | floors, pit fills and external layers | modest |
| 5 Rougier Street (1981.12) | *AY* 14/6 | a pit fill and its timber lining | very small |
| 36 Aldwark (1983.1) | Tomlinson (1989c) | two ?soil deposits; assessment only | very small |
| 24–30 Tanner Row (1983–4.32) | *AY* 14/6 | five contexts, mainly from a timber-lined pit (dated C11–12) | very small |
| 46–54 Fishergate (1985–6.9) | *AY* 11/2 | three pit fills dated late C10/first half C11 | very small |
| 7–9 Aldwark (1985.5) | McKenna et al. (1988); Tomlinson (1989d) | fills of two pits, ?Anglo-Scandinavian | very small |
| 22 Piccadilly (1987.21) | Carrott et al. (1995) | mostly waterside dumps; assessment only | small |
| 1–9 Micklegate (1988–9.17) | O'Connor (1990); Dobney et al. (1993); Kenward and Hall (2000a) | various deposits associated with post-and-wattle buildings and their surroundings | modest |
| Adams Hydraulics, Phase I (1990–1.13) | Alldritt et al. (1990) | one levelling/'agricultural' deposit; evaluation only | very small |

| Site name | References | Nature of site | Size of corpus of samples |
|---|---|---|---|
| 104–12 Walmgate (1991.21) | Carrott et al. (1992a) | pit fills; evaluation only | very small |
| Carmelite Street (1991.9) | Carrott et al. (1991) | one linear cut fill; evaluation only | very small |
| 41 Piccadilly (1992.18) | Dobney and Hall (1992) | one dump deposit; evaluation only | very small |
| 38 Piccadilly (1992.4) | Carrott et al. (1992b) | two build-up deposits overlying a cobbled surface; evaluation only | very small |
| North Street (1993.1) | Carrott et al. (1993a) | dump deposits; assessment only | small |
| 148 Lawrence Street (1993.11) | Carrott et al. (1994a) | one pit backfill; evaluation only | very small |
| 9 St Saviourgate (1995.434) | Carrott et al. (1998a) | pit fills; assessment only | small |
| All Saints' Church, Pavement (1995.47) | Hall et al. (1998) | occupation deposits from boreholes; assessment only | very small |
| St George's School (1995.1) | Buckland (1995); Hajnalova and Charles (1995) | occupation deposits; evaluation only (by ARCUS); dating not wholly certain | very small |
| Foss Bridge/Peasholme Green/ Layerthorpe Bridge (1996–7.345) | Hall et al. (2000b) | riverside dumps and features (dating frequently imprecise) | modest |
| Davygate (1997.102) | Carrott et al. (1997) | a single dump deposit; evaluation only | very small |
| 2 Clifford Street (1999.256) | Hall and Kenward (2000b) | probable external accumulations | very small |
| 41–9 Walmgate (1999.941) | Johnstone et al. (2000) | mainly floors and associated make up; assessment only | small |
| 4–7 Parliament Street (1999.946) | Hall and Kenward (2000a) | some perhaps middens, but all probably pit fills | very small |

ated: decay of plant matter is slow and the heap fails to compost properly.

Of course, the Anglo-Scandinavian deposits in York are not entirely derived from the decay of plant and animal remains, and in some cases have no perceptible organic content. It is worth considering how the inorganic component originated. Some is clearly artefactual — pottery, the debris of brick and tile, and building stone. This is true even of the fine mineral particles, which under the microscope can be often be seen to be fragments of fired material. Much of the sand grade and finer sediment may have accumulated in an essentially natural way, through windblow and trample, or by excavation from the underlying natural deposits. Another source would have been the erosion of Roman building stone and mortar. Probably the bulk of the mineral sediment, however, was imported, either deliberately as make up or accidentally with plant resources and perhaps turf. 'Clay layers', often actually silts or clay silts, have been recorded fairly often, having been used as levelling or packing. The origin of these materials has not yet been investigated, though some undoubtedly was dug up from the underlying moraine. Some clean sands may have been brought from further afield, although some beds of well-sorted sands occur in places in the moraine within the limits of the early town.

Many deposits with a silty texture (often perceptible as a silky or soapy feel between the fingers) have proved on closer investigation to be ash. Most of this presumably was wood ash and, indeed, fragments of wood charcoal are often dispersed through it. Further investigation of such deposits may reveal ash derived from peat, but this is a neglected area of research in York. Charcoal itself, presumably mainly derived from fuel, is abundant in many Anglo-Scandinavian deposits, sometimes forming an appreciable component (Fig.87).

## *Wood as a component of the build up*

If we consider the materials contributing the bulk of the organic build up at sites like 16–22 Coppergate, 6–8 Pavement and so on, it is evident that uncharred wood and timber in one form or another is often significant. Apart from structural material, and smaller fragments which may represent decayed structures or artefacts, debris from woodworking was at times and in places an important contributor to bulk and water retention in deposits. Although probably very much under-recorded archaeobotanically (to judge from records made during excavation at Coppergate, for example), wood chips — fragments up to about 25mm in maximum dimension, often in thin flakes or wedges, and distinguished by having one or more straight cut edges — have been quite frequently noted in assemblages of plant remains from Anglo-Scandinavian sites (Fig.87). Given the preservative qualities of tree bark employed by tanners, one might wonder whether the presence of so much tannin-rich material (especially bark, but to a lesser extent also wood) was not a major factor in the 'self-preservation' of these richly organic occupation deposits, as alluded to in connexion with bracken- and leather-rich deposits at Vindolanda on Hadrian's Wall by Seaward (1976). This is certainly an area where some simple experimental studies could easily be made. Fig.87 also indicates how frequently bark may be recorded in these occupation deposits.

## *Other components of build up*

For many of the organic deposits, studies of the plant remains and parasite eggs have shown that a major component was faeces, whilst in numerous others concentrations of dyeplants have been recorded (both are discussed further below).

The volume of human faecal material at 16–22 Coppergate has been estimated by Kenward and Large (1998b) as over 45m³. The volume of compressed faeces, largely human, buried in those areas of York with Anglo-Scandinavian anoxic waterlogging must be enormous. Assuming there is about 100ha of Anglo-Scandinavian waterlogged deposits in the city and (perhaps dangerously) that Coppergate (with an area of 0·1ha) is typical, the total volume of buried faeces could be of the order of 45,000m³ (but see p.493). To this can be added an enormous quantity of plant material originating in dyeing processes, to judge from the amounts of material interpreted as dyebath waste at Coppergate and other sites (see pp.395, 404).

Bone is another very significant component of the deposits, although its volume is perhaps rarely as great as the subjective impression gained during excavation. Nevertheless, it is estimated that some millions of bone fragments, contributing many cubic

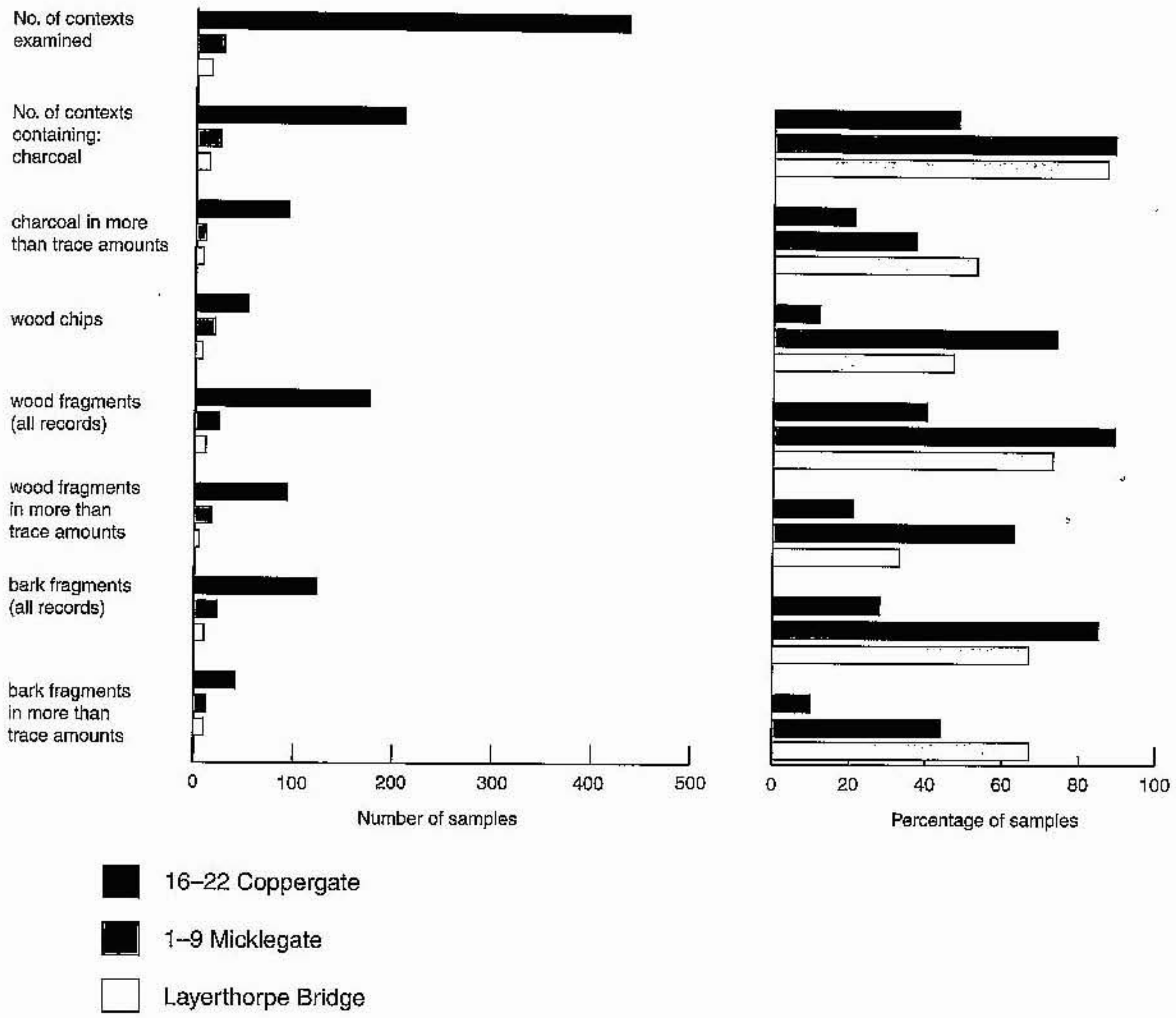



*Fig.87 Records for charcoal, wood chips, wood fragments in general, and bark fragments in samples from which plant remains have been studied from Anglo-Scandinavian deposits from three sites in York*

metres to the accumulated deposits, were recovered from excavations at 16–22 Coppergate, if both hand-collected and sieved material are considered.

While some layers consist of only one kind of material, it is not surprising that many, perhaps most, contain a mixture of components of various origins. Disentangling the complex mixtures of biological remains (and other material) in these more heterogeneous deposits is one of the more challenging aspects of environmental archaeology, but it is essential if environment and activity in the past are to be elucidated.

## An astonishing diversity of evidence

It has been established that a great variety of materials contributed to the build up in Anglo-Scandinavian York. For the biological remains, the quality of preservation in many of the deposits has been such that extraordinarily — even bewilderingly — long lists of plant and insect remains have often been compiled from studies of only a kilogramme or two of raw sediment. Thus, for example, more than 30 of the insect assemblages from 16–22 Coppergate each included over 100 species of beetles (out of perhaps 900 beetle species recorded from the site as a whole, and out of about 3,800 on the modern list for the British Isles). For the plant remains, as many as 82 taxa of vascular plants have been recorded from a single sample (again from 16–22 Coppergate), out of a total for the site as a whole of 431 (for comparison, nearly 3,000 plant species are established in Britain at the present time).

Why have so many species been found? For the plants, the explanation lies principally in their exploitation by human beings, who brought a wide range of plant materials to York for many purposes, and also imported larger or smaller amounts of even more plant species incidentally with plant or other resources (e.g. woodland moss and turves). For the insects, other explanations must be sought. Undoubtedly, numerous insects were also brought accidentally with plant resources, water and turf. However, many species were established in the town, taking advantage of a range of habitats created by human activity. Unique insect communities arose which are not paralleled in nature (Kenward and Allison 1994a). Species which are normally rare in natural habitats were able to prosper — those which reproduce rapidly as an adaptation to patchy, short-lived habitats, such as dung, found huge concentrations of habitat, and slowly reproducing species normally found in small numbers in stable, long-term habitats were also able to build up large populations.

## Structural materials

The first impression gained by a visitor to Anglo-Scandinavian York would doubtless have been of a vast expanse of crowded buildings in what was one of the largest urban centres of the period. What were these buildings made of? And where did the building materials come from?

Excavation answers the first of these questions in broad terms. Post-and-wattle buildings have been recorded at various locations, notably at 6–8 Pavement, in the Period 4B levels at 16–22 Coppergate, and at 1–9 Micklegate. A later stage of building at Coppergate (Period 5B) employed massive oak planks and uprights, as did buildings at 25–7 High Ousegate (Benson 1902; *AY* 8/3, 247), King's Square (Stead 1968; see Fig.75, p.299) and 1–9 Micklegate. The quantities of roundwood required for wattle buildings (not to mention all the ancillary structures such as fences, screens and pit linings) must have been very large, to extrapolate from the amounts surviving in the ground. The above-ground structures would have a short existence before the ravages of moulds and perhaps also insects led to their collapse: Hall et al. (*AY* 14/4) suggested a lifetime of 10–15 years, so that there would have been a continuing need for replacement. The environmental impact of winning all this wood is considered below (pp.411–18). The spider beetle *Tipnus unicolor* (Piller and Mitterpacher), or at least its rarity, may offer further evidence for the short life of buildings (see p.400).

The broad nature of the structures at this period is thus well established, but some details are not. Outstanding amongst these lacunae is continuing uncertainty as to the nature of the roofs. When the report on plant and invertebrate remains from 16–22 Coppergate was written, this question was merely touched on. More evidence has since come to light; combined with work on various sites elsewhere, this has clarified the picture somewhat. Kenward and Hall (*AY* 14/7, 723–4) discussed the records of brushwood at Coppergate and considered the possibility that at least some of it represented layers from within roofs. Similarly, evidence for turves might point to the use of this material in roofing (ibid., 724–5).

While the case for brushwood as a component of roofing is still weak, that for turf roofs has strengthened somewhat. Perhaps the best indicator that turf was used frequently in Anglo-Scandinavian York is the heath grass, *Danthonia decumbens* (Fig.88). This rather short-growing grass (typically 10–40cm tall) is widespread on poorer soils, especially sandy or peaty, often damp, substrates, particularly on heaths and moors. That the cleistogenes (fertile spikelets forming in the culm bases rather than on aerial stalks) were recorded from some contexts at Coppergate suggests the basal parts of the plant found their way into the deposits; routes for this include turves, but also gut contents from herbivores such as sheep which crop closely. In the absence of any clear evidence for gut contents, and in view of some records of heathland insects (and a variety of heathland plants), the importation of *Danthonia* in grass sods is a distinct possibility (see further discussion by Hall 2003). Heather might be brought for a variety of purposes but some records of roots and basal twigs of this plant, and of mosses from heathland surfaces, might suggest the use of turves rather than cut heather. For one of these cases, it was specifically sug-

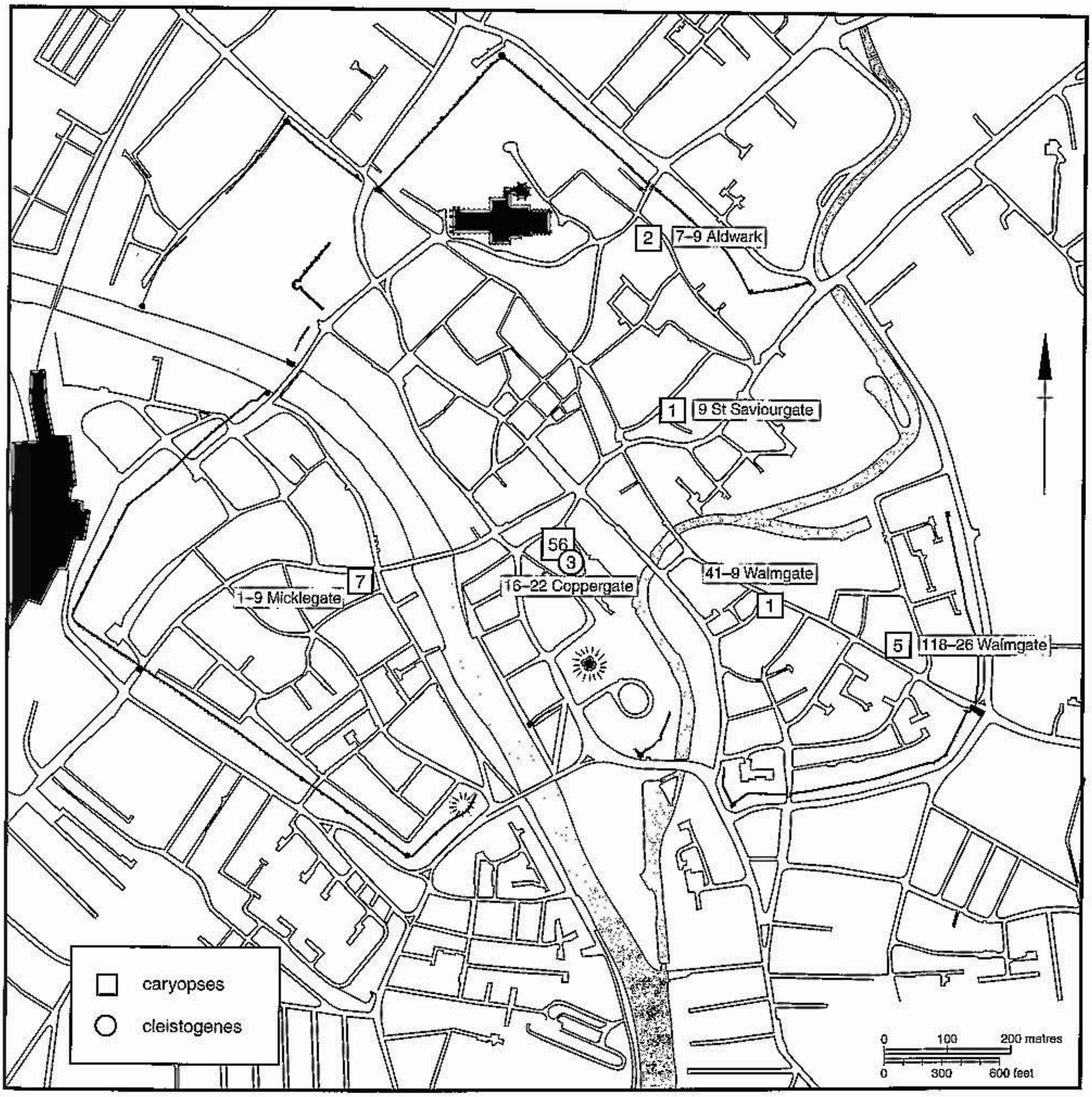



*Fig.88 Numbers of contexts with* Danthonia decumbens *(heath grass) remains from sites in Anglo-Scandinavian York*

gested that a range of typical heathland/moorland insects in the deposit had probably been imported in cut turf (*AY* 14/7, 611).

Heathland/moorland insects, mostly *Ulopa reticulata* (Fabricius) and *Micrelus ericae* (Gyllenhal), were recorded from a small number of contexts at Coppergate. As there was no indication of an origin in peat, turf was favoured as a likely source for these remains (ibid., 724). The argument for turf is greatly strengthened by the lack of records for these insects from Period 3 (see Table 17, p.415), when buildings were insubstantial. The evidence for the importation of peat to Anglo-Scandinavian York is minimal (pp.414–16), in contrast to the numerous records for Roman York, and its fairly frequent occurrence in post-conquest deposits, e.g. at a site in Bedern (*AY* 10/3) and at two sites in Swinegate (Hall et al. 1991; Carrott et al. 1994b). Ants from heathland were found at nearby 6–8 Pavement during the preliminary investigation (Buckland et al. 1974), but heath/moor insects were present only in traces in the main series of samples (*AY* 14/4, 221); inspection of the database for the site shows that most of the records were of *Strophosomus sus* Stephens. This rather large weevil seems much more likely to have arrived in turf than in cut vegetation since it drops from vegetation when disturbed. Importation of specimens caught in spider webs on heather is just possible, however.

The very fragmented remains of 'outdoor' insects found in floor deposits of some of the houses at Coppergate (*AY* 14/7, 550, 555, 557, discussed 736), may have originated in turf roofs. The cycles of changes in moisture status and the action of scavengers may gradually have reduced the corpses in turf to particles small enough to filter down as dust. If this explanation is correct, there should be parallel evidence from fragmented plant remains, and we may have a much-needed tool in the difficult campaign (conceptually) to reconstruct ancient roofs. Unfortunately, other explanations for the presence of fragmentary insects cannot be ruled out; for example, bats reduce insect cuticle to minute fragments (e.g. Swift et al. 1985), and commensal rodents may do the same.

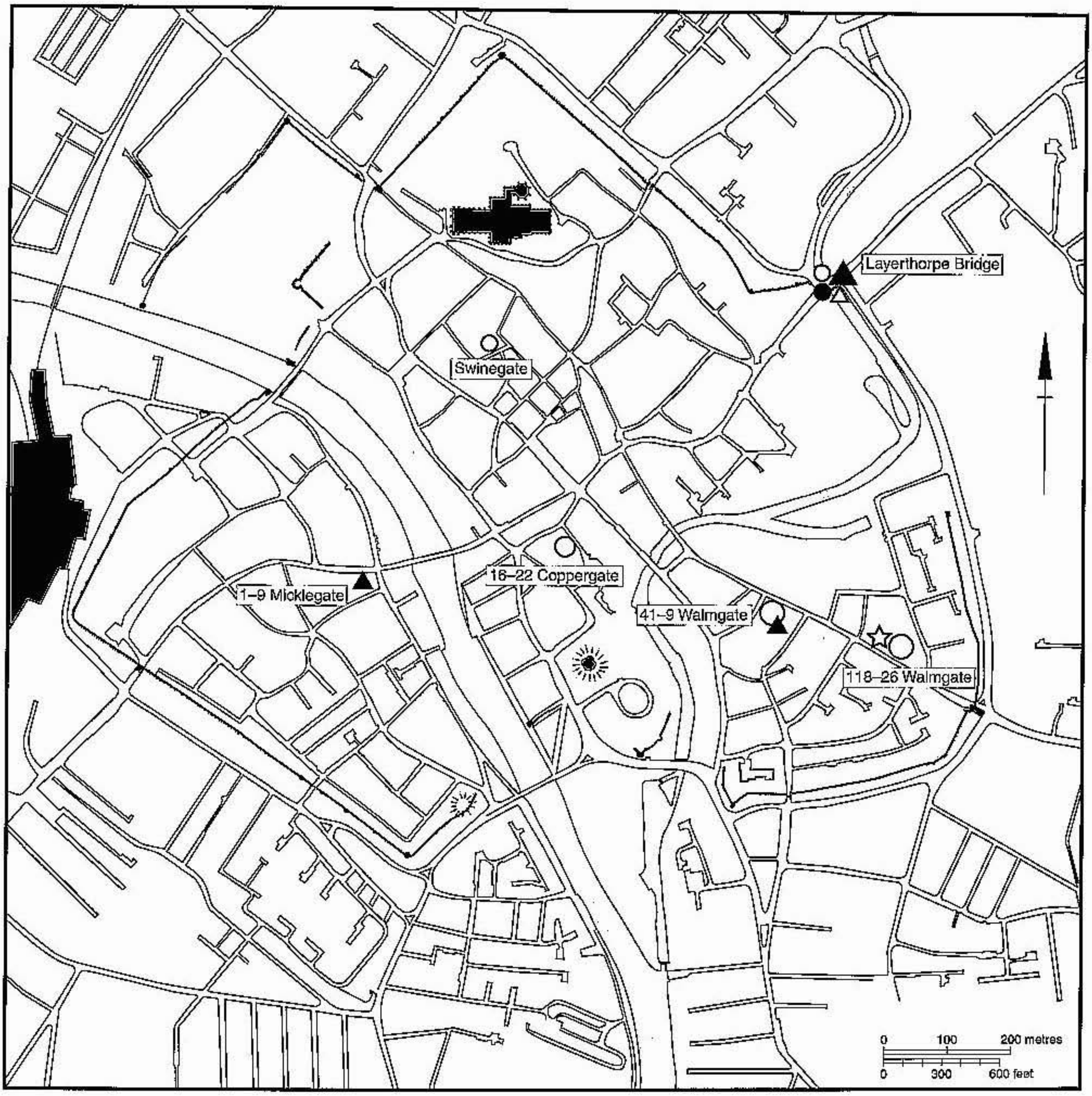
Perhaps the most likely materials to have been used for roofing in Anglo-Scandinavian York are 'Norfolk reed' (the common reed, *Phragmites australis* (Cav.) Trin. ex Steudel) and cereal straw. The archaeobotanical evidence for the former is sparse, whilst for the latter there is abundant 'proxy' evidence in the form of seeds of cereal weeds together with some vegetative material which may be the undecayed remnants of straw culms. In no case, however, has a large concentration of cereal straw been recorded — somewhat contrary to expectations, given the excellent state of preservation of so much plant material in the town at this period. Some records of remains of the saw-sedge *Cladium mariscus* (L.) Pohl (Fig.89) may point to the use of this plant as thatching material; perhaps the most convincing examples are those of charred and uncharred leaf fragments from Layerthorpe Bridge and charred leaf fragments from 1–9 Micklegate and 41–9 Walmgate. This last-mentioned site also yielded some possible evidence for cereal straw thatch in the form of partly charred ('toasted') remains of oat spikelets and for straw fragments with a coating of fine black particles, probably soot; some similar part-charred material was seen in two contexts at 2 Clifford Street.

If thatched roofs were used in Anglo-Scandinavian York, they might have have needed an 'underlay' of some kind, perhaps turf or brushwood, laid over a system of timbers or roundwood poles as in the tradition of the Northern Isles of Scotland (e.g. Fenton 1978), the Hebrides (e.g. Geddes 1955), and parts of north and west England and Ireland (e.g. Buchanan 1957; Evans 1974). However, only at 16–22 Coppergate has a deposit of brushwood been found which could be interpreted as a collapsed roof — though it might equally be argued that such material would, under normal circumstances, have been used for fuel after it had been stripped from the roof, and thus would mostly not enter the archaeological record.

The 'sooty' straw from 41–9 Walmgate has been mentioned but the fact that this is the only record of sooted material is a matter for note. On the assumption that Anglo-Scandinavian buildings had open hearths with at most a small opening in the roof for smoke to escape, the insides of roofs should have become heavily smoke-blackened (cf. Letts 1999) and debris from such roofs ought, preferentially, to survive in the fossil record. It might also be argued that roofs would frequently have caught fire, yet no layers of charred thatching materials have been found (the charred saw-sedge leaf material, cf. Fig.89, was dispersed amongst other components of the deposits in which it was found and may merely represent saw-sedge used as fuel; cf. Rowell 1986).

Many of the 'dry decomposer' insects found in Anglo-Scandinavian buildings (e.g. *AY* 14/7, 671–2) would have found thatch a congenial habitat (Smith 1996). Much the most abundant beetle in floors at Coppergate was *Lathridius* (probably mostly *L. pseudominutus* (Strand)), very likely to have lived in thatch, but also in floors and walls. Whether insects would have been deterred from living in the superstructure by smoke contamination is uncertain (Smith et al. 1999).

The presence and condition of timber, wattle and basketwork may be indicated by insect remains, and timber beetles are a constant in Anglo-Scandinavian




○ uncharred nutlets △ uncharred leaf fragments ☆ uncharred epidermis fragments

● charred nutlets ▲ charred leaf fragments

*Fig.89 Records of vegetative material and nutlets of saw sedge* (Cladium mariscus) *from Anglo-Scandinavian and early medieval sites in York. The size of the symbol provides a guide to the frequency with which remains were recorded*

deposits in York. Kenward and Hall (*AY* 14/7, 658) listed the insects associated with wood which were recorded from Coppergate: twenty species were considered particularly likely to have exploited structural timber or wattle. Some, notably the woodworm beetle *Anobium punctatum* Degeer (from almost two-thirds of the contexts for which insects were quantified), *Ptilinus pectinicornis* (Linnaeus) (from more than one in ten contexts), and the powder-post beetle *Lyctus linearis* (Goeze) (from about one-fifth of the

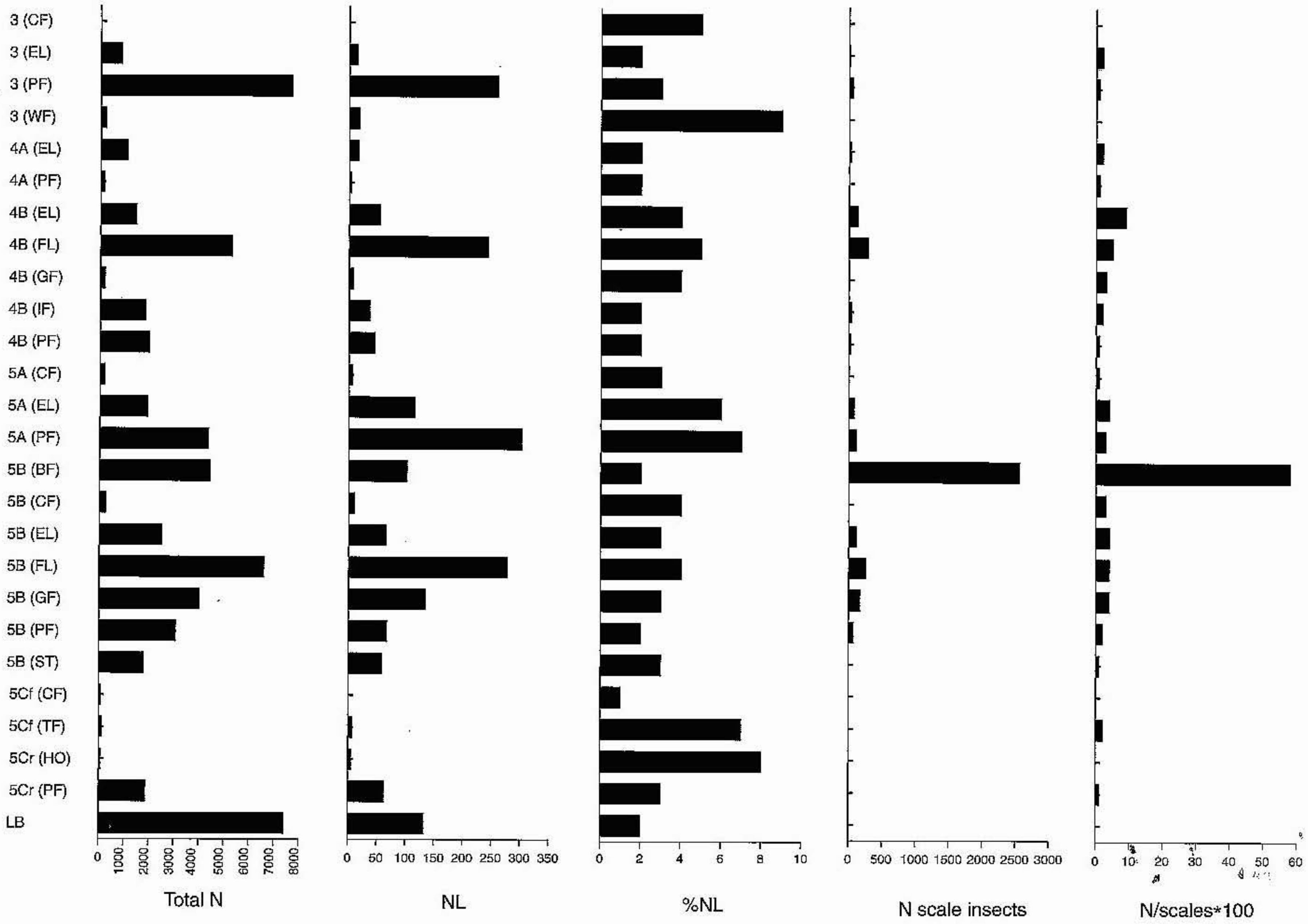



*Fig.90 Records of wood-associated beetles from Anglo-Scandinavian deposits at 16–22 Coppergate and 6–8 Pavement (LB) by period and feature type. For key to abbreviations,* *see Table 10, p.393*

contexts) were clearly established on the site, and some other species were quite frequent (e.g. *Grynobius planus* (Fabricius)).

*A. punctatum* and *L. linearis* are capable of causing considerable damage to timber, although not in proportion to the paranoia that has been generated by the pest control industry! They were, however, most unlikely to have caused appreciable damage to any but (ironically) the best-constructed and longest-lived buildings in the past, fungal decay of timbers at ground level probably being the factor limiting the life of most (*AY* 14/4, 190; *AY* 14/7, 722–3 and see above, p.376). Perhaps significantly, there was no concentration of wood-associated beetles in and around the buildings at Coppergate (Fig.90). Even in long-lived Roman, medieval and post-medieval buildings, it is likely that insects caused relatively little structural damage. Woodworm takes many decades to weaken large timbers significantly, and the death-watch beetle (*Xestobium rufovillosum* (Degeer)), cause of much alarm to modern building conservators, damages timbers immensely slowly and would rarely have concerned people in the past, except superstitiously (the adults knock their heads against the inside of the pupal cell, producing what is said to be a disturbing sound in a silent room).

*Gracilia minuta* (Fabricius) is a small black longhorn beetle which bores in fine twigs, and is well known from wickerwork (Duffy 1953, 195; Hickin 1975, 241). It is fairly often recorded from Anglo-Scandinavian York and, when it occurs in large numbers, as in one pit fill at Coppergate (*AY* 14/7, 520), it probably indicates the presence of material such as basketwork. At Coppergate it occurred in seventeen contexts, suggesting that it was well established in the town. Another longhorn beetle, the attractively patterned *Phymatodes alni* (Linnaeus), is so frequently found (e.g. 29 contexts at Coppergate; *AY* 14/7) that it, too, surely must have lived in basketwork or, more probably, in wattle or light roof supports.

Scale insects (*Chionaspis salicis* (Linnaeus) and *Lepidosaphes ulmi* (Linnaeus)) were abundant in some layers of Period 4B at Coppergate, doubtless originating from wattle in walls and perhaps in furniture and roofs including brushwood (Fig.90). They were also sometimes immensely abundant in brushwood layers amongst the 'backfills' (heterogeneous series of apparently dumped deposits) in the Period 5B structures. The scale insects are fairly firmly attached to the host twigs and branches, and only likely to be released in large numbers over a long period of time, suggesting an origin on structural wood rather than firewood which would presumably have been quickly used up. Another route by which scale insects may have entered the deposits is via the stripping of bark from twigs prior to their use for purposes such as basketry; the bark may well have decayed preferentially or have been overlooked.

see Table 10, p.393

A range of other materials may have been used in finishing structures, among them textiles and skins. Moss would have been invaluable in packing cracks in walls and such a use might explain why small amounts of moss were observed in so many surface-laid deposits at Coppergate, although evidence from remains of standing structures for moss used in this way is lacking. Moreover, Anglo-Scandinavian York has not provided evidence of the double-skinned wattlework 'cavity-wall' construction employed in 7th-century buildings at Deer Park Farms, Co. Antrim, N. Ireland (Hamlin and Lynn 1988, 44–7).

## Conditions and activities within buildings

The first issue to be confronted in discussing what it was like inside Anglo-Scandinavian buildings in York is whether the excavated 'floor' deposits relate to the use phase or abandonment (or low-grade use) of the structures. Obviously, if they do not represent the litter accumulating during use they cannot provide evidence for human activity and living conditions. It has been argued that floors are the one place where there should *not* be accumulation, but the present authors do not agree: such a view is too coloured by modern attitudes. We suggest that in a culture where organic waste was produced in huge quantities, and where floors were damp, there would inevitably have been a net accumulation of biological (and other) remains on floors, even if they were occasionally swept or scraped off. The arguments have been rehearsed elsewhere (*AY* 14/7, 725). Hall et al. (*AY* 14/4) offered a model of the way mineral and organic material may have accumulated on Anglo-Scandinavian floors, which clearly shows how much debris may build up; analogous deposits in Iceland and Greenland are discussed by Amorosi et al. (1992) and Buckland et al. (1994).

Before discussing the debris of occupation, it is worth considering whether any of the archaeological deposits represent 'made' floors, that is, material used to make a level living surface. It was suggested in the account of the 6–8 Pavement site (*AY* 14/4) that made floors and periods of accumulation in use could be distinguished, and in a few cases mineral-rich floor layers at Coppergate may represent material used for levelling. There is, of course, always the possibility that sediment used for levelling may be richly organic and contain abundant fossils, having been excavated from earlier occupation deposits. The redeposition of identifiable remains certainly can occur in this way (a notable case being at the Magistrates' Courts site in Kingston-upon-Hull; Hall et al. 2000a). The secondary deposition of delicate organic remains is discussed by Dobney et al. (1997).

Is it possible to determine the quality and use of buildings from biological remains in their floors (and in deposits which can be argued to contain waste cleaned from floors)? First of all, it must be emphasised that it is important to avoid regarding litter accumulating on floors as evidence of low-quality occupation — it is the *nature* of the build up which matters. It should be possible to distinguish clean from filthy living conditions using insect remains, their value lying in the wide range of species capable of exploiting the many kinds of habitats created by human life, combined with the fact that the animals concerned are not deliberately exploited by humans. If a *community* of insects requiring a particular habitat is present in the deposits formed on a house floor, then it is very likely that the habitat existed in the house; the main exceptions to this are where earlier material has been imported to make up floors — which should be detected through careful excavation in most cases — and where turf has been used. If fauna from within houses can be identified, then conditions within the buildings, and something of their construction, can be determined.

An extremely distinctive group of species has been repeatedly detected in house floor deposits, both subjectively (*AY* 14/6, 398–9; *AY* 14/7, 662–7) and objectively (Carrott and Kenward 2001). For ease of discussion (and despite the dangers of circular argument) this group is termed 'house fauna'. The species assigned to this group are only likely to be found together in fairly dry litter with some mould growth, and many have been recorded in modern buildings (at least of the kind normal until the mid 20th century; Kenward and Allison 1994a).

The Anglo-Scandinavian period at 16–22 Coppergate has provided classic examples of house fauna assemblages. Unfortunately, house fauna communities evidently developed in structures used to house livestock as well as those used primarily by people (Kenward and Hall 1997), so that it is essential to determine which kind of use is represented. This is generally not too difficult since there is a characteristic suite of organisms which signal stabling — one which is conspicuously rare in those parts of Anglo-Scandinavian York investigated bioarchaeologically.

House floor deposits may be encountered in situ or as dumps; in the latter case, it may be necessary to disentangle very mixed communities including post-dumping decomposer successions. Large quantities of house fauna, presumably from floor clearance but perhaps sometimes introduced as residual material in backfills, were observed in some pit fills at Coppergate (*AY* 14/7).

The gross condition of the floors at Coppergate (in Periods 4B and 5B/5C), indicated by the predominance of house fauna, was generally best described as rather damp, but certainly not wet. There were, however, some occasions when insects indicating rather more foul conditions became established, perhaps as a result of particular activities. In some cases, flies indicating very unpleasant conditions, including the housefly *Musca domestica* Linnaeus and stable fly *Stomoxys calcitrans* (Linnaeus), occurred in substantial numbers in the post-and-wattle buildings of Period 4B (*AY* 14/7, 548, 564). The range of insects recorded suggested that it was cosy and well sheltered within these structures. It can be argued that the floors of the Period 4B post-and-wattle buildings were certainly domestic, the evidence including the presence of both human fleas and lice. The relative rarity of human lice in the Period 5B floors, together with other evidence, perhaps suggests that the floor deposits represented workshops, and it is possible that if these buildings had any domestic function, then the occupants lived on an upper floor. Human fleas were frequently recorded and sometimes abundant in floors of both periods (and in many other deposits) at Coppergate, representing a minor nuisance which would have been unavoidable in houses of this kind.

The kinds of materials which may have been deliberately scattered onto floors to sweeten them and to provide a dry and somewhat absorbent living surface include rushes, bracken, leaf litter, wood chippings, straw, hay and moss. Fossil remains likely to have originated in one or more of these materials are variously recorded from floor deposits in Anglo-Scandinavian York, though never in high concentrations. Rush seeds, for example, as a proxy for the use of the whole cut plants as litter, are present in many cases but usually in low concentrations, in contrast to the large numbers of rush seeds from floors of post-conquest medieval date at some other sites (e.g. Magistrates' Courts site, Hull; Hall et al. 2000a). Indeed, in the three cases where rush seeds were abundant in floors at Coppergate, the species concerned was the short-growing toad rush (*Juncus bufonius*) whose seeds are much more likely to have arrived on muddy feet than with cut rushes. It may well be, in fact, that the rather well-drained floors at this site were not conducive to the preservation of plant remains from litter in a recognisable state, though insects were not particularly strongly decayed. The organic content of the floors of Period 4B at Coppergate was close to 40%, testifying to the presence of a great deal of humified plant material. Studies of the differential decay of delicate plant and animal remains under varying depositional conditions must be seen as a priority in understanding the taphonomy of floors, and of course of archaeological deposits in general. As an aside, we would also argue strongly for the routine recording of material forming the matrix of archaeological deposits rather than merely the identifiable remains present as 'inclusions', even if the former are listed only at a rather superficial level, such as 'bark fragments' or 'herbaceous detritus'.

The same arguments about decay patterns apply to waste matter which found its way onto floors, either accidentally or through deliberate discard. Evidence of food remains is largely restricted to bones and the more robust kinds of plants; hazel nutshells, for example, were recorded from most of the floors at Coppergate and Pavement (and seem likely to represent debris from 'snacking'). Other waste which became incorporated into floors included dyeplants, which were occasionally abundant, wool cleanings (indicated by sheep parasites), wood chips and ash. A substantial proportion of accumulation indoors may, however, have resulted from the trampling of mud from outside, incidentally accounting for a range of biological remains in addition to the toad rush seeds mentioned above. The flow of material was probably two-way, since a greater thickness of accumulation would surely be expected unless there was at least some attempt to scrape or sweep out buildings at intervals. The abundance of 'house fauna' in deposits adjacent to buildings and in some of the pits at Coppergate may point to such clearance.

While it seems likely that earth floors were the norm in Anglo-Scandinavian York, there is some evidence from the excavation record for plank floors (e.g. the charred remains of planks from Structure 5/5 at Coppergate). Such floors could be kept completely clean, although litter and especially insects might accumulate beneath them, having fallen through cracks. The subterranean insect fauna recorded from a gully within one of the Period 5B buildings at Coppergate (*AY* 14/7, 607) suggests that this cut was covered.

It seems likely for Period 4B at Coppergate, at least, that the buildings were people's homes, especially given the range of artefacts recovered, and the records of hearths, food remains and human lice. Many of the activities in these houses are discussed elsewhere (principally in sections dealing with craft and food). One 'activity' which may be mentioned here is sleeping. Excavations in other Viking-Age towns have revealed structures within buildings which gave every sign of being beds (e.g. in Dublin; Wallace 1992). The evidence in York is much less clear, although one of the Coppergate buildings (on Tenement D in Period 4B) may have had benches or beds against both walls. The Early Christian buildings at the Deer Park Farms site in Co. Antrim had what (on excavational evidence) seemed to be bed areas, and this was supported by the biological analyses (Allison et al. 1999a; 1999b). No such evidence was obtained at Coppergate, although the sampling regime was (with 25 years' hindsight) not ideally suited to detecting zonation within buildings.

Most of our evidence for life indoors in Anglo-Scandinavian York inevitably has come from the major excavation at Coppergate. The identification of 'floors' at 6–8 Pavement (*AY* 14/4) was far less clear because of the limited lateral extent of the excavated trenches and, although many of the layers probably formed during occupation, some may have been make up and others external layers. However, if it is assumed that the Pavement deposits were mainly floor build up, it appears that conditions in the structures at the site were broadly like those at Coppergate. The relative abundance of some insects varied, but not in an ecologically consistent way. There may perhaps have been a greater tendency towards occasional episodes of 'foulness' at Pavement and in Period 4B at Coppergate.

Floors of post-and-wattle buildings of the Anglo-Scandinavian period were also revealed by excavation at 1–9 Micklegate, although there was only limited sampling and analysis. The biological remains were broadly similar to those from 'floor' deposits at Coppergate and Pavement, and suggested reasonably dry buildings. Preliminary analyses of the small number of samples from deposits interpreted as floors at 41–9 Walmgate indicated that these, too, were acceptably dry, though moister here and there. The floors never yielded seething assemblages of house fauna like those seen at other sites, suggesting that they were used in different ways. Unfortunately, detailed analysis was impossible because the samples had degraded during more than two decades of storage prior to examination.

Analyses to date have given some indications as to the range of conditions and uses of floors of this period. However, there is clearly much unrealised potential and, should further examples be revealed, a far more intensive sampling strategy should be adopted in order to allow for spatial analysis and statistically significant comparison through time within single buildings and between buildings and sites.

The floors of some buildings in both of the main Anglo-Scandinavian structural phases at Coppergate had been cut into. In Period 4B there were large pits, one with fills including abundant honeybees, *Apis mellifera* Linnaeus (*AY* 14/7, 765–7). In Period 5B there were gullies cut into floors, one of them apparently having been used to dispose of waste water (since it contained resting eggs of water fleas, presumably imported in water; *AY* 14/7, 595–6), and another perhaps having been covered (and consequently colonised by subterranean species). The function of these pits and gullies is far from clear and most of the fills appear to represent floor litter which had spilled into them (or perhaps filtered through floorboards) or had been deliberately dumped.

The lack of evidence for large-scale flooding in Anglo-Scandinavian York has already been mentioned. On a more local scale, were there occasions when either the local water-table rose or rainfall was so heavy that drainage failed and the 'basements' in the Period 5B buildings at Coppergate flooded? The presence of gullies within the buildings might at first sight suggest that this was the case but in two cases (both in Tenement B) these cuts appear to have been entirely within the buildings (*AY* 14/7, fig.157). It seems likely that they were associated with some craft activity, textile processing being much the most likely. Perhaps they were just soakaways for waste liquor; there is nothing to suggest that they were related to livestock kept in the buildings (cf. Fenton 1978, 117ff.). Even the gullies which exited the buildings (Tenements C and D) seem as likely to have been used to carry effluent as to have been intended as flood drains. Like the entirely internal gullies, those on Tenements C and D sometimes contained abundant dyeplant debris, perhaps from the emptying of dye vats.

The outlines of the Period 5B buildings at Coppergate contain a series of more or less level deposits referred to as 'backfills'. While some of the lower of these may in fact be floor deposits (*AY* 14/7, 596), most do, on both stratigraphic and biological evidence, seem to have been dumps, although of a variety of different kinds. They give no clear evidence that they represent a change of use of the buildings, such as to the housing of livestock.

The evidence in the ground for the wooden structures in Anglo-Scandinavian York does not offer a clue as to how well lit and ventilated they were. In theory, the quantity and structure of outdoor background insect fauna in floor deposits should give clues as to how open structures were, following arguments presented by Kenward (1985), but there is a problem in determining how outdoor remains entered structures. Many of them may have been imported in one way or another rather than having flown in through openings. The large quantity of highly comminuted remains of outdoor insects found in some floors at Coppergate (*AY* 14/7, 736), for example, seem unlikely to have arrived on the wing, and these animals perhaps came from the roofs (see p.380) or were imported in materials of some kind. It was formerly thought that the presence of large numbers of certain waterside beetles was evidence of open-sided structures, the insects drifting in on the breeze as they migrated in swarms, but (however improbable it may appear) these beetles are now believed to have lived in the buildings (see, for example, *AY* 14/7, 733). Bearing in mind the many ways in which outdoor insects might be brought into a building, it now seems much less likely that background fauna can be used in a positive way to indicate an open construction. On the other hand, very restricted faunas in floors may stand as evidence of a firmly closed structure (e.g. the Roman wooden store building with abundant grain pests at Coney Street, York; *AY* 14/2), but no unequivocal examples from the Anglo-Scandinavian period have been found. At best, a few of the internal deposits of Period 5B buildings at Coppergate may fall in this category.

## External surfaces and the external environment

There is inherently a particularly strong bias against the existence of a fossil record for surfaces in cleaner, drier places in towns. Preserved remains at such sites may often represent atypical circumstances; there is always a danger of misinterpretation consequent upon over-representation of foul conditions for taphonomic reasons: filth, where abundant, will often have been self-preserving. It is important to draw a distinction between conditions in open areas such as yards, gardens and streets, where people would normally be experiencing the environment at first hand as they went about their daily lives, and those in disposal areas, which would presumably be avoided and where rapid accumulation of organic matter might favour preservation. This section deals primarily with the former; the latter are considered on pp.394–5.

Reconstruction of conditions and activities in yards and other open areas by any means presents considerable difficulties. Soils will have been disturbed, and any plant remains may represent materials imported for a variety of reasons and by various routes. Invertebrates may thus represent the best hope for ecological reconstruction. The deposits formed on the external surfaces themselves may be of little value in this respect (although they may be important for wider reconstruction where there is good preservation). In many cases there appears to have been much informal dumping, which introduced a wide variety of remains from elsewhere. Open areas are likely to have been rather dry and well drained, often disturbed by human activity or by livestock, particularly chickens and pigs, so that there was strong decay of biological remains, making preservation unlikely.

Remains of value in reconstructing surfaces are thus more likely to be found in pits and other cuts, although under some circumstances there may be surface preservation. The Anglo-Scandinavian material at Coppergate (*AY* 14/7) provides a good case in point for, while external surface deposits contained larger numbers of well-preserved insect (and other delicate) remains than is the case at most sites, it was rarely clear whether they had originated in situ. Indeed, the presence of distinct house fauna assemblages here and there in deposits formed on external surfaces strongly indicated dumping or scatter from within the nearby buildings, and botanical evidence showed that some layers were rich in dyeplant waste (*AY* 14/7, fig.196). It did appear, however, that the concentrations of fly puparia found scattered in surface layers had developed where they were found, indicating short-lived patches of very foul material such as dung or moist food waste, and rarely were there beetle communities suggesting rather longer-lived rotting matter. Some insects associated with weeds were considered too abundant in the assemblages from the site as a whole to be present by accident (ibid., 654), and it seems that some plants, particularly crucifers, nettles and docks and/or knotgrasses, were able to survive. There was also a limited non-phytophagous (plant-feeding) open ground fauna, consisting of ground beetles and others able to survive where a few scattered plants or piles of loose debris provided shelter. Some other plants were at least occasionally able to gain a foothold, but do not have characteristic insects associated with them; plants such as fat hen (*Chenopodium album* L.) are also large seed producers so it is difficult to judge whether the abundant seeds of these weeds can be translated into a luxuriant growth or a few poorly grown but still seed-prolific specimens.

Most of the phytophages recorded in Anglo-Scandinavian York may have been imported in moss, turf, cut vegetation, water, brushwood or dyeplants, as well as being 'background fauna' which arrived on the wing and in bird droppings. The abundance of one genus of weevils seems not to be so easily explained: *Sitona* species were repeatedly recorded and had a strong statistical association with house fauna at Coppergate, suggesting either that they were brought with materials used in houses or were attracted to them in some way. Some *Sitona* may have been imported with peas and beans, for several species feed on these plants. Alternatively, they may have been imported with dyer's greenweed, since at least a few species have been found on it. These weevils are regarded as a component of 'hay' fauna (Kenward and Hall 1997), but there is only limited evidence for such material being brought to York in the period considered here. It is worth mentioning that *Sitona* species were very frequent in medieval floor and dump deposits at the Magistrates' Courts site, Hull (Hall et al. 2000a), and, although their origin was not clear, it appeared most likely that they had arrived with pulses.

Shells of snails, mainly the large garden snail *Helix aspersa*, were rather often found at Coppergate and although some were undoubtedly of modern origin (*AY* 14/7, 472, 526, etc.), others appeared to be ancient, supporting the hypothesis that disturbance did not completely sterilise the yard areas. In general, though, disturbance seems to have been intense, not least as a result of the digging of pits and ditches and through dumping. It may be that much of the town was sterilised in this way, but that a flora of opportunistic weeds appeared almost immediately disturbance ceased and quickly contributed to a 'seed bank' forming in the deposits and which was the source of new plants at some later stage. The rate at which vegetation can re-appear in apparently sterile environments was amply demonstrated during phases of non-excavation at Coppergate when the ground quickly became colonised by dense stands of annual weeds.

So, as a source of information about surface conditions, we are largely thrown back on cut fills. This means it is necessary to attempt to determine the likely origin of the various components of what are often very complex assemblages from the fills of wells, ditches and pits. Pits in some cases may be rather effective in sampling the biota of the surroundings, especially insects. If there is water in them, then small or inept species may land on the surface by accident and be trapped, while larger walking insects may fall in and drown. The 'pitfall' effect appears to have operated for some Anglo-Scandinavian pits at Coppergate (*AY* 14/7, 567–8, 614, 627).

While the open areas at Coppergate appear mostly to have been sterilised by intensive use during the Anglo-Scandinavian period (see above), there is a little evidence that at some stages there was development of more stable vegetation to the rear of the site (*AY* 14/7, 624–7). The cut containing the Anglian helmet (*AY* 17/8) appears likely to have been a well, whose fills may date to the Anglo-Scandinavian period, the biota suggesting open disturbed ground with annual and perennial weeds, plant litter and perhaps dung. Some of the pits in the backyards at 16–22 Coppergate gave somewhat similar evidence, although in rather less clear form. Animals may possibly have been kept in these backyards and at times maintained a short turf by grazing. The lowest and uppermost parts of the succession in one of the trenches at 6–8 Pavement (*AY* 14/4) were thought perhaps to have been external deposits on the evidence of the plant remains, but this was not clearly supported by the insects. In the assemblages as a whole from Pavement, as at Coppergate, there were rather few phytophages likely to have originated in yards and alleyways, other than crucifer and nettle feeders, and even these were present only in small numbers. Nothing suggested the presence of livestock at the Pavement site with any certainty.

Given the relative paucity in the fossil record of insects associated with the sorts of weeds likely to have grown in the Anglo-Scandinavian town, were stands of weeds established on the sites? If not, how do we explain the abundant weed seeds? One or more of the following explanations may account for this contradiction: (a) that isolated plants (or localised patches) produced the seeds (the taxa concerned are typically prolific seed producers) but supported relatively few insects; (b) that the seeds entered in the faeces of livestock; (c) that the seeds fell from plants growing on roofs (either 'live' turf or poorly maintained thatch); (d) that they were wind-blown or trampled to the site from further afield; (e) that they grew in brief periods of neglect; (f) that they originated in whole mature plants cut during ground clearance; (g) that the seeds originated in backfill soil containing a seed bank slowly accumulated over a long period; or (h) that most of the weed seeds were brought with some plant material such as straw or hay. Amongst the plant-feeding insects, nettle-feeders were particularly well represented. Unfortunately, the data are not adequate to determine statistically whether numbers of nettle-feeders and nettle 'seeds' are cor-

**Table 7** Records of (a) fruits of stinging nettle and annual nettle (all records, and those where the semi-quantitative abundance score was greather than '1', a 'trace') and (b) of nettle-feeders from 16–22 Coppergate; for plants, numbers of contexts are translated into percentages (in parentheses) for those periods for which large numbers of contexts were examined. There was no significant association between the records of nettle fruits and insects ($p >> 0.05$)

(a)

| Period | No. contexts examined for plants [no. pit fills] | *U. dioica* >1 | | all *U. dioica* | | *U. urens* >1 | | all *U. urens* | |
|---|---|---|---|---|---|---|---|---|---|
| | | all | pit fills | all | pit fills | all | pit fills | all | pit fills |
| 3 | 89 [54] | 15 (7) | 8 (9) | 61 (69) | 36 (40) | 14 (16) | 9 (10) | 69 (78) | 46 (52) |
| 4A | 12 [3] | 4 | – | 8 | 1 | 2 | – | 11 | 2 |
| 4B | 148 [29] | 7 (5) | 2 (1) | 76 (51) | 14 (9) | 11 (7) | 9 (6) | 110 (74) | 23 (16) |
| 5A | 47 [19] | 1 (2) | - | 27 (57) | 9 (4) | 2 (4) | – | 35 (74) | 12 (6) |
| 5B | 96 [41] | 3 (3) | 2 (2) | 53 (55) | 26 (25) | 3 (3) | 3 (3) | 63 (60) | 31 (30) |
| 5Cr | 24 [22] | 1 | 1 | 14 | 12 | 5 | 4 | 23 | 20 |

(b)

| | Period/number of individuals | | | | | |
|---|---|---|---|---|---|---|
| | 3 | 4A | 4B | 5A | 5B | 5Cr |
| *Heterogaster urticae* (Fabricius) | 17 | 2 | 19 | 4 | 28 | 10 |
| *Trioza urticae* (Linnaeus) | 3 | | 1 | | | |
| *Trioza urticae* (nymph) | | | (1) | | (1) | |
| *Brachypterus glaber* (Stephens) | | | 2 | | 1 | |
| *Brachypterus urticae* (Fabricius) | | | 1 | | 2 | |
| *Brachypterus* sp. | 8 | 2 | 7 | 6 | 3 | 3 |
| *Apion (Taenapion) urticarium* (Herbst) | 3 | | | | | |
| *Cidnorhinus quadrimaculatus* (Linnaeus) | 12 | | 5 | | 6 | |
| Total | 43 | 4 | 35 | 10 | 40 | 13 |
| Total period N | 36463 | 2648 | 16230 | 18652 | 39356 | 3473 |
| Percentage nettle insects | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | 0.4 |

related in archaeological assemblages at Coppergate (Table 7).

In terms of visual impact, trees are important, and they also provide shade and raw materials. Were trees a significant feature of Anglo-Scandinavian York? As far as the evidence from the plants themselves is concerned we can adduce the few records for stumps or roots of elder (*Sambucus nigra* L.) from Coppergate (Table 8a); the living plants they represent may also go a long way to explaining the abundance of elder seeds in so many deposits (Table 8b). Elder is, of course, one of the most successful colonists of nutrient-rich soils in the vicinity of human occupation. Many of the seeds from other trees and shrubs may also have come from within the town, though those with edible fruits have routes via consumption by humans or other animals.

Another source of imported tree seeds would have been the abundant woodland moss brought to the site. Most of the insects associated with living trees

**Table 8a** Records of elder (*Sambucus nigra*) stumps or roots from 16–22 Coppergate

| Context | Period | Nature of material |
|---|---|---|
| 18659 | 3 | roots |
| 34753 | 3 | roots |
| 36098 | 3 | stump/root |
| 34967 | 4B | branching trunk/stump, max. diam. 10cm (part of fence line) |

**Table 8b** Records of elder (*Sambucus nigra*) seeds from Anglo-Scandinavian deposits in York. Percentages in brackets indicate very low numbers of contexts examined

| Site | No contexts examined | No. contexts with elder seeds | % | No. with more than traces | % |
|---|---|---|---|---|---|
| 6–8 Pavement | 55 | 51 | 93 | 2 | 4 |
| 5–7 Coppergate | 18 | 11 | (61) | 0 | 0 |
| site adjacent to 1–5 Aldwark | 8 | 8 | (100) | 3 | (38) |
| 16–22 Coppergate | 430 | 340 | 79 | 33 | 8 |
| 118–26 Walmgate | 17 | 16 | (94) | 3 | (18) |
| 5 Rougier Street | 2 | 1 | (50) | 0 | 0 |
| 24–30 Tanner Row | 5 | 1 | (20) | 0 | 0 |
| 46–54 Fishergate | 3 | 0 | 0 | 0 | 0 |
| 7–9 Aldwark | 7 | 7 | (100) | 5 | (71) |
| 22 Piccadilly | 6 | 4 | (67) | 1 | (17) |
| 1–9 Micklegate | 27 | 11 | 41 | 0 | 0 |
| Adams Hydraulics, Phase I | 1 | 0 | 0 | 0 | 0 |
| 104–112 Walmgate | 3 | 2 | (67) | 0 | 0 |
| North Street | 9 | 8 | (89) | 1 | (11) |
| 9 St Saviourgate | 10 | 8 | (80) | 5 | (50) |
| All Saints' Church, Pavement | 5 | 5 | (100) | 0 | 0 |
| Foss Bridge/Peasholme Green/Layerthorpe Bridge | 15 | 12 | (80) | 2 | (13) |
| Davygate | 1 | 1 | (100) | 1 | (100) |
| 2 Clifford Street | 5 | 4 | (80) | 1 | (20) |
| 41–9 Walmgate | 7 | 5 | (71) | 1 | (14) |
| 4–7 Parliament Street | 4 | 2 | (50) | 0 | 0 |

recorded in Anglo-Scandinavian York seem likely to have been imported with moss. On the other hand, the small bark beetle *Scolytus rugulosus* (Müller) offers a small hint that fruit trees were grown in the town. It was recorded from five of the samples from 1–9 Micklegate, usually as single individuals. It was also recorded from three contexts at Coppergate (*AY* 14/7, 658), although undiagnostic fragments seem likely to have been included in the 23 records of '*Scolytus* sp.' from that site. According to Balachowsky (1949) it is associated with Rosaceae, on domestic forms of which it may be a serious pest, and is only extremely rarely known to occur under the bark of other woody plants. (A wide range of woody rosaceous plants was recorded from the Coppergate site, though mainly as remains of fruits or seeds and of course quite probably imported to the site — as discussed above.) While the specimens may have emerged from rosaceous firewood, or even from hawthorns growing in the town, it is tempting to suggest that there were fruit trees of some kind here and there, perhaps in the very hypothetical 'gardens' where the bees (see p.397) were kept.

There is no clear evidence from the biological remains for cultivation at any of these sites. The three plants contributing vegetables to the diet of the Anglo-Scandinavian inhabitants of York — leeks, peas and field beans — all seem likely to have been grown on a small scale, perhaps in gardens or 'allotments' rather than on a field scale, but there seems to be no easy way of proving this. Broadly speaking, the insect remains offer no evidence of cultivation at any of the sites although several species often found in cultivated areas were present, some being fairly frequent.

## Open water on sites *versus* imported water

A reliable water supply is crucial for human settlement. The quantities required in Anglo-Scandinavian York for consumption by humans and livestock, and for craft and industrial processes, must have been enormous. Most parts of central York are within relatively easy reach of one of two rivers, the Ouse and Foss, both of which seem likely to have flowed throughout the year in the Anglo-Scandinavian period, so far as we can judge.

Was the water potable? The water in both rivers was probably passably clean when it reached York, although the Foss, at least, was used for processes which would have caused substantial pollution: there is good evidence for Anglo-Scandinavian tanning at the Layerthorpe Bridge site (Hall et al. 2000b, and see p.407). Further analysis of deposits at 22 Piccadilly may provide more information concerning the Foss. To date, the only deposits indicating dumping along the Ouse have been observed at North Street (Carrott et al. 1993a), but samples from them have so far only been examined in a very cursory way. A hint as to water quality comes from riffle beetles (various members of the family Elminthidae, including the very rare *Macronychus quadrituberculatus* Müller; Kenward and Hall 2000a), all of which require clean, moving water. Small numbers have been recorded from Anglo-Scandinavian deposits at 1–9 Micklegate and Coppergate. While these beetles may have flown to the sites and died there, it appears far more likely that they were brought in river water. Unfortunately, they may have been washed down from cleaner reaches rather than having lived in the York area. Records of freshwater mussels (*Unio* and *Anodonta* spp.) from Coppergate also suggest reasonably clean water, assuming that they were not imported from elsewhere. O'Connor (1984, and in *AY* 14/7, 780) has postulated that changes in the relative abundance of *Unio tumidus* Philipsson and *U. pictorum* (Linnaeus) through the Anglo-Scandinavian period at Coppergate may possibly indicate degradation of water quality by pollution as the town increased in size, the more pollution-tolerant *U. pictorum* becoming relatively more frequent. Clearly further research, using riverine sediments, is required to address this significant aspect of past human impact; the study of lead from alluvial deposits at North Street by Hudson-Edwards et al. (1999), which shows a slight increase in lead levels from the 10th century onwards, forms a useful start.

Many of the freshwater plants and invertebrates recorded from Anglo-Scandinavian deposits in York seem likely to have been brought with water intended for one use or another. Records of true aquatic plants (as opposed to emergents which might be cut for some reason, for example with reed for thatch) are extremely sparse (Table 9). Certain water beetles are common in occupation deposits of this period (particularly *Helophorus* and *Ochthebius* species), but the former, at least, is a conspicuous component of the 'background fauna' of insects arriving in flight. Another group clearly originating in water are the cladocerans (water fleas, particularly *Daphnia* spp.). These little animals are represented by their ephippia, which are resistant eggs formed in the body of the adult. They are fairly common in deposits accumulating under various circumstances, ranging from floors to cesspits. At Coppergate they may have been under-recorded, but nevertheless were found in over 60 contexts (Fig.91; Table 10). The greatest concentrations were in deposits associated with structures of Period 5B, particularly in a gully inside Structure 5/3 on Tenement B, where they were accompanied

**Table 9** Records (numbers of contexts) from which aquatic plants (counted in groups POTA, LEMN or CHAR, cf. AY 14/7, 678) were found at Anglo-Scandinavian sites in York; some other taxa, e.g. *Oenanthe* spp., which are counted in other groups, too, are not included here

| | *Chara* sp(p). | *Lemna* sp(p). | *Lemna trisulca* (sterile fronds) | *Potamogeton* sp(p). |
|---|---|---|---|---|
| Groups | CHAR | LEMN | LEMN | POTA |
| 6–8 Pavement | | 2 | | |
| '1–5' Aldwark | | 2 | | |
| 16–22 Coppergate | | | | 4 |
| 104–12 Walmgate | 1 | | | |
| North Street | | | 1 | |
| Layerthorpe Bridge | | | | 1 |

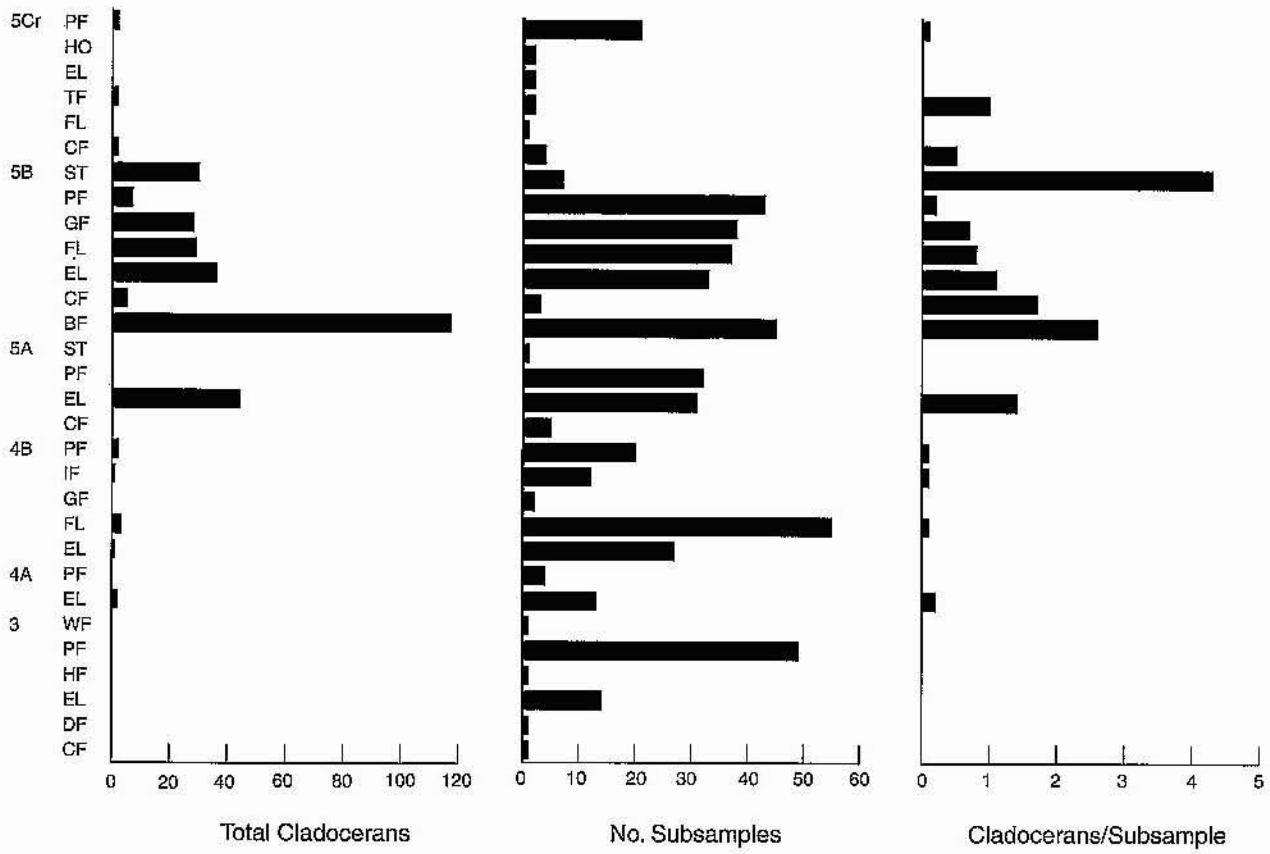



*Fig.91 Records of cladocerans from 16–22 Coppergate by period and feature type. For key to abbreviations, see Table 10, p.393*

Table 10 Records of cladocerans from those samples from 16–22 Coppergate wherethe number per sample was greater than 3

*Key for Table 10 and Figs.90–1*

BF = backfills; CF = non-specific cut fills; DF = depression fill; EL = external layers; FL = floors; GF = gully and ditch fills; HF = hearth fill; HO = post-hole fills; IF = fills of cuts within structures ('internal' fills); PF = pit fills; ST = associated with structures; TF = trench fill; WF = well fill

| Period | Feature Type | Context | Sample | Subsample | No. cladocerans |
|---|---|---|---|---|---|
| 5A | EL | 8282 | 257 | /1 | 30 |
| 5A | EL | 8290 | 261 | /T | 9 |
| 5B | BF | 15361 | 776 | /T | 7 |
| 5B | BF | 15470 | 815 | /1 | 23 |
| 5B | BF | 15470 | 815 | /C | 6 |
| 5B | BF | 15471 | 816 | /1 | 12 |
| 5B | BF | 15471 | 816 | /2 | 12 |
| 5B | BF | 15471 | 816 | /3 | 12 |
| 5B | BF | 15526 | 827 | /1 | 30 |
| 5B | BF | 15530 | 831 | /1 | 6 |
| 5B | EL | 15583 | 908 | /T | 18 |
| 5B | EL | 21478 | 1711 | /T | 15 |
| 5B | FL | 15559 | 872 | /1 | 6 |
| 5B | FL | 14297 | 70506 | /1 | 6 |
| 5B | GF | 15560 | 851 | /1–3 | 9 |
| 5B | GF | 15560 | 852 | /1–3 | 6 |
| 5B | GF | 15581 | 857 | /1–3 | 7 |
| 5B | ST | 8730 | 375 | /(1) | 15 |
| 5B | ST | 8730 | 375 | /2–3 | 15 |

by more water beetles than might reasonably be expected indoors (*AY* 14/7, 595–6).

These records of water fleas in what were clearly surface (or in the case of the gully, internal) deposits, are surely indicative of the disposal of waste water, the ephippia or live adults containing them having been brought with supplies. It might be argued that records of these animals from cuts in the open may indicate populations living in open water, but in at least some cases they seem to indicate waste disposal. At 4–7 Parliament Street (Hall and Kenward 2000a) a sample from a cut fill provided seven aquatic beetles and bugs, and numerous cladocerans. Bearing in mind the extremely foul nature of the deposit as inferred from other evidence, these freshwater crustaceans seem most unlikely to have lived in situ in the cut, since the water would have been intolerably polluted. They therefore seem much more likely to have been deposited in waste water (from dyeing, perhaps), or entered via faeces, having been inadvertently ingested. Our understanding of the sources of water on occupation sites such as these would be greatly enhanced by identifying a wider range of water fleas (Cladocera and Ostracoda), as well as diatoms (which are unicellular green algae often sensitive to water quality).

Although York is well provided with rivers, and the Anglo-Scandinavian sites which have been investigated for waterlogged plant and invertebrate remains in any detail are located no more than 200m from them, other water sources should be considered. Structures which were unequivocally wells have not been recorded. A Period 3 feature at Coppergate described as a barrel well consisted only of a single barrel and may have had various uses. Cut 6422 at Coppergate was perhaps the only other really well-like feature of the period (but note that it was only 2m deep, not 4m as implied by the incorrect scale on fig.167 of Kenward and Hall's account in *AY* 14/7). However, there is no evidence from the flora and fauna of the thin, level, basal deposits that it had served as a well. There may have been shallow pit-like wells. Some of the pits at Coppergate lacked evidence for the disposal of foul waste and appear on the basis of the insect remains to have been left open for a long period and sometimes to have contained water. Such pits were identified at the rear of the site in Period 5C (*AY* 14/7, 627); the pit containing the Anglian helmet (*AY* 17/8) may be another example. They may have provided water, but equally they may represent cuts abandoned on a change of use or ownership. If water was obtained in this way, it would be very likely to contain water fleas and beetles such as *Helophorus* and *Ochthebius*.

The question of water supplies is a difficult one. Higher water-tables in the Anglo-Scandinavian period may have provided springs locally on the slopes of the moraine underlying the town (see p.370). Roman drains and culverts may still have carried clean water which could be tapped here and there; the system contained flowing water in places at least to the 1970s (Phillips 1985, 57–9). We may find that systematic analysis of faecal deposits believed to originate from humans and from livestock shows, for example from the abundance of water fleas or the nature of the diatom flora, that the quality of water drunk by these two groups differed.

## Waste disposal

Much of what has been excavated in Anglo-Scandinavian York consists of waste of one kind or another, and most of what we know about the town has been discovered by analysing it. Some of the richest sources of waste material, of course, are the fills of pits.

Twenty-five years of study of the fills of pits in Anglo-Scandinavian York lead us to believe that their primary function was for waste disposal. With the possible exception of the 'wells' mentioned above, there is no clear evidence for any other 'primary use'. Were pits *exclusively* used for waste disposal? Possible uses would be as drainage sumps, for processes such as dyeing and tanning, and for storage. Pit storage seems extraordinarily unlikely in what seem always to have been rather moist deposits, although one or two cuts within buildings may conceivably fall in this category (perhaps more in the nature of cellars than traditional storage pits). One example of this is cut 22557 in the wattle building on Tenement C in Period 4B at Coppergate (*AY* 14/7, 557–60) — an almost cellar-like feature which incidentally contained large numbers of honeybees.

Bearing in mind the very large scale of wool processing at Coppergate it is possible that lined pits were used for dyeing. Corroborative evidence in the form of clay linings, the remains of skins used as liners, or stones used as pot boilers, is absent, however.

On balance, then, it must be accepted that pits were dug specifically for waste disposal. The argument that the elaborate wicker linings present in many of them represent excessive effort for such a use is spurious, since cesspits, at least, would have had a substantial life during which there was a pressing need to avoid collapse (*AY* 14/7, 747–8).

Many pits were clearly cesspits on the basis of bioarchaeological analysis of their fills, which are characterised by assemblages rich in cereal 'bran', food remains such as fruitstones and pips, eggs of intestinal parasites, and fish bones which carry evidence of having been chewed and of having passed through the digestive tract. A component of large, branching mosses, presumably material used as toilet wipes, is often associated with this faecal material. Where insects are numerous in such deposits they are typically dominated by species favoured by extremely foul conditions, including various flies (*AY* 14/7, 746–7). Some of the pit fills at Coppergate appear to have been so foul that they could not be colonised by beetles, only a very restricted range of specialised flies being able to exploit them. Where large populations of insects were able to develop, it is likely that the fills had been exposed for a considerable period, with implications for human health (see below).

Some waste was certainly dumped onto surfaces. At Coppergate there was evidence, particularly from fly puparia, for patches of foul matterbut large quantities of dyebath waste were occasionally tipped onto the ground to judge from spreads of 'burgundy' coloured material which proved on closer examination to be rich in madder root fragments. The deposits dated to Period 3 at this site appear to represent accumulation in an area lacking substantial buildings but used for industrial purposes (there were numerous hearths) and for waste disposal both into pits and onto surfaces (*AY* 14/7, 509–27). Of course a proportion of waste may have been carried away from occupation areas and in this respect it is unfortunate that it has not been possible to carry out full analyses of what have been interpreted as Anglo-Scandinavian waterside dumps at the 22 Piccadilly and North Street sites.

Various stages in textile processing would have required large quantities of water and, if the relevant processes were carried out on properties rather than at the river edge, there would have been a need to dispose of what would often have been foul waste water. This may be the reason why some of the ditches or gullies excavated at Coppergate were dug; it seems unlikely that they would have been necessary for carrying away rainfall on soils which would have absorbed water freely, although it is just conceivable that there was local groundwater seepage which needed to be carried away. If this was the function of these ditches and gullies it would explain why dyeplants were so often abundant in the fills (cf. *AY* 14/7, fig.196b). Clearly these ditches were dug for drainage since none formed tenement boundaries.

## Feeding the inhabitants of Anglo-Scandinavian York

A consideration of the diet of the inhabitants of the Anglo-Scandinavian town implies three principal questions: what was eaten (and drunk)? how was food obtained? and was the diet conducive to good health? The first of these is relatively easily, if incompletely, answered. Plant, invertebrate and vertebrate foods are considered separately. For all of these categories, the evidence is broadly consistent from all of the sites studied, but the enormous corpus of material from Coppergate dominates our view. Anglo-Scandinavian York appears to have covered a considerable area, of which we have estimated up to 100ha may have deposits of varying thickness with waterlogged preservation.

In this context, it is worthwhile considering how large the population of Anglo-Scandinavian York may have been. An attempt by Kenward and Large (1998b) to calculate how many people's faeces might have been disposed of in pits of Anglo-Scandinavian date at Coppergate is relevant here. Their conclusion — which was regarded as highly tentative — was that around two people per tenement were, on average, living at the site. This estimate appears low, but it was argued that allowance must be made for periods without evidence of houses on the site (although pits were still dug during these), under-estimation of the degree of decay and compaction of faeces, and the likelihood of disposal off site. Against these was set the biological evidence that many of the pits, or layers in them, did not consist entirely or even in part of faecal material. Following this reasoning we may calculate on the basis of the volume of faeces preserved by waterlogging (see p.376) that of the order of 6,000–10,000 people on average lived in the town — excluding those who lived in areas without waterlogged preservation and any within the 'waterlogged area' whose faeces were removed from it. For another view on population see pp.320–1.

### *Plant foods and fungi*

Although biased in favour of the more readily preserved remains — nutshells and fruitstones rather than soft foods like vegetables — the archaeological record for Anglo-Scandinavian York is rich. The results presented by Kenward and Hall (*AY* 14/7) for Coppergate (see especially their table in fig.191m, pp.685–9) provide the basic list for plant foods; from the records from other sites in the town we can add only one more plant, lentil, *Lens culinaris*, though it seems very likely that the few charred remains (from 2 Clifford Street and 24–30 Tanner Row) were in fact reworked from underlying Roman deposits.

Cereals and fruits form the bulk of the fossil remains of plant foods for this period in York, the former largely as 'bran'. Most of the bran is not more closely identifiable than 'wheat/rye', though bran or whole uncharred caryopses of barley and oats have also been identified. In the case of charred grains, all these four cereals have been recorded, with wheat and barley by far the most commonly observed, though no cereals were ever abundant (Table 11). The long list of fruits includes many which would not be considered a regular part of the diet of most people today, notably

**Table 11** Records of charred cereal grains from Anglo-Scandinavian York (minor categories such as the few records for chaff of various kinds have been excluded)

| Taxon | No. contexts | % (of 631 contexts examined) | No. contexts with more than a trace | % |
|---|---|---|---|---|
| *Avena sativa* (cultivated oats) | 33 | 5 | 2 | 0.3 |
| *Avena* sp(p). (oats) | 136 | 22 | 5 | 0.8 |
| *Hordeum* sp(p). (barley) | 177 | 28 | 3 | 0.5 |
| *Secale cereale* (rye) | 61 | 10 | 4 | 0.6 |
| *Triticum 'aestivo-compactum'* (bread/club wheat) | 203 | 32 | 5 | 0.8 |
| *Triticum* sp(p). (wheat) | 36 | 6 | 1 | 0.2 |

sloes (*Prunus spinosa*), hawthorn (*Crataegus*), rose (*Rosa*) and rowan (*Sorbus aucuparia*). These wild-collected fruits must have been a vital source of, for example, vitamin C, though we have no clue from the fossil record as to how they may have been used. Storage or preservation in some way for use beyond the autumn would have greatly enhanced their value, even allowing for an inevitable reduction in vitamin C content. To judge from their frequent occurrence in deposits rich in foodstuffs, seeds of flax (linseed, *Linum usitatissimum*) were also a regular part of the diet, providing valuable fatty acids and, were it needed, a natural laxative!

The list of vegetables is limited. Two pulses (if we discount lentil) have been recorded: pea and field bean, both of which might have been eaten fresh in season or, perhaps more likely, have been dried for use throughout the year. The delicate leaf tissue of leek will usually have decayed and, even when preserved, may not always have been recognised during analysis. How far other green leafy plants may have contributed to the diet is difficult to judge; this is certainly an avenue for future study, concentrating on the identification of epidermis fragments from those cesspit fills with the best preservation by anoxic waterlogging.

Food flavourings are a very prominent group within the plant remains from Anglo-Scandinavian York and indicate that a wide range of seasoning was available. Seeds of coriander, celery, dill and opium poppy seem most likely to have been used in their own right, whilst those of summer savory presumably represent the whole fresh or dried herb. Summer savory is today used in northern Europe with field beans, and thus perhaps we are seeing a tradition extending at least as far back as the 10th century. As for possible flavourings for drinks, both hops and bog myrtle are recorded and seem likely to have been used (they would act as preservatives as well as flavourings); in no case, however, have very high concentrations of either plant been found which might indicate waste from making beer or other drinks.

A group of organisms, many of which are edible but which are scarcely known in archaeology, are the fungi (no longer considered by most biologists to be plants). There is a strong tradition of eating a wide range of mushrooms throughout much of Europe, including Scandinavia, and they represent an excellent source of flavoursome food, both on their own and in combination in dishes such as stews. Although most edible fungi are soft and decay quickly, it is conceivable that fragments of the fruiting body might be recognised in suitable deposits. Spores from such fruiting bodies might be more likely to survive in the ground, but unfortunately they are probably insufficiently distinctive in their size, shape and ornamentation to be identifiable with certainty to types which might have been eaten. One group with rather distinctive spores, however, are the puffballs, some of which make good eating. Remains of giant puffball (*Calvatia gigantea* (Batsch: Pers.) Lloyd, formerly *Langermannia gigantea*) have been noted from Anglo-Scandinavian Coppergate (*AY* 14/7, 527, the identification now confirmed by Professor Roy Watling).

Though this material had aged beyond the point where it could be eaten, and the fungus has a variety of uses (Pegler et al. 1995, 14–17), it is hard to believe that the succulent, and (when suitably prepared) delicious, young fruiting bodies were not exploited for food. The other species of macro-fungus identified from Anglo-Scandinavian York, the bracket fungus *Daedalea quercina* (L.) Pers. (again, the identification can now be regarded as certain), is surely too leathery to have been eaten and was probably brought attached to wood.

## *Invertebrates as food*

Marine shellfish are abundant in Anglo-Scandinavian deposits in York. At Pavement mussel and oyster shells were numerous (*AY* 14/4, 180), although it was not clear whether they were thrown onto floors or derived from redeposited sediment used in levelling, and at 5–7 Coppergate there were smaller concentrations. Enormous numbers of shellfish valves were recovered from 16–22 Coppergate, mostly by hand collection (*AY* 14/7, especially 690 and 756–8; O'Connor 1984). Oysters (*Ostrea edulis* Linnaeus) were predominant (groups of twenty or more individuals were recovered from over 200 contexts). There were much smaller numbers of mussels (*Mytilus edulis* Linnaeus) and cockles (*Cerastoderma edule* (Linnaeus)), and some records of winkles (*Littorina littorea* (Linnaeus)) and whelks (*Buccinum undatum* Linnaeus). Even allowing for possible under-representation of the smaller species and for differential decay of mussel shells (which break down in the soil), oysters seem to have been by far the most heavily exploited shellfish. Clearly marine molluscs, especially oysters, were a significant resource in Anglo-Scandinavian York, although no guess can be made as to their proportional contribution to diets. It is not known how shellfish were brought to the town — presumably by ship — but were they fresh or at least sometimes preserved in some way?

One context at Coppergate gave substantial numbers of a range of small marine molluscs, either from fish guts or from a catch of shellfish which had not been sorted before it was brought to York (*AY* 14/7, 756–7).

Freshwater molluscs may also have been exploited. Valves of *Unio* and *Anodonta* species were 'surprisingly numerous' at Coppergate (*AY* 14/7, 757; O'Connor 1984), where exploitation as food is argued for the former, although the small size of the *Anodonta* valves was regarded by O'Connor as possibly indicative of their collection for some other use, perhaps as scoops. The very common 'garden snail' *Helix aspersa* is one of the few terrestrial invertebrates known to have been exploited for food in the British Isles. It is quite often recorded from Anglo-Scandinavian York. O'Connor (1985) considered that it was 'an opportunist detritivore exploiting the debris of human settlement' at Coppergate, and there is no evidence that it was eaten. *H. aspersa* hibernates in clusters, so the groups of shells recorded should not be assumed to have been deposited by humans (and many of the shells were clearly modern, see p.388).

Honeybees were very frequent, and sometimes abundant, in Anglo-Scandinavian deposits at Coppergate (*AY* 14/7, 706–7) and they have been repeatedly recorded from other sites (e.g. at 1–9 Micklegate, 2 Clifford Street and 4–7 Parliament Street). These records, and others from British archaeological sites, are discussed by Kenward (in press). Two deposits at Coppergate yielded large numbers of bees, clearly either the result of the killing or natural death of a hive or of prolonged deposition of corpses adjacent to a hive. At the three other sites mentioned there seem to be too many records to be accounted for by accidental deaths unless there were hives nearby (Table 12). However, other means of entry for bees need to be evaluated: firstly, their ingestion with food (having been contaminants in honey); secondly ejection during the extraction of honey from combs (or in subsequent purification); and thirdly, extraction during purification of wax. The superb preservation of some of the bees from 4–7 Parliament Street might suggest a direct entry rather than a route involving processes such as heating and straining. The effect of passage through the human gut requires study. Clearly bees, and probably bee-keeping, had a significant place in Anglo-Scandinavian York. This is not surprising, since honey would have been the only significant source of sugar prior to the importation of sugar from the tropics later in the medieval period. (According to Smith (1882), sugar cane was first known in India, whence it is said to have been brought to Europe by the Venetians about the middle of the 12th century, and was early cultivated on the islands of the Mediterranean. Afterwards it was introduced to Spain and Portugal, and also the Americas, becoming firmly established by mid 16th century.)

**Table 12** Records of bees (*Apis mellifera* and Apoidea sp.) from Anglo-Scandinavian deposits in York.

Key: * = count includes semi-quantitative records and totals in fact much higher; A mel = *Apis mellifera*; Apoid = Apoidea sp., probably *A. mellifera*. The number of records for 16–22 Coppergate given here is larger than given in *AY* 14/7, 706–7, because further analyses have been carried out.

| Site name, code and reference | date, feature types | as | contexts | individuals |
|---|---|---|---|---|
| 41–9 Walmgate (Johnstone et al. 2000) | ?Anglo-Scandinavian layer and pit fill | ?A mel | 1 | 1 |
| | | Apoid | 1 | 1 |
| 4–7 Parliament Street (Hall and Kenward 2000a) | Anglo-Scandinavian yard deposits | ?A mel | 1 | 1 |
| | | A mel | 3 | 8 |
| 16–22 Coppergate (*AY* 14/7; details in *Technical Reports*) | Anglo-Scandinavian: wide range of feature types | ?A mel | 2 | 2 |
| | | A mel | 55 | 1377* |
| | | Apoid | 155 | 199* |
| 1–9 Micklegate (Kenward and Hall 2000a) | Anglo-Scandinavian layer and pit fills | A mel | 6 | 7 |
| | | Apoid | 6 | 6 |
| 2 Clifford Street (Hall and Kenward 2000b) | Anglo-Scandinavian deposits | ?A mel | 1 | 1 |
| | | A mel | 1 | 3 |
| All Saints' Church, Pavement (Hall et al. 1998) | ?Anglo-Scandinavian deposit (pile hole) | A mel | 1 | 1 |
| Layerthorpe Bridge (Hall et al. 2000b) | Anglo-Scandinavian river deposits and dumps | Apoid | 6 | 6 |
| 7–15 Spurriergate (Hall et al. 2000c) | 11th-century pit | A mel | 1 | 1 |

One important use of honey must have been in making fermented drinks like beer and wine and, of course, mead. The last of these would leave no clear record in the ground, but beer might be detected by the remains of concentrations of plants used for flavouring, and wine by the presence of concentrations of seeds of various fruits, perhaps accompanied by their skins. As noted above, no very high concentrations of such remains have been observed in Anglo-Scandinavian deposits: remains of the fruits of hop are frequently recorded, though usually in modest numbers, whilst the large quantities of seeds of a wide variety of wild fruits are invariably found in faecal deposits. The hop fruits may represent the use of this plant in dyeing or as a medicinal plant, for example.

A second bee product, wax, may be mentioned here. Like honey, it must have been important and have had a wide range of uses. Kenward and Hall (*AY* 14/7, 766) discuss the records from Coppergate of numerous fragments of wax and a wax ball bearing the marks of twine. One aspect of this invaluable material which might be investigated further is its purification (given that this might have been the source of concentrations of bees).

## *Vertebrate foods*

There is abundant evidence, in the form of bones, for the consumption of vertebrates in Anglo-Scandinavian York, although the only published account relating to bones of this period is for selected material from 16–22 Coppergate (*AY* 15/3) (see Table 20, p.428). At this site, remains of cattle always formed the largest component, especially in the Period 3 material; in Period 5B, by contrast, there was a much wider range of wild birds (although most were present in very small numbers) and a higher proportion of pig bones (ibid., tables 39–40, and see Fig.92). Overall, there was nothing to suggest that wild birds and mammals contributed significantly to the diet. Fish, on the other hand, seem to have been eaten frequently, with herring and eel two of the most important. The wide range of fish represented can be judged from *AY* 15/3, table 56; they included sturgeon, salmon, trout, pike, cod and haddock. Clearly both freshwater and marine resources were being exploited.

O'Connor suggested that the livestock remains gave no evidence for organised butchery and that beasts may have been 'brought in and slaughtered as required and shared amongst several households, the role of butcher being taken by whomsoever ... had a sharp knife and a rough idea of how to use it.' It will be interesting to see if this pattern is repeated throughout Anglo-Scandinavian York (see pp.435–6).

## *Food preservation and storage*

Food storage is essential to a stable urban economy, given that most plant foods, including staples, are produced seasonally in temperate regions, but the bioarchaeological evidence from York at this period gives no clear indication of how any materials were preserved. Grain storage is one obvious topic to be explored in view of the abundance of evidence for cereals in the town. The best indication of how cereals may have been stored comes from the records of grain pests. These beetles were very abundant in Roman York, e.g. at Coney Street (*AY* 14/2), Skeldergate (*AY* 14/3) and Tanner Row (*AY* 14/6). In complete contrast, they were definitely not a significant problem in cereal storage in the Anglo-Scandinavian period in York, and in fact may have been wholly absent. Even if the few grain beetles recorded from samples of this date were contemporaneous (which the authors doubt), they were clearly so rare as to be insignificant. No assemblages of insects consisting of likely communities of potential 'native' grain pests have been found either, although many generalist species which were commonly present in Anglo-Scandinavian York were recorded from stored grain in the 19th and early 20th centuries (see, for example, Hayhurst 1940; Hinton 1945).

It is postulated that the rarity of specialist grain pests was a consequence of non-centralised grain storage and distribution systems radically different from those of the Roman and post-conquest periods. We can perhaps envisage grain storage at the level of sacks or jars in individual tenements where even

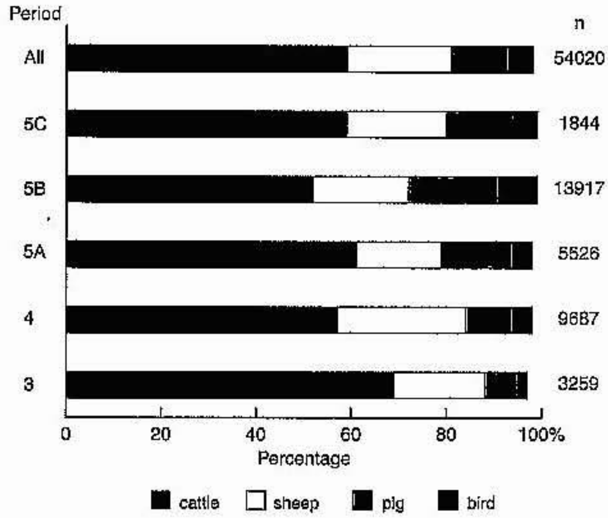



*Fig.92 Hand-collected vertebrate remains from Anglo-Scandinavian deposits at 16–22 Coppergate*

if infestations arose the pests would be unable to move on to other stores. The substantial number of fragments of rotary querns (41) found in Anglo-Scandinavian levels at 16–22 Coppergate (*AY* 17/14, table 255) certainly points to local milling of grain rather than a supply of flour to households from a centralised store.

As already noted, small numbers of remains of grain pests *have* been found in deposits dated to this period: at Pavement (*AY* 14/4, 185), Coppergate (*AY* 14/7), 2 Clifford Street (Hall and Kenward 2000b), and a single *O. surinamensis* from a pit fill of uncertain date, possibly Anglo-Scandinavian, at Walmgate (Buckland 1995). These records are all suspect in some way, with contamination in the laboratory as a depressingly likely source, while residuality of Roman remains, intrusion by later material and incorrect context dating are also possible. For the Pavement site it was suggested that they were contaminants from Roman material which was being processed at the same time, while at 16–22 Coppergate residuality, contamination in processing, later intrusion and incorrect dating were all possible (*AY* 14/7, 760–1). This latter site offers a cautionary lesson — early in analysis grain pests were found in a rather large number of contexts given preliminary Anglo-Scandinavian dates, but a (blind) request for a more careful evaluation of dating moved almost all of them to the post-conquest period and revealed others to have been cut by later features! The Clifford Street samples were processed at a time when samples rich in grain pests from other sites were also undergoing analysis, and there is also the possibility of reworking, given the presence of Roman pottery through the Anglo-Scandinavian deposits at Clifford Street. It may be thought that a degree of special pleading is being applied in an unwillingness to accept these records as authentic, but the dangers of this are more than outweighed by the seriousness of incorrectly assuming that they were contemporaneous. Why are the grain pests never at all common in these deposits when they typically develop large populations when they infest grain?

Why are grain pests, specifically, singled out as likely contaminants? The reason is that they are recognisable as not 'belonging' to the Anglo-Scandinavian fauna. Most of the Roman and post-conquest fauna (and much of the flora) is identical in character to that of Anglo-Scandinavian settlement and so would not be recognised as such when residual or contaminant. So far as redeposition of Roman remains is concerned, Roman pottery is common in later deposits (*AY* 16/5) so there is no reason why other remains should not also be residual (cf. Dobney et al. 1997). One species which may also occur as residual remains in Anglo-Scandinavian deposits is the spider beetle *Tipnus unicolor*. This robust and easily recognisable species is characteristic of old and slightly damp buildings. It was common in Roman York (e.g. at Skeldergate, *AY* 14/3), but then very rare until the post-conquest period. As Table 13 indicates, *T. unicolor* was commonest at Coppergate in Period 3, when there were no buildings in the excavated area, then rare, and only began to increase in abundance again in Period 5C. This pattern of abundance may have resulted from re-deposition of Roman remains in the earlier period, the beetle perhaps re-establishing itself when buildings of relatively good quality had been present for some time. The abundance of this spider beetle in the small isolated Early Christian settlement at Deer Park Farms, Co. Antrim (Allison et al. 1999a and 1999b; Kenward and Allison 1994b), appears to undermine this line of argument, but may have been a result of the long life of that settlement or of climatic differences.

Storage of some other plant products will have been straightforward: hazelnuts, walnut, linseed, field beans, peas and other dried 'seeds' such as the flavourings dill, celery seed and coriander, would all survive for many months in a dry place. Crab apples probably remained edible for quite long periods, too, and may have been dried. For the soft fruits such as raspberry, blackberry and bilberry, storage beyond a day or two would only have been possible by cooking (when they could have kept for some days) or, for the longer term, with the use of large quantities of honey or in the form of ferments. The one certain

**Table 13** Records of the spider beetle *Tipnus unicolor* from Anglo-Scandinavian and post-conquest deposits at 16–22 Coppergate by period

| Period | *Tipnus* | | | |
|---|---|---|---|---|
| | no. individuals | in no. subsamples | Period total no. samples N>20 | Individuals/100 subsamples |
| 3 | 8 | 6 | 68 | 12 |
| 4A | 1 | 1 | 18 | 6 |
| 4B | 1 | 1 | 114 | 1 |
| 5A | 0 | 0 | 60 | 0 |
| 5B | 4 | 4 | 190 | 2 |
| 5Cf | 0 | 0 | 3 | 0 |
| 5Cr | 1 | 1 | 28 | 4 |
| 6 | 3 | 2 | 14 | 21 |

'leaf' vegetable available to the inhabitants of Anglo-Scandinavian York, leeks, would presumably have stood in the ground through much of the winter. Honey, itself, is an excellent energy source which would have kept more or less indefinitely.

Vertebrates would have presented fewer problems of seasonality, since at least a few individuals of domestic livestock would have been available for slaughter and consumption fresh throughout the year. Similarly, at least some wild mammals and birds could have been hunted in every month, although as noted on pp.398–9 they appear not to have been used on a large scale. We know of no bioarchaeological or artefactual evidence for storage of the meat of mammals and birds in Anglo-Scandinavian York, even though the tradition of smoking meat is well established in Scandinavia. Fish, too, would have been available to catch all year round, although their quality and the ease with which fishing could be carried out would vary. Preservation of excess meat and fish is of course desirable and common in most European cultures. While much fish was probably brought to York fresh (running boats up the Ouse on the tide), the strong Scandinavian tradition of fish preservation by pickling, drying and smoking would lead us to expect that such preserved products were also available. Detecting pickled fish, presumably filleted, at the point of consumption would be difficult unless characteristic suites of flavourings were recognised. Dried and smoked fish might be recognised by the proportions of post-cranial to cranial bones, and the particular cranial bones present.

Studies of plant and animal remains in Anglo-Scandinavian occupation deposits in York have given us extensive lists of ingredients but we can say little about how the ingredients were prepared and cooked, and how they were associated into dishes and meals. Even when a range of foods are found together in a discrete patch of faeces, for example, they may represent successive meals or mixing during deposit formation. Perhaps the only evidence for a prepared food is the discovery of fragments of charred material which appears to be bread from Coppergate (20 records), 1–9 Micklegate (3) and 2 Clifford Street (1). Records of zonation of burning in bones might give clues as to how joints were cooked, but no systematic analysis has been made. Fruitstones up to about 12mm in maximum length seem often to have been swallowed, to judge from the quantities observed in faecal deposits in pit fills, though whether they were eaten fresh or cooked cannot be determined from the remains. Likewise small fish bones seem to have been swallowed fairly often, the remains bearing characteristic evidence for crushing during chewing and acid etching in the gut (*AY* 14/7, fig.193a). That these bones survived digestion indicates that they had not been cooked for long periods (cf. *AY* 14/4; Nicholson 1993). Again, patterns of burning of fish bones might suggest means of cooking.

## Human health

As pointed out by Kenward and Hall (*AY* 14/7, 758), human remains of Anglo-Scandinavian date are uncommon in York so that direct observation of skeletons cannot be used to deduce pathological conditions, and thus indirect evidence must be sought. This evidence may be in the form of conclusions as to the quality of diet, or indications of toxins or pathogens.

Judging from the food remains discussed above, the townspeople had a rich and varied diet available to them, overall. Whether individual diets were good throughout the year is another matter, and probably impossible to ascertain given the fact that the deposits analysed were almost always formed over weeks, months or years, and that debris representing different components of the diet may have had different disposal routes. Faecal layers in which fruitstones are rare may suggest the possibility of vitamin C deficiency, but only if green vegetables were not being consumed in quantity (the evidence for leafy vegetables is currently restricted to leek).

The possibility that the large quantities of corncockle seeds present in cereals may have had a deleterious effect on health was mentioned by Kenward and Hall (*AY* 14/7, 758); it clearly deserves further study. Peas and/or beans appear to have been contaminated by the bean weevil *Bruchus rufimanus*, which has frequently been found in cesspits in the town, doubtless having been swallowed with cooked pulses. The effect of low-level contamination by this and other insects (perhaps including aphids, cf. Hall et al. 1983b), was probably negligible, however, since quite high levels of insect contamination of food can be tolerated (Venkatrao et al. 1960).

As mentioned above, material interpreted as human faeces has been widely recorded in Anglo-Scandinavian deposits in York both in primary contexts (typically pit fills), and occasionally as reworked faecal concretions, and this is some of the best evidence available regarding health. It is characterised by the presence of high concentrations of wheat/rye (*Triticum/Secale*) 'bran', usually accompanied by a suite of other plant remains likely to have been ingested in food. These include seeds and sometimes other parts of fruits like blackberry, sloe and apple and, where preservation is very good, even seed coat fragments and other tissues of pulses (peas and beans) and leaf fragments of leek. With the bran in these deposits, almost invariably, are abundant eggs of the intestinal parasites whipworm (*Trichuris*) and roundworm (*Ascaris*) (e.g. *AY* 14/7, 696–7, 758–9). Infestation by these two nematode gut parasites was probably very common, perhaps ubiquitous. The numbers of eggs were sometimes large so that individuals may have carried heavy burdens of parasites at times, with an inevitable effect on the well-being of individuals whose health was challenged by some other factor. No other internal parasites have been unequivocally recognised from Anglo-Scandinavian York, although identification of the rather featureless eggs of, for example, liver flukes, is very difficult.

Infection by the common nematode gut parasites occurs all too easily. Vast numbers of eggs are produced by both *Ascaris* and *Trichuris* (e.g. Markell and Voge 1976, 240, 261), and they remain infective for some time. The exposure of faeces in pits is attested by evidence from some sites (for example Coppergate), and it is likely that parasite eggs, as well as disease-causing micro-organisms, were dispersed by insects as a consequence (Kenward and Large 1998b). Infection by drinking water seems possible where wells or other sources of water were close to cesspits or contaminated ditches.

Despite the negative effects of gut parasites and contaminant corncockle seeds, the typical Anglo-Scandinavian alimentary tract will have enjoyed a diet rich in roughage, much of it in the form of 'bran' so that transit times were low and we can suggest that diseases such as diverticulitis and bowel cancer were rare. The liveliness of digestive systems is attested by the abundance of fruitstones (and sometimes fish bones) which had plainly been voided in faeces.

People may have carried gut parasites without realising it, but some other invertebrates would have had a tangible effect on humans, namely fleas, lice, flies and ticks. The last of these groups is represented only by rare records of the sheep tick *Ixodes ricinus* (Linnaeus), which attacks a wide range of warm-blooded animals. In addition to being irritating, *I. ricinus* can carry Lyme disease (caused by spirochaetes) and may have been favoured by higher temperatures in the Anglo-Scandinavian period (Lindgren et al. 2000). Human fleas (*Pulex irritans* Linnaeus) were very common at Coppergate, especially in deposits associated with buildings (they were recorded from 197 contexts; *AY* 14/7, 698–703), and have regularly been recorded from other sites of the period. The fact that only one human flea was recorded from the Pavement site may be ascribed to failure to recognise their remains during that early study. Clearly fleas were at least a minor nuisance, and they may have been vectors of disease. A few fleas of dogs and rodents have also been recorded, and they too may have been annoying and potentially injurious to health.

Human lice (*Pediculus humanus* Linnaeus) were also fairly frequent at Coppergate, with records from nearly 60 contexts, particularly in floors of Period 4B (*AY* 14/7, 698–700). *P. humanus* has occurred regularly in small numbers at other sites, and the absence of early records undoubtedly reflects non-recognition. The frequency with which these very delicate insects are now recovered from suitable archaeological deposits suggests that they were extremely common, perhaps ubiquitous. Oddly, the numerous bone combs recovered from Coppergate, in particular, all appear to have had teeth too coarsely set to have functioned in combing nits (*AY* 17/12, 1923–34). By contrast, what were clearly nit combs are described by Schelvis (1991; 1992; 1998) and Fell (2000), and a fine-toothed boxwood comb of post-conquest date from Coppergate is described by Morris (*AY* 17/13, 2309–12). Although in themselves a minor irritation, *P. humanus* is known to carry human disease. It is perhaps only a matter of time before the pubic louse, *Pthirus pubis* (Linnaeus), is discovered in Anglo-Scandinavian York, since it is now known from Roman and medieval Carlisle (Kenward 1999a).

A single bedbug, *Cimex lectularis* Linnaeus, was recorded from Coppergate, and seems more likely to represent the form associated with humans than that found on pigeons. If so, bedbugs either survived in Britain from the Roman period (for which there are a few records) or were re-introduced, quite possibly by the far-travelling Vikings. Bedbugs are probably disadvantaged by the more flimsy kind of human dwelling, and may not have been able to become abundant until well into the post-conquest period, when the general standard of urban buildings improved.

O'Connor (*AY* 15/3, table 54) gives Anglo-Scandinavian records for the black rat, *Rattus rattus* Linnaeus, from Coppergate, and it appears very likely that the animal was established at least on the fringes of the town. We do not know whether plague struck York at this period but the presence of black rats obviously makes it possible. We need to search for remains of the plague flea, *Xenopsylla cheopis* (Rothschild), although plague can also be spread by other species, including human fleas and fleas associated with rodents, some of which have been recorded from Coppergate.

Several species of flies known to carry disease, including the housefly and stable fly, have been identified from Coppergate, where they were sometimes abundant (*AY* 14/7, 762–3). The numerous beetles living in cesspits may also have carried a range of pathogens (Kenward and Large 1998b). Fly puparia from Anglo-Scandinavian York have not been studied systematically, but species of medical importance were certainly both ubiquitous and abundant. Various biting midges and mosquitoes must have been common, too, but it has not yet been practicable to identify the abundant remains of the group to which these flies belong. An attempt to investigate these would be worthwhile in view of the ability of some of the species to carry disease, particularly malaria, which may have been a constant threat in a town fringed by marshland and, it is suspected, with a climate warmer than that of the 20th century.

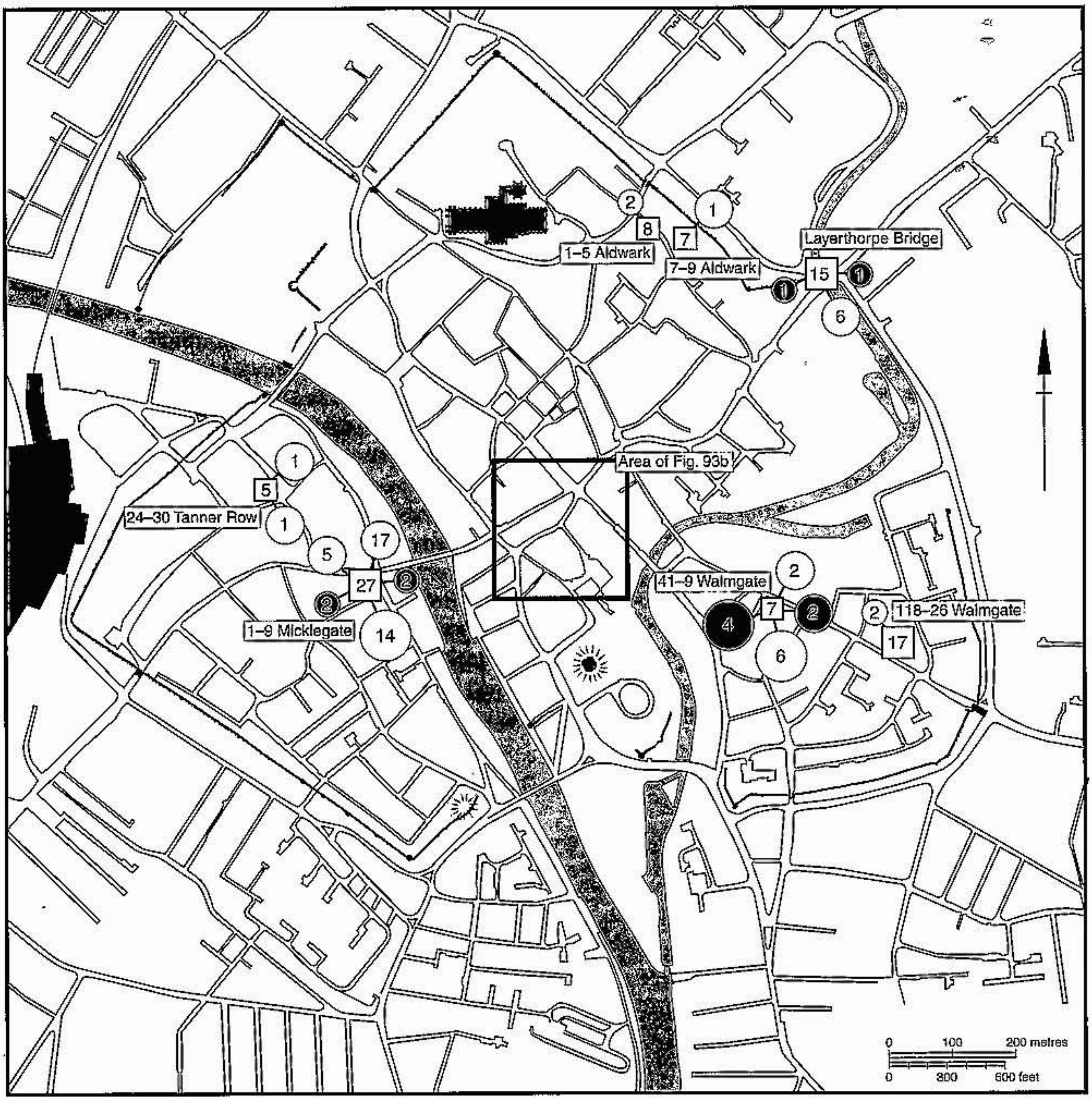
## Textile working

One of the consistent features of plant assemblages from Anglo-Scandinavian sites in York has been the presence of plants likely to have been used in certain stages of textile working, especially dyeing and mordanting. The presence of one of them, dyer's greenweed (*Genista tinctoria* L.), was signalled during very early work on insect remains from Pavement, when material of the weevil *Apion difficile* Herbst, which feeds almost exclusively on this plant, were recognised (Kenward et al. 1978, 63). Subsequently, a suite of taxa was found at 16–22 Coppergate comprising dyer's greenweed, madder (*Rubia tinctorum* L.), woad (*Isatis tinctoria* L.) and the clubmoss *Diphasiastrum complanatum* (L.) J. Holub (as *Diphasium complanatum*, *AY* 14/7, 709–15 and 767–9). Some other plants recorded at that site might also have served to provide dyestuffs (ibid., 770–1). Incidentally, the *Apion* proved to be very common, too. As a further aside, it may be mentioned that insects in addition to *Apion difficile* may have been imported with the large quantities of *G. tinctoria* and other dyeplants obviously utilised in Anglo-Scandinavian York, but they are difficult to recognise unless they are abundant or alien. In particular, *Sitona* species and a range of other *Apion* species, both of which genera are rather numerous in deposits of this date, may have been brought with *G. tinctoria*, host to at least some species in both genera (Hoffmann 1958, 1768) (see, however, the discussion of the possible origin of *Sitona* with peas and beans, p.388).

Remains of some or all of these plants were subsequently recorded from other deposits of Anglo-Scandinavian date in the city and, indeed, the clubmoss, in particular, has become something of a 'marker fossil' (with the caveat that it may in some cases be reworked); the distribution of records for these plants is shown in Fig.93. It is worth remarking here that small amounts of some of these dyeplants were discovered in the 1990s in the dried residues from the samples from 6–8 Pavement originally examined in 1977 (Hall 1998, 6); clearly it is important to retain at least some material from excavations for future study to check for remains which are not recognised or not identifiable initially.

That dyeing was one of the processes in textile working which took place within the city is clear from the concentrations of dyeplant material in many of the deposits, especially at Coppergate (cf. *AY* 14/7, 709–10, 712–13). In many other cases, however, only traces of material were recorded and it seems likely that we are dealing with a 'background' of debris spreading from an epicentre in the Coppergate/Ousegate area (and with another focus at 1–9 Micklegate), though of course we still only have records from a few sites (Fig.93). Although dyeing must have taken place along with the various other processes involved in turning raw fibres into finished garments, the precise way in which dyeing was undertaken remains obscure. Thus, no vessels survive which

(a)




might have served for dyeing large hanks of wool, let alone lengths of cloth. Cardon and du Chatenet (1990) record the former practice of dyeing with woad in pits or gullies. This may explain the records of concentrations of remains interpreted as dyebath waste in the fills of some cut features, though none was noted as having the kind of waterproof lining one presumes would be necessary for such a use. In any case, it is difficult to see how these could be distinguished from cuts into which dyeplant material had simply been discarded from vats or other vessels.

Between them, the three main dyeplants — woad, madder and greenweed — will have provided the three primary colours and from these most intermediate shades. The red colouring matter from madder (mainly alizarin and pseudopurpurin) and the blue of woad (indigotin) match the evidence for these

(b)

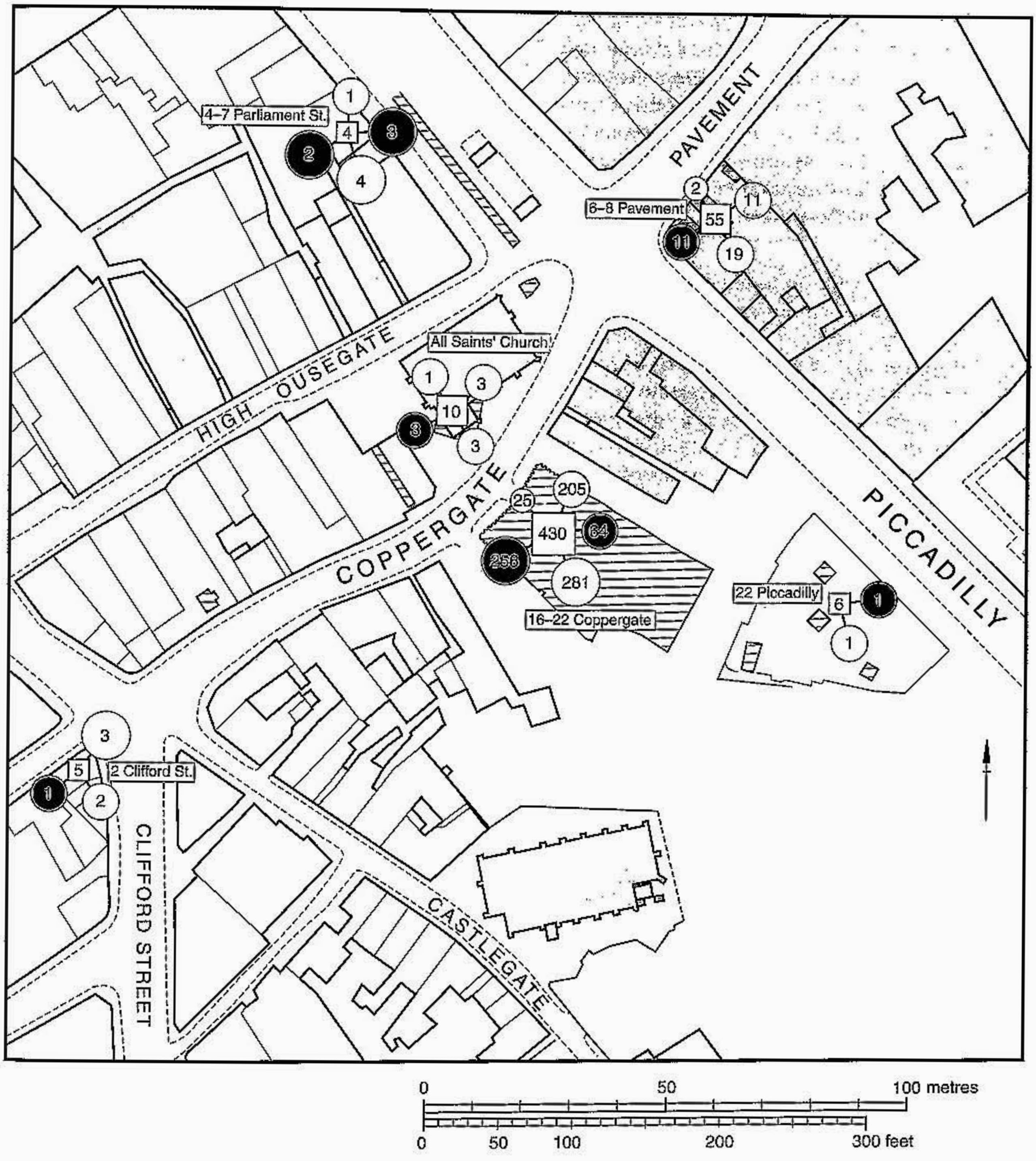



*Fig.93 (above and facing) Evidence from Anglo-Scandinavian York for plants used in dyeing and mordanting. The central square in each 'constellation' gives the number of contexts examined (and the size of the symbol provides a crude measure of the scale of investigation thus: smallest, 1–9 contexts; medium, 10–99 contexts; largest, >99 contexts examined). The peripheral symbols show the numbers of contexts in which remains of the plants were recorded: white, clubmoss* (Diphasiastrum complanatum *(L.) J. Holub); green, dyer's greenweed* (Genista tinctoria L., *though note that this plant dyes yellow unless used with another dye); blue, woad* (Isatis tinctoria L.*); yellow, weld* (Reseda luteola L.*); and red, madder* (Rubia tinctorum *L.). The size of these peripheral symbols reflects the proportion of investigated contexts which contained the taxa in question, though of course, for sites with relatively few samples, the importance of the remains may sometimes be exaggerated by this device (e.g. for Tanner Row, where the taxa were each recorded in one of only five samples). The scale adopted for these is: small, recorded in 1–9% of contexts; medium, 10–49%; and large, present in 50% or more* substances from studies of dyestuffs on textile fragments (*AY* 17/5). This indicates that dyeing took place locally — whilst the yellows (from genistein) from dyer's greenweed (and perhaps other plants, of which the most likely is weld or dyer's rocket, *Reseda luteola*, Fig.93) fill a gap resulting from the non-survival of these substances on textile fibres which have been buried in the ground.

The clubmoss appears to have been imported specifically for use as a mordant, for these primitive plants have been shown to accumulate aluminium (e.g. Hutchinson and Wollack 1943), one of several metals whose ions act on certain dyestuffs to make them more light- and wash-fast and to alter the colour they produce. In the absence of alum (potassium aluminium sulphate), which was presumably not available to dyers in the Viking world unless there was trade with those areas where alum could have been produced at that period (probably only the eastern Mediterranean, cf. Singer 1948), such a raw material would have been invaluable and this must explain the importation of a commodity almost certainly collected in the wild from some part of Scandinavia or northern central Europe. Although important in later centuries, the 'local' alum industry of north-east Yorkshire did not begin to become established until the early 17th century (Pickles 2002).

The quantities of dyeplant (including clubmoss) recovered at 16–22 Coppergate (and variously at almost every other site with Anglo-Scandinavian contexts in central York) — which must represent a fraction of the total amount originally used, given losses to decay and presumed disposal away from the sites excavated — incline one to wonder whether dyeing was not being practised on an almost 'industrial' scale; if so, it would certainly require large-scale trade to support it.

The kinds of textile raw materials for which there is evidence in Anglo-Scandinavian York from yarns or textile fragments have been considered by Walton Rogers (*AY* 17/11) and that author also mentions archaeobotanical evidence for achenes ('seed') of hemp and for seeds, capsule debris and 'scutching waste' of flax from Coppergate. These fibre plants were presumably retted in the vicinity, though the only good evidence for this activity is the later material of clumped flax stem fragments (with seeds and capsule debris) from a medieval river deposit at Layerthorpe Bridge (Hall et al. 2000b).

Turning now to animal fibres, the working of wool is well attested by remains of this fibre as staples or clumps of raw wool, as well as fragments of yarn and woven textiles (*AY* 17/11), and a range of textile-working artefacts at Coppergate. Studies of insects have contributed substantially to our knowledge of wool processing, revealing it to have been a common and widespread activity. In view of this, and given the number of 'small finds' of wool of various kinds, the lack of records of raw wool fibres from samples analysed for biological remains is quite surprising. This might be taken to indicate that wool came to Coppergate ready cleaned; however, there are numerous records of the very distinctive adults and puparia of sheep keds, *Melophagus ovinus* (Linnaeus), and sheep lice, *Damalinia ovis* (Schrank), or both, from the Anglo-Scandinavian period in York as a whole. These remains are considered to have been deposited as a result of wool (or fleece) cleaning, and many of them are from deposits which were clearly domestic floors, although the insects (especially the robust ked puparia) seem to have been scattered widely, perhaps with floor sweepings. There is a strong impression that the remains of adult keds, which appear to have very weak cuticle, are in most cases recovered only because they remained within the extremely tough puparia until released during sample processing (something also suggested by Robinson 1981, 204); this explains how they may have become dispersed without decaying.

It is perhaps worth mentioning here that the sheep parasites at Coppergate are statistically very closely correlated, in their occurrence in deposits, with *Apion* species (probably including numerous unrecognised *A. difficile*) and with some scarabaeid dung beetles (*Geotrupes* spp., *Aphodius prodromus* Brahm and *A. granarius* (Linnaeus)). One possible explanation for the latter association is that wool cleanings, including sheep 'dags' (wool matted with dung), fell onto floors or were discarded immediately outdoors and attracted the dung beetles. Human fleas were positively correlated with these dung beetles, too, and it seems possible that slovenliness in leaving wool cleanings on floors provided a nutritionally rich substratum for flea larvae. The association of all these insects may reflect the fact that cleaning and dyeing were carried out in the same place.

## Tanning and leather working

The importance of leather to the Anglo-Scandinavian inhabitants of York is evident from the study undertaken by Mould, Carlisle and Cameron (*AY* 17/16), founded on the large corpus of well-preserved material of leather offcuts and finished leather artefacts from Coppergate, Piccadilly and Bedern. However, the location of the tanners' establishments where the hides and skins were converted into leather has for a long time been a matter of debate.

Benson (1902, 64) described pits in High Ousegate which he thought to have been used for tanning: 'Amidst this subsoil were a number of horizontal timber balks, about 9" x 9" rebated, and a quantity of piling ... these indicate that the area was the site of tan pits ... The pit towards High Ousegate rested on a twelve-inch bed of puddled clay, the centre pit had a nine-inch bed of yellow sand, whilst the one at Coppergate end had, at the bottom, a lime deposit five inches in thickness' [*sic*]. This interpretation as tan pits has subsequently been questioned and the structures reinterpreted as cellared buildings (*AY* 8/3, 238–50).

Subsequently, some biological and other evidence from deposits rich in leather offcuts at 6–8 Pavement led Buckland et al. (1974) to postulate that early processes in leather making (i.e. hide cleaning and then tanning) might have been practised at this site. However, most or all of the materials such as fine charcoal and ash, as well as the plant and insect remains they discuss, are quite likely to have had some other origin, and were frequent in contemporaneous deposits at Coppergate for which there is absolutely no reason to suppose an association with tanning. Moreover, the abundant leather offcuts at Pavement (considered in *AY* 8/3) indicate a later stage in the utilisation of leather, either its working into articles in the buildings or the use of offcuts from elsewhere as litter on house or stable floors, the latter seeming to be a reasonable interpretation to be placed on leather offcuts in many cases (Hall and Kenward 1998).

Part of the evidence of Buckland et al. (1974) for hide preparation (necessary prior to tanning) at Pavement was the record of a single specimen in each of the four samples of the beetle *Trox scaber* (Linnaeus); later analyses showed it to be present in nearly half of the samples from this site, but mostly as single individuals and in a few cases as two. These are consistent with the data from 16–22 Coppergate but in contrast to those from Anglo-Scandinavian and early medieval deposits at Layerthorpe Bridge where it was present in 30 of the samples at a mean frequency of 3·6 per sample when present, and was sometimes very numerous. Moreover, many of these samples also yielded high concentrations of decayed bark fragments and also sclereids — clusters of lignified cells which form in some kinds of bark, and which are resistant to decay, being released as the bark decomposes (these will certainly have been overlooked in material examined prior to 1999). In the case of Layerthorpe Bridge, we are probably dealing with redeposited waste from tan pits. It may be significant that, though never abundant, small (2–35mm) scraps of uncut leather were recorded from seven of the eleven contexts at this site which contained bark and sclereids. The recognition of tanning waste using plant and invertebrate remains is discussed by Hall and Kenward (2003), who also consider suites of remains indicative of various other craft activities.

Vertebrate resources had other uses in craft and industry, notably horn, antler and bone in the making of a variety of artefacts. The importance of these materials is highlighted by MacGregor et al. (*AY* 17/12), who include combs, pins, knife handles, needles, thread reels, spindle whorls, skates, box lids, and so on.

## Livestock, their food and their parasites

Although most of the faecal deposits at Coppergate, for example, are thought to be of human origin (and at Pavement a discrete human stool preserved by mineralisation was studied by Jones in *AY* 14/4), some contexts have been described as perhaps containing or consisting of pig faeces on the basis of a low ratio of *Trichuris* to *Ascaris* eggs, and in at least one case measurements of *Trichuris* eggs suggested *T. suis* (of pigs) might have been present (*AY* 14/7, 759 and 778–9). Such a ratio has been said to be indicative of pig, rather than human, faeces (Taylor 1955), although this assertion requires objective testing. Subsequently, some material examined as part of a project to draw together the information discussed here has given some more support to this idea: samples from 4–7 Parliament Street (Hall and Kenward 2000a), for example, were found to have low

Table 14 Records of uncharred ('waterlogged') cereal or cereal/grass chaff from Anglo-Scandinavian sites in York

| Site | Record | No. contexts examined | No. cases | No. cases with more than traces of remains |
|---|---|---|---|---|
| 16–22 Coppergate | Cerealia indet. ) | 430 | 29 | 9 |
| | Gramineae/Cerealia ) | | 8 | 2 |
| 1–9 Micklegate | Cerealia indet. ) | 27 | 6 | 3 |
| | Gramineae/Cerealia ) | | 2 | 0 |
| North Street | Gramineae/Cerealia | 9 | 1 | 0 |
| 2 Clifford Street | Gramineae/Cerealia | 5 | 1 | 0 |
| 41–9 Walmgate | Cerealia indet. | 7 | 1 | 0 |
| 4–7 Parliament Street | Cerealia indet. | 4 | 4 | 4 |

*Trichuris* to *Ascaris* ratios and, whilst rich in wheat/rye 'bran' and other food debris, also contained substantial concentrations of uncharred cereal chaff (Table 14), something which is unlikely to have formed more than a small component of human food but which is very typical of animal feed.

Support for the presence of pigs, or at least their uncleaned skins, at Coppergate is provided by small numbers of records of the pig louse *Haematopinus apri* Goreau. However, in no case were these lice especially abundant (cf. one of the house floors at the Deer Park Farms site, Co. Antrim; Kenward and Allison 1994b). It is worth mentioning here that *H. apri*, now found on wild boar, appears to have been the louse of British pigs in the medieval period, probably only being replaced by *H. suis* (Linnaeus) when modern pig varieties were introduced. *H. apri* is now extinct in Britain (*AY* 14/7, 778).

There were also (in addition to numerous sheep lice) lice from cattle, goats, horses and cats, but again in small numbers and certainly not providing evidence that these animals lived on the site.

With regard to the keeping of livestock in the town, it has been suggested by Kenward and Hall (2000b) that conditions resembling those in an old-fashioned farmyard may have existed at 118–26 Walmgate. The buildings may have been byres or stables, and the food remains may have represented either domestic occupation or the feeding of livestock with scraps (or both); pigs seem the most likely animals to be kept at a site such as this. Pigs might well be fed cereal cleaning waste, accounting for the records of chaff and whole or fragmentary seeds of cornfield weeds, and might produce ambiguous evidence in the worm egg record (either by recycling human faeces or through their own infections). The Walmgate area of York may represent an early stage of urban settlement, with crowded smallholdings which would eventually be subdivided into tenements to form an urbanised area of the kind seen closer to the centre of York at this period (and as discussed for the Norwegian town of Bergen (Krzywinski and Kaland 1984) (see also p.495). This is clearly a topic for further research using structural and bioarchaeological evidence.

For the Roman and post-conquest periods in York there is good evidence for the stabling of horses (or other equines), in the form of large quantities of stable manure, a material whose identification in archaeological deposits is discussed by Kenward and Hall (1997). By contrast, clear identification of stable manure is conspicuously rare for the Anglo-Scandinavian period, suggesting real differences in the importance of horses. Stable manure may be recognised by combinations of plant remains from cut vegetation, typically grassland, various materials used as absorptive litter (which may include bracken, moss, peat, wood chips and perhaps even leather), insects imported with 'hay' and other materials, insects favoured by foul but open-textured rotting matter, and, in the

Roman and post-conquest periods, grain pests from cereal feed. The probable absence of grain pests in the 5th to mid-11th centuries may make it harder to recognise stable manure, but the combination of other components should still be diagnostic.

Although a few samples at the Pavement and 16–22 Coppergate sites contained quite large numbers of insects which would have been favoured by stable manure, they may equally have exploited other rather foul decaying matter, and they were not accompanied by unusually large quantities of plants considered typical of stable manure. One exception was a very deep narrow wattle-lined cut (6422, to the rear of Tenement D on the Coppergate site in Period 5B) which conceivably started life as a well but was eventually used as a repository for stable manure amongst other fills (*AY* 14/7, 611–13). Thus it appears that horses were not normally kept stabled in what is the archaeologically best-known part of York. Might they have been kept in the open? It has been suggested, albeit on rather limited evidence, that the area to the rear of the Coppergate site may, in Period 5C, have been grazed (*AY* 14/7, 624–7). Perhaps this was the kind of place where horses were kept in paddocks, or tethered. Even if horses were kept indoors, stable manure may only very rarely have been allowed to accumulate or have been dumped on occupation sites. Perhaps it was too valuable as manure to be wasted. On the other hand, urban stabling needs large quantities of imported food in the form of hay and cereals, not easily available in a decentralised economy, so that animals were left outdoors where there was at least limited grazing. Certainly horses entered into the life of Anglo-Scandinavian York, for artefacts associated with horses were quite frequent at Coppergate (*AY* 17/6, 704–9; *AY* 17/14, 2558–9; see also *AY* 15/3, 152, 183–4).

Perhaps the most likely livestock to be have been kept within the Anglo-Scandinavian town are chickens, and certainly bones of domestic fowl are well represented in assemblages of vertebrates. In view of this, the complete lack of records of lice and fleas parasitic on chickens is odd. It was suggested in *AY* 14/7 that some of the shallow 'scoops' recorded at Coppergate may have been produced by the scratching and dust-bathing of chickens; a modern parallel is discussed by Dobney et al. (2000). Geese, too, seem likely to have been kept, but again have left no evidence in the form of parasites. Eggshell was frequently recorded in occupation deposits at Coppergate and elsewhere, but no identification has been made and no entire 'lost' eggs appear to have been recorded.

Quite large numbers of bones of cats and dogs have been found in deposits of the Anglo-Scandinavian period in York, and a single cat louse (*Felicola subrostratus* (Burmeister)), was reported from Coppergate (*AY* 14/7, 596).

## Vermin and their parasites

The status of wild (or domestic) animals as vermin is a matter of some subjectivity. Among the mammals from Anglo-Scandinavian deposits at Coppergate listed in *AY* 15/3 (table 54) bank vole, field vole, water vole, wood mouse, house mouse and black rat might all, under some circumstances, be regarded as pests, and one suspects that cats might be, too. Of these species (and ignoring the moot case of cat), only house mouse and black rat were represented by more than a few bones. It is suspected that, had sieving been carried out on a much more systematic basis, the status of all of these species at Coppergate would be much clearer. It is worth noting that a few individuals of fleas found on rats and mice (*Nosopsyllus fasciatus* (Bosc) and *Ctenophthalmus nobilis* (Rothschild)) were also recorded from Coppergate. Both may carry diseases of human beings, and *N. fasciatus* is certainly implicated as a plague transmitter, as is the human flea. It seems unlikely that any birds would have been regarded as a nuisance, on the assumption that tender greens and cereals were not being cultivated in the town.

## The influence of the rivers

The rivers Ouse and Foss were clearly important in determining the location of Jorvík, through its accessibility by water for trade in a period when ships were the principal means of long-distance transport. This would have been at least as true for the Scandinavian colonists as for the Romans who sited *Eboracum* for its strategic value 800 years earlier. It used to be suggested that the reason why so much organic matter is preserved in archaeological deposits in York is that it was regularly soaked by floodwater (and see discussion on p.372 concerning Benson's and Ramm's comments on flooding), but there is no good evidence from sediments or biological remains to support this. Although aquatic and waterside organisms are fairly common in occupation depos-

**Table 15** Proportion of aquatic insects (adult beetles and bugs) from Anglo-Scandinavian sites in York

| Site | %NW |
|---|---|
| 6–8 Pavement | 1.4 |
| 118–26 Walmgate | 1.8 |
| 16–22 Coppergate | 1.4 |
| 1–9 Micklegate | 1.9 |
| 41–9 Walmgate | 1.9 |
| 2 Clifford Street | 0.4 |
| 4–7 Parliament Street | 2.7 |

its, there are far more plausible explanations for their presence than flooding to a level which would be surprising even today, when run-off into the rivers is enhanced by artificial drainage above York and when both rivers have been narrowed so much that the escape of flood water is impeded. This said, were any areas ever subject to flooding? Of the sites for which significant bioarchaeological analyses have been made, that at 1–9 Micklegate seems the most likely to have been in danger of inundation. However, there were no more remains of riverine plants and invertebrates than at sites on higher ground (indeed, the former are always rare; see Table 9, p.392). Thus, the proportion of aquatic insects, for example, fell only slightly above the mean for those sites for which data are available (Table 15); the highest value came from 4–7 Parliament Street, one of the most elevated of the sites, and variations may depend primarily on the amount of water imported. The river level in the Roman period was estimated by Hall et al. (*AY* 14/3) to lie below 4m OD, well below the level of Anglo-Scandinavian occupation here, and it seems entirely possible that it had not risen significantly by the 9th century (Kenward et al. 1978, fig.40; Tooley 1990; Long et al. 1998).

## Salt-marsh and estuarine habitats

Records of macrofossil remains of some obligate salt-marsh plants from Anglo-Scandinavian York (Table 16) have, together with those for similar plants from Roman deposits, posed something of an interpretative problem. If they arrived from salt-marsh vegetation in the vicinity, we have to allow that the rivers in York were not only tidal at least as far as the city (*fide* Briden 1997) but also sufficiently saline for halophyte plants to become established along the high water mark (most are plants only found in such habitats). Another hypothesis is that these remains arrived in the city incidentally with vegetation cut or grazed from salt-marsh, i.e. with hay or in herbivore dung. If the latter is the explanation, then we must assume that animals reached York on the hoof from salt-marsh grazing within the time required for

**Table 16** Records of salt-marsh plants from Anglo-Scandinavian York (numbers of contexts); remains were 'waterlogged' unless otherwise indicated

| | *Armeria maritima* (Miller) Willd. (calyx) | *Aster tripolium* L. | cf. *A. tripolium* | *Juncus gerardi* Loisel. | *J.* cf. *gerardi* | *J.* cf. *maritimus* Lam. | cf. *Limonium* sp(p). (calyx) | *Triglochin maritima* L. | *T. maritima* (charred) |
|---|---|---|---|---|---|---|---|---|---|
| 6–8 Pavement | | 1 | | | | | | | |
| 5–7 Coppergate | 1 | | | | | | | | |
| 1–5 Aldwark | | | | | 1 | | | | |
| 16–22 Coppergate | | | 4 | 19 | 16 | 2 | 1 | 3 | |
| 9 St Saviourgate | | | | 1 | | | | | |
| Layerthorpe Bridge | | | | | | | | 1 | |
| 41–9 Walmgate | | 2 | | | 1 | | | 2 | 1 |

complete transit of salt-marsh plant material through their guts. Tracing the changes in the lower Ouse and the Humber should not be too difficult using sedimentological and bioarchaeological studies, providing suitable sections can be located.

Marine littoral invertebrates, and some estuarine and salt-marsh ones, may provide a tool for tracing the extent of marine influence into estuaries in the past. However, as an ecological grouping they are not without their complications. *Ptenidium punctatum* (Gyllenhal), a small beetle primarily associated with seaweed on the strandline, was found in large numbers in some Anglo-Scandinavian layers at Pavement and Hall et al. (*AY* 14/4, 181–2) have discussed the significance of this species at length, concluding that it probably exploited some specialised kind of decaying matter on the site. Rather remarkably, the species was not found at the nearby (and one would have imagined very similar) Coppergate site (*AY* 14/7, 747). There is a record of *P. ?punctatum* from an evaluation of medieval deposits in the Gowthorpe, Finkle Street and Micklegate area of Selby (Carrott et al. 1993b), from the supposed Kirk Dyke, in company with a rather unusual assemblage of insects and not far from the tidal River Ouse. In the absence of the York records this might have been interpreted as evidence of saline water, but obviously this is not the only possible explanation. Another marine littoral insect which adapted itself to habitats on occupation sites in the past was the fly *Thoracochaeta zosterae* (Haliday), whose puparia are often abundant, especially in deposits interpreted as cesspit fills (Belshaw 1989; Webb et al. 1998).

## The rural landscape and the environmental impact of resource winning

York did not exist in isolation: it was dependent on the local landscape for its raw materials and food supply. One vital source of information about the rural hinterland of a town like York should be extractable sequences of peat laid down in wetland areas. Peat deposits can be regarded in two ways: firstly, their very existence stands as evidence of the nature of the local landscape and of the availability of a resource; secondly, and potentially more important, bioarchaeological information concerning conditions at the time of deposition is locked up in them.

The only published information from a natural site near York is for Askham Bog a few kilometres south-west of the city, where two studies of pollen in sequences of peat have been made (Kenward et al. 1978; Gearey and Lillie 1999). Unfortunately the upper part of the stratigraphy at this wetland site has been disturbed by human activity (including peat cutting, perhaps as early as the Roman period, and dike cleaning). Consequently the top metre of sediments, in which the Anglo-Scandinavian period should be recorded, cannot be reliably dated (Gearey and Lillie 1999, table 7.2). However, fen peat was probably still abundant in low-lying areas around York, despite Roman depredations (in fact, Roman cutting of raised bog peat probably promoted regrowth of fen peat). Peats have frequently been observed within York's presumed catchment, for example in ditch sections. The only bioarchaeological investigations of any of these peats, other than that at Askham, were work at Thornton, some 20km south-east of York, where deposits dated to the first half of the first millennium AD were analysed for insect remains by Hill (1993), and an assessment of thin but extensive Bronze Age peats at North Duffield, about the same distance to the south of the city. Prehistoric peat was recently discovered at a site in St Paul's Green, only a few hundred metres to the west of the city centre, but here it is clear from the stratigraphic record that it became buried during the Roman period. It seems likely that any peat resources close to the city would either have been buried or worked out during the first half of the first millennium.

In the absence of direct information from natural in situ deposits, can we deduce anything of York's rural environs in the Anglo-Scandinavian period? A variety of biological remains in occupation deposits in the town may provide indirect evidence for this, although of course precise location and quantification of natural and semi-natural habitats and land-use types detected in this way will be very difficult. Some vegetation types, notably woodland, heathland/moorland, various kinds of wetland, and pastureland, seem likely to have been present near the town to judge from the quantity of plant remains representing them, and to a lesser extent from the evidence of the insect remains. There are obviously dangers in arguing that quantity indicates proximity: some of the dyeplants, for example, seem far more likely to be imported than of local origin. The distance over which materials were carried would be determined by their value as resources.

## *Timber and woodland management*

There can be little doubt that the inhabitants of Anglo-Scandinavian York made a considerable impact on woodland, presumably in the environs of the town (though see comments in previous section); the huge quantity of timber surviving — from brushwood and wattle to large oak planks and posts — stands as evidence for the importance of woodland to the economy. The question of how far this resource was carefully managed to remain sustainable is less easily answered. On the face of it, the large quantities of poles used to make wattle and wicker structures at Coppergate, as well as the many turned wooden objects formed from stems with a diameter within Rackham's (1976) definition of 'underwood' (cf. *AY* 17/13, 2101), stand as evidence for woodland managed by rotational coppicing. However, studies of the numbers of annual rings and the diameters of the poles from Coppergate do not give a clear indication of a cyclical management regime: there is not an overwhelming predominance of specimens of similar age, as might be expected for material cut from a large stand of systematically coppiced woodland from which rods were cut at regular intervals. As Figs.94–5 show, most of the stems of hazel and willow used for wicker structures fell in a rather broad age range, so whilst coppicing (and possibly pollarding) may — perhaps must — have been practised, it did not follow a regular regime but was probably opportunistic (or, and much less plausibly, the roundwood used at Coppergate came from a series of managed woodlands with very different rotations).

Botanical analysis has revealed the use of woodland moss on a large scale at some sites. Given the low rate of regeneration of moss, the impact on woodland of harvesting this crop must have been marked. Moss-carpeted woodland floors would soon have been replaced by leaf litter or even bare soil or, where felling had occurred, by a ground flora of vascular plants, followed by eventual regeneration of trees and shrubs (where damage to seedlings by grazing herbivores was prevented). This impact would have been augmented by the effects of running pigs in woodland. The continuing availability of such mosses into the later Anglo-Scandinavian period and beyond suggests either that the area of woodland available was enormous, so that these effects were diluted, or that moss was a sufficiently valuable commodity to have been transported over considerable distances. There is, however, nothing amongst the insect records from moss-rich layers to suggest importation from continental Europe. The kinds of mosses recorded through the sequence at 16–22 Coppergate show no particular pattern, with the same major taxa recorded throughout.

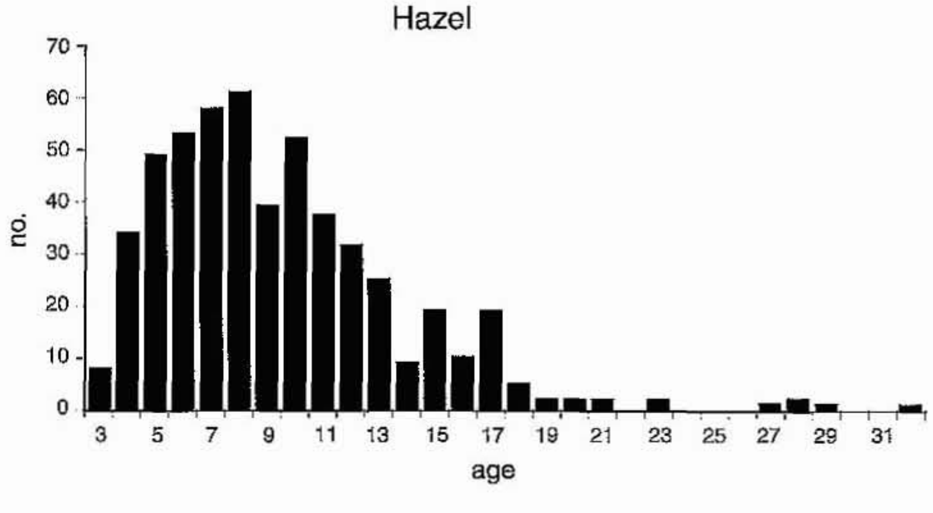



*Fig.94 Distribution plot of roundwood ring counts for all hazel specimens from wicker and wattlework structures from Anglo-Scandinavian deposits at Coppergate*

Many kinds of plants and insects were certainly brought to the town incidentally in woodland moss. At Coppergate, for example, some of the Anglo-Scandinavian pits gave a substantial number of woodland insect species, including the small stag beetle *Sinodendron cylindricum* (Linnaeus), while in a few cases it has been suggested that landsnails were been imported in this way (*AY* 14/7, 514–15, 545, 576, 661, fig.183). A component of plants other than mosses from woodland floors was regularly recorded, at least from Coppergate, the most conspicuous being wood sorrel (*Oxalis acetosella* L.), of which seeds, abscission plates from the bases of the leaf stalks, rhizome fragments, stem epidermis, and even hairs from the stems, were all recorded. This plant must surely either have been imported incidentally with moss or with leaf litter. A similar route is suggested for the leaves (and perhaps also seeds) of holly (*Ilex aquifolium*). It seems contradictory to have collected moss for sanitary purposes in which large prickly leaves were present, so moss intended for other purposes (possibly filtering or packing), or even leaf litter, for example as a flooring material, may account for some of this woodland component. Holly leaves were quite frequent in pit fills but not strongly correlated with remains indicating faeces. Perhaps they were picked from the moss before its use but ended up in the same repository.

Not all the wood brought to Anglo-Scandinavian York was destined for structures or artefacts. Much must have been used as fuel, so that its quality would have been rather less important. It is suspected that a proportion of the wood-associated insects recovered from occupation sites was brought with collected firewood (although some may then have colonised decaying structural timbers). Some bark beetles and dwellers in epiphytic moss probably arrived in this way. The bark beetle *Leperisinus varius* (Fabricius) has occasionally been found in archaeological deposits under circumstances leading to the suspicion that it emerged from logs, probably of ash (*Fraxinus*), intended for firewood; ash burns particularly well when green by comparison with other woods and so might have been favoured. Ash is rather common in Anglo-Scandinavian York, for example at 1–9 Micklegate (Dobney et al. 1993; Kenward and Hall 2000a) and at Pavement (*AY* 14/4, 185), while there were records from about 50 Anglo-Scandinavian contexts at Coppergate (*AY* 14/7). Ash was, however, at least sometimes used for structural timber. Wood for fuel would also be a source for some corticolous mosses, especially, for example, *Ulota*, recorded from 100 contexts at six Anglo-Scandinavian sites.

Studies of woodland history are perhaps inclined to concentrate on stands of woodland or the spaces

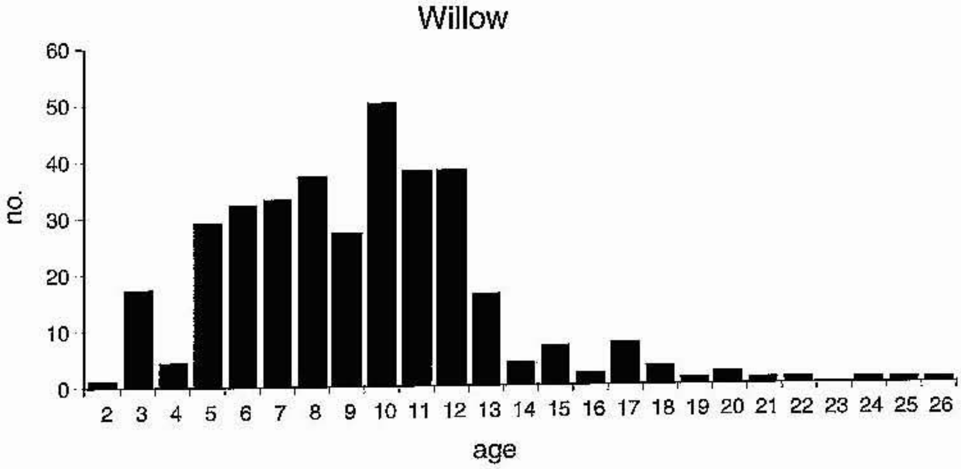



*Fig.95 Distribution plot of roundwood ring counts for all willow specimens from wicker and wattlework structures from Anglo-Scandinavian deposits at Coppergate*

in between, with rather little consideration of the transitional habitats afforded by woodland margins and their linear versions, hedgerows. These are the places where no doubt much of the wild plant food in the form of nuts and berries was gathered by York's Anglo-Scandinavian inhabitants and they would perhaps have been subject to less control by landowners than the forests and fields they bounded.

## *Heath and bog*

Heathland and moorland is well represented amongst the plant remains from Anglo-Scandinavian York; indeed, if the remains of heather described by early workers (Benson 1902; Ramm 1971) were correctly identified, this plant is one of the more conspicuous components of deposits in York at this period. Heather, and a suite of others likely to have grown with it on heathland and moorland, were frequently recorded at Coppergate, for example (*AY* 14/7, 653), although many of these plants are not restricted to acid soils. The table in *AY* 14/7, fig.181, omitted *Vaccinium* from the list; it was recorded from 31 contexts at Coppergate as seeds and from a few others in the form of fruit epidermis fragments and 'tori', the rounded plates from the apex of the fruit. The last of these is probably diagnostic for *V. myrtillus*, the bilberry. The source of these remains might be only a few kilometres from the town if areas of heathland had developed on the poorest sandy soils (as at Strensall and Skipwith Commons), although Baines (1840) notes that heather grew then as close to the city as the Heslington 'Tillmire', an area of common land just to the south of York. The question of the date at which the heaths around York first developed is one which remains to be answered. In particular, we might ask whether turf cutting, starting with the construction of the first Roman fortress but perhaps resumed with renewed vigour in the period we are considering here, caused soil degradation and hastened the process of acidification.

In what form were the heathland resources brought into York? Apart from the fruits of bilberry brought as food, the more obvious possibilities for the vegetative remains are turf, heather plants brought whole for thatching, cut heather shoots selected for dyeing or for artefacts such as besoms, and heathland mosses (for similar purposes to those from woodland and, like them, containing various biological remains as contaminants). Various strands of evidence are relevant here. Generally speaking, heathland insects (mostly the froghopper *Ulopa reticulata* and the weevil *Micrelus ericae*) are rare in Anglo-Scandinavian deposits in York (Table 17), especially by comparison with some Roman sites, and certainly very much less frequent than heather. This perhaps suggests that heather, at least, was imported largely as whole plants or cut material (from which most insects would have tumbled during collection). If turves were used regularly in large quantities, a wide range of insects would be predicted to have been brought, either sheltering in the litter layer or as corpses which had died some time before the turf was cut.

Ants from heathland were found at the Pavement site during the preliminary investigation (Buckland et al. 1974), but heathland/moorland insects were present only in traces in the main series of samples (*AY* 14/4, 221); as mentioned on p.380, most of the records were of the weevil *Strophosomus sus*, perhaps offering a hint of the presence of turves.

One beetle which deserves mention at this point in view of its frequent occurrence in Anglo-Scandinavian York (and in many other archaeological deposits) is the small chafer *Phyllopertha horticola* (Linnaeus), which is found far more often than its present-day distribution and abundance in the York area would lead us to expect. Either it was far more common in the past or its importation was favoured in some way, or perhaps both. It is mentioned here because it is likely to have been imported in turf or cut vegetation (Kenward et al. 1992, 8). It is a rather bumbling insect, and seems quite likely to be caught up in cut plants. Since it is most common on acid soils, it may well have been brought with heather or heathland turves.

Another aspect of the exploitation of peatland is represented by the records for the moss *Sphagnum*, leaves and shoots of which have been observed at several Anglo-Scandinavian sites in York (Table 18). That these were brought as fresh or dried moss rather than as fossils in peat is suggested by the paucity of records of peat (and a complete lack of examples of peat composed of *Sphagnum* itself). A further piece of negative evidence in this respect is the absence of one particular species, *S. imbricatum*, formerly an important peat-forming species (e.g. Daniels and Eddy 1990; Green 1968), very widely recorded in

**Table 17** Records of heathland insects from Anglo-Scandinavian deposits at 16–22 Coppergate. The numbers of contexts where more than 19 adult beetles and bugs of the groups used in calculating statistics for each period are as follows: P3, 49; P4A, 4; P4B, 90; P5A, 42; P5B, 141; P5Cf, 3; P5Cr, 21. There were no records of heathland insects from Periods 3, 4A and 5Cf.

| Taxon | Period | no. contexts | no. individuals |
|---|---|---|---|
| *Rhacognathus punctatus* (Linnaeus) | 5B | 1 | 2 |
| *Macrodema micropterum* (Curtis) | 5B | 2 | 5 |
| *Scolopostethus decoratus* (Hahn) | 5B | 1 | 8 |
| *Strophingia ericae* (Curtis) | 5B | 1 | 2 |
| *Ulopa reticulate* (Fabricius) | 4B | 1 | 5 |
| | 5A | 2 | 4 |
| | 5B | 12 | 53 |
| *Bradycellus ruficollis* (Stephens) | 5B | 1 | 2 |
| *Lochmaea suturalis* (Thomson) | 5B | 2 | 7 |
| *Strophosomus sus* (Stephens) | 4B | 1 | 1 |
| | 5A | 2 | 14 |
| | 5B | 2 | 5 |
| | 5Cr | 1 | 2 |
| *Micrelus ericae* (Gyllenhal) | 4B | 7 | 22 |
| | 5A | 1 | 3 |
| | 5B | 8 | 28 |

**Table 18** Records for *Sphagnum* and for peat from Anglo-Scandinavian York

| Site | No. contexts examined | No. (%) contexts with remains of *Sphagnum* | No. contexts with peat recorded |
|---|---|---|---|
| '1–5' Aldwark | 8 | 2 (25) | |
| 16–22 Coppergate | 430 | 22 (5) | |
| 118–26 Walmgate | 17 | 5 (29) | |
| 5 Rougier Street | – | – | 1: burnt peat fragments (?reworked) |
| 7–9 Aldwark | 7 | 5 (71) | |
| 1–9 Micklegate | 27 | 4 (15) | |
| 104–12 Walmgate | 3 | 1 (33) | |
| 9 St Saviourgate | 10 | 5 (50) | 1: peat fragments |
| All Saints' Church, Pavement | 5 | 1 (20) | |
| Foss Bridge/Peasholme Green/ Layerthorpe Bridge | 15 | 5 (33) | 1: ?burnt peat fragments<br>1: detritus peat fragments |
| 41–9 Walmgate | 7 | 2 (29) | 1: ?peat/mor humus |

**Table 19** Records of waterside/aquatic-marginal/reedswamp plant taxa (counted in group PHRA, though not necessarily exclusively so) from Anglo-Scandinavian York (number of contexts from which remains were recorded)

| | 6-8 Pavement | 118-26 Walmgate | 1-5 Aldwark | 16-22 Coppergate | 24-30 Tanner Row | 7-9 Aldwark | 22 Piccadilly | 1-9 Micklegate |
|---|---|---|---|---|---|---|---|---|
| *Alisma* sp(p). | 20 | | 2 | 28 | | 1 | | 1 |
| *Apium nodiflorum* (L.) Lag. | | | 4 | 1 | | 3 | | |
| *Baldellia ranunculoides* (L.) Parl. | | | | 2 | | | | 1 |
| *Caltha palustris* L. | 15 | 1 | 1 | 19 | | | | |
| *Cicuta virosa* L. | 1 | | | 1 | | | | |
| *Cladium mariscus* (L.) Pohl. | 25 | 6 | | 10 | | | | |
| *C. mariscus* (vegve fgts) | | | | | | | | |
| *Eleocharis palustris* s.l. | 45 | 12 | 5 | 237 + 2ch | 1 | 6 | 1 | 14 + 2ch |
| *Eupatorium cannabinum* L. | | | | 1 | | | | |
| *Glyceria* cf. *fluitans* (L.) R. Br. | | | | 1 | | | | |
| *Hippuris vulgaris* L. | | | | 1 | | | | |
| *Hydrocotyle vulgaris* L. | 7 | 1 | | 6 | | | | |
| *Iris pseudacorus* L. | 4 | 1 | | 23 | | | | 1 |
| *Juncus subnodulosus* Schrank | | | 1 | 5 | | | | |
| *Lycopus europaeus* L. | 17 | 3 | | 11 | | | | 1 |
| *Lythrum salicaria* L. | | | 1 | 5 | | | | |
| *Menyanthes trifoliata* L. | 15 | | | 67 | | 1 | | 3 |
| *Oenanthe aquatica* (L.) Poiret in Lam. | 2 | | | 2 + ?3 | | | | 1 + ?5 + ?1ch |
| *Oe. fistulosa* L. | 2 + ?3 | 1 | | 1 + ?2 | | | | |
| *Oe. fluviatilis* (Bab.) Coleman | | | | | | | | |
| *Oe. lachenalii* C.G. Gmelin | | | | 2 + ?1 | | 2 | | |
| *Phragmites australis* (Cav.) Trin. Ex Steudel | | | | 3 | | | | |
| *Ph. australis* (culm nodes or fragments) | 1 | | | 6 | | | | |
| *Ranunculus lingua* L. | 1 | | | 1 | | | | |
| *Scirpus lacustris* s.l. | | | | 4 | | | | |
| *Scirpus maritimus/lacustris* | 10 | 2 | | 18 | 1 | | | 1 |
| *Scutellaria galericulata* L. | 3 | | | 1 | | | 1 | |
| *Solanum dulcamara* L. | | | | 4 | | | | |
| *Sparganium* sp(p). | | | | 2 | | | | |
| *Typha* sp(p). | 6 | | | 7 | | | | |

post-conquest medieval deposits in York as well as in Hull. Indeed, more generally, it has been noted in at least 102 archaeological contexts from 31 sites, mostly in central and eastern Yorkshire (A.R. Hall, unpublished data), for example at Blanket Row, Hull (Carrott et al. 2001), and from post-conquest Coppergate and medieval deposits at Bedern, York, but not from the Anglo-Scandinavian period.

## *Wetland*

Plant taxa from wetland habitats, other than true aquatics (see pp.391–2) or acid bog plants, occur from time to time in Anglo-Scandinavian deposits in York (Table 19). The tall emergent waterside taxa included in this group have usually been considered to have arrived with cut vegetation for thatch or litter of some

**Table 19** *(contd)*

| | 104-112 Walmgate | North Street | 9 St Saviourgate | All Saints' Church | Layerthorpe Bridge | 2 Clifford Street | 41-9 Walmgate | 4-7 Parliament Street |
|---|---|---|---|---|---|---|---|---|
| *Alisma* sp(p). | | 2 | 1 | | | | | |
| *Apium nodiflorum* (L.) Lag. | | | | | | | | |
| *Baldellia ranunculoides* (L.) Parl. | | 1 | | | | | | |
| *Caltha palustris* L. | | | | | | | 1 | |
| *Cicuta virosa* L. | | | | | | | | |
| *Cladium mariscus* (L.) Pohl. | | | | | 1ch | | 3 | |
| *C. mariscus* (vegve fgts) | | | | | 1 + 2ch | | | |
| *Eleocharis palustris* s.l. | 2 | 3 | 1 | 4 | 7 + 1ch | 3 | 6 | 1 |
| *Eupatorium cannabinum* L. | | | | | | | | |
| *Glyceria* cf. *fluitans* (L.) R. Br. | | | | | | | | |
| *Hippuris vulgaris* L. | | | | | | | | |
| *Hydrocotyle vulgaris* L. | | 2 | | | | | | |
| *Iris pseudacorus* L. | | | | | | | 2 | |
| *Juncus subnodulosus* Schrank | | | | | | | | |
| *Lycopus europaeus* L. | | | | 1 | | | | |
| *Lythrum salicaria* L. | | | | | | | | |
| *Menyanthes trifoliata* L. | | 1 | | | 2 +1ch | | 5 | |
| *Oenanthe aquatica* (L.) Poiret in Lam. | | | | | | | ?1 | |
| *Oe. fistulosa* L. | | | | | | | | |
| *Oe. fluviatilis* (Bab.) Coleman | | | | | 1 | | | |
| *Oe. lachenalii* C.G. Gmelin | | | | | 2 | | | |
| *Phragmites australis* (Cav.) Trin. Ex Steudel | | | | | | | | |
| *Ph. australis* (culm nodes or fragments) | | | | | | | | |
| *Ranunculus lingua* L. | | | 1 | | | | | |
| *Scirpus lacustris* s.l. | | | | 1 | | | | |
| *Scirpus maritimus/lacustris* | | | | | | | | 1 |
| *Scutellaria galericulata* L. | | | | | | | | |
| *Solanum dulcamara* L. | | | | | | | | |
| *Sparganium* sp(p). | | | | | 1 | | | |
| *Typha* sp(p). | | 1 | | | | | | |

kind (e.g. Kenward et al. 1978). The numbers and amounts of these plants are usually small, however, and in no cases have deposits formed largely from cut waterside vegetation been observed. A few fen insects have been recorded (e.g. *Dromius longiceps* Dejean), but these are as likely to have arrived on the wing (or even with water) as in cut vegetation. Wetland insects are common in occupation deposits in the town, but the more abundant species (e.g. *Carpelimus bilineatus* Stephens, *C. fuliginosus* (Gravenhorst), *Anotylus nitidulus* (Gravenhorst) and *Neobisnius* sp.) undoubtedly lived on the sites, apparently often within buildings (*AY* 14/7; Kenward and Allison 1994a; Carrott and Kenward 2000).

## *Arable and pasture*

Evidently large parts of the surroundings of Anglo-Scandinavian York were still in a semi-natural state (as defined by Kenward and Allison 1994a, 56, following Rackham 1989, 226), as heathland, woodland and wetland. However, unless there was a substantial long-distance trade in cereals and livestock, arable and pasture must have made up a large proportion of the landscape in order to provision the inhabitants of the town. Cereals were presumably grown locally, though there is no evidence from the cereals themselves or their weed contaminants to confirm or refute this. In so far as they can be used as soil indicators, the weed seeds point to exploitation of neutral to acid soils, rather than those formed on chalk or limestone. Most of the local soils, where not too wet, would have been suitable for arable cultivation. Similarly, most would also have supported pasture, including those inundated in winter (and such areas seem likely to have been largely devoted to grazing, at least while any hay crop was not standing). Pastures not subjected to heavy grazing seem the most likely source for the very large quantities of dyer's greenweed which were brought to the town in the Anglo-Scandinavian period, though it is not impossible that the plant was deliberately cultivated or even imported from further afield to supply the needs of the urban dyers. Edlin (1951, 133) notes that the plant was sometimes cultivated in the past — in the case he cites, in south-east England.

Two of the dyeplants, madder and woad, must surely have been cultivated to provide the enormous quantities of dyestuff needed; the location of the fields remains quite unknown, however. Both may be grown in the York area today, though madder seems to require shelter to succeed and may well never have been a viable field crop, even allowing for higher summer temperatures. Woad is more likely to have been a field crop at this latitude (it was, for example, grown with teasels in the Selby area in the 19th century, according to McMillan 1984) though there seems to have been no persistent tradition of growing it much further north in England than south Lincolnshire during the second half of the second millennium AD. Either or both may have been brought from much further afield, even from overseas. As remarked elsewhere, the one plant used in Anglo-Scandinavian York which must surely have been imported from abroad is the clubmoss *Diphasiastrum complanatum*, presumably brought from Viking homelands in Scandinavia or northern Germany. It is inconceivable that it was cultivated.

## Climate

Dark (2000) has summarised evidence for the pattern of climatic change during the first millennium AD. The Anglo-Scandinavian period was probably warmer than present-day on a range of evidence (Kenward in press).

Bioarchaeological evidence from York concerning climatic change has been alluded to elsewhere (e.g. *AY* 14/7, 781). The nettlebug *Heterogaster urticae* (Fabricius) had a southerly distribution in the mid 20th century, yet has been very regularly recorded from Anglo-Scandinavian York: there were, for example, eight records from Pavement (*AY* 14/4, 219) and 64 from Coppergate (*AY* 14/7, 489). Although plant materials may have been imported in bulk from further south or even from overseas, it is quite impossible to believe *H. urticae* was carried with such frequency without being accompanied by a range of other thermophilous insects, so it must have been a very common denizen of the nettlebeds of Viking-Age York. The return of the nettlebug to the York area in the late 1990s, as global temperatures increased, seems to demonstrate the sensitivity with which it responds to climate.

Some other species with possible climatic implications were noted from Pavement and Coppergate, and from more recent excavations. *Anthicus bifasciatus* (Reitter) has been found at three sites and *Acritus homoeopathicus* Wollaston was recorded from Pavement; both have southerly distributions in Britain at the present-day. *Anthicus antherinus* (Linnaeus), found at 1–9 Micklegate (Kenward and Hall 2000a) and provisionally recorded from Coppergate, is known from southern England, as far north as Derbyshire (Buck 1954). All three are associated with decomposing matter and may have been favoured by artificial habitats, so it is uncertain whether they were responding to generally higher temperatures or by the special conditions of the Anglo-Scandinavian town. The significance of some *Platystethus* species which are north of the distributions given by Hammond (1971) is not certain; the apparent recent restriction of their distribution is probably a mixture of modern under-recording (P.M. Hammond, pers. comm.) and a greater abundance in the north of England in the past. *Phymatodes testaceus* (Linnaeus), *Eurydema oleracea* (Linnaeus), and *Cryptolestes duplicatus* (Waltl) were all recorded from 1–9 Micklegate but are not normally found so far north today; *E. oleracea* has also been found in a late Anglo-Scandinavian deposit at 118–26 Walmgate. The possibility that these insects were imported rather than reflecting local climate is discussed below.

The method of recording adopted for insect remains from most of the sites considered here was intended to maximise archaeological reconstruction rather than to obtain large numbers of records of rarities, so information about some climatically significant species may have been lost; it would be useful to return to stored specimens to search for such species.

## Trade: distance and volume

Biological remains offer evidence of trade of various kinds over short and long distances. Trade may be considered at several levels, but in the context of a discussion of Anglo-Scandinavian York will be divided into *regional* trade (say, beyond a few hours journey from a site but within northern England) and *long-distance* trade (beyond this, but particularly overseas). The procurement of materials from areas within one day's round journey is not considered in this section. Generally speaking, trade within a single geographical area may be difficult to detect using biological remains, since the fauna and flora can be expected to have been fairly uniform. Exceptions will be importation of materials not locally available: marine, high moorland and chalkland resources fall in this category for York. Marine shellfish and crustaceans were obviously, of necessity, imported to the town (p.397) and are clear evidence of trade links unless it is believed that occupants of the sites always went to the sea in person!

Trade over longer distances is perhaps more interesting to archaeologists and biologists alike. Some invertebrates were introduced dead, as in the case of the Red Sea cowrie *Cypraea pantherina* (Solander) from the 16–22 Coppergate site (*AY* 14/7, 781), showing saw marks and probably used in manufacturing some form of personal decoration. Imported insects (and most other invertebrates) are very unlikely to be found unless they become established at least locally, although rare cases may occur. Osborne's (1971) record of the longhorn beetle *Hesperophanes fasciculatus* Falderman from Roman Alcester, probably imported from the Mediterraean, provides an example, but no parallels are known from the Anglo-Scandinavian period. It has been suggested above that some, at least, of the dyeplants were imported from beyond the immediate surroundings of York, perhaps from further south (madder and woad) or certainly from overseas (clubmoss). Such importation may conceivably account for the presence of insects which have a southerly distribution in Britain today (see p.418). Importation of madder and woad from continental Europe is a possibility, although at least a few non-British insects might be expected to have been brought with them and encountered at Coppergate or Micklegate if this was the case. The clubmoss was almost certainly brought from Scandinavia or northern Germany, areas which support numerous readily identifiable beetles and bugs which are not found in the British Isles. The fact that such insects were not found at Coppergate where the clubmoss was enormously common may seem surprising at first, but *D. complanatum* grows as creeping stems rather than as clumps which would shelter insects, and was presumably dried and to some extent cleaned before making the journey across the North Sea, reducing the likelihood of insects being transported with it.

It is notable that the 1–9 Micklegate site has provided a rather larger number of 'unusual' insect remains *pro rata* than the large body of samples from Coppergate. This may be a real phenomenon, but it is just conceivably an artefact of a further ten years of experience and improved rapid identification skills. However, the former site was close to the main Ouse waterfront, where the presence of large quantities of imported materials may inevitably have led to the importation of insects. Three of these, *Phymatodes testaceus*, *Cryptolestes duplicatus* and *Eurydema oleracea*, seem to be likely candidates to have been imported with raw materials from southern England or the continental mainland (including the southern fringes of the Baltic) to this riverside site: the first two with wood and the last with woad (Kenward and Hall 2000a). All may have originated locally, however, if temperatures were higher or a wider range of natural habitats existed.

## Land-use zonation

Sufficient sites of Anglo-Scandinavian date in York have now been investigated at least on a small

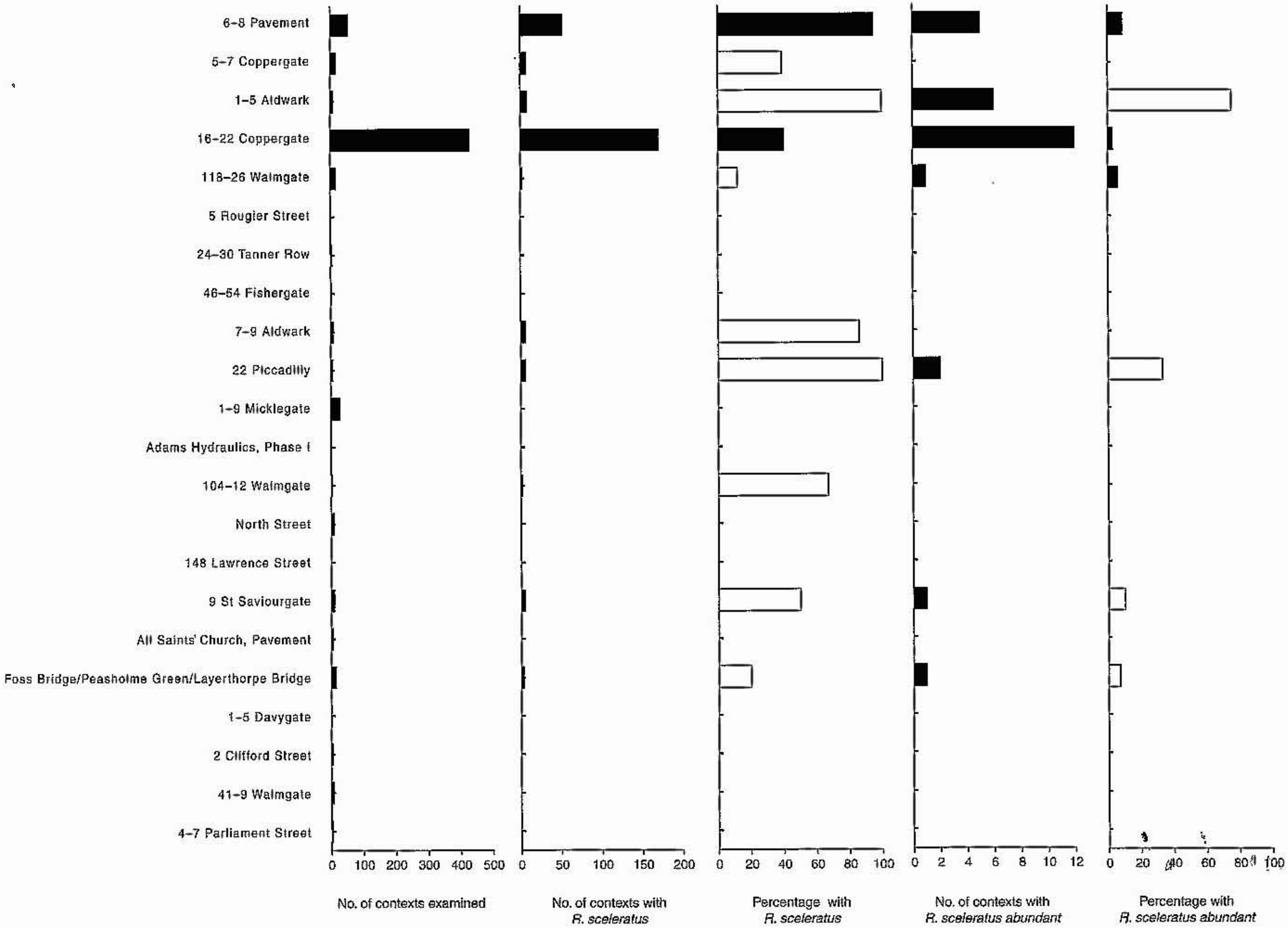



*Fig.96 Records of* Ranunculus sceleratus *from Anglo-Scandinavian sites in York. Some percentages are based on very small numbers of samples and these are shown in light tone*

scale for us to begin to search for systematic differences in their biota and to construct hypotheses about variations in living conditions and human activity.

It seems probable that the area represented by the 16–22 Coppergate excavation was densely built at the street frontage, at least from Period 4B onwards, and that the tenement yards were intensively used in all periods. The buildings at Pavement appear to have had a character broadly similar to those of Period 4B at Coppergate, but we have no first-hand information about conditions in the open areas associated with them. There are hints from the plant remains at Pavement that the area behind the buildings had open access to the River Foss. There were very abundant achenes of celery-leaved crowfoot (*Ranunculus sceleratus* L.) in many deposits from that site which seem likely to have been introduced by the trampling of mud from an area of disturbed but at least seasonally wet ground. The introduction of these seeds by flooding or in buckets of river water seems unlikely in view of the relative rarity of other aquatic organisms. The different recording methods employed over the years make it difficult to demonstrate objectively, but *R. sceleratus* was certainly by no means so prominent at Coppergate, either because the riversides differed between the two sites, or (more probably) because there was less direct traffic between the river and the occupation area at the latter site (Fig.96).

The small area investigated at 5–7 Coppergate probably represents a very disturbed but rather muddy yard area, whilst the few assemblages from All Saints' Church, Pavement, closely resemble many of those from 16–22 Coppergate. By contrast, the material from 4–7 Parliament Street (Hall and Kenward 2000a) has given an overall impression that that site was in some respects unlike anything studied at 16–22 Coppergate, especially if it is accepted that the three 'dumps' examined really formed on surfaces and not in unrecognised large pits. (Cuts on the scale of those seen in what may well be equivalent tenements fronting the Ousegate-Pavement line at 44–5 Parliament Street would not necessarily be recognisable as such in sections in an excavation as small as that at 4–7 Parliament Street.) Nevertheless, it seems possible that the 4–7 Parliament Street site lay in an area with poorer drainage than was experienced at 16–22 Coppergate and 6–8 Pavement; it was well above the slope to the river seen at those two sites on what may have been an undulating plateau with drainage impeded by Roman earthworks and walls. The deposits appear to have formed far from the street frontage, considerably removed from the likely position of houses, and so may represent an area where the foul conditions generated by keeping livestock (probably pigs, see pp.407–8) would be tolerated.

Plant and insect remains from 1–9 Micklegate, the only site so far to yield large numbers of Anglo-Scandinavian deposits south-west of the Ouse in York, were essentially very similar to those from 16–22 Coppergate. The numbers of samples from other sites in this area (24–30 Tanner Row and 5 Rougier Street, cf. *AY* 14/6) are too few to form the basis for any meaningful comparison.

Recrossing the river, the site at 2 Clifford Street, although only studied on a very small scale, appears to have differed from those in Micklegate, Coppergate and Pavement, even though it lay barely 100m from 16–22 Coppergate. While the rather sparse plant remains were generally much like those from many deposits at Coppergate, two of the five assemblages were unusual in having prominent components of material preserved by charring and consisting in large part of cereal grains or spikelets, primarily oats. At 16–22 Coppergate, for example, there were only two contexts (out of 430) from which more than traces of charred oat grains or spikelets were recorded (a third context yielded quite large amounts of uncharred oat spikelets but came from a sequence of deposits representing perhaps the best evidence at Coppergate for stable manure, cf. p.409).

By contrast, charred oats were frequent at 118–26 Walmgate (Kenward and Hall 2000b) and 41–9 Walmgate (Johnstone et al. 2000), and part-charred material of the kind noted at Clifford Street was also recorded at 41–9 Walmgate (Fig.97). Whatever the source for this material, we may be beginning to see a pattern emerging in which two foci — in the Coppergate/Pavement area, and perhaps another area including 1–9 Micklegate — contrast with those more 'peripheral' sites characterised by the presence of concentrations of charred and part-charred oats (with the Clifford Street site having deposits of both types). One possible explanation is that roofing types, assuming the material represents thatch, differed, the more inflammable straw thatch perhaps being frowned upon where settlement was densest and replaced by

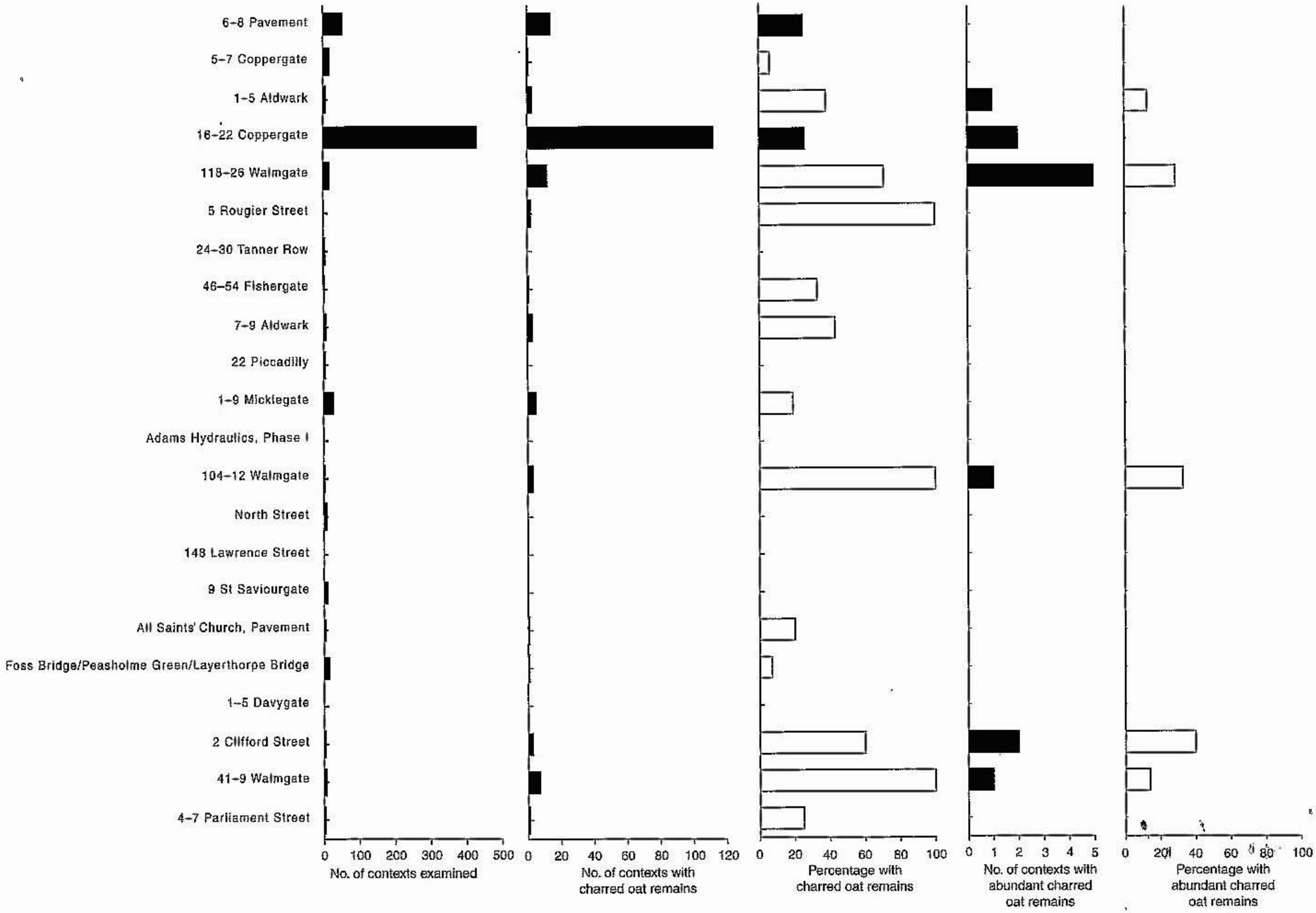



*Fig.97* *Records of charred and uncharred oats from Anglo-Scandinavian York. Some percentages are based on very small numbers of samples and these are shown in light tone*

turf or some other material (cf. p.378). Another possibility is that chaff-rich oats were abundant at these 'fringe' sites because they were fed to livestock. In either case, there would have been sufficient of the material for a proportion of it to have been accidentally charred.

Perhaps the most outstanding feature of the (admittedly small corpus of) samples from 118–26 Walmgate is the almost complete lack of any evidence for the suite of plants used in textile dyeing seen at almost every other site in York with Anglo-Scandinavian deposits (Kenward and Hall 2000b; Fig.93, p.404). Yet some of these dyeplants were recorded from contemporaneous deposits around 200m away at 41–9 Walmgate (Johnstone et al. 2000), albeit in very small amounts. Perhaps the former site — the one so far investigated which is furthest from the 'epicentre' of dyeplant use and disposal in the city centre — was simply too far for remains to arrive by accident, and textile dyeing was not an aspect of the local economy in the Walmgate area.

The assemblages from 118–26 Walmgate showed other, more subtle, characteristics which differentiated them from those from the town centre. The floors never yielded seething assemblages of house fauna like those seen at the other sites, suggesting that the buildings were used in different ways. One possibility is that conditions resembling those in an old-fashioned farmyard existed there, as suggested on p.408, the buildings being byres or stables, and the food remains representing either domestic occupation or the feeding of livestock, probably pigs, with scraps. The Walmgate area of York may represent an early stage of urban settlement, with crowded smallholdings, perhaps originally farmsteads, which would later be subdivided into tenements.

Moving to the area east of the town centre, developer-funded excavations at 9 St Saviourgate revealed excellent preservation of Anglo-Scandinavian organic deposits which unfortunately have to date only been submitted to assessment (Carrott et al. 1998a). Even so, it is clear that this site presented an environment different from anything seen at Coppergate and Pavement, although perhaps with some affinity to the 4–7 Parliament Street site. Annual nitrophile weeds were very abundant in the assemblages from a series of Anglo-Scandinavian pit fills from St Saviourgate, suggesting conditions not unlike a poorly kept farmyard; this impression is strongly reinforced by records of large numbers of dung beetles (*Aphodius* spp.). We may tentatively suggest that the site was either far enough from the town centre or, like 4–7 Parliament Street, sufficiently removed from buildings for activities which would generate very unpleasant conditions to be tolerated. It is to be hoped that this material can be subjected to detailed study before it degrades in storage.

Moving further east, very foul conditions certainly seem to have existed along the banks of the Foss in the vicinity of what is now Layerthorpe Bridge. As noted on p.407 Anglo-Scandinavian deposits from an excavation here consistently gave evidence for very decayed bark and large numbers of the beetle *Trox scaber*, together considered to indicate the presence of waste from tanning (Hall and Kenward 2003). This process would have generated extremely foul effluent, and tanning has rarely been tolerated close to (at least the more refined) dwellings in the past.

Land-use zonation is clearly a topic for further research using structural and bioarchaeological evidence; we are perhaps obtaining the beginnings of an understanding of the way different areas of Anglo-Scandinavian York were used, paralleling results from Roman Carlisle (Kenward 1999b).

## The beginning and end of Anglo-Scandinavian York

All that has been discussed above relates in large part to the heyday of Anglo-Scandinavian York. Taking a chronological view, we may ask, firstly, what the Scandinavians found when they came to York, secondly, how the town evolved through time, and thirdly, from the bioarchaeological point of view, what impact the Norman conquest had.

With regard to the first of these questions, there is limited structural and artefactual evidence for an Anglian presence in the centre of York, and certainly nothing to suggest a thriving town. All of the bioarchaeological analyses made to date tend to support this. The rare deposits yielding well-preserved biological remains which seem connected with the Anglian period — the pit containing an Anglian helmet at Coppergate (*AY* 17/8) and some pit fills at a site between Bedern and Aldwark (*AY* 14/5) — are subject to doubt as to dating. The helmet pit has been argued to have been infilled in the Anglo-Scandinavian period (*AY* 17/8). The pits at Bedern gave a radiocarbon date in the Anglian period, but it has been suggested that they may have incorporated later material (*AY* 3/3, 150). In either case, the plant and invertebrate remains from the Bedern pits suggest no more than low-density occupation, perhaps in a rather damp corner of what had been the Roman fortress. How did the pattern of occupation in York arise? Were small tenements laid out essentially *de novo*, or did they develop organically from less heavily subdivided holdings, perhaps farmsteads, whose insubstantial remains have yet to be discovered?

One approach to the question of the mode of development of Anglo-Scandinavian York may be to use insects strongly associated with human dwelling areas (synanthropes), which Kenward (1997) has postulated increase in their diversity with time in any given settlement. Inspection of the data for 16–22 Coppergate phase by phase does not show any significant increase with time, so that the town had either been established for some time before the earliest period (3) in that area, or had been preceded by farmsteads with a well-developed synanthrope fauna, paralleling the rich fauna seen in deposits at the tiny isolated rath site at Deer Park Farms, Co. Antrim (Kenward and Allison 1994b; Kenward et al. 2000). It would be enlightening to examine the synanthropic fauna of samples dated to the very earliest phases of Anglo-Scandinavian culture across York to determine whether there was an initial stage with a limited range of species, as may have been the case at Viborg, Denmark (Kenward 2002).

It has been argued that the Fishergate area may represent the Anglian *wic*, but such bioarchaeological evidence as has been recovered suggests that this area was only intermittently occupied; the investigated area again appears not to have developed into a significant settlement. It thus appears likely that the Scandinavian brigands, traders or settlers who came to the desirable spit of elevated land between the Ouse and the Foss in mid 9th century themselves brought about the development of a town in the modern sense. York in Alcuin's time may only have been a tight-knit ecclesiastical community and its lay associates — it is hard to believe that a more densely urban settlement could have existed without leaving clearer traces in the archaeological record.

As to the development of Jorvík through the mid 9th to mid 11th centuries, it is too soon to try to draw any conclusions. The course of events at Coppergate is well documented, but there is insufficient information from elsewhere. Among the pressing questions regarding the growth of York is whether it developed primarily as a trading and craft centre, through urban spread, or whether at least some areas were initiated as agricultural settlements which gradually succumbed to urbanisation.

As far as the 'end' of Anglo-Scandinavian York is concerned, the Norman conquest is surprisingly hard to detect bioarchaeologically. Although it has not yet been possible to carry out more than an assessment of most of the early post-conquest material, it appears that in many respects life continued unchanged. A notable exception is the apparently abrupt appearance of grain pests, surely related to the establishment of central storage as part of the new politico-economic control system (although the extent to which the changing abundance of and methods of husbandry for horses was a factor requires critical evaluation). Even here, however, the precise timing of the arrival of these insects is uncertain: did they come first in grain supplies supporting the conquest (as seems to have been the case in the early Roman period), or did they gradually establish themselves in large stores over a longer period of time? More substantial changes had occurred by the later medieval period, a range of plant foods including the imported fig and grape appearing in large quantities, and the insect fauna showing appreciable modification, presumably as buildings became cleaner and drier.

## Future research

We have alluded in many places in this discussion to those areas where bioarchaeological research into Anglo-Scandinavian York could be concentrated in future. Much of this research is predicated upon the survival of York's superb archive of delicate biological remains preserved by anoxic waterlogging. Unfortunately, this resource may be under threat from the effects of past and future development, and perhaps of climatic change. Kenward and Hall (2000c; forthcoming) have argued that at least the superficial deposits in York may be undergoing irreversible decay. It is important that their hypothesis is put to the test as soon as possible, and if there is any doubt as to the stability of the deposits there should be a two-pronged strategy: to alter ground conditions in an attempt to halt further decay; and to make very detailed investigations of representative sites in case that attempt fails.

That said, what should our future priorities be? Firstly, it is essential to maximise the information obtained from those deposits which are destroyed legitimately within the course of the planning process by focusing on research priorities and ensuring that sampling and recording are appropriate. The 5% destruction sanctioned within York's implementation of PPG16 should be seen as providing opportunities for investigation rather than as an excuse for removing deposits with only cursory examination. Developer-funded excavations can provide the material for future research, but developers cannot be expected to fund that research. Thus, synthetic programmes based on samples from well-excavated evaluations need to be sufficiently well thought out to attract funding from research councils or English Heritage.

Secondly, we would urge that the time has come for a major programme of research excavation on the scale carried out at 16–22 Coppergate between 1976 and 1981, taking advantage of the important lessons learnt over the last quarter of a century. The questions which bioarchaeology poses today were not thought of 25 years ago, and the sampling and analysis strategies were, as an inevitable consequence, limited. To give two examples, we now realise that floor deposits should be sampled in great detail in order to investigate changes through time and use of internal space, and that analysis of the way pits were used may be better served by investigating the interfaces between fill layers than by studying only the 'pure' middles of contexts. Techniques of biomolecular analysis are now known to offer an opportunity to extend greatly our understanding of the resources used on sites (for a recent review see Brothwell and Pollard 2001), and the desire to monitor the success of in-ground preservation has emphasised the need for accurate records of the preservational condition of biological remains (e.g. Kenward and Large 1998a). Ideally, detailed excavation should be carried out in several zones of the city, for example in the Skeldergate riverside area, along Walmgate, in the Parliament Street area, and in the town centre on the fringes of the area with extensive organic preservation, in order to test for occupation which did not generate the 'compost heap' seen in the Coppergate/ Pavement area.

The environmental archaeology of Anglo-Scandinavian York seems generally to be considered to have been the subject of a great deal of investigation. In one sense this is so but, as will be clear from the foregoing, the work carried out so far has (with rare exceptions) concentrated on the Coppergate/ Pavement area, and, in truth, only one extensively excavated site (16–22 Coppergate) has been more than cursorily investigated. Although a substantial number of samples from 6–8 Pavement and 5–7 Coppergate has been studied, both sites were excavated in small trenches whose archaeology was not entirely clear, limiting their value and, in the case of 5–7 Coppergate, leaving dating rather uncertain; of course even radiocarbon dating was very crude at that time, relying on whole-sediment radiocarbon assay rather than single-item AMS dating. Studies of other sites with deposits of the period have been minor, or funds have not yet been made available to study them. A selection of the material from 1–9 Micklegate was examined, representing the only other substantial corpus of information. Work on the archive of unprocessed sediment samples from the 9 St Saviourgate, North Street and 22 Piccadilly sites is of the highest priority, and this material should be investigated before it decays in store.

We suggest the following as particular areas for research into Anglo-Scandinavian York:

What climatic change, if any, occurred immediately before and during the period? Was the climate conducive to easy travel and successful agriculture, including growing warmth-demanding plants such as madder?

What did the incoming Scandinavians find on the site of Jorvík? Were Roman buildings still in use?

Was there functional zonation? How representative is a site such as that at 16–22 Coppergate of the town as a whole? Is the zonation suggested by the spatial distribution of evidence for dyeplants borne out by areas so far uninvestigated?

Were some areas of 'high status' (cleaner and better cared for) and consequently poorly represented in the record?

Are variations in preservation primarily related to ground conditions or to organic input?

Did some structures and possibly areas of the town have a primarily domestic character, while others were purely used for craft, industry and trade?

A list of smaller-scale topics for investigation would be huge, but might include:

What roofing materials were used?

Was beekeeping a common urban pastime?

Can we extend the known ranges of activities and materials exploited through studies of biological remains?

What were the rivers and their fringes like?

Can studies of marine molluscs elucidate their origin and patterns of exploitation and supply?

Lastly, York did not exist in isolation in the Anglo-Scandinavian period. It needs to be placed in its local, regional and international setting. As far as rural sites are concerned, there is effectively no information from any group of organisms, and detailed studies of Saxon/Anglo-Scandinavian rural sites in the region must be seen as a particularly high priority, to address a broad range of questions, especially those concerned with provisioning, with comparisons of urban and rural conditions, and with the effects of changes of political control on the way of life at isolated farmsteads. Location and palaeo-environmental studies of rural and natural sites within its hinterland are a high priority; we know next to nothing of producer sites for this thriving urban settlement. Investigation of trade in biological raw materials (such as dyeplants) over greater distances is also crucial and will demand changes in the approach to identification of insects, at least.

In addition to giving a picture of local landscape and change through time, rural sites (and natural deposits, for which no significant post-Roman material appears to have been studied) will also be important as a source of information about climate, providing large insect assemblages can be recovered; the evidence for temperatures higher than those of the 20th century from towns is strong, but largely depends on a single species (p.418).

Bioarchaeological studies have completely changed the way we look at the Anglo-Scandinavian period in York and elsewhere, but clearly there are many new avenues to be explored, and a great deal of consolidation of existing knowledge to be undertaken.