ENVIRONMENTAL EVIDENCE

ANIMAL BONES AND SHELLS by Bob Wilson, bird bones identified by Enid Allison and fish bones identified by Mike Wilkinson

Analysis of the Faunal Remains: Objectives

The faunal assemblage from the moated manor provides an opportunity to compare material from this relatively poorly-known medieval settlement type with that from other contemporary sites. Preliminary sampling during 1980 of the bones collected revealed potentially significant differences compared to other sites in the region. Pig was unusually well represented (41%), while sheep (15%) was under-represented. Fallow deer and rabbit bones appeared to be more common than usual compared to other sites in the area. Thus the importance of a detailed analysis of the assemblage and its interpretation in the context of regional medieval settlement was evident. In order to maximise cost- effectiveness, the objectives of the study and priorities for analysis were drawn up (see Table 1), and the report subsequently prepared based on sections A and B.

Contents of the Report

The disparate classificatory groups of vertebrate bones and marine molluscan shells are treated together, since the bulk of the material is comprised of domestic and dietary refuse. Data are presented in the same format as that employed in previous reports prepared by the author. Emphasis has been placed on variability in the distribution of waste from butchery, cooking and consumption within and around the domestic and farm buildings, based on a general model for the spatial distribution of bones developed for the Iron Age site of Mingies Ditch, Oxon. Evidence for the farm economy is also discussed in order to facilitate comparison with the documentary evidence available for the organisation of medieval farms.

Collection of the Material

The material collected consisted of 11,105 bones of vertebrates and 2,265 shells of marine molluscs, which were mostly recovered during the course of routine excavation. Small quantities of soil were sieved, yielding some 1,670 fragments of bones and shells. The bulk of the assemblage dates from the early 13th to late 15th century A.D. (questions of residual and intrusive material are discussed below as they arise).

Condition of the Bones

The general preservation of the bones was good, with the surfaces showing little sign of extensive leaching or encrustations of iron oxides or hydroxides. Cracking and whitening of bones deposited in the upper levels of the site indicate that leaching had begun, but very few bones appeared to have disintegrated as a result of this factor. Some mechanical destruction from scavengers such as dogs and rodents was evident from gnawing marks.

Species Identification

Remains of bird and fish were extracted from the collection and sent, respectively, to Enid Allison and Mike Wilkinson for identification. Further assistance on the identification of some molluscs was obtained from Mark Robinson.

The Counting of Bone and Shell Fragments

The method of counting fragments was intended to be consistent with the procedure used in previous reports. The frequency of general classes of bones and shells in the different phases of the site's use is given in Table 2, that of fragments of different species in Tables 3 (mammals), 4 (birds), 5 (fish) and 6 (marine molluscs).

Occurrence of Mammals

Mammal species present are listed and quantified in Table 3, to which the following comments may be added. No positive identifications of goat were made. It is possible that wild pig occurs among the domesticated pig. An incomplete third phalanx from F134 in Phase 5 may be that of a donkey. Fallow deer bones appeared to offer no major problem of identification, despite the absence of their distinctive antlers. Red and roe deer bones were few but listed identifications appear certain. A further shaft of tibia from F162 (13th to 14th century) is probably of roe deer.

Small mammal bones presented difficulties in that some skeletal elements of different species could not be separated satisfactorily. The size ranges of black and brown rat are still uncertain but no rat bones were as robust as the author's comparative specimens of modern brown rat, and no bones were attributed to this latter species. The least common species identified was a tibia of stoat Mustela erminea among 15th- century demolition debris of F186. A tibia of hedgehog was noted among unstratified debris but was not recorded elsewhere.

Bird Bones by E. Allison and R. Wilson

Identifications, bone measurements and data on sex and age were provided by Enid Allison. Summaries of this information are given below where relevant.

Overall frequencies of identified bones from sieved and unsieved deposits are given in Table 4. Chief species of interest among the identifications are Quail Coturnix coturnix and the Herring/Lesser Black-backed gull, which at the time of writing had not previously been recorded from excavations in Oxfordshire. Tufted duck, Peafowl, Moorhen and Barn owl are less commonly occurring records.

Fish Bones by M. Wilkinson and R. Wilson

This section is based on identifications and notes made by Mike Wilkinson. Results of identification are given in Table 5.

A variety of freshwater, migratory, and marine species were represented by small numbers of identifiable bones and greater numbers of unidentifiable elements or fragments, particularly fin rays. Chief occurrences of note are those of Bass Dicentrarchus labrax, Scad Trachurus trachurus and Herring Clupea harengus which had not been recorded previously from archaeological contexts in Oxfordshire. Herring bones were identified later from Blackfriars, Oxford.

The size range of bones within each species and the number of species in this small group of identified bones indicates that they represent only a fraction of the bones of fish which were originally present on the site. This is confirmed by the results of sieving.

Occurrence of Marine Molluscs and Crustacea (Table 6)

Sea oysters, mussels, cockles and whelks were present as expected. In 15th-century floor debris (F512) in room A9, was a claw of edible crab Cancer pagurus; a carapace of the same species came from early 14th-century construction debris (F892) in room A1.

Representation of Species by Phase Group

Table 7 shows the frequencies of selected mammal species as percentages of the total number of mammal bones in each phase group. In addition, remains of bird, fish, oyster and marine mussel are expressed as a percentage index of the number of mammal bones in each phase group. This facilitates comparison with species representation at other medieval sites in the region. It emerges that pig, fallow deer, rabbit, domestic and wild birds and oyster are relatively abundant, whilst sheep is unusually less well represented. The significance of these findings will be discussed below.

Some chronological changes in species representation are apparent, with possible increases in the abundance of sheep and oyster, and a corresponding decline in the frequency of pig bones. However, these results must be qualified to some extent by the variability of bone and shell debris across the site.

Intrasite Variability In Species Representation

After the initial recording of the faunal data and prior to significant knowledge of, and integration with, the archaeological evidence, specific objectives were formulated which might be profitably tested by further analysis of the data thus far collected. These were:

1. To document using species identifications and other data such variability as occurred in:
   a) buildings
   b) rooms of buildings
   c) external areas
   d) peripheral areas

2. To test and modify as necessary the following expectations:

A. That the preparation, secondary butchery and consumption of food occurred either

a) in the central area of the site (or was at least focussed in an area adjacent to it). This derives from a model of activity formulated for the Iron Age site at Mingies Ditch, Oxon, and for other, Romano-British sites. Comparison

of the site's centre with surrounding areas is made difficult by the fact that most of the moat and other peripheral areas were not excavated. Moreover, the layout of the site is more complicated than that of Mingies Ditch, and findspots of bones were recorded within a 5m grid system, and sometimes only to within a larger area of a room or building.
or

b) at specialised areas around the general centre of activity.

In order to examine these expectations particular attention was to be paid to the following:

i) internal and external contexts of buildings.
ii) particular buildings, rooms, or structures. Asymmetry in the layout of site buildings might assist in locating centres of activity.
iii) deposits associated with other specific structures, e.g. ovens and hearths, within a building.

B. That centres of activity are to be located according to the presence of relatively high proportions of bones of certain small or medium-sized species, namely sheep, pig, rabbit, domestic fowl and all fish. Potential complicating factors are listed below:
i. Bones of smaller species and small fragments of large ones would tend to be incorporated into deposits near to where food was prepared, or where table refuse was incompletely cleared away.

ii. Larger bones would tend to be removed from cooking or eating areas by rubbish clearance.

iii. Small bones would enter internal contexts such as postholes, pits, robber trenches, softer floor layers and even walls (through rodent scavenging).

iv. Scavenging, trampling, and weathering may have destroyed small bones exposed in external contexts such as courtyards. The relative absence of such bones in the more protected contexts within buildings should be diagnostic of the absence of food preparation and consumption (but see (v) below).

C. "Peripheral activity" on the site should be recognised by a relative abundance of large bones among outlying contexts as a result of conditions i-iv above and the following factors:

v. The cleaning of areas of high social status, e.g. a hall or chapel.
vi. Scattering from scavenging would tend to disperse larger fragments farther than small ones.
vii. Slaughtering and primary butchery of large or medium- sized carcasses, e.g. of cattle and sheep, which would take place some distance from kitchen and eating areas (2-40 m. on rural sites).
viii. Areas of the butchery of larger carcasses may not be easily located because of the intensity of scavenging or the intensive human use of longer bones for marrow, tallow, or other products.

Another difficulty is the possibility that butchery and its associated waste disposal may have occurred outside the excavated area, e.g. outside the moat, or at adjacent farms or in the chase i.e. butchery of venison.

Intrasite Variability: Internal and External Contexts

Table 8 shows the relative frequencies of bones and shells in internal and external contexts of buildings. In Table 9 the frequencies of mammal species are shown as percentages of the total number of bones of horse, cattle, pig and sheep in each phase group. Percentages of other identified animal remains are expressed as an index percentage of the total number above. The percentages of identified and burnt bones are the total number of the four species, or the total or burnt bones, divided by the number of the four species above plus the number of unidentified fragments.

It can be seen from Table 9 that bones of smaller mammals, e.g. pig, rabbit with hare, and nearly all groups of bird bones, are better represented in internal than external contexts. The same is true of unidentified bones, which are by nature likely to be smaller. Conversely, a higher percentage of cattle bones, and likewise of identified bones, is attested in external than internal contexts. Sheep, rodents, fish and mussels are generally better represented in internal contexts, but the figures here display some variability which may be related to a variety of cultural factors, including changes of diet, and the destruction of domestic buildings and the alteration of habitats (e.g. of rodents). On the whole, the smaller and finer bones of small and medium-sized species appear to be better represented inside buildings, whilst bone debris from outside tends to consist of coarser material.

If this pattern is compared with results from the medieval tenement site at the Hamel, Oxford, there too bones of pig were more abundant in internal deposits. However, it was concluded for that site that pigs were being slaughtered at a relatively early age and the bones were therefore less durable and tended to disintegrate more rapidly when deposited in external areas. A similar rationale was proposed by Meadows for the site of Hajji Firuz.

Despite the latter interpretations, sheep, rabbit with hare, fish and mussel are still better represented than cattle in internal deposits. This suggests that immaturity of pig bones is not the only factor which accounts for the trend of fine debris to coarse in moving from internal to external contexts.

One possibility is that the smallest bones might be more vulnerable to degradation in external areas. However, it is thought that this factor alone does not adequately explain the relative frequencies observed, since the bones from Hardings Field are far less degraded than those at Mingies Ditch, where the results were nevertheless thought to point to cultural or ecological processes rather than fragmentation alone.

Thus the comparison of internal and external contexts appears to confirm that the internal contexts of buildings were functionally and spatially related to the cooking and consumption of food. It is possible now to refine this pattern further in order to locate the specific centres of such activities within the buildings in question.

Intrasite Variability: Within Buildings And Rooms

Using the method outlined in the previous section, Tables 10 and 11 present fragment frequencies, percentages and percentage indices of animal bones and shells regrouped according to the rooms of buildings in which they were excavated. This comparison does not allow for any differences between phase groups, which may point to chronological changes; however, as will be seen below, such influences do not significantly affect the results.

Most bones inside the buildings occurred in the foundations of the rooms designated A1 - A14, although some rooms, e.g. A2, A6, A7, A11 and A14, for a variety of reasons yielded few bones. Buildings B, F, H, T and W contained the most important of the modest deposits in the remaining 14 buildings.

Overall quantities of debris and the species representation presented in Table 11 indicate at first glance that the most important rooms in terms of cooking and consumption refuse are A1, A9, A10 and A12, followed by a less important group consisting of A3, A4, A5, A13, A14, T, F, and W.

These results were then evaluated systematically for all buildings. Percentages and percentage indices of bones and shells obtained for each building were ranked for each of nine criteria thought to be most relevant of results given in Table 11 and according to whether the lowest or highest values indicated the greatest association with cooking and eating. Individual rankings of buildings, according to the percentage obtained for each criterion, are given in Table 12.

Where sets of rankings were compared for individual rooms and buildings, a considerable amount of the variability in ranking appeared to be due to chance variation of species presence in the original samples, particularly the smallest ones. A further difficulty of interpreting these results was the uncertainty which would be involved in rating any one criterion as more reliable than any other.

The last difficulty was resolved by treating each criterion equally. Random variation due to small sample size of some building groups was cancelled by adding together the rankings of all criteria for each room or building. This gave a total which indicated the average ranking of the room in comparison to the others.

However, not all of the difficulties due to small sample size were eliminated by this method. Where bones were less commonly present, or, as frequently, were absent from bone groups of rooms, this resulted in equal and low rankings for several criteria which thereby contributed to a lower total of ranked values for some bone groups.

This problem, however, mainly applies to the less important rooms or buildings where bones from cooking and eating were scarcely present. Their bone groups will have been displaced from the most important results by the differentiation given to the rooms with the most abundant remains.

Overall or average rankings of building deposits obtained by this method are given at the bottom of Table 12. Grand totals show that rooms A1 and A9 have the lowest totals followed by A10 and three others of the A block of buildings. The method therefore shows that these rooms contained the smallest and finest bones and fragments and the best representation of small animal species. This confirms the indications obtained by the visual inspection of results that cooking and eating occurred in or near these rooms.

These findings are also an independent confirmation of the other architectural and historical evidence that the A block of buildings were domestic in nature as opposed to the other buildings of the farmyard. Other buildings close to Block A, such as B, F, T, and W, tend to have higher ranking totals compared to those of buildings further away eg. G, H, I, J and K.

Densities of Bones in Buildings and Rooms

The ranking of buildings presented above cannot, however, be accepted quite at face value, since one of the criteria, i.e. the quantity of bones in a building, is partly dependent on the area and volume of deposits excavated. This factor must also affect the other criteria to a lesser extent, though their percentage values are proportional rather than absolute measures.

The volume of excavated deposits was too difficult to calculate, and the limited accuracy of such measures would be further diminished by the variable presence of much tumbled stone. The area excavated, however, was easily obtained from the site plan, and where this factor is taken into account in calculating the densities of bone debris, a somewhat different pattern emerges for the distribution of bones in the buildings.

Results presented in Table 13 show that the density of bones and shells in most buildings was low, i.e. less than 5 fragments per square metre of building area. Densities were greater, up to around 12 fragments per square metre, in A1, F, A10, T and A12. Bones were very abundant, around 30 fragments per square metre in A5 and most of all in A9 at around 50 fragments per square metre.

These figures represent only an approximate index of bone density since they clearly depend in part on the depth of deposits as well as their horizontal extent. Deposits in A9 were said to be slightly deeper than those in the rest of Building A. The depth of deposits in the farmyard buildings was affected by deeper, mechanical top soil stripping; also, the wall foundations here were shallower than elsewhere.

However, the results are useful because the relatively large areas of some rooms, especially A1, indicate that the large quantities of bones found there are spread less densely than their numbers at first suggest. Conversely, the bones in rooms A5 and A9 are more densely concentrated than at first appears. Such figures make no distinction, however, between deposits associated with the primary use of the buildings and those derived from their construction or destruction.

Intrasite Variability: Phases And Feature Groups of coarse and fine debris

In Tables 14 and 15 the percentage index method of Tables 10 and 11 is used to examine the largest groups of bones and shells from different phases and feature types within buildings and from the most significant of the external contexts. Only the results from buildings A1, A5, A9, A12 and B are worth splitting into phase groups.

Room A1 gives consistent results for the medium and large mammal bones in Phases 2 to 5, although the presence of bones of smaller animals varies. The `fineness', or relative lack of coarse debris of the bones of medium sized species is only exceeded by those of Phase 4/2 in Room A9. In A9, however, the overall densities of bones and the relative abundance of bones of small animal species greatly exceed those of Room A1 in their respective phases, except where finely fragmented bird bones give a high value for A1 in Phase 4/2. The purest deposit of eating or cooking refuse therefore comes from floor or "occupation" deposits which thus appear characterised by a relative abundance of pig, rabbit with hare, domestic fowl, fish, and oyster. Besides the probable presence of debris from cooking and eating in these areas, the results indicate the clearance of coarse refuse from the floors of these buildings and this explanation can be applied to the interpretation of more variable results in other buildings.

The demolition phase of Room A5 contains a predominance of cattle bones and suggests that the presence of coarse debris affects the overall figures for this room in Tables 10 to 12, although the nature of the phase does not preclude the possibility that such material debris also accumulated during the earlier occupation of the building. The same is true of the Phase 5 debris in Room A12, where coarse debris is particularly common in the robber trenches, suggesting that the debris in this case was incorporated following the abandonment and/or demolition of A5. In Building B, however, bone from Phase 4 is coarser than that from Phase 5.

Coarseness of cattle and horse bones in external features is most evident for bones of Phase 5 in the sump F504 and gully F518 of the courtyard which is enclosed by Rooms A4, A9, A12, W and F. Similar debris occurred in the following: drain F115; Phase 4/2, between Rooms A11 and A12, and in the moat, Phase 2. Less coarse debris occurred in the moat upcast (Phase 2), in the `dump' debris F573 above Building E (Phase 4/2), and in the general demolition layers, F186 and F189, above Block A, and over the yard, F119.

The least coarse debris in external contexts occurred in the courtyard layer F519 (Phase 4/2), and should perhaps be regarded as an extension of the fine debris found within Block A at this time. A similar interpretation is likely for higher values of bird bones in the sump and gully (F518) of this courtyard.

The last group of bones of some interest was associated with the ovens and hearths in various buildings. Not surprisingly, 8% of a relatively small group of bones were burnt. Other areas or layers containing material such as charcoal or ash yielded little evidence of burnt bones. Bones appear rarely burnt by accident unlike those at some prehistoric sites.

Intrasite Analysis of Skeletal Element Representation

Collation of data regarding the distribution of skeletal elements was restricted to an examination of the most productive contexts. This was undertaken in order to determine whether there were any characteristic distributions of elements which further explained the patterns of species data already observed.

In view of the objectives of the study, as outlined above, it was important to discover the composition of debris in deposits associated with the area where food was cooked and consumed. It was possible that the percentages of elements might show:

1. whether butchery had taken place in any of the buildings, and what form it took, or
2. whether the bones mainly represented refuse left behind after eating.

The species considered to be most worthy of investigation was sheep, since proportions of skeletal elements were already known to vary more than those of pig or cattle in urban medieval and post-medieval deposits. Such discoveries allowed a crude division of the process of butchery and consumption into several stages:

1. Primary butchery: slaughtering, gutting, skinning and some dismemberment of the carcass, such as the removal of limb extremities or the division of large carcasses for ease of transport.

2. Secondary butchery, either
   a) the division of the main meat carcass by a commercial butcher (a stage not expected to be present at the site), or
   b) division of the carcass, or portions of it, within the household/kitchen prior to cooking.

3. The consumption and dismemberment of cooked joints at the meal table.
4. The breaking up and boiling of bones as butchery or other waste for the purpose of extracting tallow, lard, glue, etc.

Also selected were several smaller species which might reveal butchery patterns different to those of sheep, and whose bones might be less susceptible to rubbish clearance than those of larger mammals. Rabbit and hare were obvious choices, although their bones were not numerous. The abundance of domestic fowl also offered an opportunity to see whether the skeletal element distributions were determined by cultural factors other than rubbish clearance.

Those rooms which contained the largest deposits of bones were chosen. Room A9 was selected because it appeared to be the main centre of deposition associated with cooking and consumption and was perhaps related to the preparation of food in the kitchen. Room A1, the hall, was also of interest because its refuse might indicate the type of debris left after most waste from the table had been cleared away. Finally, A5 was chosen because this room stood away from the main centre and might indicate other kinds of dumped rubbish.

In addition, several external contexts appeared to offer useful comparative information, such as the moat and its upcast (Phase 2), the dump debris (F573), and drain (F115, Phase 4/2). Features in the demolition phase, Phase 5, would yield information of less certain value because the sources of this debris are less easily determinable.

Skeletal Element Representation Of Sheep

Sample sizes were small, even for rooms or areas where debris appeared most abundant, yet Table 16 shows a distinctive trend in the representation of skeletal elements of sheep. Skeletal elements of the body, i.e. the upper limb bones and especially vertebrae, are disproportionately abundant in Rooms A9 and A10, thus correlating with the concentration of refuse associated with food preparation and consumption. Head and foot debris becomes more common further away from this area.

In terms of the numbers of body elements of sheep compared to head and foot elements, the former were most abundant in rooms A9, A10 and A1. They occurred in lesser quantities in external contexts and in Rooms A12 and A5, together with Buildings B, F and W (which are at intermediate distances from A9), and were found least frequently in Buildings H, I, J and K (the most distant group). The exact reverse was the case for the occurrence of head and foot elements, which increased in abundance with distance from A9.

This pattern appears to indicate that refuse from the primary butchery of the carcass was disposed of separately and further away than the refuse from kitchen preparation and consumption, as represented by body elements. Bone debris in A9 and its vicinity appears to represent waste from cooking and, primarily, consumption.

Skeletal Elements Of Pig

Evidence for the distribution of skeletal elements of pig allows further exploration of the ideas put forward above. A somewhat different pattern emerges here, including a marked difference between room A9 and neighbouring contexts. Higher percentages of loose teeth, partly indicating greater disintegration, contribute to a larger amount of head debris than occurred generally for sheep. Metacarpals and metatarsals occurred in relatively high quantities in A9, and, in contrast to sheep, bones from head and limb extremities generally predominate over body elements. This need not contradict the findings above, since the head, neck and trotters of pig offer more edible tissues than the same parts of sheep. Bones from these parts of pig therefore feature more prominently in debris from food preparation and consumption. Parts of sheep heads e.g. brains, may of course have been eaten, but given the pattern discussed above, they would probably have been removed before cooking rather than on consumption.

Skeletal Elements Of Cattle

Bones of cattle show a different distribution pattern, with few elements in and around the centre of food preparation and consumption. Parts of foot and head were commonest in external features, notably F504, F 518, F573 and F115. This patterning could come from practices of rubbish clearance or from scavenging, with large bones being more likely to be redistributed after butchery or cooking. In addition, boneless meat was probably brought to the place of cooking and/or eating, with most bones being disposed of elsewhere.

Skeletal Elements Of Rabbit And Hare

Cranial and metapodial debris of rabbit and hare was generally uncommon, whilst bones from the main meat carcass was relatively abundant. Data in Table 19 also indicate a trend for the metapodial and head elements to be found away from the centre of food preparation and consumption, where the vertebrae and upper limb bones predominate.

This is significant because mandibles and metapodials should have been more prominent among the small bones of Building A. Since this contradicts the general pattern whereby small bones occur in the central area of the site, it suggests that, as for sheep, the dumping of feet and head parts took place outside the central buildings.

Thus, as for sheep carcasses but in contrast to pig, the heads and feet of rabbit and hare appear to have been separated from the carcass and dumped elsewhere before most of the bones reached room A9. Heads and paws might have been removed at the same time as the skin, and this most probably took place in the kitchen prior to cooking.

Whilst fewer rabbit bones survive compared to sheep and cattle, the complete humeri and femuri recovered nevertheless outnumber those from the larger species. This observation suggests (thought not conclusively, since cattle and sheep bones may have been rendered further for tallow, glue etc.) that owing to its small size the main meat carcass of rabbit was disjointed little before cooking.

Skeletal Elements Of Domestic Fowl

Results in Table 20 show that, as for rabbit and hare, the head elements of domestic fowl are scarcely represented, and that the bones from the head and feet tended to occur more frequently in external contexts and with distance from A9. Again the evidence suggests that the bones in A9 and nearby are refuse from food processing and consumption.

Skeletal Elements Of Sheep: An Index Of Bone Degradation

An index of bone degradation was calculated as a crude measure of the extent to which sheep bones had been degraded by processes such as leaching, scavenging, or trampling. This consists of the percentage presence of four skeletal elements (mandible, radius, tibia and loose teeth) in groups of sheep bones. A low percentage indicates that bones are well preserved and a high percentage indicates highly degraded bones. For those contexts in which bones are highly degraded (c.f. 72-93% of bones at Mingies Ditch, Oxon) the percentage index is thought to be related to both the type of deposit and the depth to which bones were buried in the ground. Similar results with less degraded material (34-72%) were obtained at Mount Farm.

This index of degradation was calculated from the data given in Table 16, and results are also shown there. The percentage index ranges from 20-65%, and confirms that the bones from this site are relatively well preserved. Sheep bones from inside buildings (20-65%), especially Room A9 (20%), tend to be better preserved than those from external deposits (42-63%). The variable pattern from individual buildings parallels the distribution of fine and coarse debris (see above), and again raises the issue of whether small, fine debris tended to be absent from peripheral buildings (e.g. B, F, W, G, H, I, J, and K) owing to differential degradation, despite the deposits in these buildings having been better protected from the weather and from scavengers.

One way of bypassing the extent to which differential degradation affects the observed patterns of skeletal element distribution is to study the spatial distribution of elements which are known to be particularly resistant to degradation.

Site Distribution Of Mandibles

Mandibles and teeth of the larger mammals are relatively resistant to bone degradation, although at this site a tendency for some pig and sheep mandibles and maxillae to disintegrate has been observed. To minimise the possibility of bias arising from such disintegration, the presence of certain teeth was used as a control. The presence across the site was plotted of individual mandibles, loose fourth deciduous premolars, and loose third molars where these could not be assigned to mandibles from the same feature. The teeth showed very little sign of mechanical damage or leaching, and mandibles of immature animals, even if disintegrated, should therefore each be represented by a single deciduous tooth, and those of mature animals by the third molar.

The mandibles recovered were too few in number to enable comparison between the buildings, but sufficient for the examination of frequencies of cattle, sheep and pig mandibles in external and internal contexts. A chi-squared test of the overall results in Table 21 (n=110) showed there was a significant difference between internal and external deposits (p=0.05, x=6.34 5.99, df2).

Statistical testing indicates that the distribution of mandibles is anomalous, and the frequencies of mandibles in particular indicate a relative deficiency of cattle and sheep mandibles in internal deposits. This is as trends in Tables 16 and 17 indicate. Although the percentage of cattle mandible fragments in A9 (Table 18) is anomalously high, few mandibles are actually represented there. As might be expected, the frequencies of mandibles in internal and external deposits vary most for cattle and sheep, and least for pig.

Some of the mandibles present in internal contexts appear derived from construction debris, or from intrusive debris following abandonment and/or demolition. This implies that the number of mandibles (especially those of cattle) found in internal contexts were over-represented. On the other hand, some of the demolition debris from Phase 5, F186 and F119 (Table 21) might have been derived from later activities within the buildings.

If mandible presence in outlying buildings, for example F, G, H and W, is interpreted as deriving from the intrusion of external deposits, the tendency for mandibles to be absent in the internal deposits, especially of Rooms A1, A9 and A12, is thereby reinforced . In other words, the presence of mandibles may be characteristic of coarse and external bone debris which sometimes becomes incorporated into internal deposits, especially within peripheral and non-domestic buildings.

Comparison of relatively resistant elements suggests on the whole that the uneven distribution of bones of large and medium- sized mammals is not due to differential degradation.

Sieving For Bones

Deposits were not extensively sieved, and some confusion arose over the labelling of several groups of bones. However, useful information was obtained by the sieving of soil from the moat F279 and from two contexts in Room A9, namely, floor layer F512/1, Phase 5, and `occupation' layer F639/1, Phase 4/2. This allows further comparison between material from internal and external deposits.

Table 22 shows the frequencies of bone fragments in these samples. Bones of smaller species, small unidentifiable bones and broken marine shells were more abundant in the samples from A9, though less frequent in the demolition phase than in the earlier occupation deposit.

Table 23 shows the percentages of animal bone and shell representation by weight. Although the samples are small, again the smaller animals are best represented in samples from A9. The weights of marine mussels indicate that this species is under-represented by routine collection because their shells are more fragile than oyster.

Table 24 shows the fragment size distributions of mammal bones. Material from the moat is relatively coarse compared to that from building A9, although debris from F512 is coarser than that from F639.

In total the evidence from these sieved samples confirms that the representation of bones of small species and unidentifiable bones is greater in sieved deposits than in unsieved material. In the former, foetal or juvenile pig bones, herring and freshwater fish species are quite prominent. The differences observed among the sieved material confirm what was concluded for routinely collected bones, i.e. that material from internal deposits is finer and smaller than that from external deposits.

Articulated Bones And Skeletons

The following five part skeletons were recorded:

Cat (F561, Phase 4/2):
Seven newly broken vertebrae, 13 rib pieces and 3 limb bones.
Small sized; ti GL 95 mm.

Cat (F186, Phase 5): Eleven limb bones with fused epiphyses except of prox. hu. A medium sized individual: ti GL 109, ra L 89, hu Bd 16.5 mm.

Puppy (F228, wall of Building M, Phase 5):
Seven vertebral and 23 rib fragments. Perhaps redeposited debris.

Black rat (F548, layer in Building A1, Phase 4/2):
Crushed cranium, 20 vertebrae and 9 limb bones. Molars erupted but lightly worn.
All epiphyses unfused except for dis. hu.

Black rat (F512, Phase 5):
Articulated hu, ra and ul of immature individual. Too few bones to be noted in Table 3.

Other Rodent Bones

Among the diffuse scatter of rodent bones recovered from the site several clusters of their bones were found with other fine debris. The most prominent concentrations of bones came from the following two features-
a) F186, demolition debris of Phase 5, grid ref 787-290.
b) F726, `charcoaly layer' in Building A5.

Retrieval of bones from these features was biased in favour of larger rodent bones, especially the tibia of Apodemus sp., and this tends to distort the counts of fragments, as does the inability to identify all skeletal elements.

Counts of identified rodent bones are given in Table 25 with counts of the number of mandibles present. Field vole and Apodemus sp. were the most abundant species followed by house mouse and shrew. Frog bones were common among these remains as were bones of small passerines, especially in F726 (17). The rodent bones in F186 were closely associated with the bones of one goose (see below). A humerus of a male buzzard (GL 98.1 mm) was also found in F726/4.

The rodent bones are mainly complete and were from both mature and immature individuals. They do not appear to have been eaten and digested by predators unless the bones were regurgitated whole.

These bones may be detritus from owl or buzzard droppings deposited near roosts among the ruins of Buildings A5 (F726) and A9 (F186). It is also possible that the rodent remains represent caches of food made by larger carnivores. A third alternative is that the rodents burrowed intensively among demolition and rubbish deposits or occupied gaps among tumbled debris. The latter two factors might also explain the presence of frog bones. The activity of predators might account for the bones of passerines, or they may simply have roosted and died amongst the ruins.

Presence Of Rabbit

The probability that some rodent bones represent later intrusions into medieval deposits raises the question of whether other animal bones are also intrusive. The status of the rabbit bones in this respect is clearly important, since it may affect our interpretation regarding the role of rabbit as part of the diet of the inhabitants, as discussed above.

Rabbit-sized animal burrows were not observed by the excavators, and no whole skeletons of rabbit were recognised which might indicate animals which died in their burrows, as did at least some of the rodents. Rabbit bones were not conspicuously associated with the rodent bones, and their occurrence did not indicate any successive occupation of previously-dug animal burrows or other holes. The distribution of rabbit bones on the site is consistent with the distribution of small, fragmented rubbish and with anomalies in the presence and absence of skeletal elements. It indicates that the bones were from butchered carcasses and that they are contemporary with the other medieval bones.

Domestic Goose (F186, 787-290)

Seventy-six bones of a mature or old goose were found with the rodent bones mentioned above. One cervical vertebra shows eburnation on the articular surface. Bone proliferation occurs on the skull, some vertebrae, distal ulna, proximal metacarpals, and on the posterior phalanges. The absence of butchery marks indicates that the goose died of natural causes. It was probably a domesticated individual.

Smaller Groups Of Articulated Bones

Articulated remains and relatively complete bones of the larger mammals were not common, probably because most were broken up by butchery, scavenging and other processes during the occupation of the site.

Crania

Cattle   i)   Pit 935, Phase 3/1:
Unfused elements from a juvenile individual
ii) Construction debris F980, Building A5, Phase 3/1:
Matching mandibles
iii) Layer 726/4. Building A5, Phase 5:
Much of a half cranium divided in the midline by butchery
Pig   i)   Layer F120, grid ref. 770-280, Phase 4/2:
Half cranium divided in the midline
ii) Layer 726/4, Building A5, Phase 5:
Much of a whole cranium lacking mandibles. Probably male. MWS of maxillae teeth is 35. Measurements (45) 124, (40) 30, (21), 57.5, (31 Length of M3) 31 mm.
Sheep i) Layer F140, Phase 4/2.
ii) Pit F124, Phase 5.
Thoracic vertebrae
Pig F600/5, 600/6 & 600/11, Building A4, Phases 3-5   Pelves
Horse F207 & F204/206, Phase 2:
Unfused portions of left and right pelves which must be from the same juvenile individual.

Limb bones

Cattle   F189, Phase 5   Mc-phl.
Pig   Pit F717, Building A5, Phase 5: Matching ulnae.
Sheep   Rubble F599, Building A4, Phase 5: Hu-ra-ul.

Discussion

Semi-articulated debris and relatively complete crania are disproportionately associated with the few pits on the site, with rooms A4 and A5, and perhaps also with

Phase 5. The distribution suggests that bones deposited in pits and in these rooms were less disturbed by depositional processes or by other activities than bones from other contexts. This is partly confirmed by the presence of the clusters of rodent bones and the goose skeleton among the demolition debris. In F726 the rodent bones occurred over the crania of cattle and pig.

Minimum Number Of Individuals (MNI)

MNI were estimated from age estimate records of Mandible Wear Stage (MWS, see next section), and other data of mandible and loose teeth presence following, in principle, the comparative method of Chaplin. This method did not entail re-examination of the mandibles themselves as a separate group, except where information was incomplete for the minor species. It was adopted in order to save time on extensive comparisons of mandibles, and indeed of other skeletal elements, but nevertheless to provide results which are fairly comparable to previous treatments of mandible remains. The method was applied to the evidence from Phases 1-5 but not to unstratified remains.

Results are given in Table 26 with percentages of species in the total. The most obvious source of bias is the absence of any mandibles of fallow and other deer. Compared with the percentages of bone fragments in Phase 5 (see Table 7), cattle are underestimated by MNI (35% vs 27%) while the less common species, except fallow and rabbit, are better represented by MNI. Percentages of pig and sheep as derived by both methods are very similar.

Age Information From Mandibles

Eruption and wear stages of the mandible teeth of cattle, sheep and pigs were recorded. The Mandible Wear Stages (MWS) were calculated following the method of Grant, with the exception that MWS were not estimated for broken mandibles where there was a degree of uncertainty of more than 2 places of the most probable MWS. The frequencies of age-staged mandibles are given in Figs. 1-3.

Ageing Of Sheep

Data in Fig. 1 indicate that nearly all of the sheep were killed after MWS 30, by which stage the 3rd molar was in wear. Many of these sheep would have matured skeletally. Their mandibles range between Stages E to I of Payne's scheme.

The sample of mandibles is small (n=15) but their age stage distribution is probably typical of the site kill-off pattern. Twenty-four third molars between stages E-I and 18 between F-I were recorded, compared to two p4 of a lamb and a hogget. A smaller sample with a similar distribution of old mandibles is recorded for 12th-century Middleton Stoney, Oxon., and, of somewhat younger mandibles, for sizeable groups from the 12th- to 16th-century site of The Hamel, Oxford, and a 16th- to 19th-century group from Church Street, and other sites in Oxford.

Although the sample sizes are not entirely satisfactory, most of these medieval distributions differ statistically (Kolmogorov-Smirnov test, Ho p -.05) from those from the Iron Age and Romano-British periods at other local sites such as Ashville, Barton Court Farm, Abingdon and Mount Farm. In these earlier samples many sheep were killed at much younger ages than during medieval times.

Since this difference with the earlier sites holds true for both rural and urban medieval sites, which display less inter- site variability, it seems that the medieval pattern may be best explained by the keeping of sheep for wool, and less by marketing strategies. However, some immature sheep were marketed from farms to towns, though confirmation of this depends upon a closer examination of urban samples from Oxford and elsewhere.

Ageing Of Cattle

Fig. 2 shows the distributions of age data of cattle for the site compared to unpublished evidence from medieval and post- medieval sites in Oxford. At Hardings Field over half of the cattle were slaughtered at late age stages, when the third molar was well worn. About one quarter, however, died or were slaughtered as calves before or as the first molar began to erupt (TWS V-E).

The presence of a high proportion of calf mandibles is characteristic of post-medieval urban deposits (Fig. 2) although it is probable that this urban pattern results from the domestic consumption of calf heads and the dumping of the crania of older cattle in uncommon but dense concentrations associated with tanneries, fellmongers, or other industrial concerns. Nevertheless the presence of the calf mandibles in post-medieval deposits and at Hardings Field, particularly in the destruction and 15th-century deposition, suggests that there is some similarity and continuity of farm husbandry between these groups but which differs at least in degree from that during the earlier medieval period when calf remains are less apparent. Further evidence of this trend will be seen among medieval mandibles from Church Street, Oxford.

It is suggested that the presence of calf mandibles is indicative of a milking economy, stimulated by the birth of calves which were frequently killed soon after. This type of husbandry may therefore have had greater emphasis during the late medieval and post-medieval periods.

Mandibles of the older cattle represent oxen and dairy cows. These animals, and particularly oxen by implication, tend to predominate at the earlier medieval period.

In the medieval group of mandibles from urban Oxford, cattle of intermediate ages (MWS 10-30) are more evident than at Chalgrove. This observation is supported by the data from medieval Church Street. The presence of these immature cattle indicate steers, unwanted bulls or sterile cows which were sent from farms to market and butchers in Oxford.

Such marketing could explain the relative absence of immature cattle being butchered at Chalgrove. Another explanation is that economic or environmental pressures severely constricted animal husbandry and farm prosperity at Chalgrove.

Sample sizes of cattle mandibles from other sites in the region are usually too small to test against the modest one from Hardings Field. Although the Romano-British sample (n=64) from 3rd-4th century A.D. Barton Court Farm, Abingdon, is not statistically different to that of Hardings Field, those from Iron Age sites almost certainly have a greater proportion of younger animals present overall. On the earlier sites, particularly Barton Court Farm, a greater proportion of calves were kept to greater ages but short of maturation before being slaughtered, presumably with the relatively successful aim of maximal meat production. This deduction may imply that both the economy and husbandry of medieval sites was much more constricted than on earlier ones.

Ageing Of Pig

Fig. 3 presents data from pig mandibles at Hardings Field and unpublished data from medieval Oxford. The two kill-off patterns are similar and a significant difference in the results is most unlikely. Further, these patterns resemble those from local Iron Age and Roman sites. Evidence for marketing patterns is not very evident.

Age Information On Domestic Birds

Table 27 presents the frequencies and percentage of immature and fully ossified bones. Domestic goose and duck were mainly eaten as old birds. To a lesser extent this is true of domestic fowl. Domestic pigeon, however, were eaten immature i.e. as squabs, presumably from a dovecote.

Bone Measurements And Other Data: Size And Sex

A selection of the more common skeletal elements were measured. Although nearly all of these measurements are specified with reference to the work of von den Driesch, they correspond closely to those taken on other regional sites. Results are summarised in Tables 28 to 31, which also include some information from other sites. Statistical testing of these results is not attempted here.

Sheep

Ranges, means and standard deviations indicate a general similarity in the size of sheep bones to those found in medieval Oxford (Table 28). They are smaller than Romano-British and Saxon sheep bones.

In the Hardings Field group the raw data from the more abundant elements, e.g. distal tibia, do not show polymodal peaks indicative of gender differences in bone size. Any potential bimodal trend may have been obscured by the effects of castration on males, or possibly by their early slaughtering, though there is little evidence of the latter.

Two medium-sized horn cores of sheep gave outer circumference lengths of 75 and 90 mm. A large, robust, curved, and broken horn, probably or ram or wether, measured 123 mm. in length and 122 mm. around the base. No polled crania were noted but might have been present in a larger sample overall. A somewhat subjective examination of six pelvic portions indicated the presence of three ewes and three wethers or rams.

Cattle

Bones of cattle at the site are larger, particularly in their distal widths, than those from medieval Oxford (Table 29). Some approach the size of large Romano-British stock. Sexual dimorphism is more evident among cattle bones, however, and the comparison of data between sites may be biased therefore by quite different proportions of larger and smaller-sexes as a result of differences in animal husbandry. Few complete bones survived at Hardings Field which might allow a detailed study of the ratios of the sexes, but some interesting points emerge.

Examination of fragmentary pelves indicated that three were of castrates or possibly bulls, and one other was female.

Figures 4 and 5 are scattergrams of data from metapodials at Hardings Field against a background plot of data from medieval Oxford. The bones of calves or recently fused ones of immature cattle are not represented here. Clustering of data appears to be restricted to the denser scatter of measurements of small bones which, in Iron Age and Romano-British samples, appear to represent cows. The diffuse spread of data from larger bones would normally be suggested to be from steers, oxen or bulls. These interpretations are supported by the presence of larger bones showing deformations, indicating the presence of draught oxen (see notes on pathology below) which are expected mainly to be castrated males. A few determinations of sex from the complete Hardings Field metapodials add some further confirmation of these results, although the method used is not altogether secure.

The evidence suggests that at least some, and possibly most of the largest cattle at Hardings Field were draught oxen and castrates. The metapodial samples are small but indicate that castrates/intact males outnumbered females. It is possible that some of the small cattle represented in the Oxford town group are not cows, but steers or bulls which were given less favourable feeding and shelter than oxen and consequently their growth was stunted. However, it is suspected that these small Oxford animals were mainly cows which suffered poorer environmental conditions than cattle at Hardings Field.

Pig

As with cattle, and compared to sites in medieval Oxford (Table 30), pig bones tend to be larger at Hardings Field with two very long metatarsals, one unfused, in evidence at Phase 5.

Rabbit And Cat

When compared with unpublished data from Oxford the measurements for other domesticated species (Table 31) suggest that they were slightly larger in size at Hardings Field. For medieval urban samples of cat bones, as for other extant species, a decline in the size of bones in the town sample following the late Saxon period is evident.

Environment And The Size Of Mammal Bones

General evidence of size differences between urban and rural sites, and the hints from elsewhere of size decreases in animals during the early medieval period, suggest environmental causes such as the general deprivation of human and animal populations in or near towns as opposed to rural ones, reflecting also differences in social status.

Bird Bones

Results for selected measurements of bird bones are given in Table 32 and in Fig. 6, which gives additional information on sex. Fig. 7 compares metatarsal measurements of bones from Hardings Field with some of known sex from black leghorn cross bantams.

Contrary to West, the metatarsi which show spur scars are considered to be of males which were killed before the spur had become fully ossified and fused to the shaft. The largest bones therefore appear to be from males as cocks or capons. Slightly fuller evidence of sex from complete and incomplete bones is given in Tables 33 and 34. These indicate a predominance of males in the samples and possibly during the later phases.

Pathology Notes: Mammals

Horncore Of Sheep:

Possibly of castrate. With slight depressions of the surface, possibly indicative of nutritional deficiencies during growth F186 760-285, Phase 5.

Mandible And Teeth:

Cattle i) Worn and pitted surface of articulation with cranium, F633, Phase 5.
ii) Absence of P2: 3/15. In one mandible scarring may indicate the tooth was lost by physical damage prior to death (MWS 44e).
iii) Periodontal disease: 2 slight instances in 19 relatively complete mandibles; MWS 39e & 49.
iv) Shear tooth M1/M2 of mandible, F581.
v) Lump at base of enamel on lingual side of maxillar M1/M2. Associated with infilled infundibulum in cusp above, F186 790-290.

Pig Little abnormality in 36 relatively complete mandibles. One 4th incisor indicated mechanical damage during life. One lower symphysis with spongy layer of bone produced, perhaps by infection, F518/1, Phase 5.

Sheep i) Absence of P2: 3/10; of MWS 39, 39 & 46, the latter mandible also lacking P3, the alveoli of these two teeth showing healing of the bone after tooth loss. The cause of the absent P2 in the other mandibles is not obvious.
ii) Periodontal disease: slight effects in 2/12 mandibles; at MWS 36 & 38.

Pelves:

Cattle Small pit in articulation surface of ilium, F186 770- 280.

Radius:

Sheep Lateral accumulation, 1-2 mm, of bone on prox. end below articulation surface, F535.

Ulna:

Pig i) slight outgrowth laterally and above elbow joint, F783.
ii) Slight outgrowth laterally beside elbow joint, in this case possibly from a healed fracture, F717.

Tibia:

Pig Accretion pad of bone on medial upper shaft, F115, Phase 4/2.

Cuneiform:

Cattle 1-2 mm. lateral outgrowth of bone. F518.

Metacarpal:

Cattle Slight distortion of anterior dis. end, F119 780-275.

Pig Unfused mc III, slight outgrowth of bone on prox. articulation.

Metatarsal:

Pig Mt IV, pad of bone swelling on distal shaft.

First Phalanx:

Cattle At least 4 affected slightly by probable mechanical stresses distorting shape of bone or producing slight outgrowths.

Third Phalanx:

Cattle Three phalanges affected similarly to the first phalanges above.

Pathology Notes: Birds

Metatarsus Domestic fowl. Bony outgrowth at proximal end, F535.

Pathological Bones Adult goose (see above, articulated bones).

Conclusions

Many of the effects described above for bird and mammal bones are abnormalities of little pathological significance and are related at most to minor injuries or to long term mechanical stress on the bones of old or working animals.

Butchery Notes

No systematic study was made, but some useful observations emerge:-

i) Dog Pelvis Showing an oblique chop through the ilium and ventral parallel cuts nearer the acetabulum These marks show that either dog meat was eaten or that dog carcasses were cut up and boiled or basted for other purposes, e.g. for fat. F20/23 i.e. either the courtyard F20, or Building A12 at Phase 4/2.

ii) Black Rat Ulna Knife cuts occur on the lateral and posterior midshaft and suggest at least the skinning, and possibly the cooking, of this animal. Floor layer F535, A12, Phase 4/2.

iii) Many small fragments of bird bones, possibly of goose, were found in clusters, e.g. F1009 in Building A1, and it was speculated that some of these bones may have been deliberately broken and boiled for fat. Alternatively, they may have been crushed by trampling.

iv) Enid Allison noted butchery marks on fowl bones. Significantly, these included cuts on the distal end of three tibiotarsi, F14, F763 & F977, and suggested that the aim of cutting was to remove the metatarsi and the feet from the rest of the carcass.

Further cuts were found on a distal humerus of fowl F600, and the proximal humerus and proximal metacarpus of goose in F1144.