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Summary

Results are presented of a study of 16,000 fragments of bone from Roman deposits within the legionary fortress at York and overlying medieval features. The earliest Roman structures, a phase of Timber buildings, gave assemblages not inconsistent with legionary sites elsewhere, though with an unusually high proportion of sheep bones. In overlying levels associated with Roman stone buildings, the proportion of pig bones was higher, and that of sheep correspondingly lower, and there was marked spatial variation in the distribution of the bones of different taxa. A 'table waste' element is tentatively identified. Overlying medieval deposits contained primary butchery debris, and evidence is presented that some assemblages were subjected to severe taphonomic attrition. Attention is drawn to the presence of young lambs in Roman assemblages, and there is discussion of pathological anomalies and biometrical data.

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Bones from Roman to medieval deposits at the City Garage, 9 Blake Street, York (1975.6)

T.P. O'Connor

Introduction

This report describes the results of a study of non-human bones recovered from excavations under the City Garage, 9 Blake Street. This excavation was undertaken in 1975-6, under the direction of R.A. Hall: detailed post-excavation studies were deferred until 1986-7. The practical work on which this report is based was undertaken in February to April 1987, and the text itself was drafted during July and August of the same year. At the time of writing, post-excavation studies were still in progress, and this report should thus be taken as a statement of results and provisional interpretation, not as a definitive, final account.

The purpose of the excavation, which is described in more detail below, was to investigate buildings within the Roman legionary fortress, to obtain both the layout of structures and a dated sequence of rebuilding. Deposits encountered in the excavation were certainly wet, but not sufficiently waterlogged to produce large-scale preservation of fine organic structures such as has been encountered elsewhere in York (e.g. see Hall et al. 1983). As a consequence, bone fragments were by far the major biological 'find', and the results of this study will have to be assessed in the virtual absence of other environmental evidence. Another departure from the usual pattern of bone studies from York sites is the lack of a corpus of bones recovered by sieving. At the time at which this site was excavated, the process of bulk-sieving had not been adopted as a routine part of the excavation process. Accordingly, the bones described herein were recovered by hand as deposits were excavated. The arguments for and against hand-collection as a bone recovery procedure have been well-aired (Clason and Prummel 1977; Levitan 1982) and need not be repeated here. Suffice it to say that in this case the only material available for study was that which had been recovered by hand-collection, and that the importance of taking the opportunity to investigate Roman deposits from within the fortress justified the use of a biased and imperfect sample.

Archaeological summary - by R. A. Hall

In 1975-6, York Archaeological Trust excavated approximately 400 sq. metres within a redevelopment site at 9 Blake Street, York. The site lies within the dextral side of the praeventura of the Roman fortress, mostly behind the row of baracks immediately behind the fortress' South-West facade. The work was directed by R. A. Hall, with supervisors D. T. Evans and S. A. Power, and executed for the most part by a team of up to a dozen experienced excavation assistants. This team tackled the contiguous Areas 1-4: simultaneously York Excavation Group investigated an adjacent trench, Area 5 (Fig. 1). The overall aim was to investigate the Roman-Norman development of the vicinity, and within the six-month time limit initially proposed by the owners, Bellway Holdings, this necessitated a decision to remove post-medieval and medieval deposits by machine in Areas 1-4. In the event, the recognition that a stone-lined pit contained fragments of medieval painted glass modified this decision within a limited area surrounding it, and when it appeared that ?late medieval deposits seemed to come down directly onto later Roman levels in Areas 1-3, the mechanical removal of deposits in Area 4 was halted at a higher level to investigate this interface more closely. Thus there are additionally some later medieval deposits from Area 4, as well as from the YEG Area 5, and from medieval features cut into Roman deposits in Areas 1-3. Apart from a timber-lined well, these consist of ?12/13th century robber trenches following the Roman walls.

A provisional interpretation suggests that the vicinity was deserted from c.400 until perhaps the 9th century, when there are vestigial traces of what may be a small post-built structure associated with a mid-9th century styca. There was a certain amount of stratification which may belong to the 10-11th centuries, and a pit contianing important evidence for the manufacture of Anglo-Scandinavian Borre-style trefoil brooches. No contemporaneous structures were recognised.

At the South-West end of the site, the later Roman features were traces of the endmost 1m or so of two adjacent barrack blocks. To their North-East was a road surface which showed signs of several patchings or re-metallings. Beyond that was a more impressive building. Its South-West range, subdivided for part of its existence, may have housed services, perhaps including a kitchen; to its North-East was a passage-way, re-surfaced on several occasions, and then a large room with an _opus signinum_ floor. This room showed signs of alterations - its South-East wall had been slightly repositioned, and cross-walls had been inserted to create four rooms of equal size. Within the foundations of this building was found a hoard of 36 silver denarii dated 66 BC-79 AD; remarkably, they must be re-deposited. Eventually the worn and slumped _opus signinum_ was sealed by c. 20cm thick layer of clean yellow sandy clay. Behind the North-East wall was a drain; to the South-East was a gravelled area. Another wall on the same alignment was encountered within Area 5, nearer to the _via praetoria_. An initial and tentative interpretation of this building is as the accommodation of a legionary tribune.

Below the Stone phase was a succession of timber buildings represented by post-holes, stake-holes and mortar lines. These structures, interrupted by the later foundations, have not yet been entirely disentangled, but at least two timber phases seem to be represented.

Post-excavation stratigraphic analysis is currently (September 1987) in progress, and should be completed during 1988.

Acknowledgements

I am greatly indebted to Dave Evans and Richard Hall for their co-operation during the preparation of this report. RAH interrupted well-earned sabbatical leave to write the archaeological summary and to comment on an earlier draft, and DTE provided copious information on the stratigraphy and phasing of over 300 individual contexts. Any flaws in this text are, however, the author's own.

Materials and methods

In all, nearly 16000 fragments of bone were recorded from deposits of Roman to medieval date. This does not constitute the total archive of bone fragments recovered from the site, as a policy of selective recording was implemented. The principal archaeological interest lay in the Roman structures and deposits associated with them, whereas the majority of the bone fragments recovered from the site were from medieval deposits. The first priority, therefore, was to ensure that all bone fragments from Roman deposits were examined. Post-Roman material was considered to be of secondary importance, and sufficient medieval and later groups were recorded to characterise bone deposition across the site during this period. Inevitably, medieval pit-digging and stone-robbing resulted in considerable reworking of Roman pottery into medieval deposits, and thus presumably of Roman bones into medieval deposits as well. This residuality problem was further justification for concentrating the examination of post-Roman groups on relatively few well-stratified deposits. This report is basically about the bones from Roman deposits under the City Garage, with additional observations concerning the overlying medieval deposits.

The recording procedure adopted for this project was something of a compromise between the academic desire to record the assemblage in great detail and the practical reality of what could be achieved given small numbers of bone fragments from each of many contexts. Across the whole site, an average of 51 bone fragments per context was recorded. From Roman deposits, the average was about 29 fragments per context, of which about two-thirds were identifiable. These circumstances obviously constrained the planning of data analyses, and thus of the appropriate recording procedures. For each context from which identifiable bones were recovered, a record was made of the number of fragments attributable to each of the taxa identified; of the number of each of a set of homologous skeletal elements of cattle, sheep and pigs; of all mandibular eruption and attrition data; of any available biometrical data; and of any notable non-metrical skeletal traits or symptoms of disease or injury. For a relatively small number of large bone groups (i.e. individual contexts yielding several hundred fragments), a more detailed record of skeletal element distribution, and a detailed record of epiphysial fusion in cattle, sheep and pig bones were made.

In addition to all of these data, a record was made of the state of preservation of the bones in each context-group. The fragments recovered from a given context were given codes describing modal fragment size, a subjective impression of the state of preservation, the degree of angularity or 'roundedness' of most fragments, the incidence of carnivore gnawing damage, and the average overall colour of the fragments. These codings are explained in greater detail in the caption to Table 1. Clearly most of the parameters being recorded required a subjective decision, but as all the bones were recorded by the same person during an intensive period of work spanning just a few months, it was felt that the results would at least be internally comparable, and would give a useful indication of the state of preservation of bones in different areas and levels of the site. Given the residuality problem outlined above, and uncertainties surrounding the sources of bone fragments in the many different feature types, this record of the preservation and physical appearance of the bones was clearly an important part of the data collection.

Dental eruption and attrition were recorded using the attrition stages defined in Grant (1982), though without using

Grant's procedures for data analysis. The recording of biometrical data followed von den Driesch (1976). Throughout this text, taxa are referred to by their vernacular English names. A full list of names with their Latin synonyms is given in Table 9.

For the purposes of this report, the data are described in three broad phases: Roman Timber phase, Roman Stone phase, and medieval. Within the Stone phase, structural evidence has allowed subdivision of Area 4 into functional sub-areas, and data from Stone phase contexts are described in terms of these sub-areas. Fig. 1 shows the relationship of the excavated areas, and the sub-divisions within Area 4.

Results

This section of the report is in two unequal parts. The first summarises the distribution of bones through the stratigraphy, concentrating on how many of which bones of what species were recovered from which deposits. These data are discussed by period, working through the site from the earliest layers to the uppermost. The second part of the results section summarises the evidence for animal husbandry and biometry, discussing the data thematically rather than chronologically. The justification for this structure is that data pertaining to age at death, butchery and biometry were sparse, and have only given samples suitable for discussion in broad period terms rather than in more closely defined chronological or spatial units.

The bone assemblages

Roman Timber phase

Deposits associated with the earliest structures on the site yielded just over 3000 identifiable bones or fragments, from 109 contexts. The distribution of these specimens was far from even, the great majority coming from Area 4.

Table 1 summarises the preservation parameters for bones from the Timber phase deposits, and shows an unsurprising degree of consistency. Modal fragment size was generally in the range 70-100mm, having been recorded as 100+mm in less than a quarter of the context-groups examined. Preservation was usually subjectively assessed as good, with about one-third of groups classed as fair. The division between these categories was based on an assessment of the degree of post-mortem development of porosity in compact bone which was otherwise hard and retaining much of its structural integrity. The incidence of gnawing varied, with over 40% of groups showing none, and most showing gnawing on just a few fragments. Only in three groups was the majority of fragments gnawed. Within Area 4, there was considerable variation in the incidence of gnawing, perhaps indicating that some groups were buried more immediately than others. There was also some variation in the overall colour of bone groups from this area, those from the western end typically being darker in colour than those from the eastern end, adjoining Area 3.

The distribution of bones of various taxa is summarised in Table 2. Overall, the proportion of cattle bones is a little lower than in other Roman groups from York, though this species still predominates. The ratio of sheep:cattle fragments for the Timber phase at Blake Street is 0.54, compared with 0.25 in 2nd-early 3rd century levels at 24-30 Tanner Row (O'Connor, forthcoming a) and 0.28 in all Roman deposits at 16-22 Coppergate. It is unlikely that this difference is a simple consequence of better preservation or recovery of small bones at Blake Street. The Tanner Row assemblage was generally in a better state of preservation than that from Blake Street, and recovery of bone fragments during excavation was consistently good. It seems more likely, therefore, that fragments of cattle bone comprised a smaller proportion of the originally deposited assemblage at Blake Street than in Roman deposits at Tanner Row or Coppergate.

Dog bones comprised nearly 10% of the identified assemblage. To a degree, this is a misleading statistic. Parts of two dog skeletons from a pit in Area 4 (Context 8186) contributed about two-thirds of the dog bones from this phase, though the remainder were generally distributed. Area 4 yielded numerous specimens of dog bones, with particular concentrations in contexts 7930 and 8222 (both surface layers). Over much of Area 4, then, dog bones were frequent rather than abundant. Bird bones were scarce overall.

Evidence of systematic butchery, in the form of bones consistently being cut or broken in the same way, was conspicuously absent. In context 8087, for example, most cattle limb bones had been extensively cut about around the articular surfaces, but this was quite unsystematic hacking rather than surgically precise butchering. However, there were a few exceptions. Context 8297 was a surface deposit in Area 4 which yielded three cattle scapulae butchered in just the same way as scapulae from 2nd-3rd century deposits at 24-30 Tanner Row (O'Connor, forthcoming a). In each case, the spinus and coracoid process had been cut off, and there was evidence of a rough hole having been cut in the blade, near the suprascapular margin. In Archaeology of York 15/2 (ibid.), evidence is presented to the effect that cattle scapulae butchered in this way are debris from the smoking, or perhaps salting or pickling, of shoulders of beef. Finding these specimens at a site within the fortress confirms that the procedure was not confined to some specialist supplier in the area of the colonia. Furthermore, context 8297 is dated by pottery to the late 1st century, a full century earlier than the Tanner Row specimens. This indicates that a particular technique for processing shoulders of beef was in use in the fortress from its earliest years.

Apart from the contexts already specifically mentioned, a few Timber phase groups are worthy of individual comment. In Area 3, contexts 3732 and 3371 both contained concentrations of pig vertebrae, an unusual element to find in any quantity on sites of any period. 3732 formed part of a hearth 3740, whilst 3771 was a nearby plaster spread. The vertebrae were not all from the same pig, so the debris must have derived from boning-out of the chines of several pig carcasses. Context 3538, a fill in drain 3548, also contained an unusually high proportion of pig bones, but these were generally distributed throughout the skeleton. At the eastern edge of Area 4, context 6558 was a surface layer which yielded a most unusual assemblage consisting of pig and fowl bones with cattle and sheep rib fragments. It is tempting to see this assemblage as table waste, rather than the product of butchering, because of the high proportion of fowl bones. This is, however, an argument based on a posteriori interpretation of the data rather than on a priori hypothesis.

Pit 8056, alluded to above (bones from fills 8186, 8188), contained a clearly secondary deposit of bone debris. There was no obvious selection of any one part of the cattle, sheep or pig skeletons, with meat-bearing and 'waste' elements all being well-represented. A remarkable inclusion was a fragmented red deer skull. The pedicles had been heavily gnawed, though it appeared that the antlers had been shed rather than cut off. Red deer bones were found occasionally in Timber phase contexts, so the species appears to have been exploited for meat. The dog skeletons included two interesting specimens: a calcaneum bearing knife cuts consistent with the dog having been skinned, and a tibia, the anterior crest of which had been gnawed, apparently by another dog. This pit also gave one of the few fish bones from Timber phase contexts; a vertebral centrum of salmon.

The wild bird taxa identified from the Timber phase are summarised in Table 3. There is little in the list to excite comment, other than to note that mallard (or mallard/domestic duck) was also the predominant wild bird taxon in Roman deposits at 24-30 Tanner Row (O'Connor, forthcoming a). The taxon 'wild goose species' described goose bones clearly not of _Anser anser_. Specific identifications of these specimens would be unwise, though most were consistent in size and proportions with modern barnacle goose. It is assumed that the raven bones were derived from wild birds which scavenged around the fortress, though the possibility that captive specimens were kept cannot be ruled out.

In sum, then, the Timber phase deposits showed some spatial variation in content and taphonomic modification, and differed a little from assemblages from other Roman deposits in York. To put a functional interpretation on the assemblages, there were no concentrations of material typical of the early stages of butchery, and kitchen or table waste seems the most plausible origin for much of the cattle, sheep, pig and bird bone. There was a substantial element of 'background', and quite a high frequency of dog bones, this last characteristic indicative not simply of dogs being kept in abundance, but of their remains being disposed of rather casually. The absence of cat is not unusual for Roman deposits in York.

Roman Stone phase.

Stone phase contexts yielded nearly 2000 identifiable fragments of bone from 76 contexts. As with the Timber phase, the distribution of bones was uneven, with more material coming from the western end of Area 4 than from the rest of the site.

Preservation parameters are summarised in Table 1. Modal fragment size was much the same as for Timber phase groups, and the incidence of gnawing was also unremarkable. Subjective preservation varied in different parts of the site, groups from the road area of Area 4 generally being less well-preserved than those from the adjoining barracks area. Overall, subjective preservation scored rather lower for Stone phase contexts than for those of the Timber phase, though just over half of the groups examined were scored as 'good' rather than 'fair'. Bone colour varied, with the road area again standing out as different. Of the 21 context groups from this part of Area 4, twelve (57%) were classed as mid-brown or darker, as against thirteen out of 54 contexts (24%) in all other areas of the site at this phase. A partial, but not complete, explanation of this colour difference may be seen in the presence at this end of Area 4 of seepages of sump oil derived from the City Garage. Small numbers of bones were noted which were oily to the touch, glossy dark brown in appearance, and which smelled strongly of mineral oil. These were relatively few, however, and cannot wholly account for the overall colour difference noted.

To turn to the distribution of the major taxa (Table 2), Stone phase contexts yielded a lower proportion of sheep bones than did Timber phase groups, giving a sheep:cattle ratio of 0.42. This ratio was not consistently distributed across the site. Fig. 2 shows a marked predominance of cattle bone in the North Kitchen area, and a much higher proportion of sheep bones in Area 3, the opus signinum building and its environs. Area 3, and Area 1 immediately to the North, also gave a remarkably high relative abundance of pig and bird bones. There is an interesting analogy here with certain of the Timber phase deposits, as the areas immediately to the North and South of the opus signinum building yielded bone assemblages composed of pig and fowl bones and sheep ribs. Again, these groups can probably be interpreted as table waste, and their disposal around one particular building may be an indication of one of its functions. This type of assemblage was conspicuously absent from the North Kitchen area, in which part of the site large fragments of cattle bone predominated, and the incidence of gnawing was, as with Timber phase deposits, markedly low.

Context 7259 yielded a cattle scapula from which the spinus and coracoid had been cut off in the same way as the specimens from Timber phase deposits. Otherwise there was little evidence of systematic butchering. A cattle horncore from 1265 had been sawn across close to the base of the core, though this probably represents recovery of the horn for artefact manufacture rather than butchery of the carcass.

Dog bones were less frequent and less abundant in Stone phase deposits than in Timber phase deposits, the great majority (33 bones out of 43) coming from the barracks area at the West end of Area 4. Other species were relatively scarce, though context 6796, a surface layer in the road area, yielded four very large pig bones certainly attributable to wild boar. The single specimen of 'other mammal' listed for this phase in Table 2 was the right mandible of a fox in context 3328. The wild bird bones from Stone phase deposits were unexceptional (Table 3). Mallard predominated, with five specimens each of wild goose sp. and raven.

Two fish bones worthy of note were vertebral centra of haddock from context 3268. This deep-water species is rare in pre-Norman deposits in York. At 24-30 Tanner Row, haddock was absent from Roman deposits, present but scarce in 11th century deposits, and relatively abundant in 12th century deposits (O'Connor, forthcoming a).

Medieval deposits.

The strategy of recording clearly post-Roman material somewhat selectively led to about 3800 identified fragments being recorded from only 31 contexts grouped as medieval with firmly medieval pottery-dating. Some further material was recorded from post-medieval contexts, and from deposits either of uncertain post-Roman date or of medieval attribution but containing substantial amounts of residual Roman pottery. This latter group of contexts is of little value to the analysis and interpretation of the results.

Table 1 summarises the preservation parameters for definite medieval deposits. Subjective preservation was less consistently good than in Roman deposits, and bones were generally lighter in colour. The incidence of gnawing was appreciably higher in medieval groups, with an overall mean incidence of 1.65, as against 0.94 in Roman Stone phase contexts and 0.91 in Roman Timber phase groups. Taking all of these points together, the survival of small bones, such as those of birds and fish, might be expected to have been better in Roman deposits than in overlying medieval contexts. Comparison of numbers of bird bones recovered from Roman and medieval deposits shows a higher proportion in Roman Stone phase groups than in medieval groups (Table 2) and this would be consistent with the difference in overall preservation. In other words, the lower proportion of bird bones in medieval groups could well have a taphonomic, rather than cultural origin.

The proportion of cattle bones in medieval groups was consistently high, with an overall sheep:cattle ratio of 0.20. Again, this could have either a taphonomic or a cultural explanation, with either factor being predominant in different contexts. For example, a deposit (4373) in a scoop (4395) in Area 4 yielded an assemblage which basically comprised a small amount of 'background' bone debris with six more or less whole adult cattle skulls, over thirty cattle metapodials, and 50 first phalanges. Although the skulls had suffered damage during burial, excavation, and prolonged storage, it was clear that at least some, and perhaps originally all, of them bore a massive depressed fracture in the centre of the frontal bone, consistent with the beast having been struck forcibly between the eyes with the proverbial blunt instrument. The occurrence of these skulls in the same deposit as a concentration of metapodials and phalanges points to their being a primary deposit of waste from the slaughter and initial butchering of a number of cattle. A conventional 'minimum numbers' estimate shows at least twelve individuals to have been represented in the recovered assemblage, though a substantial disparity between the recovered numbers of left and right side specimens of the same element indicates that the original 'killed population' was much larger (see Fieller and Turner 1982 for a discussion of this line of reasoning). Context 4373 overlay deposits with 10-11th century pottery, and was overlain by deposits with 11-12th century pottery, which raises an interesting point. The large quantity of bones of 10th-11th century date which were recovered from 16-22 Coppergate (O'Connor, forthcoming b) were notable for the lack of any highly selected groups, in particular any primary deposits of butchers' debris. In contrast, the Blake Street site has produced this very distinctive group, representing the slaughter and dressing-out of cattle on a substantial scale. Does this show spatial patterning in the processing of carcasses, or is it just a fluke? Further examination of bone assemblages of Anglo-Scandinavian to Norman date from various points around the city may answer this question.

The assemblage from context 4373 was not typical of those from post-Roman deposits. Most other groups did, it is true, consist of a high proportion of cattle skull bones, but the main characteristic of these groups was the predominance of cattle teeth, detatched from mandibles or maxillae. By way of example, Table 4 shows the proportion of loose cattle teeth recovered from ten medieval groups, with four Roman groups for comparison. Clearly, it is somewhat unusual for a bone assemblage to contain such high proportions of teeth, and an explanation must be sought. The fact that the teeth were nearly all separated from the alveolar bone in which they were originally seated shows the considerable extent to which the cattle skulls in which the teeth originated must have been broken up. This could either have happened during the butchering of the cattle, or during deposition and burial. A butchery procedure which would lead to most of a beast's teeth being knocked out is difficult to envisage: besides, the accompanying fragments of mandible and maxilla were broken rather than cut. It seems far more likely that the skulls broke up during deposition, burial, and, possibly, reworking and secondary deposition. On this model, the high proportion of loose cattle teeth would be an indicator of major taphonomic damage, and the high overall proportion of cattle bones in these groups would thus be likely to be a consequence of the preferential survival of relatively robust cattle teeth in an agressive taphonomic environment in which substantial destruction of bones occurred, rather than being a useful indication of the content of the assemblage as originally deposited.

Having somewhat exhaustively considered the origins of the high proportion of cattle bones in the medieval groups, there is little left to say concerning the other taxa in Table 2. Cat bones were far from abundant, but there were certainly more of them, and less dog bones, than in Roman deposits. Bones of hunted 'game' species were few, and even waste pieces from the working of red deer antler, which are often quite common in deposits of 9th-12th century date in York (e.g. in O'Connor, forthcoming b) were scarce. One other noteworthy absence was of concentrations of goat horncores. So many 11th-13th century deposits around York have now produced pits filled with goat, or goat and cattle, horncores that such concentrations almost come to be expected.

The wild birds from medieval deposits require little comment, and are listed in Table 3. The single specimen of pheasant was from context 3290, a fill of well 3110, and can be dated to the 13th-14th century. The hand-collected assemblage of fish bones from medieval deposits showed the usual marked bias towards the larger gadid species, and any quantification of relative abundance would be quite meaningless. The great majority of the bones were of cod, with a few specimens of haddock, ling, and a pleuronectid flatfish.

One post-medieval group worthy of description came from context 2101, a fill of pit 2103, which contained pottery of 15th-16/17th century date. The bones recovered from this pit are summarised in Table 5, and a number of characteristics of the assemblage should be noted. Bird and fish bones together comprised one third of all identified bones, a much higher proportion than in any Roman or medieval deposits. The cattle bones included remains of an immature individual, a calf of three to four months old presumably slaughtered as veal, and the sheep bones included a high proportion of bones from the forequarters. These characteristics were also apparent in 17th century deposits of refuse at 1-5 Aldwark (O'Connor 1984), the only substantial post-medieval bone assemblages from York studied to date. Also included in the assemblage from 2101 was the partial skeleton of a sparrowhawk. Other records of raptorial birds from archaeological deposits in York have, in the main, been of taxa likely to have lived as scavengers around the town, such as buzzard or red kite. The sparrowhawk is much more likely to have been kept as a hawking bird, and its presence in a refuse pit at this site may give an indication of the status of one of the local residents.

To summarise, assemblages from post-Roman deposits were diverse, though this may reflect post-depositional diagenesis rather than any cultural factors. Most assemblages were of uspecialised 'background' debris, though there is clear evidence that the site was used for the slaughter and dressing-out of cattle at some time in the 10th-11th century.

The livestock

Data pertaining to husbandry practice and pathology were sparse, but sufficient information has been obtained to merit summary and discussion. The results are described in the same broad period groups that were used above, followed by general discussion.

Roman Timber phase.

An assessment of age at death based on the state of tooth eruption and attrition in cattle, sheep and pig bones is summarised in Table 6. The cattle were nearly all slaughtered as adults, though it should be noted that small numbers of calf bones were recovered from Timber phase contexts. Almost half of the cattle mandibles were classed as 'elderly'; that is, attrition on the third molar had attained grade j sensu Grant (1982, 92). A similarly high proportion of 'elderly' cattle was noted in groups from 2nd-3rd century contexts at 24-30 Tanner Row (O'Connor, forthcoming a), so this would appear to be a characteristic of Roman bone assemblages from York in general, rather than of this particular site. In the discussion of the results from Tanner Row it was argued that cattle in this oldest age category were 7-8 years old or older at death, and that they were probably derived from herds kept mainly for dairying. A similar conclusion would seem to be valid for the results from Blake Street.

The sheep mandibles also gave results similar to those from Tanner Row. The majority of the mandibles were from sheep classed as 'adult' (i.e. approximately 3-6 years old), but there were also a number of specimens from lambs aged about 3-6 months. The results show that very young lambs were exploited for food within the fortress from its earliest period.

The pig mandibles showed no evidence of a concentration on slaughtering at any particular age, though a tentative estimate of the modal age at death would lie around two to three years old. The age distribution shown in Table 6 is consistent with most other groups of pig mandibles from York sites. The only discernible long-term trend is for the proportion of 'adult' mandibles to be highest in Roman samples and lowest in post-medieval samples, and these results are consistent with that trend.

Two discontinuous dental anomalies were recorded in cattle and sheep mandibles (Table 7). The first was the congenital absence of the lower second premolar (LP2), a trait which has been documented by Andrews and Noddle (1975). LP2 was congenitally absent in two out of the 19 mandibles in which the appropriate part of the mandibular corpus could be examined, a frequency of absence of 10.5%. This should be compared with a rate of about 1% in modern cattle (Andrews and Noddle op. cit.), 5-6% in post-Roman groups from York (O'Connor 1986, 10), and 18.5% in Roman cattle mandibles from Tanner Row. Out of 26 sheep mandibles in Timber phase deposits in which the LP2 alveolus could be examined, congenital absence was noted in only one specimen, a frequency of 3.8%. This is similar to the frequency recorded for this trait in sheep mandibles from other archaeological deposits around York.

The second trait which was recorded was the absence or substantial reduction of the distal column of the lower third molar (LM3) in cattle and sheep mandibles. This trait was noted in two out of 22 cattle mandibles (9.1%) and no sheep mandibles out of twelve in which LM3 was in situ. There are no comparative quantified archaeological data for this trait, as a policy of scoring normal, as well as abnormal, specimens of LM3 was first adopted for the recording of the Blake Street material, and published instances from other sites comprise isolated, unquantified specimens. Andrews (quoted pers. comm. in Noddle 1980, 404) quotes a frequency of about 0.5% for this trait in modern cattle. In passing, it should be noted that one cattle mandible, from context 7864, showed congenital absence of LP2 and reduction of LM3, a most unusual coincidence of traits.

Timber phase deposits yielded only a few specimens showing symptoms of disease or injury. Arthropathic disorders have commonly been recorded in groups of cattle bones from York sites, but Timber phase deposits produced only two. The first was an astragalus from context 7363 which exhibited an area of eburnation with associated attrition of the articular surface, occupying about one square centimetre on the distal medial facet. This specimen appears to represent a clear-cut case of osteoarthritis, probably attributable to chronic abnormal stress on the hind limbs as a result of the beast being used for haulage. The second specimen was a cattle metatarsal of less simple diagnosis. The proximal articulation was surrounded by osteophytes, and showed a granular necrosis of the articular surface. The symptoms were not those of osteoarthritis, nor of spavin, a condition which has commonly been observed in cattle metatarsals from archaeological sites (Baker and Brothwell 1980). In typical cases of spavin, the distal group of tarsals is found to be fused to the proximal end of the metatarsal by massive development of osteophytes which encase the joint. The articular surfaces of the metatarsal and naviculocuboid are not involved. In this particular specimen, substantial destruction of the articular facets of the metatarsal was apparent, the granular nature of the lesions suggesting involvement of an infective organism. The proximal part of the medullary cavity showed no sign of osteomyelitis, however, so any infection must have been restricted to the joint capsule. Perhaps the safest diagnosis of this specimen would be that the joint became infected, possibly as a result of some injury, and that necrosis associated with this infection led to bone destruction and extensive remodelling of the proximal part of the metatarsal.

Two pig bones from Timber phase deposits showed symptoms of disease. One was a femur which bore a linear hyperostosis along the posterior aspect of the shaft; essentially an over-development of the _linea aspera_, perhaps as a response to over-stressing or injuring the muscles in this part of the thigh. The second specimen was a mandibular corpus with a large periapical abcess developed below the deciduous fourth premolar.

Stone phase.

Remarkably few age-attributable cattle and sheep mandibles were recovered from Stone phase deposits (Table 6), and comparison with results from Timber phase deposits cannot be made. Rather more pig mandibles were recovered, however, and these showed a slightly different age pattern to the sample from Timber phase contexts. The modal age of slaughter was probably about the same, but Stone phase contexts produced a greater proportion of pigs aged between about three and five months. The results indicate a small change in the exploitation of pigs, with increased slaughter of very young animals to provide 'sucking pig' for the table.

Quantification of dental anomalies was also rather inconclusive, with no cases of congenital absence of LP2 or reduction of LM3 being found in cattle or sheep mandibles (Table 7). A sheep mandible from context 4749 presented an unusual case of retention of part of the deciduous fourth premolar long after the permanent fourth premolar had come into wear. A small, roughly triangular, piece of the deciduous fourth premolar, comprising the occlusal part of the distal column, was wedged into the tooth-row between the permanent fourth premolar and first molar. At the time of the animal's death, attrition was occurring on the anterior column of the fourth premolar, on most of the retained piece of deciduous fourth premolar, and on the adjoining first molar. Interproximal attrition between the first molar and the retained fragment had produced a notch in the mesial aspect of the molar 'locking' the piece of deciduous premolar into position.

Medieval.

Surprisingly few mandibles of cattle, sheep and pigs were recovered from definitely medieval deposits, though the results shown in Table 6 are based on sufficient specimens to indicate much the same pattern of age at death as in other medieval assemblages from York. Cattle and sheep were mostly slaughtered as adults, though few were kept to an advanced age. In this respect, the age distribution of the cattle mandibles differs from that seen in Roman deposits. The mandible of a neonatal calf was noted, though this isolated specimen need not indicate that cattle were bred nearby. The pig mandibles were mostly from second and third year pigs, without the group of three to five month old piglets noted in Roman Stone phase deposits.

No specimens of congenitally absent LP2 or reduced LM3 were noted in the sheep mandibles, out of seven and six cases examined respectively. In cattle mandibles, LP2 was congenitally absent in two cases out of sixteen (12.5%), a frequency similar to that observed in the sample from Roman deposits. The plethora of loose cattle teeth in medieval features provided a large sample of LM3 for examination, and eight specimens out of 53 (15.1%) showed reduction or absence of the distal column. Although this percentage may seem to be much larger than that obtained for the sample from Timber phase deposits, nonparametric testing of the raw data showed the difference to be insignificant (chi-squared = 0.10; 1 degree of freedom; p>0.05). Context 1237, a fill in pit 1243 with 11/12th century pottery, yielded a most unusual cattle mandible in which both LP2 and LM3 appeared to be congenitally absent, leaving only four teeth in the mandible. Distinguishing the congenital absence of a tooth from well-healed ante-mortem loss is always a hazardous business, but post-mortem damage to the alveolar bone distal to LM2 has fortuitously provided a cross-section of the alveolar bone parallel to the occlusal plane. Examination of this section showed no trace of a resorbed LM3 alveolus. Furthermore, the distal aspect of LM2 bore no obvious interproximal wear facets such as often develop between adjacent cattle molars, so the interpretation that LM3 never developed seems secure.

Only three specimens from medieval deposits showed clear symptoms of disease or injury. A cattle os innominatum from context 3289 bore small areas of eburnation on the pubic and ischial margins of the acetabulum, probably a straightforward instance of stress-induced osteoarthritis. Less easily diagnosed was a cattle calcaneum from context 4329, on which the subtentaculum tali had been almost totally destroyed by some localised, but apparently serious, necrotic condition. A pyogenic infection may have been the cause of the bone destruction, though the condition appears not to have spread to the adjacent articular surfaces. The area of destruction is approximately 20mm by 15mm, and extends into the corpus of the calcaneum to a depth of 15mm. From the same context came a pig fibula which bore a raised exostosis on the inner aspect, some 35-40mm proximal to the distal end. Such exostoses are not unusual on pig fibulae, and probably result from a severe blow to the leg, causing bleeding between the fibula and tibia with subsequent ossification of the haematoma. In this specimen, however, there appears to have been some infection of the wound, with pus formation.

Biometry.

A relatively modest archive of metrical data was obtained. The data pertaining to the discussion which follows are summarised in Table 8.

Medieval contexts gave a sample of twelve complete cattle metacarpals, measurements of which showed quite low variability, coefficients of variation for the measured variates falling in the range 5%-10%. An estimate of reconstructed shoulder height (= max length X 6.125: von den Driesch and Boessneck 1974) showed the cattle to have been of the small size typical of medieval samples, the range of the estimates being from 1.01m to 1.16m. An analysis of the relationship between length and distal epiphysial breadth showed a simple linear relationship, with two markedly robust specimens, perhaps attributable to bulls, and one rather slender specimen. In summary, then, the medieval cattle were small, and showed little variation in the conformation of the metacarpal. Insufficient measurable specimens were obtained from Roman deposits to allow a comparison to be made.

A small number of measurable cattle horncores was obtained from medieval and Roman Timber phase deposits. The figures given in Table 8 show the medieval specimens to have been on average a little larger than those from Roman deposits, but conceal a more significant difference. In a study of cattle horncores from 24-30 Tanner Row (O'Connor, forthcoming a), attention was drawn to the presence in the sample of specimens of a very distinctive form of horncore, a form commonly recovered from Iron Age and Roman sites and described in some published sources as the 'Celtic shorthorn' type. These cores are characterised by being very short and markedly flattened in basal cross-section. In biometrical terms, postero-dorsal curve length is low, whilst an index of maximum basal diameter/minimum basal diameter is high. The relationship between the length of the cores and this basal index was examined separately for medieval and Timber phase specimens. In the medieval sample the two variates were not significantly correlated: there was no simple overall relationship between length and cross-sectional shape. In the Roman sample, however, the variates showed a strong negative correlation ($r = -0.79$; $n = 8$; $p < 0.05$). Case-by-case inspection showed that three cases in the Roman sample showed the characteristics of the so-called 'Celtic shorthorn' type, whilst the other five were longer and less oval in basal cross-section. Although the sample was only small, this result agrees with that obtained from the Tanner Row samples in showing cattle of the Roman period in the York area to have comprised a mixture of the 'shorthorn' form typical of pre-Roman samples with more heavily-horned stock. It is interesting to note that the specimens from Blake Street were from Timber phase deposits, early in the Roman settlement of the area, and yet still comprised a mixture of these two types of horncore.

Of the sheep bones, only the tibiae gave useful samples of biometrical data, and these samples were not particularly informative. Table 8 shows small but significant size differences between Roman Timber phase and Stone phase samples and between Stone phase and medieval samples, though the relatively high variance of the Stone phase sample should be noted. A small number of complete pig metapodials were measurable, and these afforded an opportunity to examine reconstructed shoulder heights of the pigs, using the conversion factors given by Teichert (1969). Table 8 shows no significant size difference between Roman and medieval pigs, and a generally small body size overall. For comparison, a single metapodial attributable to wild boar gave a reconstructed shoulder height of 1062mm. Teichert (ibid.) lists reconstructed shoulder heights for samples of ancient and modern pigs, both wild and domestic. The results obtained from Roman and medieval specimens from Blake Street agree closely with those given by Teichert for Central European material of the same date. A sample of pig metapodials of late 2nd-early 3rd century date from 24-30 Tanner Row gave a mean reconstructed shoulder height of 756mm (s.d. = 48.3; $n = 13$), not significantly different to the sample from Stone phase deposits at Blake Street.

Timber phase deposits yielded sufficient complete limb bones of dogs to allow calculation of the range of shoulder height represented in this species. The regression equations given by Harcourt (1974) were used for this purpose. As the sample will have included measurements from two or more individual elements from the same individual, the mean and standard deviation of the sample would not be usefully representative of the population of dogs from which it was derived. However, the range and variance give a good impression of the variability of dogs in Timber phase deposits. Table 8 shows reconstructed shoulder height to have ranged from 273mm to 646mm: virtually from 'lap dogs' to animals suitable for hunting or guard duties. The coefficient of variation for this sample was 26.3%. This already high value should be regarded as a minimum, as the inclusion of replicate values from individual skeletons may have tended to reduce the apparent variation. The presence of specimens giving a reconstructed shoulder height of less than

300mm indicates the keeping of virtually non-functional 'pet' dogs around the fortress during the earliest phase of building.

Biometrical data from domestic fowl bones from Blake Street were included in Allison's detailed study of bird bones from a number of sites in York (Allison 1985, 107-8). Although the sample from Blake Street was only small, the results were sufficiently diverse to show the presence of variability not solely attributable to sexual dimorphism. In other words, it is evident that the domestic fowl population of late 1st-2nd century York comprised a mixture of several phenotypically-defined demes perhaps analogous to modern breeds.

Discussion

There are two obvious subjects for discussion with respect to the results from Blake Street. The first is to what extent the bone debris from this legionary area of the city resembled, or differed from, that deposited on the south-west side of the River Ouse and excavated at 24-30 Tanner Row (O'Connor, forthcoming a; Hall et al., forthcoming). The second question is how far the results from Blake Street are consistent with the pattern of livestock exploitation described by King (1978; 1984) from Roman military and civilian sites throughout Western Europe.

The biggest single difference between the results from Roman groups from Blake Street and from Tanner Row is the higher proportion of cattle bones at Tanner Row. Obviously, simple comparisons of fragment counts are only useful as a rather coarse means of analysis, but the difference between the two sites is large enough to be convincing. In late 2nd to early 3rd century deposits at Tanner Row, cattle bones comprised 69% of cattle, sheep and pig bones, compared with 54% in Timber phase groups and 53% in Stone phase groups at Blake Street. This difference can probably be explained in terms of the different types of deposit encountered at the two sites. Roman deposits at Blake Street were predominantly within and immediately around buildings and associated with their use and occupation. Although some of the Tanner Row material was derived from floor levels within structures and pits associated with them, the majority came from dumps and accumulations of material, at least some of which were deliberately deposited in order to raise ground levels. Included in these deposits was one remarkable group which consisted almost entirely of butchered cattle long-bones. The Tanner Row assemblages appeared to include bone debris derived from secondary, if not primary, butchery of cattle carcasses, an element which was not characterised within the Blake Street assemblages. The higher proportion of cattle bones at Tanner Row may therefore only represent the difference between the debris discarded by the butcher, and the debris thrown away at peoples' kitchens and dining tables.

Within the results from Blake Street, there is a change in the relative proportions of cattle, sheep and pigs between the Timber and Stone phases. The relative abundance of cattle bones remained about the same, but the proportion of pig bones was much higher (and of sheep accordingly lower) in Stone Phase deposits. To consider the Stone Phase data first, comparison with results given by King (1984, 189-91) shows that the relative abundance of pig bones of 25% is consistent with British legionary sites, and contrasts with the rather low proportion of pig bones typically seen at auxiliary sites and 'unromanised' or pre-Roman settlements. The lower proportion of pig in Timber phase deposits might just be evidence of the tendency described by King for very early Roman sites in Britain to show a pattern of exploitation more akin to that seen at pre-Roman sites, i.e. with less pig and more sheep bones.

Another characteristic of some early Roman sites is the presence of first year lambs in the food debris (Maltby 1981, 175), and Table 6 shows a group of young lambs to have been identified in Timber Phase deposits. Regrettably, the data from Stone Phase deposits are too few to confirm either the presence or absence of young lambs in later groups. At Tanner Row (O'Connor, forthcoming a) small numbers of first year lambs were present throughout 2nd-3rd century deposits, so the age distribution seen in Timber Phase levels at Blake Street may be typical of Roman York in general, rather than of early Roman deposits in particular. Maltby (ibid.) has also drawn attention to the presence at many Roman sites of a high proportion of sheep slaughtered at an age between the eruption of the lower second and third molars, which he interprets as an emphasis on the slaughter of second and third year sheep for their meat. This tendency was not apparent in 2nd-3rd century groups from Tanner Row, nor in the 1st-2nd century material from Blake Street. In this respect, Roman York seems to differ a little from other urban and legionary sites, with most sheep having been slaughtered as fourth to sixth year beasts.

The age distribution of pig mandibles differed between Timber and Stone Phase groups at Blake Street, there being a higher proportion of young pigs represented in Stone Phase groups. Comparison with results from Tanner Row shows that the age distribution seen in pig mandibles from Timber phase deposits is consistent with that seen in 2nd-3rd century levels at Tanner Row, the higher proportion of young pigs in Stone Phase deposits being the exception.

To summarise the discussion so far, then, the results from Blake Street are generally consistent with those from other legionary sites in Britain save for a rather low relative abundance of cattle bones, which may be a reflection of spatial patterning in bone disposal within the city, and the emphasis on keeping sheep to a greater average age than is usually seen at Roman sites. A high proportion of adult sheep in food debris would seem to indicate that sheep were valued in the main for secondary products, producing an age-structure in the samples deposited within the city very similar to that seen in medieval groups. Whether wool or milk was the more favoured product canot be determined. In fact, the city would have drawn its livestock from many different producers, each of whom could have been implementing a different husbandry regime, favouring different products.

Within Stone phase contexts, bone groups showed quite marked spatial variation, which corresponded to some extent with the location of specific structures. This at least would seem to indicate that bone groups from this phase were mainly from primary deposits, and not merely 'background' debris. At the time of writing, it is not possible to examine the Timber phase data in the same way, as the structures attributed to this phase have yet to be disentangled. One particular characteristic of Timber phase deposits was the high frequency of dog bones, representing animals of varied size and build. Harcourt (1974) has drawn attention to the high variability of dogs from Roman deposits in Britain, which would be consistent with the breeding of dogs, if only haphazardly, for specific purposes. Late 1st-2nd century deposits at the fort at Castleford, South Yorkshire, also produced remains of an assortment of dogs (S. Stallibrass, unpublished MS), and it would seem that dogs accompanied the Roman military during the early stages of their settlement. The decline in the frequency of dog bones from Timber to Stone phase deposits at Blake Street may indicate a change in disposal habits rather than an actual decline in the abundance of the species. This is another question which can be addressed when the Timber phase structures are fully resolved.

To bring this brief discussion to a close, the results presented here show a pattern of bone deposition quite consistent with other legionary sites in Britain. The increase in pig from Timber to Stone phase could be seen as an increasingly 'Roman' influence, though the same trend would have to be recorded from more sites in York to be convincing. Also in need of further clarification are the questions of bird and fish exploitation, and the arrival of rodent vermin in the fortress. In the absence of sieved small bones from Blake Street, little can be said on these subjects. Overall, the assemblage has produced a modest amount of information, and more will probably emerge as other Roman groups from York are recorded and made available for comparison.

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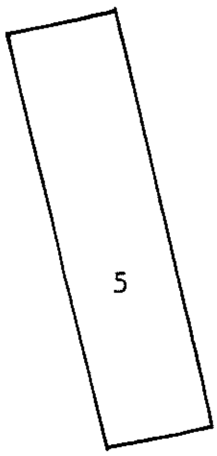

Fig. 1. Excavation areas, showing relationship of trenches.

Subdivisions within Area 4 are for Roman Stone phase deposits only.
b = barracks
r = road
n = north kitchen area
s = south kitchen area
p = passageway

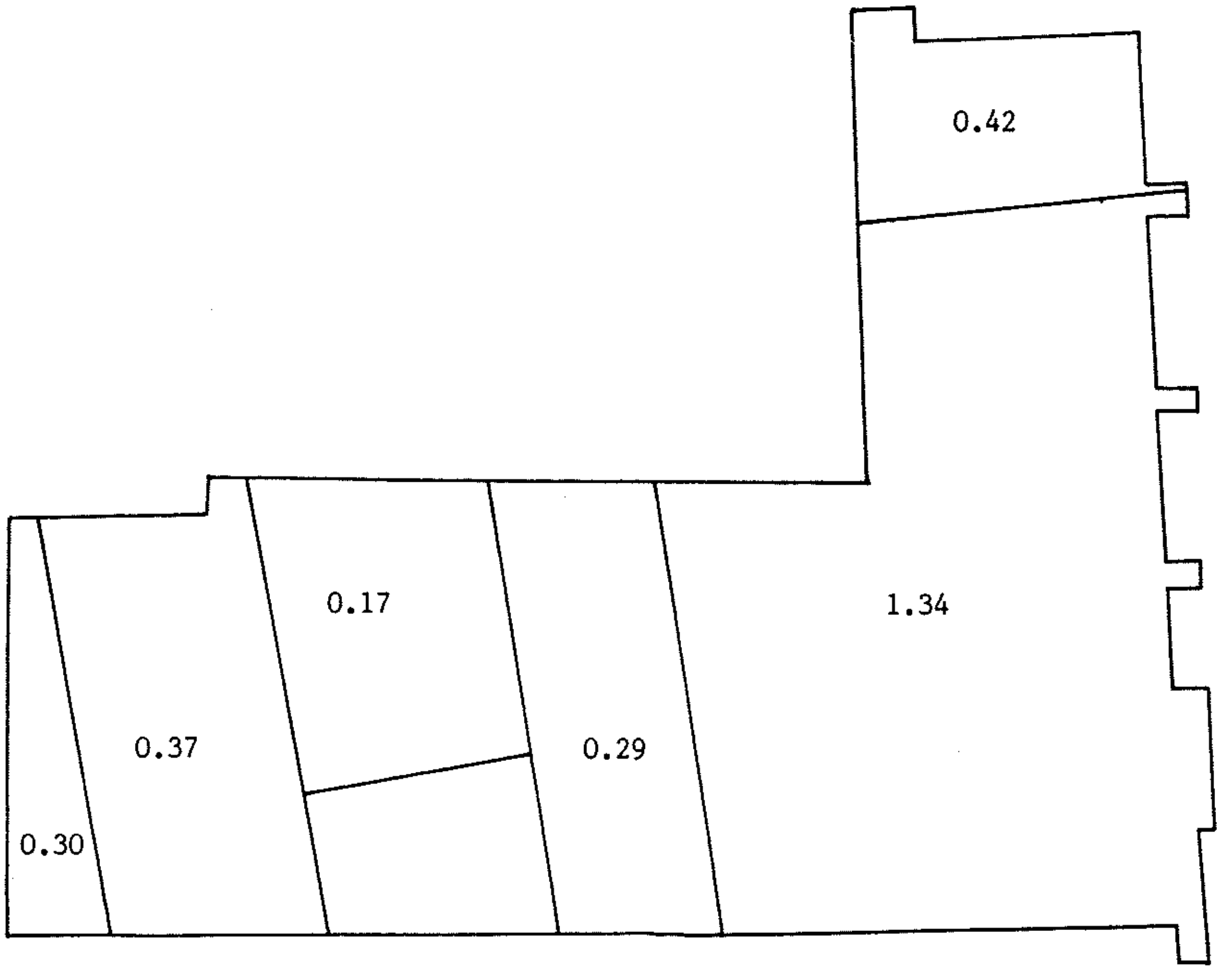

Fig. 2. Roman Stone phase. Values of the ratio sheep frags:cattle frags plotted for main structural areas of the site. Note the very high proportion of sheep bones in Area 3.

Roman Timber phase

Fragment size	1	2	3	4	5	6
Area 1	-	-	-	-	1	-
Area 3	-	-	-	2	12	5
Area 4	0	0	1	16	53	19

Gnawing	0	1	2	3
Area 1	1	-	-	-
Area 3	8	2	9	-
Area 4	37	28	21	3

Subjective preservation	1	2	3	4	5	6
Area 1	-	-	-	-	1	-
Area 3	-	-	-	3	16	-
Area 4	-	1	-	34	54	-

Average colour	1	2	3	4	5	6
Area 1	-	-	-	1	-	-
Area 3	-	1	10	6	2	-
Area 4	-	6	38	39	6	0

Table 1 (part). Taphonomic parameters summarised for Roman Timber phase contexts. Key to columns at end of Table.

Roman Stone phase

Fragment size		1	2	3	4	5	6
Area 1		-	-	-	3	4	-
Area 3		-	-	-	2	3	1
Area 4	passageways	-	-	1	2	10	1
	N Kitchen	-	-	-	1	4	4
	S Kitchen	-	-	-	1	1	-
	road	-	-	-	4	15	2
	barracks	-	-	-	3	13	1

Gnawing		0	1	2	3
Area 1		2	2	3	-
Area 3		2	1	3	-
Area 4	passageways	6	1	4	3
	N Kitchen	7	2	-	-
	S Kitchen	-	1	2	-
	road	10	7	3	1
	barracks	6	7	3	1

Subjective preservation		1	2	3	4	5	6
Area 1		-	-	-	5	2	-
Area 3		-	-	-	3	3	-
Area 4	passageways	-	-	-	5	8	-
	N Kitchen	-	-	-	5	4	-
	S Kitchen	-	-	-	-	2	-
	road	-	-	-	12	9	-
	barracks	-	-	-	6	11	-

Average colour		1	2	3	4	5	6
Area 1		-	1	6	-	-	-
Area 3		-	2	3	1	-	-
Area 4	passageways	-	4	6	3	-	-
	N Kitchen	-	1	5	3	-	-
	S Kitchen	-	1	1	-	-	-
	road	-	2	7	11	1	-
	barracks	-	1	10	5	1	-

Table 1 (part). Taphonomic parameters summarised for Stone phase contexts. Key to columns at end of Table.

Medieval

Fragment size	1	2	3	4	5	6
Area 1	-	-	-	1	4	-
Area 3	-	-	1	2	4	-
Area 4	-	-	-	-	10	1
Area 5	-	-	-	-	4	4

Gnawing	0	1	2	3
Area 1	1	-	4	-
Area 3	-	1	6	-
Area 4	3	-	8	-
Area 5	-	2	6	-

Subjective preservation	1	2	3	4	5	6
Area 1	-	-	1	4	-	-
Area 3	-	-	1	4	2	-
Area 4	-	-	4	4	3	-
Area 5	-	-	-	4	4	-

Average colour	1	2	3	4	5	6
Area 1	-	3	2	-	-	-
Area 3	-	-	4	3	-	-
Area 4	-	2	7	2	-	-
Area 5	-	-	3	5	-	-

Table 1 (part). Taphonomic parameters summarised for medieval contexts.

Key:
Fragment size: 1 - 0-10mm; 2 - 10-30; 3 - 30-50; 4 - 50-70; 5 - 70-100; 6 - 100+mm. A single value is recorded for each context denoting the size interval which contains most fragments, i.e. mode.

Gnawing: 0 - no fragments gnawed; 1 - one or two gnawed; 3 - several gnawed; 4 - the majority gnawed.

Subjective preservation: 1 - horrid; 2 - poor; 3 - mediocre; 4 - fair; 5 - good; 6 - excellent.

Average colour: 1 - white; 2 - fawn (2.5Y8/4); 3 - ginger (2.5Y7/6); 4 - mid-brown (2.5YR5/8); 5 - dark-brown (5YR3/2); 6 - black. The Munsell colours are given as examples of each category, not as limits.

Roman Timber phase

Area	1	3	4
horse	-	-	3
cattle	5	271	1126
sheep	16	131	615
goat	-	1	9
red deer	-	2	24
roe deer	-	-	5
pig	-	83	340
wild boar	-	-	2
cat	-	-	-
dog	-	2	292
hare	-	1	8
human	-	-	-
other mammal	-	-	-
fish	-	-	4
fowl	-	12	67
goose	-	-	7
other bird	-	9	16
unidentified	3	130	681

Roman Stone phase

Area	1	3	4p	4n	4s	4r	4b
horse	-	-	-	-	-	-	-
cattle	97	71	146	48	8	354	119
sheep	41	95	43	8	1	130	36
goat	5	3	-	-	-	-	-
red deer	1	-	-	1	-	-	-
roe deer	1	-	-	-	-	1	-
pig	77	134	42	7	8	100	23
wild boar	-	-	-	-	-	4	-
cat	1	-	-	-	-	-	-
dog	1	1	1	6	-	1	33
hare	3	1	-	-	-	-	-
human	-	-	-	-	-	1	-
other mammal	-	1	-	-	-	-	-
fish	-	4	-	-	-	-	-
fowl	23	55	15	5	-	28	1
goose	5	18	3	1	-	1	-
other bird	2	9	3	-	-	6	2
unidentified	67	95	121	31	-	230	41

Table 2 (part). Numbers of fragments attributed to major taxa.
4p - Area 4 passageway
4n - Area 4 North Kitchen area
4s - Area 4 South Kitchen area
4r - Area 4 road
4b - Area 4 barracks

Medieval

Area	1	3	4	5
horse	5	6	8	12
cattle	685	519	1184	320
sheep	45	185	251	71
goat	-	3	2	-
red deer	-	-	5	2
roe deer	3	-	2	2
pig	50	58	199	37
wild boar	-	-	-	1
cat	3	3	2	1
dog	5	8	6	3
hare	-	2	2	-
human	-	-	-	-
other mammal	-	2	1	-
fish	-	-	13	5
fowl	5	10	75	7
goose	5	3	7	4
other bird	1	2	8	1
unidentified	199	647	437	89

Table 2. Numbers of fragments attributed to major taxa.

Timber phase
Mallard 10; raven 5; wild goose sp. 3; crane 2; rock dove 2; teal, crow, duck sp. 1.

Stone phase
Mallard 11; wild goose sp. 5; raven 5; crow 1.

Medieval
Mallard 5; pheasant 1; golden plover 1; raven 1.

Table 3. Wild bird taxa recorded from contexts attributed to main phases of settlement.

	cattle frags	loose cattle teeth	teeth/frags x 100%
Medieval			
1200	223	189	84.8
1221	161	97	60.2
1236	221	120	54.3
1237	337	144	42.7
1242	142	49	34.5
3226	60	30	50.0
3240	184	99	53.8
3289	130	83	63.8
4657	127	28	22.0
4329	268	27	10.1
Roman			
6416	78	0	0
8186	193	1	0.5
8227	91	0	0
8297	71	3	4.2

Table 4. Comparison of the relative proportion of loose cattle teeth in medieval and Roman deposits.

cattle	83
sheep	17
pig	8
dog	1
fish	18
fowl	41
goose	4
other bird	18
unidentified	25

fragment size	5
gnawing	2
subjective preservation	5
average colour	3

Sheep bones subdivided by skeletal element

horncore	-
mandible	2
epistropheus	-
scapula glenoid artic.	9
humerus distal epiph.	4
metacarpal prox. epiph.	-
pelvis acetabulum	1
tibia distal epiph.	1
metatarsal prox. epiph.	-
phalanx prima	-

Table 5. Summary of the bones recovered from context 2101, the fill of a pit pottery-dated to 15th-16th/17th century.

	N	J	I	S	A	E
Cattle						
Timber phase	-	-	-	2	11	12
Stone phase	-	-	1	-	3	1
Medieval	1	-	-	3	11	3
Sheep						
Timber phase	-	8	2	6	12	-
Stone phase	1	-	-	2	3	-
Medieval	-	-	-	1	11	-
Pigs						
Timber phase	-	1	5	10	8	-
Stone phase	-	7	3	9	4	-
Medieval	-	2	1	6	5	-

Table 6. Summary of attribution of cattle, sheep and pig mandibles from main phases of occupation to age groups on the basis of eruption and attrition.

N = neonatal.
J = juvenile; permanent 1st molar not in wear.
I = immature; permanent 1st molar in wear, 2nd molar not in wear.
S = subadult; 2nd molar in wear, 3rd molar not in wear.
A = adult; all three permanent molars in wear, 3rd not heavily worn.
E = elderly; 3rd molar showing advanced wear on all columns.

	Cattle..........				Sheep...........			
	p+	p−	m+	m−	p+	p−	m+	m−
Timber phase	17	2	20	2	25	1	12	−
Stone phase	5	−	2	−	7	−	2	−
Medieval	14	2	45	8	7	−	6	−

Table 7. Summary of occurrence of non-metrical dental anomalies in cattle and sheep mandibles attributable to main phases of settlement.
p+ = lower 2nd premolar or its alveolus definitely present
p− = lower 2nd premolar and its alveolus congenitally absent
m+ = lower 3rd molar complete in all columns
m− = lower 3rd molar with reduced or absent distal column

Cattle horncores			
Roman Timber phase			
maximum basal diameter	43.50	4.75	8
minimum basal diameter	30.15	5.10	8
basal circumference	123.50	15.15	8
length of outer curve	115.50	26.21	8
Medieval			
maximum basal diameter	46.86	8.97	5
minimum basal diameter	33.16	7.27	5
basal circumference	130.40	24.34	5
length of outer curve	118.60	26.91	5
Cattle metacarpals			
Medieval			
GL	178.20	7.46	12
BP	51.03	2.99	12
SD	28.17	2.51	12
BD	47.41	3.01	12
BT	52.48	3.61	12
Sheep tibia			
Timber phase BD	23.72	0.83	10
Stone phase BD	24.64	2.29	7
Medieval BD	25.51	1.36	17
Pig metapodials			
Reconstructed shoulder height			
Timber phase	(685, 714, 770)		
Stone phase	779.2	48.5	9
Medieval	(700, 705, 789)		
Dog limb bones			
Reconstructed shoulder height			
Timber phase	487	128	15
	(min. 273; max. 646)		

Table 8. Summary of biometrical data discussed in the text. The table gives mean, standard deviation and number of cases. For small numbers of specimens, recorded values are bracketed. All measurements are in millimetres. Abbreviations follow von den Driesch (1976).

horse	*Equus* sp. f. domestic
cattle	*Bos* sp. f. domestic
sheep	*Ovis* sp. f. domestic
goat	*Capra* sp. f. domestic
red deer	*Cervus elaphus* L.
roe deer	*Capreolus capreolus* L.
pig	*Sus* sp. f. domestic
wild boar	*Sus scrofa* L.
cat	*Felis* sp. f. domestic
dog	*Canis* sp. f. domestic
hare	*Lepus europaeus* Pallas
human	*Homo sapiens* L.
fox	*Vulpes vulpes* L.
goose	*Anser* c.f. *anser* f. domestic
barnacle goose	*Branta leucopsis* Bechstein
mallard	*Anas platyrhynchos* L.
teal	*Anas crecca* L.
domestic fowl	*Gallus* sp. f. domestic
pheasant	*Phasianus colchicus* L.
sparrowhawk	*Accipiter nisus* (L.)
buzzard	*Buteo buteo* (L.)
red kite	*Milvus milvus* (L.)
crane	*Grus grus* L.
golden plover	*Pluvialis apricaria* (L.)
rock dove	*Columba livia* Gmelin
crow	*Corvus corone* L.
raven	*Corvus corax* L.
salmon	*Salmo salar* L.
haddock	*Melanogrammus aeglefinus* (L.)
cod	*Gadus morhua* L.
ling	*Molva* c.f. *molva* (L.)

Table 9. List of taxa referred to in the text and tables.