

**Late Romano-British - early medieval  
socio-economic and cultural change:  
Analysis of the mammal and bird  
bone assemblages from the Roman  
city of *Viroconium Cornoviorum*,  
Shropshire: Volume 1: Text**

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## Abstract

The late Romano-British – early medieval transition remains a poorly understood phenomenon. The exact nature of the so-called cessation of Roman Britain is still contested, and the subsequent period is poorly understood because of historical misconceptions and a paucity of evidence. Various perspectives have been postulated to account for this transition, ranging from unsuccessful acculturation and discontinuity to concepts of Late Antiquity. Traditionally it has been assumed that some form of ‘systems collapse’ occurred, although its existence and severity remain largely unsubstantiated.

The analysis of artefact categories to elucidate this epoch has largely been unsuccessful for a variety of reasons (the period becomes largely aceramic, etc). Yet systematic zooarchaeological study of this period has not been attempted. Such an analysis would therefore be innovative and might provide hitherto unconsidered interpretations. The zooarchaeological study presented here has allowed a consideration of two important aspects common to most perspectives: the agrarian economy (agricultural production and distribution) and the cultural identity of the population (through the exploration of their gastronomic tastes).

The city of *Viroconium Cornoviorum* is ideal for conducting such a research project because it is one of very few sites with direct continuity of activity over this transitional period. It has been the object of extensive excavations, during which large finds assemblages were retrieved. Assessment determined that the baths basilica site was suitable in terms of size, content and chronological spread. It was characterised by Roman public buildings transformed into an early medieval private residence of an important individual.

Analysis of the vertebrate assemblage demonstrated that there was no downturn in the agrarian economy, animal husbandry or distribution networks between the 4<sup>th</sup> and 7<sup>th</sup> centuries AD. The composition of the assemblage throughout the period of activity adhered to the typical urban Romano-British diet (thus demonstrating their *Romanitas*). During the 6<sup>th</sup> – 7<sup>th</sup> centuries AD subtle changes occurred. Animal utilisation, butchery and discard practices were modified, and wild species were more actively exploited. A cultural rather than utilitarian explanation has been developed to account for these changes.

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# 1. Introduction and background

## 1.1. Introduction

The demise of the western Roman empire in the early 5<sup>th</sup> century AD had a profound effect on Britain, the aftermath of which remains largely obscure. It is not until the emergence of Anglo-Saxon England in the late 7<sup>th</sup> century AD that the historical and archaeological situation becomes clearer. The intervening period has subsequently become immortalised as the ‘Dark Ages’. This term is somewhat misleading and ‘early medieval’ may be substituted in its place. Traditionally the early medieval period is thought to have been a time of social upheaval with a systems collapse and fragmentation of the Roman infrastructure. More recent perspectives view early medieval Britain in a similar vein to continental Europe: the concept of ‘Late Antiquity’. Because of the paucity of reliable documentary and archaeological evidence the study of the early medieval period remains problematic. A zooarchaeological approach has yet to be attempted. Animal bone analysis has the advantage that it can be used to consider the agrarian economy and regional distribution networks, whereas many artefacts from this period are luxury imported items rather than everyday objects. Because of the rarity of large well-dated early medieval sites few suitable assemblages exist. *Viroconium Cornoviorum* is virtually the only site in Britain with extensive 1<sup>st</sup> – 7<sup>th</sup> century AD occupation that has been comprehensively excavated. The resultant assemblages are therefore ideally suited to exploring what actually occurred during the late Romano-British – early medieval transition. This thesis outlines the period in question, details the evidence from *Viroconium*, identifies the most pertinent questions, determines how zooarchaeological variables can be applied to their elucidation, displays the results of analysis, discusses them in relation to the site and period in question, makes conclusions based on the research questions and makes suggestions for future work (and the dissemination of this important dataset).

This chapter contextualises the *Viroconium* baths basilica vertebrate assemblage, the analysis of which forms the basis of this thesis. It also provides the necessary background information to the research aims. Analysis of the vertebrate assemblage was used to gain an understanding of the following (see Chapter 2):

- the ‘nature’ of *Viroconium* as a settlement
- the ‘economic geography’ of *Viroconium* and its hinterland
- the ‘cultural identity’ of *Viroconium*’s population

It is important to remember that ‘specialist’ archaeological analyses cannot, and should not, take place in isolation without considering their historical setting, etc. The topographical and geographical setting of *Viroconium* is initially considered. Next the historiography of *Viroconium* is considered because it has culminated in the present interpretation of the site, especially the baths basilica and is therefore significant. The archaeological evidence from the baths basilica, combined with its interpretation and dating, is discussed in some detail as it is the foundation of this study. Understanding the northern Marches region in the later prehistoric, Roman and early medieval periods is central to the formation of research objectives (see Chapter 2) and the interpretation of the resultant dataset (see Chapters 6-12). The wider archaeological and historical setting is summarised for this very reason. Finally, models and perspectives pertaining to this poorly understood epoch are outlined to help place the baths basilica into its national setting (see Chapter 12).

## 1.2. Topography and geography

*Viroconium* lies at the centre of Shropshire (Figure 1). It is situated on a major crossing point of the River Severn (forming the western terminus of Watling Street). Although the modern county of Shropshire is not totally synonymous with the hinterland of *Viroconium* the development of the former is fundamentally linked to the latter. Outlining the topography and geography of Shropshire is therefore useful when placing *Viroconium* into its environs (and crucial when considering the pastoral economy). Rowley (1972: 21-25) has divided Shropshire into seven different regions (Figure 2):

**North-west uplands:** An area of undulating trias, blanketed with glacial drift, and areas of mere and peat bog. The surface of the plain is broken only by the upstanding sandstone ridges of Nesscliffe, Pim Hill, Grinshill and Hawkstone. This landscape is largely a product of post 17<sup>th</sup> century AD drainage. It is agriculturally prosperous.

**Northern plain:** This area lies just west of Oswestry and where the Denbighshire hills come into Shropshire. This area is largely 'Welsh' in character. Pastoral farming and limestone quarrying predominate. Woodland clearance was not completed until the 17<sup>th</sup> century AD.

**Shropshire coalfield:** The Shropshire coalfield is just beyond the Wrekin. This area is the only extensive industrial landscape in Shropshire. Coalfields stretch from Lilleshall (in the north-east) to Coalbrookdale and Brosely (in the south-west) to Wrockwardine (in the west) and Oakengates (in the east).

**Eastern sandstone plain:** This area lies beyond the Severn 'rich' where sandstone countryside predominates. This area was originally part of Worcestershire and is located on the ancient Morfe Forest.

**Shropshire uplands:** The Shropshire uplands can be divided into two distinct areas. The 'highland areas' are based on the ancient pre-Cambrian rocks of south central Shropshire, which run south-west to north-east. This includes the Long Mountain, Stapeley, Stiperstones, the Long Mynd and the Stretton Hills. The 'Shropshire uplands' is a more varied area, with heath, moor-land and mountain pasture, but with rich fertile valley bottoms. It is characterised by small sandstone and limestone escarpments, such as Wenlock Edge and Hoar Edge. Mixed agriculture dominates the 'Shropshire uplands'.

**Southern hills:** An isolated area based on the 'high-reared' Cleve Hills. The basalt-capped hills are the highest in the county reaching 548m. Cleobury Mortimer and the Wyre Forest in the south 'belong' more to Worcestershire than Shropshire.

**Clun forest:** A more mountainous area than the southern hills and is still partly 'Welsh'. It is completely rural in character.

Using this nomenclature for the region, *Viroconium* lies on the western-most edge of the 'Shropshire coalfield'.

## 1.3. Historiography of *Viroconium*

As previously noted, *Viroconium* is virtually unique in that continuous 1<sup>st</sup> – 7<sup>th</sup> century AD activity at the site has been identified. Unlike other Romano-British cities *Viroconium* has not subsequently developed into an urban centre, so most of the archaeology remains intact; it is essentially a 'green-field' site. It is therefore a very valuable resource, a fact that was recognised when the government purchased most of the area within the ramparts in the 1970's (which is now administered by English Heritage). The remainder



is owned by the National Trust. White & Barker (1998: 31) have described *Viroconium* as the ‘... largest archaeological laboratory in the world’. For these reasons *Viroconium* has a long history of antiquarian and archaeological excavation (see White & Barker 1998: 12-31). Major excavations include the following:

- Thomas Wright 1859 excavation centred on the ‘Old Work’
- George Fox 1894 & 1896 a small excavation of the baths
- J P Bushe-Fox 1912-3 an area adjacent to the baths
- Donald Atkinson 1923 the forum
- Kathleen Kenyon 1936-7 the baths and baths basilica
- Graham Webster 1955-66 the baths, *macellum* and *palaesta*
- Philip Barker 1966-90 the baths basilica
- Simon Esmonde-Cleary 1991-2 the city defences

*Viroconium* has also been subject to various aerial photographic surveys from the 1950’s onwards, principally the work of Arnold Baker, Jim Pickering and Chris Musson (see White & Barker 1998; Whimster 1989). Until the advent of geophysical survey these were responsible for our understanding of the city’s layout. The 1990’s saw a barrage of different geophysical techniques employed at the site (see Gaffney & Gaffney 2000). A large scale survey of the city and its environs was undertaken as part of the ‘Wroxeter Hinterland Project’ (WHP) (Gaffney *et al.* 2000). The WHP was followed up by the ‘Wroxeter Hinterlands Survey’ (WHS), which expanded upon the original project design. They included a multi-disciplinary approach, using excavation, field-walking, geophysical survey and topographical survey to complement one another. A 70km<sup>2</sup> area of the surrounding landscape was sampled in this manner. A highlight of the WHP was an extensive gradiometry survey covering the entire walled area of the city. White & Barker (1998: 31) stated that as a result of this survey, ‘... the accepted picture of *Wroxeter* as an under-populated city, or even as a failure, is certainly incorrect’. Both the WHP and WHS will shortly be published together (Gaffney *et al.* forthcoming) and have greatly enhanced our understanding of *Viroconium* and surrounding area (see below).

## **1.4. *Viroconium*’s baths basilica**

As previously stipulated, the vertebrate assemblage deriving from the excavations at the baths basilica form the basis of this thesis, it is therefore necessary to outline the nature of the evidence and its interpretation (plus dating). The archaeological evidence from *Viroconium*’s baths basilica complex is extraordinary. The following outlines its structural history, chronology and phasing, and interpretation.

### **1.4.1. Structural history**

The following has been summarised from Barker *et al.* (1997: 224-238) and provides a brief description of the changing nature of the site. Figures 3-7 outline plans of the structural phases.

#### **Phases T-V:**

These phases characterise repairs to the basilican structure, although there was little active maintenance in the first 100 – 150 years of the building’s life. Maintaining the baths basilica would have been the responsibility of the *curiales*. Subsidence of the floor became a problem and a programme of repairs, albeit on a pragmatic approach, occurred between the late 3<sup>rd</sup> and early 4th century AD, coinciding with the re-establishment of Imperial control after the Carausian episode. In the north aisle, a large rectangular pit was cut into the *opus signinum* and possibility represented a semi-permanent stall. The south room in

the annexe featured a series of interconnected pits and gullies 'associated with a small wattle storage bunker'.

#### **Phase W:**

There were three major re-floorings and numerous repairs during this phase, a different attitude compared to Phase T-V. Floors consisted of 'unlovely' beaten earth or mortar on crushed sandstone. The structure was still roofed and publicly used: it was kept clear of surface rubbish and there was an 'astonishing' degree of wear on the successive floors. Many people would have been entering the *frigidarium*, but around AD 300 the doors to the *tepidarium* and *caldarium* were blocked, which suggests the two flanking *sudatoria* were still in use.

At the end of the 4<sup>th</sup> century AD the *insula's* drainage and water-supply were overhauled. A water pipe north of the stone gutter was removed and replaced, plus two thirds of the stone gutter was replaced by a timber-box drain. Maintenance led to the annexe being completely put over to industrial use, the roof was removed, a door knocked through and the north room floor levelled and two open fronted lean-to structures erected (Buildings 59 and 60). Industrial use of the annexe was characterised by a charcoal filled pit, small casting pits outside, mixed mortar, and deposits of *opus signinum*, *tesserae* and tile chippings.

#### **Phase X:**

This phase saw the gradual decline of the area. A series of light weight wattle walled structures (Buildings 54 – 56) were erected, located in the eastern end. Building 54 was probably used for metal working. Slaked lime was spread out in the annexe and a hearth built in the southern doorway. The Phase W lean-to structures were demolished and doors knocked through the northern room walls (access to Buildings 57 and 58). East of the *frigidarium* doorway, the floor was quarried away (probably to maintain smaller bath suites to the south of the basilica). The basilican roof may have survived, albeit in a dangerous state (evidenced by the lack of weathering on floor surfaces). The north portico floor was restored by building a wooden board-walk over the damaged pebble originals. The access to the basilica shell from the boardwalk was limited by location of Buildings 57 & 58. The west portico roof was dismantled. Buildings 63 and 64 were erected either side of the western door. Access to the baths was limited to the external *palaestra*. At some point the main baths were sealed off while the two smaller subsidiary baths remained in use.

#### **Phase Y:**

Buildings at the eastern end of the basilica were demolished, plus much of the basilica (the roof, clerestory, gables and possibly the colonnades). There was a fundamental change in use. The floor was covered by layers of dumped soil that were capped with roof slates. The porticos were also cleared of buildings and abandoned. The basilica wall was lowered, and the space seems to have come back into public use. No structures were located, but worn surfaces indicated considerable use. This included the latrine entrances and suggested some public facilities were still in operation. Access to the area was limited as the larger doorways had been blocked. One permanent stone structure was erected in the south aisle.

Areas peripheral to the baths basilica also underwent considerable change. The area between the north – south street and the precinct wall was sealed with dumped earth and became the focus of industrial

activity. A series of deep rectangular pits connected by gullies were cut into the soil. There was also a large furnace associated with Building 1. At the eastern end of *insula* 2 a furnace of mid 4th century AD date was also sealed by dumped soil. Another 'extensive' pit and gully system was cut into this. The larger features appeared to have been soakaways and were lined with roof slates. Several smaller features were clay-lined and might have been settling tanks. The area was then levelled and Building 36 erected. It consisted of large square pits filled with alternating layers of clay and cobbles (containing sherds of 7<sup>th</sup> century AD Palestinian *amphorae*). These were the footings for a substantial structure.

The basilican shell now underwent a radical change. Most of the northern wall was carefully removed (a 6m high, 60m long section). The adjacent east – west street was quarried away. It was quarried to a depth of 1m, the spoil sieved to retrieve the cobbles and to grade material. It was then backfilled with finer material and organic material (making wheeled transport impossible). The remains of the north portico were subject to intensive industrial activity. A large number of hearths, constructed of ceramic or stone roof tiles and containing carbonised grain and quern fragments, were present.

### **Phase Z:**

A series of rubble platforms were laid out for timber buildings during this phase. All conformed to Roman units of measurement (*pM* = *pes Monetalis*) and were orientated with the baths basilica. It appeared to be a preconceived development. Structural evidence was limited to postholes and beam slots (with the exception of one stone structure; see below), which demarcated their layouts. At least 36 timber-framed buildings were identified. Numerous other wattle and daub structures also existed. The largest platform (Building 10), measuring 114*pM* x 53*pM*, occupied a large portion of the baths basilica. It included two large pad-stones sited on the central doorway in the basilica south wall, a rectangular platform consisted of freshly-broken rubble packed with wall plaster and mortar (probably from the baths), two areas protruding in the south-west and south-east corners (projecting wings) and a planked verandah joining them. The lack of internal structures was indicative of timber-framing. Analogous villa buildings suggest it was probably two stories high.

The former south aisle featured seven platforms (each around 28*pM* x 8*pM*), a gap for the southern central doorway, six structures (Buildings 17 – 21, 27 and 28) and another gap for the main entrance to the *frigidarium*. To the north of these platforms on the south aisle were two additional platforms. To the west was the platform for Building 11 with the remains of a low wall as the remainder consisted of postholes and beam slots, it may have been open sided, like a *loggia*. East of Building 10 was the only masonry building (Building 31) constructed against the east wall of the basilica. Its walls were of freshly quarried sandstone bonded with mortar. Most of the entrances to the basilican area were blocked or had structures constructed against them. A fenced path also dictated movement across the area.

Outside the basilica numerous other buildings were constructed. Three sub-phases of buildings were located on the west portico (Buildings 14, 25, 29, 32 – 34 and 37 – 39). Another group of buildings were constructed on the southern side of the east – west street (Buildings 12 and 40 – 44), which was a secondary development after it was used for pedestrian traffic. The northern side was covered with planking to form a boardwalk. The precinct of the baths contained four separate buildings (Buildings 6, 23, 24 and 68). Some were lean-to structures erected against the north precinct wall. One of the free-standing structures featured a large porch. These buildings were associated with gravel paths, fence lines and rubbish pits (in the south room of the annexe). Outside the precinct, the eastern edge of *insula* 5 was

likely grassed over and featured one deep timber-lined pit, probably a cistern. The southern frontage of *insula 2* contained several sub-phases. Initially it contained a row of seven buildings (Buildings 45 – 51). Another building to the east had an elaborate porch (Building 35). Most of them conformed to 20pM. These were replaced by five buildings (Buildings 7 – 9, 13 and 15), three of which also had elaborate porches set on pad-stones.

### **1.4.2. Interpretation**

The following section outlines the interpretation of the archaeological evidence.

#### **Phase T-V: Repairs and modifications:**

This phase mostly represents repairs and modifications to the basilican structure while it was still in public use and requires little further explanation. Changes to the south room of the annexe possibly represent cultural changes (which social or gender groups had access to the baths). Alternatively, the industrial aspect might suggest the south room of the annexe never played a part in the ritual of going to the baths.

#### **Phase W: The last re-flooring:**

The successive floors each became heavily worn in turn. It is difficult to estimate numbers of people or duration of time, but using the analogy of the temple precinct at Bath (Cunliffe & Davenport 1985: 74-75) it represented many years. This phase coincided with large-scale changes to the administration of the empire, which ultimately dictated how the baths basilica was treated. The reason for closing-off an unsafe area may have been because the *curator rei publicae* (responsible for municipal finance) was unwilling to shoulder the burden of maintaining the structure. This was exacerbated by Imperial government placing greater financial burdens on individual *curiales*: Constantine and Constantius II seized local revenue for state use. A series of laws passed between AD 374 – 395 stipulated that one-third of tax revenue was to be redirected to the towns. This was on the condition that it be used to maintain public buildings and to heating the baths. It is thought that these laws resulted in the re-vamped drainage system and complete closure of the annexe at *Viroconium*. Presumably the annexe was a workshop for maintaining the baths themselves.

#### **Phase X: The building yard:**

Industrial use of the annexe appears to have declined during this phase and was transferred into the baths basilica itself. This would imply that attempts at maintaining the basilica ended and that it fell out of public use with access being restricted. Only porticos appear to have maintained any public function. As with the annexe in the previous phase, this activity was presumably aimed at keeping the baths operational and requires little further explanation.

#### **Phase Y: Dismantling and the market:**

The basilica walls were probably lowered and the roof dismantled. The basilican area seems to have come back into public use. There was little evidence of any structural activity within the internal area of the baths. However, the paths and worn surfaces, especially around the latrine entrances, demonstrated that large numbers of people were using the area. Barker *et al.* (1997: 230) concluded, ‘... *there was still an authority in control and concerned to keep the building safe and useable, even if only as an open space.*’ It had possibly become an open market: the forum was in all likelihood deserted at this point. It has also been suggested that the one permanent structure located in the south aisle of the baths basilica

was ‘... a municipal office or even a tax collection point’ (Barker *et al.* 1997: 230). A system of taxation in kind (*annona*) was now operating across the empire (see Jones 1964: 448-462) and Esmonde-Cleary (1989: 9-10) has suggested such a system would have significantly boosted the local production of goods.

### **Phase Z: The ‘great rebuilding’:**

By the late 4<sup>th</sup> century AD, the Roman state was legitimising the disposal of public buildings to private citizens (see Jones 1964: 733). Barker *et al.* (1997: 231) concluded that this situation also transpired at the baths basilica, despite *Viroconium* being beyond imperial control. This individual halted the gradual decline of the basilican area by remodelling the site in a ‘radical’ new fashion. The authority in overall control changed a public space into a private space, as suggest by the plan of Building 10 and the restricted access to the basilican area. The west door was blocked by three separate structures (Buildings 29, 34 and 38) and one of the south doors was completely blocked by Building 21, for instance. The grandiose Building 10 was reminiscent of British ‘winged-corridor’ villas (see Hingley 1989: 47-51, Figure 21) and more continental ‘tower –façade’ villas (see Wilkes 1986: 63-66). The latter were very popular in the late empire and only a few English examples exist, Littlecote, Wiltshire, for example.

Redevelopment of the site was a massive undertaking that ‘... was far more than ... the construction of a private demesne by a single individual’ (Barker *et al.* 1997: 234). The frontages of the buildings on *insula* 2 suggest domestic dwelling, unlike those surrounding Building 10 in the shell of the basilica. These were constructed on predetermined plots of land, but with slightly different architectural styles. This might suggest individual ownership and their styles hint at high status dwellings for an ‘elite or high status artisans’ (Barker *et al.* 1997: 235).

The *frigidarium* may have been in use in Phase Z (although possible evidence has been truncated away). Its survival (the ‘Old works’) may indicate a use that afforded it protection in the early medieval period. Its east – west alignment and vaulted roof would have been ideal for a church. The western plunge pool could have been used as a font. The surrounding hypocausts included 12 inhumations. British parallels for this exist and include St Paul-in-the-Bail, Lincoln (Jones 1993: 25-27) and Jewry Wall, Leicester (Kenyon 1948: 8). Alternatively, it may have been a granary because it was ‘full of burnt wheat’ (Wright 1872: 121). The date of this is uncertain, but might represent a tax collection point. The former baths service area featured a complex series of buildings that may have been agricultural or industrial in character. They might also have been storage facilities for the *annona*.

The person responsible for the reorganisation of central *Viroconium* was someone brought up ‘... in a late Roman cultural tradition ...’ (Barker *et al.* 1997: 237) who employed a trained architect/surveyor working *in more Romanorum*. Barker *et al.* (1997: 237) suggested two possibilities to account for this individual, the first is,

‘... existing civil government, with an emerging magnate drawn either from the members of the *ordo*, or possibly even the curator of the town or one of his family; the second is the church.’

The former would fit Gildas’ description in *De Excidio Britanniae* of a class of *tyranni* or Christian sub-kings. By the early 6<sup>th</sup> century AD they ruled well-established kingdoms, especially in the west (Pretty 1989: 174-175). Vortigern, a *tyrannus superbus* linked to Powys in the early 5<sup>th</sup> century AD, or figures claiming decurial lineage, such as St Patrick’s father or the family of Ambrosius Aurelianus, may have served as,

*'... a model for late Roman, Christian magnate taking over the government of an established territory after the collapse of centralised provincial Roman government in Britain.'* (Barker *et al.* 1997: 237)

Alternatively, *Viroconium* may have formed the centre of a Roman diocese with an Episcopal villa at its heart. The village of Wroxeter had an important early Anglo-Saxon church and minster that possibly had links back to a small post-Roman 'celtic' church (Bassett 1992a & 1992b: 35-39). Barker *et al.* (1997: 238) concluded,

*'... whether a sub-king, ruling magistrate, or bishop occupied the shell of the basilica there is little doubt that here is the archaeological witness to an historical process hitherto unattested: the establishment of private magnates at the end of provincial government.'*

### **1.4.3. Phasing and dating**

Phases of activity at the baths basilica have been allocated chronological ages based on a number of different methods and criteria. Numismatic evidence has been combined with ceramic and metal artefact typologies. These were complemented with numerous radiocarbon date determinations. Finally more subjective factors were taken into account, such as the longevity of particular events and probable life-spans of timber-framed structures, for instance. Together these sources have provided a broad chronological framework in which events at the baths basilica can be placed. Due to the nature of the site and the less than precise dating techniques, the chronological dates provided for individual phases generally overlap. These dates should be taken as *terminus-ante-quem* and *terminus-post-quem* markers, rather than representing absolute periods of activity.

The following date ranges have been summarised from Barker *et al.* (1997: 240-241):

- |             |                            |   |
|-------------|----------------------------|---|
| • Phase T-V | repairs and modifications  | late 3 <sup>rd</sup> – 4 <sup>th</sup> century AD       |
| • Phase W   | the last re-flooring       | late 4 <sup>th</sup> – mid 5 <sup>th</sup> century AD   |
| • Phase X   | the building yard          | late 5 <sup>th</sup> – mid 6 <sup>th</sup> century AD   |
| • Phase Y   | dismantling and the market | early 6 <sup>th</sup> – late 6 <sup>th</sup> century AD |
| • Phase Z   | the great rebuilding       | early 6 <sup>th</sup> – late 7 <sup>th</sup> century AD |

## **1.5. Northern Marches: Later prehistoric – early Romano-British situation**

Matthews (1999: 173) stated, '*Few would now contest that understanding the Iron Age is ... vital to a full understanding of the Roman period and beyond*'. Therefore, if the late Romano-British and early medieval socio-political and economic situation at *Viroconium* is to be understood it is necessary to consider what is known of the local pre-Roman Iron Age tribal group, the Cornovii. As with all indigenous tribal groupings within Britain prior to the Roman conquest the known history of the Cornovii is extremely limited. The information and sources that do exist are problematic for a variety of reasons: for example, the miscomprehension of tribal groupings (cultural affiliations and geographical ranges, etc) by classical authors and the underlying political machinations that motivated them (see Gwinup & Dickinson 1973). Webster (1991: 6) concluded that the Cornovii are difficult to identify archaeologically because unlike some other groups in pre-Roman Iron Age Britain they had no coinage and no distinctive forms of pottery (see below). Most of the 'known facts' are pure conjecture based on assumptions, semi-contemporaneous literature of varying credence and analogies drawn from north-western Europe.

### **1.5.1 Geographical range**

Webster (1991: 6) suggested that the Cornovii formed part of a larger grouping, the 'Western Marches hillfort culture', which was based on a regional pottery style centred in the Malverns. The Cornovii would have formed the northern most facet of this grouping, based on watersheds and hillfort distribution (see below).

Based on this, the area inhabited by the Cornovii may well have extended beyond the confines of modern Shropshire towards the west and north, whilst on the eastern and southern margins it had approximately the same demarcation. However, if the supposed territories of neighbouring tribes are considered (the Brigantes to the north, the Coritani to the east and the Dobunni to the south) then Cornovian territory conceivably extended into Cheshire, Staffordshire, Herefordshire and Worcestershire (Figure 8). This is supported by the fact that *civitates* have yet to be identified in these areas, although it must be remembered that the Romans were quite adept at simplifying tribal divisions for their own administrative purposes (Webster 1991: 21-22).

This view has largely persisted, although the territory has now been extended even further to the north. White & Barker (1998: 32) consider Cornovian territory to have encompassed not only the whole of modern Shropshire, but also more importantly the entirety of Cheshire (Figure 9). They suggested this area had '*... a coherent geographical unity ...*' and that the Mersey formed a natural border with the Brigantes to the north. Consequently, the Wirral would have been included within Cornovian territory and potentially this projecting piece of land may have provided the 'horn' (*Cornu-*) element to the tribal name (White & Barker 1998: 32).

Perhaps the most significant aspect of this suggestion is that it provides the Cornovii with direct access to the sea, rather than via the Severn (through the territory of the Dobunni), and places Meols within their sphere of control. Meols has not only produced early medieval material, but also two silver coins belonging to the Coriosolites (Chitty & Warhurst 1977; Matthews 1999: 182), an Iron Age tribe based on the Armorican peninsula (modern Brittany), and also earlier Carthaginian coins. This has led several researchers (Matthews 1999: 187; White & Barker 1998: 32-34) to suggest that the site represents an emporium, similar to Hengistbury Head in Dorset, although the primary reason for the Coriosolites to trade with the Cornovii remains unclear because of the Cornovii's supposed lack of material wealth (see below).

### **1.5.2. Material culture**

The Cornovii have been considered as a comparatively poor tribe socially and materially (White & Barker 1998: 35; Rowley 1972: 40; Webster 1991: 12). This premise has led to views such as that '*... they {the hillforts and farmsteads} do not offer evidence of anything more than a poor backward, rural community*' (Webster 1991: 14). Such viewpoints have almost entirely been based upon the minimal volume of material culture retrieved from Cornovian territory and the absence of a distinctive regional style. More recently the perception that material culture and goods are the sole delimitating factors in the ascription of socio-economic prosperity have been widely questioned (Arnold & Davies 2000: 67; Matthews 1999: 189-190; White & Barker 1998: 35). Two studies in particular have offered alternative perspectives on the organisation of pre-Roman Iron Age society in the northern and central Marches: Matthews' (1999)

consideration of the Irish Sea trade route and Jackson's (1999) re-evaluation of hillfort size and distribution (see below).

If one accepts White & Barker's (1998: 32) supposition that Cornovian territory extended as far north as the Wirral then salt production becomes a major component in their economic base (something not considered by earlier researchers). The Cornovii would consequently control three of the four inland brine springs in Britain: Middlewich, Nantwich and Northwich (White & Barker 1998: 34). Both Matthews (1999: 178-181) and White & Barker (1998: 34) refer directly to the work of Morris (1985) on 'Very Coarse Pottery' (VCP) salt containers. In the middle Iron Age VCP from the three sites was centred in the heart of Cornovian territory, while VCP from their sole competitor, Droitwich (in Dobuunian territory), dominated the lower Severn and southern Shropshire. This situation had changed by the late Iron Age with Cornovian VCP dominating the entire region, including Dobunni territory. White & Barker (1998: 34) concluded that this represented a more successful marketing of the product, whereas Matthews (1999: 178-181) has warned against aggressive market led interpretations and proposes that the distribution is simply a reflection of increased coastal and riverine transport.

Matthews (1999: 190-192) and White & Barker (1998: 35) ultimately considered prestige and status to be expressed in terms of patronage and stock control, i.e. 'wealth-on-the-hoof', rather than through conspicuous consumption. Salt production will have been fundamentally linked to the other great Cornovian economic mainstay, pastoral agriculture. Preserving meat using salt would have been crucial both pre- and post-conquest (and into the early medieval period).

### **1.5.3. Settlement patterns**

The last decade or so has seen a radical revision of Cornovian settlement patterns, especially for the pre-Roman Iron Age period. This has obvious implications regarding 'economic geography' of the region (see Chapter 2). Stanford (1980: 83 & 85-86) considered hillforts throughout the Marches to have been the principle form of settlement up to the Roman advance into the area during the mid 1<sup>st</sup> century AD, citing the presence of the four-post structures as evidence of habitation and the virtual absence of non-hillfort sites. Even contemporary researchers, however, questioned this interpretation. Guilbert (1981: 112) considered four-post structures more likely to represent grain storage structures and this is now the accepted interpretation.

Whimster's (1989) re-evaluation of the aerial photographic evidence from the Marches has made Stanford's (1980) initial standpoint completely untenable. Whimster (1989: 4) considered a zone 50km by 60km covering an area east from Newton to Wroxeter and north from Knighton to Oswestry; approximately one-third falls into Clwyd and Powys, and the remainder falls into Shropshire and the northern extremities of Herefordshire and Worcestershire. Whimster (1989: 64) concluded that the 114 previously recorded hillforts and enclosures presented '*... a seriously unbalanced picture of native settlement during the first millennium BC and the Romano-British period ...*' and the majority of the new discoveries represented Iron Age and Romano-British farmsteads, which reflected '*... the evolution of a complex system of upland and lowland agricultural settlement*'. The limited number of villas within the immediate vicinity of *Viroconium* has also led many researchers to conclude that the Cornovii were materially and culturally poor with an agriculturally undeveloped hinterland (see below). This assumption has long been questioned, for example Webster (1991: 93). The WHP and WHS have now



demonstrated a densely settled (albeit un-Romanised) hinterland with a well-structured agricultural base, i.e. field systems and track-ways (Buteux *et al.* 2000: 73; Gaffney *et al.* forthcoming).

The farmstead at Duncote Farm (2km north of *Viroconium*) demonstrates what effect the coming of Rome had on the indigenous field system. The excavation demonstrated five phases of activity: progressing from an irregular series of ditches in the late Iron Age, to a 'chequerboard' of fields conforming to the Roman acre (early 2<sup>nd</sup> century AD) and finally to enclosure more reminiscent of industrial activity. A possible explanation is that a veteran took over the farmstead in the 2<sup>nd</sup> century AD, as it lay within *Viroconium's territorium* (White & Barker 1998: 66-67).

Although the bulk of the indigenous Cornovian population remained in the rural areas the development of *Viroconium* caused settlement patterns and distributions to alter. The majority of enclosed farmsteads in the Upper Severn valley with a rectilinear plan cluster around *Viroconium* and are presumably contemporaneous. This may reflect an intensification of agricultural production to meet the requirements of a growing population (White & Barker 1998: 68). Arnold & Davies (2000: 40) state that the climatic optimum occurring at the time would have also created conditions favourable to increased production and denser settlement patterns.

#### **1.5.4. Agricultural base**

Our knowledge of the agricultural economy in Cornovian territory is largely dependent on the recognition and interpretation of settlement patterns and field systems and as the previous section outlined, our understanding of the pre-Roman Iron Age and the Romano-British Cornovian countryside has radically altered in recent years. The topography and geology of the region to a great extent dictated the nature of the agriculture (see above). Upland areas were perhaps utilised for pastoral farming while the valley bottoms were more suitable for arable cultivation. Farmsteads generally cluster in the valley bottoms, especially on the well-drained soils of the Severn and its tributaries (Webster 1991: 90-92; Whimster 1989: 58, Figure 36). Some form of transhumance may have been practiced, as it certainly was in later periods (Stamper 1989b: 54 & 64).

The Cornovii in the pre-conquest period were either materially poor, or chose more abstract concepts to demonstrate wealth and status within society (see above). This led White & Barker (1998: 34) to question why traders from the continent chose to trade with the Cornovii at Meoles, and concluded pastoral agricultural produce must have been the reason: wealth was measured in terms of 'heads' of stock. Webster (1991: 93) also considered agriculture to be the main source of Cornovian wealth. Cattle seem to have been the mainstay of the pastoral regime, regardless of the topographical constraints in some areas, in pre-Roman Cornovian society to the present (see Baugh 1989). Rowley (1972: 34) interpreted the field systems around the Long Mynd as evidence for 'prehistoric cattle ranching'. It has even been suggested that cattle rearing and trading were ultimately the reason for *Viroconium's* later success, much like Oswestry's in the medieval and post-medieval periods (Stamper 1989a: 24 & 1989b: 56-57). This successful trade culminated with the 19<sup>th</sup> century AD Welsh cattle droves (see Colyer 1976; Hughes 1988).

Many authors cite the presence of the Roman army as having a profound impact on the agricultural base of the Cornovii (see Arnold & Davies 2000: 91; White & Barker 1998: 46 & 51-52). Even though agricultural surpluses existed within pre-Roman Cornovian society the arrival of the Roman army would

have provided an impetus to produce an even greater surplus, brought technological innovations and different agricultural management strategies. Arnold & Davies (2000: 44-45) suggested that a consistent ability by the local tribe to produce an agricultural surplus was a necessary pre-requisite before the establishment of *civitates*. Conversely, most authors (see Arnold & Davies 2000: 65; Stamper 1989: 24-25; Webster 1991: 94-96; White & Barker 1998: 68) also agree that despite increased production, the Cornovii remained un-Romanised. They demonstrated very few outward and conspicuous elements, such as architectural innovations and alterations in material culture. Nucleation of settlement around *Viroconium* was one of the few indications of change in the agricultural base.

Shropshire, and in particular towns such as Ludlow and Shrewsbury, have a long-standing association with leather and cloth production (Randall 1908: 428-433). This industry would appear to have its origins in antiquity. Spindle-whorl production and tanning or fulling pits having been found at 'numerous sites' at *Viroconium* (White & Barker 1998: 56). By-products of the beef trade would have been of considerable importance.

### **1.5.5. Attitudes towards Rome**

When considering how long Romano-British attitudes and lifestyles persisted at *Viroconium* it is necessary to assess to what extent the Cornovii were Romanised in the first instance. Webster (1991: 18) suggested that the average Cornovian may have welcomed the appearance of the legions in the 1<sup>st</sup> century AD, as a formalised system of law and taxation would replace '*... the whim of a local tyrant who took what he fancied*'. Such a viewpoint is rather fanciful and has little basis in fact. A more reasonable supposition would be that the advance of Rome would have certainly bought the Cornovii the prospect of entering into commerce, initially with the military garrison and later the civilian settlement at *Viroconium* (Webster 1991: 31). This commerce would have been predominantly in agricultural produce (White & Barker 1998: 51-52). Not everyone within Cornovian society would have benefited from such opportunities (White & Barker 1998: 52) and the perceived lack of Romanisation within the countryside may be a manifestation of this (Webster 1991: 56-57 & 94).

Stanford (1980: 140) suggested that the majority of hillforts fell into disuse either immediately prior to or as the Roman forces advanced, Eddisbury, Maiden Castle, Moel y Gaer, Old Oswestry, Ebury and the Wrekin, for example. The Wrekin suffered a fire at this point, which Stanford (1980: 140) interpreted as the forcible evacuation (or at least the cessation of activity) of the hillfort. The chance find of a *pilum* in 1990 at the Wrekin goes some way in supporting this (Webster 1991: 12); White & Barker (1998: 38) state two that have been found. This would suggest that the Cornovii did not initially submit willingly to their subjugation by Rome, although White & Barker (1998: 32) suggested the Cornovii submitted immediately.

A group of marching camps/forts situated close to the Wrekin may denote the need for a military presence to quell trouble (Webster 1991: 28): Cound Hall, Wroxeter I and II, Leighton, Attingham Park and Norton I and II (Arnold & Davies 2000: 6). However, Arnold & Davies (2000: 4) have suggested this group represents a staging post in an already secure area to conduct offensive operations from Scapula's campaign against Caratacus and the Silures in AD 78, for instance.

The roadside settlement at Meole Brace (6km west of *Viroconium*) has been interpreted as a market for those not wishing to travel onto *Viroconium*. The site produced high frequencies of amphorae, storage

jars and weights that suggest commerce. Little of this material appears to have found its way onto the adjacent farmsteads. White & Barker (1998: 65) suggested this may be ‘... a reflection of the continued resistance of the Cornovii to consumer goods {i.e. Romanisation}, a trait traceable within the Iron Age’.

Stanford (1980: 154) quotes Richmond’s (1963) view that *Viroconium*’s militia became a regular army unit (*Cohors I Cornoviorum*) in honour of the long-standing necessity to defend themselves against attack from Wales. *Cohors I Cornoviorum* was the only indigenous unit to be stationed within Britain (at Newcastle on Hadrian’s Wall) during the 4<sup>th</sup> century AD, as recorded by the *Notitia Dignitatum* (White & Barker 1998: 103). This may signify the degree to which the Cornovii had been successfully Romanised and were trusted by the authorities after the initial ‘trouble’.

Overall, Cornovian attitudes towards Rome seem slightly contradictory. It is evident that the upper echelons of Cornovian society certainly adopted Romanised institutions and lifestyles fairly quickly. They did not become embroiled in the unrest fostered by some other tribes after the initial conquest. Perhaps the legacy of the Cornovian elite’s willingness and enthusiasm to embrace Rome can be seen in the scenario put forward for the region and *Viroconium* in the early medieval period.

## 1.6. Northern Marches: Late Romano-British – early medieval situation

*‘The dark Ages are nowhere darker than in Shropshire.’* (Rowley 1972: 42)

As the above quote suggests, the history of the Cornovii (their Romano-British descendants to be more precise) is typically obscure in the immediate sub-Roman period. It remains enigmatic into the early medieval period when other regions of Britain start to leave the ‘Dark Ages’ behind (Gelling 1992: 28; Rowley 1972: 42). This period is also difficult to detect archaeologically in the Marches region (Rowley 2: 46; Whimster 1989).

In the early medieval period many hillforts in the western part of Britain were re-occupied: Cadbury Congresbury, Somerset (Rahtz *et al.* 1992), Coygan Camp, Carmarthenshire (Wainwright 1962), Dinas Powys, Glamorgan (Alcock 1963), High Peak, Devon (Pollard 1966) and South Cadbury, Somerset (Alcock 1982). This has generally been interpreted as a response to the breakdown of Romanised society and the increased need for defence against Germanic folk movements (see Burrow 1981: 5-6; Edwards & Lane 1988; Fowler 1971: 211-212; Hooke & Burnell 1995; Jones 1984: 65). It is also thought to have been accompanied by elites re-establishing traditional tribal organisation and social structures (White & Barker 1998: 132), tribute rather than moneyed taxation, for instance. In the early medieval period, the Wrekin hillfort (approximately 6km east of *Viroconium*) was not re-occupied and post-Roman activity at the baths basilica may have fulfilled a similar function (see above).

The former territory of the Cornovii at this juncture (7<sup>th</sup> century AD) was surrounded by newly developing ‘Welsh’ kingdoms to the west. Increasingly, the Anglo-Saxon kingdoms were also encroaching from the north, east and south-east. Gwynedd occupied all of north-west Wales, while Powys to the south encompasses what had been Ordovician and Deceanglian territory (White & Barker 1998: 132). Powys initially extended eastwards to include much of what had been Cornovian territory and Powys actually consisted of a loose confederacy of minor rulers. White & Barker (1998: 132) suggested ‘... that Wroxeter and Chester were within this confederation whilst still retaining their status

as quasi-autonomous units along with their immediate territory'. Figure 10 outlines the possible extent of the early medieval territory centred on *Viroconium*.

This would have fundamentally tied the inhabitants of *Viroconium* and their hinterland to the alliances and hostilities between the 'Welsh' and encroaching Anglo-Saxon kingdoms. At this point, an alliance existed between Christian Gwynedd and Powys (led by Cadwallon and Cynddylan respectively), and the pagan Anglo-Saxon kingdom of Mercia under the rule of Penda. This arrangement was mutually beneficial to all concerned and had been primarily instigated to counter the aggressive expansion of the Northumbrians, led by Oswald. A series of engagements took place throughout the mid 7<sup>th</sup> century AD (Rowley 1972: 43-44; Stanford 1980: 177-178; Webster 1991: 137-140; White & Barker 1998: 132-134). Powys was the weakest member of the triumvirate and subsequently paid the highest price in terms of ceded territory, *realpolitiking* in order to maintain the alliance. Powys' power-base was in the Welsh foothills, so it is probable that *Viroconium* and its hinterland (being on the western periphery) were given over to Mercia (White & Barker 1998: 135).

In the late 7<sup>th</sup> – early 8<sup>th</sup> centuries AD, the Tribal Hidage document of Mercia that recorded the calculation of tax and war services due the Mercian king, noted several groups of people who were present on the periphery of Mercian territory. One such group was termed the *Wreocensætna* and refers to either the 'people of the Wrekin' or the 'people of Wroxeter' (Higham 1993: 68-70 & 74-75; Webster 1991: 139; White & Barker 1998: 135). If this were the case and *Virconium* still had some vestigial importance it might explain an anomaly in the medieval diocesan boundary between Lichfield and Hereford (Bassett 1990). Rowley (1972: 35) also suggested that a large unit once existed in the vicinity, based on the regularity of the parish boundaries between the Wrekin, the Severn and the Tern. An ecclesiastical presence at *Viroconium* is also supported by a structure interpreted as a probable church (White & Barker 1998: 107-108; Gaffney *et al.* 2000: 93). King Penda would not have tolerated a Christian bastion within his realm and this would have sealed the fate of *Viroconium* (White & Barker 1998: 135). Activity at *Viroconium* (see above) ceased at approximately the same time the modern village of Wroxeter was established.

### **1.7. Late Romano-British – early medieval transition: Overview**

Social, political and cultural factors often contradict one another during this transitional period (see Hines 1996), so determining what occurred and the processes responsible is fraught with difficulty. The late Romano-British – early medieval 'continuity' debate has largely focussed on what occurred at urban centres in the immediate post-Roman period. When outlining this debate two factors have to be taken into consideration: Romano-British urbanism and definitions of 'continuity'. Researchers do not universally agree on the nature of urban settlement, i.e. the extent to which Romano-British towns and cities conformed to modern concepts of urbanism (as social, cultural and economic central places). Wachter (1995: 408) reiterated the distinctions made by Hill (1977: 294) and Biddle (1976: 328) of 'town life' and 'life in towns', respectively. Definitions of 'continuity' also fluctuate with some being overly rigid, for instance Brooks (1986: 79) considered, '... *unbroken occupation and use of ... a town site ...*' to denote continuity. How unbroken occupation might be decisively established archaeologically remains problematic.

### **1.7.1. Nature of the evidence**

The physical evidence is rather sparse for the early medieval period, especially the 5<sup>th</sup> – 6<sup>th</sup> centuries AD. Most of the artefact categories traditionally used by archaeologists as dating tools either stagnate or fall-out of use, coinage and pottery styles principally (see Chapter 5). The early medieval period also saw a return to building in wood, so structural remains are ephemeral and easily missed. The sub-Roman phenomenon of ‘dark earth’ remains enigmatic with various authors attributing it to abandonment, deliberately deposited top soil for agriculture or occupation debris all leading to soil formation (see Macphail 1981; Courty *et al.* 1989; Sidell 2000; Yule 1990). Indicators of environmental change, denoting land-use change, remain ambiguous. Palynology has indicated limited re-forestation in some areas, although the date remains problematic (see Bell 1989; Dark 2000).

Documentary evidence for the early medieval period is also problematic. Most sources are not contemporaneous with the events they recount, their geographical focus does not allow for universal application and the authors were politically motivated and/or misinformed (see Wright 1995). Esmonde-Cleary (1989: 164-165) placed the authors writing about late- and post-Roman Britain into the following categories: those near contemporaries working in the ‘late-Antique’ style (historical or hagiographical), such as Orosius and Zosimus; authors of British origin writing in the 5<sup>th</sup> – early 6<sup>th</sup> centuries AD, i.e. St. Germanus of Auxerre and Constantius of Lyon; and ‘insular sources’ (Celtic and Saxon) writing at a later date, Gildas for instance.

### **1.7.2. Models of continuity**

If one discounts the now defunct concept of ‘Romano-Saxon’ Britain (see Hawkes & Dunning 1961; Gillam 1979; Myres 1956; Roberts 1982), it is possible to group the different perspectives regarding the late Romano-British – early medieval transition into five broad categories:

#### **Progressive devolution:**

Roman Britain wound down slowly as the 5<sup>th</sup> century AD progressed. No Roman political and economic structures or culture existed beyond AD 450 and these had been in gradual decline for the previous century. Migrations from the Low Countries (Holland, Denmark and Germany) commenced in the very late 4<sup>th</sup> century AD, whilst an indigenous way of life lingered on the northern and western margins of Britain. The migrants were initially pagan and the indigenous peoples practised Christianity. The Germanic migrants became dominant across most of Britain by the 7<sup>th</sup> century AD. This perspective is also fundamentally tied to the ‘continuity’ debate: whether or not continuous socio-economic and political institutions (and settlements, e.g. urban centres) persevered during this transitional period. See: Alcock (1973); Frere (1967); Millett (1992).

#### **Discontinuity:**

A distinct and identifiable discontinuity existed between the end of Roman Britain and Anglo-Saxon England. This perspective suggested that Roman Britain had prospered until approximately AD 400, but dramatically collapsed around AD 430. Relatively small-scale Germanic migration started to occur in eastern England from early – mid 5<sup>th</sup> century AD. Therefore, there was no overlap between a functioning Romano-British province and the evolution of the Anglo-Saxon kingdom. The Saxons, through military action and political alliances (often intermarriage) gradually absorbed the indigenous people and their

institutions. See: Bassett (1989); Brooks (1986 & 1988); Casey (1979); Esmonde-Cleary (1989, 2000 & 2001).

#### **Unsuccessful acculturation:**

Roman Britain underwent a transition in the 3<sup>rd</sup> – 4<sup>th</sup> centuries AD, rather than the 5<sup>th</sup> century AD. The model of classical urbanism had floundered by the 4<sup>th</sup> century AD and Roman-British towns merely functioned as ‘administrative villages’. The concept of *Romanitas* never took hold and was only ever a passing fad. Conversely, the countryside developed considerably. Villas were the focus and village-like settlements began to form around them from the 4<sup>th</sup> century AD. Migration did not occur in large numbers, rather the indigenous population adopted Germanic fashions in the east, which did not permeate into northern and western peripheral areas until later. See: Dixon (1996); Faulkner (2000); Liebeschuetz (1996); Reece (1980, 1988, 1989, 1996 & 1999).

#### **The east – west divide:**

This perspective is similar to ‘unsuccessful acculturation’ with one exception. The indigenous population maintained certain aspects of the Roman administrative system into the 5<sup>th</sup> century AD. Britain was essentially divided into two halves: to the east society centred on a highly Romanised Christian elite, and to the west and north society centred on an un-Romanised pagan aristocracy. During the early 5<sup>th</sup> century AD the former depended upon Germanic mercenaries, which became dominant. See: Evans (1990); Higham (1992, 1993, 1994, 1995 & 1999).

#### **Late Antiquity:**

Between the 4<sup>th</sup> – 6<sup>th</sup> centuries AD Britain underwent the same religious, cultural, political, social and economic transition as continental Europe (a period referred to as ‘Late Antiquity’). Britain during this period shared the same Romano-Christian identity with the rest of Europe. In some respects, Britain’s Roman heritage survived longer than in other north-western provinces, hence its ability to promote Christianity in Ireland. See: Dark (1994, 2000a & 2000b).

## 2. Research questions

### 2.1. Introduction

*'The enormous quantity of animal bone, coupled with the need for speed of publication, has precluded the consideration of much of the bone from the basilican area, a fact which we regret and hope can be remedied in future.'* (Barker *et al.* 1997: 192)

The possibility that the mammal and bird bone assemblages from the various excavations at *Viroconium* were suitable as the basis of a doctoral thesis was initially raised by Dr Roger White (Academic Director, The Ironbridge Institute/Research Fellow, Institute of Archaeology & Antiquity, University of Birmingham) in the autumn of 1998 while the author was also employed at the University of Birmingham. In conjunction with Dr Sara Lunt (Senior Curator, English Heritage) and Dr Umberto Albarella (Research Fellow, University of Sheffield, formerly Zooarchaeologist, English Heritage) it was determined that the material was accessible and that a research project was feasible, based on pre-existing archaeological questions.

### 2.2. Research questions

*'Although traditional evidence provides some insights into the differential nature of these changes {in later Roman Britain}, the use of vertebrate remains as a tool in identifying economic, political, and social changes has long been ignored.'* (Dobney 2001: 43)

The criticism which has often been levelled at 'specialist' contributions, that they are rarely integrated with site interpretations and contribute little to wider archaeological synthesis, is still largely valid. This is particularly true of the Romano-British period because large datasets exist; it represents a missed opportunity (Dobney 2001: 36; Dobney *et al.* 1999: 15; Grant 1989: 135; Huntley & Stallibrass 1995: 156; King 1991: 18; Maltby 1981: 155 & 2002: 88). Analysis of the *Viroconium* assemblages therefore provides the opportunity to remedy this situation in part. The formulation of research questions has been greatly facilitated because post-excavation analysis has already been carried out (see Barker *et al.* 1997; Chadderton 2000; Ellis 2000), and so the vertebrate remains may be used to confirm, complement and elucidate questions unanswerable by other categories of evidence.

The suspected nature and extent of the material (see below), combined with the archaeological background (see Chapter 1), have indicated three principle areas of research that may be elucidated using the mammal and bird bone assemblages from *Viroconium*. These were:

- the 'nature' of *Viroconium* as a settlement
- the 'economic geography' of *Viroconium* and its hinterland
- the 'cultural identity' of *Viroconium*'s population

In reality these themes are very much interconnected, although for the purposes of discussion it has been necessary to isolate them. Analysis of taphonomic processes, which is a legitimate avenue of research in its own right, is regarded as a secondary, but necessary, prelude to this study (Chapters 4-5). Before discussing how the assemblages have been sampled, and how particular zooarchaeological variables have been utilised in regard to the research topics, the results of an assessment of all the available *Viroconium* material will be outlined.

## 2.3. The assemblage

### 2.3.1. Quantity

All the animal bone from the various *Viroconium* excavations had recently been re-housed from a variety of locations to the English Heritage storage facility at Atcham, Shropshire. The exact quantities involved were unknown because it has yet to be archived properly. Over Easter 1999 the author and Adam Smith (formerly an MSc student, University of Sheffield) catalogued the assemblages under the direction of Heather Bird (Curator, English Heritage). It was discovered that the assemblages consisted of 1255 containers of varying sizes:

- 247 plastic crates (600 x 400 x 300mm)
- 26 large cardboard boxes (various dimensions)
- 865 'museum' cardboard boxes (450 x 240 x 180mm)
- 117 small cardboard boxes (various dimensions)

The plastic crates are the containers that the material will eventually be re-boxed into. Table 1 outlines how the assemblage was divided between the different excavations. The Barker and Webster (see Chapter 1) excavations constituted the major proportion of material stored at Atcham: 43% and 49% respectively. Given the differing sizes of storage container, these estimates were obviously unreliable and so it was necessary to calculate quantities of bone in a different manner. Prior to the start of the re-boxing programme, each original storage container, i.e. 'museum' box, had fortunately been given an AML (Ancient Monuments Laboratory) reference number, and these were still recorded on the plastic crates where re-boxing had taken place. Based on these AML numbers it was calculated that each plastic crate contained an average of 2.2 'museum' boxes. This meant that material from the Barker and Webster excavations realistically formed 49% and 44% of the entire assemblage respectively.

### 2.3.2. Phasing

The two excavations have been phased as follows:

#### **Barker: The baths basilica:**

See Chapter 1 for a summary of the baths basilica excavations.

#### **Webster: The legionary fortress:**

Summarised from Chadderton (2000: 17-64):

- |              |            |                             |
|--------------|------------|-----------------------------|
| • Phases 1-3 | 57 – 66 AD | the first legionary period  |
| • Phase 4a   | 66 – 79 AD | the second legionary period |
| • Phase 4b-7 | 79 – 90 AD | the depot period            |

#### **Webster: The baths and *macellum*:**

Summarised from Ellis (2000: 11-77):

- |            |   |                                |
|------------|---|--------------------------------|
| • Period 1 | late 1 <sup>st</sup> – mid 2 <sup>nd</sup> century AD | the early town                 |
| • Period 2 | 2 <sup>nd</sup> century AD                            | public buildings               |
| • Period 3 | 3 <sup>rd</sup> – 4 <sup>th</sup> century AD          | late town and early post-Roman |

### 2.3.3. Assessment

In the autumn of 1999 an assessment of the material was conducted to determine the quantity, temporal range and 'quality' (preservation, fragmentation, residuality, etc) of the Webster and Barker assemblages prior to the formulation of research questions and subsequent sampling strategy (repeated here in



verbatim). Assessment was carried out in accordance with established guidelines (English Heritage 1991 & 2002).

The contents of 40 plastic crates, selected at random from both sites, were assessed using the diagnostic zone system of Albarella & Davis (1994) and Davis (1992). This, based on the original AML reference numbers, constituted 6% of the entire assemblage. The contents of another 60 plastic crates were also scanned to determine whether they differed substantially to those assessed, which they did not. Therefore, based on the average of 2.2 'museum' boxes (AML reference numbers) per plastic crate, estimates were calculated from the assessed material, for the Barker and Webster assemblages separately. Tables 2-4 outline the estimate totals for 'countable' elements, 'ageable' cattle, pig and sheep/goat mandibles and 'measurable' elements.

### **Context:**

Being able to contextualise the animal bones was crucial, a failure to do so would have severely curtailed their information potential and interpretative value, so considerable effort was made to achieve this. The chronological division and spatial distribution of material could only be assessed once the Barker and Webster archives had been computerised (comprising almost 8000 context records, taking approximately five weeks). The archives relating to the earliest phases (the legionary fort) of the Webster (Chadderton 2000) excavations were unavailable, but this did not effect the assessment, as very little of the available animal bone appeared to derive from these phases. As the distribution of bone fragments in individual contexts had not been catalogued, even on a presence/absence basis, it was estimated that there were approximately 2054 contexts from the Barker excavations and 1572 contexts from the Webster excavations that could conceivably contain bone. These included all negative features and layers/deposits, but excluded structural features, etc that were assumed to contain very little bone. Of the deposits considered likely to contain animal bone, some were also excluded because of uncertain phasing and dubious interpretation. Remaining contexts probably containing bone were divided by phase (see above) and feature type accordingly for the Barker and Webster excavations separately (Tables 5-6).

### **Sample:**

Assessment of the 40 plastic crates determined that there was an average of 3.6 contexts contained within each. At this initial stage it was felt that, given the strict time limits of a PhD, no longer than 18 months should be spent recording material. Based on the assumption that it is possible to record the contents of 2.2 'museum' boxes per day (from experience at the Birmingham Zooarchaeology Laboratory, University of Birmingham), using the diagnostic zone system of Albarella & Davis (1994) and Davis (1992), it would be possible to analyse approximately 56% of the combined *Viroconium* assemblages in 18 months. It was therefore necessary to develop a sampling strategy that would answer the specific research questions that would be answerable using around half of the available and useable material.

### **Considerations:**

Assessment of the material and contextual information highlighted several points that had to be considered prior to the formulation of the sampling strategy. These were:

1. the figures derived from the assessment were ultimately 'guestimates' because there was no way of directly relating boxes of bone to the contextual information (short of cataloguing each storage container in turn)

2. not all secure contexts would actually contain bone and the average value of 3.6 contexts per plastic crate almost certainly concealed significant variation between contexts
3. particular deposit types, for instance posthole fills, would contain very small quantities of animal bone. In addition, a number of floor and dump deposits were made up of mortar, which contained small quantities of bone that would rarely be useable. It was possible to quantify these for the Barker excavations, but not for the Webster excavations
4. the definition of 'layer' was reasonably precise for the Barker excavations, but term was used very broadly in the Webster excavations. Deposits described as 'layers' from the Webster excavations also included 'dumps' (as defined in the Barker excavations). This would therefore make analysis of secondary deposition for the Webster material considerably more problematic
5. the possibility that ephemeral early medieval features, similar to those identified from the Barker excavations (Chapter 1), were also present, but unrecognised, on the Webster site could not be entirely dismissed (Roger White pers. comm.). If this were the case, it would have serious implications for any study, as late Romano-British deposits would also include early medieval material
6. during post-excavation analysis of the archive, deposits from the Barker excavations were categorised on the perceived rate at which they accumulated and how quickly they became sealed (see Barker *et al.* 1997: 201-218 & Appendix 11; Chapter 5). This provided better stratigraphic control and greater potential for reconstructing site formation processes than were available for the Webster excavations

### **2.3.4. Summary**

By assessing all the mammal and bird bone assemblages excavated from *Viroconium* it has been possible to determine which was the most suitable for application to the research questions (see below). Based on certain characteristics, such as chronological and spatial distribution, quantities of material, preservation and good stratigraphic control, it has been determined that the Barker baths basilica material provided the most suitable assemblage for elucidating the research questions (see Chapter 3).

## **2.4. Zooarchaeological elucidation**

Before discussing how particular zooarchaeological variables have been utilised in the elucidation of these topics, each research area has been outlined in turn.

### **2.4.1. The 'nature' of *Viroconium***

Structural evidence from *Viroconium* implies that there was a period of decline in the later 3<sup>rd</sup> – 4<sup>th</sup> centuries AD. This in many respects mirrored the general empire-wide situation. At *Viroconium* the public buildings fell into disuse or adopted more utilitarian functions, and the material culture appears to have stagnated and a new conservatism subsequently prevailed (see Chapter 1). This is especially apparent at the baths basilica where there was evidence for successive periods of running repairs to the basilican structure (Phases T-V – W), industrial activity within it (Phase X – the 'building yard') and the construction of an open-air market when the roof was dismantled (Phase Y). Unlike most Late Romano-British towns and cities, however, *Viroconium* underwent a renaissance with the construction of an aisled wooden complex (Phase Z – the 'great rebuilding'), which may have remained in use until the latter half of the 7<sup>th</sup> century AD. This makes *Viroconium* unique in Britain. Several possible interpretations of the Phase Z activity have been proposed, and include the palatial seat of a *tyrannus*, who controlled the former territory of the Cornovii, or a bishopric of the western celtic church (see White & Barker 1998: 121-126; Chapter 1). Exploring the nature of this activity is the obvious application for the analysis of the vertebrate assemblage. Pursuing several different avenues of research and considering various factors affecting the formation of the assemblage may make this achievable (see below).

**Settlement density:**

The size of the population at *Viroconium* is central to understanding the nature of activity that occurred at the baths basilica site. Estimating the size of Romano-British and early medieval populations is problematic, especially those dwelling in urban centres. Population estimates for Roman Britain range between a third of a million (Russell 1958) to six million (Salway 1981: 544 & Smith 1977) depending on the criteria used to generate them. Estimating the early medieval population is equally problematic (see Miller & Hatcher 1978: 28-29). Millett (1992: 181) has questioned the wisdom of attempting to compare estimates from the two periods for this reason.

It has often been assumed that Romano-British towns represented a 'sea of urbanism', with dense settlement filling the walled areas, as for instance in the pictorial depictions of Sorrell (1981). This viewpoint has been questioned by various researchers who claim Romano-British urbanism represented a purely administrative function and an opportunity for the societal elite to indulge in conspicuous consumption and other displays of wealth (see Dixon 1996; Chapter 1). Such interpretations have even led to the suggestion that farming may have occurred within the walled areas of Romano-British towns and cities, i.e. Wachter's (1974) '*villae in urbibus*', and encompass the on-going debate regarding the nature of urban 'dark earth'. More recently, geophysical survey at *Viroconium* has provided tantalizing evidence for dense structural activity even in the peripheral *insulae* (Gaffney *et al.* 2000; Chapter 1), which has led White & Barker (1998: 31) to state that, '*... the accepted picture of Wroxeter as an underpopulated city, or even as a failure, is certainly incorrect*'. It has to be remembered that this geophysical evidence does not necessarily equate to a high population density; only excavation will confirm the nature of these features by determining the nature of these structures and recovering *in-situ* occupation debris, etc. Analysis of the vertebrate remains may provide some insight into the density and size of the late Romano-British and early medieval populations at *Viroconium* by considering the volume of material and specific concentrations.

**Social status:**

The proposition that the series of wooden structures erected during the 'great rebuilding' (Phase Z) were built under the direction of, and controlled by, a *tyrannus* or bishop implies high status activity (see above; Chapter 1). This hypothesis may be tested through the analysis of the mammal and bird bone assemblages (selection of rare taxa, high utility body parts, etc). It is unlikely that it will be possible to differentiate between secular and ecclesiastical elites. Several researchers have successfully utilised the presence and ratios of particular taxon as secular and ecclesiastical signatures, although these studies focus on Saxon and post-Norman conquest sites (see Dobney & Jaques 2002; Sykes 2001).

**Craft specialisation:**

Fundamental to determining population and structural densities at *Viroconium* is identifying the nature of activities that were being practised within the settlement. The identification of craft activities at the baths basilica would provide an invaluable insight into the nature of the late Romano-British and early medieval settlement (also relevant to 'economic geography': see below). Grant (1989: 140) suggested tanning might have been a centralised activity taking in urban centres, whereas the processing of wool would have occurred at the point of origin. A series of Phase Y pits (Contexts A196, A241, A252 and A318), soakaways (Contexts A244 and A345) and gullies (Contexts A253/A332/A337 and A333/A336) has been interpreted as a tanning facility, partly because some these features were timber lined and contained

comminuted bone (Barker *et al.* 1997: 122-126). A dog coprolite was also discovered in soakaway A345 (an essential ingredient in the tanning process).

It appears that antler working was also being carried out at the baths basilica site. Armour-Chelu (1997: 358-359) reported that the majority of antler fragments came from two spatially discrete areas of the site: Phase Z dump B277 and drain deposits from the east – west street (Contexts E74, E91, E92 and E95). Conversely there appears to have been no specialised horn-working going on in the vicinity of the baths basilica (Armour-Chelu 1997: 357), which implies that they were transported elsewhere for processing and manufacture. Fifty-five pieces of worked bone waste, six bone spindle whorls and various other bone objects attest to the possibility that bone working may have been carried out at the site, albeit on a small-scale (see Pretty 1997).

A characteristic form of butchery and fragmentation affecting cattle long bones has been noted from many urban Romano-British settlements (see Chapter 7). This probably relates to the rendering of marrow fat (Dobney 2001: 39-40; Dobney *et al.* 1996: 27; Maltby 1979: 39; Stokes 2000: 69). These deposits have usually been interpreted as homogenous entities that derive from the same process. Dobney (2001: 39-40) has recently questioned this viewpoint, suggesting this practice might have formed a specialised trade in itself, which manufactured a range of marrow fat based products. Evidence for this has been noted from Lincoln, where several groups of cattle mandibles with burnt and fractured diastema's were discovered (Dobney *et al.* 1996: 25-26, Plates 1-2), and conceivably similar deposits have thus far gone un-noticed at the baths basilica. Therefore, the positive identification of this type of deposit at the baths basilica site would indicate further craft specialisation at the bath basilica.

Armour-Chelu (1997: 357) did not specifically report on any such deposits within the baths basilica assemblage, and the material assessed by the author did not include any discrete concentrations of this type of material. Quantities of the characteristically smashed long bones were observed, however, mixed with material derived from other activities. This may reflect the homogenising affect of the municipal waste collection suspected to have been in operation at *Viroconium* (Barker *et al.* 1997: 195; see Chapter 5). Incidentally, the presence of discrete deposits of heavily butchered cattle long bones obviously has implications for the application of a 'diagnostic zone' system of quantification (see Chapters 3 & 7).

### **Waste disposal:**

Waste disposal has already been touched upon in relation to craft specialisation. Understanding the nature of waste disposal and reconstructing site formation processes is central to elucidating the research topics outlined above and below. Not only does an analysis of waste disposal practices provide a valuable insight into activity at the baths basilica site, but also it is crucial to the effort of 'stripping away' the taphonomic layers that may bias any interpretation (see Chapters 4-5).

Central to understanding waste disposal practices at the baths basilica site are the dumps of material that were employed as building platforms, especially in Phase Z. These were primarily used to repair subsidence within the former basilican structure. Barker *et al.* (1997: 195) suggested that these dumps represent contemporary secondary deposition rather than true 'residuality' because many of them had a distinctive character and composition; see the case study of dumps C527 and D1569 (see Chapter 5). This is thought to reflect the probable municipal waste collection (see above); a similar situation was postulated at Lincoln (Dobney *et al.* 1996: 11, 24 & 57-58) for the waterfront sites. Abundant inclusions

of animal bone, including 'ox skulls', were a common feature of the dumps (Contexts D762, D885, etc). Barker *et al.* (1997: 107) suggested that it may have been normal practice to deliberately dump butchery waste on areas of ground prior to levelling. Armour-Chelu (1997: 357) concurred, stating that structured deposition was evident: '*This would suggest that, when dumping was to occur, some disposal of butchery (and perhaps other more noisome refuse) was carried out immediately prior to dumping*'. It has been possible to test this hypothesis.

Investigating the dump deposits and site formation processes will also provide a valuable opportunity to consider further the nature of urban 'dark earth'. Understanding this phenomenon has become a central concern for those attempting to decipher late Roman – early medieval urbanism, for instance Macphail (1981), Courty *et al.* (1989), Sidell (2000) and Yule (1990). 'Dark earth' was initially thought to represent a single process: the destruction of late Romano-British settlements by the Saxons. A more complicated process is now suspected, which includes the dumping of material, agriculture and soil formation (see Chapter 1).

#### **2.4.2. The 'economic geography' of Viroconium and its hinterland**

Many of the factors central to understanding the 'economic geography' of late Romano-British and early medieval *Viroconium* have already been alluded to, although it will be necessary to consider several aspects in the effort to understand fully the relationship between the city and its hinterland (see Chapter 1).

##### **Late Romano-British economy:**

As the previous chapter highlighted (Chapter 1), there is a fundamental lack of agreement regarding the nature of economic structures of late Romano-Britain (i.e. formalist versus substantivist perspectives), and the role that urban centres fulfilled within the system. Most researchers agree that agricultural goods and other products were distributed through urban centres (*coloniae*, *civitates* and 'small towns') to varying degrees. Formalists argue for distribution in a market economy driven by supply and demand; substantivists emphasise state taxation centres in a command economy imposed on a simplified tribal system, represented by the *civitates*. For recent overviews of formalist and substantivist perspectives see Temin (2001) and Greene (2000) respectively, and Manning & Morris (2003: Chapter 12).

##### **Early medieval economy:**

In contrast, the 'economic geography' of early medieval Britain in the immediate post-Roman centuries is poorly understood. The Romano-British monetary system, taxation, trade routes and production centres all appear to have collapsed to a greater or lesser extent during the 5<sup>th</sup> century AD. They were replaced with a barter system that was mediated by the former Romano-British elite, many of whom seem to have been descendants of the old tribal aristocracies (see Faulkner 2000). Taxation in kind, broadly similar to the late Romano-British *annona*, may well have encouraged the maintenance of an agricultural surplus (Hinton 1990: 6-7; White & Barker 1998: 116). In this respect, the demise of the Roman empire may have had little noticeable effect. This assumption may be testable through the analysis of the vertebrate remains from the baths basilica by identifying direct continuity between animal exploitation in the two epochs through species composition, body part distribution, mortality patterns/population age structures, butchery patterns and waste disposal practices.

### **Producer and/or consumer:**

Central to understanding and reconstructing the 'economic geography' of the region around late Romano-British and early medieval *Viroconium* is to what extent the city was self-sufficient in terms of agricultural produce or whether it was reliant on resources from the surrounding countryside. This question is intimately linked to the population density of *Viroconium*. If the '*villae in urbibus*' model (see Wachter 1974) is correct, a relatively small number of people living in the city could potentially have been self-sufficient. More probably, as suggested by the geophysical survey data (see above; Chapter 1), a sizeable population was housed within the city and would have been unable to support itself fully. Even if the latter situation was the case, however, some agricultural produce would have derived from the settlement itself, for instance chickens are thought to have been bred at urban settlements (Grant 1989: 144; King 1991: 17).

To understand fully the provisioning of late Romano-British and early medieval *Viroconium*, the results of the present analysis should be compared with those from contemporary and analogous sites. This, however, is problematic because of the uniqueness of *Viroconium*. No directly comparable datasets presently exist from towns with apparently continuous activity and occupation until the latter half of the 7<sup>th</sup> century AD. It will therefore be necessary to compare the late Romano-British and early medieval baths basilica assemblages to three different types of dataset: other late Romano-British urban assemblages; assemblages from sites re-occupied in the immediate sub-Roman period (such as hillforts) and Saxon/early medieval urban assemblages. An extensive search was conducted for analogous assemblages and despite the large numbers of excavated sites few suitable assemblages actually exist. Even some of those listed below are of limited use.

Late Romano-British urban assemblages ideally suited for comparison with *Viroconium* include those from Caerleon (O'Connor 1986); Carlisle (Stallibrass 1992, 1993a & 1993b); Causeway Lane, Leicester (Gidney 1999), Colchester (Luff 1993), Exeter (Maltby 1979), the General Accident site, York (O'Connor 1988), Lincoln (Dobney *et al.* 1996) and Portchester Castle (Eastham 1975; Grant 1975).

Iron Age sites re-occupied in the immediate sub-Roman period have often been interpreted as the residences of the former Romano-British elite, who re-exerted their control and influence along more traditional tribal lines once Roman institutions and administrative systems had begun to disintegrate (Burrow 1981: 155-156; Chapter 1). Valuable insight may be provided by comparing such assemblages to those from the baths basilica, particularly to that from the 'great rebuilding' in Phase Z because it may represent the same function. Understanding how resources were utilised from the hinterlands of post-Roman towns may be enhanced by comparing such urban assemblages with those from rural farmsteads occupied in the immediate post-Roman period. Sites in the latter category that will be examined include Bantham, Devon (Coy 1981), Cadbury Congresbury, Somerset (Noddle 1992), Dinas Powys, Glamorgan (Alcock 1987; Gilchrist 1988), Glastonbury Tor, Somerset (Harcourt 1970), Latimer, Hertfordshire (Hamilton 1971), Lower Bridge Street, Chester (Morris 1985) and Poundbury, Dorset (Buckland-Wright 1987). Post-Roman deposits from the fortress, York, (Allison 1995; Rackham 1995) can also be used for comparison.

Comparison with early Saxon urban assemblages will also be pertinent. This will enable both provisioning and ethnicity to be explored. There may well be similarities between early medieval *Viroconium* and the early Saxon settlements, caused by the pragmatic considerations of utilising the

former Romano-British agrarian superstructure. Conversely there may be notable discrepancies because of differing 'cultural identities' and ethnicity (see below). Possible early Saxon sites to consider include Cheddar, Somerset (Higgs & Greenwood 1979), Mucking, Essex (Done 1993), Southampton (Bourdillon 1988, 1994; Bourdillon & Coy 1980), Portchester Castle, Dorset (Eastham 1976; Grant 1976) and West Heslerton, East Yorkshire (Richardson in press).

### **Hinterland:**

To identify changes in the 'economic geography' of *Viroconium* and its hinterland between the late Romano-British and early medieval periods, it would be necessary to consider contemporary nearby rural settlement, but there are virtually no such assemblages. This unfortunate situation has occurred for two reasons. Firstly, very few sites have been excavated and, secondly, the very acidic subsoil of the region causes severe degradation of bone (see Chapter 4). Even excavations conducted in recent years, for instance Whitley Grange villa (Hammon 1998), have not produced useable assemblages.

As an alternative, assemblages from outside the immediate vicinity of *Viroconium* may be used, although caution will have to be exercised. Obvious assemblages to use in this manner include Buxton, Derbyshire (Bishop 1990), Dodder Hill, Worcestershire (Davis 1988), Elms Farm, Essex (Johnstone & Albarella 2002), Frocester, Gloucestershire (Noddle 2000; Bramwell & Noddle 2000) and West Stow, Suffolk (Crabtree 1989, 1990, 1991 & 1994). The results from West Stow may be of limited use in this respect because Sykes (forthcoming) has concluded that the West Stow analysis was largely unsuccessful for the detection of ethnic identity.

### **2.4.3. The 'cultural identity' of Viroconium's population**

Evidence for the nature of early medieval activity in the western peripheries is slight and inconclusive, especially for the Cornovii (Gelling 1992: 28; Rowley 1972: 42). Much has been written regarding the nature of the British 'Dark Ages', and the cultural proclivities of the population (see Dark 2000; Laing 1990). With the demise of the Roman empire, the western periphery of Britain appears to have reverted to something more akin to pre-Roman Iron Age society (Bassett 1989; Esmonde-Cleary 1989: 175; Evans 1990). Consequently, the former tribal groupings and territories developed into kingdoms (White & Barker 1998: 130-131). *Viroconium* may have come within the confederacy of Powys, which has led White & Barker (1998: 132) to suggest '... that Wroxeter and Chester were within this confederation whilst still retaining their status as quasi-autonomous units along with their immediate territory'. This suspected autonomy may have affected the survival of the *Romanitas* of *Viroconium's* inhabitants. The extent to which the inhabitants of post-Roman *Viroconium* retained their *Romanitas* into the 5<sup>th</sup> – 7<sup>th</sup> centuries AD has been a topic of much debate (Barker *et al.* 1997: 203 & 248; Brooks 1986: 82; Dixon 1996: 156; Esmonde-Cleary 1989: 187 & 221-222; Higham 1992: 82 & 104; White & Barker 1998: 128-130).

In the area around *Viroconium* any Germanic presence or influence from the continental church, had a negligible impact until the mid-7<sup>th</sup> century AD (White & Barker 1998: 134-135). It should therefore be possible to consider the degree to which *Viroconium's* population clung onto their *Romanitas*. This approximate date would also appear to mark the end of occupation within *Viroconium's* central *insulae* and the foundation of the medieval village of Wroxeter. Presumably the two episodes were linked to a certain degree (see Chapter 1). A Saxon presence or influence in the final phase of activity at *Viroconium*

is conceivable, but prior to Phase Z it should certainly be possible to chart the effect of the demise of the Roman empire upon the indigenous population and economy.

The decline of Roman influence within Britain would obviously have had a profound impact on the population in two principle ways: practically through the demise or stagnation of various institutions and technologies, and ideologically through the loss of *Romanitas*. The degree of dependence on Roman systems varied, however, and a whole series of factors would have led individuals and groups (social, administrative, economic and religious) to react in very different ways across the five provinces of late Roman Britain. Clear regional differences existed in pre-Roman Iron Age Britain, such as those based on tribal diversity and geographical contrasts, and in many respects the imposition of the homogenous Roman super-structure served to obscure them (Millett 1992: 68). This acculturation occurred both through the deliberate policy of promoting the concept of *Romanitas* and through the availability and use of Roman material culture (see Jones 1997: 29-39). Such differences may have asserted themselves once the Roman Empire started to fragment is a real possibility, much as evidenced by the many ethnically based conflicts have occurred since the demise of the Soviet Union in 1989: the 'new world order' has perhaps more accurately equated to 'old world disorder' (see Chomsky 1994).

### **Palaeogastronomy:**

If diet and its culinary expressions are to be utilised in relation to ethnicity and acculturation then it is necessary to go beyond the simplistic reconstruction of production methods that are so common to many zooarchaeological studies: an increasingly frequent criticism (Gerritsen 2000: 169-170; Hamilakis 1999: 56-57 & 61; Meadows 1994: 135; Parker-Pearson 2000: 218). As stated by Parker-Pearson (2000: 218), '*... what we might call palaeogastronomy – has yet to make its mark as a recognised aspect of the discipline.*'

Attempting to identify ethnic and ideological affiliations from archaeological evidence is an exceptionally fraught process, one that perhaps embodies the fundamental problem central to all archaeological research. Material culture does not necessarily equate to social groups or identities; changes in material culture do not automatically imply ideological change (Edmonds 1995: 14-17; Jenkins 1997; Jones 1997: Chapter 2). In part analyses of food residues may elevate the situation because, as Gerritsen (2000: 170) stated, '*... food and eating habits often function as a lens, a means of analysing broader social and cultural patterns and processes.*' Consumption embodies inter-human relationships on many different levels. Hamilakis (1999: 57) has summarised the basic premise, '*First, it is a primarily communicative signifying social act and secondly, it is a means of social self construction.*' This has been clearly demonstrated by anthropological and historical research, to summarise Goody (1982), Meadows (1994: 135) and Mennell (1985):

- food distribution: the politics of allocation and the economics production and taxation
- food preparation: incorporates gender politics, division of labour, plus cultural and social conceptions of flavour, presentation and dining etiquette
- food consumption: group (whether geographical, social or ethnic) identity and competition, notions of sharing and hospitality, taboos and specific customs

It has been argued that dietary preferences and culinary practices are more 'resilient and conservative' than other cultural behaviours. This makes them ideally suited to analysing evolving cultural identities (Hesse 1986: 17). Reputedly 'socio-cultural' behavioural patterns alter more slowly than do 'economic-technical' developments, therefore the 'foreignness' of another people may be observed through their



culinary preferences (Teuteberg 1986: 12 & 14). This assumption is questionable, and is partially contradicted by the aspersion that cuisines do not 'travel' particularly well because of the availability of ingredients etc, and are consequently subject to all manner of aberrations (see Revel 1984: 18-19).

Numerous case studies have successfully charted how dietary modifications occur within a society when that society has undergone upheaval through external or internal pressures. Ziemann (1998), for instance, demonstrated that there was an initial rush for all things 'western' post-1989 reunification in the former German Democratic Republic (GDR) before a desire for 'traditional' foodstuffs reasserted itself (out of nostalgia). Other case studies have shown how immigrants initially modify their dietary habits to 'fit-in' before becoming established and accepted into their host-nations before traditional cuisines undergo a renaissance, the Greek community in post-Second World War north America for instance (see Tangires 1998[#1216]; Theodoratus 1981). If caution is applied it may be possible to identify dietary preferences and patterns particular to late Romano-Britain and chart their continuity into the early medieval phases of activity at the baths basilica. Various analyses of archaeological animal bone assemblages have successfully achieved this, colonial period sites from North America for instance (often supported by documentary evidence) (see Langenwalter 1990; Martin 1986; Reitz 1985; Reitz & Honerkamp 1983; Scott 1996). Attributing ethnic identity through food residue has often hinged upon the use of taxonomic signatures to denote food avoidances. Almost all societies have some form of food avoidance (see Simoons 1994).

#### **Romano-British cuisine:**

When contemplating acculturation and social affiliations within the Roman Empire there has been a tendency for researchers to view the processes involved purely from the Roman perspective, i.e. '*... along a progressive scale of Roman-ness*' (Meadows 1994: 133), which has generally led to a one-sided discourse that has ignored the 'British' experience (Barrett 1989: 235-236). In part it should be possible to redress the balance by considering how the indigenous population reacted to the Roman withdrawal in the 5<sup>th</sup> – 7<sup>th</sup> centuries AD through their culinary habits. It is apparent that cattle were central to the pastoral economy of Romano-Britain and that urban victualling was one of the principle motivations (Dobney 2001: 36; Grant 1989: 136-137; King 1978 & 1984; Maltby 1984: 163 & 2002: 89). The use of taxonomic signatures may be of limited use because the Romans had few strong dietary taboos, their attitude towards hippophagy was ambivalent, although horse-flesh was not widely consumed for instance (see Simoons 1994: 180-187).

Anthony King (1978, 1984, 1991, 1999a & 1999b) has been one of the few researchers to conduct a systematic survey of the Roman diet across the whole empire in the effort to deduce any patterning. This has been achieved by considering the relative proportions of cattle, pig and sheep/goat to one another by site-type, chronological period and geographical location. An overall pattern of 'dietary regions' became apparent that were roughly comparable to the provinces and climatic/topographic zones. Environmental factors were one of several causal factors, although it was not pejorative (King 1984: 194-197 & 1999a: 188). The process of Romanisation seemed to culminate in two aspects that directly affected culinary preferences across the empire (King 1999a: 188-190): the 'Rome' and 'military' diets.

Firstly, west-central Italy (Etruria, Latium and Campania) demonstrated a pork-rich diet. Prior to the late Republican and Imperial periods the region did not demonstrate this trend. Multi period sites, such as the Settefinestre villa, suggested this increased consumption of pork was directly related to social status

(King 1999a: 161). Vine and olive cultivation dominated the region, according to the classical authors, and King (1999a: 171) suggested that pig husbandry would have been an ideal accompaniment. In addition, the flow of taxes and the *annona* to the region (via Rome) made it the most-wealthy area within the empire (King 1999a: 189). The second pattern originates from the army stationed just north of the Alps during the 1<sup>st</sup> century AD. King (1984: 198 & 1999a: 182 & 189) claimed this related directly to the ethnic make-up of those serving: the '*barbarization*' of the western army. The 'military' diet placed a far greater emphasis upon the consumption of beef, as did the indigenous diets of *Lugdunensis*, *Aquitania*, *Belgica*, *Germania Superior*, *Germania Inferior*, and *Raetia*.

During the pre-Roman Iron Age of Britain the indigenous population reared and consumed a greater proportion of sheep/goat over either cattle or pig (confirmed by Hambleton 1999). The conquest of Britain saw the transmission of the 'military' diet through the presence of the legions (King 1999a: 189). Initially only military sites, and their attendant civilian settlements, maintained the beef dominant diet, but over the next two centuries there was a gradual permeation of the 'military' diet through all echelons of society. This culminated in the dietary acculturation of even the most parochial rural settlements, i.e. there was a demonstrable progression through time. Gradually a homogeneous beef-based diet became the norm. Each site-type retained its own peculiarities, for instance military sites still had the highest proportions of cattle (King 1984: 193). The 'Rome' diet had a far less significant impact. The 'Rome' diet was difficult to export (or emulate) because of the unique socio-economic conditions in west-central Italy. Only particularly wealthy and highly Romanised sites could afford the pork-based diet, such as Fréjus-Alguières, Provence, France and Fisbourne villa respectively (King 1984: 201 & 1999a: 189).

The 4<sup>th</sup> – 5<sup>th</sup> centuries AD saw a long period of stability end. This change was characterised by two elements (King 1999a: 190). First, the western Mediterranean (Spain, Provence, north Africa and Italy) began to adopt the dietary habits that were already established in the eastern provinces: a greater proportion of sheep and goats. Second, north of the Alps beef became even more dominant and pig more marginal. Most areas retained their distinctiveness, and in some instances pre-Roman Iron Age preferences started to re-establish themselves, for example the British penchant for mutton (which became dominant in the medieval period). King (1999a: 189-190) concluded that for most of the western Empire it would be inaccurate to describe the process of Romanisation as a unified cultural dictum emanating from Rome. Regions essentially retained their traditional cuisines. For Britain (King 1999a: 189) '*... it is preferable to refer to the 'Gallicization' or 'Germanization' of the diet, with the Roman army as the apparent catalyst for dietary change*'. This possibility has repercussions when analysing the ethnicity of early medieval Britain through its dietary and culinary preferences because the next influx of Germanic migrants could have conceivably obscured the picture. It also has to be remembered that due to over-riding taphonomic considerations and the various methods researchers have applied to the analysis of assemblages it is necessary to publish in detail the intricacies of each technique used, otherwise inter-site comparison is impossible or highly dubious (Luff 1993: 21; Maltby 1985: 35).

Romano-British sites generally tend to produce little evidence for the extensive exploitation of wild animals. Grant (1989: 144-145) suggested this reflects the efficiency and intensity of the Romano-British agricultural system. However, hunting in most societies incorporates a range of socio-cultural meanings (see Almond 2003; Cartmill 1993; Marvin 2001), although this aspect has yet to be fully explored for the Romano-British period. Medieval populations utilised wild animal resources far more extensively than

their Romano-British forbearers (Grant 1989: 144-145), although whether this is applicable to urban populations is questionable because of supply and availability factors. A diachronic increase in the proportion or range of wild animals at the baths basilica may indicate changing ideologies. Modifications in hunting practices are certainly evident between Anglo-Saxon and Anglo-Norman England (see Sykes 2001 & forthcoming), for instance. Such an undertaking will obviously consider particular species and avoid those of uncertain status or those that were purely commensal. O'Connor (1989: 19) has suggested that the utilisation of wild animal resources in Romano-British and medieval towns does not necessarily reflect differences in availability, but rather the ability to pay for them. Caution will have to be applied when interpreting any apparent change in the utilisation of wild species, therefore as it may reflect changes in social status rather than cultural affinities. Skeletal representation will also have to be taken into account, as deer may have simply been utilised for their antler (see above).

## **2.5. Zooarchaeological variables**

To demonstrate how individual zooarchaeological variables may be utilised in relation to the themes, questions and problems outlined above, the same three headings have been used. Most zooarchaeological variables, however, have more than one application and this, *inter alia*, complicates the task of interpreting individual zooarchaeological variables. Particular variables may have less interpretative value than others for this reason, for example a high percentage of cattle within the assemblage could infer dietary identity, urban supply structures, regional land use, effects of specialised butchery or refuse collection. Caution will therefore have to be applied when considering such widely applicable variables. Conversely, others with a narrower application may provide less ambiguous interpretations, such as non-metrical traits because the causal factor is congenital, relating to population structure. The usefulness of certain variables may well be enhanced if they are considered carefully in conjunction with other categories of artifactual evidence, such as the pottery.

### **2.5.1. The 'nature' of Viroconium**

#### **Species composition:**

The relative importance of the major domesticates, especially cattle, pig and sheep, as well as the frequency of wild species, will be explored. By comparison with the research of King (1978, 1984 & 1999a) this may suggest whether or not early medieval *Viroconium* was high or low status, civilian or military. In doing so it may be possible to determine whether a larger lower status population, or a smaller higher status population was present, by gauging the range and extent of particular species. If a homogenous pattern is noted it may well infer an urban 'proletariat', such as that noted for Saxon Southampton (see Bourdillion 1988 & 1994). Alternatively, if higher proportions of more non-ubiquitous animals, such as exotic species, are recorded a high 'status' population may have been present, therefore demonstrating the ability to directly control all available resources. This should also help determine to what extent *Viroconium* was a producer or consumer site (see below).

#### **Skeletal representation:**

Analysis of body part representation will help elucidate the 'nature' of late Romano-British and early medieval *Viroconium* by allowing waste disposal practices to be reconstructed and inferences regarding the socio-economic status of the population. However, the affect taphonomic processes have upon body part distribution will require careful consideration when interpreting this data. Many Romano-British

urban centres, for instance Exeter (Maltby 1979: 12-13 & 38), have produced discrete deposits containing cranial and lower limb elements. Such deposits have been interpreted as evidence of primary butchery having taken place in the vicinity. A prevalence of the higher meat-bearing elements, such as the humerus and femur, might indicate the remains of high status consumption (although other explanations would have to be discounted first).

### **Age structures:**

The age-at-death (mandibular tooth eruption and wear, plus post-cranial fusion) of the major domesticates can be used to infer the social status of the population. A predominance of mature animals, for instance, may suggest that they were not being specifically bred for meat consumption, but had been utilised for other activities, such as traction and dairy products. Conversely a high proportion of younger animals could suggest that they were being primarily bred for meat (at least those finding their way to *Viroconium*) and may generally imply the presence of higher status individuals. However, mortality curves produced from tooth eruption and wear, plus post-cranial epiphyseal fusion, for the major domesticates also relate directly to husbandry practices, i.e. the regional economic geography, and will consequently require careful interpretation.

Romano-British urban centres were generally supplied with adult and elderly cattle, which indicates that they were utilised as multi-purpose animals and were not reared especially for their meat (Dobney 2001: 36-37; Grant 1989: 136; Maltby 2002: 89). By the later Romano-British period, however, there is some evidence to suggest that a specific meat trade may have developed, because younger animals started to be supplied to urban settlements (Luff 1993: 57; Maltby 1979: 30-31; O'Connor 1988: 86). Maltby (1979: 90) has suggested that this represented a down turn in arable cultivation, meaning cattle were no longer required so much to provide traction. Therefore, the importance of pastoral agriculture may have increased, and land previously used for arable cultivation may have been turned over to hay meadows, etc. It may be possible to test this hypothesis by considering the zooarchaeological data in conjunction with the botanical and palynological evidence. Alternatively, it could indicate a change in the social status of the urban population. It has been suggested that, in the late Romano-British period, urban centres had become the preserve of a social elite (Dixon 1996; Chapter 1).

### **2.5.2. The 'economic geography' of Viroconium and its hinterland**

Reconstruction of the processes enabling the provisioning of *Viroconium* and the control of those resources may be attempted from the following.

#### **Species composition:**

The fundamental difference between the late Romano-British and medieval agrarian economies were that the former revolved around cattle whereas the latter focussed on sheep. As previously discussed, cattle were utilised as a multi-purpose beast during the Romano-British period (see above). Initially cattle would have been used for traction before being slaughtered for their meat, hides and horns (see above). In contrast, the medieval economy across much of Britain developed into one that centred on sheep husbandry and wool production (Hoskins 1955; Munro 1994). It will therefore be possible to determine whether this change in the agricultural economy started to emerge in the immediate post-Roman centuries.

Grant (1989: 144) has suggested that the scarcity of wild animals in Romano-British assemblages may be a testament to the efficiency of the agricultural economy. Wild species were relied upon more heavily during periods of agrarian stress in both the Romano-British and medieval periods, although more so in the latter, although this is not so applicable to large urban centres. If the established Romano-British agrarian economy stagnated or collapsed in the 5<sup>th</sup> – 7<sup>th</sup> centuries AD, then *Viroconium's* inhabitants may have had to rely on alternative resources. Interpreting any apparent increase in the range or proportion of wild species will be complicated by the changing attitudes towards hunting. There is evidence to suggest that hunting started to become an acceptable past-time for high status and wealthy Romano-Britons, especially villa owners (Salway 1981: 60), for instance the high frequency of red deer noted at Chedworth villa, Gloucestershire (Hammon 2002). The unusual nature of Whitley Grange villa has led to the suggestion that it may have been a 'holiday cottage' for a wealthy member of *Viroconium's* elite, who may have pursued hunting and fishing with friends there (White & Barker 1998: 111).

Imported or exotic species may attest to the existence and maintenance of long-distance trade networks (Dobney 2001: 37). Roman Britain saw a number of species introduced or occasionally transported from continental Europe, the Middle East and north Africa. Species recorded in Romano-British deposits include the garden dormouse (*Eliomys quercinus*) from Tanner Row, York (O'Connor 1988: 108-110, Table 30), black rat (*Rattus rattus*) from various sites (Dobney 2001: 38; Armitage *et al.* 1984) and numerous species of bird (Parker 1988), for example pheasant (*Phasianus colchicus*). The positive identification of any comparable species from early medieval contexts at *Viroconium* may be evidence for the maintenance of such trade links, providing such remains derive from securely dated deposits.

#### **Non-metric traits:**

This applies solely to cattle. A variety of non-metric traits may be utilised to identify the presence of different populations of cattle, as there were no standardised types in the modern breed sense, which would imply procurement of animals from a broad hinterland. Traits that will be examined include the size/type of horncore, the absence of the mandibular second premolar, the absence/reduction of the mandibular third molar hypoconulid and variation in the mandibular mental foramen.

#### **Skeletal representation:**

By recording a range of skeletal elements, which represent all major subdivisions of the body (cranium, shoulder, rump and lower limbs), it will be possible to demonstrate whether live animals were present within *Viroconium* (either driven to the settlement or being bred in/immediately adjacent to the settlement) or were being brought into the city as prepared joints of meat.

The marketing of cattle may have been a centralised activity. Distinctive deposits of primary butchery waste may be evidence for this (Grant 1989: 140-141). It has been reported from several sites, including Exeter (Maltby 1989: 40), that such deposits become scarce in the late Romano-British period, although this was not the case at Lincoln (Dobney *et al.* 1996: 24-28). O'Connor (1986: 241) suggested a 'relaxation' of this centralised system with the withdrawal of the military at Caerleon. Craft specialisation may have been a centralised activity, especially the working of products derived from cattle such as hides and horncores (Grant 1989: 140). The range and proportions of skeletal elements at the baths basilica may demonstrate the existence and continuity of such craft activity.

### **Age structures:**

Mortality curves will be reconstructed from mandibular tooth eruption and wear, plus post-cranial epiphyseal fusion. This will have to be analysed in conjunction with the consideration of *Viroconium's* social status (see above), otherwise the respective interpretations may contradict one another. By doing so it may be possible to comment on whether viable breeding populations of the major domesticates were present within the settlement itself, in the immediate hinterland or were being driven to *Viroconium*: essentially determining whether *Viroconium* was a 'producer' or 'consumer' site, and the inhabitant's ability to control resources. However, herein lies the problem alluded to above, a high proportion of young animals could possibly denote the presence of a breeding population or that *Viroconium's* inhabitant's exerted enough influence over agricultural resources to dictate that they were supplied with the choicest meat, for instance very young piglets may denote the presence of a breeding population or the taste for 'suckling pig'. If supply from the hinterland is the most likely proposition, then it may be possible to infer what the animals were being utilised for prior to supplying *Viroconium* with meat (see above).

The norm for Romano-British urban settlements appears to have been for cattle and sheep to have been killed when they were adult or elderly, which implies they were utilised for a variety of products (Grant 1989: 136). There is evidence from an increasing number of sites that in the late Romano-British period cattle were slaughtered across a greater age range (see above). This has been interpreted as evidence for the development of a specific meat trade, which developed as a response to increased urbanism (Luff 1993: 57; Maltby 1979: 30-31). Grant (1989: 138) noted at Portchester Castle, Dorset, that in the 4<sup>th</sup> century AD the majority of sheep were killed before full maturity, presumably for meat, whereas by the late Saxon phases mortality profiles suggested an emphasis on wool production.

### **Size and shape of individuals:**

Measurements will be routinely taken for the all major domesticates and principal wild species on a range of skeletal elements. This will enable the size of late Romano-British and early medieval animals to be compared through time at *Viroconium* and with other sites. Any increase or decrease in size may imply changes in breeds or husbandry practices between the late Romano-British and early medieval husbandry periods. The result be used to test the hypothesis that late Roman Britain was characterised by a complete 'systems collapse', which resulted in the regression of agricultural technology and knowledge (see Jones 1978: 304-308; Rostovtzeff 1957: 476-477).

Cattle may be particularly useful in this respect because they primarily supplied traction and meat, although sheep biometry may not be a good indication of husbandry practices because improving the quality of the wool would have been the principle motivation (Grant 1989: 143). Therefore, deliberate breed improvement would not be directly reflected in the size or shape of the skeleton, because the impetus for 'better' wool would probably not affect these variables. The range and diversity of dog breeds attests Romano-British husbandry skills. It demonstrates the ability to select and consciously develop particular physical and behavioural traits for different reasons; reputedly the Roman's were the first people to have deliberately bred lapdogs (Grant 1989: 143 & 145; see Cram 2000; Harcourt 1974). Therefore, by determining whether the diversity of Romano-British dog 'breeds' continued into the early medieval period may be a good indication for the continuity of husbandry skills. Conceivably, the wide

range of canine diversity noted in some areas of Romano-Britain may simply reflect isolated breeding populations, and this requires consideration.

#### **Sex of Individuals:**

Sex may be inferred from the morphology of the pelvis, in the case of cattle and sheep, and biometrical distinction (see Chapter 3) may be attempted for all the common domesticates. This will be used in the reconstruction of herd/flock structures and likely husbandry strategies. As discussed previously, the majority of cattle supplied to urban centres through the Romano-British period were mature, and it has been assumed that most of these would have been female. Supposedly the majority would have been cows because they would have been supplied once they had ceased to be successful breeders, whilst bulls and castrates were kept on rural settlements until they reached the end of their working lives (Grant 1989: 139).

#### **2.5.3. The 'cultural identity' of Viroconium's population**

Inferring the 'cultural identity' of *Viroconium's* inhabitants should not require the recording of any additional variables, but can be attempted from those noted for the other aspects. Numerous studies of assemblages from the north American colonial period have demonstrated the potential for identifying the ethnicity and cultural identity of particular households. The accuracy of such interpretations is often demonstrable through supporting documentary evidence, for example at Fort Michilimackinac, Michigan (Scott 1996).

#### **Species composition:**

Many ethnic groups demonstrate preferences or taboos for particular meats from different species, usually for cultural and more occasionally religious reasons (see Simoons 1994). The relative importance of the major domesticates can be tested against the previously models of King (1978, 1984, 1991 & 1999a) and Crabtree (1989, 1990 & 1994), as well as direct comparisons with sites such as Saxon Southampton (Bourdillon 1980, 1988 & 1994; Coy 1977).

#### **Butchery:**

Butchery is not completely dictated by anatomical and other functional considerations, it also reflects cultural norms (Aird 1985: 5; Binford 1978: 47; Grant 1975: 383; Maltby 1989; Noe-Nygaard 1977; Swatland 2000: 56-63). Researchers have discovered a series of typically Romano-British butchery practices, especially from urban centres, including butchering cattle scapulae to enable curing and the smashing of cattle long bones to obtain marrow fat (Dobney 2001: 39-41; Grant 1989: 141; Maltby 1989; Seetah 2002). It will be possible to compare cattle butchery at *Viroconium* directly with this established pattern, and to determine whether any similar pattern exists for pig and sheep. Specialised butchery practices can also be used to deduce the 'cultural identity' of *Viroconium's* late Romano-British and early medieval population, e.g. hook damage on scapulae and the extensive butchery/fragmentation of cattle long bones noted on some Romano-British sites (see above).

## 3. Methods

### 3.1. Introduction

The following chapter outlines the rationale for the chosen recording system, the recording system protocol, the criteria used for taxonomic distinction and a summary of the quantification methods. Where necessary some themes have been divided into 'recording' and 'analysis' sections, for example the method for recording tooth eruption/wear and post-cranial epiphyseal fusion is outlined in the former and how comparison of the two ageing methods was attempted in the latter. When considering which zooarchaeological variables to focus on it was necessary to develop them in conjunction with the research questions, to ensure that the relevant data was recorded. To summarise, the three research questions were (see Chapter 2):

- the 'nature' of *Viroconium* as a settlement
- the 'economic geography' of *Viroconium* and its hinterland
- the 'cultural identity' of *Viroconium*'s population

The following zoo-archaeological variables have been employed in the attempt to produce data to consider the above questions:

- |                             |                      |
|-----------------------------|----------------------|
| • species composition       | questions 1, 2 and 3 |
| • anatomical representation | questions 1 and 2    |
| • butchery patterns         | questions 1 and 3    |
| • age structures            | questions 1 and 2    |
| • sex ratios                | question 2           |
| • biometrical data          | question 2           |
| • non-metric traits         | question 2           |

### 3.2. Sampling

Sampling decisions range from which part of a site to excavate to which sections of a specialist report to publish (see O'Connor 2000: 28-31 & 2003: 93-96). Ideally specialists are involved in this process from the on-set, although in reality they often only become involved at the post-excavation stage. Sub-sampling very large assemblages from stratigraphically complex urban excavations has two principal benefits (Luff 1993: 21). Firstly, it is a cost effective necessity central to developer funded projects (see Coy 1989) and, secondly by prioritising specific bone groups the limiting effects of residuality can be countered by focussing on the most secure deposits (O'Connor 1989: 192). An additional reason can be added; sampling an assemblage to target certain bone groups to answer specific research questions.

#### 3.2.1. Assemblage sample

In regard to the *Viroconium* excavations many of the sampling decisions had already been made, i.e. which deposits were excavated, how much of each was excavated and which retrieval method was used. The author was restricted to making decisions of how to sample the resultant assemblages. To reiterate, in 18 months it would be possible to record approximately 56% of the baths basilica (Barker) and baths and *macellum* (Webster) assemblages. It was established that the baths basilica assemblage was more suitable for studying the late Romano-British to early medieval transition because of its chronological sequence. It was also established that the baths and *macellum* assemblage possibly included hitherto unidentified post-Roman material (see Chapter 2). It was therefore decided to concentrate upon the baths



basilica. This decision alone largely solved the problem of how to sample the *Viroconium* material. This decision was also fortuitous in that post-excavation analysis had been completed on the baths basilica site, unlike the baths and *macellum* (which was in the process of being published in 1999). In addition, considerable thought had already gone into the degree of stratigraphic control at the baths basilica site. Individual deposits were categorised on their perceived rate of accumulation and likelihood of later disturbance: the A-B-C category deposits (see Chapter 5). Animal bones from these deposits formed the basis of sample for this thesis. Refer to Appendix 1 for a list of these deposits.

### **3.2.2. Sample size**

Luff (1993: 21) stated that,

*'... there is a common fallacy that assumes all urban sites yield large bone samples which are suitable for data analysis. As a site increases in complexity and length of occupation, collective sources of bias will reject greater numbers of bones from analysis.'*

A considerable amount of work has been conducted on sample size adequacy in archaeology (see Baxter 2003; Casteel 1979; Cherry 1978; Cochrane 2003; Grayson 1981; Higham 1968; Levitan 1983; Orton 2000; Turner 1984; van der Veen & Fieller 1982). There appears to be little agreement on what constitutes an acceptable sample size. One major factor is that the target population (i.e. the 'life assemblage') is always unknown; archaeological assemblages are incomplete 'death assemblages' by default (see Chapter 4). This problem is compounded by how to determine sample size adequacy and the level of accuracy required. Various researchers (see above) have considered the number of taxonomic groups (or artefact types) within a sub-sample expressed as a proportion/ratio of the total number within an excavated assemblage as a measure. Measures of diversity are influenced by the total number of cases in a population, the proportion in which the particular species occurs, the accuracy required and the probability of obtaining that accuracy: Table 4 in van der Veen & Fieller (1982: 296) demonstrates this point clearly. Measures of diversity have demonstrated that fairly small sub-samples may be representative in terms of taxonomic groups, for example O'Connor (2003: 108) demonstrated that '*... beyond a mean sample size of about 50 identified specimens, the rate of addition of new taxa rises only slowly*'. Other researchers however have argued that samples may have to be substantially larger to produce adequate samples of ageing data, etc (see Turner 1984: 74). O'Connor (2003: 109) concluded,

*'Given the likely heterogeneity of any archaeological deposits, even those that are closely related stratigraphically, sampling frequently, rather than sampling big, is more likely to give results that reflect the generality of the deposits, rather than being skewed by the specific content of parts of one or two excavated contexts.'*

Sample size has been considered throughout the analysis of the baths basilica material, and where necessary groups have been excluded or patterns based on small numbers of observations and cases have been highlighted as tentative.

### **3.3. Method selection**

Assessment of the Webster and Barker assemblages demonstrated that they had considerable information potential. Even by using a selective diagnostic zone system (Albarella & Davis 1994; Davis 1992) the combined assemblages would produce something in the realm of 50000 'countable' fragments, 3200 'ageable' (cattle, pig and sheep/goat) mandibles and 12000 'measurable' fragments (see Chapter 2). It

was apparent that it would not be possible to record all the material within the scope of a PhD, for example a recent doctoral thesis generated only 17000 identifications (Richard Thomas pers. comm.). As outlined in the previous chapter (Chapter 2), in 18 months it was possible to record approximately 56% (e.g. 28000 fragments) of the material. Selection of the most suitable material for answering the research questions went some way in reducing the volume of material to be recorded; the 'A', 'B' and 'C' classified deposits from the baths basilica (Barker *et al.* 1997: 201-220 & Appendix 11; Chapter 5).

### **3.3.1. Anatomical elements**

After determining the nature of the assemblage during the assessment it was decided to record the following range of anatomical elements: basal horncore/antler; zygomaticus; isolated mandibular fourth deciduous premolar; isolated mandibular third molar; mandible (one or more cheek teeth *in-situ*); scapula; humerus; radius; metacarpal; pelvis; femur; tibia; astragalus; calcaneum; metatarsal; first phalange.

### **3.3.2. Recording method**

To record the baths basilica material it was still necessary to choose an efficient recording system that generated the right volume and 'type' of data in the amount of time available, while tackling the problem of interdependence between fragments. Two methods were considered:

#### **Every identifiable fragment:**

The 'half-bone' approach developed by Halstead (Halstead 1992: 32-33; Smith & Halstead 1989: 433-434). The 'half-bone' method was principally developed for extremely fragmented prehistoric assemblages to maximise their information potential. For quantification purposes, proximal and distal halves of long bones were treated as separate units, hence 'half-bone'. MNE (minimum number of elements) figures are calculated from NISP (number of identified skeletal parts) by discounting any fragment that could conceivably have come from the same anatomical element as another.

#### **Diagnostic zones:**

The 'diagnostic zone' system developed at English Heritage (Albarella & Davies 1994; Davis 1992). The 'diagnostic zone' method was developed to generate only the most crucial information efficiently within the sphere of commercial archaeology by targeting specific aspects of an assemblage. For a fragment to be recorded a specified section (i.e. 'diagnostic zone') of an anatomical element had to be present, for example the distal medial articulation. At least 50% of the specified section had to be present. With the exception of the mandible, NISP counts also represented MNE and required no further quantification.

#### **Evaluation of methods:**

Each method was tested, using the same set of fragments, to assess their suitability to record the baths basilica assemblage (the results outlined in verbatim here). Both methods were applied to five separate contexts containing approximately 1500 fragments in total. As one would expect, the 'half-bone' method produced larger NISP counts than the 'diagnostic zone' method, although took considerably longer to record. The greatest discrepancy existed for cattle long bones, especially the femur, and canon bones. The 'diagnostic zone' method was found to slightly under-estimate these elements, due to greater fragmentation. This problem did affect the medium sized domestic mammals. There was less discrepancy between the two methods for isolated teeth and compact bones. In all likelihood this reflected less severe fragmentation given their greater durability. When MNE was calculated for the

'half-bone' method the figures were generally comparable (as were anatomical distributions and ageing data, etc).

Overall, as there appeared to be little to distinguish the two methods in terms of information potential, practical considerations became the deciding factor. The 'diagnostic zone' method would generate a similar dataset to the 'half-bone' method, but with less expenditure of time. The 'half-bone' method normally compares all the fragments from the same anatomical element at the same time to discount those that might come from the same bone. This approach was not feasible for the baths basilica assemblage because fragments were not marked, which meant fragments from different contexts could not be mixed. Conceivably this process could have been carried out at the context level, although this would probably result in over-representation. In addition, due to the size of the assemblage sorting and storing fragments by anatomical element was impractical. It was therefore decided to opt for a modified version of the 'diagnostic zone' method.

The wisdom for doing so was independently confirmed later. In 2000 an MSc student at the University of Sheffield, Kim Burrows, analysed a small assemblage from the adjacent Webster excavations (*insula 5 portico*) for her dissertation. This included a comparison of the 'diagnostic zone' method devised by the author (see below) and the 'half-bone' method. After comparing the resultant datasets subjectively and statistically Burrows (2000: 108-110) concluded that,

*'The time saved by using Method 2 {'diagnostic zones'} would allow a larger dataset to be collected, and thus may be more representative of the whole. ... the two recording methods produce very similar results. Thus the amount of data lost using the quicker Method 2 is minimal.'*

It has to be remembered that selective 'diagnostic zone' methods are not suitable for all assemblages. The assessment stage is therefore crucial in determining the peculiarities of an assemblage. A competent assessment will allow a recording system to be devised accordingly to generate a dataset applicable to the overall research aims.

### **3.4. Recording protocol and criteria**

The 'diagnostic zone' method that has been used to record the baths basilica assemblage is a modified version of the system developed by Albarella & Davies (1994) and Davies (1992). Other 'diagnostic zone' systems were also consulted (see Cohen & Serjeantson 1996; Dobney & Rielly 1998; Serjeantson 1996) and additional variables were adopted from Dobney *et al.* (1999). Modifications tailored the design of the basic system to accommodate the peculiarities of the baths basilica assemblage noted during the assessment and evaluation of the recording systems. Some elements had an additional zone added to ensure they were not under-estimated, proximal radius, femur and metapodials for instance. Although, this complicated quantification, as anatomical elements with two zones had to have their NISP converted to MNE (see below), it was felt to be worth it due to the information gain and to alleviate a possible bias.

#### **3.4.1. Database**

The baths basilica assemblage was recorded directly onto a custom-designed Microsoft (MS) Access 2000 – XP database. Measurements were recorded directly into the Access database with Mitutoyo 'digimatic' vernier callipers interfaced with the computer using an 'input tool'.

### **3.4.2. Taxonomic identification**

Taxonomic identification, either to species or group, was carried out using the reference collection held at the Department of Archaeology, University of Sheffield. When necessary other collections were also consulted, such as the Zooarchaeology Laboratory, University of Birmingham. Recognised published criteria were used in conjunction with the reference material (unless otherwise stated separation was attempted on all anatomical elements):

#### **Sheep/Goat:**

The distinction between sheep (*Ovis aries*) and goat (*Capra hircus*) was routinely attempted on the horncore, mandibular deciduous third premolar, mandibular deciduous fourth premolar, distal humerus, distal radius, metacarpal, distal tibia, astragalus, calcaneum and metatarsal. The criteria of Boessneck (1969), Kratochvil (1969), Payne (1985) and Prummel & Frisch (1986) were used.

#### **Domestic pig/Wild boar:**

The distinction between domestic pig (*Sus domesticus*) and wild boar (*S. scrofa*) was routinely attempted on the mandibular dentition and post-cranial skeletal elements, using the metrical criteria of Payne & Bull (1988). The overall size of the post-cranial elements was also used as an indication, bearing in mind the often quite different morphology of modern pig breeds.

#### **Horse/Donkey:**

The distinction between horse (*Equus caballus*) and donkey (*E. asinus*) was routinely attempted on any *in-situ* permanent mandibular dentition by the shape and extent of penetration of the buccal enamel fold, using the criteria of Davis (1980 & 1987).

#### **Dog/Red fox:**

The separation of dog (*Canis familiaris*) and red fox (*Vulpes vulpes*) was attempted using morphological criteria devised by the author when recording the baths basilica material. It is hoped these criteria be developed and tested before publication in the near future. The work of Babendererde (1976) and Ratjen & Heinrich (1978) was not employed because copies were only obtained towards the end of recording and identification.

#### **Domestic cat/Wild cat:**

Domestic cat (*Felis catus*) and wild cat (*F. silvestris*) distinction was attempted using the morphological criteria of Kirk (1935) and Kratochvil (1973).

#### **Red deer/Fallow deer:**

Red deer (*Cervus elaphus*) and fallow deer (*Dama dama*) were separated using the morphological criteria of Lister (1996).

#### **Rabbit/Hare:**

The separation of rabbit (*Oryctolagus cuniculus*) and hare (*Lepus* sp.) was carried out using the morphological criteria of Callou (1997).

#### **Chicken/Guinea fowl/Pheasant:**

Chicken (*Gallus gallus*), Guinea fowl (*Numida meleagris*) and pheasant (*Phasianus colchicus*) distinction was attempted on the scapula, coracoid, carpometacarpus, femur and tarsometatarsus, using criteria developed by Albarella (Umberto Albarella pers. comm.) and MacDonald (1992).

### **Crows:**

The morphological (but not the metrical) criteria of Tomek & Bocheński (2000) were used when separating the crow family.

### **Rodents:**

Distinction between rat (*Rattus* sp.) and water vole (*Arvicola terrestris*) was attempted on cranial and mandibular fragments (principally teeth); all post-cranial fragments were recorded as 'rat/water vole' (although it may be possible to separate them – Keith Dobney pers. comm.). Smaller rodents were also separated on the morphology of their teeth and all post-cranial elements were recorded as 'small rodent'.

### **Frog/Toad:**

Frog (*Rana* sp.) and toad (*Bufo* sp.) distinction was attempted on the acetabulum using the morphological criteria of Böhme (1977).

## **4.4.3. Anatomical elements**

### **Countable fragments:**

The following skeletal elements and corresponding 'zones' were always recorded for all identifiable domestic and wild mammals:

- horncore >50% basal transverse section
- zygomaticus >50% nasal section
- fourth deciduous premolar >50% aboral occlusal surface
- third molar >50% aboral occlusal surface
- mandible at least one *in-situ* cheek tooth (as above)
- scapula >50% *collum scapulae* (up to the spine)
- distal humerus >50% medial trochlea
- proximal radius >50% medial section of the articulation
- distal radius >50% medial section of the articulation
- proximal metacarpal >50% medial section of the articulation
- distal metacarpal >50% achsial section of at least one condyle
- pelvis >50% ischial section of the acetabulum
- proximal femur >50% caput femoris
- distal femur >50% medial condyle
- distal tibia >50% medial section of the articulation
- calcanium all of the sustentaculum and >50% dorsal articulation
- astragalus >50% of the lateral section
- proximal metatarsal >50% medial section of the articulation
- distal metatarsal >50% achsial segment of at least one condyle
- first phalange >50% achsial section of the articulation

When specimens were unfused the corresponding epiphysial fusion plane on the metaphysis or diaphysis was to be counted. Isolated deciduous fourth premolars and third molars only relate to the larger mammals, e.g. cattle, pig, sheep/goat and deer. Rodents and small insectivores were recorded in a slightly different fashion: the mandibular first molar and all other post-cranial elements were routinely recorded, except the phalanges.

The following skeletal elements and corresponding 'zones' were always recorded for all identifiable domestic and wild birds, when over 50% of the specified area was present.

- coracoid proximal articulation
- scapula proximal articulation
- humerus distal articulation
- ulna proximal articulation

- carpometacarpus            distal articulation
- femur                        distal articulation
- tibiotarsus                distal articulation
- tarsometatarsus         distal articulation

#### **Non-countable elements:**

This category included those skeletal elements that provide useful information on body part representation for the major domesticates, but are not readily identifiable to species. The following skeletal elements have been group by size division into large mammal (cattle and horse sized animals) and medium mammals (sheep/goat and pig sized animals).

- ribs                        >50% dorsal/vertebral articulation
- vertebrae                >50% cranial AND caudal articulations

#### **Side:**

Side was recorded as either 'left', 'right' or 'indeterminate'. No attempt was made to side the phalanges.

#### **3.4.4. Post-cranial epiphyseal fusion**

Post-cranial epiphyseal was recorded as either 'neonatal', 'unfused', 'fusing' or 'fused'.

#### **3.4.5. Tooth eruption and wear**

Mandibular tooth eruption and wear was recorded for cattle and pig using the criteria of Grant (1982) and Payne (1973 & 1987) for sheep/goat.

#### **3.4.6. Sexing**

Sex was recorded as either 'female', 'male', 'probable female' or 'probable male'.

#### **Cattle:**

The pelvis was sexed using the ilio-pubic ridge and median acetabular border (see Grigson 1982: 8, Figure 1).

#### **Pig:**

Pigs were sexed by comparing the morphology of the mandibular canines (see Schmid 1972: 81, Plate 4). Male canines are larger, more robust and convex on their distal face, whereas female canines are smaller, more gracile and concave on their distal face.

#### **Sheep/goat:**

Sheep/goat remains were sexed using the same criteria as for cattle (see above).

#### **3.4.7. Butchery**

Three aspects of butchery evidence were recorded: type of butchery mark, location of butchery and the carcass reduction stage. Butchery evidence was recorded as either 'cut', 'chop' or 'saw' marks, plus combinations. The location of butchery marks on an anatomical element was recorded pictorially using *pro-forma* recording forms (see below).

#### **3.4.8. Biometry**

Measurements are listed in the Appendix 2 by taxon and anatomical element. The majority of measurements follow von den Driesch's (1976) definitions. All pig measurements follow the definitions of Payne & Bull (1988). Humerus 'BT', 'HT', 'HTC' and tibia 'Bd' measurements were taken for all species according to Payne & Bull (1988). Cattle, sheep/goat and deer metapodials were measured using

the criteria described by Davis (1992). Mandibular equid teeth were measured according to Davis (1980 & 1987).

### **3.4.9. Taphonomic Indicators**

The following variables were recorded as taphonomic indicators. The rationale for having chosen specific variables is discussed in the relevant chapters (see Chapters 4-5).

#### **Fragmentation:**

Fragments were placed into one of the following categories: '100%', '>50%', '50%' and '<50%'.

#### **Preservation:**

Surface preservation was recorded as either 'poor', 'moderate' or 'good'. Good preservation was characterised by very little exfoliation and abrasion to original surfaces and broken edges; conversely poorly preserved material had suffered considerable attrition to original surfaces and broken edges.

#### **Angularity:**

Angularity of break was recorded as either 'spiky' or 'rounded'. In addition, a separate field recorded whether or not a fragment had received any new breakage.

#### **Gnawing:**

Gnawing was recorded as either 'canid', 'felid', 'rodent' or 'part-digested', plus combinations.

#### **Burning:**

Burning was recorded as either 'singed', 'burnt' or 'calcined'.

### **3.4.10. Pathology**

For cattle, the splaying of metapodial distal condyles was recorded (see Chapter 7). The presence or absence of these conditions was routinely recorded, so their frequency could be accurately calculated. Any other conditions were catalogued when encountered. All pathological specimens were separated from the main assemblage to enable further description, analysis, photography, etc.

### **3.4.11. Non-metric traits**

Three different non-metric traits were recorded for cattle mandibles: extra/morphologically unusual mental foramina on the distema, absent second premolars and reduced/absent hypoconulids on the third molar (see Chapter 7). The presence or absence of these conditions was routinely recorded, so their frequency could be accurately calculated. Any other conditions were catalogued when encountered. All non-metric specimens were separated from the main assemblage to enable further description, analysis, photography, etc.

## **3.5. Analysis**

### **3.5.1. Software**

Data was manipulated within MS Access, but was also exported into MS Excel 2000 – XP and SPSS Inc. SPSS 10.0 – 11.0. Bibliographic references were compiled and managed in Thomson ISI ResearchSoft EndNote 4 – 8.

### **3.5.2. Taxonomic identification**

Metrical distinction was attempted where applicable to support morphological separation (see above), for example sheep/goat metapodials using Boessneck (1969).

### **3.5.3. Quantification**

#### **Frequencies:**

As previously discussed, the main advantage of 'diagnostic zone' methods is that NISP equates directly to MNE and requires no additional manipulation. The system chosen to record the bathus basilica assemblage recorded more than one zone for certain anatomical elements (see above). These elements were the mandible, radius, metacarpal, femur and metatarsal. Therefore, it was necessary to determine the MNE of these elements. Calculating MNE for the limb bones was a simple matter of taking into account the most frequently occurring zone (and side).

Calculating mandible MNE involved a more complicated procedure. The mandible MNE figures were calculated by adding all the isolated fourth deciduous premolars and third molars to mandible NISP counts (excluding those with neither *in-situ* fourth deciduous premolars nor third molars) because each tooth represents a single mandible. The potential overlap between the point at which the fourth deciduous premolar was shed and the third molar erupted had to be checked. This was achieved by considering mandibles with either tooth from assemblage. It was discovered there was an overlap for cattle: fourth deciduous premolar stages 'j' to 'n' and third molar stages 'V' to 'b'. One 'set' of the corresponding teeth was then excluded from the calculations. No overlap existed for either pig or sheep/goat.

#### **Anatomical representation:**

When necessary, MNE values were adjusted for anatomical elements that occur more than twice in one skeleton. Phalanges were divided by four for cattle, pig and sheep/goat. Pig metacarpals and metatarsals were divided by two. Canid, felid, mustelid, etc metapodials were divided by eight.

### **3.5.4. Post-cranial epiphyseal fusion**

Post-cranial epiphyseal fusion ages were attributed using Reitz & Wing's (1999: 76, Table 3.5) combined summary of Schmid (1972: 75, Table 9) and Silver (1969). Appendix 6 outlines the suggested absolute ages.

### **3.5.5. Tooth eruption and wear**

Mortality profiles were constructed for cattle and pig using the board categories proposed by O'Connor (2003: 160, Table 31) and Payne's (1973) for sheep/goat.

Both isolated and *in-situ* teeth were utilised to maximise the potential of the available data. Mandibles from young individuals are prone to greater levels of attrition (see Munson 2000; Munson & Garniewicz 2003; see Chapter 4). Using isolated mandibular deciduous fourth premolars helps redress the problem. However, this involved the stochastic replacement of missing data, which can be problematic (see O'Connor 1988: 84 & 123 & 2000: 88-89). To counter this, profiles that included isolated teeth were compared to profiles created using only mandibles with a definite stage. The former did not differ significantly from the latter (other than the inclusion of greater frequencies of very young specimens).

Comparing tooth eruption and wear data to the post-cranial epiphyseal fusion data to identify any discrepancies is a necessary step when constructing mortality profiles and interpreting husbandry regimes.



However, assigning absolute ages to relative stages is problematic because the chronological age at which teeth erupt (and post-cranial elements fuse) fluctuates considerably. Many factors affect the maturation of a mammal skeleton, including breed, nutritional state, sex, etc (see Moran & O'Connor 1994: 269-270 & 273-275). An attempt has been made to confer absolute ages to the various stages. Two sources have been used where possible to highlight the potential age ranges.

**Cattle:**

Appendix 3 outlines the suggested absolute ages for O'Connor's (2003: 160, Table 31) cattle age stages.

**Pig:**

Appendix 4 outlines the suggested absolute ages for O'Connor's (2003: 160, Table 31) pig age stages.

**Sheep/goat:**

Appendix 5 outlines the suggested absolute ages for Payne's (1973) sheep/goat age stages.

**3.5.6. Tooth and fusion data compared**

Based on the absolute ages quoted above the following correlations between post-cranial epiphyseal fusion and tooth eruption and wear can be made.

**Cattle:**

- neonate = Neonate
- early fusing = Juvenile – Sub-adult 1
- mid/late fusing = Sub-adult 2 – Adult 2
- post-late fusing = Adult 3 – Elderly

**Pig:**

- neonate = Neonate – Juvenile
- early fusing = Immature 1 – Sub-adult 2
- mid/late fusing = Adult 1 – Elderly

**Sheep/goat:**

- neonate = A
- early fusing = B – C
- middle fusing = D – E
- late fusing = F
- post-late fusing = G – I

**3.5.6. Sexing**

Researchers have attempted to use various anatomical elements to sex cattle, such as the atlas, axis, astragalus and calcaneum, although most are now considered problematic (Grigson 1982: 7-12). Modern zooarchaeology favours two approaches: morphology and biometrical analysis, using the pelvis and metacarpals respectively.

**Cattle:**

Biometrical differentiation favours the metacarpal because of its load-bearing position in the skeleton, which reflects the greater bulk of male animals (Higham 1969). Indices are created from measurements, although these can be problematic for two principle reasons. Condyles are often affected by pathological splaying that can obscure any sexual dimorphism (Bartosiewicz 1987; Bartosiewicz *et al.* 1997: 91-92; Fock 1966. Breed and castration also complicate the picture (Grant 1975: 401[#533]; Grigson 1982: 10-12; Howard 1963: 92; Maltby 1979: 33).

Indices developed Howard (1963) have been used to analysis the baths basilica data: mid-breadth (SD/GLx100) against distal breadth (BatF/GLx100). Width at the distal epiphyseal fusion point (BatF) has been substituted for maximum distal width (Bd) to counter biasing from pathological condyle splaying. The possibility that castrates were present in the sample has also be considered. Bones of castrates are generally longer and more gracile than complete males (Grigson 1982: 11; Maltby 1979: 33), although this is influenced by the age at which castration took place (Grant 1975: 401; Luff 1993: 60). The following index was used to explore this: distal breadth (BatF/GLx100) against greatest length (GL).

#### **Sheep/goat:**

Sheep/goat remains were sexed using the same criteria as for cattle (see above).

### **3.5.7. Butchery**

#### **Carcase reduction:**

Butchery allows cultural inferences to be postulated directly. The physical and anatomical characteristics of an animal only partially dictate how a carcass is butchered. A large proportion of butchering practices are not dictated by purely functional considerations and this allows ethnographical and culturally defined trends to develop, which may be as readily identifiable as any artefact type (Aird 1985: 5; Binford 1978: 47; Grant 1975: 383; Noe-Nygaard 1977). National, regional and religious variation, plus social stratification, may all be reflected directly in butchery techniques (Gerrard 1979: 313-322, Figures 5-57; Maltby 1989; Moore *et al.* 1983; Swatland 2000: 56-63).

Relating butchery evidence to stages in the carcass reduction process was carried out using the ethnographic work of Binford (1981) on Nunamiut Eskimo moose and caribou butchery. This was carried out with the obvious caveat that modern Nunamiut butchery practices may have little in common with late Romano-British and early medieval urban practices or with the different species involved. The Nunamiut data was displayed pictorially showing the location of butchery marks on individual skeletal elements for each stage of the reduction process and was also summarised in table format (Binford 1981: 98-133, Figures 4.06-4.38, Table 4.04). The former aspect made it particularly useful as a quick reference when physically recording material.

Several other locations/orientations of butchery marks were added to compliment those of Binford (1981). This was deemed necessary to prevent many of the *Viroconium* butchery marks falling into the 'other' category. The additional categories were: transverse marks zygomaticus; longitudinal/diagonal marks on shafts equating to filleting on long bones and cannon bones; transverse marks on epiphyses equating to dismembering on long bones and cannon bones; transverse marks located mid-shaft on the first phalange were assumed to represent skinning.

### **3.5.8. Biometry**

#### **Log-ratio technique:**

By utilizing the 'log-ratio' technique of Simpson *et al.* (1960: 356-358), which has been developed for use in zooarchaeology by Meadow (1981), Payne & Bull (1988) and Davis (1996), measurements from different anatomical elements can be combined to form larger datasets for comparative purposes. This method calculates the logarithm of the ratio between a measurement and its standard. Few standards have been published. The exception is a standard for sheep, calculated from a flock of unimproved Shetland

sheep (Davis 1996). Many researchers choose their own standard from the material under study, taking into account chronological period, geographical region and any specific research questions. Such standards are usually measurements from a particular phase, which allows direct comparison with the remainder of the assemblage. Measurements were pooled for length, width and depth separately because measurements taken along the same axis are highly correlated (Davis 1996: 605). Only one length, width or depth measurement was taken from any single specimen to avoid possible biasing (Umberto Albarella pers. comm.).

Phase W measurements were adopted as the standard. Roman breed improvements should have occurred by the fourth century AD and any stagnation and decline of husbandry practices in the immediate post-Roman period should not have occurred. Ideally measurements from Phase T-V would have been used as the standard, but produced too few cases. The following measurements have been used to calculate log-ratios (metapodial 'BatF' and '3' have been used to avoid splayed specimens):

- cattle and sheep/goat: Appendix 7
- pig: Appendix 8
- domestic fowl: Appendix 9

**Skewness:**

Skewness was used in some instances to aid the interpretation of distributions, particularly whether or not a single population was present and the likely composition of male and female animals. This approach was only partially successful (see Chapters 7-10). The following outline has been summarised from SPSS. Skewness is a measure of the asymmetry of a distribution: a normal distribution is symmetric (with a value of zero), whereas a distribution with significant positive skewness has a long right tail and a distribution with significant negative skewness has a long left tail. As a rough indication, a skewness value more than twice its standard error represents a departure from symmetry.

## 4. Taphonomy

### 4.1. Introduction

*'One sometimes wonders whether there is any similarity between a published bone report and the animals exploited by ancient humans.'* (Davis 1987: 23)

The above quote highlights why it is of the up-most importance to consider taphonomic factors. The purpose of this chapter is to 'strip away' the various taphonomic layers to leave a 'filtered' assemblage that can be analysed and applied to the research questions (see Chapter 2), not doing so could obscure or alter the final interpretation. The 'stripping away' has been carried out in the following order:

- retrieval and sample bias
- gnawing and attrition
- weathering and preservation
- trampling and abrasion
- burning
- fragmentation
- secondary deposition and residuality

Secondary deposition and residuality are considered in the next chapter (Chapter 5). Fragmentation is considered in the chapters regarding specific taxa, primarily in the corresponding body part distribution and butchery sections. A historiography of taphonomy and taphonomic research is not necessary within this discussion, but brief definitions and descriptions of what constitutes 'taphonomy' are necessary.

### 4.2. Taphonomy: definition

Archaeological taphonomy can be divided into 'first and second order changes' (Davis 1987: 23; Reitz & Wing 1999: 112 & 114-122). First order changes include the behaviour and activity of past humans, other animals, plants and geological processes involved in the accumulation, deposition, attrition and reworking of an assemblage, which are beyond archaeological control. Second order changes include archaeological excavation, recovery, analysis and publication, which are possible to control. The following definitions are useful when attempting to differentiate between the various components involved in taphonomic research (Lyman 1999: 3):

- agent: the 'immediate physical cause' of modification to an animal carcass or bone (see Gifford-Gonzalez 1991: 228), such as gravity, human beings or dogs
- process: the dynamic action of an agent on the carcass or bone, such as down-slope movement, fracturing or gnawing
- history: a general (relative) chronology of the agents and processes involved

Pathways are notoriously complicated and often involve inter-related and cyclical processes that make the identification of particular agents extremely difficult (Lyman 1999: 3). Modelling has often been used in the attempt to simplify the taphonomic pathways and to demonstrate the physical loss of material (and information) at each stage, for example the flow diagrams of Davis (1987: 22, Figure 1.1), Hesse & Wapnish (1985: 19, Figure 9), Meadow (1981: 65, Figure 1), Medlock (1975: 225, Figure 2) and Reitz & Wing (1999: 111, Figure 5.1).

A plethora of agencies and processes may therefore be involved within the overall taphonomic process, which have a potentially limiting effect on information retrieval, by reducing and distorting the

composition of vertebrate assemblages (Locock *et al.* 1992: 297; Lyman 1999: 1; O'Connor 2000: 19; Reitz & Wing 1999: 112). Failure to consider taphonomic factors may result in unsubstantiated assumptions and incorrect interpretations (Davis 1987: 23; Locock *et al.* 1992: 297; Lyman, 1999: 1). To this end Gifford (1981), summarised by Lyman (1999: 5), outlined two principle aspects of taphonomic research. Firstly, 'stripping away' the taphonomic signatures from an assemblage to '*... obtain accurate resolution of the prehistoric biotic community ...*' and, secondly '*... determining the nature of the taphonomic overprint in order to be able to list the precise taphonomic mechanisms responsible for a given fossil assemblage ...*'. Taphonomic research relies on the assumption that human behaviour and environmental/ecological 'laws' have remained constant and unchanged through time (i.e. uniformitarianism) and can be analysed through ethnographic, middle-range and experimental research (Lyman 1999: 2 & Chapter 2; Reitz & Wing 1999: 122-124). Such approaches still invariably rely on assumptions, but it may be argued that these are realistic and testable assumptions.

Some agencies and processes have been construed as more relevant and important than others in zooarchaeological research (O'Connor 2000: 20). The effect that scavenging canids, principally domestic dogs for the majority of sites, have on the physical location, species and skeletal composition, and severity of fragmentation of a vertebrate assemblage, derived from human activity, is considered especially pertinent (for instance Brain 1967, 1976 & 1981; Marean 1991; Payne 1985; Stallibrass 1990). In particular cases other agencies may be more relevant, resulting in the same processes. The effect owls have on small vertebrate cave assemblages (see Andrews 1990; Bocheński 1993; Williams 2001) or in extreme cases ungulate gnawing (Brothwell 1976; Kierdorf 1994; Sutcliffe 1973), for example.

### **4.3. Retrieval and sample bias**

#### **4.3.1. Outline**

Identifying recovery biases in archaeological assemblages is crucial. Numerous authors have considered this problem, for instance: Clason & Prummel (1977), Gamble & Bailey (1994), Grayson (1984), James (1997), Jones (1983), O'Connor (1988), Payne (1972b, 1975 & 1992), Rackham (1982), Shaffer & Baker (1999), Shaffer & Sanchez (1994), Stahl (1996) and Wing & Quitmyer (1985).

The absence of particular skeletal elements or species in an assemblage may simply reflect a failure to recover them, rather than representing any particular form of human activity or a high attrition rate. This is especially relevant when hand retrieval is the principal recovery method, as it inevitably favours the recovery of the large skeletal elements from the larger mammalian species. The smaller elements, and also the small species of mammal, bird and fish, can be virtually ignored. The failure of hand retrieval to collect the smaller skeletal elements, and presumably the smaller fragments, of the large domestic mammals was illustrated by the sieving experiments of Payne (1972b: 59-60): sieving doubled the number of cattle bones recovered, while pig increased by a factor of ten and sheep by a factor of over 20. Sieving can remedy this situation and various techniques have been employed (see below). There is some debate regarding which method is the most suitable, taking into account recovery rates, efficiency and time/funding constraints (see de Moulins 1996; Levitan 1982). Invariably this leads to confusion. Sieving requires specialised equipment and it can also be very labour intensive. These factors often combine resulting in the haphazard implementation of on-site sieving strategies that often negates any benefit they might possess.

Wet sieving is generally recognised as the most favourable method. It leads to the most complete recovery of archaeological artefacts. Water is the most effective means of breaking down the aggregate soil matrix without further damaging the artefacts and has the added advantage of cleaning the artefacts, which makes their identification and collection easier (Payne 1972b: 52). This technique has two forms. Firstly, 'bulk' wet sieving large volumes of material for the recovery of artefacts usually on 4-10 mm aperture. Secondly, 'flotation' of smaller samples (often 20-30 l in volume) principally for the recovery of botanical remains. The 'heavy residue' is washed over a sieve/mesh, usually 1-2 mm aperture, for artefact recovery. However, James (1997: 395) suggested that flotation is unsuitable for the recovery of vertebrate remains because bone recovery is incidental, only small quantities of heavily fragmented specimens are produced and integration with other recovery techniques is difficult. This viewpoint has been heavily criticised by Shaffer & Baker (1999: 1182). Alternatively, 'bulk' dry-sieving has the advantage of being a less complicated process, does not require as much specialised equipment and is faster and easier to implement. This method also has its critics, Payne (1972b: 49) and Thomas (1969: 392) argued the level of recovery fluctuates greatly, depending upon soil colour, texture and moisture content, the personnel involved, the time of day, the concentration of artefacts produced and the size of any accumulated backlog (although the same arguments also be apply to wet-sieving).

Regardless of whether wet- or dry-sieving is used mesh size is particularly important: the smaller the mesh the more laborious – the larger the mesh the more biases. A 3 mm ( $\approx 1/8$  ") sieve is considered the optimal aperture size (James 1997: 395-396; Payne 1972b: 52-53; Shaffer & Baker 1999: 1181; Shaffer & Sanchez 1994: 528). Three mm mesh is fairly durable and residues can be sorted by eye, but still improves on hand retrieval. To obtain good samples of land snails, mineralised seeds and rodent bones, etc smaller meshes are required, however (Jones 1982: 75; Payne 1972b: 53 & 1992: 2; Stahl 1996: 33-35).

Identifying recovery biases in an assemblage is a crucial initial step in any analysis. A badly biased sample should be recognisable by carefully considering the proportions, and presence/absence, of particular elements from the larger mammals. A dearth of carpals, tarsals and phalanges relative to limb bones, absence of isolated teeth or scarcity of unfused epiphyses to diaphyses, for instance. A high proportion of identifiable specimens and large fragments may also be an indicator (Payne 1975: 14). If recovery bias is suspected there are several ways of reducing it. Quantification methods can be employed to 'even out' discrepancies between large and small species: MNI (minimum number of individuals) is preferable to NISP for this reason (Payne 1975: 14).

Another method is the application of 'correction factors'. Thomas (1969) carried out a series of sieving experiments to determine what proportion of retrieved mammal bone assemblages were lost through different aperture sieves. This was achieved by dividing different species into size categories. Correction factors could then be calculated for each size category and mesh size based on the following formula (Thomas 1996: 396):  $\text{total bones} \div \text{recovered bones} = \text{correction factor}$ , for example the correction factor for 'Class I' (mouse – gopher sized animals)  $1/4$  " recovered fragments would be  $2981 (\text{total bones}) \div 141 (\text{recovered bones}) = 21.14$  (correction faction). These factors could then be applied to archaeological data, using the following formula:  $\text{initial frequency of bones} \times \text{correction factor} = \text{corrected frequency}$ . Any estimation of missed proportions should be taken as a broad indicator because of inter-site variability

(Shaffer & Sanchez 1994: 525). Thomas (1969: 399) stated that 'test units' should be analysed from each 'culturally homogeneous unit' to gauge any variation.

### **4.3.2. Baths basilica**

Theoretically all deposits were dry sieved from 1970 onwards at the baths basilica site. A variety of mesh sizes were used (3 mm, 5 mm or 10 mm) for dry sieving. Unfortunately, no formal records were kept relating to the volume sieved or mesh size used for individual deposits (Roger White pers. comm.). Heavy residues from the wet sieving programme were processed on a 5 mm mesh (Charles *et al.* 1997: 324 & 327). In the vast majority of cases there were no details on individual bags of material to indicate which collection method had been used and which mesh size if they had been dry sieved. All these factors combined make the identification of any existing recovery bias extremely problematic. The recorded assemblage has therefore been treated as a single entity regardless of retrieval method, which is far from ideal. Various efforts were made to identify any bias regardless.

Perkins & Daly (1968: 103-104) noted a higher ratio of foot to limb bones for cattle, and the reverse pattern for sheep and goat in a Neolithic Turkish assemblage. This was interpreted as cattle being butchered where they were hunted and killed, with the joints of meat being dragged back to the village in the skins, which still had the foot bones attached, whilst the sheep/goat carcasses were small enough to transport whole: the 'schlepp effect'. Payne (1975: 11) demonstrated that wet sieved samples led to virtually identical ratios of limb and foot bones for cattle and sheep/goat, whereas a biased hand retrieved sample produced a pattern similar to the Turkish material: the 'pseudo-schlepp effect'.

The ratios of limb and foot bones for the baths basilica cattle and sheep/goat were plotted against Payne's (1975: 11, Figure 5) ratios by phase (Figure 11; data taken from Table 37). MNE figures have been used to account for more than one zone being recorded for some elements. The baths basilica ratios are not directly comparable to Payne's. A slightly different suite of elements were used; Perkins & Daly (1968: 99) included the ulna, patella, second phalange and third phalange, not recorded for the baths basilica. Despite this, the baths basilica cattle and sheep/goat limb to foot ratios for all phases mirror the 'pseudo-schlepp effect' produced by the biased hand retrieved sample, although not as pronounced. This suggests that a recovery bias does exist within the baths basilica assemblages, but the haphazard dry-sieving policy has lessened the effect to some degree. The alternative explanation could be that differences in species utilisation account for the slightly different limb and foot bone ratios between cattle and sheep/goat, although would seem unlikely, as the pattern remains constant regardless of chronological phase.

The number and range of small species of mammals and birds would seem to suggest a good recovery rate (see Chapter 6), although the range of skeletal elements collected for the smaller species also highlight the presence of a recovery bias. This can be illustrated by comparing the range and proportion of skeletal elements for the lagomorphs and rodents to one another (Figure 12). Before comparison it should be pointed out that, whereas the range of rodent elements should result directly from recovery, the pattern for lagomorphs may have been affected by butchery, etc. The majority of lagomorph bones should have been recovered even by the 10mm mesh (with the possible exception of isolated third molars and first phalanges), whereas even the 3mm mesh will have failed to collect a significant number of rodent bones (excluding semi-complete crania and long bones). Figure 12 would seem to confirm this hypothesis. The lagomorphs were represented by the majority of recorded zones, including first phalanges, with no single zone accounting for more than 13% of the lagomorph assemblage. The rodent

assemblage was dominated by the mandible, semi-/complete long bones and pelvis. No third molars, metacarpals, astragalus, calcaneum or first phalanges were retrieved. Scapula and metatarsals only accounted for less than one percent of the rodent assemblage.

This would suggest that any mammal or bird smaller than cat, lagomorph or domestic fowl was under-represented in the baths basilica assemblage. Because many small species have no real economic value the relevance of their absence is somewhat annulled and environmental reconstruction can mostly be achieved on a presence or absence basis. Exceptions may be the smaller game birds, such as woodcock and quail, whose real economic significance could be under-valued. As the baths basilica assemblage has been grouped together, regardless of recovery technique, there is no possibility of employing correction factors to gauge what has been lost. In addition, elements from neonatal piglets are also likely to have fallen through the 10mm and 5mm apertures, and even the 3mm aperture will not have retrieved the smaller elements.

The examination of the baths basilica assemblage has suggested the presence of a recovery bias. This would seem to affect the smallest elements from the medium-sized mammals, such as isolated teeth and first phalanges, and virtually all the skeletal elements from the smaller species (although a wide variety of microfauna were still retrieved). Because recovery methods were not routinely recorded and material labelled accordingly, it has not been possible to quantify the degree of loss. Even if the relevant information had been recorded it is doubtful such an exercise would have been viable, as the wet sieved heavy residues were collected on a 5mm aperture, which would have also lead to considerable loss. A 1mm and 3mm aperture should have been used (see English Heritage 2002: X̄). Ideally, a range of different recovery techniques (and mesh sizes) should be employed that enable biases to be identified and quantified to some extent.

## **4.4. Gnawing and attrition**

### **4.4.1. Outline**

Scavenging animals have a detrimental effect on the information potential of animal bone assemblages for two reasons: destruction and secondary deposition. A greater volume of research has been carried out on the former, (see Bartram & Marean 1999, Blumenschine & Marean 1993, Brain 1981, Klein *et al.* 1999, Marean 1991, Marean & Spencer 1991, Payne & Munson (1985), Pickering 2002 and Stallibrass 1990). Relatively little exists on the latter, for instance Marean & Bertino (1994). Wide varieties of animals destroy bone by gnawing and move bone through burrowing. These may be contemporary or intrusive and include domestic and wild species of canids, felids, mustelids and rodents. The ease with which gnawed bone can be attributed to a particular species fluctuates (see Andrews & Nesbit Evans 1983, Blumenschine & Marean 1993: 279-280, Blumenschine *et al.* 1996, Brothwell 1976, Greenfield 1988, Hayes 1983, Kierdorf 1994, Moran & O'Connor 1992, Schmitt & Juell 1994 and Selvaggio & Wilder 2001).

Domestic cat and rodent gnawed bone is normally readily identifiable and generally occurs in insignificant amounts. The majority of gnawed bone is usually ascribed to domestic dog. The assumption that dogs account for the majority of gnawing may actually be incorrect because the domestic pig as a bone consumer has been largely overlooked (Stallibrass 1990: 152). Pigs were widely bred, stalled and even left to roam-free in urban centres, so could be responsible for considerable amounts of



attrition and redeposition. Greenfield's (1988: 473) pioneering study observed bone chewing by pigs. It was noted that pigs left a very similar taphonomic signature to dogs (taxa and element). On macroscopic observation there was little to distinguish between the pig and dog tooth marks. Pig gnawing was characterised by 'long shovel-type' marks and the absence of puncture marks (Greenfield 1988: 476-478).

In some respects, if both vectors produce a similar pattern, distinguishing between dog and pig is irrelevant. The identification, quantification and consideration of the potential bias are the principle concerns of study. The identification of gnawed bone is fairly straight forward, if recognisable teeth marks are present. Blind testing of inter-analyst correspondence in the identification of tooth marks has demonstrated that experienced researchers routinely recognise 97% of marks, and even novices with as little as three hours tuition spot 86% of marks (Blumenschine *et al.* 1996: 503). However, the ability to spot gnawing is partially dependent on the surface preservation (cortical integrity) of the bones being recorded, as badly abraded and exfoliated bone can obscure it. In addition to actual tooth marks other indicators can be used: body part representation and fragmentation. Scavenging canids demonstrate a preference for certain anatomical elements and tend to gnaw them in a consistent manner, whilst the elements themselves have physical characteristics that determine durability. These combine to produce a distinctive pattern. Actualistic experimental work (see Brain 1981; Marean & Spencer 1991; Payne & Munson 1985) has identified this pattern (see below).

#### **4.4.2. Baths basilica**

Table 7 summarises the proportion of dog (or conceivably pig) gnawed cattle, pig and sheep/goat fragments from the baths basilica by phase. An average of 13% cattle, 21% pig and 13% sheep/goat fragments have been gnawed (combining 'canid gnawed' and 'partially digested' fragments). There appears to be a high level of correlation between phases, excluding those with small numbers of cases. Pig bone fragments have recorded the highest frequency of gnawing; they are generally favoured because they are especially greasy and fatty. Twenty-one percent is not particularly high. It is not uncommon for one third of a Romano-British assemblage to be gnawed (personal observation). The baths basilica material has therefore been subject to an 'acceptable' level of attrition (one that does not obscure anthropogenic signatures) by scavenging animals, which should not bias the analysis and interpretation.

This is supported by comparing the percentage MNI of skeletal elements to the ratio of gnawed and ungnawed elements for cattle, pig and sheep/goat (Figures 13-15; Tables 8-10). The two variables may not be directly comparable, as the most heavily gnawed elements would presumably be 'non-countable', due to more severe fragmentation. Heavily gnawed elements often result in only the mid-shaft of limb bones remaining unmodified, and morphologically identifiable for instance (Marean & Spencer 1991: 651). Figures 13-15, however, suggest there is no direct correlation between the amount any particular skeletal element has been gnawed, and the relative abundance of that element.

Brain (1981) studied the taphonomic patterns of goat bones at several indigenous villages in the lower Kuiseb Valley in south-west Africa in the attempt to distinguish between detritus from human activity and scavenging dogs. The number of each element was expressed as a percentage of the most commonly occurring element. This demonstrated the expected pattern that the principal taphonomic agents would produce. A surprising level of concordance existed between goat and bovid patterns, despite the different chronological ages and species involved, and the different destructive and accumulating agencies (Brain 1981: 21-22). Brain (1981: 21) concluded that the differential destruction of different skeletal elements

was largely based upon the physical structure and fusion state of epiphyses. The proximal humerus (late fusing and not especially dense) is often totally absent, whereas the distal humerus, (early fusing and dense) survives largely intact, for instance. Payne & Munson (1985: 32) carried out a series of attrition experiments using two Redbone Coonhounds (a large north American dog breed). Their goat experiment produced a very similar to that of Brain's (1981: 23, Figure 18a & 277, Table 5), although frequencies were generally higher (Payne & Munson 1985: 35 & Figure 1). This was thought to be because Payne & Munson (1985: 35) only used two carcasses, whereas Brain did not know the exact number of carcasses involved (results on percentage MNI, which assumed that all specimens of the commonest element had survived).

The body part representation of cattle, pig and sheep/goat for each individual phase and all phases combined were compared to Brain's (1981: 23, Figure 18a & 277, Table 5) and Payne & Munson's (1985: 41, Table 2) goat skeletal element attrition-survival patterns to determine any similarities (Figures 16-18; Tables 11-13). Brain's (1981: 23, Figure 18b & 277, Table 8) bovid skeletal durability patterns were deemed unsuitable for comparison, as they were derived from an archaeological source, and the exact taphonomic agents responsible were therefore unknown. The cattle from the baths basilica (Figure 16), for either individual phases or all phases combined, demonstrate virtually no similarity to the goat pattern noted by Brain (1981: 23, Figure 18b & 277, Table 5), and only a semblance to Payne & Munson (1985: 35 & Figure 1). However, cattle from the baths basilica showed a high level of inter-phase correspondence. Even elements prone to high dog attrition (the calcaneum, for instance) frequently occur and the levels of high- and low- utility elements fluctuate with no clear distinctions. This pattern demonstrates that whole carcasses were present. This would suggest an anthropogenically derived signature that has not been overly biased by the activities of scavenging animals.

Comparing pig bone to the patterns of Brain (1981: 23, Figure 18b; 277, Table 5) and Payne & Munson (1985: 35 & Figure 1) may not be appropriate. Pigs are generally slaughtered before they reach full skeletal maturation (immature bone is prone to greater attrition) and pig bone is particularly attractive to scavengers because of its fat content. Despite this caveat, pig body part representation (excluding Phase X) more closely resembles the taphonomic pattern than cattle (Figure 17). Overall pattern shows a clear dominance of mandibles and considerably lower proportions of the post-cranial elements. This may be a genuine taphonomic pattern for the reasons outlined above; alternatively mandibles might be over-represented because of the way they were quantified (see Chapter 3). It has therefore been difficult to determine whether the observed pattern resulted from human activity or scavenging dogs.

The baths basilica sheep/goat patterns demonstrate the closest similarity to the taphonomic patterns (Figure 18). This suggests that the baths basilica sheep/goat assemblage has been subject to a significant attritional agency. However, the sheep/goat assemblage did not demonstrate especially high gnawing frequencies, with an overall average of 14.9% (Table 7).

To confirm the lack of parity between the patterns of Brain (1981: 23, Figure 18b & 277, Table 5) and Payne & Munson (1985: 35 & Figure 1) and the baths basilica cattle, pig and sheep/goat body part distributions an 'index of fragility' was created. This was based on the assumption that smaller anatomical elements and those of immature individuals are more prone to destruction by scavenging animals (see Brain 1981: 21; Payne & Munson 1985: 37). Fragmentation was plotted by epiphyseal fusion state ('fused', 'unfused' or 'neonate') for the humerus, tibia, scapula, astragalus, calcaneum and

first phalange for cattle, pig and sheep/goat (Figures 19-21; Table 14-16). All produced a similar pattern. The fused scapula, humerus, tibia and calcaneum were the most fragmented, unfused specimens were only moderately fragmented and neonatal specimens the least fragmented. This represents an inversed taphonomic pattern. The astragalus demonstrated a similar pattern and the first phalange demonstrated no clear pattern. However, the observed pattern for neonatal specimens may be due to a recovery bias (highly fragmented neonatal material would not have been retrieved), rather than an attritional one. In additionally, the neonate plots were based on a small number of cases, unlike the fused and unfused specimens. Taking this into account the overall pattern is still fairly conclusive, particularly for the fused and unfused specimens, and would suggest that fragmentation was derived from some other agency, i.e. butchery, other than scavenging dogs, and supports body part distributions.

## 4.5. Weathering and preservation

### 4.5.1 Outline

Behrensmeyer (1978: 153) defined weathering in its broadest sense can be defined, as

*'... the process by which the original microscopic and inorganic components of bone are separated from each other and destroyed by physical and chemical agents operating on the bone in situ, either on the surface or within the soil zone.'*

This general definition of weathering encompasses what in zooarchaeological terms normally gets referred to as 'preservation'. This usually involves an assessment of the overall condition of a fragment from its external surfaces using a range of subjective criteria, such as flaking, appearance of cracks and porosity of the bone. A more refined definition of weathering simply refers to the amount of time a bone was exposed on the surface prior to incorporation into the archaeological record and soil matrix. However, differentiating between surface exposure and burial within the soil matrix may be difficult.

Estimating longevity of exposure is useful in determining whether a fragment derives from primary or secondary deposition. A variety of factors dictate the extent to which a fragment is weathered and preserved. Lyman (1999: 361-366) summarises the variables that are thought to influence the weathering and preservation of bone (summarising Behrensmeyer 1978):

- skeletal element: the physical size and structural density of an individual anatomical unit
- taxon: the physical size, structural density and porosity of skeletal elements from different species varies
- depositional micro-environment: the general environment (moisture, acidity, abrasion and light, etc) of the depositional area can affect an entire assemblage
- vegetation habitat: the vegetation habitat can create differences in micro-climate and affecting the 'accumulation history'
- micro-environment of a spatial point: the specific environment of a single bone (see 'depositional micro-environment' above)
- years since death: 'intra-carcass variation', i.e. different individuals die at different times that dictates when bones become defleshed and exposed
- exposure duration: is the amount of time between exposure (after the flesh has been removed) and burial of fragments
- accumulation history: active accumulation; the depositional pattern would differ considerably between the burial of a fresh articulated carcass and an old exposed disarticulated carcass

Weathering, and its resultant preservation, is a linear process that occurs over a temporal period. However, all the above variables combine to determine the rate and severity of weathering, which makes measuring longevity of exposure and degradation extremely difficult. It is therefore almost impossible to

translate into chronological time; the quantification of weathering duration is relative rather than absolute. Nevertheless, useful information relating to depositional processes can be gleaned from a consideration of bone preservation. It also has to be remembered that pre-depositional treatment, such as cooking, may affect how a particular bone weathers (see Nicholson 1992, 1993, 1996 & 1998).

#### **4.5.2. Baths basilica**

Weathering from exposure on the surface was not specifically recorded for the baths basilica material. Instead the overall preservation (see above) of the baths basilica assemblage was gauged by assigning one of three subjective categories to each recorded fragment: 'good', 'moderate' or 'poor' (see Chapter 3). Table 17 summarises the overall preservational state for the major domesticates by chronological phase. Regardless of species or phase there is a high level of correspondence that would indicate bone preservation derives predominantly from inclusion in the burial environment. The majority of specimens are either well-preserved or moderately well-preserved: an average of 49% cattle, 53% pig and 52% fragments were well-preserved, and 48% cattle, 46% pig and 44% sheep/goat were moderately well-preserved. Very few fragments were weathered to any great degree, i.e. were poorly preserved: an average of 4% of the cattle and sheep/goat fragments, and only 2% of pig. This would also imply that the majority of fragments were incorporated into the burial environment fairly rapidly.

With the exception of Phase W (Table 17) all the chronological periods broadly match the average figures outlined above. Phase W differs in that the largest proportions of fragments were moderately well-preserved, and a higher than average number of fragments poorly preserved: 12% cattle, 6% pig and 8% sheep/goat. Much of the more poorly preserved material from Phase W derived from dumps/levelling deposit from the last re-flooring of the baths basilica, which almost certainly denotes the fact that it represents contemporary secondary deposition (see Chapter 5).

A small number of fragments demonstrated a very particular weathering pattern. This was generally characterised by poor surface preservation that included extensive bleaching and exfoliation. Patches of green coloured algae-like growth that seemed comparatively recent in appearance usually accompanied it. Frequently this condition only affected one end of a fragment, whereas the other extremity demonstrated comparatively 'normal' preservation. It was concluded that such specimens had been left exposed between fieldwork seasons after being partially excavated; algae-like growth would be extremely unlikely to survive within the burial environment for over 1000 years.

### **4.6. Trampling and abrasion**

#### **4.6.1. Outline**

Trampling by either humans or large ungulates can have a dramatic effect on bone in two ways. Firstly, the bone can be spatially transported away from its original place of deposition, and secondly the bone can suffer attrition. This can equally affect bone buried within the substrate or exposed on the surface. Recognising and quantifying trampling, and its effects, is therefore important when analysing archaeological bone assemblages. Horizontal movement normally affects bone that is still exposed on the surface; passing humans and animals inadvertently kick loose objects some distance. The longer a bone is exposed the more likely it is to be moved in this way, and this is partially dependent on the hardness of the ground surface (see below). Vertical movement usually affects bone that has already been incorporated into the burial environment. Typically this movement is downwards, as pressure is applied

directly overhead. If however the substrate is reasonably friable and pressure is applied obliquely then there may be some upward movement (Olsen & Shipman 1988: 536-537).

Downward movement is dependent on a number of factors, which include the intensity of trampling, the degree of compaction of the soil matrix, the volume of soil covering the trampled object, and the weight and dimensions of the object (Villa & Courtin 1983: 273). To this Olsen & Shipman (1988: 537) added the force applied by the trampling agent. Shape also has some bearing on the degree of movement of a buried object, as a wide flat object would offer more resistance than a smaller more compact object of the same density and weight. Size certainly affects how long an object remains exposed on the surface before incorporation into the burial environment: smaller objects are more readily pushed into the substrate (see Nicholson 1992).

The degradation of trampled bone occurs in two ways. Firstly, trampled bone may become more heavily fragmented due the forces exerted upon it, and secondly movement against the substrate and its inclusions will abrade and mark the bone surface. It should be possible to differentiate between 'naturally' abraded bone and bone which has been abraded through trampling. It has been noted that the fluvial transportation of bone tends to abrade the entire surface of a fragment; where as aeolian abrasion only erodes the exposed or uppermost sections of the bone. In addition, 'natural' abrasion does not produce the striations that trampling does (Lyman 1999: 382; Shipman & Rose 1983). When bone is trampled the substrate particle size determines the degree of polishing (along with duration of trampling, etc), whilst the striations caused are fairly uniform regardless of particle size (Olsen & Shipman 1988: 543).

Olsen & Shipman (1988: 537) concluded that fragmentation from trampling tends to affect the weakest part of skeletal elements, and therefore leaves no distinctive pattern of fragmentation. Element size is often thought to be a factor in the survivability of trampled bone, although Nicholson's (1992: 87) experimental work demonstrated a more complicated picture: small mammal, bird and amphibian bones survived trampling and abrasion tests relatively well, and size was not the determining factor. Fish bones in the same experiments were more heavily fragmented, and size appeared to be more relevant. It was concluded that shape played a crucial role, for instance small compact bones were preferentially covered and were therefore afforded a greater degree of protection. Flat bones (even if structurally fragile) also tended to survive well (Nicholson 1992: 89).

As with most attritional agencies trampling degrades weathered bone more severely than fresh bone (Lyman 1999: 379-380; Olsen & Shipman 1988: 537). Pre-depositional treatment of bone also affects the durability of trampled and abraded bone and it has been discovered that cooking has a great influence, as cooking degrades the bones latent elasticity and tensile strength (Nicholson 1992: 88-89).

Many researchers have raised the concern that trampling marks may mimic butchery marks (see Behrensmeyer *et al.* 1986). Bone that is trampled in or on the substrate may be striated by inclusions that mimic cut marks made with either flint or fine bladed metal tools. Experimentation suggests that abrasion marks only appear like cut marks superficially and on microscopic or closer macroscopic inspection (considering frequency within the assemblage, number of marks per bone, location on the bone, orientation of marks, their morphology and depth, plus association with polishing) they can almost always be eliminated (Olsen & Shipman 1988: 549).

Despite the importance of trampling as a taphonomic agent identifying it within an archaeological assemblage is extremely difficult. Lyman (1999: 380) suggested that it is crucial to determine whether bone was fresh or weathered prior to trampling (see above). It would therefore be possible to gauge this by 'refitting' fragments and measuring the distance between breaks. This is based on the proposition that poor 'refit' is indicative of fragmentation prior to deposition and contiguous breaks infer post-depositional fragmentation (from trampling or the pressure of sedimentary overburden). However, such an approach would be completely untenable when dealing with large multi-period urban assemblages and would not unequivocally qualify the presence of trampled bone.

#### **4.6.2. Baths basilica**

The 'sharpness' of fragment edges was recorded for the baths basilica assemblage (see Chapter 3). Broken edges were subjectively assessed, and were awarded one of two categories: spiky or rounded. This was based on a similar premise to Lyman's (1999: 380) bone 'refitting' in that 'rounded' edges were assumed to represent abraded material (which may have been trampled), whilst 'spiky' edges represented material that had been broken and rapidly buried or had been broken by sedimentary pressure. In addition, the presence of new breakage was also recorded, so as not to confuse the picture. Whether or not abraded edges actually signify trampling is possibly a secondary consideration, as regardless of the agency responsible 'rounded' edges in all likelihood indicate secondary deposition. This theme will be explored in greater depth in the next section (Chapter 5) and is only summarised here. Table 18 outlines the proportions of unbroken and broken fragments, with either 'spiky' or 'rounded' edges, for the major domesticates by chronological phase. As with the weathering patterns (see above), there was a fairly high concordance between cattle, pig and sheep/goat: approximately 18-23% remained unbroken, 72-73% had 'spiky' edges and only 5-10% had 'rounded' edges. This implies that at least three-quarters of the assemblage was incorporated into the burial environment rapidly. Perhaps only between 5-10% of the assemblage was exposed and/or trampled by humans and animals within *Viroconium*. There are a few notable exceptions to this general pattern: almost 18% of the Phase T-V pig had 'rounded' edges and 21% of Phase W cattle.

### **4.7. Burning**

#### **4.7.1. Outline**

Not only is the analysis of burnt bone relevant for the reconstruction of species utilisation and culinary practices it is also of crucial importance when considering site taphonomy. As highlighted above, burning is a particularly important taphonomic agent that greatly affects the susceptibility of bone to destruction through other attritional agencies. Burning usually results from the deliberate heating of bone (and its associated soft-tissue) by humans as they cook and prepare food. It is however possible for bone to become accidentally burnt once it has been discarded and/or incorporated into the archaeological record, especially in arid environments (see Lyman 1988; James 1989: 9-10). Such an eventuality is extremely unlikely for most north-west European assemblages and any evidence of burning in the baths basilica material is almost certainly anthropogenic in origin.

Burning results in the modification of colour, morphology, size, structural density and chemical composition. Perhaps the most widely used criterion for recording burnt bone in zooarchaeology is

colour change and overall morphology. The baths basilica material, for example, was recorded using a four-point scale (see Chapter 3) that is very similar to that outlined by Johnson (1989: 441):

- unburned
- scorched: superficial burning (equates to 'singed' at *Viroconium*)
- charred: blackened, towards charcoal (equates to 'burnt' at *Viroconium*)
- calcined : blue-white, loss of all organic material, plastically deformed

Such definitions are mainly descriptive, although it may be possible to assign broad categories regarding heat source, temperature and resultant bone structure from them. Lyman (1999: 386) summarises the experimental work of Shipman (1988) and David (1990), which would give the three categories used to record the burnt baths basilica material the following board temperature ranges:

- singed: up to approximately 550°C
- burnt: between approximately 550-700°C
- calcined: over approximately 700°C

Bone condition at the time of burning will obviously affect how it is modified (Lyman 1999: 387-389). Cooking, as the burning agent, will obviously affect how bone is burnt and modified because the surrounding soft-tissue affectively acts as a protective layer. Burnt bone resulting from food preparation will have been differentially heated and preserved, due to differences in 'covering' (thickness, plus water and fat content). Fluctuations should therefore be expected.

Burnt bone is more susceptible to mechanical and chemical attrition than un-burnt bone (Lyman 1999: 389-391). Fragmentation is more severe because burnt bone is more brittle, as the organic components (collagen fibres) have been removed (see Nicholson 1992). Re-crystallization of the bone mineral may also have some impact on its tensile strength. Acidic conditions also degrade burnt bone more rapidly; this may be of relevance when considering the baths basilica material. Bone is rarely destroyed by the burning itself, but by the resultant fragmentation; burnt bones are therefore less likely to be retrieved and identified from archaeological sites than un-burnt bone (see Lyman & O'Brien 1987).

#### **4.7.2. Baths basilica**

Table 19 outlines the proportions of burnt bone for the major domesticates by phase. As with the preservation and abrasion from the baths basilica there is considerable correspondence between individual phases and species. Approximately 98% of the major domesticate bone is un-burnt, 2% 'singed' and less than 1% is either 'burnt' or 'calcined'. There is some variance within the individual phases, but the fluctuations are generally within 1% percent of the average. Phase X has the greater variation, which is probably a direct reflection of the small dataset. This would indicate that the baths basilica assemblage has not been overtly affected by burning. The fact that the largest component of the burnt identified fraction of the assemblage is 'singed' bone, and the smallest 'calcined', would suggest that the burning did indeed derive from the preparation and cooking of food.

#### **4.8. Summary**

A consideration of recovery, gnawing, preservation, trampling and burning within the recorded fraction of the baths basilica assemblage all suggest that it is largely unaffected by these limiting variables and its information potential and interpretative value is essentially intact. Therefore, it will be possible to tackle the research questions with the dataset. As a cautionary note, it has to be remembered that the level of

attrition from any of the agencies discussed above may be underrepresented within the recorded assemblage, due to the particularities of the methodology. The diagnostic zone system focussed on specific parts from a range of skeletal elements. Consequently badly degraded and fragmented material would not have been recorded, and it this material which in all likelihood expresses the true extent of degradation.



## 5. Deposition

### 5.1. Introduction

The identification and recognition of 'reworked' (secondary deposition and residuality; see below) material is perhaps the single most important and potentially limiting factor in the analysis of archaeological artefacts and data. This especially applies to deeply stratified urban deposits (Dobney *et al.* 1996: 15-16 & 1997: 81; Evans & Millett 1992: 225; Serjeantson 1989: 3), such as those at the baths basilica. There are two primary reasons for identifying and quantifying reworked material within archaeological assemblages. Firstly, when either chronological or spatial divisions are considered during the analysis of finds assemblages, the failure to identify material located away from its original place of deposition or chronologically earlier material re-deposited in later contexts may result in erroneous interpretations. In extreme cases, this might completely invalidate the results. Secondly, the identification and quantification of reworked material may be used as an invaluable interpretative tool in the reconstruction of 'site formation processes'; the quintessential core of all archaeological research.

The consideration and study of reworked material in European archaeology is a reasonably recent phenomenon, occurring over the last three decades or so, and results from the increased number of urban excavations (Dobney *et al.* 1997: 81; Evans & Millett 1992: 225). Despite the recognition that reworked material is a central and important aspect in archaeological finds analyses there is a severe lack of literature on the subject. Most of the existing literature relates to intrinsically datable finds categories (pottery, metalwork, coins, etc). A query by the author (Hammon 2001) on the 'ZOOARCH' mailing-list, asking about references on the subject, produced only two responses: a book review (Albarella 1998) of *'Of butcher's and breeds'*, a monograph on the analysis of animal bone assemblages from multi-period sites in Lincoln by Dobney *et al.* (1996), and an article on the relationship between different site formation processes resulting in the distribution and deposition of medieval – post-medieval seeds and pottery from Romsey, Wiltshire (Green & Lockyear 1994). On investigation the Green & Lockyear (1994) paper did not examine residuality specifically, and has not been considered further. In addition, many site reports fail to mention if reworking was even considered. The failure to consider reworking has very serious implications and *'... are perhaps too dreadful to contemplate'* (i.e. incorrect interpretations) (Dobney *et al.* 1997: 81). A failure to do also negates the demand for and implementation of controlled excavation.

### 5.2. Secondary deposition and residuality: Definitions

Before discussing the problem of how to identify, quantify and confront the problem of reworked archaeological material, it is necessary to define two terms in particular: 'secondary deposition' and 'residuality'. Secondary deposition may be defined as the re-deposition of an artefact in a different spatial location from where it was originally discarded ('primary deposition'), but importantly within the same chronological period. In other words *'... the lateral transference of essentially contemporaneous material, normally through the importation of raw materials or waste disposal ...'* (Dobney *et al.* 1997: 81). This could be the cleaning-up and dumping of butchery waste from a specific activity area into rubbish pits for reasons of sanitation, for example. Residuality can be described as chronologically earlier artefacts being disturbed and incorporated/re-deposited into a temporally later context, as *'... evidenced*

*by material dated to an earlier period becoming embodied in later strata ...'* (Dobney *et al.* 1997: 81). The medieval robbing-out of Roman foundations may result in the deposition of Roman artefacts within medieval contexts, for example. Residual artefacts therefore always result from secondary deposition, but conversely secondary deposition does not always equate to residuality (Albarella 1998: 73). Chronological/temporal divisions may, in this instance, refer to either a historical sub-division, e.g. 69-96 AD (the Flavian period), or an archaeological/site specific sub-division, usually based on semi-objective criteria and observations, such as structural sequences and distinct periods of activity, devised for the researcher's benefit, e.g. Phase Z 'the great re-building of the baths basilica' (early 6<sup>th</sup> – late 7<sup>th</sup> century AD).

The distinction between secondary deposition and residuality is regularly confused in the literature. For example, Lyman's (1999: 513-514) glossary definition of secondary deposition (based on Antia 1979: 108 & 111) states,

*'Secondary deposit: 1) deposit 'produced by reworking and concentration from older sediments; a) refers to a primary vertebrate deposit which has been buried, diagenetically altered, excavated, fragmented, and then further concentrated to form a bone-bed, b) formed by the reworking of older vertebrate deposits.'*

This definition incorporates both secondary deposition and residuality, thus highlighting the above point. One reason for this common amalgamation may be the arbitrary use of the term/phrase '*in-situ*' (place of original deposition of an archaeological artefact) and by inference the chronological framework of deposition. *In-situ* has several connotations, which confuse the situation, as Schiffer (1996: 17) asked,

*'... does 'original' {i.e. 'in-situ'} position refer to its 1) location of manufacture? 2) location of use? 3) first place of cultural deposition? 4) last place of cultural deposition? Or 5) location after first environmental disturbance?'*

This rhetorical question could be extended to include any number of combinations of depositional pathways. Therefore, when discussing reworked archaeological material it is necessary to clearly state the exact meaning of your terminology to avoid confusion. To this end, the definitions of secondary deposition and residuality quoted above have been adhered to in this thesis.

### **5.3. Vertebrate residuality**

#### **5.3.1. Identification and problems**

The identification of residual bioarchaeological material is severely hampered by the fact that in very few instances is the material intrinsically datable, other than by scientific methods, such as carbon dating and amino acid racemisation, which are prohibitively expensive to be routinely used on most commercial or research projects (Dobney *et al.* 1996: 15-16 & 1997: 82). Consequently zooarchaeological research has to rely on relative dating based on stratigraphy and absolute dating by association. The latter involves chronologies developed from artefact categories that are intrinsically datable, such as pottery and metalwork. In the majority of instances, this effectively means that vertebrate remains are dated by the associated pottery. This practice is open to debate and the assumption that depositional pathways of bone and pottery are suitably analogous is potentially dangerous. As Dobney *et al.* (1997: 82) stated,

*'... the basic premise of this association is flawed by the undeniable fact that different finds assemblages are incorporated into deposits by completely different routes and*

*perhaps at widely different times. If we cannot recognise this phenomenon, then much of our interpretation of biological data is undermined.'*

Animal bones deriving from slaughter, butchery, cooking and craft residues do not have an extended life-span ('use-live') as cultural objects, unlike pottery and metalwork. An imported piece of fine tableware or a semi-precious metal brooch may have been handed down through several generations before breakage or accidental loss and subsequent incorporation into the archaeological record, for example. Bone fragments created as a by-product of 'economic' activity, either cooked or raw, are normally collected and disposed of fairly rapidly because of their general unpleasantness and possible health risk they represent. There are a few instances where vertebrate remains (animal or human) would not be rapidly deposited, for example ornaments and tools made of bone, or antler, such as hairpins and knife handles. These categories of artefact are usually readily identifiable and are assumed to have a latent use-life and can be discounted from standard zooarchaeological analysis. Their analysis usually forms another specialist area altogether, the work of MacGregor (1989, 1991 & 1999), for example.

The difficulty of distinguishing between long use-life and residuality (Evans & Millett 1992: 226; Tomber 1991: 59, especially relevant in ceramic studies, may also apply to vertebrate remains in certain situations. A particular class of very unusual bone artefacts from the baths basilica illustrates this point. Sixty fragments of human skull were recovered. Half came from the nave of the basilica in the Phase X and Phase Y dumps, and the remainder came from the platform of Building 10 (Phase Z). Only four of the skull fragments derived from pre-Phase X levels. Approximately nine individuals are represented and most appear to belong to young adult males. This group exhibits a number of unusual traits, in varying combinations, that include orange-brown colouration, a 'greasy' surface, damage from sharp-edged blades, post-mortem decapitation and one example also had green staining.

Chemical analysis and infra-red spectroscopy of the superficial surface residues showed a series of oils and fats to be present, deriving from safflower, sunflower, linseed and/or palm oils (Wilkinson & Barker 1997: 368). The treatment with vegetable oils would appear to be deliberate, rather than accidental contamination. Animal remains from the same contexts do not have this staining. This combined with the knife marks and post-mortem decapitation suggests some form of 'ritual' activity. The particular characteristics of individual skulls led to the following tentative postulation: skulls or skullcaps were inverted, soaked or filled with oil, and placed on either bronze or copper plates/trays (Wilkinson & Barker 1997: 369). One cattle or equid skull fragment in a similar condition was also found, located on the opposite side of Watling Street to a temple complex. This temple contained a carved stone horse's head (Bushe-Fox 1914: 6, Plate 8) and subsequent excavation produced a clay horse's head (Bushe-Fox 1916: 34, Plate 23.2). This led to the suggestion that the temple was dedicated to Epona (Wilkinson & Barker 1997: 369). If these assorted skull fragments represent some form of 'ritual' behaviour in and around the baths basilica, then these objects could have had an extended use-life. If it had not been for the residue coating them they would in all likelihood have been ascribed a different depositional pathway, thus biasing any interpretation.

### **5.3.2. Case-study**

To highlight the problem of recognising, identifying and quantifying animal bone residuality and depositional pathways in relation to pottery one case-study has been outlined and a critique proffered.

Dobney *et al.* (1996) in *'Of Butchers and breeds'* presented the analysis of a group of Roman to post-medieval mammal and bird bone assemblages from various sites in Lincoln.

### **Research outline:**

The usual problem of extensive reworking of the deeply stratified deposits existed. Acknowledging the fact that vertebrate remains are not intrinsically dateable it was decided to construct a 'bone index'. This was based on data collected during the assessment phase and compared to a similar 'pottery residuality index' devised by the ceramicists. This process had two aims, firstly to determine whether the two artefact categories demonstrated similar patterns, to explore the underlying rationale of equating bone and pottery residuality, and secondly to test assumptions regarding perceived measures of vertebrate residuality.

The 'pottery residuality index' was formulated on a hierarchical basis using two categories (Dobney *et al.* 1996: 18). First, each context/deposit type was allocated a point depending on the perceived likelihood of it containing primary material. For example, pits would score highly, i.e. '1', whilst robber trenches and demolition debris would be scored low, i.e. '3'. Second, context/deposit type was also classified based on the proportion of Roman and medieval pottery contained within it: '0' = no pottery present; '1' = less than ten percent residual; '2' = pottery sherd numbers unknown or containing less than twenty sherds; '3' = over ten percent obviously residual.

Once this was achieved the following algorithm was applied (Dobney *et al.* 1996: 18-19):

- *'If a context group scores 1 on either pot or stratigraphy it is assumed to be a deposit with less than 5% residuality and therefore useful'*
- *'If a context group scores neither 1 or 3 for either pot or stratigraphy then it is assumed to be of uncertain status'*
- *'If a context group scores 3 or more for pot and stratigraphy it is assumed to be a mixed deposit'*

The 'bone index' used the following variables and gradations (Dobney *et al.* 1996: 19): preservation was recorded as either 'variable', 'poor', 'fair', 'good' or 'excellent'; angularity as either 'variable', 'spiky', 'rounded' or 'battered'; colour as either 'variable' or 'non-variable'. Preservation and angularity were considered to be more reliable indicators than colour and the scores were skewed accordingly. Combinations of these variables dictated the construction of the 'bone index' (Appendix 10), which could be directly compared to the 'pottery residuality index'. The concordance of the 'pottery residuality index' and 'bone index' is summarised in Appendix 11.

Dobney *et al.* (1996: 19) concluded that, *'The results of this simple exercise show some quite startling results: that there is almost no concordance of pottery and bone indices at any level'*. They go on to outline the most probable causes for this lack of correlation:

- the criteria and variables used as a measure of residuality to construct the 'bone index' are fundamentally flawed
- the absence of correspondence simply demonstrates the different depositional pathways that bone and pottery take as they are incorporated into the archaeological record

### **Critique and points of reference:**

In most respects Dobney *et al.* (1996: 19) have offered their own critique. In essence the study was far from ideal, mainly as it was based on a commercial project, so was subject to time and budgetary constraints. The two indices were conceived separately from one another because evaluating measures of

residuality between different artefact categories was not a central research objective. Thus, there was a basic lack of parity between the ways in which both sets of artefacts were recorded. They concluded that their research should simply be used to highlight the considerable problems inherent in the current method used to date bone assemblages, and that more specific studies should be initiated, using more precise variables and backed by scientific dating techniques (Dobney *et al.* 1996: 19).

Albarella's (1998) book review of *'Of butchers and breeds'* criticises their approach on a number of points. The most significant criticism is that the variables employed were not actually measuring residuality. Albarella (1998: 73) suggested that what was being measured was in fact *'... the likelihood of redeposition rather than residuality'* and subsequently it should be no surprise that no correlation exists. Albarella (1998: 73) concluded that the Lincoln study's questioning of the wisdom of applying pottery residuality to bone assemblages was a dubious supposition.

## **5.4. Baths basilica site formation**

The rationale behind this chapter is to enable a consideration of the stratigraphy, phasing and reworking of material at the baths basilica site. Unravelling the stratigraphic sequence at the baths basilica was a major undertaking because of the nature and extent of the deposits, particularly the post-Roman sequence. No artefacts intrinsically dated Phases Y and Z. Therefore, it was necessary to carefully reconstruct the site formation processes, paying specially attention to likely function and potential use-life (see above). This section should be read in conjunction with the narrative describing the nature of activity and chronological framework at the baths basilica (see Chapter 1).

### **5.4.1. General considerations**

Because no structures have been dated beyond the 7<sup>th</sup> century AD, no *terminus post quem* exists for the latest material. Material from the upper deposits of Phase Z, which interfaced with the topsoil above (Layer I/II), could not easily be assigned to one horizon or the other. Determination of the interface between the two horizons had to take into account that with worn floor and yard surfaces small artefacts could have become lodged in small cracks and because archaeological cleaning is invariably more comprehensive than contemporary cleaning, the *'... distinction between 'on' and 'in' the surface is hard to maintain'* (Barker *et al.* 1997: 193-194).

Part of the site was ploughed until the archaeological excavations commenced in the mid-19<sup>th</sup> century AD. There is also evidence for limited manuring, from the presence of medieval and post-medieval pottery sherds. Bioturbation appears to have been negligible because the lack of 'tree-bowls' have suggested the site was never overgrown. Lateral movement of objects through 'plough-damage' was thought to be minimal because cobbles have only been dragged a metre (Barker *et al.* 1997: 193), although it may be argued that small objects, such as pottery and animal bone, may conceivably have been dragged much further, as they offered less resistance.

### **5.4.2. A-B-C category deposits**

Due to the very complex nature of the baths basilica stratigraphic sequence each deposit was assigned to one of the following categories during post-excavation analysis:

- Category A: *'floors or habitation surfaces, including some building platforms'*
- Category B: *'pits, hearths and other features which have been rapidly backfilled'*
- Category C: *'dumps which have worn surfaces or have been rapidly accumulated'*

These categories were based on the perceived rate of accumulation, security of deposit date and whether they were considered to be 'non-habitational' in origin. White (1997: 371) stated that, '*Ultimately the decision rested upon a subjective assessment of each context*'. The basic rationale behind this exercise was '*... to demonstrate that a number of strata were newly deposited so that finds associated with these strata were more likely to have been in use or newly mislaid*' (Barker *et al.* 1997: 201).

### **5.4.3. Artefact dating and deposition**

Dating sub-Roman sites has been fraught with difficulty for a number of reasons (principally the extended use-life of late Romano-British artefacts and the lack of distinctive sub-Roman objects and styles), it is therefore necessary to briefly consider the major finds categories from the baths basilica.

#### **Coins:**

The latest coins found at the site date to 388-402 AD and were retrieved from the robber trench of the north portico colonnade. They therefore date to Phase X or Phase Y (Barker *et al.* 1997: 168). This is the normal situation for the western England and north Wales, where two groups were issued between 388-395 AD and 395-402 AD (both in 'coin issue period 27'). The latter group was issued under Honorius (the reverse read *SALVS REIPVBLICAE*). It has been established that Roman military control in the west continued beyond the reign of Magnus Maximus and an absence of this latter group in the region may infer the withdrawal of troops by Arbogastes in 393 AD (see Casey 1989). The coin supply to *Viroconium* may have therefore ceased approximately one decade prior to the rest of Britain (Brickstock & Casey 1997: 265).

#### **Pottery:**

The latest pottery sherds come from amphorae that may date up to the 7<sup>th</sup> century AD (Barker *et al.* 1997: 168). The vast majority of pottery dated to the 3<sup>rd</sup> – 4<sup>th</sup> centuries AD. Because of the way in which the material was originally recorded, it was not possible to positively identify all amphorae types. However, they only formed less than one percent of the total pottery assemblage, and 60% of the amphorae were either type Gauloise 4 or Dressel 20 (Symonds 1997: 269). Much of the pottery was manufactured before 300 AD. The majority of it has been given a *terminus post quem* of 367 AD, based on the coin evidence. Symonds (1997: 270) made the following statement,

*'... a veritable porridge of pottery sherds. Although, it is quite normal for sometimes quite considerable amounts of residual pottery to occur on Roman urban sites, it is unusual that an entire site should be composed almost entirely of residual material'*.

An attempt was made to confront pottery residuality, but due to constraints of time and resources it was only possible to conduct the analysis by phase and ware type (for Phases W, X, Y and Z). It used techniques and computer software developed by Laflin *et al.* (1993) that considered spatial patterns. The overall conclusions merit outlining because they add something to the general picture of the site formation processes, despite the problematic pottery dating and different depositional pathways between bone and pottery (see above). Unsurprisingly the spatial distribution of Phase W sherds was concordant with the location of the dumps, such as C527 (see below), and where floor surfaces had been patched from excessive wear. In Phase Z the greatest concentration of sherds mirrored the location of building platforms, especially those of Buildings 10 and 11 (White 1997: 312-315).

An analysis of the distribution of the later wares provided an insight into when the baths basilica became aceramic. The fine ware fabrics of Oxfordshire and Nene Valley (plus coarse Calcite-gritted wares)

proved most useful in this respect. All increased in Phase W, peaked in Phase X, declined in Phase Y, increased again in Phase Z and remained constant or declined post-Phase Z. This pattern is slightly different to the norm, whereby a steady increase in quantities recovered would be followed by a relative decline in the last phase. If the chronological positions of Phases X and Y are reversed, the expected pattern is replicated, and this was confirmed by the more detailed analysis of certain forms and wares. Black burnished wares produced the clearest picture. All display a peak in Phase X, a sudden decline in Phase Y and a larger peak in Phase Z. This anomaly is thought to demonstrate the fact that by Phase Z all pottery at *Viroconium* was residual (White 1997: 315).

It has been suggested that the use-life of artefacts may be in the region of two centuries from manufacture to final deposition (see Wilson 1959). However, this approximation has more recently been questioned by Going (1992) with regard to Roman Britain. In addition, Barker *et al.* (1997: 193) suggested with respect to the latest phases at the baths basilica that,

*'This range may be extended in sites which are on the margins of a centralised economy, like Wroxeter, or in periods when new types were not being produced so that conservatism and conservation must be taken into account'*.

The following scenario has consequently been postulated for the baths basilica. Late wares and forms were only imported into the town in bulk during the latter half of the 4<sup>th</sup> century AD (at the beginning of Phase W). Bulk imports would initially have enabled a liberal attitude towards discarding broken pottery, and subsequent incorporation into Phase W dumps. This trend peaked in Phase X, approximately 50 years after the supply had ended, and deposition gradually decreases. Phase Y was characterised by renewed public use of the baths basilica (see Chapter 1), but pottery deposition rapidly subsided. This is indicative of a new conservatism by *Viroconium's* inhabitants regarding irreplaceable material culture. The supposition is supported by the increase in the number of mended and riveted pots in Phase Y (White 1997: 316).

Roman pottery in Britain underwent two major transitions. The first was connected to the demise of the south Gaulish Samian industry and the greater export of black-burnished ware from Dorset (approximately 120 AD). The second occurred in the early – mid 3<sup>rd</sup> century AD when central and east Gaulish Samian, amphorae and colour coated ware production ended. *Viroconium*, particularly the baths basilica, effectively missed the first transition. As a consequence, the second was more clearly defined: assemblages began at a peak, then steadily declined or uniformly rose from a 'baseline' (depending on the wares involved). However, White (1997: 318) concluded '*... that there was perhaps much less continuity in the pottery than might have been expected.*'

### **Wound-wire headed pins:**

The lack of chronological distinction between the upper horizons of Phase Z and Layer I/II (see above) caused the dating of one artefact category to be questioned, wound-wire headed pins. These pins have been found on a number of sites, such as Gadebridge Park, Hemel Hempstead (Neal 1974) and have been dated variously between the 12<sup>th</sup> – 18<sup>th</sup> centuries AD. The ambiguous origins of these pins have been discussed by Caple & Warren (1982). *Viroconium* produced 57 examples: 30 from Layer I/II, 21 from dumps/robber trenches and six from archaeological trenches. Previously archaeologists have been reluctant to attribute a Roman date to these pins. However, the baths basilica examples might be late 4<sup>th</sup> century AD and illustrate the problem of recognising post-Roman material (Barker *et al.* (1997: 194).

#### **5.4.4. Dumps and building platforms**

The baths basilica site was characterised by large dumps of re-deposited material. Primarily, these dumps were either for levelling areas of subsidence, such as the extensive Phase U floor of compacted beaten earth (D673-679) that was laid over the mosaic (Panels G and H) in the north aisle (Barker *et al.* 1997: 60), or as building platforms, such as the huge Phase Z rubble platform (D100A-G) stretching across the nave, north aisle and north portico for Building 10 (Barker *et al.* 1997: 140-145). It has been concluded that these dumps represented material that had accumulated elsewhere in the city before being brought to the baths basilica for construction purposes. Therefore, they constitute secondary deposition, rather than residual material (see definitions above). See Appendix 1 for a summary of dumps that produced bone.

Supposedly, waste disposal within Roman towns and cities was a municipal activity organised by the *ordo*. This may be especially pertinent in the case of *Viroconium*, as there was no evidence for backyard rubbish pits and middens, unlike other conurbations, such as Silchester (Boon 1974: 90). It is unlikely that 5<sup>th</sup> century AD, or later, pits would have been missed, due to the intensity of excavation, and only one example was recorded: a bone filled aceramic pit (A23), which had been dug into the north-south road surface (Barker *et al.* 1997: 195).

It was also readily apparent that some of the dumped material represented primary deposition. Certain dumps contained complete skulls and articulated skeletal elements, D1282 in the south aisle (Phase Y) for instance. It contained seven cattle skulls that had been poll-axed. It is not known whether these cattle skulls represent slaughterhouse waste, or some form of ritual behaviour (Barker *et al.* 1997: 103 & 195). At the time of writing, Barker *et al.* (1997: 195) stated that, '*The lack of analysis of much of the animal bone prevents us from being too specific about the nature of this bone waste*'. Additionally, both freshwater and marine fish vertebrae and scales were found articulated and were obviously deposited and buried prior to complete decomposition.

Barker *et al.* (1997: 195) suggested that many of these dumps had their own distinctive components that were not shared by others, for example the dumping in Phase W, and concluded that,

*'If we assume that each dump in this phase is derived from a single source elsewhere in the city (and this is a big assumption), then the study of these distinctive components may allow us to speculate on the origins of these dumps and the kinds of institutions or establishments which created them'*.

### **5.5. Animal bone deposition at the baths basilica**

#### **5.5.1. A-B-C category deposits**

Fragmentation, preservation, angularity and gnawing were all plotted by Category A, B and C deposits for cattle, pig and sheep/goat. This was done for all phases combined (Figures 22-25; Tables 20-23). The same exercise has not been carried out for different feature types because it would largely replicate the initial analysis, as feature type was a principle determinant when deposits were ascribed a category (see above).

#### **Fragmentation:**

The proportions of fragmentation (100%, >50%, 50% and <50%) for cattle, pig and sheep/goat regardless of context category demonstrated the same overall patterns (Figure 22; Table 20). Approximately 20% of all bones recorded were complete (100%), 50% were over half complete (>50%), 5% were half complete



(50%) and 25% were less than half complete (<50%). This homogeneity is surprising, considering the criteria on which the categories were based. It was expected that Category A deposits would have contained more fragmented assemblages, as they included feature types such as floors, which would result in higher levels of attrition through trampling, etc. Category C deposits would also include more severely fragmented assemblages, due to reworking. Hypothetically, Category B deposits would be the least fragmented, as they mainly derived from the fills of negative features. The observed pattern may therefore have resulted from either a high level of re-deposition regardless of feature type, or the entire assemblage was subjected to the same intensity of pre-depositional breakage, for example marrow extraction.

#### **Surface preservation:**

When surface preservation was considered for cattle, pig and sheep/goat, a similar scenario emerged. There was very little to distinguish between the A, B and C category deposits (Figure 23; Table 21). Approximately, half of the material in each category, regardless of species, was either well preserved or moderately well preserved, with less than 5% in any category being poorly preserved. Overall, especially when cattle and pig were considered, Category B deposits were marginally less well preserved. Again this is surprising, as potentially the rapid accumulation of material in the fill of negative features should have resulted in better preservation. Alternative explanations for this may be that Category B deposits included a lesser volume of lime mortar in comparison to Category A (including more structural elements) and C deposits (including more demolition debris, i.e. mortar fragments), so the natural acidity of the soil would not have been so affectively neutralised. There is also the possibility that surface preservation is not a good taphonomic indicator, being more dependent on pre-burial treatment, such as cooking (see above).

#### **Angularity of break:**

Angularity of break for all major domesticates mirrors the general pattern already noted from fragmentation and preservation (Figures 24; Table 22): Category A, B and C deposits demonstrate very little variation from one another. Approximately, between 5-15% of all breaks were rounded. A slightly inverse pattern to that which might have been expected was noted. Overall Category A deposits included the smallest proportion of rounded breaks, despite the fact that bone fragments exposed on floors and surfaces should have become more abraded than those rapidly sealed within the burial environment.

#### **Canid gnawing:**

Gnawing again demonstrates the same general pattern as the other taphonomic measures, regardless of species or deposit category (Figure 25; Table 23). Between 10-20% of all recorded skeletal elements for cattle, pig and sheep/goat demonstrated evidence of gnawing. On one level this is gratifying, as it suggests that overall only a small proportion of the assemblages comprised material that does not represent anthropogenic activity, but the lack of differentiation between the categorised contexts sheds no light on the depositional nature of the site.

### **5.5.2. Functional analysis of dump deposits**

A functional analysis was then attempted on two Phase W floor-foundation dump deposits (Barker *et al.* (1997: 195-201): C527 (the north portico) and D1569 (the nave). Both dumps were similar in volume and were deposited in the late 4<sup>th</sup> century AD. C527 produced 1793 artefacts (93% of which was pottery), whereas D1569 produced 852 artefacts (56% pottery). The artefacts were grouped by perceived

function (Appendix 12). Appendix 13 summarises the non-ceramic artefacts from C527 and D1569 discussed in the text (pages 198-201). The functional divisions are based on the criteria outlined by Barker *et al.* (1997: 201-202).

The wall plaster contained in C527 appeared freshly broken and may have been added for extra substance. The smaller volume of coinage in C527 may be indicative of earlier coinage still circulating as currency, thus avoiding deliberate inclusion in common rubbish. The human bone in C527 was fairly ambiguous and may have come from either accidental inclusion, a 'criminal episode' or from 'obscure practices' (Barker *et al.* 1997: 198). The jet beads from D1569 appear to be from one necklace, rather than manufacturing, due to the absence of waste material. The 32 coins from D1569 have been reinterpreted as a hoard. C527 would seem to be the earlier deposit. Although, both contained 4<sup>th</sup> century AD material, i.e. C527 included coins of Constantine 1 and Crispus, while D1569 contained coins of Constantius I and II, C527 also included three 1<sup>st</sup> century AD glass vessels, two 2<sup>nd</sup> century brooches and the majority of the pottery was earlier than the 4<sup>th</sup> century AD.

It was concluded overall that D1569 contained more 'pure' rubbish and '*... that the differences between the 2 dumps are probably as much due to their date of accumulation as to their function or source of origin*' (Barker *et al.* 1997: 201). Although, there are clear differences between the compositions of the two deposits, ascribing likely sources is extremely difficult.

#### **C527/D1569 bone assemblage comparison:**

To test the assumptions made about the two dumps, and to determine whether inter-deposit/context comparison and analysis of animal bone assemblages was viable, it was decided to consider the bones from C527 and D1569 in a similar fashion to the A-B-C category analysis. C527 produced 210 'countable' fragments, whereas D1569 produced 111, which is a broadly similar ratio to that of the other categories of artefact between the two deposits. Species composition is fairly standard with the range of mammals and birds one would normally expect to encounter (Table 24). Unfortunately, due to the small sample size, the proportions of the major domesticates to one another may not be particularly relevant, but are still worth summarising. The most noticeable difference is the slightly higher proportion of cattle in D1569 at the expense of pig and sheep/goat (Table 25).

Perhaps a better gauge for comparing the differences in deposit formation is to consider perceived measures of bone taphonomy (see below): fragmentation, surface preservation, angularity of break and canid gnawing. Figure 26 and Table 26 summarises these variables by the most economically 'important' mammals grouped by approximate size, i.e. cattle combined with red deer, and sheep, goat, pig and roe deer combined. There appears to be a visible difference between C527 and D1569, but no real difference between the cattle/red deer and sheep/goat/pig/roe deer size categories within each context. C527 is more fragmented than D1569, with a lesser proportion of complete skeletal elements and a greater proportion with less than 50% present. Preservation follows the same pattern; C527 has less well-preserved fragments, whereas D1569 has no poorly preserved fragments. Angularity of break is more ambiguous. All categories include approximately 20% rounded breaks with the exception of D1569 sheep/goat/pig/roe deer, which has less, and this may be the result of the low number of observations. In contrast to the pattern noted for fragmentation and preservation, D1569 had suffered roughly half as much canid gnawing as C527. As C527 is more fragmented and less well preserved, the opposite pattern might have been expected, as gnawing is a direct agent of fragmentation. This may be interpreted as C527

being more heavily fragmented through some anthropogenic agency, or trampling, before incorporation into the burial environment. The poorer preservation in C527 may be the result of either some pre-depositional activity, such as boiling, or harsher burial conditions, for example a lower pH value (C527 had less plaster within it, thus the naturally acidic soil would have been less effectively neutralised). C527 may also have been buried more rapidly than D1569, hence less canid gnawing.

In addition, skeletal representation (Figure 27) and butchery (Table 27) were also considered to determine whether anything could be added to the original artefact functional analysis or bone taphonomic indicators. Anatomical representation and butchery may be used to denote function, i.e. the presence or absence of joints of meat or off-cut waste, which in turn could alter the taphonomic interpretation. Due to the small sample sizes involved cattle, red deer, sheep, goat, pig and roe deer were combined for C527 and D1569 for this exercise. This is probably a reflection of the small sample size, as opposed to any other factors. Most skeletal elements are represented, including skull fragments and lower limb bones, which is indicative of mixed butchery refuse deriving from more than one activity, rather than refuse primarily from food preparation or consumption (Figure 27). Tentatively, it could be said that D1569 contained a greater proportion of high utility elements, such as scapula, humerus, radius, femur and tibia. There is nothing to suggest that the anatomical composition of the two dump deposits influenced the perceived taphonomic measures above. Butchery evidence is not consistent with fragmentation, as D1569 was the more heavily butchered context (Table 27). Skeletal representation for both C527 and D1569 is fairly indistinct; neither demonstrated any obvious patterns.

The proportions of unfused and fused post-cranial skeletal elements were compared for cattle, pig and sheep/goat (Table 28). For all species, D1569 had more unfused fragments (approximately one third to a half) than C527. There may be a taphonomic factor behind this pattern, i.e. young specimens suffering from a greater degree of post-depositional destruction and recovery bias, as D1569 is the less fragmented and better preserved deposit.

Overall, the analysis of the mammal bone from C527 and D1569 has demonstrated that they do appear to have distinct characteristics. The obvious inference is that they represent deposits that formed from specific, if still elusive, activities. This would suggest that these particular dumps have not been subjected to extensive reworking, and subsequently do not contain large amounts of residual material. However, the possibility still exists that they derive from contemporary secondary deposition (the municipal waste collection hypothesis), and therefore cannot provide any useful spatial information for analysis. It should be possible to carry out this form of inter-context analysis on other deposits, as there are a total of 81 contexts with 50 or more 'countable' fragments, and 51 contexts with 100 or more.

As a secondary issue, the higher proportions of pigs, meat bearing bones and younger specimens within D1569 may indicate a higher social status than C527. If so, the mammal bones may conceivably support the alternative interpretation suggested by Barker *et al.* (1997: 201) that D1569 represents '*... the residue of a house of ill-repute*', i.e. the jewellery, toilet implements and 'table' vessel sherds.

### **5.5.3. Anatomical elements from the same individual**

To aid the determination of how rapidly individual deposits accumulated and whether reworking took place all fragments that were articulated, or appeared to come from the same animal, have been correlated (Table 29). Some combinations of skeletal element and species were perceived to be superior indicators

of rapid accumulation than others. For example, adult pig mandibles, unlike other mammal, rarely become separated at the diastema (unless deliberately chopped axially) and consequently the left and right mandibles are routinely retrieved together from the same context. Additionally, when fragmentation is not too severe the left and right sides of the cranium are often retrieved together, so horncores and the zygomata may not be reliable indicators. This has been noted for a range of animals from cattle to small microtinae. A similar phenomenon occasionally applies to the pelvis, although the larger mammal pelvis usually separates into left and right innominates.

It was obvious some articulated remains represented intrusive inclusions, for instance the lagomorph remains from D343 (Table 29), with at least three very young individuals represented by a range of skeletal elements. This group of bones has been interpreted as an underground nesting chamber. It was not possible to differentiate between hare (*Lepus* sp.) and rabbit (*Oryctolagus cuniculus*) using morphological criteria, although in all likelihood these specimens are rabbit because hares do not nest underground. Other species that were considered intrusive included mole and small microtinae.

Once the poor indicators and intrusive material had been excluded there were 43 instances where articulated or skeletal elements from the same individual occurred: Category A 20; Category B 9; Category C 14. These divide by deposit type accordingly: pit fill 2; cut fill 6; layer 6; surface 3; structure 8; dump 14; unassigned 4. The most interesting aspect is that 14 instances are from dump deposits (Contexts B277, C78, C267, C306, C495, D283, D329, D762, D1333 and D1335). Dump B277 includes two examples and D329 includes four. Of these dumps two have been designated Category A, two as Category B and six as Category C, therefore this broadly supports the overview that the dumps accumulated rapidly.

## 5.6. Summary

It is clear from the author's inquiry on 'ZOOARCH', the largely unsuccessful Lincoln study and analysis of the baths basilica assemblage that the problem of vertebrate residuality remains a poorly understood phenomenon. To gain a fuller understanding of the factors involved in vertebrate taphonomy it is imperative that future project designs incorporate specific features that allow different artefact categories to be compared and related directly to stratigraphic data. Attempts at understanding site formation processes and vertebrate residuality as an 'after thought' at the post-excavation stage are almost by default going to be unsuccessful. For this reason, most zooarchaeologists acknowledge its relevance, but ultimately fail to really consider vertebrate residuality in any meaningful way. Further specific studies are a prerequisite if vertebrate residuality is to be better understood. Despite this gloomy protestation, it has been possible to demonstrate with reasonable certainty that much of the animal bone assemblage, and most importantly that from the dump deposits, appears to be contemporaneous with the on-site activity. At the very least it does not appear to be obviously residual for the most part.

## 6. Species composition

### 6.1. Introduction

The following chapter will outline the quantities of fragments recorded and the range of species encountered. The relative proportions of one species to another will also be considered. Any diachronic patterns will be highlighted and discussed. The results of which will then be contemplated in regard to the overall research aims (see Chapter 2).

### 6.2. Quantities

NISP (Number of Identified Skeletal Parts) and MNE (Minimum Number of Elements) counts generated from the baths basilica assemblage at *Viroconium* are outlined in Tables 30-31 by taxon and phase. A total of 23801 NISP were recorded over 18 months. Once correlated, it was discovered that 595 NISP could not be dated any more securely than to the late 5<sup>th</sup> – late 7<sup>th</sup> centuries AD (Phase X to Phase Z). Because these fragments encompass two centuries and several phases of activity they have been discounted. This leaves a useable assemblage of 23206 NISP with a MNE count of 16254. To summarise Tables 30-31, the totals divide by phase accordingly:

<u>Phase</u>	<u>Date</u>	<u>NISP</u>	<u>MNE</u>
T-V	late 3 <sup>rd</sup> – 4 <sup>th</sup> century AD	388	279
W	late 4 <sup>th</sup> – mid 5 <sup>th</sup> century AD	4479	3123
X	late 5 <sup>th</sup> – mid 6 <sup>th</sup> century AD	159	130
X-Y	late 5 <sup>th</sup> – late 6 <sup>th</sup> century AD	2302	1568
Y	early 6 <sup>th</sup> – late 6 <sup>th</sup> century AD	4599	3281
Y-Z	early 6 <sup>th</sup> – late 7 <sup>th</sup> century AD	3362	2360
Z	early 6 <sup>th</sup> – late 7 <sup>th</sup> century AD	7917	5513

Each phase, with the exception of Phases T-V and X, has produced a reasonably sized data-set that will make it possible to determine diachronic change and to consider the peculiarities of exploitation and husbandry for each of the major species. Phases T-V and X will be more problematic, although they have both produced large enough data-sets to consider species composition, it will be considerably more difficult to analyse how individual species were utilised, i.e. body part representation and mortality profiles, etc.

### 6.3. Domestic – wild

The ratios of domestic and wild mammals and birds to one another can provide invaluable information when establishing the nature of a site and its possible supply infrastructure, etc. Table 32 outlines this information by phase, based on MNE values. It also includes two additional categories, ‘uncertain mammals’ and ‘uncertain birds’. These categories account of specimens that could not be positively identified on morphological grounds, for example ‘cattle/red deer’, and species that cannot be placed into any one category with any certainty, domestic duck and the mallard (*Anas platyrhynchos*), its wild progenitor, for instance.

To summarise Table 32, domestic mammals dominated the assemblage, ranging between 79-92%; wild mammals were the second most numerous category and ranged between 2-10%; domestic birds (essentially the Galliformes because geese and ducks could not be assigned a category; see above), ranged between 2-6%; wild birds ranged between 2-3%. If wild species of no economic importance (accidental

inclusions and commensal species, etc) were excluded domestic species would become even more predominant. There appears to be little diachronic fluctuation in these frequencies; domestic mammals remain consistently high. Wild mammals demonstrate a slight increase, especially in Phases Y and Y-Z. However, their overall contribution remained small. Based on this evidence, the agricultural economy, attendant husbandry practices and redistribution infrastructure in and around *Viroconium* remained unaffected by the wider economic and political upheavals affecting the ailing Roman empire.

Grant (1981: 208) argued that in the 4<sup>th</sup> – 5<sup>th</sup> centuries AD as the Roman infrastructure fell into disrepair,

*‘... relationships between villas and markets, movement of stock and foodstuffs and the management of the villa estates may well have been adversely affected. Thus the need to supplement the diet by hunting may have become more pressing than at any previous time.’*

This argument, however, is overly simplistic and in recent years has generally fallen out of favour as new evidence has become available and new perspectives accounting for the late Romano-British – early medieval transition have been developed (see Chapter 1). For example, West Stow, the Romano-British and early Saxon settlement, certainly demonstrates no increase in the proportion of wild species (Crabtree 1990: 106-107 & 1994: 43).

### **6.3. Cattle – pig – sheep/goat**

When reconstructing the animal economy of a site, and resultant husbandry regimes, evaluating the relative frequencies of the major domesticates (cattle, pig and sheep/goat) to another is useful tool. Identifying any diachronic changes in these proportions often denotes a shift in emphasis of agricultural production or victualling. Figure 28a and Table 33a outline the percentages produced by the baths basilica. Phases T-V and X may not be representative because they are based on far smaller samples than the remaining phases. Combining all the baths basilica phases the following mean averages are produced: cattle 59%, pig 23% and sheep/goat 18%.

MNE counts are not necessarily the most suitable measure when assessing the likely contribution that particular species made to a sites economy. The amount of meat and the range of by-products an animal or carcass would have provided to the economy is species specific. At the vast majority of sites meat would have been one of the major animal products, if not the principal component. Therefore, calculating the probable contribution of meat that a particular species would have made to the inhabitants diet may be more pertinent than using MNE values alone. Using the mid-point values from the Manching data set (see Boessneck *et al.* 1971: 9) employed by Dobney *et al.* (1996: 22) and O’Connor (1991: 238) it is possible to achieve this. This considered a cattle carcass to weigh 275kg, a pig carcass 85kg and a sheep carcass 37.5kg. Using these figures, a cattle carcass would generate just over three times as much meat as a pig carcass and just over seven times more than a sheep carcass. Figure 28b and Table 33b outline the percentages produced by the baths basilica.

This demonstrates that an average of 84% of all meat supplied to *Viroconium* was beef. The overall importance of cattle to *Viroconium*’s economy would have been even greater when the range and volume of secondary products that they would have provided are also taken into account. This would have included horn, hides, tallow and marrow fat, and there is some evidence indicating their utilisation at the baths basilica (see Chapters 1 & 7).

A diachronic pattern emerges from the baths basilica, notwithstanding Phases T-V and X, in relation to the frequencies of the major domesticates (see above). Based on MNE values, the proportions of cattle essentially remain constant between 56-60%, pig increase from 16% in Phase W to 25% in Phase Z and sheep decrease from 25% in Phase W to 16% in Phase Z. Phase X-Y demonstrated a higher proportion of cattle (67%), and it is between Phases W and X-Y when pig becomes more numerous than sheep. Pig supplanting sheep as the second most numerous domesticate may result from heightened *Romanitas* at *Viroconium*, at the expense of more 'traditional' Iron Age cuisine, principally based on sheep (see Hambleton 1999). The proportional increase in pig may also mirror the change in use of the baths basilica, from public building to high status residence (see Chapter 1).

Inter-site comparison using the relative frequency of the major domesticates to one another has also proved a valuable interpretative tool, notwithstanding the caveat that different retrieval and recording methods can influence the results. King's (1978, 1984, 1991, 1999a & 1999b) continued survey of dietary trends across the Roman empire, using the relative proportions of cattle, pig and sheep to one another, discovered two broad trends. To summarise (see Chapter 2), these were the 'Rome' and 'military' diets. The 'Rome' diet featured a high pork content that was directly connected to social status. The 'military' diet centred around beef that was the direct result of the 'Gallization' and 'Germanization' of the army. The 'military' diet was predominant throughout Britain. The proportion of beef on any settlement had a direct relationship with the degree of Romanisation present, thus the greatest beef concentrations were noted on military sites and urban centres (based on King 1999a: 180, Table 3): see Table 34.

Figure 29 summarises this information graphically; both military categories have been combined and the *vici* category incorporates *canabae*, as a result of utilising King's (1984: 218-224, Table 4 & 1999a: 193-195, Appendix) articles to increase the available sample. The same information has also been plotted chronologically to demonstrate the increasing predominance of cattle (Figure 30). This is particularly evident by the 3<sup>rd</sup> and 4<sup>th</sup> centuries AD.

When the relative frequencies from *Viroconium* are compared to King's (1999a; see above) work, it is apparent that the overall proportions noted at the baths basilica conform to the normal pattern expected for an urban centre. Both the proportion of cattle and pig from the baths basilica are greater and sheep/goat slightly lower than King's (1999a: 180, Table 3) overall averages. The relatively high proportion of cattle at the baths basilica may be due to the fact that *Viroconium* had initially been a military garrison (see Chapter 1), whereas in King's (1999a: 180, Table 3) summary all urban centres have been amalgamated, which include *colonia*, *civitas* capitals, etc. *Viroconium* may, therefore, reflect the 'military' diet more strongly than some of them. A regional factor may also be partially responsible for the high proportion of cattle; Shropshire's geography is well suited to cattle husbandry and the area has traditionally been cattle country (see Chapter 1). The baths basilica data also demonstrates that the dietary trends well established in the later Romano-British epoch continued unchanged into the early medieval period.

#### **6.4. Sheep – goat**

Combining sheep and goat could potentially bias any interpretation, because sheep and goats, although often herded together and utilised for the same products, have significantly different environmental

tolerances, feeding preferences, reproductive patterns and secondary products, etc (see Redding 1984). It is therefore important to consider the likely composition of any ovicaprid assemblage (Halstead *et al.* 2002: 545). Table 35a outlines the ratios suggested by morphological separation: the majority were sheep.

In medieval and post-medieval assemblages there is often a discrepancy between the frequencies of goat horncores and post-cranial elements. This may partially be due to an identification bias, as horncores are readily distinguishable. However, an alternative explanation may exist; goat horns still attached to hides were actively traded with the Continent (Albarella 2003: 80-81). Considering a similar hypothesis has been postulated for fallow deer antler and metapodials in the Romano-British period (Sykes 2004: 77-7), it may be pertinent to consider the ratios produced by horncores alone. Five phases produced both sheep and goat horncores and suggests a higher proportion of goats (Table 35b), although the small number of cases may not be truly representative.

When all anatomical elements were considered the baths basilica assemblage provided an average of almost 14 sheep to one goat, with a possible diachronic increase in the frequency of goat in the latter phases of activity (see above). However, when the horncore sample is considered the ratio decreases to almost two sheep to one goat. This latter ratio is probably based on too few cases to be a reliable indicator, but does highlight the potential ambiguities.

At Colchester, Luff (1993: 66) noted a small number of goats and the deciduous teeth suggested a ratio of 2.3 lambs to one kid. A ratio of 10:6 was provided by horncores from Exeter, although the metapodials and calcaneum provided lower proportions of goat. Maltby (1979: 41-42) concluded that this discrepancy was partially taphonomic and was exaggerated by the presence of polled sheep. Few goats were noted at the General Accident site, York (O'Connor 1988: 75). The largest concentration of goats noted from a Romano-British assemblage was at the temple site of Uley, although they had a ceremonial rather than economic function. Consistently high proportions of goat were noted; up to 77% of the major mammals were goat in Phase 5 (4<sup>th</sup> century AD) (Levitan 1993: 295, Figure 204, 300, Microfiche 2:B2-B3, Figure 7). This demand for goats may have affected the surrounding area, for instance the low overall frequency of goats at Frocester villa, also in Gloucestershire (Noddle 2000: 218, Table 15). Typical rural Romano-British settlements demonstrate similar fluctuations in the low proportions of goats present. Barnsley Park, Gloucestershire, included a small goat population that varied between one and two percent of the total assemblage (Noddle 1985: 83, Table 1). Middle Saxon levels at Southampton demonstrated a ratio of eight sheep to one goat (Bourdillon & Coy 1980: 109). The post-Roman phases at West Stow, Suffolk, demonstrated an increase in the proportion of goats. Expressed as a percentage of the sheep bones they increased from <1% to almost 2% (Crabtree 1989: 7, Table 2). The sheep goat ratio would appear to fluctuate considerably across late Roman and early medieval Britain, so it is therefore difficult to assess the significance of the baths basilica ratio. It would appear as though goat was not extensively utilised at *Viroconium*, though. Chapter 9 discusses the possible reasons for keeping mixed flocks.

## **6.5. Equid – cattle**

A survey of 190 Roman sites in Britain revealed that equids represent an average of five percent of the total of equid and cattle bones. The ration between the two taxa is higher on rural sites (1:10) than urban



sites (1:25), and military sites produced an intermediate value (1:20) (Johnstone & Albarella 2002: 33).

The following ratios were produced for the baths basilica assemblage (based on Table 31):

- Phase W 1:225
- Phase X-Y 1:120
- Phase Y 1:148
- Phase Y-Z 1:153
- Phase Z 1:43

The baths basilica therefore had significantly less equid remains than the norm. This could reflect the formal public function of the baths basilica. Even the increased proportion of equid remains in Phase Z (Table 30-31) is below the Romano-British norm. This increase may reflect the high-status nature of the 'great rebuilding' and the residents desire to ride.

## 6.6. Deer – major domesticates

King's (1978: 216) survey observed that deer remains only occasionally form more than five percent of the total cattle, pig and sheep/goat assemblage from any Romano-British site. The baths basilica assemblage produced a total deer MNE of 339 (Table 31). Expressed as a percentage of the total cattle, pig and sheep/goat assemblage the deer remains formed only 2%; well below the threshold of 5% suggested by King (1978: 216). Individual deer species, and their relevance, have been considered in Chapter 11.

Several authors have noted an increase in the relative proportions of deer on Romano-British sites with time. King (1978: 216) states that the proportion of deposits which include deer remains increases from 39% in the 1<sup>st</sup> century AD, 53% in the 2<sup>nd</sup> century AD, 71% in the 3<sup>rd</sup> century AD to 79% in the 4<sup>th</sup> century AD. At Chalk villa deer bones increase from 5% to 13% during the final phase of occupation in the 4<sup>th</sup> century AD (Eastham 1972: 142) and at Latimer villa the frequency of deer bones increase from 4% to 19% by the late 3<sup>rd</sup> century phase, and the two post-Roman villa phases produced frequencies of 14% and 21% (Hamilton 1971: 164, Table 8). When considered by phase, the baths basilica produced the following frequencies (deer remains expressed as a proportion of their respective cattle, pig and sheep/goat assemblages) (based on Table 31):

- Phase T-V <1%
- Phase W 1%
- Phase X 2%
- Phase X-Y 2%
- Phase Y 3%
- Phase Y-Z 3%
- Phase Z 3%

Despite not being statically valid this might suggest the baths basilica assemblage corresponds to the trend for increasing deer numbers reported for the rest of Roman Britain. As the baths basilica site obviously flourishes into the early medieval period (based on the archaeological evidence and results of the faunal analysis) increasing deer remains cannot be a response to economic hardship and the collapse of the established agricultural infrastructure. The situation at *Viroconium* counters the argument made by Grant (1981: 208) that in the 4<sup>th</sup> and 5<sup>th</sup> centuries AD as the Roman infrastructure fell into disrepair hunting deer was an economic necessity. Other social factors may therefore be responsible. It may be the case that hunting deer was already becoming a leisure pursuit of the upper echelons of society in the late

Roman period. At *Viroconium* this view is supported by the interpretation of several villas in the hinterland being ‘hunting lodges’ (see Chapter 12).

## 6.7. Domestic fowl – pig – sheep/goat

Maltby (1997) conducted a survey of the proportions of domestic fowl to pig and sheep/goat from 123 assemblages. It was discovered that domestic fowl were consistently more common on urban sites. Domestic fowl were also more common on sites that had greater frequencies of pig (see above). This led to the conclusion that domestic fowl were also an indicator of how Romanised a site was. Major urban centres produced the following averages (taken from Maltby 1997: 412, Figure 2): domestic fowl 10%, pig 35% and sheep/goat 55%.

Table 36 outlines the percentages produced by the baths basilica assemblage. These were based on MNE values (Table 31) rather than NISP to negate the fact that more anatomical elements and zones were recorded for the mammalian skeletons (see Chapter 3). All phases of the baths basilica therefore match the overall trend for Romanised urban centres. The proportions of domestic fowl actually decrease at *Viroconium*. This occurs because the frequency of pig increases (see above).

## 6.8. Duck – goose

Goose remains are always reasonably scarce in Romano-British contexts and ducks usually outnumber geese. A preference for duck over goose appears to have been an entirely Romano-British phenomenon, as goose became predominant in the medieval period (Parker 1988: 209). The switch seems to have occurred by the early-mid Saxon period, as evidenced by sites such as Pennyland, Milton Keynes, Buckinghamshire (Ashdown 1993: 154, Table 31), Ipswich, Suffolk (Jones & Serjeantson 1983: 3, Table 2) and West Stow, Suffolk (Crabtree 1989a: 208). At Melbourne Street, Southampton geese massively outnumber ducks: 353 compared to only three specimens (Bourdillon & Coy 1980: 81, Table 17.1 & 118). At Lincoln the switch is also apparent. Forty three ducks and 25 geese were recovered from 3<sup>rd</sup> – 4<sup>th</sup> century AD deposits, whereas late Saxon deposits produced one duck and 18 geese (Dobney *et al.* 1996: 132, Table 7). However, some variation also exists. Roman Exeter (Maltby 1979: 203, Table 95) and Leicester (Gidney 1999: 312, Table 66) both produced approximately equal proportions of ducks and geese.

The baths basilica produced the following duck to goose ratios (all species of ducks and geese have been combined; based on Table 31):

- Phase X-Y      1:1
- Phase Y        6:1
- Phase Y-Z      3:1
- Phase Z        7:1

Although based on a small number of specimens this would suggest that the Roman trend for a greater exploitation of ducks over geese continued in to the early medieval period at *Viroconium*.

## 6.9. Summary

The baths basilica assemblage is dominated by domestic animals throughout. Wild species of mammals and birds are present in small numbers, and actually increase slightly in the latter phases, but would ultimately have contributed little to the site economy. This would imply that *Viroconium's* hinterland

suffered no agricultural systems collapse with the 'official' demise of the empire in the early 5<sup>th</sup> century AD. Distributions networks also appear to have been little affected. The proportion of the major domesticates to one another mirror the general trend noted for north-western European urban centres (as noted by King 1978, 1984 & 1999a). Cattle were predominant with smaller frequencies of pig and sheep. A diachronic shift is evident from the baths basilica assemblage; pig increase at the expense of sheep. The former pattern may reflect the baths basilica swift from public building to high-status residence. The latter reflects a wider trend of decreased mutton consumption, as the population became more Romanised. The ratio of sheep and goat remains enigmatic, as inter-site comparison has revealed ratios fluctuate considerably, although goat was not extensively utilised at *Viroconium*. Horse bones are rarely encountered on urban sites and suggests that horsemeat was not regularly consumed, a view supported by King (1978: 225). *Viroconium* is no different to any other Romano-British urban centre in this respect; a trend which continued into the early medieval period. The proportion of deer within the assemblage falls below the norm for Britain, but demonstrated a slight increase in the later phases, and supports the view expressed above that wild species made little contribution to the site economy or diet. The ratio of ducks to geese also mirrors the general Roman trend throughout activity at the baths basilica. Overall, the baths basilica conforms to the general pattern noted for late Roman Britain. Importantly this pattern continues unchanged into the early medieval period and demonstrates an unbroken cycle of agricultural production and the ability to distribute it.

## 7. Cattle

### 7.1. Introduction

This chapter will discuss the cattle remains excavated from the *Viroconium* baths basilica. Firstly, it will consider the range of skeletal elements present and their distribution within particular context types. It will then discuss the evidence for ageing and consider butchery practices. Finally, the results and implications of biometric analyses, as well as non-metric traits, will be considered. The concluding discussion will draw together inferences made from the skeletal evidence and discuss their implications in terms of the research questions asked (Chapter 2).

### 7.2. Anatomical representation

Cattle skeletal distributions are presented in Figure 31 and Table 37, following the procedures detailed in Chapter 3. Figure 31 is based on MNE values to counteract the effects of differential fragmentation, making diachronic and inter-context comparison more valid. The highest MNE for any single skeletal element is 102 for Phase T-V, 1566 for W, 42 for X, 951 for X-Y, 1474 for Y, 1065 for Y-Z and 2825 for Z. The graphs produced for Phases T-V and X are clearly questionable because of the small samples, although both demonstrate fairly similar patterns to the other phases based on far larger samples.

The possibility that the observed patterns result from taphonomic processes has already been considered; see Chapter 4. To summarise, a recovery bias appears not to have affected cattle body part distribution, as despite only haphazard sieving, large numbers of isolated teeth and phalanges were retrieved, in addition to very young specimens. Neither differential preservation nor fragmentation appears to be responsible for the observed pattern, as comparatively large numbers of the more fragile skeletal elements, such as the femur, are present. If the reverse were true, then peaks of the more compact and robust elements, such as the astragalus, would be expected and this is not the case.

All recorded skeletal elements are well represented, and this suggests that at least some whole carcasses were present at the baths basilica. Anatomical representation is relatively even in the later phases (Y, Y-Z and Z), but much more irregular in the early phases (T-V, W, X and X-Y); this contrast is independent of sample size. Nonetheless, broadly the same body parts are over- or under-represented in all phases: the mandible, scapula (not in Phase X), metacarpal and metatarsal are generally the most numerous skeletal elements, whilst horncores are the least well represented. The low frequency of horncores could reflect variance in the age and sex structure of the population; alternatively, it may suggest that horn working was taking place, and that horncores were being removed for processing elsewhere in *Viroconium*. The high proportions of mandible, metacarpal and metatarsal suggest over-representation of butchery waste, whereas the later phases may represent a change in waste disposal practices at the baths basilica.

### 7.3. Disposal practices

As the *Viroconium* baths basilica dataset is so large, it has been possible to consider the distribution of cattle body parts for individual phases by deposit type. This may elucidate differential disposal practices and highlight diachronic change. Cattle bones were distributed across all deposit types recorded at *Viroconium*, including pit fills, cut fills, posthole fills, layers, hearth fills, floors, surfaces, structures and dumps (see Chapter 5). The category 'other' has been excluded from this analysis because it is of little

interpretive value, as have contexts not assigned to a deposit type. Cattle bones, regardless of phase, were present in the different context types in the following quantities (NISP):

- pit fill 315
- cut fill 2404
- posthole fill 117
- layer 790
- hearth fill 13
- floor 12
- surface 917
- structure 1643
- dump 4024

The small numbers derived from hearth fills and floor deposits automatically excluded them from further analysis. When divided by phase the numbers involved obviously decrease, which has excluded other deposit categories from some phases. One hundred NISP was deemed the minimum number of fragments necessary for constructing body part distribution graphs by phase and deposit type, although this figure is fairly arbitrary, because 100 NISP produces smaller MNE values. However, if larger NISP values had been utilised too few comparable datasets would have been produced. See Chapter 3, for a consideration of sample sizes, quantification techniques, etc.

MNE values used to construct body part distributions were as follows (Figures 32-36; Tables 38-42):

- Phase W (Figure 32; Table 38): cut fill 105; layer 215; surface 224; dump 467
- Phase X-Y (Figure 33; Table 39): cut fill 948; dump 75
- Phase Y (Figure 34; Table 40): pit fill 87; cut fill 132; posthole fill 92; layer 203; surface 372; structure 114; dump 717
- Phase Y-Z (Figure 35; Table 41): cut fill 390; layer 93; surface 326; dump 345
- Phase Z (Figure 36; Table 42): pit fill 78; cut fill 86; surface 456; structure 1049; dump 1204

Diagrams display element frequencies expressed as a proportion of 'minimum number of individuals' (MNI), often designated as '%MNI'. Broken down by context type and phase, body part representation of cattle broadly illustrates the patterns already outlined (Figure 31; Table 37): more uneven representation in the early phases and more even in the later phases; and the most abundant element is usually the mandible, scapula, metacarpal or metatarsal. Deviations from the usual pattern tend to be based on very small samples (e.g. Phase X-Y dumps and Phase Y pit fills). Thus the skewed anatomical representation of early phases is not the product of a few large deposits of extreme composition and indeed it should be noted that the context groups under discussion are comprised of several different deposits. Equally, the more even anatomical representation of later phases is not an artefact of the pooling of different deposits of skewed, but complementary composition.

There is no indication, therefore, that different deposit types received skeletal elements associated with different stages of the butchery, cookery and consumption cycle. On the contrary, the different deposits received bone of broadly similar composition and, arguably, especially so in the early phases when composition is most skewed anatomically.

The composition of surface deposits might be expected to be shaped by taphonomic, rather than depositional, factors in that fragments left on surfaces would have been subject to greater attrition through trampling (see Chapters 4-5). This would be characterised by a higher frequency of the more durable and

compact bones, such as teeth, astragalus and phalanges. This is not obviously the case, however, and perhaps a distinction should be drawn between bone fragments on and within surfaces.

Cattle body part distribution within dump deposits is reasonably homogeneous regardless of phase. It appears to represent the accumulation of general waste material deriving from whole carcasses. This may support the hypothesis that the dumps consisted of material collected municipally across *Viroconium* (Barker *et al.* 1997: 195; see Chapter 5), which were laid down as secondary structural deposits. Municipal waste collection would presumably mix together material deriving from a range of activities, which would conceivably mask activity specific signatures, thus providing a homogenized pattern (as suggested for Lincoln – see Dobney *et al.* 1996: 11, 24 & 57-58). This is less the case for the early phases and possibly reflects the need to patch floors, make-up subsidence, etc, in the later phases (see Chapter 1). Alternatively, this diachronic pattern denotes more meat-off-the-bone when considered in conjunction with increased cutting in the later phases (see below).

## **7.4. Ageing**

### **7.4.1. Epiphyseal fusion**

The post-cranial epiphyseal fusion data for cattle indicate that the majority of individuals were slaughtered once they had reached skeletal maturity (Figure 37; Table 43). There is little variation between phases. Figure 37 and Table 43 and display cattle fragments as ‘early’ (6-24 months), ‘middle’ (24-42 months) or ‘late’ (42-48 months) fusing skeletal elements (see Chapter 3). Post-cranial epiphyseal fusion for Phase T-V is based on 98 observations, Phase W on 1399, X on 37, X-Y on 889, Y on 1479, Y-Z on 1042 and Z on 2836. Phase T-V and especially Phase X are too small to be relied upon.

In all phases, the proportion of ‘early’ fusing elements that were unfused was very low. Among ‘middle’ fusing elements the proportion of unfused specimens was rather higher, rising from 3% in Phase W to 19% in Phase Z. Of the ‘late’ fusing elements, approximately a third to a half were unfused or fusing. The small number of neonatal specimens is also displayed, as a proportion of the total number of post-cranial specimens (so as not to bias the ‘early’, ‘middle’ and ‘late’ categorization). Using the ages suggested by Schmid (1972: 75, Table 9) and Silver (1969: 252-253, Table A) for epiphyseal fusion, the pattern outlined above indicates that the majority of individuals were skeletally mature and most died as young adults, rather than as juveniles (‘late’ fusing elements fuse between 42-48 months). State of fusion was not recorded for vertebrae, but it was noted during the recording of material that a large proportion was fused, suggesting that many cattle reached late adulthood before slaughter. According to Schmid (1972: 75, Table 9) and Silver (1969: 252-253), vertebral fusion occurs between seven and nine years of age.

### **7.4.2. Tooth eruption and wear**

A more precise, and probably more accurate, picture of age at death emerges when mandibular tooth eruption and occlusal wear are considered, using the stages of O’Connor (1991: 250, Table 67; 2003: 160). Figure 38 and Table 44 summarise cattle mortality derived from tooth eruption and wear, and Appendix 14 lists the raw data. Based on Silver (1969:262, Table D), a ‘juvenile’ animal may be around five-six months old (eruption of the first molar), an ‘immature’ animal may be around 15-18 months old (eruption of the second molar) and a ‘subadult 1’ animal about 24-30 months old (eruption of the third molar). Grigson (1982: 13) quoted Degerbøl (1970), who suggested the hypoconulid comes into wear at

approximately five years. Methods of recording and analysis are detailed in Chapter 3, together with a discussion of problems associated with creating mortality profiles from tooth data and the complications caused by fragmentary archaeological material.

The mortality curve for Phase T-V is based on 21 cases, for Phase W on 274, for Phase X on nine, for Phase X-Y on 146, for Phase Y on 169, for Phase Y-Z on 167 and for Phase Z on 390. Phases T-V and X may not be representative, due to small sample size, although they still display the same overall patterns as the other phases. As with body part distribution and the post-cranial epiphyseal fusion data, there is a considerable level of consistency between phases. The vast majority of animals were slaughtered as adults: approximately 50-60% of animals had reached 'adult 3' (enamel exposed on the third molar distal column) and a further 10-25% were 'elderly' (the third molar had reached Grant (1982) wear stage 'j'). Approximately 15-30% of the cases from each phase were slaughtered at 'subadult 2', 'adult 1' and 'adult 2'. Low numbers of very young and young animals were present: 'neonatal' individuals in Phases T-V, W, Y, Y-Z and Z, 'juvenile' individuals in Phases W, Y and Z, and 'immature' individual in Phases X-Y, Y and Z.

#### **7.4.3. Data correlation**

Occasionally the mortality curves produced by the two evidential strands contradict one another. To assess this possibility, it is first necessary to equate post-cranial epiphyseal fusion stages to tooth eruption and wear stages, using their corresponding ages. Based on the ages quoted above, the 'juvenile', 'immature 1', 'immature 2' and 'sub-adult 1' mandible categories equate to the 'early' epiphyseal fusion category. The 'sub-adult 2', 'adult 1', 'adult 2' mandible categories equates to the 'middle', and perhaps 'late', fusion categories. Therefore, no discrepancy appears to exist between the two datasets.

### **7.5 Sexing**

Sexing cattle specimens has been attempted in two ways (see Chapter 3): pelvic morphology, using the ilio-pubic ridge and median acetabular border, has been employed and biometrical analysis of the metacarpal, using shape indices.

#### **7.5.1. Pelvis**

Table 45 outlines the numbers and proportions of sexed cattle pelvises from the baths basilica. The figures are summarised here with definite and probable identifications combined. Female to male ratios have also been provided. Phase X has been excluded, as it only produced one case (a female). The results for Phase T-V, and to a lesser extent, for Phases X-Y and Y-Z may not be representative, due to small sample sizes. The remaining phases show a clear prevalence of female animals, although the proportion of males apparently increases over time.

#### **7.5.2. Metacarpal**

In the attempt to sex the baths basilica cattle metacarpals biometrically, it has been necessary to modify the indices developed by Howard (1963) to counter the effects of pathological condyle splaying (see Chapter 3). Appendix 19 lists the biometrical data used (specimens demonstrating splaying have been annotated). Width at the distal epiphyseal fusion point (BatF) has been substituted for maximum distal width (Bd). Figure 39 displays the results of 'MB/L' (mid-breadth=SD/GLx100) against 'DB/L' (distal breadth=BatF/GLx100). Phase T-V is based on one case, Phase W on 12, Phase X-Y on one, Phase Y on

nine, Phase Y-Z on 10 and Phase Z on 42. If the larger group of smaller and more gracile individuals represents females and the smaller group of larger and more robust individuals represent males, the scatter plot (Figure 39) seems to confirm the morphological criteria used to sex the pelvis (Table 45).

No attempt has been made thus far to identify the presence of castrates, which reputedly have a larger greatest length (GL), whilst being slighter (Grigson 1982: 11; Maltby 1979: 33), although age of castration greatly influences skeletal development and overall size and shape (Grant 1975: 401; Luff 1993: 60). To explore this, shape indices are generated in a slightly different manner: Figure 40 plots 'DB' (BatF/GLx100) against 'GL'. Phase T-V is based on one case, Phase W on 12, Phase X-Y one, Phase Y nine, Phase Y-Z on 10 and Phase Z on 44. The group of larger 'males' breaks down into sub-groups of short very robust and long moderately robust specimens, which may tentatively be attributed to bulls and castrates respectively.

Interestingly, when the two plots (Figures 39-40) are annotated by splayed and unsplayed specimens a distinct and significant pattern emerges. Figure 41 demonstrates that the vast majority of splayed specimens derive from the physically larger 'male' individuals. When Figure 42 is considered the two clusters tentatively identified as bulls and castrates (see above) are equally affected by splaying (possibly because of their greater body mass). It is, however, extremely unlikely that complete males were used as beasts of burden because they are unpredictable and potentially dangerous; both groups of larger individuals probably represent castrates, which were castrated at different ages, thus affecting their skeletal development (see Bartosiewicz 1987; Bartosiewicz *et al.* 1997; Chapters 2 & 12). It may, therefore, be argued that castrates were routinely employed as beasts of burden before being slaughtered for meat at the end of their working lives.

## **7.6. Butchery**

To elucidate cattle butchery patterns within the baths basilica assemblage, three approaches have been undertaken. Firstly, the frequency of butchery marks by phase and skeletal element is considered. Secondly, the butchery marks evident on the *Viroconium* material are allocated to particular stages in the carcass reduction process. Thirdly, specific butchery patterns that have been identified from other Romano-British urban assemblages are explored across the period of activity at the baths basilica site to determine whether they continued into the early medieval period.

### **7.6.1. Frequency and butchery marks**

Table 46 outlines the frequency of butchery marks from the baths basilica assemblage by phase and anatomical element. Isolated fourth deciduous premolar, third molar and metapodial NISP have been excluded from the calculations. The percentage of NISP values displaying one or more butchery marks varied very little between phases:

- Phase T-V            18%
- Phase W             17%
- Phase X             18%
- Phase X-Y          20%
- Phase Y             19%
- Phase Y-Z          20%
- Phase Z             21%



This range of frequencies is broadly comparable to analogous sites, for instance Elms Farm, Essex, with an overall frequency of 28% (Johnstone & Albarella 2002: 16). However, frequencies of butchery marks are not routinely provided in faunal reports (e.g. Exeter – Maltby 1979; the General Accident site, York – O'Connor 1988; Lincoln – Dobney *et al.* 1996; Portchester Castle, Dorset – Grant 1975, 1976), but in some respects this is unimportant because frequencies can fluctuate greatly between assemblages because of different recording systems and quantification methods.

A more complicated picture, but a broadly similar one, emerges when the same data are considered by anatomical element (Table 46). Figure 43 displays this information graphically. Phase T-V is based on 165 observations, Phase W on 2314, Phase X on 57, Phase X-Y on 1324, Phase Y on 2201, Phase Y-Z on 1632 and Phase Z on 4213. Phases T-V and X should probably be discounted, as they are based on too few observations to be reliable. From the remaining phases it is immediately apparent that bones of high meat utility/value, such as the scapula, pelvis (and to a lesser extent the humerus and femur) are generally more heavily butchered than those of lower meat utility. Butchery of medium (radius and tibia) and low (metacarpal, astragalus, calcaneum and metatarsal) meat utility elements fluctuates considerably. This may be the result of fragmentation and relatively small samples, etc. The elements of lowest meat utility (horncore, zygomaticus, mandible and first phalange) demonstrate the lowest frequency of butchery. Butchery frequency may relate directly to the volume of meat surrounding a particular element; a greater volume of muscle may equate to a higher degree of processing. It is, therefore, necessary to explore how butchery marks related to particular stages in the carcase reduction process.

Table 47 summarises type of butchery mark ('chop', 'cut' and 'saw') by anatomical element and chronological phase. Chops account for the majority of butchery marks, although the frequency of cut marks increases over time. Cut marks expressed as a percentage of total butchery by phase increase from 14% in Phase T-V to 33% in Phase Z (based on Table 47):

- Phase T-V           14%
- Phase W             19%
- Phase X             20%
- Phase X-Y          27%
- Phase Y             31%
- Phase Y-Z          34%
- Phase Z             33%

This trend is considered in more detail below.

### **7.6.2. Carcase reduction stages**

When the *Viroconium* material was recorded, butchery marks were allocated to a particular stage in the carcase reduction process. These stages were defined as 'skinning', 'dismembering', 'filleting' and 'other'. For this purpose, the ethnographic butchery data collected by Binford (1981: 98-133, Figures 4.06-4.38, Table 4.04 ) were used as a guide (see Chapter 3). In addition, several other locations/orientations of butchery marks were added to compliment those of Binford (1981). This was deemed necessary to prevent many of the *Viroconium* butchery marks falling into the 'other' category. The additional categories were (see Chapter 3): transverse marks zygomaticus; longitudinal/diagonal marks on shafts equating to filleting on long bones and cannon bones; transverse marks on epiphyses equating to dismembering on long bones and cannon bones; transverse marks located mid-shaft on the first phalange were assumed to represent skinning.

Figures 44-48 display carcasses reduction stages by anatomical element for Phases W, X-Y, Y, Y-Z and Z. Table 48 summarises the data for all phases. Butchery marks location on a single specimen often related to several stages in the carcass reduction process, hence the greater number of observations. Phases T-V and X have been excluded from analysis, due to the low number of observations made for each. Using the criteria outlined above, it was possible to allocate the majority of butchery marks to a particular stage in the carcass reduction process. It was noted that without the additional categories a sizeable proportion of butchery marks, regardless of anatomical element, would have fallen into the 'other' category.

Butchery marks located on the skull demonstrated fluctuating levels of correspondence to the modified categories of Binford (1981). Horncore butchery almost exclusively related to dismemberment, whereas between 62-87% of butchery to the zygomatic arch was unclassified (the remainder all denoted skinning). Mandibular butchery classification varied considerably: 33-83% dismembering and 17-67% unclassified.

For the long bones, regardless of phase, the largest butchery component constituted dismemberment (generally between 25-80% and usually over just 50%). Approximately 10-40% of marks derived from filleting. Very few marks were interpreted as skinning on the long bones, which is perhaps unsurprising. For the first phalange it was possible to allocate 79-91% of the butchery marks; all of which were interpreted as skinning. The remainder that could not be allocated often comprised chops to the proximal articulation (all aspects), and could conceivably relate to dismemberment.

The girdle bones (scapula and pelvis) and compact bones (astragalus and calcaneum) demonstrated low levels of correspondence: 57-99% and 39-57% of butchery could not be classified respectively. Almost all the classified butchery denoted dismemberment, with a very small amount of filleting also located on the scapula. Due to the anatomical location of these body parts the unclassified marks, in all likelihood, also derive from dismembering. The only real ambiguity that existed between Binford's (1981) groupings, plus the additional categories, and the butchery evidence from *Viroconium* were those on the metacarpal and metatarsal. With the exception of Phase Y, considerably less of the 'other' butchery marks were attributable to the re-defined categories for metacarpals than metatarsals. Metatarsals, additionally, included marks interpreted as both dismembering and filleting, whereas metacarpals included only dismembering. This indicates that the cannon bones were butchered in different ways, although no obvious explanation is apparent.

In conclusion, the full carcass reduction process is represented throughout the period of activity at the baths basilica. There appears to be little fluctuation between the late Romano-British and early medieval periods, notwithstanding increased knife use in the later phases; the physiological characteristics and properties of the skeletal-muscular system may restrict the degree of variance in the primary division of the carcass, whereas skinning an animal and filleting meat from the bone may not be subject to the same constraints, which therefore allow socio-cultural trends to develop.

### **7.6.3. Romano-British butchery practices: Inter-site comparison**

Based on Seetah's (2002) experimental work, which replicated several butchery marks peculiar to urban Romano-British assemblages, it was decided to focus on specific butchery marks on the scapula, proximal femur, astragalus, calcaneum and proximal metatarsal to chart any changes within the baths basilica assemblage. This was attempted using the categories devised for Maltby's (1989) research into rural and

urban Romano-British butchery patterns in Hampshire. The rationale for choosing each element will be explained as the individual elements are considered below.

The values provided in the following diagrams demonstrate the frequency of particular butchery categories, expressed as a percentage of the total number of fragments with butchery evidence. Each category has been treated separately regardless of the presence of other butchery marks. Combinations of particular marks have not been considered (see Tables 49 & 51-54 for data summaries).

### **Scapula:**

Maltby (1989: 93, Table 3) divided butchery on the scapula into the following categories:

- S1 axial/oblique chop through glenoid cavity running in latero-medial direction
- S2 repeated axial/oblique chops through glenoid cavity running in a latero-medial direction
- S3 horizontal superficial chop marks; around glenoid cavity
- S4 axial chop/blade/saw marks; lateral spine
- S5 other axial chop/blade/saw marks; lateral aspect of blade
- S6 superficial chop/blade marks; medial/caudal aspects of blade
- S7 other chop/blade/saw marks; lateral aspect of blade
- S8 horizontal knife cuts; around glenoid cavity
- S9 axial knife cuts; lateral aspect of blade (including blade)
- S10 axial knife cuts; medial blade
- S11 other knife cuts; lateral and cranial aspects of blade
- S12 other knife cuts; medial and caudal aspects of blade

For the purposes of this exercise the first two categories were combined, as they essentially relate to the same process. Figure 49 and Table 49 outlines the results. Only Phases W, X-Y, Y, Y-Z and Z were analysed in this manner because Phases T-V and X provided too few cases. Phase W is based on 81 observations, Phase X-Y on 47, Phase Y on 65, Phase Y-Z on 40 and Phase Z on 130 observations.

Removal of the scapula spine falls within Maltby's (1989: 93, Table 3) type S4 category. Over 70% of scapulae from Phase W demonstrated this type of butchery, but thereafter the proportion had declined to 40-50%; by Phases Y-Z and Z. One possible interpretation for this is a decline in typical urban Romano-British butchery practices at *Viroconium* in the sub-Roman/early medieval period.

Maltby (1989: 81) discovered that partial or complete removal of the spine occurred equally on both rural and urban sites, and was the only type to do so. On rural sites it was often accompanied by cut marks associated with filleting (types S9-S12). Interestingly, there appears to be an overall increase in the frequency of these categories at *Viroconium*, especially type S11, indicating that changes in butchery practice are not related to abandonment of the cleaver in favour of the knife, as they would not have been heavy enough to chop through the spine. Types S3 and S7 also increase through time.

Chopping the scapula in this manner appears superfluous in modern butchery terms, as it is an easy process to disarticulate the shoulder at the glenoid and fillet off the meat component; mainly the trapezius, and parts of the latissimus, deltoidus and triceps brachii muscles (Seetah 2002: 60-61). After replicating this technique, Seetah (2002: 60-61) concluded that it was part of the meat removal process, especially as blows to the glenoid fossa and spine would have been particularly dangerous to the practitioner if holding the glenoid, as it would have brought the butcher's fingers very close to the zone being chopped. It would be more sensible for meat to have still been attached to the bone. This interpretation disagrees with Thawley (1982b: 219), who suggests that removal of the spine was to disarticulate the shoulder joint. This was not filleting in the modern sense because the spine would have to be removed later after the

meat was detached from the bone. Using the modern 'paring' method to remove meat from the scapula is particularly time consuming and the urban Romano-British method would have been considerably faster (Seetah 2002: 60-61). One type of cut mark noted on the *Viroconium* material, and placed into the type S11 category, consisted of one or more concentric and semi-circular marks running medio-laterally around the anterior aspect of the spine. This may represent a new technique for removing meat from the scapula without chopping through the spine and having to remove it later.

One form of archetypal Romano-British scapula butchery not considered by either Maltby (1989) or Seetah (2002) is hook damage, possibly because it is not technically part of the carcase reduction process, and leaves no actual butchery marks. Hook damage is characterised by a roughly circular, rectilinear or irregular hole of varying dimensions through the blade. These holes are usually positioned within 50mm of the suprascapular margin and midway between the anterior and posterior edges. The reason for hanging shoulder blades from metal hooks is thought to have been for curing meat (Dobney 2001: 40-41; Lauwerier 1988: 156). Analysis suggests that this was carried out in a variety of ways, including brining, hot and cold smoking, which relate directly to the butchery 'type' present. Scapulae demonstrating hook damage and trimmed glenoid cavities (types S3 and S8) with chopped spines (type S4) may represent brined or cold smoked joints, as trimming would allow salt to penetrate the meat more thoroughly. However, only 12% of scapulae demonstrating chopped spines were recorded as having hook damage (all phases combined), so this proposition is unlikely. Reputedly, brining would have provided a longer shelf life than hot smoking without immersion in brine (Dobney 2001: 41; Dobney *et al.* 1996: 27). Linear knife marks on the medial aspect of the blade (type S10) and nicks/shaving marks (types S5, S6 and possibly S7), especially on the margo thoracalis, probably derive from slicing off the dried meat (Lauwerier 1988: 156). Dobney *et al.* (1996: 27) discovered a higher frequency of hook-damaged scapulae with spines removed in 1<sup>st</sup> century AD deposits at Lincoln.

Table 50 outlines frequencies of hook damage and probable hook damage for the baths basilica assemblage: there were few incidences of hook damage from the baths basilica assemblage. These figures do not reveal any change in the hanging and curing of shoulder joints from the Romano-British to the early medieval period, but such low frequencies probably do not reflect the true picture at *Viroconium* because, in all likelihood, severe fragmentation may have obscured any diachronic pattern.

The inter-site variability of this butchery method has not been fully assessed, although numerous instances have been recorded from urban and/or military sites, such as Catterick (Stallibrass 2002: 411), Elms Farm, Essex, (Johnstone & Albarella 2002: 16), the General Accident site, York (O'Connor 1988: 82-84) and Lincoln (Dobney *et al.* 1996: 26-27), and to a lesser extent on rural sites, such as Chedworth villa, Gloucestershire (Hammon 2002) and possibly at Wantage, Oxfordshire (Maltby 1997: 159). A slightly different pattern emerged from Caerleon; scapulae were removed during primary processing and discarded, leaving 'stewing steak' (O'Connor 1983: 107-110; 1986: 231).

#### **Proximal femur:**

Figure 50 and Table 51 summarises the following butchery types, as defined by Maltby (1989: 97, Table 7):

- F1 proximal articular surface (head and neck) chopped through
- F2 superficial chop marks on and around the proximal head and neck
- F3 axial chop through proximal running in anterior-posterior direction

- F4 axial/oblique chop through shaft running in anterior-posterior direction
- F9 superficial axial blade/chop/saw marks on shaft
- F10 knife cuts; medial aspect of proximal end
- F11 other knife cuts; proximal end
- F12 (other) knife cuts on shaft

As with the scapula the first two categories have been combined, as they basically represent the same process: removal of the femoral head by one or more heavy chops to the neck obliquely to the axial plane of the bone. Disarticulated femur heads have been noted from Gloucester (Maltby 1979: 182), Cirencester (Thawley 1982b: 220) and Caerwent (Hambleton & Maltby in prep), while chopped acetabula from Silchester (Maltby 1984a: 201) demonstrate the same process.

Seetah (2002: 36, 51-52) concluded that chopping through the femoral head required little effort and would have been a simple process once the joint had been exposed. Exposure of the joint would have been made possible by cutting through the gluteobiceps muscle. Often subsidiary marks close to the site of disarticulation are noted and they probably relate to this, rather than misdirected chops. This is a different process to that used by modern butchers: rather than slicing into the flesh and severing ligament attachments, the femur head was chopped through while still attached to the acetabulum. Modern aesthetic considerations dictate that the gluteobiceps is cut on the anterior surface of the femoral/pelvic joint, enabling removal of the whole leg by cutting the ligaments. The Romano-British practice of chopping through the femoral head may be interpreted as a time/labour saving device.

Phase W is based upon 21 observations, Phase X-Y on 22, Phase Y on 34 and Phase Z on 55 observations. These relatively low figures have to be borne in mind when interpreting the data. Phases T-V, W and Y-Z had too few cases to be useable. Chops to the femoral head and neck (types F1-F2) fluctuate throughout the period of activity at the baths basilica, but do not demonstrate any clear pattern. Approximately half of all femoral heads had been chopped through (type F1), and around three-quarters demonstrated superficial chops to the head and neck (type F2). This implies that the very efficient urban Romano-British method of disarticulating the hind leg at the acetabulum continued into the early medieval period at *Viroconium*. Types 3 and 4 are also caused by chops and heavy blows and again appear to be used in all phases at *Viroconium*. Type F4 splits the shaft leading to the severe fragmentation periodically encountered on Roman sites, and has several possible interpretations (discussed below). Type F9 represents marks associated with filleting, including running a blade down the shaft, which often leaves characteristic shallow scoop marks. This form of butchery has been encountered on all the major meat-bearing long bones at *Viroconium*. Maltby (1989: 84) reports that this form of butchery on the femur is very variable frequency on urban sites and also occurs on rural sites.

As with the scapula, fine cut marks, presumably made by knives, on the femur are more informative than chop marks. Knife marks to the shaft and proximal region increase in the later phases of occupation at the baths basilica: type F11 rises from 5% in Phase W to over 20% in Phases Y and Z, unlike type F12, which does not occur until Phase Z. Overall, butchery evidence from the femur matches the pattern provided by the scapulae, indicating increased use of labour-intensive knife butchery in later phases.

### **Astragalus:**

Figure 51 and Table 52 displays the corresponding butchery marks for the astragalus. Maltby's (1989: 99, Table 9) categories are:

- A1 oblique/horizontal chop through proximal usually running anterior-posteriorly
- A2 superficial chop/saw marks proximal
- A3 oblique/horizontal chop through centre of bone usually running anterior- posteriorly
- A4 superficial anterior-posterior chop/saw marks; anterior aspect of central part of bone
- A5 oblique/horizontal chop through distal usually running anterior-posteriorly
- A6 superficial chop/saw marks; distal
- A7 axial/oblique split through bone
- A8 repeated axial splits through bone
- A9 knife cuts; anterior aspect of centre of bone
- A10 knife cuts; anterior aspect distal end
- A11 superficial; axial blade/chop/saw marks

Phase W is based on 23 cases, Phase X-Y on 12, Phase Y on 19, Phase Y-Z on 14 and Phase Z on 42. Types A1, A3 and A5 represent the disarticulation of the astragalus from the tibia (see below). Phase Y and especially Phases X-Y and Y-Z produced small samples. Phases W and Z indicate that chop marks decline, whereas cut marks increase. This broadly supports the pattern noted for the calcaneum (see below), and suggests that the method of disarticulating the hock joint, as noted by Maltby (1989) and replicated by Seetah (2002), generally remained the favoured technique up to abandonment of the site, thus demonstrating direct continuity between the late Romano-British and early medieval periods. The superficial equivalents of types A1, A3 and A5 (A2, A4 and A6 respectively) demonstrate a similar pattern. As on other elements, knife marks on the astragalus (types A9 and A10) increase in the later phases of activity at the baths basilica. Cases where the astragalus has been split axially (types A7 and A8) may have occurred when the tibia was split, implying that they were still attached (Maltby 1989: 85). The highest occurrence of this type of butchery at *Viroconium* is in Phase W (17% of butchered fragments) and the only other instance is from Phase Y-Z. This could reflect the practice of heavily butchering bones for marrow extraction or some other purpose (see below), which is often noted in urban Roman deposits.

### **Calcaneum:**

Butchery on the calcaneum has been classified according to the categories defined by Maltby (1989: 100, Table 10), as follows:

- C1 oblique/medio-lateral chops through calcaneal tuber
- C2 superficial chop/saw marks; calcaneal tuber
- C3 oblique/horizontal chops through the distal end
- C4 superficial chop/saw marks; distal end
- C5 oblique/horizontal chops through centre of bone
- C6 superficial chop/saw marks; centre of bone
- C7 knife cuts; centre of bone
- C8 knife cuts; distal end

Figure 52 and Table 53 displays the results from *Viroconium* baths basilica. Phase W is based upon 48 observations, Phase X-Y on 32, Phase Y on 43, Phase Y-Z on 30 and Phase Z on 80. As previously discussed, types C1, C2, C3 and C5 all relate to the same action: the severing of the Achilles tendon to expose the astragalus and tibia. Chopping through the bone (C1, C3 and C5) is well represented throughout the period of activity at the baths basilica, as is the superficial equivalent of type C5 (C6). The superficial chop mark equivalents of C1 and C3 are less frequent and display diachronic patterning: C4 declines through time, while C2 increases. Types C7 and C8 encompass knife marks to the distal and central portions of the element on the medio-lateral and anterior aspects. Both types demonstrate a distinct increase in Phases Y-Z and Z. This supports the pattern already noted from the scapula and

proximal femur, and suggests knife use was becoming more prevalent at *Viroconium* in the 6<sup>th</sup> and 7<sup>th</sup> centuries AD. The frequency of type C7 increases, although its chop mark equivalent (C4) remains constant through time. Perhaps this is the clearest indication yet that the knife became the implement of choice at *Viroconium*.

Chopping through the hock joint, comprised of the astragalus and calcaneum, is fairly characteristic of urban sites during the Romano-British period. Heavy blows were delivered to the astragalus that occasionally split it transversely, while the calcaneum was split either along the calcaneal tuberosity or through the centre of the bone near the most proximal part of the articulation (Maltby 1989: 85-86). Seetah (2002: 45-46) replicated this, firstly by chopping the calcaneum to sever the Achilles tendon, which exposes the second location, the region between the astragalus and tibia, thus allowing disarticulation. Disarticulation of the hock joint was more labour-intensive than either the scapula or femoral head. Severing the Achilles tendon required three blows and disarticulating the astragalus from the tibia required four. Modern butchery favours foot removal at the tibial/metatarsal joint. This also occurs on Romano-British material, it may be asked why chops also occur on to the astragalus/calcaneum, as disarticulation at this point would be excessive and unnecessary. However, experimentation suggests that butchery of the astragalus and calcaneum was actually part of the disarticulation process, rather than post-dismemberment preparation for the pot. The hock joint is surrounded by many muscle and ligament attachments, which would require considerable time and effort to bone out with a knife (Seetah 2002: 45-46). It would be far easier and quicker to chop into the Achilles tendon, resulting in chop marks on the calcaneum which correspond to Maltby's (1989: 85-86) types C1-C2, C3 and C5. This opens up the hock to allow a chop through the ankle joint, which results in the characteristic fragmentation of the astragalus: Maltby's (1989: 85-86) types A1, A3 and A5. This technique is also more logical if the smaller stature of Romano-British cattle is taken into account, and also requires less whetting of blades (Seetah 2002: 61), as less butchery is required.

### **Proximal metatarsal:**

To determine whether carcasses at *Viroconium* were butchered on the ground or suspended, butchery located on the proximal metatarsal has been analysed (see below). Butchery marks were categorised using the criteria of Maltby (1989: 101, Table 12):

- M1 axial chop through proximal end
- M2 axial chop through shaft
- M4 repeated axial chops through proximal and shaft
- M5 superficial medio-lateral chop/saw marks; posterior aspect of proximal end
- M6 superficial medio-lateral chop/saw marks; anterior aspect of proximal end
- M7 superficial horizontal chop/saw marks; shaft
- M8 horizontal chop/saw through shaft
- M10 medio-lateral knife cuts; anterior aspect of proximal end
- M11 medio-lateral knife cuts; posterior aspect of proximal end
- M12 knife cuts on shaft
- M14 superficial axial blade/chop/saw marks on shaft

Figure 53 and Table 54 displays the results. Types M1, M2 and M4 have been combined, as they relate to the same process (see below). Phase W is based on 34 observations, Phase X-Y on 22, Phase Y on 15, Phase Y-Z on 28 and Phase Z on 44. Type M5 chops to the posterior aspect of the proximal metatarsal, which denote the characteristic urban Romano-British disarticulation method, occur at a reasonably consistent level throughout the period of activity at the baths basilica, ranging from 60% to just under

80%. The other typical urban Romano-British habit of splitting the metatarsal axially to remove marrow (and conceivably in preparation for craft working), represented by types M1, M2 and M4, also occur in every phase. Type M7 increases and type M6 possibly decreases through time.

With regards to butchery practices in the Roman period the question has also been raised whether or not slaughtered animals were hung for butchering or were placed on the ground. Seetah (2002: 65-66) suggested that butchery marks on metapodials might elucidate this question. Iron Age and rural Romano-British cattle metatarsals often demonstrate cut marks to their anterior surfaces, which is thought to denote skinning (see Maltby 1989: 86). This suggests that slaughtered animals were butchered on the ground while lying on their backs. The butcher would approach the animal from the posterior, and would hold the foot allowing an initial cut to be made to the anterior surface (requiring the most force), and then to the medial and lateral aspects using less force (Seetah 2002: 65-66). This equates to Maltby's (1989: 101, Table 12) type M10, and to a lesser extent types M11 and M12. Urban Romano-British metatarsals often demonstrate a different process with cut marks being most frequent on the lateral – posterior aspect (as well as on the anterior aspect) and examples have been noted from Cirencester and Caerwent (Hambleton & Maltby in prep). This equates to Maltby's (1989: 101, Table 12) type M5. Seetah (2002: 65-66[1303]) concluded from this that carcasses were probably hung up by their Achilles tendons. Hanging would also facilitate the butchery of the vertebrae and the dorsal aspect of the ribs and sternum. Corresponding chop marks have been noted on urban Romano-British material, e.g. at Caerwent (Hambleton & Maltby in prep) and Winchester (Maltby 1989: 88). The frequency of type M5 greatly outnumbers incidences of types M10-12 at *Viroconium*, which implies carcasses were routinely hung for butchery; a process that continued into the early medieval period (see Figure 53).

#### **7.6.4. Longbone 'smashing'**

Heavily chopped and fragmented humeri, radii, femora and tibiae are the only form of distinctive urban Romano-British butchery not to have been discussed so far. This form of butchery is characterised by the detachment of long bone epiphyses from their diaphyses and then the heavy chopping and smashing of both components into smaller fragments.

Such severe fragmentation has obvious implications for the identification and quantification of skeletal elements, especially when a selective diagnostic zone system is employed. An attempt was made by the author during the initial assessment to identify deposits of this nature in the knowledge that their presence would have serious implications for the recording system utilised. Heavily chopped and fragmented cattle long bones were noted, but did not form distinct and discrete deposits, and were uniformly distributed across the entire *Viroconium* assemblage. This occurred at a fairly low level and possibly reflects the homogenising influence of municipal refuse collection, where material deriving from different activities has become mixed and deposited together (see Chapter 5).

Discreet assemblages of heavily fragmented cattle long bones have been observed at Chichester cattle market (Levitan 1989: 244), Elms Farm, Essex (Johnstone & Albarella 2002: 17), Exeter (Maltby 1979: 39), the General Accident site, York (O'Connor 1988: 82), Lincoln (Dobney *et al.* 1996: 27), Little Chesters, Derbyshire (Askew 1961: 108), The Lanes, Carlisle (Connell & Davis forthcoming: 10-11) and Tort Hill East, Cambridgeshire (Albarella 1998: 103-104).



Van Mensch (1974: 163) interpreted similar deposits from Zwammerdam, Netherlands, as waste from soup kitchens. This has been widely questioned. Alternative interpretations include the extraction of marrow, marrowfat and other lipids (Dobney *et al.* 1996: 27; Maltby 1979: 39; Stokes 2000: 69). Boiling the fragmented bones would have been a more efficient way of extracting the marrow fat, as it produces a more pure fat despite being quite labour intensive (Saint-Germain 1997: 155).

Another form of bone 'processing' was noted at the baths basilica: bone splitting. Table 55 outlines the frequencies of splitting by anatomical element. The axial splitting of long- and canon bones was presumably carried out to remove the marrow. This would have been considerable less labour intensive than chopping up bones into small fragments and boiling them. The radius, metacarpal, femur, tibia and metatarsal were all equally, but variously, split with no overall pattern emerging. The humerus and femur were split to a lesser degree. The following proportions of long- and canon bones were split by chronological period: Phase W 16%; Phase X-Y 12%; Phase Y 6%; Phase 11%; Phase Z 7% (based on Table 55). Tentatively, it the occurrence of bone splitting reduced over time and might reflect the changing nature of the site.

## 7.7. Biometry

The *Viroconium* baths basilica assemblage produced a large quantity of cattle biometrical data. The assemblage as a whole produced 735 tooth measurements and 3356 post-cranial measurements, distributed by phase as follows (excluding Phase X-Z):

- Phase T-V            39
- Phase W             477
- Phase X             12
- Phase X-Y          326
- Phase Y             681
- Phase Y-Z          452
- Phase Z             1287

Summary statistics (minimum, maximum, mean, standard deviation and coefficient of variation) are provided for all measurements, which produced 10 or more cases per phase: Tables 56-61. Appendices 15-23 list measured specimens by phase and context.

Biometrical analysis centred on three thematic avenues of research. Firstly, individual measurements are considered by phase to determine if there is any diachronic size change, which might indicate breed improvement or the converse or changing quality of husbandry. Histograms display the frequency of particular measurements, usually the most numerous for any given element. Secondly, indices will be employed to assess the shape of individual animals. In all likelihood large and more robust individuals will represent males (see above), especially if the first biometrical analysis suggests no overall size change. Thirdly, an inter-site comparison will be attempted, using individual measurements and pooled log ratios, to determine how *Viroconium* compared to other contemporaneous and analogous sites.

Before commencing on the biometrical analyses, it is first necessary to consider the variability of sexual dimorphism displayed by individual anatomical elements. Grigson (1982: 7) states that cattle teeth are not dimorphic. Presumably, the humerus is markedly dimorphic because its load-bearing position in the forelimb, although Higham (1969) and Grigson (1982) do not consider it; Payne & Bull (1988: 61, Table 3) noted that pig humerii are very dimorphic. The metacarpal is generally considered very dimorphic,

although pathological splaying of the condyles complicates its use (see above; Chapter 3). The distal tibia is not very dimorphic: according to Higham (1969: 65, Table 1) there is a 15% overlap between female and male specimens. Higham (1969: 65, Table 1) also considered the astragalus to be a poor indicator of dimorphism (with a female/male overlap of 25%), although other researchers have suggested the opposite, for instance DeGusta & Vrba (2003: 1019). The distal metatarsal is not especially dimorphic, demonstrating an 18% overlap between female and male specimens (Higham 1969: 65, Table 1). Therefore, the humerus and metacarpal may be considered the most reliable indicators of dimorphism in the following study. Higham (1969: 64) also states that width measurements generally display the greatest dimorphic variation.

It was noted in several of the following histograms (and those generated for the log ratio values) that visually there appeared to be a slight increase in the proportion of large specimens in the later phases (see below). This was initially thought to represent a small, but significant, increase in the number of males being supplied to *Viroconium* (as purported by the sexed pelvises; see above). To test this hypothesis skewness values were generated (see Chapter 3). Table 62 outlines skewness values by phase for third molar (width), humerus (HTC), metacarpal (BatF), tibia (Bd), astragalus (Bd) and metatarsal (3) measurements, plus pooled width, length and depth log ratio values. To avoid biasing the results extreme outliers were first discounted, i.e. values that may have derived from recording errors or possible misidentification (listed in Table 63). The results were inconclusive (Table 62); no diachronic pattern is evident and fairly high standard errors tend to invalidate the results. Skewness, therefore, does not support the supposition that greater numbers of male cattle were reaching *Viroconium* in the later phases.

### **7.7.1. Diachronic size change**

#### **Third molar:**

Cattle third molar produced more width than length measurements. Figure 54 displays third molar widths by phase. Phase T-V is based on 11 cases, Phase W on 158, Phase X on 6, Phase X-Y on 96, Phase Y on 102, Phase Y-Z on 120 and Phase Z on 235. All phases appear to demonstrate a fairly normal distribution that centres around 15-15.5mm. Phase Z produced the only real anomaly with a single measurement of 8.1mm (ID 10133 Context D81). The tooth that produced this measurement unfortunately was not separated when it was initially recorded, and due to the way in which the assemblage is currently stored it has not been possible to go back to it. Considering analogous sites, this specimen again seems surprisingly small. By comparison, the smallest third molar width from Elms Farm, Essex, was 12.8mm (Johnstone & Albarella 2002: 70, Table 16, 174, Appendix). It, therefore, cannot be said with any certainty whether this measurement derived from a genuinely small specimen or simply from a recording error.

Between phases there is little variation, and there appears to be no third molar width increase during the later Roman period or a decrease in the immediate post-Roman centuries. This continuity may imply that husbandry practices remained relatively unchanged throughout the period of activity at *Viroconium*.

#### **Humerus:**

The height of the humerus trochlea (HTC) is displayed in Figure 55 by phase. Phase T-V is based on one case, Phase W on 27, Phase X on two, Phase X-Y on 30, Phase Y on 73, Phase Y-Z on 56 and Phase Z on 121. The mean varies between 29-30mm regardless of phase, with the exception of Phase T-V, which

produced only one case that measured 26.5mm. Measurement 'HTC' gives an overall range of 20.0-37.2mm, and there is little fluctuation in this range for any phase. Phases X-Y (late 5<sup>th</sup> – late 6<sup>th</sup> century AD) and Y (early 6<sup>th</sup> – late 6<sup>th</sup> century AD) had several cases in the upper range of this spectrum, which suggests no rapid downturn in husbandry practices in the immediate post-Roman period. Interestingly, the smallest example derived from Phase Z, although this hardly constitutes a stagnation of husbandry practices. Overall, the height of the trochlea remained virtually static throughout the period in question. Phases Y and Z tentatively suggest a large majority of females and a smaller proportion of males.

### **Metacarpal:**

Figure 56 displays the breadth of the metacarpal distal epiphyseal fusion point (BatF) by phase. Phase T-V is based on five cases, Phase W on 90, Phase X two, Phase X-Y 38, Phase Y on 63, Phase Y-Z on 56 and Phase Z on 178. Phases T-V and X have been discounted because they produced too few cases to be reliable. The measurements range between 40.9-67.9mm with mean values of between 47.8-51.5mm. There is very little diachronic variation, which indicates that the stature of the cattle population remained constant through time. The distributions suggest that the majority of individuals were female with smaller proportions of male animals. There appears to be no significant fluctuation in the sex ratio through time. Specimens with splayed condyles have been annotated in Figure 56. Splaying is generally confined to the larger specimens, which presumably represent castrates (see above).

### **Tibia:**

Figure 57 displays distal tibia width (Bd) by phase. Phase W is based on 14 cases, Phase X-Y on 22, Phase Y on 87, Phase Y-Z on 24 and Phase Z on 126. The measurements range between 46.7-70.7mm with a mean of 56.4mm. There appears to be little fluctuation between phases, and the range and average size of animals remained fairly constant. Phases Y and Z tentatively suggest a large majority of females and a smaller proportion of males.

### **Astragalus:**

Astragalus measurements are a valuable source of biometric information for two reasons. Firstly, the size of the astragalus relates directly to its weight bearing position in the muscular-skeletal system and consequently it has a strong correlation to animal size. Secondly, the astragalus is an especially robust compact bone, which survives well in archaeological deposits, and therefore provides large numbers of measurements. Figure 58 displays cattle astragalus width (Bd) by phase. Phase T-V is based on three cases, Phase W on 46, Phase X on one, Phase X-Y on 42, Phase Y 119, Phase Y-Z on 51 and Phase Z on 169. Astragalus 'Bd' provides a wide range of measurements from 26.9-64.6mm. These minimum and maximum measurements represent extreme cases (see below). Due to the large range, measurements have been rounded to the nearest whole millimetre to generate Figure 58. The mean value regardless of phase is between 38mm and 39mm. Phase X only produced one 'Bd' measurement of 41.2mm. There is no obvious increase or decrease in size through time, which corresponds with analysis of the other measurements.

A particularly small astragalus from Phase Y-Z with a 'Bd' of 26.9mm (ID 22543 Context D116) and a large example from Phase Z with a 'Bd' of 64.4mm (ID 16396 Context C191) were recovered. Both measurements are considerably smaller and larger respectively than any from analogous assemblages. Elms Farm, Essex, produced a range of astragalus 'Bd' measurements of 29.3-47.5mm (Johnstone & Albarella 2002: 70-72, Table 16, 182-183, Appendix) and Lincoln produced a range of 33.4-49.9mm

(Dobney *et al.* 1996: 148-151, Appendix 1). The measurement of 64.4mm seems exceptionally large: even larger than 'modern' improved breeds, for example Launceston Castle, Cornwall (Albarella & Davis 1996: 107-109, Table 36). When other measurements from this specimen are considered (GL1 61.8mm and D1 54.4mm) it is clear that it represents a very robust individual.

### **Metatarsal:**

Metatarsals appear to be less affected by pathological conditions than do metacarpals and the depth of condyles less so than width (see below). Figure 59 illustrates measurement '3' values by phase. Values have been rounded to the nearest 0.5mm for Figure 59. Phase T-V produced seven cases, Phase W 70, Phase X one, Phase X-Y 41, Phase Y 62, Phase Y-Z 58 and Phase Z 164. An average value of between 25.0 and 25.5mm was the norm for all phases, and the one case from Phase X produced a value of 22.7mm. The range of values present also remained fairly static between phases, ranging between 21.7mm and 30.3mm. Phase Z produced two outliers, one with a value of 19.2mm and one of 31.4mm. The overall impression provided by metatarsal measurement '3' is that no apparent increase or decrease in size occurred over the period in question. This confirms the view provided by the other individual measurements, as well as the pooled length, width and depth log ratio values (see below).

### **7.7.2. Breed and/or sex**

#### **Horncores:**

A relatively small number of horncores with complete transverse basal sections was recovered, and an even smaller number with complete lengths. This is due to two factors: firstly, horncores are more fragile than teeth or post-cranial skeletal elements and are subsequently prone to greater levels of fragmentation; and, secondly, horncores may be separated from the rest of the carcass and transported elsewhere for specialised craft working, although there is little direct evidence of this at *Viroconium* (see above).

Interpreting cattle horncore biometry is more complicated than for other skeletal elements, because horncore size and shape fluctuates greatly depending on breed/type and sex (Armitage & Clutton-Brock 1976; Armitage 1984; Dobney *et al.* 1996: 32). This conversely makes them particularly interesting when researching cattle exploitation and husbandry. The situation is further complicated as determining the age of a horncore is not straightforward. The method for age classification, based on the morphology and porosity of a core, originally proposed by Armitage & Clutton-Brock (1976) and later refined by Armitage (1984), has been questioned more recently (Umberto Albarella pers. comm.). A deliberate policy of only measuring adult specimens was implemented, although the possibility that occasional immature specimens were measured cannot be entirely dismissed.

Figure 60 displays the size and shape of transverse basal horncore sections for each phase by plotting minimum against maximum width. Phase T-V is based on three cases, Phase W on 23, Phase X-Y on seven, Phase Y on 41, Phase Y-Z on 23 and Phase Z on 51. Phase X produced no measurable horncores. All phases fall within the same range of measurements. The relationship between the two measurements is roughly linear, which indicates there is little shape difference between small and large individuals. This could imply that all the cattle at *Viroconium* represent individuals from the same breed. If size can be used for sex differentiation then females are present in each phase, and males are only present in Phases W, Y, Y-Z and Z, and are especially common in Phase Y-Z, consistent with other evidence for changing sex ratio.

Horncore lengths at *Viroconium* vary between 88.5mm and 172.7mm. Using the classification of Armitage & Clutton-Brock (1976: 331), the horncores from the baths basilica fall into the small (less than 96mm), short (96-150mm), medium (150-210mm) and long (greater than 210mm) horn categories. Figure 61 gives the indices of basal diameter over length and illustrates clear chronological variation; Phase T-V is based on one case, Phase W on seven, Phase X-Y on two, Phase Y on 12, Phase Y-Z on five and Phase Z on 12. Tentatively, horncores appear to get progressively longer and thinner through the period of study, as is particularly evident between Phases W, Y and Z. In conjunction with the interpretation of the basal shape plots (Figure 60), it would appear that females had shorter more robust horns and males had longer more gracile horns at *Viroconium*. The possible presence of castrates has not been considered (see above).

If the assumption that the smallest individuals are female and the largest are male is correct, the homogeneity of basal shape noted within the *Viroconium* material contradicts the sex determination of Armitage (1984) and Armitage & Clutton-Brock (1976). It is further contradicted if the *Viroconium* bulls had longer more gracile horns than females. According to this system the opposite should occur: females have longer horncores in proportion to the basal circumference and are circular in cross-section, whereas male horncores are short in proportion to the basal circumference and are more oval in cross-section (Armitage 1984: 43; Armitage & Clutton-Brock 1976: 332). Despite this, the interpretation that Phases T-V and X-Y contain only cows, whereas Phases W and Y-Z, and especially Phases Y and Z, contain bulls is generally supported by the post-cranial biometry (see below).

#### **Humerus:**

Figure 62 plots the shape indices for the humerus trochlea. Phase T-V is based on one case, Phase W on four, Phase X on one, Phase X-Y on eight, Phase Y on 24, Phase Y-Z on 19 and Phase Z on 36. A linear relationship exists between 'BT' and 'HTC' measurements, which indicate that there is a direct correspondence between the width and height of the trochlea. Regardless of size the overall shape does not fluctuate considerably, and shape does not appear to alter over time. This may imply that the *Viroconium* cattle derived from the same breeding populations, and were not subject to selective breeding to improve meat yield etc, nor to radical changes in quality of husbandry. The majority of smaller individuals again presumably represent females, while the larger individuals (a few in each phase) would represent males.

#### **Tibia:**

Shape indices were created for the distal tibia by plotting width against depth (Figure 63). Phase W is based on 12 cases, Phase X-Y on 20, Phase Y on 80, Phase Y-Z on 21 and Phase Z on 113. Phases T-V and X produced no distal tibia with both 'Bd' and 'Dd' measurements. A strong linear relationship between 'Bd' and 'Dd' is immediately apparent. This indicates that regardless of size overall shape does not change. This conceivably means that only one breed was present. In early phases, smaller presumably female specimens predominate, but the number of larger presumably male specimens increases over time.

#### **Astragalus:**

Figure 64 displays the shape indices for the astragalus. Phase T-V is based on one case, Phase W on 31, Phase X-Y on 33, Phase Y on 111, Phase Y-Z on 42 and Phase Z on 148. Two outliers have been excluded from the plots, so as not to obscure the overall pattern: a small gracile individual from Phase Y-

Z (ID 22543 Context D116), with a Bd/GLlx100 of 45.5 and a DI/GLlx100 of 55.0, and a particularly large individual from Phase Z (ID 16396 Context C191), with a Bd/GLlx100 of 104.5 and a DI/GLlx100 of 88.0. Neither demonstrated any pathological or other unusual morphology.

A similar range of measurements occurred in each phase, which indicates no change in size over time (Figure 64). However, virtually no linear relationship exists between the two indices/axes, which suggests a considerable variation in shape, although based on observations made from the other elements this probably does not relate to breed. Unlike the previous elements the astragalus demonstrates no clear clustering of smaller and larger individuals. This supports the view that the astragalus is not markedly dimorphic (see above).

### **7.7.3. Log ratios: Inter-site comparison**

Many of the measurements taken from the *Viroconium* cattle and from comparable assemblages, have produced relatively few cases, so that analyses of individual measurements is often impossible or of little interpretive value. By utilizing the 'log ratio method' of Simpson *et al.* (1960: 356-358), which has been developed for use in zooarchaeology by Meadow (1981), Payne & Bull (1988) and Davis (1996), this can be partially overcome (see Chapter 3). Phase W (late 4<sup>th</sup>-mid 5<sup>th</sup> century AD) *Viroconium* cattle measurements were adopted as the standard. The rationale for this was that Roman breed improvements should have occurred by the 4<sup>th</sup> century AD (even on the western periphery) and any decline of husbandry practices in the immediate post-Roman period should not have taken place.

#### ***Viroconium:***

The choice of measurements (see Chapter 3) from the Phase W sample used to create the standard produced 1829 cases for width, 951 for length and 1424 for depth. As pooled width measurements from *Viroconium* produced the highest number of cases, as they did for analogous assemblages, they will be discussed first to establish whether the overall size of animals changed through time and how it compares to other sites. Length and depth will then be considered to determine whether a similar picture emerges; if differences are apparent, the measurements refer not only to size, but also to shape.

Width: Figure 65 displays the log ratios for the combined baths basilica width measurements. Size increases from left to right along the X axis, with the standard value calculated from the Phase W sample represented by '0'. For the combined width measurements, Phase T-V produced 18 cases, Phase W 264, Phase X six, Phase X-Y 175, Phase Y 396, Phase Y-Z 226 and Phase Z 744. Phases T-V and X therefore produced too few cases to be of much interpretive value, but fall within the range provided by the other phases. There appears to be no change between any of the phases, which confirms the analysis of individual measurements (see above). This implies that, if breed improvement occurred at *Viroconium*, it was prior to the late 4<sup>th</sup> century AD, as might be expected, and that there was no immediate decline in husbandry techniques during the post-Roman period. Several outliers were present. Phase X-Y includes one case with a value of -0.35, Phase Y-Z one case with a value of -0.31, and Phase Z two cases of -0.32 and -0.34. These values are significantly smaller than the norm. Single values in all likelihood represent abnormally small individuals.

Overall, Phases W and X-Y demonstrate a relatively narrow range and produce a largely symmetrical distribution, with just a slight 'tail' of larger specimens. Interpreted in conjunction with the previous biometrical analysis (see above), Phases W and X-Y appear to be composed overwhelmingly of cows. In

contrast Phases Y, Y-Z and Z all demonstrate a wider range, which produce more asymmetrical distribution curves. This suggests a continued predominance of cows, but with a growing frequency of males. If the wider range observed in the later phases was due to breed improvement then the curves should presumably mirror those for the Elms Farm assemblage from Essex (Johnstone & Albarella 2002), which remain symmetrical, but shift towards the right (see below).

**Length:** Log ratio values from the *Viroconium* baths basilica length measurements produced four cases from Phase T-V, 99 from Phase W, two from Phase X, 80 from Phase X-Y, 230 from Phase Y, 139 from Phase Y-Z and 397 from Phase Z (Figure 66). Phases T-V and X produced too few cases to be useful, although, they fall within the expected range. The overall pattern that emerges from the length log ratio values is virtually identical to that produced by the width values.

**Depth:** *Viroconium* depth log ratio values produced 13 cases from Phase T-V, 180 from Phase W, two from Phase X, 128 from Phase X-Y, 319 from Phase Y, 178 from Phase Y-Z and 604 from Phase Z (Figure 67). These values produced the same overall pattern to those produced from the width and length log ratio values, in terms both of a stable overall size range and of a growing proportion of males.

#### **Colchester:**

Colchester produced comparable datasets from three phases (Luff 1993: 183-197, Microfiche): Period 6 (1<sup>st</sup> – 3<sup>rd</sup> century AD), Period 7 (3<sup>rd</sup> – 4<sup>th</sup> century AD) and Period 8 (4<sup>th</sup> – 5<sup>th</sup> century AD). Width ratios are based on 19 cases in Period 6, 14 in Period 7 and nine in Period 8; length ratios are based on six cases in Period 6, 21 in Period 7, whereas Period 8 produced none; depth ratios are based on seven cases in Period 6, 5 in Period 7 and 5 in Period 8. Colchester is a useful comparison because it is one of the few published faunal reports that include raw data, rather than summary statistics. Additionally, Colchester has provided tentative evidence for continental imports being used to improve indigenous stock (Luff 1993: 130). Width log ratio values (Figure 68) indicate that they were in the upper part of the size range of the *Viroconium* cattle. Length values (Figure 69) highlight more clearly the significant increase in size between Periods 6 and 7 noted by Luff (1993: 122). Cattle from both phases fall into the upper range from *Viroconium*, but are on average larger. The few depth values support the observed pattern (Figure 70).

#### **Dodder Hill:**

Dodder Hill, Worcestershire, (Davis 1988) produced a very small comparable dataset from the 1<sup>st</sup> century AD, but has been included because so few faunal assemblages have been analysed from the Marches region of England. Width ratios are based on 22 cases, length ratios on eight and depth ratios on 22. Dodder Hill width, length and depth log ratio values (Figures 71-73) form a small range, which centre on the standard value calculated from the *Viroconium* Phase W cattle, and support the argument that no obvious breed improvement occurred in the northern Marches region during the Roman period.

#### **Elms Farm:**

To determine whether *Viroconium* cattle were improved Roman types or essentially unimproved indigenous stock, log ratio values were compiled for Elms Farm (Johnstone & Albarella 2002: 173-186, Appendix) in Essex, where evidence for deliberate breed improvement, probably using continental imports, was claimed (see below). Elms Farm produced comparable datasets from five phases (Johnstone & Albarella 2002: 3): Period II (Late Iron Age – Romano-British transition), Period III (mid 1<sup>st</sup> – mid 2<sup>nd</sup>

century AD), Period IV (mid 2<sup>nd</sup> – mid 3<sup>rd</sup> century AD), Period IV-V (mid 2<sup>nd</sup> – mid 4<sup>th</sup> century AD) and Period V-VI (mid 4<sup>th</sup> – 5<sup>th</sup> century AD). Width ratios are based on 103 cases in Period II, 99 in Period III, 142 in Period IV, 92 in Period IV-V and 143 in Period V-VI; length ratios are based on 57 cases in Period II, 45 in Period III, 47 in Period IV, 32 in Period IV-V and 54 in Period V-VI; depth ratios are based on 81 cases in Period II, 85 in Period III, 130 in Period IV, 80 in Period IV-V and 122 in Period V-VI (Figure 74).

The size and range of cattle from Elms Farm Period II is almost exactly the same as for the *Viroconium* cattle, whereas cattle from Elms Farm Periods III-VI are consistently and significantly larger (Figure 74). Johnstone & Albarella (2002: 42-45) concluded that the Period II-III increase in cattle size resulted from deliberate breed improvement, and formed part of a first ‘wave’ of Romanisation (along with the introduction of archetypal Roman butchery techniques and a change in frequency of several non-metric traits) that related to a military presence. This indicates that *Viroconium* cattle were of a similar size to Late Iron Age and unimproved Roman cattle. Length values also confirm this observation (Figure 75). Period II length log ratio values emphasize the presence of several larger cattle, which Johnstone & Albarella (2002: 42-45) interpreted as continental imports. Depth values also provide the same pattern (Figure 76).

#### **Lincoln:**

Lincoln (Dobney *et al.* 1996: 148-175, Appendix 1) produced analogous datasets from the 3<sup>rd</sup> and 4<sup>th</sup> centuries AD, although the first sample is based on too few cases to be of much interpretative value. Width ratios are based on 13 cases in the 3<sup>rd</sup> century AD and 303 in the 4<sup>th</sup> century AD (Figure 77); length ratios are based on 12 cases in the 3<sup>rd</sup> century AD and 221 in the 4<sup>th</sup> century AD (Figure 78); depth ratios are based on 25 cases in the 3<sup>rd</sup> century AD and 478 in the 4<sup>th</sup> century AD (Figure 79). Dobney *et al.* (1996: 33) tentatively suggest the importation of larger animals in the 3<sup>rd</sup> century AD, based on a small 1<sup>st</sup> – 3<sup>rd</sup> century AD sample (not illustrated here). Both Lincoln phases produced a single log ratio value of 0.28, which denotes the presence of considerably larger cattle. Overall, Figures 77-79 illustrate that the smaller 4<sup>th</sup> century AD Lincoln cattle are the same size as those from *Viroconium*.

#### **Six Dials:**

Six Dials, Southampton, produced comparable datasets from three phases (Andrews 1997: 13-14; Bourdillon & Andrews 1997: 242; University of Southampton 2003): ‘early’ Middle Saxon (early-mid 8<sup>th</sup> century AD), ‘middle’ Middle Saxon (mid 8<sup>th</sup>-early 9<sup>th</sup> century AD) and ‘late’ Middle Saxon (mid 9<sup>th</sup>-early 10<sup>th</sup> century AD). Width ratios are based on 53 cases in the ‘early’ phase, 572 in the ‘middle’ phase and 235 in the ‘late’ phase; length ratios are based on 40 cases in the ‘early’ phase, 305 in the ‘middle’ phase and 97 in the ‘late’ phase. No ‘depth’ measurements were provided on the database. Despite being chronologically later than the baths basilica site, Six Dials has been included because of the possibly analogy between *Viroconium* and Saxon Southampton (see Chapter 2): the control of resources and modes of urban supply. It has been argued that Saxon Southampton was supplied with animal products through centrally controlled estates located in its hinterland (Bourdillon 1988 & 1994; Bourdillon & Andrews 1997). When width and length log ratio values are considered (Figures 80-81), it is apparent that cattle from both sites were of an equivalent size and shape; suggesting that Saxon Southampton was supplied with unimproved indigenous types. The Six Dials width log ratio values clearly demonstrate a bimodal distribution (Figure 80), indicating a majority of females and a smaller number of males.



Interestingly, it would appear that Six Dials was supplied with a greater proportion of males than was *Viroconium* in the later baths basilica phases.

## **7.8. Non-metric traits**

Several non-metric traits were routinely recorded for cattle (see Chapters 3). These were primarily from the mandible, including additional and morphologically unusual nutrient foramina, absence of the second premolar and reduction or absence of the third column (hypoconulid) of the third molar. High frequencies of these conditions in past populations may reflect the smaller and more endogamic nature of herds, where recessive traits could become more dominant. It has to be remembered, however, that we currently know little about the founder effect and genetic drift in ancient livestock populations (O'Connor 1988: 89). In addition, environmental factors, such as nutrition, can effect the development of individual teeth (see Miles & Grigson 1990).

### **7.8.1. Nutrient foramina**

This condition has a range of manifestations, including enlarged or elongated examples to extra mental foramina. Photographs in the Lincoln faunal monograph demonstrate the range and variety of foramina encountered (Dobney *et al.* 1996: 34, Plate 6b). Figure 82 and Table 64 display the frequencies of this condition. Phase T-V is based on three observations, Phase W on 20, Phase X produced none, Phase X-Y on 11, Phase Y on 27, Phase Y-Z on 16 and Phase Z on 43. Phases T-V, X and X-Y were based on too few observations to be reliable. To summarise, Phase T-V produced 0% examples, Phase W 0%, Phase X 0%, Phase X-Y 46%, Phase Y 19%, Phase Y-Z 13% and Phase Z 19%. Excluding Phases T-V, X and X-Y this leaves a range of between 13% and 19%.

Of the conditions discussed, abnormal nutrient foramina are perhaps the most poorly represented in faunal reports, so few comparable datasets exist. Elms Farm, Essex (Johnstone & Albarella 2002: 21), produced a frequency of 12% in Period II (mid 1<sup>st</sup> century BC – mid 1<sup>st</sup> century AD), 30% in Period IV-V (mid 2<sup>nd</sup> – mid 4<sup>th</sup> century AD) and 25% in Period V-VI (mid 3<sup>rd</sup>-5<sup>th</sup> century AD).

*Viroconium* falls within this range and appears to follow a similar pattern, whereby the occurrence increases through time. Tentatively this suggests a smaller breeding population after Phase W and may reflect either selective breeding or reduced gene flow between local herds, although this is difficult to substantiate.

### **7.8.2. Second premolar**

There is a possibility that ante-mortem loss and alveolar absorption could mimic congenital second premolar absence, although O'Connor (1988: 89) considers this unlikely. Figure 82 and Table 64 display the frequencies of this condition. Phase T-V is based on six observations, Phase W on 85, Phase X on three, Phase X-Y on 25, Phase Y on 59, Phase Y-Z on 58 and Phase Z on 125; Phases T-V and X cannot be relied upon. The baths basilica assemblage produced the following frequencies: Phase T-V 0%, Phase W 17%, Phase X 0%, Phase X-Y 8%, Phase Y 5%, Phase Y-Z 17% and Phase Z 17% (Figure 82; Table 64). This provides a range of between 5% and 17%, but no useful linear trend through time (excluding Phases T-V and X).

A range of samples from York, Beverley and Lincoln analysed by O'Connor and Scott demonstrated a frequency of 5-6% (O'Connor 1988: 89). The following frequencies were recorded from Chichester

cattle market (Levitan 1989: Table 5a): Phase 2 (1<sup>st</sup> – 2<sup>nd</sup> century AD) one out of nine (11%), Phase 3 (2<sup>nd</sup> - 3<sup>rd</sup> century AD) two out of 13 (22%), Phase 5 (4<sup>th</sup> – 5<sup>th</sup> century AD) three out of 12 (25%). An occurrence of 26% was noted from Romano-British Castleford, West Yorkshire (Stallibrass 1982: 9), based on a small sample of 27 mandibles. At Anglo-Scandinavian Coppergate, York (O'Connor 1989: 164), 25 out of 368 (7%) second premolars were absent. Romano-British Corbridge, Northumberland, produced a frequency of 7% absent second premolars (Meek & Grey 1911: 241-242). The absence of second premolars at Elms Farm, Essex, actually declines from around 8% to 3% (Late Iron Age – Early Saxon) (Johnstone & Albarella 2002: 21). Three instances of absent second premolars were recorded from Romano-British levels at Exeter (Maltby 1979: 40). The General Accident site, York, demonstrated a frequency of 19% from both Romano-British and medieval assemblages. The 1<sup>st</sup> century AD Lincoln sample produced one (6%) absent second premolar, the 4<sup>th</sup> century AD sample produced 51 (12%), the Late Saxon sample one (2%), the high medieval sample one (5%) and the late post-medieval sample one (2%) (Dobney *et al.* 1996: 33).

Again, the frequency of absent second premolars from *Viroconium* fall within the range provided by analogous and contemporaneous assemblages. Based on the examples quoted above, occurrences of absent second premolars increase through the Romano-British period, and decrease in the medieval period. This decrease appears to happen gradually over hundreds of years, although the Elms Farm, Essex, assemblage (Johnstone & Albarella 2002: 21) does not conform to this. Beyond this little can be said because of the considerable level of variation noted from these sites.

### **7.8.3. Third molar**

Of all the mandibular non-metrical traits considered, reduced and absent hypoconulids produced the largest sample (Figure 82; Table 64): Phase T-V is based on six observations, Phase W on 81, Phase X on four, Phase X-Y on 27, Phase Y on 72, Phase Y-Z on 77 and Phase Z on 152. As with almost every other aspect of the assemblage, Phases T-V and X were too small to be of any interpretative value. The following frequencies of absent or reduced third molar hypoconulids were observed from the baths basilica assemblage: Phase T-V 0%, Phase W 9%, Phase X 0%, Phase X-Y 11%, Phase Y 8%, Phase Y-Z 10% and Phase Z 14% (Figure 82; Table 64). Excluding Phases T-V and X, between 9% and 14% of all hypoconulids were either reduced or absent. No overall chronological patterning was observable, as the frequency fluctuated from phase to phase.

Romano-British Brancaster, Norfolk, demonstrated a frequency of 29% (Jones *et al.* 1985: 130), whereas only 2% was observed at Caister-on-Sea, Lincolnshire (Harman 1993: 229). Anglo-Scandinavian Coppergate, York (O'Connor 1989: 164) produced 16 absent or reduced hypoconulids. At Elms Farm, Essex (Johnstone & Albarella 2002: 21), almost 13% of hypoconulids were reduced or absent in Period II (mid 1<sup>st</sup> century BC – mid 1<sup>st</sup> AD century), which fell to 7% in Period III (mid 1<sup>st</sup> – mid 2<sup>nd</sup> century AD) and 5% in Period IV (mid 2<sup>nd</sup> – mid 3<sup>rd</sup> century AD) before increasing to 11% in Periods V (mid 3<sup>rd</sup> – mid 4<sup>th</sup> century AD) and VI (late 4<sup>th</sup> – 5<sup>th</sup> century AD). Ten cases from 76 mandibles (13%) had absent or reduced hypoconulids from Romano-British levels at Exeter, but no examples of medieval date existed (Maltby 1979: 40).

The baths basilica sample falls into the frequency range provided by the other sites, but it is difficult to identify any temporal patterning, as Elms Farm, Essex (Johnstone & Albarella 2002) provided the only other multi-period sample.

## 7.9. Discussion

### 7.9.1. Anatomical representation

The range of skeletal elements demonstrated by all phases (Figure 31), with the exception of Phase X, would suggest that whole carcasses were present at *Viroconium*. Elements normally discarded during primary stages of carcass dismemberment are present, such as cranial fragments and lower limb bones, etc. The possibility that horncores, metapodials and phalanges were transported to *Viroconium* attached to skins cannot be entirely discounted, but is unlikely because no large-scale 'industrial' craft working has yet been identified in the city (White & Barker 1998: 56). The observed body part distribution does not indicate whether live animals were present within *Viroconium*, although practical logistical considerations would almost certainly dictate their presence (see above). Driving live animals to *Viroconium* for slaughter would be far simpler than transporting whole carcasses. What is clear is that the residue of both primary dismemberment and secondary butchery (relating to the major meat bearing bones) is present within the sample.

The pattern produced by body part distribution demonstrates the over-representation of mandibles, scapula, metacarpal and metatarsal, especially in the early phases (Figure 31). This pattern is unlikely to result from differential preservation, as the scapula is relatively fragile, or a recovery bias, as the high mandible count includes significant numbers of isolated teeth. The relatively low frequency of long bones may have been caused by the archetypal Romano-British practice of chopping long bone into small fragments for marrow fat extraction, but no individual contexts appeared during recording to be characterised by particularly high frequencies of this type of fragmentation (see above). Additionally, if this were the case, then metacarpals and metatarsals would be equally affected. The opposite is actually true; metapodials are amongst the most frequent anatomical units at the baths basilica. The observed pattern, therefore, either demonstrates an over-representation of butchery waste or an under-representation of high meat utility bones (see below).

The rather homogenous nature of material from individual context types, in all likelihood, derives from large-scale carcass processing (Figures 32-36). This was apparently in operation throughout the period of activity at the baths basilica site. Whether this represents commercial ventures or a centrally organized operation remains unclear. Superficially this supports the hypothesis that the disposal of slaughter, butchery and cookery waste was a municipal responsibility (Barker *et al.* 1997: 195; see Chapter 5). However, body part distribution and butchery evidence suggests that meat was routinely boned out before distribution (meat-off-the-bone), especially in the later phases, which negates this possibility.

Overall, the distribution of skeletal elements found at *Viroconium*, which derives from non-specialised activities, generally matches that found at other analogous urban sites, including Romano-British Colchester (Luff 1993: 47-48), 4<sup>th</sup> century AD and later Exeter (Maltby 1979: 12-13, 38), 4<sup>th</sup> century AD Lincoln (Dobney *et al.* 1996: 24) and 5-8<sup>th</sup> century AD York Minster (Rackham 1995: 539, Table 22). Exeter appears to have demonstrated a greater degree of spatial variation than the other sites, as distinct primary waste deposits, consisting of cranial and lower limb fragments, were discovered in ditches, and horncores were generally absent, presumably being transported elsewhere for working (Maltby 1979: 12-13, 38).

### 7.9.2. Ageing

Regardless of phase, post-cranial epiphyseal fusion data from *Viroconium* indicate that most cattle were skeletally mature when slaughtered, with a slightly higher proportion of younger individuals in the later phases, especially Phases Y and Z (Figure 37). Tooth data indicate a broadly similar mortality profile (Figure 38), but a slight discrepancy exists between the two datasets: post-cranial epiphyseal fusion data suggests a greater proportion of younger adults than do the tooth data (see above). Various explanations may account for this discrepancy. The corresponding young mandibles may have been discarded elsewhere, although this is unlikely because mandibles are over-represented in the assemblage. Conversely, older limb bones may have been discarded elsewhere. This possibility is more plausible, as high and medium utility body parts could have been transported elsewhere for cooking, consumption and long bone smashing for marrow fat extraction, etc. This cannot be substantiated without assemblages from adjacent sites being available for analysis, however. Conceivably, castration exaggerates the proportion of immature post-cranial elements by delaying fusion. The age at which castration was carried out would affect this. This possibly becomes more pertinent with the apparent increase in the proportion of males during the later phases. Lastly, differential preservation may be responsible. Younger mandibles are prone to higher levels of attrition than mature mandibles (see Munson 2000; Munson & Garniewicz 2003), but the same may be argued for immature and mature post-cranial body parts respectively (see Chapter 3).

Overall, epiphyseal fusion and mandibular tooth data from the baths basilica site indicate that the majority of animals were slaughtered when adult or elderly. Slaughtering cattle once they had reached skeletal maturity would have been the optimum strategy if beef production were the principle motivation. This may be too simplistic, if the interpretation of analogous assemblages is correct. Romano-British cattle are thought to have been multi-purpose animals that were initially utilised as beasts of burden and for dairy products, for example at Exeter (Maltby 1979: 31), the General Accident site, York (O'Connor 1988: 86) and Lincoln (Dobney *et al.* 1996: 30).

The later phases included a greater number of animals slaughtered when 'neonatal', 'juvenile', 'immature' or 'sub-adult' (Figure 37). An increase in the proportion of immature animals in later Romano-British phases has also been noted at several other sites, including intramural Colchester (Luff 1993: 57), Exeter (Maltby 1979: 30-31 & 90), the General Accident site, York (O'Connor 1988: 86). This may represent a change in the nature of carcase processing or an increase in beef exploitation. The latter situation may have occurred because of either greater consumer-urban demand or a downturn in arable production. At Colchester an increased demand for beef was not observed from the later extramural areas (Luff 1993: 57), which implies a connection to social differentiation and the ability to control resources.

The exploitation of cow's milk was rarely mentioned by the classical authors (White 1970: 277), although Pliny mentions its use for medicinal purposes (*Naturalis Historia* XXV.53 & XXVIII.33; Jones 1963: 89-91 & 1966: 205). As Dobney *et al.* (1996: 30) highlight, it would be wholly unwise to suggest cow's milk was not widely utilised in the north-westerly provinces, particularly because Pliny was writing almost exclusively about classical Italy. Additionally, Apicius mentions few recipes incorporating beef (Flower & Rosenbaum 1958), and this may highlight the importance of cattle as a means of traction.

### **7.9.3. Sexing**

Based on pelvis morphology and metacarpal biometry (Figures 39-40) the majority of cattle at *Viroconium* appear to have been female with a smaller number of males. The earlier phases seem to be almost exclusively comprised of cows, whereas the later phases also include a small, but significant, number of males. This pattern is confirmed by the general biometrical analyses of various anatomical elements (Figures 54-59): degree of skewness and bimodal distributions (see below). When metacarpal shape indices (Figures 39-42) are considered alone the group of larger 'males' breaks down into sub-groups of short very robust and long moderately robust specimens. Both are equally affected by splaying and presumably represent castrates (see above). Because castration affects skeletal develop, this may imply that *Viroconium* bulls were castrated at two principle ages. When discussing what to look for in and how to train plough animals/beasts of burden, Columella (*De Re Rustica* VI.2.1-15; Forster & Heffner 1968: 127-137) makes the automatic assumption that castrates would be utilised.

### **7.9.4. Butchery**

All stages of the carcass reduction process are represented in every phase from the baths basilica (Figures 43-48). The distribution of butchery stages by anatomical element remains reasonably consistent through time and, in all likelihood, reflects the physiology of the muscular-skeletal system. Notwithstanding unclassified butchery marks (see above), the majority of butchery related to dismemberment and a smaller proportion of filleting. Very few instances of skinning were recorded, excluding those located on the zygomaticus and first phalange.

This pattern has to be considered in conjunction with anatomical representation (Figures 31-36) to be fully understood. Although, very few scapulae butchery marks could be attributed to any stage in the reduction process, scapulae were the most numerous high utility elements present; this would imply meat was filleted from the bone prior to discard. Most long bone butchery marks derived from dismemberment, although most elements were only moderately represented. This could imply that these anatomical elements were removed from the site with meat still attached; otherwise higher proportions of filleting marks would have been present. Fragmentation, principally long bone 'smashing', does not account for this pattern, as it occurred in relatively low frequencies throughout. Nor is this pattern an artefact of the recording system favouring dismembered epiphyses over filleted shafts, otherwise increased knife use over time would have been missed.

The most significant diachronic change in butchery patterns from *Viroconium* is increased knife-use alongside predominant cleaver butchery, especially in Phases Y, Y-Z and Z (Figures 49-53). This could imply one of three things: the availability and supply of butchery implements, the adoption of more intensive and laborious butchery techniques or a changing cuisine and cultural proclivities. It is unlikely that increased knife-use at *Viroconium* occurred as a consequence of the changing availability of butchery implements because the mainstay of Romano-British butchery was the ubiquitous cleaver, which was essentially a dual-purpose implement that combined qualities of both knife and cleaver. *Viroconium* produced one example (Manning 1985; Pretty 1997: 252). It was heavy and durable at the back edge while sharp and pointed at the front edge (Seetah 2002: 70-71, Table 1); butchery marks recorded as either 'cuts' or 'chops', in all likelihood, were actually made by the same tools. Therefore, an increase in 'cut' (knife?) marks may represent a change in the way the same tool was employed.

Changing butchery techniques may have been a response to changes in supply: the later Phases at the baths basilica produced greater numbers of large oxen (and bulls). The higher frequency of cut marks noted from the later phases may imply that a different technique had been employed to butcher physically larger animals; perhaps they were too robust to chop through and had to be 'boned-out' more thoroughly. Alternatively, changing butchery techniques demonstrate evolving gastronomical tastes and represent wider socio-cultural trends (see Chapter 12).

#### **7.9.5. Biometry**

All the biometrical analyses confirm that the size and shape of cattle from the baths basilica site remain constant throughout the period of activity (see above). This might be an indication that there was no decline in the quality of husbandry between the late Romano-British and early medieval periods. Conversely, because inter-site comparison (Figures 65-81) confirms that the *Viroconium* cattle were unimproved indigenous types (not subject to the same breed development that animals in the core of Roman Britain were) it would have been surprising if cattle had decreased in size by a substantial degree.

## 8. Pig

### 8.1. Introduction

This chapter will discuss the pig remains excavated from the *Viroconium* baths basilica. Firstly, it will consider the range of skeletal elements present and their distribution within particular context types. It will then discuss the evidence for ageing and consider butchery practices. Finally, the results and implications of biometric analysis will be considered. The concluding discussion will draw together inferences made from the skeletal evidence and discuss their implications in terms of the research questions asked (see Chapter 2).

Due to the problematic nature of positively distinguishing wild boar all the specimens initially recorded as 'possible wild boar' have been considered in this section along with specimens originally recorded as 'domestic pig'. This has not biased the interpretation of the pig data because they occur in relatively small numbers, but has enabled a serious consideration as to whether wild boar is present in the baths basilica assemblage (see below).

### 8.2. Anatomical representation

Pig skeletal distributions by phase are presented in Figure 83 and Table 65, following the procedures detailed in Chapter 3. Figure 83 is based on MNE values to counteract the effects of differential fragmentation, making diachronic and inter-context comparison more valid. The highest MNE for any single skeletal element was 45 for Phase T-V, 419 for W, 19 for X, 269 for X-Y, 698 for Y, 449 for Y-Z and 1191 for Z. The graphs produced for Phases T-V and X are clearly questionable because of the small samples, although both demonstrate fairly similar patterns to the other phases based on larger samples.

The zygomaticus is entirely absent. During the recording of the material it was observed that zygomatic bones were present within the assemblage, albeit in lower numbers than for the other ungulates. Their absence must therefore be an artefact of the recording system, which stipulated that 50% of the zygomatic arch had to be present for it to be 'countable' (see Chapter 3). It will be necessary to remember that skull fragments are actually present in the assemblage as the interpretation is made.

Mandibles were generally the most common skeletal element. This is unlikely to be an artefact of the recording system because great care was taken to avoid over-representation of mandibles; to re-iterate, the mandible MNE figures were calculated by adding all the isolated fourth deciduous premolar and third molar to mandible NISP counts (excluding those with no *in-situ* fourth deciduous premolar or third molar), as each tooth effectively represents a single mandible. Unlike cattle there is no overlap between the shedding of the fourth deciduous premolar and the eruption of the third molar (see Chapter 7). In all likelihood the high frequency of mandibles results from the taphonomic processes active at the baths basilica site. It is not unusual for the mandible to be the most frequent skeletal element because they fragment reasonably easily, but survive well overall (see Chapter 4), plus they are also highly diagnostic.

With the exception of the zygomaticus all body parts are represented, which demonstrates that whole carcasses were present at the baths basilica site. The most numerous elements are generally the mandible, scapula, tibia, astragalus and calcaneum. This pattern may be partially a taphonomic artefact because the scapula (especially the glenoid fossa, coracoid process and neck), the distal tibia and the astragalus are all

reasonably robust and durable elements. The humerus, radius and pelvis are all equally well represented. Because the humerus is considerably more durable than the radius this may suggest its removal from the site. Femora, metapodials and phalanges are the least well represented body parts: the femur may be slightly under-represented because it does not survive well and is not particularly diagnostic; proximal metapodials are prone to high levels of attrition; phalanges are probably subject to a recovery bias. Overall there appears to be a mixture of butchery waste (mandibles, lower limb elements, etc) and high utility elements, such as the scapula and humerus. This could imply that slaughtering and butchery was occurring in close proximity to the site.

There is the hint that the post-cranial elements are less differentiated in the later phases (Y, Y-Z and Z) than the earlier ones. Notwithstanding the mandible, which is still over-represented in the later phases, this pattern is similar to that noted for sheep, albeit not as pronounced as that noted for cattle (see Chapters 7 & 9). This implies that the earlier phases (T-V, W, X and X-Y) contain greater proportions of butchery waste, represented by cranial fragments, lower limb elements and lower utility elements, and that higher utility elements were being selectively removed. Therefore, the later phases may demonstrate changing attitudes towards waste disposal practices.

An articulated partial skeleton of a neonate (Bone ID 19879-19890) was recovered from Phase X-Y Context 306. Another was also recovered from Phase Y-Z Context C240 (Bone ID 20756-20758). This implies that pigs were deliberately bred within the settlement itself.

### 8.3. Disposal practices

As with cattle the large size of the data set has enabled the distribution of body parts across different context types to be considered. Pig bones were distributed across all deposit types encountered at *Viroconium*, including pit fills, cut fills, posthole fills, layers, hearth fills, floors, surfaces, structures and dumps (see Chapter 5, for definitions of these terms). The category 'other' has been excluded from this analysis because it is of little interpretive value, as have contexts not assigned to a deposit type. Pig bones, regardless of phase, were divided across deposit types as follows (NISP):



Using the arbitrary minimum sample size of 100 NISP within an individual deposit (see Chapter 3), it was possible to produce graphs for Phase W layers (MNE 82) and dumps (MNE 149) (Figure 84; Table 66), for Phase X-Y cut fills (MNE 201) (Figure 85; Table 67), for Phase Y layers (MNE 110), surfaces (MNE 168) and dumps (MNE 267) (Figure 86; Table 68), for Phase Y-Z cut fills (MNE 141), surfaces (MNE 84) and dumps (MNE 172) (Figure 87; Table 69), and for Phase Z surfaces (MNE 76), structures (MNE 467) and dumps (MNE 501) (Figure 88; Table 70). There appears to be little differentiation between the various deposit types and the patterns produced generally conform to those noted above. Any



discrepancies could result from the relatively small samples used to produce the graphs, for example the Phase Z surface plot (Figure 88).

## **8.4. Ageing**

### **8.4.1. Epiphyseal fusion**

Figure 89 and Table 71 display pig fragments as 'early' (12-24 months), 'middle' (24-30 months) or 'late' (42 months) fusing skeletal elements (based on Schmid 1972: 75, Table 9; Silver 1969: 264-265, Table G). The number of neonatal specimens is also displayed, as a proportion of the total number of post-cranial specimens (so as not to bias the 'early', 'middle' and 'late' categorization). The techniques used for recording and analysing post-cranial age data are detailed in Chapter 3. Post-cranial epiphyseal fusion for Phase T-V was based on 55 observations, Phase W on 503, X on 28, X-Y on 296, Y on 795, Y-Z on 551 and Z on 1300. Phase T-V and especially Phase X are too small to be relied upon.

There is little variation between phases (Figure 89): approximately 70-75% of the 'early' fusing elements are fused, around 30-40% of the 'middle' fusing elements and 5-10% of the 'late' fusing elements. In addition, 2% of post-cranial elements from Phase T-V are neonatal, 5% from Phase W, 18% from Phase X, 4% from Phase X-Y, 6% from Phase Y, 2% from Phase Y-Z and 4% from Phase Z. The post-cranial epiphyseal fusion data for pig indicate that the majority of individuals were slaughtered before they had reached skeletal maturity; most were killed before they reached 42 months. This profile suggests large-scale meat production was the principle motivation behind pig husbandry, rather than a more gourmet cuisine favouring the selection of younger individuals.

### **8.4.2. Tooth eruption and wear**

A more complicated, and probably more accurate, picture of age at death emerges when mandibular tooth eruption and occlusal wear is considered. Figure 90 and Table 72 summarise pig mortality derived from tooth eruption and wear, and Appendix 24 lists the raw data. The categories proposed by O'Connor (1991: 250, Table 67) were used to construct mortality profiles. Appendix 4 provides suggested absolute ages for the mandible stages. Methods of recording and analysis are detailed in Chapter 3, together with a discussion of problems associated with creating mortality profiles from tooth data and the complications caused by fragmentary archaeological material.

The mortality curve for Phase T-V was based on 5 cases, for Phase W on 105, for Phase X on 4, for Phase X-Y on 72, for Phase Y on 193, for Phase Y-Z on 122 and for Phase Z on 372 cases. Phases T-V and X may not be representative, due to small sample size, although they still display the same overall patterns as the other phases. As with body part distribution and the post-cranial epiphyseal fusion data, there is a considerable level of consistency between all phases. Individuals were slaughtered at each age stage, with approximately 70-75% being slaughtered as sub-adults and adults. Very few individuals reached old age. The presence of neonates could either represent the deliberate slaughter of new-borns as 'suckling piglets' or alternatively their presence could be natural infant mortality (see below).

### **8.4.3. Data correlation**

Mortality curves produced by the two evidential strands may contradict one another. To assess this possibility, it is first necessary to equate post-cranial epiphyseal fusion stages to tooth eruption and wear stages, using their corresponding ages (Appendices 4 & 6). Based these suggested ages the 'immature'

and 'sub-adult' mandible categories equate to the 'early' epiphyseal fusion category. The 'adult' mandible category equates to the 'middle', and perhaps 'late', fusion category (see Chapter 3). The two strands of age-at-death evidence would generally appear to support one another, although there is one possible exception. There are relatively few deaths after 'late' fusion (42 months), but there is a reasonable number of mandibles in the 'adult 2' category (23+ months), especially Phases W, Y, Y-Z and Z. The difference between the two evidential strands is slight and does not invalidate the overall results. In all likelihood, it has been caused by attempting to amalgamate the two methods, both of which rely on varied empirical data to provide ages.

## 8.5. Sexing

The sex ratio of pig has been determined from the mandibular canine teeth and their respective alveoli (see Chapter 3). Table 73 outlines the female to male ratios by chronological phase. With the exception of Phase W, the number of sows and boars is approximately equal. This indicates that intensive pork production was not being pursued at the baths basilica site. However, the use of pig canines to determine sex ratios is somewhat problematic because male canines are easily recovered, due to their greater size. In reality there may have been a greater proportion of females because breeding sows would have been crucial to maintaining a population, which was deliberately and frequently culled for meat.

## 8.6. Butchery

In the effort to elucidate pig butchery patterns within the baths basilica assemblage, two approaches have been undertaken. Firstly, the frequency of butchery mainly by phase and skeletal element is considered. Secondly, the butchery marks evident on the *Viroconium* material are allocated to particular stages in the carcass reduction process.

### 8.6.1. Butchery frequency

Table 74 summarise the frequency of butchery marks ('chop', 'cut' and 'sawn') from the baths basilica assemblage by phase and skeletal element. Isolated fourth deciduous premolar and third molar NISP have been excluded from the calculations. Phases T-V and X are based on samples that are too small to be reliable. The percentage of NISP values displaying one or more butchery marks demonstrated a distinct increase through time, which is linked to the increased knife butchery in the later phases (see below):

- Phase T-V            2%
- Phase W             6%
- Phase X             10%
- Phase X-Y          8%
- Phase Y             12%
- Phase Y-Z          9%
- Phase Z             11%

These proportions are considerably smaller than the corresponding proportions of butchered cattle bone (see Chapter 7), presumably because pig carcasses are smaller than cattle carcasses and therefore require less butchery to reduce them into manageable portions of meat.

Table 47 summarises type of butchery mark ('chop', 'cut' and 'saw') by anatomical element and chronological phase. Chops account for the majority of butchery marks, although the frequency of cut

marks increases over time. Cut marks expressed as a percentage of total butchery by phase increase from 8% in Phase W to 40% in Phase Z. To summarise Table 47 (Phase T-V and X have been excluded, due to the low number of cases):

- Phase W 8%
- Phase X-Y 27%
- Phase Y 32%
- Phase Y-Z 40%
- Phase Z 40%

This trend of increased knife-use matches that already noted for cattle (Chapter 7). Overall, the butchery marks seem to relate directly to carcass reduction and cooking. The range of skeletal elements displaying butchery marks supports this interpretation (Tables 75); mandibles and upper limb elements frequently display butchery evidence, whereas metapodials and phalanges do not.

### **8.6.2. Carcass reduction**

When the *Viroconium* material was recorded butchery marks were allocated to a particular stage in the carcass reduction process. These stages were defined as 'skinning', 'dismembering', 'filleting' and 'other'. For this purpose, the ethnographic butchery data collected by Binford (1981: 98-133, Figures 4.06-4.38, Table 4.04) were used as a guide (see Chapter 3). In addition, several other locations/orientations of butchery marks were added to compliment Binford's (1981). This was deemed necessary to prevent many of the *Viroconium* butchery marks falling into the 'other' category. The additional categories were (see Chapter 3): longitudinal/diagonal marks on shafts equating to filleting on long bones and cannon bones; transverse marks on epiphyses equating to dismembering on long bones and cannon bones; transverse marks located mid-shaft on the first phalange were assumed to represent skinning.

Table 76 display carcasses reduction stages by anatomical element and chronological phase. Phases T-V and X are of little interpretative value because of small sample size. Overall, there is only moderate correspondence between the categorised butchery marks of Binford (1981) and the locations of butchery marks on the *Viroconium* pig remains. In very few cases was butchery attributable to either 'skinning' or 'filleting', and the greatest level of association existed for butchery marks pertaining to 'dismemberment'. The low instance of skinning is unsurprising because pigs were almost exclusively exploited for their meat, as evidenced by the age-at-death profiles (see above), although pig leather was occasionally produced in the past (see Reed 1972). The lack of filleting in Phases T-V, W, X and X-Y may indicate that meat was eaten directly off the bone. Filleting meat from the bone in Phases Y, Y-Z and Z seems to represent a distinct change in culinary practices and has a direct association with the increased knife use. As postulated for increased knife-use in cattle butchery this may represent changing cultural trends (see Chapter 7). Many butchery marks fall into the 'other' category. In most instances they form no distinguishable pattern and therefore probably relate to random fluctuations in butchery technique. One trend that was observed was the tendency to split the two halves of the mandible at the anterior end with a heavy chop or chops. There appears to be no chronological variation in the numbers of split mandibles.

## 8.7. Biometry

The *Viroconium* baths basilica assemblage produced a relatively large quantity of pig biometrical data. The assemblage as a whole produced 937 tooth measurements and 335 post-cranial measurements, these divide by phase as follows (excluding Phase X-Z):

- Phase T-V            5
- Phase W            134
- Phase X            4
- Phase X-Y          89
- Phase Y            298
- Phase Y-Z          182
- Phase Z            560

Summary statistics (minimum, maximum, mean and standard deviation) are provided for all measurements, which produced 10 or more cases per phase: Tables 77-81. Appendices 25-32 list measurements by anatomical element, chronological phase and context.

Biometrical analysis centred on three thematic avenues of research. Firstly, the possibility that wild boar are present in the sample is considered. To enable this sexual dimorphism has to be taken into consideration simultaneously (see below). This has been achieved by creating indices that outline variation in size and shape by plotting two variables against one another as scatter-plots. Secondly, individual measurements are considered by phase to determine if there is any diachronic size change. This will provide some indication of likely husbandry practices, such as breed improvement, or conversely their decline around *Viroconium*. Histograms displaying the frequency of particular measurements, usually the most numerous for any given element, will be used to achieve this. Thirdly, an inter-site comparison will be attempted, using individual measurements and pooled log ratios, to determine how *Viroconium* compared to other contemporaneous and analogous sites. The log ratio method is explained in Chapter 3.

Before commencing on the biometrical analyses, it is first necessary to consider the variability of sexual dimorphism displayed by individual anatomical elements. Fortunately, Payne & Bull's (1988: 61, Table 3) work on biometrical components of variation in wild boar provides the necessary information: to summarise, the teeth are not dimorphic, the humerus and tibia are both very dimorphic and the astragalus less so.

Skewness values were generated for individual measurements and pooled log ratio values in the attempt to infer sex ratios from the distributions (see below). Table 82 outlines skewness values by phase for fourth deciduous premolar (WP), first molar (WA), second molar (WA) third molar (WC), humerus (HTC), tibia (Bd) and astragalus (GLI) measurements, plus pooled width, length and depth log ratio values. Teeth, although not very dimorphic (see above), have been included because they have provided the largest datasets. To avoid biasing the results extreme outliers were first discounted, i.e. possible wild boar and values that may have derived from recording errors or possible misidentification (listed in Table 83). As for cattle (see Chapter 7), the results are inconclusive; no diachronic pattern is evident and fairly high standard errors tend to invalidate the results. Skewness, therefore, does little to elucidate the sex ratios provided by the canines (see above).

### **8.7.1. Domestic/wild and/or sex**

As previously discussed attempting to distinguish between domestic pig and wild boar is problematic, principally because wild boar is the progenitor of the domestic pig (see Chapter 3). To summarise, there are no reliable morphological indicators and physical size is also unreliable because there is a considerable overlap between wild and domestic. Therefore, the presence of wild boar within an assemblage is usually inferred, rather than definitely stated. For this reason specimens initially recorded as 'possible wild boar' have been included in the pig dataset. The standard wild boar measurements published by Payne & Bull (1988) have not been used because there may be little similarity between modern Turkish wild boar and those from Roman and early medieval Britain; the size and morphology of wild boar fluctuates considerably across Europe (see Genov 1999). Teeth may actually be a more reliable indicator for differentiating between domestic and wild because they are the least sexually dimorphic elements (see above).

#### **First molar:**

Figure 91 displays plots of shape indices created for the mandibular first molar. Anterior cusp width (WA) has been plotted against posterior cusp width (WP), based on 267 cases. Phase has not been considered at this juncture. To make the interpretation of this plot easier specimens of known sex have been marked, where tooth row completeness has permitted, i.e. mandibles with both canines and first molars (46 sexed cases). When 'WA' is plotted against 'WP' two distinct clusters are produced: small individuals clustering together, forming the majority; two exceptionally large individuals, as distinct outliers. In all likelihood, the small individuals which form the majority represent domestic pig, as both female and male specimens are equally interspersed within the cluster. The four exceptionally large individuals, therefore, almost certainly represent wild boar (one specimen from Phase W, one from Phase X-Y and two from Phase Y-Z). Unfortunately, none of these specimens were sexed, which may have confirmed this interpretation, i.e. if they had been female.

#### **Second molar:**

Figure 92 displays plots of shape indices created for the mandibular second molar. Anterior cusp width (WA) has been plotted against posterior cusp width (WP), based on 269 cases (33 of which were sexed). Specimens of known sex have been indicated where tooth row completeness has permitted, i.e. mandibles with both canines and second molars (33 sexed cases). A similar pattern emerges to that produced by the first molar, although less distinct. There is a cluster of small individuals forming the majority, which contains all the specimens of known sex (equally interspersed as before), and a group of four larger specimens (one specimen from Phase W, one from Phase X-Y and two from Phase Z). These too, presumably represent domestic pigs and wild boar respectively.

#### **Third molar:**

Figure 93 displays plots of shape indices created for the mandibular third molar. Anterior cusp width (WA) has been plotted against mesial cusp width (WC) and length (L) against mesial width (WC), based on 198 and 115 cases respectively. It has not been possible to annotate these plots with specimens of known sex because there are too few complete tooth rows, i.e. mandibles with both canines and third molars. When 'WA' is plotted against 'WC' three reasonably distinct clusters are produced: small individuals clustering together, forming the majority; a small cluster of approximately 12 individuals forming an intermediate group; two exceptionally large individuals, as distinct outliers. This could be

interpreted as domestic females, domestic males and wild boar respectively. Alternatively, the intermediate group could represent castrated males, which would discount the two exceptionally large individuals as wild boar. Measurements 'WA' and 'WC', however, demonstrate a linear relationship to one another in all three clusters. This suggests that, regardless of size, shape does not vary significantly. As a result the initial interpretation is more credible because the presence of large, but gracile individuals, which would fall below the linear association, should denote castrates.

When the 'L' against 'WC' plot is considered only two distinct clusters are formed: a cluster of small individuals forming the majority and a cluster of four large individuals. The linear relationship between 'L' and 'WC' is less well defined and may obscure sexual dimorphism. Therefore, the majority of smaller individuals could represent domestic pigs, both female and male, and the four outlier's wild boar.

#### **Humerus:**

A similar pattern is produced when humerus trochlea measurements 'BT' and 'HTC' are plotted against one another, using 86 cases (Figure 94).

#### **Tibia:**

Distal tibia measurements 'Bd' and 'Dd' produce a plot that is similar in structure to that produced by third molar width measurements, although the relationship between the two measurements is not as strong (Figure 95), based on 97 cases: a cluster of small individuals, forming the majority, approximately eight cases forming an intermediate cluster and approximately nine cases forming a cluster of large individuals. Again, this could represent domestic females, domestic males and wild boar respectively.

#### **Astragalus:**

Astragalus measurements 'GLI' and 'GLm' plotted against one another form two distinct clusters (Figure 96), based on 106 cases: a large cluster of smaller individuals and a separate cluster of nine larger individuals. Therefore, it is superficially similar to the second third molar plot ('L' and 'WC') and the humerus trochlea plot. Unlike the other two plots, however, the astragalus measurements demonstrate a strong linear relationship. The cluster of smaller individuals has fewer cases in its upper range. This could represent domestic pigs, both female and male, whereas the group of nine could be wild boar.

### **8.7.2. Diachronic size change**

Single measurements from particular skeletal elements have been plotted as histograms by phase to assess whether there was any diachronic gross increase or decrease in size. Measurements from the fourth deciduous premolar (WP), first molar (WA), second molar (WA), third molar (WC), humerus (HTC), tibia (Bd) and astragalus (GLI) have been used because they provided the largest number of cases. Although, teeth are not sexually dimorphic (see above) they have been included because they provide the largest datasets. As with most other avenues of investigation Phase T-V and Phase X have produced too few cases to be of much interpretative value.

#### **Deciduous fourth premolar:**

Figure 97 displays fourth deciduous premolar posterior cusp width (WP) measurements based on the following number of cases: Phase T-V two; Phase W 18; Phase X one; Phase X-Y eight; Phase Y 44; Phase Y-Z 21; Phase Z 71. The mean value ranges between 7.9-8.5mm. Little can be gleaned from Phases T-V, W, X and X-Y, other than they are within the range of Phases Y, Y-Z and Z. Phases Y, Y-Z and Z demonstrate unimodal normal distributions, which suggest single populations, i.e., domestic pigs,

with approximately equal proportions of female and male individuals. Two individuals from Phase Z of 9.4mm and 9.6mm may just be large males, rather than wild boar, as they are not substantially larger than the norm. There is no apparent diachronic change in stature.

#### **First molar:**

Figure 98 displays first molar anterior cusp width (WA) measurements based on the following number of cases: Phase W 30; Phase X-Y 21; Phase Y 65; Phase Y-Z 45; Phase Z 114. Values have been rounded to the nearest 0.2mm due to the wide range present. The mean value ranges between 9.8-10.2mm. All phases (except Phase Z) fall within the same range and demonstrate unimodal normal distributions, suggesting roughly equal proportions of female and male domestic pigs. Phase Z demonstrates a unimodal uneven distribution, which possibly represents a larger group of female and a smaller group of male domestic pigs. Several phases include outliers that are considerably larger than the norm: Phase W includes one individual of 13.2mm, Phase X-Y one of 13.0mm and Phase Y-Z includes two individuals measuring 12.8mm and 13.4mm. In all likelihood these represent wild boar. There appears to be no overall increase or decrease in size.

#### **Second molar:**

Figure 99 displays second molar anterior cusp width (WA) measurements based on the following number of cases: Phase T-V one; Phase W 37; Phase X-Y 19; Phase Y 61; Phase Y-Z 44; Phase Z 113. Values have been rounded to the nearest 0.2mm due to the wide range present. The mean value ranges between 12.2-13.0mm. All phases generally fall within the same range, although their distributions and what they represent are not so clear. Phases Y, Y-Z and Z demonstrate unimodal uneven distributions that contain a large group of smaller individuals and a small group of larger individuals, which could tentatively represent females and males respectively. Two outliers of 15.4mm from Phases W and X-Y may represent wild boar. Overall, there appears to be no diachronic change in stature.

#### **Third molar:**

Figure 100 displays third molar mesial cusp width (WC) measurements based on the following number of cases: Phase T-V one; Phase W 21; Phase X two; Phase X-Y 17; Phase Y 45; Phase Y-Z 28; Phase Z 91. Values have been rounded to the nearest 0.2mm due to the wide range present. The mean value ranges between 12.4-14.8mm. Phases T-V, W, X-Y and Y contain too few cases to be useful. Phases Y and Z appear to have unimodal uneven distributions, which may imply the presence of female and male individuals belonging to the same population (as above). An outlier from Phase Y-Z of 19.4mm, and possibly one from Phase Z of 16.8mm, may represent wild boar. From the available evidence there appears to be no increase or decrease in the size of animals.

#### **Humerus:**

Figure 101 displays humerus 'height' of trochlea constriction (HTC) measurements based on the following number of cases: Phase W 10; Phase X-Y eight; Phase Y 24; Phase Y-Z six; Phase Z 53. Values have been rounded to the nearest 0.5mm due to the wide range present. The mean value ranges between 7.9-8.5mm. Phases W, X-Y and Y-Z contain too few cases to be of much interpretative value. Phases Y and Z demonstrate distinct unimodal distributions. Phase Z displays the same pattern already noted for other elements: an uneven distribution that possibly denotes a larger group of females and a smaller group of males. Outliers measuring 23.0mm or above could conceivably represent wild boar: Phases X-Y, Y, Y-Z and especially Z.

**Tibia:**

Figure 102 displays tibia distal width (Bd) measurements based on the following number of cases: Phase T-V one; Phase W six Phase X-Y five; Phase Y 22; Phase Y-Z 16; Phase Z 55. Values have been rounded to the nearest 0.5mm due to the wide range present. The mean value ranges between 29.0-31.0mm. Phases T-V, W and X-Y provide little useful information due to their small sample sizes. Phases Y and Y-Z demonstrate unimodal distributions, notwithstanding outliers of 35.5mm and 37.0mm, and 36.5mm, 37.0mm and 40.0mm respectively. In all likelihood these individuals represent wild boar distinct from the physically smaller domestic pig populations. Interpreting Phase Z is more problematic: a unimodal uneven distribution containing the majority of cases is followed by three small and distinct groups of larger individuals, albeit of only a small number of cases each. The distribution of the main group could indicate a majority of smaller females and a smaller proportion of larger males. This would make the three small groups of larger individuals all wild boar. Overall, there is no diachronic change in stature.

**Astragalus:**

Figure 103 displays astragalus greatest lateral length (GLI) measurements based on the following number of cases: Phase W eight; Phase X-Y 10; Phase Y 27; Phase Y-Z 14; Phase Z 49. Values have been rounded to the nearest 0.5mm due to the wide range present. The mean value ranges between 40.5-43.5mm. Phases W, X-Y and Y-Z are based on too few cases to be reliable indicators. Phases Y and Z display poorly defined distributions that demonstrate no clear patterns, for instance no extreme outliers stand distinct from the main groups. It has therefore not been possible to comment on population structure or the likely presence of wild boar.

**8.7.3. Log ratios: Inter-site comparison**

Many of the measurements taken from the *Viroconium* pigs produced relatively few cases, and this combined with the fact that analogous assemblages generally produce small numbers of comparable measurements, means that analysis of individual measurements is often impossible or of little interpretive value. To counter this, the log ratio method of Simpson *et al.* (1960: 356-358) has been employed (see Chapter 3). To summarise, the logarithm of the ratio between a measurement and its standard are combined with different measurements to form larger samples. Phase W (late 4<sup>th</sup> – mid 5<sup>th</sup> century AD) *Viroconium* pig measurements were adopted as the standard (see Chapter 3).

***Viroconium*:**

Phases T-V and X generally provided too few cases to be of any interpretative value.

Width: Figure 104 displays the log ratios for the combined baths basilica tooth width measurements. Size increases from left to right along the X axis, with the standard value calculated from the Phase W sample represented by '0'. For the combined width measurements, Phase T-V produced four cases, Phase W 105, Phase X three, Phase X-Y 65, Phase Y 217, Phase Y-Z 138 and Phase Z 387. The width log ratios demonstrate that there was no diachronic change in stature of the *Viroconium* pigs. Notwithstanding the outliers (see below), each plot displayed unimodal normal distributions, which may suggest there were approximately equal proportions of female and male animals. Phase W produced outliers of 0.08 and 0.13, Phase X-Y of 0.08 and 0.12, and Phase Y-Z of 0.11, 0.12 and 0.14. These cases may represent wild boar.



Figure 105 displays the log ratios for the combined baths basilica post-cranial width measurements, based on the following number of cases: Phase T-V one; Phase W 15; Phase X-Y 12; Phase Y 46; Phase Y-Z 21; Phase Z 98. The post-cranial width log ratio values also confirm that there was no overall diachronic change in the stature of domestic pigs at the baths basilica site. Due to the low number of cases it has not been possible to comment on the structure of the distributions for Phases T-V, W, X-Y and Y-Z. Phases Y and Z produce unimodal distributions, notwithstanding the outliers (see below) that are reasonably symmetrical, although Phase Z possibly hints at a larger group of smaller individuals and a small group of large individuals; presumably females and males respectively. Again, the outliers may represent wild boar: Phase Y (values of 0.09, 0.11 and 0.12); Phase Y-Z (0.10, 0.11 and 0.14); Phase Z (0.08, 0.09, 0.10, 0.11, 0.13 and 0.14).

Length: Figure 106 displays the log ratios for the combined baths basilica tooth length measurements, based on the following number of cases: Phase T-V two; Phase W 21; Phase X one; Phase X-Y 16; Phase Y 54; Phase Y-Z 23; Phase Z 106. Tooth length log ratios also confirm the impression provided by the width log ratios that the size of the *Viroconium* domestic pig populations remain static. Distinct outliers are present in Phases Y-Z (values of 0.10 and 0.12) and Z (a value of 0.10).

Figure 107 displays the log ratios for the combined baths basilica post-cranial length measurements, based on the following number of cases: Phase W 18; Phase X-Y 18; Phase Y 51; Phase Y-Z 46; Phase Z 102. Again, there appears to be no diachronic change in stature. Phases W and X-Y contain too few cases to enable comments on their distribution to be made. Phases Y, Z and to a lesser extent Y-Z produced unimodal distributions with attendant outliers very similar to those already discussed (see above). Phase X-Y contained outliers of 0.08 and 0.11, Phase Y 0.08 and 0.12, Phase Y-Z 0.09, 0.10 and 0.12 and Phase Z 0.08, 0.09, 0.10, 0.11, 0.12 and 0.13. Phase Z is possibly the closest plot to a true bimodal distribution indicating the presence of two distinct populations. The majority of individuals range between -0.06-0.06 and display the distribution pattern that may indicate the presence of a large number of smaller females and a small group of larger males. A second cluster of cases, ranging between 0.08-0.13, displays a normal distribution. This conceivably represents equal proportions of female and male wild boar.

Depth: Figure 108 displays the log ratios for the combined baths basilica post-cranial depth measurements, based on the following number of cases: Phase T-V one; Phase W six; Phase X-Y five; Phase Y 19; Phase Y-Z 14; Phase Z 54. Depth log ratios also support the view that the stature of domestic pigs at *Viroconium* remained static through time. Too few cases exist to enable comments on the likely structure of the domestic pig population and the possible presence of wild boar to be made.

### **Elms Farm:**

Width: Figure 109 displays the log ratios for the combined Elms Farm tooth width measurements, based on the following number of cases (see Chapter 7, for phasing summary): Period II 75; Period III 51; Period IV 28; Period IV-V 20; Period V-VI 24. Period II (Late Iron Age-Romano-British transition) and Period III (1<sup>st</sup> – 2<sup>nd</sup> century AD) contain a range of individuals that are broadly similar in size to those from *Viroconium*. Period IV (2<sup>nd</sup> – 3<sup>rd</sup> century AD) sees a shift towards larger individuals and Johnstone & Albarella (2002: 32) interpret this as evidence of deliberate breed improvement, albeit a century after cattle were improved with imported continental stock. Periods IV-V (3<sup>rd</sup> – 4<sup>th</sup> century AD) and V-VI (4<sup>th</sup>

– 5<sup>th</sup> century AD) demonstrate a continuation of this trend. It would, therefore, appear as though domestic pigs from *Viroconium* were of a fairly standard un-improved indigenous type. All the plots display unimodal normal distributions, which suggest single populations were present and may denote approximately equal proportions of female and male animals.

**Length:** Figure 110 displays the log ratios for the combined Elms Farm tooth length measurements, based on the following number of cases: Period II 18; Period III 16; Period IV eight; Period IV-V three; Period V-VI 10. Tooth length log ratios from Elms Farm also fall within the range calculated from the baths basilica domestic pigs, although the deliberate breed improvement observed in Period IV (see above) is not evident, which may be a product of the relatively small number of cases used to generate the tooth length log ratios. Alternatively, it may imply that the shape of the Elms Farm pigs changed, i.e. they were selectively bred to increase robusticity to produce greater meat yields, although whether tooth data can be used to extrapolate body shape is debatable.

#### **Lincoln:**

Figure 111 displays the log ratios for the combined Lincoln tooth width measurements (Dobney *et al.* 1996: 192-193, Appendix 1; see Chapter 7, for phasing summary), based on the following number of cases: 3<sup>rd</sup> century AD 16; 4<sup>th</sup> century AD 116. Tooth width log ratios from Lincoln also fall within the range observed from *Viroconium*. The 3<sup>rd</sup> century AD distribution displays two clusters, which may denote female and male animals, although this is based on a low number of cases. The 4<sup>th</sup> century AD plot displays a unimodal normal distribution, which suggests a single population with roughly equal proportions of female and male animals.

#### **Six Dials:**

Figure 112 display the post-cranial width and log ratio values for Six Dials (see Chapter 7, for a summary of the phasing). Six Dials has been included because of the possibly analogy between *Viroconium* and Saxon Southampton (see Chapter 2): the control of resources and modes of urban supply. Width values indicate a similar size range to the *Viroconium* pigs. When length values are considered a slightly different picture emerges; the ‘middle’ Middle Saxon especially, indicate a smaller size range. This would suggest that pigs from Saxon Southampton were the same size as those from *Viroconium*, but stockier. Interestingly, when another Saxon site from southern Britain is considered the width values fall below the *Viroconium* range (Figure 113): 7-9<sup>th</sup> century AD Maiden Lane, London (West 1988; University of Southampton). Perhaps Saxon pigs were on average smaller than their late Romano-British counterparts or the size range of the *Viroconium* sample has been inflated by the presence of wild boar.

## **8.8. Discussion**

### **8.8.1. Body part distribution/disposal practices**

Mandibles were the most frequently occurring pig skeletal element from the baths basilica assemblage, followed by the scapula, tibia and astragalus. This almost certainly represents a taphonomic signature. After which, the higher utility elements tend to be the most abundant (Figures 83). Overall, body part distribution suggests whole carcasses were present and that the observed pattern represents butchery and ‘kitchen’ waste, which was not selectively disposed of. Phases Y, Y-Z and Z demonstrate less differentiation between elements, which could indicate changing disposal practices. Consideration of individual deposit types by phase generally confirms this (Figures 84-88).

Similar taphonomic patterns, and the perceived presence of whole carcasses, were noted at Elms Farm (Johnstone & Albarella 2002: 30, 63, Table 8, 142, Figure 60) and Romano-British – Saxon Portchester Castle (Grant 1975: 386, 388, Table IVc, Figure 201; 1976: 269-270, Table IVc).

The presence of very young articulated partial skeletons from Phases X-Y and Y-Z (see above) would seem to confirm that breeding populations of pigs were present within *Viroconium*. Five articulated burials of young individuals at Exeter were also seen as evidence for pig rearing within the city (Maltby 1979: 58), as were neonates from Lincoln, in addition to pigs supplied from outside the settlement (Dobney *et al.* 1996: 44).

### **8.8.2. Ageing**

Both pig post-cranial fusion and tooth eruption and wear from the baths basilica indicate that approximately 70-75% of individuals were slaughtered before or around two years of age (Figures 89-90). Twenty-four months would have been the point at which individuals were reaching skeletal maturity (see Schmid 1972: 75, Table 9; Silver 1969: 264-265, Table G). This suggests that meat production was the principle motivation behind pig husbandry at the baths basilica site. Therefore, it would have been non-sensical to rear pigs beyond their reaching maximum body weight.

This exploitation was more intensive than that noted for Romano-British Colchester, where approximately 40% of individuals were slaughtered at around two years of age, based on the eruption of the third molar. An increase in erupting first molars and worn third molars indicates there was a gradual increase in the proportion of six month and two year old plus animals in the post-Boudican (later 1<sup>st</sup> century AD) period (Luff 1993: 77, 81). Luff (1993: 78) suggested this mortality profile may indicate pigs were farrowed twice a year.

The available ageing evidence from Elms Farm indicates a similar pattern. Post-cranial fusion suggested the majority of individuals were slaughtered between one and two-three years of age (Johnstone & Albarella 2002: 78, Table 23, 145, Figure 64). Tooth eruption and wear suggests a shift towards slightly younger slaughter between Period III (1<sup>st</sup> – 2<sup>nd</sup> century AD) and Period IV (2<sup>nd</sup> – 3<sup>rd</sup> century AD) (Johnstone & Albarella 2002: 31, 78, Table 24; 146, Figure 65). This has been interpreted as the result of breed improvement: improved breeds probably developed faster and could therefore be slaughtered earlier.

Tooth wear and eruption from Exeter also provides a similar pattern to that noted for Colchester and Elms Farm: approximately 80% of individuals were slaughtered before or at two years of age (Maltby 1979: 55, 186, Table 80, 89, Table 83). Overall, throughout the Romano-British period pigs were slaughtered at a fairly constant rate (Maltby 1979: 57): 25% killed in first year; 35% in second; 30% in third.

Lincoln, between 1<sup>st</sup> – 3<sup>rd</sup> centuries AD, based on tooth data, demonstrated a normal intensive pork production profile, although in the 4<sup>th</sup> century AD a higher proportion of adult (2-3 years) animals were noted, suggesting that culling went beyond the optimum meat strategy (Dobney *et al.* 1996: 44, 145, Table 37, 118, Figure 70). The post-cranial data contradicted the tooth data slightly, and Dobney *et al.* (1996: 44, 145, Table 38, 118, Figure 71) postulated that the post-cranial skeleton probably developed more slowly in primitive breeds or that prepared joints of meat were supplied to the city.

The General Accident site in York (O'Connor 1988: 88, Table 23) also provided similar profiles, as did evidence from Romano-British Portchester Castle (Grant 1975: 394, Table VIIc, 398, Figure 205),

although later (Saxon) phases demonstrated a slightly older mortality profile (Grant 1976: 277, Table VIIc, 280).

The presence of neonates and/or very young individuals at these sites has generally been interpreted as tentative evidence for the consumption of 'suckling' pig: Butt Road, Colchester (Luff 1993: 78); Exeter (Maltby 1979: 57); General Accident site, York (O'Connor 1988: 88). The Roman's supposedly had a particular fondness for 'suckling' pig (White 1970: 318-320); however other author's have questioned this assumption. Their presence at Elms Farm, for instance, was interpreted as natural mortality because they were mostly articulated (Johnstone & Albarella 2002: 30). Pigs suffer a relatively high level of infant mortality, which could explain the presence of neonates. Sutherland (1967: 61) states that 20% of piglets die before weaning, mostly in their first two-three days, partially due to their inability to regulate body temperature.

The *Viroconium* pigs therefore appear to have been exploited very much in the standard Romano-British tradition: deliberate and reasonably intensive meat production. Pigs could be bred outside the constraints of the seasonal cycle of cattle and sheep. This being the case they may well have been farrowed twice a year, as at Colchester (see above). Many of the classical authors recommended twice yearly farrowing, such as Varro (*Rerum Rusticarum* II.4.14; Hooper & Ash 1993: 359-361) and Pliny (*Historia Naturalis* VIII.77; Rackham 1997: 143). Columella (*De Re Rustica* VII.9.4; Forster & Heffner 1968: 292), only recommended it for commercial reasons, i.e. the proximity of an urban market. Such a husbandry regime would bring with it certain problems, as the sows would have to be styed over winter until June or early July (Grigson 1982: 304-305), which would require additional resources beyond pigs being useful converter's of waste into protein.

### **8.8.3. Sexing**

Mandibular canines and their respective alveoli suggested there were approximately equal proportions of female and male pigs at *Viroconium*. At Lincoln a similar sexual division was interpreted as evidence for non-intensive pork production (Dobney *et al.* 1996: 44). However, as suggested previously (see above), the number of male canines has almost certainly been exaggerated by differential preservation. If the biometrical data has been interpreted correctly, the majority of individuals at *Viroconium* were female.

The possibility that castrates were present within the assemblage has not been specifically considered, although no especially gracile individuals were noted. Pig castration may have been practiced in Romano-Britain: Columella (*De Re Rustica* VII.9.1; Forster & Heffner 1968: 293) recommended castration at either six months or three-four years, if they had been used for breeding; Varro (*Rerum Rusticarum* II.4.1; Hooper & Ash 1993: 365) recommended between six months and one year.

### **8.8.4. Butchery**

Most butchery marks appear to relate to carcass reduction to produce manageable joints of meat. The earlier phases (T-V, W, X and X-Y) are devoid of filleting marks, which suggests that meat was eaten off the bone. Conversely, in Phases Y, Y-Z and Z there is an increase in the frequency of cut marks, many of which have been interpreted as filleting. This may indicate a changing cultural trend; especially as the size of animals remained unchanged and did not require a change in technique, as postulated for cattle (see Chapter 7). Split mandibles have been encountered in other Romano-British assemblages, such as Portchester Castle (Grant 1975: 392) and Elms Farm, where it was suggested that this was to facilitate the

removal of the tongue (Johnstone & Albarella 2002: 30), although there are easier means of removing the tongue (see van Wijngaarden-Bakker 1990: 168-169, Plate 3).

### **8.8.5. Biometry**

Biometrical analysis provides some evidence to suggest that wild boar were present within the sample. The shape indices created by plotting third molar anterior and mesial widths (WA and WC) and distal tibia breadth and depth measurements (Bd and Dd) both demonstrated three distinct clusters (Figures 93 & 95): a large group of smaller individuals containing the majority of cases, an intermediate small group of large individuals and a small group of very large individuals. These have been interpreted as female domestic pigs, male domestic pigs and wild boar of both sexes respectively. When individual measurements were considered two plots in particular displayed distinct groups of outliers, which are also thought to indicate the presence of wild boar: Phase Z height of the humerus trochlea constriction (HTC) and distal tibia breadth (Bd) (Figures 101-102).

Few analogous and contemporaneous sites have produced wild boar biometrical data. Exeter (Maltby 1979: 58) produced one possible wild boar measurement from the Romano-British epoch: an astragalus with a greatest lateral length (GLL) of 50.7mm. The baths basilica assemblage produced six measurements over 50.0mm (Appendix 31). As previously stated, the Turkish wild boar standards produced by Payne & Bull (1988) may not be applicable, due to the considerable geographical variation in the size and morphology of wild boar, for instance the Colchester domestic pigs demonstrated a considerable overlap with the Turkish sample (Luff 1993: 76-77). The *Viroconium* domestic pig sample also demonstrated a considerable overlap with the Turkish wild boar.

Further evidence is provided when log ratio values were considered. Post-cranial width log ratios from Phases Y, Y-Z and Z (Figure 105), plus Phase Z post-cranial length log ratios (Figure 107), all demonstrated bimodal distributions. The majority of cases in each example formed a cluster of smaller individuals that had a positively skewed distribution. In all likelihood these denote mainly female animals with a smaller proportion of males, i.e. a single population. This leaves a small cluster of large individuals, which are thought to represent wild boar. Phase Z length log ratios demonstrates this exceptionally well (Figure 107), and displays a normal distribution that could indicate equal proportions of female and male wild boar.

The interpretation of the baths basilica bimodal distributions as domestic pig and wild boar is given further credence when the distribution of log ratio values is considered from analogous assemblages. In no instance is a similar pattern produced, and only unimodal distributions were present denoting domestic pig populations (Figures 109-113).

The *Viroconium* dataset suggests the overall size and morphology of pigs remained unchanged through the period of activity at the baths basilica site (Figures 104-108). The *Viroconium* pigs were of a similar size to those from Periods II and III at Elms Farm. The Elms Farm biometry indicated a slight, but statistically significant, size increase between Periods III and IV, and this 2<sup>nd</sup> century AD increase was interpreted as deliberate breed improvement (Johnstone & Albarella 2002: 32, 148, Figure 67; 149, Figure 68). The *Viroconium* pigs would therefore appear to be of a standard unimproved indigenous type. At some sites evidence for a decrease in size between the Romano-British and medieval periods has been observed, for example from Exeter (Maltby 1979: 58, Figure 16, 59, Figure 17), and based on the

*Viroconium* data this may have occurred post-7<sup>th</sup> century AD This, however, may have been a purely regional phenomenon, as other sites demonstrate no such decrease, such as the General Accident site, York (O'Connor 1988: 99).

## 9. Sheep/goat

### 9.1. Introduction

This chapter will discuss the sheep and goat remains excavated from the *Viroconium* baths basilica. Firstly, it will consider the range of skeletal elements present and their distribution within particular context types. It will then discuss the evidence for aging and consider butchery practices. Finally, the results and implications of biometric analysis will be considered. The concluding discussion will draw together reference made from the skeletal evidence and discuss their implications in terms of the research questions asked (Chapter 2).

Bone fragments positively identified as either sheep (*Ovis aries*) or goat (*Capra hircus*) have been included in the analyses, as have those fragments not positively speciated: 'sheep/goat'. It was possible to positively identify the following proportions of ovicaprine remains: Phase T-V 32%; Phase W 34%; Phase X 33%; Phase X-Y 38%; Phase Y 38%; Phase Y-Z 32%; Phase Z 40%. It was, therefore, possible to positively speciate 36% of all caprine remains from the baths basilica, using morphological criteria (see Chapter 3). Speciation of the metacarpal, calcaneum and metatarsal, using morphological criteria, has generally been confirmed by biometrical analysis (see below).

Combining sheep and goat could potentially bias any interpretation, because sheep flocks and goat herds may have been subject to quite different husbandry regimes (Halstead *et al.* 2002: 545). Morphological separation suggests a ratio of almost 14 sheep to one goat (see Table 35a; Chapter 6). Therefore, the implication is that the majority of animals from *Viroconium* were sheep and the inclusion of a small minority of goat remains should not bias the results and their interpretation. The remainder of the narrative will therefore simply refer to 'sheep'.

### 9.2. Body part distribution

Sheep skeletal representation is presented in Figure 114 and Table 84, following the procedures detailed in Chapter 3. Figure 114 is based on MNI values to prevent multiple counting of single specimens and also to counteract the effects of differential fragmentation, making diachronic and inter-context comparison more valid. The highest MNI for any single skeletal element was 12 for Phase T-V, 52 for W, four for X, 21 for X-Y, 32 for Y, 29 for Y-Z and 65 for Z. The graphs produced for Phases T-V and X are clearly questionable because of the small samples, although both demonstrate fairly similar patterns to the other phases based on larger samples.

The zygomaticus is one of the least frequently occurring body parts present in the baths basilica assemblage. As postulated for the total absence of pig zygomatic arches (see Chapter 8), this is partially an artefact of the recording system. The diagnostic zone system stated that 50% or more of the zygomaticus had to be present for it to be 'countable' (see Chapter 3). Differential preservation is also a factor, because cranial elements fragment more readily and are not as durable as most post-cranial body parts (see Chapter 4). In all likelihood, sheep zygomatic arches are under-represented in the dataset.

Horncores are unlikely to have been effected by a recovery bias, so alternative explanations have to be fostered to account for their low frequency in the baths basilica assemblage. Notwithstanding other taphonomic reasons, such as differential preservation or deficiencies in the diagnostic zone system (see

Chapter 4), two causal factors are likely. Firstly, it is not uncommon for horns to be removed from butchery waste to other locations for working. The baths basilica site has produced some tentative archaeological evidence for special craft-activities (Barker *et al.* 1997: 63-64 & 122-125). Horn-working was often carried in conjunction with working metapodials and leather production: horns and lower limb bones were often initially left attached to the hides. However, as Figure 114 attests, metapodials were often one of the most frequently occurring elements from the *Viroconium* sheep assemblage, which suggests they were not be utilised in specialist craft-production (see below). Secondly, certain types of Romano-British and early medieval sheep may have been hornless and their presence would reduce the proportion of cores in the assemblage. No congenitally hornless craniums were noted in the baths basilica material, although this could be due to fragmentation, so their presence cannot be entirely discounted. Two polled specimens were noted: one from Phase (ID 14116 Context B521) and one from Phase Y-Z (ID 21866 Context 277).

Mandibles were generally the most predominant skeletal element. This is unlikely to be an artefact of the recording system because great care was taken as to not cause an over-representation of mandibles (see Chapter 3). In all likelihood the high frequency of mandibles results from the taphonomic processes active at the baths basilica site. It is not unusual for the mandible to be the most frequent skeletal element because they fragment reasonably easily, but survive well overall, e.g. isolated teeth (see Chapter 4).

The relatively small number of first phalanges is almost certainly due to a recovery bias: to briefly re-iterate, the 'pseudo-schlepp effect' (see Chapter 4).

All body parts are represented and this indicates that whole carcasses were present at the baths basilica site. As explained above, mandibles are generally the most frequently occurring elements due to taphonomic reasons. Metapodial and tibia fragments are present in reasonably high proportions. This may also be partially taphonomic because they are reasonable robust and survive well. Conversely, the astragalus and calcaneum are present in relatively small numbers despite usually surviving well, which may indicate a recovery bias. This interpretation gains credence when frequencies of astragali and calcanei are compared directly with those of the metatarsal; in all likelihood, if butchery waste was being discarded elsewhere it would have affected all three elements equally. The higher utility elements, such as the scapula, humerus, pelvis and femur, are the least frequently occurring body parts (with the exception of horncores and the zygomaticus: explained above). This could be a reflection of the higher levels of processing that they were subjected to or alternatively imply that a proportion of them were transported elsewhere for consumption. Overall, regardless of phase, there is an admixture of butchery and kitchen waste representing all stages in the carcass reduction process. With the possible exception of the horncores (see above), there appears to be no specialist craft residue, such as low numbers of metapodials, in the assemblage.

There appears to be less differentiation between the frequencies of body parts in the later phases (Y, Y-Z and Z), similar to the pattern noted for pig, albeit not as pronounced as the similar pattern noted for cattle. This implies that the earlier phases (T-V, W, X and X-Y) contain greater proportions of butchery waste, represented by cranial fragments, lower limb elements and lower utility elements, and that higher utility elements were being selectively removed. Therefore, the later phases may demonstrate changing attitudes towards waste disposal practices.



### 9.3. Disposal practices

As with cattle the large size of the data set has enabled the distribution of body parts across different context types to be considered. Sheep bones were distributed across all deposit types encountered at *Viroconium*, including pit fills, cut fills, posthole fills, layers, hearth fills, floors, surfaces, structures and dumps (see Chapter 5, for definitions of these terms). The category 'other' has been excluded from this analysis because it is of little interpretive value, as have contexts not assigned to a deposit type. Sheep bones, regardless of phase, were divided across deposit types accordingly (NISP):



Using the arbitrary figure of 100 NISP within an individual deposit (see Chapter 3) it was possible to produce graphs for Phase W dumps (Figure 115; Table 85), Phase X-Y cut fills (Figure 116; Table 86), for Phase Y dumps (Figure 117; Table 87), for Phase Y-Z surfaces (Figure 118; Table 88), and for Phase Z dumps (Figure 119; Table 89). As it has only been possible to construct body part distributions for single deposit types within any one phase little can be inferred regarding disposal practices. However, there appears to be little to differentiate between the various deposit types and the phase body part distributions noted above. Any discrepancies could result from the relatively small samples used to produce the graphs.

Several partial articulated neonatal skeletons were recorded: Phase Z Context E85 (ID 7589-7595), Phase Y Context D1332 (ID 8018-8023) and Phase Y Context D1335 (ID 20830-20840). It is interesting to note that two of them came from adjacent deposits in Area D from Phase Y (west portico). Articulated neonatal skeletons would usually be interpreted as evidence for the presence of breeding populations, however such an interpretation is problematic when made for sheep, although a particularity of the tooth eruption and wear mortality curves makes this a possibility (see below).

### 9.4. Ageing

#### 9.4.1. Epiphyseal fusion

Figure 120 and Table 90 display sheep fragments as 'early' (3-16 months), 'middle' (15-36 months) or 'late' (36-42 months) fusing skeletal elements, based on Reitz & Wing's (1999: 76) combined summary of the fusion ages of Schmid (1972: 75, Table 9) and Silver (1969: 264-265, Table A). The number of neonatal specimens is also displayed as a proportion of the other categories combined. The techniques used for recording and analysing post-cranial age data are detailed in Chapter 3. Post-cranial epiphyseal fusion for Phase T-V was based on 83 observations, Phase W on 664, X on 29, X-Y on 203, Y on 469, Y-Z on 313 and Z on 726. Phase T-V and especially Phase X are too small to be relied upon.

There is little variation between phases (Figure 120): approximately 5-10% of the 'early' fusing elements are unfused, around 30-40% of the 'middle' fusing elements and 55-65% of the 'late' fusing elements. In

addition, 1% of elements from Phase T-V are neonatal, 2% from Phase W, none from Phase X, 2% from Phase X-Y, 6% from Phase Y, 3% from Phase Y-Z and 3% from Phase Z (expressed as a proportion of the unfused, fusing and fused elements combined). The post-cranial epiphyseal fusion data for sheep indicate that the majority of individuals were slaughtered before they had reached skeletal maturity; most were killed before they reached 36-42 months. This profile is quite normal if the principle motivation behind sheep husbandry was meat production.

#### **9.4.2. Tooth eruption and wear**

A more complicated, and probably more accurate, picture of age at death emerges when mandibular tooth eruption and occlusal wear is considered. Figure 121 and Table 91 summarise sheep mortality derived from tooth eruption and wear, and Appendix 33 lists the raw data. The categories proposed by Payne (1973: 299) were used to construct mortality profiles. Methods of recording and analysis are detailed in Chapter 3, together with a discussion of problems associated with creating mortality profiles from tooth data and the complications caused by fragmentary archaeological material.

The mortality curve for Phase T-V was based on 20 cases, for Phase W on 112, for Phase X on seven, for Phase X-Y on 33, for Phase Y on 77, for Phase Y-Z on 62 and for Phase Z on 156 cases. Phase X, and to a lesser degree Phase T-V, may be unreliable because of the low number of cases used to construct their mortality curves.

As with body part distribution and post-cranial epiphyseal fusion data, there is a considerable level of consistency between all phases. Individuals were slaughtered at each age stage, apart from stage 'I' (8-10 years). Phases W, Y, Y-Z and tentatively T-V are directly comparable: approximately 0-5% of individuals fall into stage 'A' (0-2 months); 15-20% into stage 'B' (2-6 months); 5-15% into stage 'C' (6-12 months); 20-30% into stage 'D' (1-2 years); 15-25% into stage 'E' (2-3 years); 10-20% into stage 'F' (3-4 years), 10-15% into stage 'G' (4-6 years); 0-10% into stage 'H' (6-8 years). A peak between stages 'D' and 'E' suggests that around 35-55% of individuals were deliberately slaughtered between the ages of 1 and 3 years.

This indicates that a meat mode of production was the principle husbandry regime, i.e. the disposal of surplus individuals before first lambing but after one, possibly two, wool clips. This pattern, therefore, broadly supports the post-cranial fusion evidence (see above). A another peak of slaughter at stage 'B' (2-6 months) is more difficult to explain, especially as very young mandibles do not survive well (see below), and could indicate that small numbers of sheep were kept within *Viroconium* for their meat and milk, i.e. surplus lambs were routinely slaughtered, so that the ewes milk could be utilised for human consumption. This possibility gains momentum when the neonatal skeletons are considered (see above). Phase X-Y represents a departure from the normal meat mode of production noted at *Viroconium*. It demonstrates that the vast majority of individuals were killed at 2-3 years (approximately 75% in stage 'E') and suggests a wool mode of production. However, this may simply be the result of a small data because the Phase X-Y mortality curve is based on only 33 cases.

#### **9.4.3. Data correlation**

Mortality curves produced by the two evidential strands may contradict one another. To assess this possibility, it is first necessary to equate post-cranial epiphyseal fusion stages to tooth eruption and wear stages, using their corresponding ages. Based on the fusion ages of the 'early' category it broadly equates

to tooth eruption and wear stages 'B' and 'C' (approximately 2-12 months), the 'middle' fusion category to stages 'D' and 'E' (approximately 1-3 years) and the 'late' fusion category to stage 'F' (approximately 3-4 years) (see Appendices 5-6; Chapter 3). The two datasets, therefore, generally illustrate the same overall pattern: the majority of individuals were slaughtered by 3-4 years of age, which broadly corresponds to a meat mode of production (see below). However, one discrepancy does exist: post-cranial epiphyseal fusion suggests a slightly older profile than does the mandibular evidence. Two possibilities may account for this discrepancy. First, tooth wear occurred more slowly than expected. An unusual diet may have been responsible, although this is difficult to explore and is reasonably improbable. Second, unfused post-cranial elements may have been subject to greater levels of post-depositional destruction. This eventuality is fairly unlikely because very young mandibles are also easily destroyed (Munson 2000; Munson & Garniewicz 2003). Therefore, the same caveat postulated for pig mortality (see Chapter 8) may be valid: attempting to amalgamate the two methods, both of which rely on varied empirical data to provide ages, produces inconsistencies.

## 9.5. Sexing

It is possible to sex sheep remains morphologically on the pelvis, using the ilio-pubic ridge and median acetabular border. Table 92 outlines the female to male ratio by chronological phase. Phase X-Y produced no pelvis fragments that it was possible to sex. These figures are rather inconclusive and provide no real support for or against the meat mode of production postulated above. The presence of wethers (castrates) has not been specifically considered because their identification from osseous material remains allusive and high problematic. As with cattle (see Chapter 7), castrates are reputedly more slender and gracile because delayed fusion allows the diaphysis (shaft) to grow for longer, although age of castration (plus nutritional factors, etc) make this far from definite (see Baker 2004). The almost certain presence of wethers in the baths basilica assemblage further negates the tentative sex ratios.

Shape indices have also been created for the metacarpal, which can be used to infer sex (see Chapter 7). However, the interpretation of caprine metacarpal shape indices is more complicated because goat metacarpals are generally shorter and more robust than sheep, which could confuse the picture. Figure 122 displays the results of 'MB' (mid-breadth:  $SD/GL \times 100$ ) against 'DB' (distal breadth:  $BatF/GL \times 100$ ). The result displays a loose cluster of smaller individuals containing the majority of individuals and a smaller cluster of larger individuals. Presumably, these represent ewes and rams respectively. Figure 123 displays greatest length (GL) against an index created by multiplying the width of the distal fusion point (BatF) by 100 and dividing the result by the greatest length (GL). It displays a similar pattern, also suggesting a greater proportion of ewes over rams, which broadly supports the pelvis sexing data.

## 9.6. Butchery

In the effort to elucidate sheep butchery patterns within the baths basilica assemblage, two approaches have been undertaken. Firstly, the frequency of butchery mainly by phase and skeletal element is considered. Secondly, the butchery marks evident on the *Viroconium* material are allocated to particular stages in the carcass reduction process.

### 9.6.1. Butchery frequency

Table 94 outlines the frequency of butchery marks from the baths basilica assemblage by phase and anatomical element. Isolated fourth deciduous premolar, third molar and metapodial NISP have been excluded from the calculations. The percentage of NISP values displaying one or more butchery marks varied very little between phases:

- Phase T-V           6%
- Phase W            6%
- Phase X            8%
- Phase X-Y          7%
- Phase Y            7%
- Phase Y-Z          8%
- Phase Z            11%

These proportions are considerably smaller than the corresponding proportions of butchered cattle bone (see Chapter 7). As with pig butchery frequencies, sheep carcasses are smaller than cattle carcasses and consequently require less butchering to reduce them into manageable portions of meat.

Table 94 summarises type of butchery mark ('chop', 'cut' and 'saw') by anatomical element and chronological phase. Chops account for the majority of butchery marks, although the frequency of cut marks increases over time. Cut marks expressed as a percentage of total butchery by phase increase from 27% in Phase W to 49% in Phase Z (based on Table 94). Phase X-Y was considerably higher at 69%, although this may just be a reflection of the relatively small number of cases used to generate the frequencies. This trend of increased knife-use mirrors that already noted for cattle and pigs (see Chapters 7-8). Overall, the butchery marks seem to relate directly to carcass reduction and cooking. The range of skeletal elements displaying butchery marks supports this interpretation (Tables 93-94); mandibles, upper limb elements and metapodials frequently display butchery evidence.

### 9.6.2. Carcass reduction

When the *Viroconium* material was recorded butchery marks were allocated to a particular stage in the carcass reduction process. These stages were defined as 'skinning', 'dismembering', 'filleting' and 'other'. For this purpose, the ethnographic butchery data collected by Binford (1981: 98-133, Figures 4.06-4.38, Table 4.04) were used as a guide (see Chapter 3). In addition, several other locations/orientations of butchery marks were added to compliment Binford's (1981). This was deemed necessary to prevent many of the *Viroconium* butchery marks falling into the 'other' category. The additional categories were (see Chapter 3): longitudinal/diagonal marks on shafts equating to filleting on long bones and cannon bones; transverse marks on epiphyses equating to dismembering on long bones and cannon bones; transverse marks located mid-shaft on the first phalange were assumed to represent skinning.

Tables 95 display carcass reduction stages by anatomical element and chronological phase. Phases T-V and X are of little interpretative value because of small sample size. Overall, there is only moderate correspondence between the categorised butchery marks of Binford (1981) and the locations of butchery marks on the *Viroconium* sheep remains. The greatest level of correspondence existed for dismembering, with no instances of skinning (with the exception of one case on a first phalange from Phase X-Y) and a few instances of filleting being present. Filleting marks demonstrated no diachronic trends. Many

butchery marks fall into the 'other' category. In most instances they form no distinguishable pattern and therefore probably relate to random fluctuations in butchery technique.

## 9.7. Biometry

The *Viroconium* baths basilica sheep assemblage produced a relatively large quantity of biometrical data. The assemblage as a whole produced 146 tooth measurements and 1105 post-cranial measurements, these divide by phase as follows (excluding Phase X-Z):

- Phase T-V            38
- Phase W             291
- Phase X             18
- Phase X-Y          109
- Phase Y             233
- Phase Y-Z          153
- Phase Z             409

Summary statistics (minimum, maximum, mean and standard deviation) are provided for all measurements, which produced 10 or more cases per phase: Tables 96-100. Appendices 34-43 list measured specimens by phase and context.

Biometrical analysis centred on four thematic avenues of research. Firstly, the sheep to goat ratios based on morphological criteria can be confirmed through biometrical analysis. This has been achieved by creating indices that outline variation in size and shape by plotting two variables against one another as scatter-plots.

Secondly, individual measurements are considered by phase to determine if there is any diachronic size change. This will provide some indication of likely husbandry practices, such as breed improvement, or conversely their decline. Histograms displaying the frequency of particular measurements, usually the most numerous for any given element, will be used to achieve this.

Thirdly, indices will be employed to assess the shape of individual animals. In all likelihood large and more robust individuals will represent males (see Chapter 3), especially if the individual measurements suggest no overall size increase. Plotting two measurements from the same element against one another, or creating indices by dividing two measurements and multiplying the results by 100, will achieve this.

Fourthly, an inter-site comparison will be attempted, using pooled log ratios, to determine how *Viroconium* compared to other contemporaneous and analogous sites. The log ratio method is explained in Chapter 3.

At present there appears to be no research available that summarises the degree of sexual dimorphism in individual skeletal elements for sheep. Anatomical dimorphic variability noted in cattle will therefore be substituted as a rough guide. To summarise, teeth are not dimorphic, the humerus is an unknown quantity (but, presumably dimorphic), the metacarpal is the most dimorphic element, the tibia demonstrates some dimorphism, the astragalus none and the metatarsal displays some dimorphism (see Chapter 7).

As for cattle (see Chapter 7), it was noted in several of the following histograms, and those generated for the log ratio values, that visually there appeared to be a slight increase in the proportion of large specimens in the later phases (see below). This was initially thought to represent a small, but significant, increase in the number of males being supplied to *Viroconium* (as purported by the sexed pelvises; see

above). To test this hypothesis skewness values were generated (see Chapter 3). Table 101 outlines skewness values by phase for fourth deciduous premolar (width), humerus (HTC), metacarpal (Bp), tibia (Bd), astragalus (GLI) and metatarsal (Bp) measurements, plus pooled width, length and depth log ratio values. To avoid biasing the results extreme outliers were first discounted, i.e. values that may have derived from recording errors or possible misidentification (listed in Table 102). The results are inconclusive; no diachronic pattern is evident and fairly high standard errors tend to invalidate the results. Skewness, therefore, does not support the supposition that greater numbers of male sheep were reaching *Viroconium* in the later phases.

### **9.7.1. Sheep and/or goat**

#### **Metacarpal:**

Boessneck (1969: 355) and Payne's (1969: 296) biometrical method for separating sheep and goat has been used to confirm the initial identifications based on morphological criteria (see Chapter 3). Two measurements from each distal metacarpal condyle produce higher ratios in goat than in sheep, with only very occasional overlapping. Figure 124a plots the condyle medio-lateral width (a) against the trochlea anterior-posterior width (1) for the medial condyle, based on 54 cases. Figure 124b displays the same information for the lateral condyle, using measurements 'b' and '4' respectively, based on 54 cases. Symbols denoting the initial identifications have been used. Morphological separation is confirmed by the biometrical method.

#### **Calcaneum:**

The distal part of the articular facet of the *os malleolare* is longer in sheep and shorter in goat. Subsequently, the articular part of the lateral process is longer than the articulation-free part in goat than in sheep. The width of this facet expressed as a percentage of its greatest length is 37-52% in sheep and 50-66% (Boessneck 1969: 353). Measurement 'C' has been plotted against measurement 'C+D' to demonstrate this, using 82 cases (Figure 125). The morphological identifications are generally confirmed.

#### **Metatarsal:**

The same method was applied to the metatarsal as it was for the metacarpal. Figure 126a displays the ratios for the medial condyle, based on 48 cases, and Figure 126b for the lateral condyle, based on 50 cases. Biometrical separation again supports the original morphological identifications, although not as clearly as it did for the metacarpal, which is unsurprising because Boessneck (1969: 355) noted some overlap in the metatarsal, but not the metacarpal.

### **9.7.2. Diachronic size change**

Single measurements from particular skeletal elements have been plotted as histograms by phase to assess whether there was any diachronic gross increase or decrease in size. Measurements from the fourth deciduous premolar (width), humerus (HTC), metacarpal (Bp), tibia (Bd), astragalus (GLI) and metatarsal (Bp) have been used because they provided the greatest number of cases. As with most other avenues of investigation Phase T-V and Phase X have produced too few cases to be of much interpretative value.

#### **Fourth deciduous premolar:**

Figure 127 displays fourth deciduous premolar maximum width measurements based on the following number of cases: Phase T-V seven; Phase W 31; Phase X one; Phase X-Y five; Phase Y 33; Phase Y-Z

18; Phase Z 45. The mean value ranges between 5.9-6.3mm. Little can be inferred from Phases T-V, X, and X-Y. Phases W, Y, Y-Z and Z display unimodal distributions that suggest the presence of single populations, i.e. a reasonably 'uniform' type of sheep was being exploited at *Viroconium*. The normal distributions imply that approximately equal proportions of female and male animals were present (with the caveat that teeth are not the best indicator of dimorphism). Phase Z may suggest a greater number of rams. Overall, there is no indication of any size increase or decrease.

#### **Humerus:**

Figure 128 displays humerus height of the trochlea constriction (HTC) measurements based on the following number of cases: Phase T-V five; Phase W 32; Phase X two; Phase X-Y 13; Phase Y 30; Phase Y-Z 17; Phase Z 53. Values have been rounded to the nearest 0.5mm due to the wide range present. The mean value ranges between 12.0-13.0mm. The low numbers of cases that Phases T-V, X and X-Y (and Phase Y-Z to a lesser extent) have provided precludes any serious consideration. However, Phases W, Y and Z suggest a single population that does not change over time.

#### **Metacarpal:**

Figure 129 displays metacarpal proximal width (Bp) measurements based on the following number of cases: Phase T-V five; Phase W 34; Phase X four; Phase X-Y 13; Phase Y 27; Phase Y-Z 17; Phase Z 42. Values have been rounded to the nearest 0.5mm due to the wide range present. The mean value ranges between 20.5-21.5mm. Phases T-V and X provide too few cases to be useful. Phase W, although not demonstrating a skewed distribution (Table 101), may indicate a greater proportion of females than males. Phase Z, and to a lesser extent Phase Y, also have normal distributions, but may infer a shift in the sex ratio of the sheep population, with a greater number of rams that appear in more equal numbers to the ewes. Overall, there is no diachronic size increase or decrease.

#### **Tibia:**

Figure 130 displays tibia distal width (Bd) measurements based on the following number of cases: Phase T-V four; Phase W 46; Phase X three; Phase X-Y 16; Phase Y 28; Phase Y-Z 24; Phase Z 48. Values have been rounded to the nearest 0.5mm due to the wide range present. The mean value ranges between 23.5-24.5mm. Phases T-V and X provide no useful comparison, being based on too few cases. A similar pattern/trend could be said to exist between Phases W and Z, as it did for the metacarpals (see above). Phase Y-Z would seem to support the supposition that the later phases contain a slightly higher proportion of larger individuals, i.e. rams. No diachronic size change is evident from the tibia distal width measurements.

#### **Astragalus:**

Figure 131 displays astragalus greatest lateral length (GLI) measurements based on the following number of cases: Phase T-V one; Phase W 29; Phase X one; Phase X-Y nine; Phase Y 31; Phase Y-Z 16; Phase Z 34. Values have been rounded to the nearest 1.0mm due to the wide range present. The mean value ranges between 25.0-27.0mm. Phases T-V, X and X-Y provide too few cases to be of any interpretive value. The remaining phases (W, Y, Y-Z and Z) display normal unimodal distributions, which indicate no obvious sexual bias and no diachronic size change.

### **Metatarsal:**

Figure 132 displays metatarsal proximal width (Bp) measurements based on the following number of cases: Phase T-V four; Phase W 31; Phase X one; Phase X-Y 10; Phase Y 27; Phase Y-Z 12; Phase Z 44. Values have been rounded to the nearest 0.5 mm due to the wide range present. The mean value ranges between 18.0-19.5mm. Phases T-V, X, X-Y and Y-Z are of limited value, being based on small numbers of measurements. Phases W, Y and Z display a similar trend to that noted for the metacarpals and tibia (see above): an increase in the number of larger, presumably male, animals during the later phases of occupation to a ratio broadening on approximately equal proportions of ewes and rams.

### **9.7.3. Breed and/or sex**

To investigate the possibility that the later phases of activity at the baths basilica see a change in sheep husbandry practices, as evidenced by the presence of flocks with more equal ewe to ram ratios. Two measurements from the same element have been plotted against one another to determine whether the number of larger and more robust individuals actually increase at the baths basilica. However, this approach is problematic because the presence of wethers (castrates) might blur the division between female and male groupings (see above).

### **Fourth deciduous premolar:**

Figure 133 plots the shape indices for the fourth deciduous premolar: Phase T-V based on 12 cases; Phase W on 21; Phase X on one; Phase X-Y on two; Phase Y on 26; Phase Y-Z on 15; Phase Z on 35. The plots indicate that there is not a strong relationship between the length and width of the fourth deciduous premolar, which limits its usefulness in establishing whether the proportion of overall larger, more robust individuals increases. Despite this there appears to have been no obvious temporal fluctuation in the size of individual animals, which suggesting there was no deliberate breed improvement or decline in husbandry practices.

### **Humerus:**

Figure 134 plots the shape indices for the humerus trochlea: Phase T-V based on five cases; Phase W on 28; Phase X on one; Phase X-Y on nine; Phase Y on 26; Phase Y-Z on 14; Phase Z on 45. A linear relationship exists between 'BT' and 'HTC' measurements, which indicate that there is a direct correspondence between the width and height of the trochlea. Regardless of size the overall shape does not fluctuate considerably, and shape does not appear to alter over time. This may imply that the *Viroconium* sheep derived from the same breeding populations, and were not subject to selective breeding to improve meat yield etc. The plots for Phases Y-Z and Z indicate that a greater number of larger individuals were present than there were in Phases T-V, W, X, X-Y and Y. If unimodal distribution suggests a single population and there is no apparent change in overall shape then this may be seen as further evidence for a greater number of rams being present in the later phases.

### **Tibia:**

Shape indices were created for the distal tibia by plotting width against depth (Figure 135): Phase T-V based on four cases; Phase W on 40; Phase X on two; Phase X-Y on 16; Phase Y on 23; Phase Y on 21; Phase Z on 44. A strong linear relationship between 'Bd' and 'Dd' is immediately apparent. This indicates that regardless of size overall shape does not change. Tibia measurements provide the same overall pattern/trend to that noted for the humerus (see above): Phase Y and especially Phase Z contain a greater number of larger individuals, which are conceivably rams.



### **Astragalus:**

Figure 136 displays the shape indices for the astragalus: Phase T-V based on one case; Phase W on 26; Phase X on one; Phase X-Y on nine; Phase Y on 28; Phase Y-Z on 15; Phase Z on 34. Measurements 'GLI' and 'Bd' demonstrate a strong relationship to one another. Overall, a similar range of measurements occurred in each phase, which indicates no change in size occurred over time. However, as with the humerus and tibia plots, there is an indication that the later phases contain a greater number of larger individuals. This is especially apparent in Phase Z where there is a distinct cluster of larger, more robust, individuals standing apart from the majority of smaller, more gracile, individuals. Unlike some of the other biometrical analyses, which indicate approximately equal proportions of ewes and rams (see above), this implies that even in Phase Z ewes greatly out-number rams.

#### **9.7.4. Log ratios: Inter-site comparison**

Many of the measurements taken from the *Viroconium* sheep produced relatively few cases, and this combined with the fact that analogous assemblages generally produce small numbers of comparable measurements, means that analysis of individual measurements is often impossible or of little interpretive value. To counter this, the log ratio method of Simpson *et al.* (1960: 356-358) has been employed (see Chapter 3). Phase W (late 4<sup>th</sup> – mid 5<sup>th</sup> century AD) *Viroconium* sheep measurements were adopted as the standard (see Chapter 3): represented by '0' in the plots.

### ***Viroconium*:**

Phases T-V and X generally provided too few cases to be of any interpretative value.

**Width:** Figure 137 displays the log ratios for the combined baths basilica width measurements. For the combined width measurements, Phase T-V produced 16 cases, Phase W 144, Phase X seven, Phase X-Y 52, Phase Y 117, Phase Y-Z 77 and Phase Z 203. The width log ratios demonstrate that there was no diachronic change in stature of the *Viroconium* sheep. With exception of Phase Z (see below), each phases demonstrated a unimodal normal distribution, which may indicate that approximately equal proportions of ewes and rams were present within the population. Phase Z is positively skewed. An outlier, with a value of 0.12, does not appear to be responsible for the observed pattern, therefore it may be seen as confirmation that the proportion of males increased in Phase Z and presumably indicates a change in the husbandry practices being conducted at *Viroconium*.

**Length:** Figure 138 displays the log ratios for the combined baths basilica tooth length measurements, based on the following number of cases: Phase T-V two; Phase W 21; Phase X one; Phase X-Y 16; Phase Y 54; Phase Y-Z 23; Phase Z 106. Length log ratios confirm that there is no overall diachronic size increase or decrease and that in Phase Z there is a definite increase in the proportion of larger specimens in the sample. Phase Z provides a positive skewness value, although there is no indication of a gradual shift in the preceding phases.

**Depth:** Figure 139 displays the log ratios for the combined baths basilica post-cranial depth measurements, based on the following number of cases: Phase T-V one; Phase W six; Phase X-Y five; Phase Y 19; Phase Y-Z 14; Phase Z 54. As with width and length log ratios, depth log ratio values demonstrate a static size range, which implies no diachronic variation, and an increase in the proportion of larger individuals in Phase Z. In addition, Phase Y-Z also demonstrates a similar shift. Both phases provide strong positive skewness value of 2.46 and 3.95 respectively. Remembering that a skewness

value of more than twice its standard error denotes skewness, these values are significant and considerably higher than those noted for the other components of the Phase Z biometrical analyses. This may imply that there was a slight change in the robusticity of the population, although whether this represents an overall change in the shape of sheep at *Viroconium* or simply confirms the presence of more rams is debatable (see below).

#### **Colchester:**

Figures 140-142 display the log ratio values for the Colchester sheep width, length and depth measurements respectively (see Chapter 7, for phasing summary). Each has provided enough cases per phase to provide a valid comparison with the baths basilica dataset. The log ratio values from all three axes fall into a similar range to that produced for *Viroconium*, although this is where the similarity ends. What is readily apparent is that even the Period 6 (1<sup>st</sup> – 3<sup>rd</sup> century AD) population is significantly larger than the *Viroconium* sheep population. The Period 7 (3<sup>rd</sup> – 4<sup>th</sup> century AD) and Period 8 (4<sup>th</sup> – 5<sup>th</sup> century AD) populations are considerably larger. Luff (1993: 131) interprets this as deliberate breed improvement, possibly using continental imports. Therefore, it may be argued that the *Viroconium* sheep were very much an unimproved indigenous type that remained essentially unaltered throughout the Romano-British period and beyond (see below).

#### **Elms Farm:**

Figures 143-145 display the log ratio values for the Elms Farm sheep width, length and depth measurements respectively (see Chapter 7, for phasing summary). Each has provided enough cases per phase to provide a valid comparison with the baths basilica dataset. Elms Farm demonstrates a similar pattern to that observed from Colchester, although perhaps more clearly. Period II (the Iron Age Romano-British transition) contained a sheep population comparable in size and shape to those from *Viroconium*. The 1<sup>st</sup> – 2<sup>nd</sup> century AD (Period III) assemblage demonstrates the presence of a small group of larger individuals, especially in the width and depth log ratio plots. Johnstone & Albarella (2002: 29) suggest that these individuals represent continental imports; presumably rams. There is then a statistically significant increase in the size of the Period IV (2<sup>nd</sup> – 3<sup>rd</sup> century AD) sheep population, which continued into the 4<sup>th</sup> and 5<sup>th</sup> centuries AD (Periods IV-V and V-VI). The Elms Farm sheep confirm the interpretation that the *Viroconium* sheep are an unimproved indigenous type.

#### **Lincoln:**

Figures 146-148 display the log ratio values for the Lincoln sheep width, length and depth measurements respectively (Dobney *et al.* 1996: 176-191, Appendix 1; see Chapter 7, for phasing summary). The size and shape of the 3<sup>rd</sup> and 4<sup>th</sup> century AD sheep populations at Lincoln appear to remain static, notwithstanding a possible slight downward shift in width log ratio values. Overall, they are consistently larger than the *Viroconium* sheep. The Lincoln sheep fall within the same size and shape range as their improved contemporaries from Colchester and Elms Farm. This might suggest that deliberate breed improvement had already taken place at Lincoln.

#### **Six Dials:**

Figures 149-150 display the width and length log ratio values for Six Dials (see Chapter 7, for phasing summary). Six Dials has been included because of the possibly analogy between *Viroconium* and Saxon Southampton (see Chapter 2): the control of resources and modes of urban supply. Both the width and length log ratio values demonstrate that sheep were consistently larger than their counterparts from

*Viroconium*; the smallest Six Dials sheep were the same size as the Phase W standard. Further more, the width and length log ratio distributions from Six Dials would suggest approximately equal proportions of female and male animals.

## 9.8. Discussion

### 9.8.1. Sheep/goat ratios

The baths basilica assemblage provided an average of almost 14 sheep to one goat, with a possible diachronic increase in the frequency of goat in the latter phases of activity (see Chapter 6). Inter-site comparison in Chapter 6, might suggest that the frequency of goats may be very site specific and no broad trends are presently evident, other than goat bones appear in small numbers at almost every site. Further study may reveal meaningful patterns, based on the geographical location, nature of activity etc, especially with improved morphological criteria (see Halstead *et al.* 2002) and the development of new techniques for caprinid separation, such as DNA (see Loreille *et al.* 1997).

If milk production was pursued within *Viroconium* then goats may have also been regularly kept, as reputedly they have greater milk yields and their milk was more desirable (White 1970: 315). Varro kept goats for their milk and does not mention their exploitation for meat and hair (Noddle 1994: 119). Goat's were inevitably also utilised for other products as well, for instance Diocletian's price fixing edit specifically mentions a cloak made of goat's hair: the *birrus Britannicus* (Rivet 1958: 123). Goatskins may have been an important source of leather in Romano-Britain. Reed (1972: 43) states that goat skin incorporates qualities more suited to leather production than calf, sheep or deer skin. The Roman military would have been an obvious consumer (see Noddle 1994: 119), as would have the civilian population: 29% of the leather from Billingsgate in London derived from goat (Miller & Rhodes 1980: 95, Figure 55). However, none of the butchery noted on the positively identified goat remains from *Viroconium* appeared to be associated with skinning (see below).

Accordingly, to Redding (1984: 234) mixed flocks would have actually acted as a 'buffer' against disease.

### 9.8.2. Body part distribution/disposal practices

To briefly summarise, zygomaticus arches, horncores and first phalanges consistently occurred in low numbers and taphonomy may be the causal factor. Both zygomaticus arches and horncores are generally susceptible to greater levels of post-depositional attrition. Additionally, the 'zone' use to record the zygomaticus may have been too restricting and horncores could have been transported elsewhere for craft working and processing. The latter is thought to be unlikely because the same phenomenon may have also affected the metapodials, which were actually one of the most frequently occurring body parts. Conceivably, horncores could be under-represented in the assemblage by the presence of hornless breeds of sheep, however none were observed during the recording of material and only two polled individuals were noted from the whole assemblage. The low number of first phalanges is almost certainly caused by a recovery bias (see Chapter 4).

There is little chronological variation in the range and proportions of body parts, although in the latter phases of activity (Phases Y, Y-Z and Z) there is less differentiation, which could imply changing waste disposal practices, as postulated for cattle and pig (Figures 31, 83 & 114). The highest utility body parts

(scapula, humerus, pelvis and femur) are generally less well represented than skeletal elements of lower utility (radius, tibia, astragalus and calcaneum). This may imply that joints of meat were being removed from the site, or alternatively they were subject to greater levels of processing and became more fragmented etc.

Consideration of individual deposit types within phases was rather inconclusive, principally because relatively low numbers of caprinid remains precluded their division into smaller units for analysis. However, when possible, individual deposit types generally confirmed body part distribution by phase (Figures 115-119). Several partial articulated skeletons of neonates and very young individuals could be interpreted as evidence for the presence of breeding flocks being maintained within *Viroconium* (conceivable if considered in conjunction with the ageing evidence: see below).

Both Colchester (Luff 1993: 26) and Romano-British Portchester Castle (Grant 1975: 386) demonstrate a similar pattern to that noted from the baths basilica: individuals were butchered, consumed and disposed of at the site and there was no evidence for industrial activities. Mandibles (or isolated teeth) were the most frequently occurring element at both sites and the author's interpreted this as a taphonomic signature. Exeter demonstrated a similar pattern, although metapodials were probably removed for working because very few adult metapodials were present (Maltby 1979: 53). In contrast, the 4<sup>th</sup> century Lincoln waterfront assemblage was comprised almost exclusively of primary butchery waste: cranial fragments and low utility elements (Dobney *et al.* 1996: 24).

Saxon levels at Portchester Castle demonstrated a similar pattern to that produced from the Romano-British phases, but displayed an even greater discrepancy between mandibles and the other elements (Grant 1976: 267).

### **9.8.3. Ageing**

Both post-cranial fusion and tooth eruption and wear broadly support one another (Figures 120-121). For the most part there is little chronological variation. The majority of individuals were killed before three-four years and a peak in slaughter occurred between one-three years of age. This implies that the principle husbandry motivation centred on meat production: individuals surplus to maintaining a viable breeding flock were killed before they reached breeding age, but after they provided one, and in some cases possibly two, wool clips. The presence of very young individuals at the baths basilica killed between two-six months (mandible wear stage B) may imply that a breeding population of sheep were actually located within *Viroconium*, and that surplus lambs were killed to make available ewes milk for human consumption. This possibility gains credence when the articulated neonate lamb burials are considered (see above). The mortality curve generated by the Phase X-Y tooth data could imply wool production; however it is based on a relatively small sample. It, therefore, does not necessarily indicate a departure from the principle meat mode of production pursued at *Viroconium*.

The pattern noted from the baths basilica data would seem to mirror those from other Romano-British urban centres. Colchester in the 3<sup>rd</sup> – 4<sup>th</sup> centuries AD demonstrated an increase in the proportion of young individuals from that noted in the 1<sup>st</sup> century AD, which suggested peak slaughter between 3-6 years. This change seemed to have occurred in the immediate post-Boudican period (Luff 1993: 70-71, Figure 4.28). Luff (1993: 70) concluded that sheep at Colchester were being exploited generally for

lamb, wool, milk and mutton. Presumably the shift towards younger individuals indicates an increasing emphasis on meat production.

Maltby (1979: 42-43, 173, Table 71) noted very little chronological variation in the Romano-British phases at Exeter. Epiphyseal fusion indicated that between 61-70% of sheep were slaughtered before 36-42 months. Teeth, however, demonstrated a peak between approximately 15-26 months. This discrepancy was thought to be taphonomic in origin; younger and less dense post-cranial elements were subject to greater post-depositional destruction. This mortality pattern was interpreted as the culling of surplus individuals in their second year between autumn and winter, partly to conserve fodder for breeding stock. The later medieval age-at-death profile demonstrated a shift: 69-82% of sheep were slaughtered pre- 36-42 months (Maltby 1979: 43, 177, Table 75).

Fourth century AD Lincoln demonstrated a similar pattern. Individuals were slaughtered at every age, although there was a distinct peak between the ages of 2-4 years (Dobney *et al.* 1996: 39, 143, Table 33, 102, Figure 52a-b). As with Exeter, Lincoln demonstrates a discrepancy between the profiles generated from mandibles and those from post-cranial fusion. Notwithstanding possible taphonomic reasons, such as the under-representation of young mandibles, and the supposition that whole carcasses were present, Dobney *et al.* (1996: 39) suggested post-cranial skeletal maturity may have taken longer in primitive breeds. Epiphyseal fusion would also have been influenced by castration (see Hatting 1983).

The small-town (and temple site) at Elms Farm also produced mortality profiles suggesting that sheep were predominantly utilised for their meat. Three-quarters of sheep in all periods, except Period III (1<sup>st</sup> – 2<sup>nd</sup> century AD), were slaughtered between 2-3 years. However, because slaughter was occurring beyond the point maximum body weight was reached secondary products were also being routinely exploited (Johnstone & Albarella 2002: 27, 74-75, Tables 19-20, 131, Figure 49 ). In all likelihood, rams and wethers were kept until they had produced one fleece and ewes until they had produced one lamb.

Portchester Castle in the later Romano-British period demonstrated peaks at 6 months, 1.5 years and 3.5 years and Grant (1975: 394-395, Table VIIb, 397-398, Figure 204) suggests that this may denote an autumn slaughter policy when the supply of fodder would have been problematic. However, Grant (1975: 405) concludes that it is not immediately obvious which mode of production, if any, was predominant and states that sheep would have been utilised for meat, milk and wool. Portchester Castle in the Saxon period displayed a similar shift to that noted for Exeter (see above). A larger proportion of animals were kept beyond skeletal maturity, which indicates a greater emphasis on wool production (Grant 1976: 277, Table VIIb, 278, Figure 150). The Saxon period also included far fewer very young individuals than did the Romano-British phases, and Grant (1976: 278) suggested that this may indicate the importance of milk production in the Romano-British period or possibly better husbandry practices in the Saxon period.

The General Accident site in York displayed a mortality pattern quite different from the normal Romano-British trend, which might denote high status activity when considered with the presence of garden dormouse (*Eliomys quercinus*), etc (O'Connor 1988: 119). One third of the Period 2-7 (mid 2<sup>nd</sup> – mid 3<sup>rd</sup> century AD) sample consisted of mandibles ages between two-four months and only 25 mandibles had all three molars in wear (O'Connor 1988: 85, Table 23, 88). This could be an exemplified case of the trend already noted from other sites, whereby very young lambs were being deliberately killed to foster the production of ewe's milk for human consumption.

The overall trend for urban Romano-British sheep exploitation is meat production, although there is some variation in mortality profiles between sites. Methodological reasons may be part responsible, as myriad different techniques are employed to re-create slaughter patterns (see Chapter 3). Differences in mortality profiles may be due to 'market forces': if meat demand were high younger animals would have been slaughtered. However, as Maltby (1979: 46) pointed out, the high immature slaughter noted from most urban centres would have been impossible to maintain and points to clear evidence of consumer markets being supplied from their hinterlands. The presence of neonates and very young lambs also points to flocks being kept with towns. Perhaps small numbers of animals were being kept within towns for the supply of milk; Columella (*De Re Rustica* VII 3.13; Forster & Heffner 1968: 247) recommended taking lambs from their dams to encourage lactation.

#### **9.8.4. Sexing**

Determining sex ratios from the pelvis was rather inconclusive (see above). However, more success was achieved through biometrical separation of the metapodials. Both the metacarpals and metatarsals provided an approximate ratio of three and a half ewes to one ram (Figures 122-123). There appears to very little comparable data from contemporary sites, although the ratio from *Viroconium* is broadly consistent with a meat based husbandry strategy.

#### **9.8.5. Butchery**

Between 6-11% of the sheep assemblage from the baths basilica site displayed butchery evidence (Table 94). This represents a lower frequency than the corresponding cattle assemblage. As with the frequency of butchered pig remains, this may simply reflect the lesser degree of processing small carcasses would require. Butchery marks were mostly chops with a lesser proportion of cut marks and virtually no saw marks (Table 95). Phase Z demonstrates a significant increase in the frequency of cuts marks. This is unlikely to represent different techniques being required to butcher larger carcasses, as postulated for a similar trend noted for the cattle (see Chapter 7). Because the same trend was also noted for the pig assemblage it may represent a 'cultural' trend.

When butchery marks were categorized they mostly derived from dismemberment with lesser proportions of filleting, whilst no skinning marks were detected. However, the majority could not be placed and consequently fell into the 'other' category (Table 96). In conjunction with body part representation this implies that primary dismemberment was taking place at the site. The lack of filleting suggests that the majority of meat was being eaten off the bone. All the marks that were placed into the 'other' category may reflect variation in technique.

A similar pattern was noted for the Colchester sheep, although Luff (1993: 26) suggested the majority of knife marks related to dismemberment, rather than meat removal. Exeter displayed a comparable range of butchery evidence, although the shafts of long bones were often chopped and quite fragmented, which could imply marrow extraction (Maltby 1979: 53). No specific evidence for this was noted at *Viroconium*. Cut marks located around joint peripheries at Lincoln indicated butchery relating to dismemberment (Dobney *et al.* 1996: 28). No chronological variation was noted between the Romano-British and Saxon phases at Portchester Castle, other than in the Saxon phases when long bones began to be split longitudinally using a heavy-bladed implement (Grant 1975: 393 & 1976: 273). None of the analogous sites appear to demonstrate the same increased knife-use observed at the baths basilica.

### 9.8.6. Biometry

Biometrical separation of sheep and goat, using the metacarpal, calcaneum and metatarsal, generally confirmed the morphological identifications (Figures 124a-126b).

The consideration of individual measurements (see above) to assess any possible chronological fluctuation in the size of sheep and to infer possible sex structures of the population demonstrated the same overall pattern regardless of skeletal element (Figures 127-132). For each measurement a unimodal distribution is apparent, which suggests that all the sheep supplied to *Viroconium* were of the same type. The size of sheep from *Viroconium* remains static throughout the period of activity at the baths basilica site. This would imply that husbandry practices remained unchanged between the 3<sup>rd</sup> and 7<sup>th</sup> centuries AD; the sub-Roman period was not characterized by an agricultural systems collapse. The later phases at the baths basilica, especially Phase Z, display more positively skewed profiles that indicate an increased number of larger individuals. This has been interpreted as an increase in the proportion of rams, which implies that the utilisation of sheep in the region was changing and/or the supply mechanisms between *Viroconium* and its hinterland was changing. This mirrors a similar trend noted for the cattle assemblage.

The pattern outlined above is supported by the shape indices (Figures 133-136). The size of individual sheep remained constant throughout the period of activity at the baths basilica and the later phases demonstrate an increase in the proportion of larger and more robust individuals (presumably rams). Also apparent from the shape indices is that the proportion of ewes still greatly outnumbered the proportion of rams. The assumption that a normal distribution of individual measurements represents an approximately equal sex ratio may therefore be incorrect (see above).

Width, length and depth log ratio values from *Viroconium* confirm that the overall size of sheep remain static between the 3<sup>rd</sup> and 7<sup>th</sup> centuries AD (Figures 137-139). They also confirm the skewness of the later phases, especially Phase Z. Compared to log ratio values for Colchester and Elms Farm (Figures 140-145), where good evidence for deliberate breed improvement probably using continental imports (see above), the *Viroconium* sheep appear to be a standard unimproved indigenous type. Breed improvement using imported stock was also postulated at the General Accident site in York (O'Connor 1988: 98, Figure 14) and at Lincoln between 3<sup>rd</sup> and 4<sup>th</sup> centuries AD, although in the latter case the use of imported stock was thought to be unlikely (Dobney *et al.* 1996: 41).

Both O'Connor (1988: 98) and Maltby (1979: 51) suggest that Romano-British sheep from the General Accident site, York, and Exeter respectively are comparable to modern Soay sheep. In the case of York, the smallest Romano-British sheep were the equivalent to a Soay ewe, weighing around 45kg, which is above the average of a modern Welsh Mountain ewe, but below both Swaledale and Herdwick (O'Connor 1988: 98).

There is a slight size increase in the size of sheep between Romano-British and medieval phases at Exeter and unimodal distributions imply single populations, which would imply continual breed improvement, rather than imported breeding stock (Maltby 1979: 49 & 51). No such size increase is apparent at *Viroconium*, therefore the Romano-British – medieval shift may have occurred after the 7<sup>th</sup> century AD.

## 10. Other domesticates

### 10.1. Equids

#### 10.1.1. Species distinction

The baths basilica assemblage produced very small numbers of equid remains: 102 NISP (Table 30) and 98 MNE (Table 31). It was only possible to positively identify three horses (*Equus caballus*) from the assemblage: Phase X-Y (ID 12763 Context D81), Phase Y (ID 9939 Context D762) and Phase Z (ID 11168 Context D473). This small proportion is probably a reflection of the criteria used for species separation, the shape and extent of penetration of the buccal enamel fold on *in-situ* permanent mandibular dentition (Davis 1980 & 1987).

#### 10.1.2. Anatomical representation

Table 103 outlines anatomical element MNE frequency data by chronological phase (calculated from 'horse' and 'equid' NISP). Because of the small number of cases it has only been possible to comment on body part distribution for Phase Z. All body parts were represented, which would suggest whole carcasses and/or live animals were present at the site. No articulated specimens were noted.

#### 10.1.3. Ageing

Table 104 details the post-cranial epiphyseal fusion data by anatomical element and chronological phase. To summarise, the vast majority of individuals from any phase were adult: ranging from 86% to 93%. The remainder were all sub-adult animals. No specimens were very young or neonatal.

#### 10.1.4. Butchery

Very few instances of butchery were observed. Butchery was recorded on scapula, humerus, pelvis, tibia and metatarsal. With the exception of a sawn metatarsal from Phase X-Y (ID 15208 Context D81) all butchery took the form of chops and cuts. Most of this butchery did not relate to a specific stage in the carcass reduction process. A Phase Z tibia (ID 19489 Context C78) had been split axially.

#### 10.1.5. Discussion

Equids other than horse appear to have been rare in Roman Britain and totally absent in the pre-Roman Iron Age (Armitage 1979; Baxter 1998: 5). In all likelihood, the baths basilica equid assemblage exclusively represents horse. The absence of very young and neonatal specimens would suggest that horse breeding was not taking place at the baths basilica.

Roman attitudes towards hippophagy appear to have been rather ambiguous. According to Simoons (1994: 187) the 'Romans' (those from the Italian peninsula) were disgusted by the thought of eating horsemeat. The horse was to a degree revered in Roman culture: the white horse was symbolic of the power of Jupiter, horses were sacrificed to Mars and Caesar dedicated herds of horses to the Rubicon by releasing them on its banks to bless the crossing of the legions (Simoons 1994: 182-183). Horses were also incorporated into Roman burial practices, as offerings (see Lauwerier & Hessing 1992; Lauwerier 1986). Lauwerier (1988: 162) suggested horse butchery denoted horse-flesh being fed to dogs, rather than for human consumption. Similar interpretations have been fostered for Romano-Britain assemblages, such as Elms Farm, Essex (Johnstone & Albarella 2002: 34). This may also be the case for



*Viroconium*. In addition, the presence of a sawn metatarsal and split tibia could indicate bone working and marrow extraction respectively.

Equid specimens produced too few measurements to enable any meaningful analysis. Equid measurements are detailed in Appendices 44-52.

## 10.2. Dog

### 10.2.1. Species distinction

No published morphological criteria to distinguish between dog (*Canis familiaris*), red fox (*Vulpes vulpes*) and wolf (*Canis lupus*) are presently available (see Chapter 3). Purely subjective criteria have, therefore, been employed. Initially physical size was used as an indicator, followed by comparison with reference material. The following number of identifications was derived at when the material was originally recorded (NISP combined for all phases; Table 30):



This section combines specimens identified as 'dog' and 'cf. dog'. In addition, it was decided to include specimens initially recorded as 'cf. wolf' in this section (see Chapter 11). Therefore, this section is based on a total NISP of 331. For convenience they have been referred to as 'dog' throughout the narrative. Those fragments identified as either 'red fox', 'cf. fox' or 'dog/fox' have been excluded (see Chapter 11).

### 10.2.2. Anatomical representation

Table 105 outlines anatomical element MNE frequency data by chronological phase (calculated from 'dog', 'cf. dog' and 'cf. wolf' NISP). Phases T-V and X produced too few cases to be reliable indicators. In Phases W, X-Y, Y, Y-Z and Z all body parts are present, notwithstanding the zygomatic arch. The lack of zygomatic arches is probably taphonomic in origin, as noted for other species from the baths basilica assemblage. Very few semi-complete dog skulls were noted from the assemblage and when present the zygomaticus had generally broken off. The range of body parts confirms that whole carcasses were present. In the case of dog, this almost certainly indicates that live animals were present. Mandibles were the most numerous skeletal element in any phase, excluding Phase X, which can be discounted. The girdle-bones were generally the next most numerous category, which were followed by fluctuating frequencies of lower limb bones. This pattern also suggests a taphonomic signature compounded by a recovery bias. The mandible, scapula glenoid cavity and neck and the pelvic acetabulum are perhaps the most durable parts of the dog skeleton. Dog long bones tend to fragment fairly easily and lower limb elements, namely the astragalus, calcaneum, metapodials and first phalanges, will have been subject to differential recovery.

It is normally assumed that the majority of dog bones will have been buried as articulated skeletons. However, very few articulated body parts were recovered from the baths basilica: only 24 of 331 'countable' elements. Only three partial skeletons were noted, interesting they all came from Phase Y, although there is no obvious explanation for this. Context 318 produced a right mandible, left mandible, left scapula and left humerus (ID 2028, 2029, 10509 and 10510), Context 329 produced a right mandible,

left mandible, left humerus, left radius, right pelvis, right femur, left tibia and two left metatarsals (ID 10421, 10422, 18409, 18410, 18411, 18412, 18413, 16819 and 16820 respectively) and Context 338 produced a left and right pelvis, plus a right femur (ID11505, 11506 and 11507). Considering the taphonomic signature noted for overall body part distribution, it is likely that many of the dog remains were initially buried as articulated skeletons in pits and other discreet features, but were subsequently disturbed and re-deposited; hence the lack of craniums and fragmentation of the long bones, etc.

### **10.2.3. Ageing**

Table 106 details the post-cranial epiphyseal fusion data by anatomical element and chronological phase. To summarise, only a very small proportion of dog bones derived from skeletally immature individuals: just over three percent of the entire dog assemblage. A small number of neonatal/very young specimens were recorded. Immature specimens, and especially neonatal or very young specimens, are likely to be under-represented in the assemblage, due to taphonomy and recovery bias. Mandibular tooth wear indicates that many individuals must have reached old age, due to the severity of wear, for instance one individual from Phase X-Y (ID 14399 Context D81) had an first molar that was worn down to the roots.

### **10.2.4. Butchery**

Four specimens demonstrated butchery evidence: a scapula from Phase X-Y displayed cut marks (ID 10388 Context D210), a mandible from an exceptionally large individual (see below) from Phase Y displayed a heavy cut mark/light chop mark (ID 19469 Context 216), another mandible from Phase Z displayed a cut mark (ID 337 Context 332) and a pelvis from Phase Z demonstrated a knife mark (ID 14447 Context D108). All specimens were from adult individuals. Butchery to mandibles could imply that some carcasses were skinned.

### **10.2.5. Biometry**

The dog assemblage from the baths basilica produced a small biometrical dataset (Appendices 53-58). Due to the great range in the size and shape of Romano-British dogs (see below) it is not pertinent to pool these measurements using the log ratio technique. Therefore, a consideration of chronological variation and inter-site comparison has been attempted by using estimated shoulder heights and individual measurements, where the number of cases permitted. Unfortunately, due to the lack of complete craniums from the baths basilica assemblage it has not been possible to calculate the cephalic, snout or snout width indices of Harcourt (1974: 153-154).

The mandibular carnassial tooth (first molar) produced the greatest number of cases for any single body part. Figure 151 plots first molar length against width, annotated by phase. As with the estimated shoulder heights, all the first molar lengths fall within the ranges outlined by Harcourt (1974: 166, Table 11 & 171, Table 14): Romano-British 15-25.5mm and Anglo-Saxon 19-25mm. Determining chronological variation in the size and shape of animals is rather inconclusive, due to the rather low number of cases, especially from Phases T-V, W and X-Y. No apparent size increase or decrease can be observed and than range of animals appears evenly distributed in every phase. The largest degree of variation occurs in Phase Y. Phase Y includes the two smallest individuals, which measure 15.4 by 5.5mm (ID 14936 Context D216) and 15.7 by 5.7mm (ID 10357 Context A318). The majority of measurements from Phase Y cluster together in the upper range. This, therefore, indicates at least two types of dog were present in the 6<sup>th</sup> century AD.

Also present in Phase Y was one exceptionally large individual, measuring 31.6 by 12.2mm (ID 19469; Context D216). This first was situated in mandibular bone, but unfortunately no additional teeth or alveoli were present because of the level of fragmentation. As this specimen was significantly larger than the usual range for either Romano-British or Anglo-Saxon dogs (as above) the corresponding teeth were measured from the wolves (*Canis lupus*) in the University of Sheffield reference collection: Specimen 03 right first molar length = 28.0mm width 11.3mm and left first molar length = 28.3mm width = 11.3mm; Specimen 0908 right first molar length = 28.4mm width = 11.2mm. The Sheffield specimens may not be wholly representative, being southern Mediterranean examples. North western European wolves may have been considerable larger (Keith Dobney pers. comm.). The baths basilica specimen may require re-evaluating in future.

Although it has not been possible to generate any of the cranial shape indices (see above), it has been possible to consider muzzle length by using various measurements from the mandibular tooth row. Figure 152a-c plots first premolar – third molar length against first-third molar length, first premolar – third molar length against first-fourth premolar length and second-fourth premolar length and first-fourth premolar length respectively. What is apparent is that regardless of chronological phase or size of the individual the ratio between either the length of the premolar or molar row and the complete tooth row remains static. Only when the distance between the first premolar and remaining premolars is considered does a slight variation appear. A small number of mandibles in the mid-size category demonstrate that the second-third premolar and fourth premolar are proportionally smaller or, in all likelihood, more crowded together.

Using the multiplication factors of Harcourt (1974: 154) for humerus, radius and tibia greatest length (GL) measurements estimated shoulder heights have been calculated (Figure 153). Only 13 long bones produced measurements, so analysis of canine diversity over time at *Viroconium* has been precluded and the measurements have, therefore, been pooled into one group. What is apparent is that the range of estimated shoulder heights from *Viroconium* fall within the range expected for Romano-British dogs noted by Harcourt (1974: 166, Table 11): 230-720mm. When mean values are considered a different picture emerges. From the baths basilica assemblage humerus, radius and tibia measurements mean values were 122mm, 161mm and 91mm, whereas Harcourt's (1974: 166, Table 11) means were 137mm, 135mm and 150mm respectively. This discrepancy probably derives from the small number of cases used to generate the *Viroconium* means. Based on Harcourt's (1974: 171, Table 14) survey Anglo-Saxon dog measurements are on average approximately 30mm larger than their Romano-British forbearers.

#### **10.2.6. Non-metric traits**

Table 107 outlines the range of non-metric conditions encountered in dog mandibles. The aetiology of these absent teeth is congenital and probably exaggerated by selective breeding (see Chapter 7). These conditions appeared to be randomly spread across the range dogs noted at *Viroconium*; only one 'house' or 'lap' dog (see below) was affected: ID 10357.

#### **10.2.7. Discussion**

Body part distribution (Table 105) indicates that all skeletal elements are represented in each phase (notwithstanding Phases T-V and X, which contain too few cases to be reliable), with the exception of the zygomaticus. This implies that whole carcasses and/or live animals were present. Mandibles, scapulae

and pelvis are generally the most frequently occurring body parts. The least abundant elements were usually the lower limb elements and especially the first phalange. This pattern suggests a taphonomic and recovery bias signature; skulls and zygomatic arches are usually absent, despite the abundance of mandibles; the girdle bones are reasonably durable; the long bones fragment fairly readily; the lower limb elements are small and often missed during excavation. Only three partial skeletons were recovered (see above). Overall, dog body part distribution could indicate that the assemblage represents disturbed and re-deposited articulated burials for the most part.

A similar situation emerges from many other urban centres. At Exeter only 22 of 91 fragments from Romano-British levels derived from partial skeletons and only 27 of 69 fragments from medieval deposits (Maltby 1979: 62). No articulated skeletal elements were recovered from Lincoln (Dobney *et al.* 1996: 46). Conversely, most dog remains from Colchester were whole or partial skeletons (Luff 1993: 134), although the various Colchester sites produced various instances of specialised deposition, for example one mid 3<sup>rd</sup> – 4<sup>th</sup> century AD pit produced two dog skeletons, one piglet skeleton and cat and bear remains. Elms Farm produced mostly articulated skeletons (Johnstone & Albarella 2002: 36, Tables 4-5).

The vast majority of dog remains were adult. Immature individuals may be slightly under-represented due to taphonomic and recovery bias, however. Neonatal/very young and old individuals were noted. It is logical to assume most animals would have been kept into adulthood if they were pets or working dogs (see below); immature specimens are therefore likely to denote natural mortality.

Only four fragments displayed any evidence of butchery, including the exceptionally large mandible from Phase Y (see above). The butchered elements (two mandibles, a scapula and a pelvis) could indicate that dogs were occasionally skinned and dismembered at *Viroconium*. It is not inconceivable that dogs at the end of their working lives were skinned and their hides used for leather. In the medieval and post-medieval periods, dog skins were often employed in leather production by the whittawyer/tawyer (Cherry 1991: 299; Thomson 1981: 171). Butchery marks to scapulae and pelvis imply that dismemberment was taking place. Therefore, *Viroconium*'s inhabitants may have periodically consumed dog meat. In this respect, it may be significant that all the butchered specimens derive from the later phases of activity at the baths basilica, predominately Phases Y and Z.

Harcourt (1974: 171) suggests that if dog meat was utilised then it was not necessarily essential to dismember the carcass; the carcass could be suspended, probably by the hind legs, and the flesh stripped off. However, the butchered pelvis from the baths basilica implies this method was not pursued at *Viroconium*. Harcourt (1974: 171) states that the position of any articulated remains could be used to determine whether muscles had still be attached, although it has not be possible to explore this at the baths basilica. A small number of Romano-British and medieval dog remains from Lincoln displayed butchery evidence consistent with skinning and de-fleshing (Dobney *et al.* 1996: 46-47). No butchery evidence was noted on any of the dog remains from Exeter (Maltby 1979: 63).

The Romano-British period saw an expansion in the diversity of canine size and morphology; characterized by the appearance of dogs smaller and larger than any previously known (Harcourt 1974: 164). This range of canine diversity, and its significance, was later confirmed by the research of Clark (1995: 17 & 2000: 168). As demonstrated above, the size of the carnassial teeth (Figure 151) and

estimated shoulder heights (Figure 153) demonstrates that the *Viroconium* dog population fall with the expected range (23-72 cm), with the exception of one exceptionally large first molar (see below).

Perhaps the most significant aspect of Romano-British canine variability was the appearance of the 'lap' or 'house' dog. Harcourt (1974: 164) stated that these dogs that were too small to serve any useful purpose and would require human 'protection'. Table 108 outlines the specimens considered to denote miniature or 'lap' dogs when the material was initially recorded.

Due to the level of fragmentation very few measurements were produced by this sample; measurements were exclusively from the first molar. When plotted with the other dog first molar measurements they clearly fall into the smallest size category (Figure 151). All the proximal femur specimens demonstrated a larger than normal greater trochanter, which is characteristic of small robust dogs (Terry O'Connor pers. comm.), which contradicts the gracile appearance of the typical 'house' or 'lap' dog. Perhaps these individuals were more terrier-like and were not purely non-utilitarian animals.

More recent research by Clark (1995: 13 & 17) indicates that 'house' or 'lap' dogs were particularly prevalent in the 4<sup>th</sup> and 5<sup>th</sup> centuries AD. Therefore, the evidence from the baths basilica suggests that this trend continued into the 6<sup>th</sup> and 7<sup>th</sup> centuries AD. A specimen with an estimated shoulder height of only 21 cm was identified from Colchester (Luff 1993: 135), specimens of 31 cm and 34 cm from Exeter (Maltby 1979: 63) and Elms Farm produced one of 25 cm from a tibia with 'typical' small dog curvature (Johnstone & Albarella 2002: 37). The miniature dog phenomenon may have been a predominantly urban one, although the work of Cram (2000) suggests they were spread over a range of settlements, including military sites. The concept of keeping an animal for purely non-utilitarian reasons is complicated (see Serpell & Paul 1994), but perhaps involved an aspect of social status in late Romano-British – early medieval Britain.

The exceptionally large mandibular carnassial tooth from Phase Y (ID 19469 Context D216) falls outside the range noted by Harcourt (1974: 166, Table 11): 15-25.5mm (Figure 151). Individuals falling outside Harcourt's (1974) range, both larger and smaller, have also been noted from other sites, for example Lincoln (Dobney *et al.* 1996: 47). As stipulated by Clark (2000: 167), the length of the carnassial tooth is of limited use when considering relative overall size, and premolar and molar teeth row lengths may be more reliable indicators. Unfortunately, as previously outlined, the baths basilica specimen essentially consisted of an isolated first molar with a small mandible fragment attached to it. Its length of 31.6mm falls well outside Harcourt's (1974: 166, Table 11) first molar range: 15-25.5mm. As argued above, if the wolves in the Sheffield reference collection are typical, then the *Viroconium* specimen presumably represents a large hunting-type dog; something akin to a modern wolf- or deer-hound.

The mandibular non-metric traits follow no observable pattern and, therefore, cannot be associated with any particular 'type' of dog. However, absent and reduced premolar and molars are, in all likelihood, a result of the conscious inter-breeding of dogs to foster particular physical traits and behavioural characteristics.

### 10.3. Cat

A small number of cat remains were recorded from the baths basilica: 65 NISP (Table 30) and 62 MNE (Table 31). Most anatomical elements were represented. The majority were from adult animals, although some immature individuals were also present. Only one very young specimen was recorded, a complete

humerus from Phase Z (ID 4631 Context D332). This may well reflect a recovery bias (see Chapter 4). Three specimens demonstrated butchery evidence: an astragalus (ID 10751) and calcaneum (ID 10753), probably from the same individual, from Phase Y Context D1332, and a femur from Phase Z (ID 656 Context D331). All were cut marks. The marks on the astragalus and calcaneum could denote skinning. Several other probable articulated specimens were recorded: a mandible, humerus and scapula (ID 10198 and 10204-102050 from Phase T-V Context D1005, a humerus and two metacarpals (ID 6628-6630) from Phase Z Context D100 and a femur and tibia (ID 12032-12033) from Phase Z Context D305. All were immature. The presumably they represent natural mortalities because no trauma or butchery was noted.

## 10.4. Domestic fowl

### 10.4.1. Species distinction

Using the morphology of the scapula, carpometacarpus, femur and tarsometatarsus to distinguish between chicken (*Gallus gallus domesticus*), Guinea fowl (*Numida meleagris*) and pheasant (*Phasianus colchicus*) the following identifications were made (NISP combined for all phases; see Table 30):

- chicken 34 (6%)
- chicken/Guinea fowl 27 (5%)
- chicken/pheasant 111 (20%)
- chicken/Guinea fowl/pheasant 376 (69%)

The low number of positive identifications is unsurprising, due to the close similarities between the taxa involved and the criteria used on each element (see Chapter 3). Conceivably, all three were present at *Viroconium*; however in all likelihood the vast majority of fragments derive from chicken because of the urban setting (see below). All the remains have been considered together and are referred to as ‘chicken’ for convenience.

### 10.4.2. Anatomical representation

Table 109 outlines anatomical element MNE frequency data by chronological phase (calculated from ‘chicken’, ‘chicken/Guinea fowl’, ‘chicken/pheasant’ and ‘chicken/Guinea fowl/pheasant’ NISP). Phases T-V and X produced too few cases to be reliable indicators. In the larger samples, especially Phases Y, Y-Z and Z, all body parts recorded (see Chapter 3) were present. This would indicate that whole carcasses and presumably live birds were present at *Viroconium*. The distribution of body parts suggests the assemblage was not unduly affected by taphonomic or recovery biases; even smaller and more fragile elements, such as the scapula, fall within the range demonstrated by larger and more durable elements, such as the humerus and tibiotarsus. The highest utility elements tended to be the most frequently represented body parts; principally the humerus, ulna and femur. In many instances, however, the tarsometatarsus was the most frequent element. This may be partially taphonomic, but could indicate that lower hind limbs were discarded as waste prior to preparation, cooking and consumption due to their low utility.

Only one partial chicken skeleton was noted. An adult fowl consisting of a coracoid, two scapulae, a humerus, two ulnae, a carpometacarpus and a tibiotarsus was recovered from a Phase W deposit (Context E96). It displayed no butchery marks, etc, but demonstrated a new-bone growth and re-modelling on the left scapula (ID 17138) just below the articular surface. However, the condition was not so advanced that it was likely to have been the cause of death.

### **10.4.3. Ageing**

Table 110 details the post-cranial fusion data by anatomical element and chronological phase. To summarise, the vast majority of individuals from any phase were adult: ranging from 87% to 100%. Unsurprisingly, a preponderance of adult birds would indicate that the principle concern of exploitation centred on egg production and meat: notwithstanding the usual caveat that immature bones may have suffered greater levels of attrition. This would indicate that the majority of birds were at least six months old, the point at which fusion occurs (see Maltby 1979: 67).

### **10.4.4. Sexing**

Most researchers would agree that the presence or absence of a spur on the tarsometatarsus can be used to denote sex. The majority of cocks and capons are spurred, whereas only a very small proportion of hens have spurs (see West 1982 & 1985); Chapter 3). However, Sadler (1991) outlines the fact that even in spurred individuals evidence for the spurs may be absent due to developmental reasons, especially in five toed types. Figure 154a-b plots greatest length (GL) of the tarsometatarsus against proximal width (Bp) and distal width (Bd) respectively. Specimens displaying either spurs or spur scars and un-spurred individuals were annotated accordingly. What is apparent is that the majority of individuals with spurs or spur scars were physically larger than those without. This would suggest that the assumption of spurred males and un-spurred females is correct. Roughly equal proportions of male and female birds were therefore present. Capons have not been specifically considered, although it has been previously noted that occasionally they have spurs longer than cock-birds (Luff 1993: 88; West 1982). Obviously, this is dependent on the age at which castration took place (see below).

Some large individuals were un-spurred and two individuals displaying evidence of spurs were in the smallest size category: an individual with spur scar from Phase Y (ID 9288 Context 762) and a spurred individual from Phase Y-Z (ID 5932 Context D116). As capons generally produce spurs, this could be seen as evidence of at least two types of chicken being present at *Viroconium*.

Recording medullary bone was not routinely carried out, as it would have been destructive. Therefore, its presence or absence was only observable on previously broken elements. Only two instances were noted from the baths basilica assemblage: a femur from Phase W (ID 21769 Context E96) and a tibiotarsus from Phase Y (ID 1968 Context D1231).

### **10.4.5. Butchery**

Very few instances of butchery were observed. With the exception of one chopped tibiotarsus from Phase W all were cut marks. This would suggest that chicken was cooked whole and consequently required little cutting to remove the meat.

### **10.4.6. Biometry**

Many of the measurements taken from the *Viroconium* chicken produced relatively few cases (Appendices 59-63), as have analogous assemblages. To counter this, the log ratio method of Simpson *et al.* (1960: 356-358) has been employed (see Chapter 3). Phase W (late 4<sup>th</sup> – mid 5<sup>th</sup> century AD) *Viroconium* chicken measurements were adopted as the standard (see Chapter 3): represented by '0' in the plots.

Figures 155-157 display width, length and depth log ratio values from *Viroconium* by phase. Width values indicate no size increase or decrease through time and the unimodal distributions imply a single

population. This is also mirrored by length and depth values. Negatively skewed values may denote a predominance of hens: length log ratio values from Phases W, Y and Y-Z; depth log ratio values from Phase Y-Z (Table 11).

Elms Farm also produced width and length log ratio values that fall within the same range as those from *Viroconium* (Figures 158-159). As with the major domesticates from Elms Farm there is a statistically significant size increase between Periods III and IV, which has been interpreted as deliberate breed improvement (Johnstone & Albarella 2002: 38). However, even the 'improved' birds are no larger than those from *Viroconium*, which implies that if breed improvement had occurred it had already taken place. Domestic fowl from the 3<sup>rd</sup> and 4<sup>th</sup> centuries AD at Lincoln (Dobney *et al.* 1996: 196-198, Appendix 1) fall within the same size range as those from *Viroconium* when log ratios are calculated (Figures 160-161). One large individual is evident from the 4<sup>th</sup> century AD length sample, which is larger than any of those from the baths basilica (with a value of 0.11).

Figure 162 compares modern chicken breeds (Bantam, Dark dorking, Old English game bird and Silver grey dorking) and red jungle fowl (measurements provided by Umberto Albarella from specimens in the Birmingham Zooarchaeology Laboratory) to the *Viroconium* (Phase W) standard (carpometacarpus measurements not included). A specimen from Snelsetter Farm, Orkney (Keith Dobney pers. comm.) has also been included for comparison. When compared to modern breeds of chicken and their wild progenitor, the red jungle fowl (*Gallus gallus*), the *Viroconium* birds are on average the same size or slightly smaller: the smallest chickens from *Viroconium* just overlap with the red jungle fowl and the largest with the two dorking breeds. The *Viroconium* standard is fractionally larger than the bantam. This wide range may lend credence to the possibility that more than one type of chicken was present at the baths basilica.

#### **10.4.7. Discussion**

It was only possible to positively identify six percent of the galliforme remains as chicken. As both the Guinea fowl (Mongin & Plouzeau 1984: 323; Zeuner 1963: 457) and pheasant (Blank 1984: 312; Parker 1988: 203; Zeuner 1963: 458) were widely distributed across the western Roman empire neither can be definitely excluded. The classical authors were aware that the Guinea fowl derived from Africa: Columella (*De Re Rustica* VIII.2.2; Forster & Heffner 1968: 323; Varro (*Re Rusticarum* III.9.16; Hooper & Ash 1993: 471). Pliny (*Naturalis Historia* X.38; Rackham 1997: 339-341) considered it to be unpalatable. However, it is unlikely either species routinely found their way into towns, as presumably they were bred or released for hunting in rural areas. Tentative evidence for which came from the late 4<sup>th</sup> century AD villa at Barnsley Park in Gloucestershire, where 12 pheasant bones were recovered (Bramwell & Webster 1985: 96). Pheasant has also been identified at Silchester (Boon 1974: 215 & 356). Zeuner (1963: 457) states that Guinea fowl was particularly expensive and may have, therefore, been beyond the means of many people. In all probability the vast majority of the galliforme remains from *Viroconium* are chicken.

Body part distribution at the baths basilica (Table 109) is comparable to other sites: Elms Farm (Johnstone & Albarella 2002: 38), Colchester (Luff 1993: 85) and Romano-British Portchester Castle (Grant 1975: 410, Table XIII). Whilst this distribution pattern demonstrates whole carcasses were present and presumably also live birds it is heavily influenced by a recovery bias and other taphonomic processes. The prevalence of tarsometatarsii could also be taphonomic in origin, rather than from some form of



deliberate disposal practice. It has been noted that a discrepancy between wing and leg elements exists in bird skeletons; forelimb bone density and survivability is partly dependent on the flight capabilities of individual species (see Livingston 1989).

The vast majority of chicken bones from the baths basilica assemblage were adult: between 87% and 100%. This range would appear to be the norm for Romano-British urban centres, although the greater attrition of immature bone has to be born in mind. Almost 90% of chicken bones from Exeter were mature (Maltby 1979: 67, 209, Table 98) and Colchester demonstrated a range of between 73% and 98% (Luff 1993: 89, Table 5.3). Such profiles conform to the dual exploitation of chickens for their eggs and meat. Both medieval Colchester (Luff 1993: 83 & 88) and Exeter (Maltby 1979: 67) hint at the greater exploitation of chickens for their meat, as indicated by the presence of a greater proportion of immature bones.

Based on body part distribution, ageing data and the limited amount of butchery evidence (see above) the chicken bones from the baths basilica assemblage almost exclusively represent food waste. No evidence was observed, which might suggest chicken was being employed in a non-utilitarian manner. Occasionally chickens appear to have played a part in Roman ritual practices, as either sacrificial offerings at temple sites, such as at Elms Farm (Johnstone & Albarella 2002: 38) and Uley (Brothwell 1997), or as grave 'goods' (see Lauwerier 1993). Alternatively, 'tearing' bird carcasses apart at the joints is a common means of dividing them into smaller portions (see Brown 2004; McGovern 2004; Serjeantson 2004). Unfortunately, this variable was not specifically looked for in the baths basilica assemblage, so the picture of bird carcass division may be incomplete.

It has been widely assumed and satisfactorily tested that male and female birds can be differentiated by the presence or absence of a spur on the tibiotarsus, notwithstanding Sadler's (1991) cautionary note (see above). Biometrical analyses from Colchester (1993: 90), Exeter (Maltby 1979: 70), Fishbourne villa (Eastman 1971: 393), Lincoln (Dobney *et al.* 1996: 48) and the General Accident site in York (O'Connor 1988: 99) all indicate that spurred individuals are generally larger than un-spurred individuals, which have been collectively interpreted as male and female birds respectively. Although males were abundant at all sites, it would appear if hens were generally predominant. *Viroconium*, therefore, falls into the expected pattern (Figure 154a-b).

An emphasis on meat production may have led to the routine caponization of male birds (see Luff 1993: 88). Capons, however, are difficult to detect archaeologically because the age at which castration was carried out affects spur development, i.e. its presence/absence and its size and morphology. Luff (1993: 88) quotes Markham (1633), who suggested males should be caponised between 14-21 days, and Richardson (1851), who suggested three months. The former would prevent spurs from developing.

Spur removal may have been connected with caponization (depending on the age of castration). Spur removal was certainly carried out at *Viroconium*, where approximately one quarter of semi-complete tarsometatarsii demonstrated a spur scar. Varro (*Rerum Rusticarum* III.9; Hooper & Ash 1993: 471) suggested burning off the spur to cauterise the wound, as did Columella (*De Re Rustica* VIII.2.3; Forster & Heffner 1968: 325) for the Guinea fowl. Tentative evidence for this practice has been identified at Colchester (Luff 1993: 92-93, Figures 5.14-5.15); however no evidence for this practice was noted from the baths basilica material.

Bearing in mind the above discussion regarding physical size and sex, plus the effects castration may have had on skeletal development, biometrical analyses at several sites have suggested the presence of more than one breed of chicken. These sites include, Colchester (Luff 1993: 90, 97) and Fishbourne villa (Eastman 1971: 393). Due to the presence of very small-spurred individuals (see above) and larger unspurred individuals from the baths basilica assemblage it may be argued that different types of chicken were present at *Viroconium* (Figure 154a-b). The *Viroconium* chickens provided no evidence for deliberate breed improvement (Figures 155-157), which is in keeping with most analogous sites, excluding Elms Farm (Johnstone & Albarella 2002: 38) (Figures 158-159). When compared to modern breeds of chicken and the red jungle fowl, the *Viroconium* birds are on average the same size or slightly smaller. The smallest chickens from the baths basilica assemblage just overlap with the red jungle fowl and the largest with the two dorking breeds. The *Viroconium* standard is fractionally larger than the bantam (Figure 162). This may also point to various types of chicken being present at *Viroconium*.

### **10.5. Summary**

Small numbers of equids, dogs, cats and domestic fowl were recorded from the baths basilica. This situation is the norm for late Romano-British urban centres, although the equid to cattle ratio was much lower at *Viroconium* (see Chapter 6). Horse was the only positively identified equid, although the presence of donkey cannot be completely ruled out. Chicken was the only positively identified galliforme, although the presence of both Guinea fowl and pheasant is a possibility. Anatomical representation and ageing data would indicate that all were represented by live animals. Equid and dog flesh may have been consumed, but specimens probably represent working animals (and pets in the case of dogs). Unsurprisingly, domestic fowl were utilised for both their meat (both sexes were present in equal proportions) and eggs. A small proportion of equid, dog and cat remains demonstrated unsystematic butchery, some of which might relate to craft specialisation (bone working and skinning). Domestic fowl demonstrated little butchery, which might denote either carcass division by tearing or the cooking of whole carcasses. The presence of a particularly large wolf/deer-hound type dog and several robust terrier type dogs (as distinct from the 'lap' or 'house' dog) might suggest they were employed in hunting.

# 11. Wild species

## 11.1. Introduction

A wide and diverse range of wild mammals and birds were recovered and identified from the baths basilica assemblage. This level of recovery is largely due to the comprehensive, albeit rather haphazard, sampling strategy that was employed (see Chapters 3-4). Tables 30-31 list the taxa encountered by NISP and MNE respectively. Rather than discuss each in turn, only those that may have had some economic importance or are unusual in some way have been considered in relation to the research questions (Chapter 2).

## 11.2. Mammals

### 11.2.1. Deer

The recording protocol adopted for the baths basilica assemblage (see Chapter 3), in all likelihood, will have resulted in an under-representation of antler. As for cattle and sheep/goat horncores, the zone stipulated for antler was a complete transverse section and because antler would have been extensively worked few complete burrs will have been present in the assemblage. This system, as a consequence, will have also under-estimated the level of craft working at *Viroconium*. Indeed, Armour-Chelu (1997: 358-359) noted several concentrations of antler working waste from the baths basilical; dump B277 in the annexe and drain deposits of the east – west street (Contexts E74 and B277).

#### **Red deer:**

A total of 317 red deer (*Cervus elaphus*) specimens (NISP) were recorded (Tables 30). In addition, a further seven specimens were recorded as 'red/fallow deer'. For the purposes of this exercise these have been incorporated into the red deer count because they are unlikely to have been fallow deer (see below). To summarise, Phase T-V included one specimen, Phase W 14 specimens, Phase X one specimen, Phase X-Y 19 specimens, Phase Y 78 specimens, Phase Y-Z 49 specimens and Phase Z 162 specimens. Therefore, it is only possible to comment on the later phases. Most anatomical elements are represented, which would suggest that deer was hunted and the carcasses transported back to the site.

When antler is considered a different picture emerges. The majority of antler burrs recorded from the baths basilica had been shed and only two specimens were still attached to frontal bones (both from Phase Z). This would indicate the deliberate seasonal collection of shed antler, presumably for working (see above). Red deer shed their antlers in March – April (MacDonald & Barrett 1993: 202). In addition, perhaps because fully grown antler is more suitable for working adult animals would have been deliberately hunted in early spring for this resource, which would explain why the majority of animals from the baths basilica were adult. However, the presence of immature animals also indicates hunting for different reasons.

A number of long bones and cannon bones had been split axially, which may have been for marrow extraction, preparation for working or both. One scapula from Phase Y (ID 1104 Context D1332) demonstrated possible hook damage. This may indicate that venison was cured in a similar fashion to beef. The same phenomenon was noted at Chedworth villa, Gloucestershire (Hammon 2002), and the

author knows of no other instances where venison was treated in this manner. Most of the post-cranial butchery evidence relates to carcass dismembering and filleting meat from the bone.

Red deer are an indigenous species that naturally inhabit forest and woodland. Their range has, therefore, decreased with the progressive de-forestation of Britain. Red deer can adapt to open environments, as evidenced by their presence on the moorlands of northern England and Scotland today, although this change of habitat has resulted in a decrease in size (Grant 1981: 206; Staines 1991: 497; Yalden 1999: 104). This was readily apparent when comparing archaeological specimens to modern reference material.

#### **Fallow deer:**

Fallow deer (*Dama dama*) were present in Britain before the last glaciation, but had become extinct by the Holocene. The Romans have been credited with their re-introduction to Britain, although there is little empirical evidence. The supposition that fallow deer were re-introduced to Britain by the Romans has been questioned and a Norman-date is thought more probable (Chapman & Putman 1991: 511; Grant 1981: 206; Yalden 1999: 104). After re-examining all the available evidence Sykes (2004: 78-79) has suggested that shed antlers and lower limb elements were probably traded from continental Europe during the Roman period. This was probably for working, although a ritual aspect cannot be entirely dismissed. No fallow deer specimens were positively identified in the baths basilica assemblage. Seven specimens were recorded as 'red/fallow deer' (Tables 30-31). These have been incorporated and considered in conjunction with the red deer specimens (see above).

#### **Roe deer:**

The baths basilica produced a small roe deer assemblage, a total of 51 specimens (NISP) (Table 30). To summarise, Phase T-V produced seven specimens, Phase X produced one, Phase X-Y five, Phase Y 15, Phase Y-Z 10 and Phase Z 13. Due to the small data set, little can be inferred regarding their exploitation, although a broadly similar pattern emerges for roe deer as for red deer (see above). A low number of shed and unshed antler burrs with higher concentrations of mandibles suggest the under-recording of the former. Roe deer generally shed their antlers in October – January, although there is considerable fluctuation (MacDonald & Barrett 1993: 211 & 213). Anatomical distribution indicates that whole carcasses were present at the site, although only one specimen derived from an immature animal. Available butchery evidence mostly relates to dismemberment. Roe deer are also a woodland animal and have been subject to the same ecological and physiological changes as red deer (see above; Grant 1981: 206).

#### **Discussion:**

Grant (1981: 205) raises three important considerations when interpreting the significance of deer remains from archaeological sites. Firstly, misidentification has been a consistent problem, mainly because red deer bones are superficially similar to cattle bones. Secondly, in many early faunal reports actual numbers were omitted. Thirdly, the distinction between post-cranial deer bone and antler has not always been made, which biases any interpretation (see below).

Grant (1981: 209) suggested that changing cultural attitudes towards hunting for purely social reasons, such as status and pleasure, were important factors in the exploitation of deer in pre-Roman Iron Age Britain. However, Grant (1981: 209) argued that hunting fell out of favour in the Romano-British period,

as the indigenous aristocracy adopted Classical lifestyles, quoting the low number of deer remains at Fishbourne (Grant 1971: 378, Table 1) as evidence.

Some later Romano-British sites demonstrate an increase in the proportion of deer bones. King (1978: 216) states that the proportion of deposits which include deer remains increases from 39% in the 1<sup>st</sup> century AD, 53% in the 2<sup>nd</sup> century AD, 71% in the 3<sup>rd</sup> century AD to 79% in the 4<sup>th</sup> century AD. At Chalk villa, Kent deer bones increase from 5% to 13% during the final phase of occupation in the 4<sup>th</sup> century AD (Eastham 1972: 142). At Latimer villa, Buckinghamshire the frequency of deer bones increase from 4% to 19% by the late 3<sup>rd</sup> century phase (VP2b). The final villa phase (VP3) and the two post-Roman villa phases (PV1 and PV2) produced frequencies of 23%, 14% and 20% (Hamilton 1971: 164, Table 8). Grant (1981: 208) concluded that in the 4<sup>th</sup>-5<sup>th</sup> centuries AD as the Roman infrastructure fell into disrepair hunting deer became an economic necessity.

The relative scarcity of deer remains on Romano-British sites may have occurred because the hunted deer were dismembered where they were killed, although Grant (1981: 209) considered this an unlikely possibility, claiming that transporting a whole carcass would have been easier: the East Coker mosaic shows a deer strung underneath a pole by its legs being carried by two men (see Burke 1978: 72, Figure 57; Scott 1977: 204, Figure 87). More recent research suggests that the dichotomy between Roman and medieval attitudes towards hunting may be more imagined than real, for example hunting appears to have been actively pursued at Chedworth villa, Gloucestershire (Hammon 2002).

### **11.2.2. Wild boar**

The possible presence of wild boar has been considered along with domestic pig, due to the problems associated with distinguishing the two using morphological or biometrical criteria. To briefly summarise, it would appear as though wild boar was present in the assemblage in small numbers (see Chapter 8).

### **11.2.3. Lagomorphs**

A total of 189 lagomorph specimens (NISP) were recorded from the baths basilica (Table 30). It was possible to make the hare-rabbit distinction in the majority of cases (see Chapter 3) however, 47 specimens could not be separated. The majority of these specimens were immature, so the criteria of Callou (1997) could not be applied with any certainty. Twenty six of these specimens were found in direct association and would have been articulated (ID 19206-19231 Context D343). All are neonatal and represent a minimum number of three individuals. Presumably this particular deposit represents a rabbit nursery and is therefore intrusive (see Chapter 4).

#### **Hare:**

A total of 68 hare specimens (NISP) were recorded (Table 30): 19 from Phase W, four from Phase X-Y, 17 from Phase Y, 15 from Phase Y-Z and 13 from Phase Z. No attempt to distinguish between brown hare (*Lepus europaeus*) and mountain hare (*Lepus timidus*) was made using morphological criteria or biometrical separation. Yalden (1999: 127) considers that hare specimens deriving from Roman deposits almost certainly represent brown hare, rather than mountain hare. There is no definite record of brown hare in Britain prior to the Romans, so may even have been a Roman introduction (Tapper 1991: 155). Anatomical distributions suggest whole carcasses were present at the baths basilica. Presumably all the hare specimens derive from human activity, rather than accidental inclusion. However, only one specimen demonstrated any butchery evidence, a scapula from Phase W (ID 973 Context C445).

### **Rabbit:**

Reputedly, the rabbit was not introduced to Britain until the Norman Conquest (Cowan 1991: 149; Yalden 1999: 138 & 158). However, the Romans did exploit rabbits for their meat in continental Europe. Rabbit was exported from Spain and established in Italy using *leporaria* (walled enclosures) (Thompson & Worden 1956: 12). Therefore, their presence in Romano-British deposits should not automatically be assumed to be intrusive. The baths basilica assemblage produced 74 rabbit specimens (NISP): 14 from Phase W, eight from Phase Y, 50 from Phase Y-Z and two from Phase Z (Table 30). Three articulated partial skeletons all from Context D116 (ID 12488-12492, 16472-16478 and 19184-19185) explain the high frequency of rabbit remains from Phase Y-Z (see above). These are almost certainly intrusive. None of the rabbit specimens demonstrated any butchery evidence or other human modification, further supporting the view that they were all intrusive.

### **11.2.4. Macaque**

A single macaque specimen (ID 6933) was recovered from Phase Y-Z Context E74: an intact fused first phalange, which was well-preserved. The specimen demonstrated no additional marks or pathologies, etc. Using morphological criteria alone it could not be identified to species, but in all likelihood is barbary ape (*Macaca sylvanus*) (see below). It had previously been recorded by Armour-Chelu (1997: 358) and its identification confirmed at the Natural History Museum.

### **Discussion:**

This unusual specimen has few contemporaries in Roman and early medieval Britain. To date, there appears to be only two other examples of barbary ape from this period: a partial skeleton was recovered from a 2<sup>nd</sup> century AD cesspit in Dunstable, Bedfordshire (quoted in Napier & Jenkins 1997: 121) and a fragmentary skull of three-three and a half year old male was recovered from the fort at Catterick, Yorkshire (Hodgson 2002: 415). The latter specimen is assumed to be of Romano-British date, despite being recovered from a modern services trench (Napier & Jenkins 1997: 121). Only one pre-Roman specimen has been discovered in the British Isles and comes from a 2<sup>nd</sup> century BC (Phase 3 ii-iii) deposit at Navan Fort, County Armagh, Northern Ireland (Napier & Jenkins 1997: 120-121), which consisted of a partial skull and mandible of five-seven year old male.

Barbary ape is indigenous to north Africa and is presently confined between Algeria, in the mountainous country between Algiers and Constantine, and Morocco, in the Er-Rif region and High Atlas mountains as far south-west as the Sous river (Haltenthorn & Diller 1977: 270). The Classical authors do not mention the barbary ape inhabiting Gibraltar, despite making numerous references to it (see Toynbee 1973: 48-53). The earliest reference to barbary apes on Gibraltar dates to the early 8<sup>th</sup> century AD and was made by the Moorish invader, Tarik Ibn Sijad (Fiedler *et al.* 1979: 382). The barbary ape seems to have been an 'extremely' popular household pet and performing animal throughout the Classical Mediterranean world, featuring in literature, art (mosaics and jewellery, etc) and on household items, including pottery (Raftery 1997: 122-123). Perhaps the most eloquent example, demonstrating the affection in which barbary apes were held, comes from Stettfeld, Baden-Wurttemberg, Germany where an amber pendant inscribed with an ape motif was found placed in the mouth of a child buried in a 2<sup>nd</sup> century AD cemetery (Gulde 1985: 197).

The Navan Fort barbary ape has been interpreted as further evidence for a sea-trade route between northern Ireland and the western Mediterranean world. It was thought extremely unlikely that the barbary

ape would have travelled overland via the British mainland because such a journey would have been detrimental to its physical wellbeing (Raftery 1997: 123). Its health would have been a principal concern considering that it must have been a valuable commodity. It is, therefore, tempting to explain the presence of the *Viroconium* specimen in similar terms. If the date of the baths basilica specimen is correct it would have travelled up either the River Severn or arrived at the post-Roman port and trading centre of Meols (see Chapter 1) from northern Africa (see above). If this interpretation is valid it would confirm the post-Roman importance of *Viroconium* and its ability to control resources through long-distance trade, as evidenced by other finds categories (see Chapter 1).

### **11.2.5. Canids**

#### **Wolf:**

The possible presence of wolf at the baths basilica has been considered in conjunction with the dog assemblage (Chapter 10). To summarise, no wolf specimens were positively identified at the baths basilica and their presence is thought unlikely. Wolves survived in England until 1550 AD, Scotland until 1740 AD and Ireland around 1770 AD (Clutton-Brock 1991: 573), although their numbers may have been greatly reduced even by the Roman period.

#### **Red fox:**

Only 13 (NISP) specimens were positively identified as red fox (*Vulpes vulpes*): one specimen from Phase W; one from Phase Y; four from Phase Y-Z; 7 from Phase Z. A further six (NISP) specimens were identified as 'probable fox' (cf. *Vulpes vulpes*): one from Phase X-Y; four from Phase Y; one from Phase Z. Additionally, 51 fragments were recorded as 'dog/fox' because no distinction between domestic dog (*Canis familiaris*) and red fox (*Vulpes vulpes*) could be made: seven from Phase W; four from Phase X-Y; 24 from Phase Y; four from Phase Y-Z; 12 from Phase Z (Table 30).

Most body parts are represented, notwithstanding the smallest anatomical elements that were presumably not recovered. This pattern may be biased, due to the probable presence of dogs in the 'dog/fox' category. Despite this, it is likely that either live foxes or complete carcasses were present at the baths basilica. In all of the three categories the vast majority of specimens were skeletally mature. Only two of the specimens demonstrated butchery. Interestingly, both specimens have been positively identified as red fox: a complete tibia (ID 4658) from Phase Y Context D1231 and a distal humerus (ID 14047) from Phase Y-Z Context B277. Both demonstrated knife marks towards their distal articulations. These marks probably represent dismemberment, rather than skinning. The humerus may have been deposited with an associated proximal radius, also positively identified as red fox (ID 14048). Even if some specimens represent accidental inclusions from scavenging animals, it would appear as though fox was deliberately hunted and carcasses were processed beyond the acquisition of pelts. As with most of the wild species demonstrating butchery this seems to be a later phenomenon.

### **11.2.6. Mustelids**

#### **Badger:**

Eleven badger specimens (NISP) were identified from the baths basilica: three from Phase W, one from Phase X-Y, five from Phase Y and two from Phase Y-Z (Table 30). A range of anatomical elements were present. Two of these specimens demonstrated cut marks: a tibia from Phase Y (ID 1543 Context D1231) and a pelvis from Phase Y-Z (ID 9574 Context B277). Cut marks to a tibia could simply relate to

skinning, however butchery to the acetabulum indicates dismemberment. Badger may have, therefore, been periodically consumed by *Viroconium*'s inhabitants. The butchery evidence combined with the fact that none of the specimens were articulated suggests they mostly derive from human activity, rather than accidental inclusion.

#### **Otter:**

Only one otter specimen was recorded: a tibia from Phase Z (ID 3046 Context D332). It also demonstrated cut marks, possibility from skinning. It is difficult to ascertain whether or not otter was deliberately hunted for its fur or purely for pleasure. It is unlikely that otter would have been considered a pest to be controlled because freshwater fish was never utilised as a major economic resource during the Romano-British period (Alison Locker pers. comm.; Coy 1989; Grant 1989: 144). Chanin (1991: 430) reported that otters only began to be hunted with dogs for their pelts in the 13<sup>th</sup> century AD.

#### **Large mustelids:**

Three large mustelid specimens were identified at the baths basilica: a metacarpal (ID 23814 Context B277) and a metatarsal (ID 23805 Context D116) from Phase Y-Z, plus a radius from Phase Z (ID 23804 Context D283). It has not been possible to determine with any certainty which species these specimens represent. There is considerable size overlap between the larger mustelid species: European mink has a head-body length of between 300-400mm, European polecat 290-460mm and pine marten 400-560mm (MacDonald & Barrett 1993: 114, 118 & 121). No cranial fragments were present in the baths basilica sample, so morphological criteria could not be applied (see von Stubbe not dated; von Wolsan 1993).

The *Viroconium* specimens are probably either European polecat (*Mustela putorius*) or pine marten (*Martes martes*). Both the pine marten (Velandar 1991: 372) and the polecat (Blandford & Walton 1991: 400) were common throughout Britain until the 19<sup>th</sup> century AD. Additionally, European mink (*M. lutreola*) cannot be entirely ruled out, however it appears to have been rare throughout the Holocene (Davison *et al.* 2000: 347). There is also a possibility that the domesticated form of the European polecat, the ferret (*M. furo*), was present at *Viroconium*. It was certainly known in the Roman world (see Davison *et al.* 1999: 155), although it was probably a later introduction to Britain (Blandford & Walton 1991: 405). Strabo stated that ferrets were used to control rabbits on the Balearic Islands (Blandford & Walton 1991: 403). Pine marten lower limb elements with cut marks, presumably denoting skinning, were identified from Saxon Fishergate, York (O'Connor 1991: 259). None of the *Viroconium* specimens demonstrated any butchery.

#### **Smaller mustelids:**

Eleven small mustelid specimens (NISP) were recovered (Table 30): one from Phase T-V, four from Phase W, four from Phase Y, one from Phase Y-Z and one from Phase Z. These were either stoat (*Mustela ermine*) or weasel (*M. nivalis*); it was not always possible to distinguish between the two species, due to similar morphology and considerable size overlap. Modern stoats attain a head-body length of between 160-310mm and weasels 173-314mm (MacDonald & Barrett 1993: 110 & 113). No specimens demonstrated any butchery evidence. Small mustelid specimens are probably either intrusive or represent animals that were attracted to the site because of the commensal small rodents.



### 11.2.7. Felids

A particularly large felid mandible (ID 1969) was recovered from Context D1231 Phase Y. It produced the following measurements (see Von den Driesch 1976: 63): 3 = 56.3mm; 4 = 53.5mm; 5 = 20.8mm; 8 = 27.4mm; 9 = 11.7mm; 10 = 10.9mm. It has not been possible to determine whether or not it belongs to domestic cat (*Felis catus*) or European wild cat (*F. sylvestris*). Attempting to apply the criteria of Kirk (1935) and Kratochvil (1973) did not remedy the situation, as it had several characteristics of both. Presumably, if it was wild cat then it had been hunted, although no butchery marks were observed. Wild cat was still present in England until the 16<sup>th</sup> century. It had been widespread until the Middle Ages, after which they steadily declined because of hunting and habitat loss (Easterbee 1991: 434).

### 11.2.8. Rodents

#### Rat/water vole:

Sixty specimens (NISP) of water vole were identified from *Viroconium*: one from Phase T-V, seven from Phase W, three from Phase X-Y, eight from Phase Y, 12 from Phase Y-Z and 29 from Phase Z. All these specimens were either cranial fragments or mandibles. No rat specimens were positively identified from the baths basilica because all the remaining 132 specimens (NISP) were from the post-cranial skeleton (see Chapter 3). However, *Viroconium* is one of relatively few late Roman sites in Britain where black rat (*Rattus rattus*) has been positively identified (see Armitage 1984: 381-382). Other sites include London and York (see Armitage *et al.* 1984: 381). However, because the brown rat (*Rattus norvegicus*) was not introduced to Britain until the 18<sup>th</sup> century AD (Taylor *et al.* 1991: 250), presumably all Romano-British rat specimens are black rat (when positively distinguished from water vole).

There is some evidence to suggest that water voles have changed in morphology (and behaviour) since the last glaciation; they have become physically larger and their incisors have become less pro-odont and their molars more odont (Boyce 1991: 214). Yalden (1999: 118) interprets this as evidence for their inhabiting areas away from water. This being the case, water voles may have been commensal, rather than accidental inclusions from owl predation (see below). Water voles appear to become scarcer in the Saxon period (see Yalden 1999: 138), presumably as a result of continued modification of their natural habitat. The 7<sup>th</sup> century AD (Phase Z) sample from *Viroconium* indicates that no decrease appears to have taken place in the Shropshire region by the earlier Saxon period.

#### Smaller rodents:

Bank vole (*Clethrionomys glareolus*), field/short-tailed vole (*Microtus agrestis*) and mice (*Mus/Apodemus* spp.) were all identified at *Viroconium* (Tables 30-31, although not in large numbers because of the difficulties in positively speciating post-cranial elements (see Chapter 3). Most specimens were simply recorded as 'small rodent': 230 NISP (Table 30). These specimens may represent contemporary or later inclusions. The house mouse (*Mus domesticus*) was established in Britain during the pre-Roman Iron Age (Berry 1991: 243), so may have been present at the baths basilica.

#### Discussion:

Few of the rodent specimens from *Viroconium* demonstrated any etching and erosion characteristic of owl digestion (see Andrews 1990; Bocheński *et al.* 1993; Williams 2001). This would suggest the majority had been attracted to the site commensally, rather than representing predator accumulations. Although, the presence of water and field vole remains may indicate that barn owls had been depositing their pellets

in the vicinity (see Yalden 1999: 118). Interestingly, the small mammal assemblage from Uley, Gloucestershire, was dominated by field voles (Levitan 1993: 262, Table 12), although owl remains were not recovered (Cowles 1993: 263, Table 13). As Dobney *et al.* (2000: 171-177) illustrated for the Roman fort at Carr Naze, Filey, East Yorkshire, such a range of small rodents might denote periods of abandonment or the use of abandoned buildings on the periphery of a settlement by owls (see below).

### **11.2.9. Mole**

Twenty-two mole specimens (NISP) were recorded from the baths basilica assemblage: one specimen from Phase T-V; one from Phase X; three from Phase X-Y; five from Phase Y; eight from Phase Y-Z; four from Phase Z (Table 30). It all probability the mole remains are intrusive. However, at various points in British history they have been deliberately hunted for their pelts (Stone & Gorman 1991: 49), and conceivably the inhabitants of early medieval *Viroconium* also utilised them in this fashion, although none of the specimens demonstrated any butchery evidence.

## **11.3. Birds**

### **11.3.1. Introduction**

When interpreting wild bird assemblages from Romano-British sites it is necessary to remember that gastronomic tastes are not universal. Ethnographic research has indicated that people feed captured birds special diets, bury carcasses in the ground, etc to modify flavours to suit their particular tastes (Parker 1988: 202). However, it has also been demonstrated that there is an inverse relationship between the palatability of flesh and the 'vulnerability'/conspicuous colouration of particular bird species (see Cott 1946; Cott & Benson 1970). The absence of butchery does not necessarily preclude consumption, as 'tearing' bird carcasses apart is fairly common (see Brown 2004; McGovern 2004; Serjeantson 2004).

### **11.3.2. Grey Heron**

One grey heron (*Ardea cinerea*) specimen (ID 23074), an adult carpometacarpus, was recorded from Phase Y-Z Context C267 (Table 30). Cott (1946: 485) reported that grey heron has been historically eaten in England and quoted Macpherson (1897), who stated young birds were often fed a special diet to improve their flavour.

### **11.3.3. Anatidae**

#### **cf. Mute swan:**

One possible mute swan (*Cygnus cf. olar*) specimen (ID 23066), an adult tibiotarsus, was recorded from Phase Z Context B150 (Table 30). Elms Farm, Heybridge, Essex (Johnstone & Albarella 2002: 59, Table 2) also produced mute swan.

#### **Whooper swan:**

One whooper swan (*Cygnus Cygnus*) specimen (ID 23049), an adult scapula, was recorded from Phase Y-Z Context C190 (Table 30).

#### **Domestic goose/greylag:**

It is not possible to distinguish between domestic goose and its wild progenitor, the greylag (*Anser anser*), using morphological or biometric criteria. The presence of other species may also confuse the situation: white-fronted (*A. albifrons*); pink-footed (*A. brachyrhynchus*); bean (*A. fabalis*); barnacle

(*Branta leucopsis*); brent (*B. bernicla*) (see Barnes *et al.* 1998: 280 & 2000: 91). Recent advances have been made using DNA techniques (see Barnes *et al.* 1998 & 2000), which have improved the situation. Only six domestic goose/greylag fragments were recorded from the baths basilica: one ulna from Phase X-Y; one scapula and one coracoid from Phase Y; one scapula from Phase Y-Z; two tibiotarsi from Phase Z (Table 30). All the specimens were skeletally mature with the exception of the scapula from Phase Y, which was juvenile. None of the fragments demonstrated any butchery marks or other modification.

#### **cf. Barnacle goose:**

One possible barnacle goose (*Branta cf. leucopsis*) specimen (ID 23056), an adult tibiotarsus, was recorded from Phase Y-Z Context C231 (Table 30).

#### **Teal/garganey:**

Only one specimen was positively identified as teal (*Anas crecca*): an adult carpometacarpus (ID 23009) from Phase Y Context A318. Ten fragments were identified as either teal or garganey (*Anas querquedula*): one humerus, one ulna and one tibiotarsus from Phase W; one scapula from Phase X-Y; one femur from Phase Y; one scapula from Phase Y-Z; one scapula, one carpometacarpus, one femur and one tarsometatarsus from Phase Z (Table 30). All specimens were skeletally mature with the exception of the two femora, which were juvenile. Only the scapula from Phase X-Y (ID 23819 Context D81) demonstrated any butchery evidence.

#### **Domestic/mallard duck:**

It is not possible to distinguish between domestic duck and its wild progenitor, the mallard (*Anas platyrhynchos*), using morphological or biometric criteria. Some researchers have claimed to have identified the presence of both at some Romano-British sites, however.

Thirty-five specimens were recorded in total from the baths basilica: three fragments from Phase T-V; nine from Phase W; one from Phase X; eight from Phase Y; four from Phase Y-Z; ten from Phase Z (Table 30). Anatomical elements represented were scapula, coracoid, humerus, ulna, carpometacarpus, femur, tibiotarsus and tarsometatarsus. Only two specimens were juvenile: a tibiotarsus (ID 23039) from Phase W Context C440 and a coracoid (ID 20773) from Phase Z Context D283. All other specimens were from adult birds. Only a single fragment, a partially burnt humerus (ID 20677) from Phase Y-Z Context B277, demonstrated any sort of modification.

#### **cf. Diving duck:**

One possible diving duck (*cf. Aytha sp.*) specimen (ID 23013), an adult humerus, was recorded from Phase Y Context A318 (Table 30).

#### **11.3.4. Common buzzard**

Four common buzzard (*Buteo buteo*) specimens were identified (Table 30). Interestingly, they all derived from Phase Z contexts: a coracoid (ID 17868) from D283, a carpometacarpus (ID 21548) from D100, a femur (ID 19731) from D107 and a tarsometatarsus (ID 21803) from E100. All fragments were from adult birds and demonstrated no modifications. Buzzards are only occasionally scavenging animals (Snow *et al.* 1998a: 358), so their presence at *Viroconium* may derive from human activity. Dobney *et al.* (1996: 52) suggested that buzzards found at Lincoln may represent 'low' status hawking birds.

### **11.3.5. Black grouse**

Only two black grouse (*Tetrao tetrix*) specimens were identified: a coracoid (ID 4555) from Phase Y-Z Context D116 and a scapula (ID 8545) from Phase Z Context D283 (Table 30). Both were from adult birds. No butchery or other modifications were observed.

### **11.3.6. Phasianidae**

#### **Grey partridge:**

Four grey partridge (*Perdix perdix*) specimens were identified from the baths basilica assemblage: a tarsometatarsus (ID 7024) from Phase T-V Context B632, a tarsometatarsus (ID 4191) from Phase W Context E96, an ulna (ID 6300) from Phase Y-Z Context D116 and a tibiotarsus (ID 10091) from Phase Z Context D100 (Table 30). All were skeletally mature. The ulna displayed knife marks.

#### **Quail:**

Four quail (*Coturnix coturnix*) specimens were identified from the baths basilica assemblage: a humerus (ID 4162) and a carpometacarpus (ID 19183) both from Phase Y-Z Context D116, plus a humerus (ID 23785) and coracoid (ID 23774) from Phase Z Context D100 and D283, respectively (Table 30). All were skeletally mature. No modifications were observed.

### **11.3.7. Rallidae**

#### **Water rail:**

One water rail (*Rallus aquaticus*) specimen (ID 23818), an adult femur, was recorded from Phase Y Context D329 (Table 30).

#### **Corncrake:**

One corncrake (*Crex crex*) specimen (ID 23817), an adult tarsometatarsus, was recorded from Phase Y-Z Context D116 (Table 30). Cott (1946: 470), who quotes Layard & Sharpe (1875-1884) and Finn (1915), states that corncrake possesses a 'considerable gastronomic reputation', so the baths basilica specimen may have been consumed. Corncrake has also been recorded at Colchester, Essex (Luff 1993: 98, Table 5.4).

#### **Moorhen:**

One moorhen (*Gallinua chloropus*) specimen (ID 20849), an adult humerus, was recorded from Phase Y Context D1333 (Table 30). According to Cott (1946: 470), numerous authors consider the moorhen edible, but not 'worth bothering with'. Fourth century AD deposits from Lincoln have also produced moorhen (Dobney *et al.* 1996: 132, Table 7).

### **11.3.8. Crane**

Three crane (*Grus grus*) specimens were recorded from the assemblage (Table 30). All three specimens were retrieved from Phase W deposits: a tarsometatarsus (ID 4191) from Context E96, a tibiotarsus (ID 11144) from Context D983 and a tarsometatarsus (ID 18966) from Context D579. All specimens were skeletally mature. The tibiotarsus displayed both knife and chop marks around the distal articulation, which gave the impression that the main section of the shaft had been deliberately removed. The purpose for which has not been ascertained, although similarly shaped bird bones have been fashioned into musical instruments because they are long, thin and cylindrical (see MacGregor 1985: 150-151; MacGregor *et al.* 1999: 1977). Crane may have also been consumed at *Viroconium*. Cott (1946: 475 & 484) reports that crane is 'delicious' when grain-fed, but requires 'hanging' to improve the flavour,

quoting Blandford (1898) and Elyot (1549). Apicius (VI.II; Flower & Rosenbaum 1958: 141-145) gave six recipes for crane. Crane has been recorded at numerous other later Romano-British sites: Colchester, Essex (Luff 1993: 98, Table 5.4), Lincoln (Dobney *et al.* 1996: 51) and York (see Allison 1985).

### **11.3.9. Charadriidae**

Five fragments were identified as Charadriidae with one additional 'possible' specimen: one specimen from Phase W; two from Phase Y; three from Phase Y-Z (Table 30). Anatomical elements represented were humerus, carpometacarpus, femur and tarsometatarsus. All specimens were from adult birds.

#### **Golden plover:**

Only one specimen was positively identified as golden plover (*Pluvialis apricia*), an adult humerus (ID 23008) from Phase Y-Z Context C268 (Table 30). Cott (1946: 471) considers the golden plover to be '... the best of all the plovers ...' for eating and states that it is on a level with woodcock, quoting Selby (1833) and Simon (1944).

### **11.3.10. Scolopacidae**

#### **cf. Jack snipe:**

One possible jack snipe (cf. *Lymnecryptes minimus*) specimen (ID 23782), an adult carpometacarpus, was recorded from Phase Z Context D100 (Table 30).

#### **Woodcock:**

One hundred and two woodcock (*Scolopax rusticola*) specimens were recorded in total from the baths basilica: two fragments from Phase T-V; twenty three from Phase W; four from Phase X; nine from Phase X-Y; twenty from Phase Y; twenty three from Phase Y-Z; twenty one from Phase Z (Table 30). Anatomical elements represented were scapula, coracoid, humerus, ulna, carpometacarpus, femur, tibiotarsus and tarsometatarsus. All fragments derived from adult birds. No specimens demonstrated any butchery or other modifications. Woodcock in the Romano-British were probably caught with nets strung-across their 'rides' or possibly 'sprint' (spring-traps), as they readily walk (Parker 1988: 204).

Relatively numerous finds of woodcock at Romano-British sites indicate it was routinely caught and eaten: Colchester, Essex (Luff 1993: 98, Table 5.4), Leicester (Gidney 1999: 312, Table 66); Elms Farm, Heybridge, Essex (Johnstone & Albarella 2002: 59, Table 2 & 60, Table 3); Roman deposits at Exeter (Maltby 1979: 203, Table 95).

### **11.3.11. Columbidae**

Twenty one fragments were recorded as Columbidae: six specimens from Phase W; one from Phase X-Y; six from Phase Y; two from Phase Y-Z; six from Phase Z (Table 30). Anatomical elements represented were scapula, coracoid, humerus, ulna, carpometacarpus, femur, tibiotarsus and tarsometatarsus. All fragments were from adult birds with one exception, a juvenile femur (ID 11914) from Phase Y-Z Context D116. No modifications were noted. In all probability, dovecots and pigeon-lofts were used to maintain ready supplies, although no examples have yet been identified in Britain (see Rivet 1982).

#### **Wood pigeon:**

Ten fragments were identified as wood pigeon (*Columba palumbus*): one humerus and one ulna from Phase W; one coracoid from Phase X-Y; one, scapula, one ulna and one tarsometatarsus from Phase Y; one scapula and one coracoid from Phase Y-Z; one tibiotarsus from Phase Z. One specimen was left as a

'cf. wood pigeon': a tibiotarsus (ID 21805) from Phase Z Context E185 (Table 30). All fragments were from adult birds and none displayed any modifications.

### **11.3.12. Barn owl**

Four barn owl (*Tyto alba*) specimens were identified from the baths basilica assemblage: a tarsometatarsus (ID 21684) from Phase W Context D163, a scapula (ID 23763) from Phase Y-Z Context D116 and a coracoid (ID 19247) from Phase Z Context D305 (Table 30). All were skeletally mature. No modifications were observed. Barn owl might denote the presence of abandoned buildings (see Dobney *et al.* 2000: 176).

### **11.3.13. Strigidae**

Two juvenile specimens were recorded as Strigidae, a scapula (ID 23764) from Phase Y Context D320 and a humerus (ID 23788) from Phase Z Context D331. An additional specimen was recorded as a 'possible': an adult ulna (ID 23795) from Phase Z Context D108 (Table 30). No modifications were noted. Owls are rarely eaten in many cultures, however Cott (1946: 461) suggested that this has little to do with edibility, but rather prejudices and superstition, and quoted the 'Duke of Bedford' who reported that the tawny owl was 'quite well-flavoured'.

### **cf. Long-eared owl:**

One possible long-eared owl (cf. *Asio otus*) specimen (ID 23065), an adult ulna, was recorded from Phase W Context C440 (Table 30). Lauwerier (1986: 208) reported that long-eared owl was almost certainly eaten in the Eastern River region of Roman Holland.

### **11.3.14. Turdidae/Sturnidae**

Two juvenile specimens were recorded as Turdidae: one fragment from Phase W; one from Phase X-Y; one from Phase Y; Phase Y-Z; five from Phase Z. Additionally, twenty nine specimens were recorded as Turdidae/Sturnidae: one fragment from Phase T-V; five from Phase W; one from Phase X-Y; five from Phase Y; twelve from Phase Y-Z; five from Phase Z (Table 30). Anatomical elements represented were scapula, coracoid, humerus, ulna, carpometacarpus, femur, tibiotarsus and tarsometatarsus. All specimens were skeletally mature. One Turdid fragment was calcined, an adult coracoid (ID 4185) from Phase W Context E96.

In all probability, the Turdidae/Sturnidae remains from the baths basilica represent accidental inclusions. However, there is some evidence to suggest that they were deliberately caught in Roman Britain. A Romano-British farmstead at Great Holts Farm, Boreham, Essex produced a collection of *Turdus* sp., possibly blackbird (*Turdus merula*), bones found in association with a sparrowhawk (*Accipiter nisus*) tarsometatarsus from a late 3<sup>rd</sup> – early 4<sup>th</sup> century AD well deposit. This has been interpreted as possible hawking evidence (Albarella 1997: 6-9; Albarella 2003a: 198). However, hawking does not appear to have been widely practiced in Roman Europe, only becoming popular in the early medieval period (Prummel 1997: 335). The fact that starlings (and presumably Turdidae) can be eaten, but are generally considered unpalatable (Cott 1946: 482), further decreases the likelihood that hawking was deliberately pursued at *Viroconium*. Cott (1946: 482) quoted Wullghby in Macpherson (1897):

*'Stares are not eaten in England by reason of the bitterness of their flesh: the Italians and other outlandish people are not so squeamish but they can away with them, and make a dish of them for all that.'*

**cf. Mistle thrush:**

One possible mistle thrush (cf. *Turdus viscivorus*) specimen (ID 23794), an adult ulna, was recorded from Phase Y-Z Context D116 (Table 30).

**11.3.15. Corvidae**

The morphological and biometrical criteria of Tomek & Bocheński (2000) for separating the species of Corvidae were not applied to the baths basilica assemblage; unfortunately they were only published towards the end of the recording stage. Subjective criteria based on morphology and to a lesser degree size (except for raven, where size is a good indicator) were used instead.

Eight specimens were recorded as Corvidae: three fragments from Phase W; three from Phase Y and two from Phase Z. Anatomical elements represented were humerus, femur, tibiotarsus and tarsometatarsus (Table 30). All the specimens were from adult birds with the exception of a juvenile femur from Phase W Context D743 and a juvenile tibiotarsus from Phase Z Context D283. None of the fragments demonstrated any form of modification. With the possible exception of the raven remains (see below), Corvididae almost certainly represent accidental inclusions. They will have been attracted to the site as scavengers (see Snow *et al.* 1998b).

**Jay:**

Two jay (*Garrulus glandarius*) specimens were identified from the baths basilica assemblage: a scapula (ID 19618) and femur (ID 19619) both from Phase Z Context D100 (Table 30). Both were adult and no modifications were observed. The edibility of Corvids seems to be ambiguous, as Cott (1946: 464 & 476) reported rook is edible, but that magpie is not especially palatable.

**Magpie:**

Seven fragments were identified as magpie (*Pica pica*): two tibiotarsi from Phase W; one femur from Phase X-Y; one femur from Phase Y; one femur and two tibiotarsi from Phase Z (Table 30). All fragments were from adult birds and none displayed any modifications.

**Jackdaw:**

Thirty two jackdaw (*Corvus monedula*) specimens were identified from the baths basilica assemblage: four fragments from Phase W; three from Phase X-Y; fifteen from Phase Y; four from Phase Y-Z; six from Phase Z (Table 30). Anatomical elements represented were coracoid, humerus, ulna, carpometacarpus, femur, tibiotarsus and tarsometatarsus. Only two specimens were juvenile: a humerus (ID 3175) and a femur (ID 23791) both from Phase Y Context D1333. All other specimens were from adult birds. No fragments displayed any butchery or other form of modification.

**Rook/crow:**

Fifteen fragments were identified as either rook (*Corvus frugilegus*) or carrion/hooded crow (*C. corone*) from the baths basilica: five specimens from Phase W; two from Phase X-Y; two from Phase Y; six from Phase Z (Table 30). Anatomical elements represented were scapula, coracoid, humerus, ulna, carpometacarpus, femur and tarsometatarsus. All specimens were from adult birds with the exception of one fragment, a juvenile tarsometatarsus (ID 4134) from Phase Z Context D100. No modifications were observed.

## **Raven:**

Fourty one raven (*Corvus corax*) specimens were identified from the baths basilica assemblage: one fragment from Phase T-V; twelve from Phase W; nine from Phase X-Y; four from Phase Y; six from Phase Y-Z; nine from Phase Z (Table 30). Anatomical elements represented were scapula, coracoid, humerus, ulna, carpometacarpus, femur, tibiotarsus and tarsometatarsus. All other specimens were from adult birds. No fragments displayed any butchery or other form of modification. Raven remains are regularly encountered in small numbers on many urban Romano-British sites: Colchester, Essex (Luff 1993: 98, Table 5.4), Leicester (Gidney 1999: 312, Table 66) and Lincoln (Dobney *et al.* 1996: 132, Table 7) amongst others.

Raven remains may simply reflect their scavenger-behaviour (Snow *et al.* 1998b: 1485); however they may have also been kept as pets and played a ritual aspect in Romano-British society (Parker 1988: 203). Deliberate deposition (often in wells and pits) has been postulated at Dunstable, Bedfordshire (Jones & Horne 1981: 69), Elms Farm, Heybridge, Essex (Johnstone & Albarella 2002: 41), Portchester Castle, Hampshire (Eastman 1975: 414), Sheepen Hill, Colchester, Essex (Luff 1982: 63) and The Lanes, Carlisle, Cumbria (Connell & Davis forthcoming: Table 1). In two cases, (Dunstable and Sheepen Hill) white-tailed eagle (*Haliaeetus albicilla*) remains accompanied them. Raven and white-tailed eagle were also found together at the Uley shrines, Gloucestershire (Cowles 1993: 263) and The Lanes, Carlisle, Cumbria (Connell & Davis forthcoming: 6), although no significance was placed upon the remains. A butchered skull has been recorded from Roman Leicester, also found in a well-deposit with incomplete jackdaw and crow skeletons (Baxter 1993: 31). White-tailed eagle is also a scavenger and 'kleptoparasite' (Snow *et al.* 1998a: 306), which might explain its presence; an often favoured interpretation (see O'Connor 1993; Mulkeen & O'Connor 1997). It would be interesting to conduct a more extensive survey, concentrating on the nature of deposition, etc, to elucidate whether the association of the two species has any wider significance.

### **11.3.16. Passeriforme**

No attempt was made to speciate any of the small Passeriformes. Fifty six fragments were recovered from the baths basilica: one from Phase T-V; five from Phase W; three from Phase X-Y; 15 from Phase Y; 13 from Phase Y-Z; 19 from Phase Z (Table 30). Coracoid, humerus, ulna, carpometacarpus, femur, tibiotarsus and tarsometatarsus were all represented. The vast majority derived from adult birds.

## **11.4. Summary**

The population of *Viroconium* appear to have utilised a wide range of wild mammals and birds. Deer had some economic importance, providing both antler and bone for working, although they would have contributed little meat to the inhabitant's diet. Deer were deliberately hunted (evident from the range of anatomical elements), in addition to shed antler being collected. The proportion of deer at *Viroconium* increased slightly in the latter phases, but still fell below King's (1978: 216) 5% threshold for Romano-British sites (see Chapter 6). This would imply that hunting for non-economic reasons may have been a factor. Hare, red fox, badger and otter were all hunted and their carcasses utilised in some way. The butchery evidence indicated skinning and dismemberment. The single macaque specimen (almost certainly barbary ape) from Phase Y-Z demonstrates that *Viroconium* was still part of an international



trading network in the early medieval period. It would have travelled either up the River Severn or arrived at the Meols emporium.

The riverine and lowland environment immediately adjacent to *Viroconium* provided its inhabitants with a rich resource, as attested by the range of birds present. The waders and other water birds may represent a seasonal resource. Similar assemblages have been encountered at Caerleon, Gwent (O'Connor 1986: 240-241, Table 17) and Colchester, Essex (Luff 1993: 98, Table 5.4), for instance. Many of the bird bones from the baths basilica did not demonstrate any modifications, which might suggest accidental inclusion. However, butchering of bird carcasses may not have been that common (see above). The Roman's fondness for birds is aptly demonstrated by the range of species identified from well-sealed kitchen deposits at *Augusta Raurica*, Switzerland by Schmid (1972: 36-37, Tables V-VII): geese (*Anser* sp.), garganey (*Anas querquedula*), goosander (*Mergus merganser*), ducks (*Anas* sp.), hazel grouse (*Bonasa bonasia*), grey partridge (*Perdix perdix*), pheasant (*Phasianus colchicus*), woodcock (*Scolopax rusticola*), pigeons (Columbidae), nightingale (*Luscinia megarhynchos*), blackbird (*Turdus merula*), thrush (*Turdus* sp.), great grey shrike (*Lanius excubitor*), starling (*Sturnus vulgaris*), chaffinch (*Fringilla coelebs*), goldfinch (*Carduelis spinus*) and hawfinch (*Coccothraustes coccothraustes*). Parker (1988: 203) suggested that catching birds might have been, '*... important seasonal events, and, if held on an estate could provide both sport and feast at both high and low social levels ...*'. Such a situation is easy to imagine for the baths basilica, especially Phase Z.

## 12. Discussion and conclusions

### 12.1. Introduction

#### 12.1.1. Application to research questions

It has been repeatedly highlighted that the archaeological evidence recovered from the baths basilica is almost unique in Britain. It demonstrates direct continuity between the late Romano-British and early medieval periods, although the site underwent considerable development and changes in function. To summarise:

- |             |   |                    |
|-------------|---|--------------------|
| • Phase T-W | late 3 <sup>rd</sup> – mid 5 <sup>th</sup> century AD   | public baths       |
| • Phase X   | late 5 <sup>th</sup> – mid 6 <sup>th</sup> century AD   | building yard      |
| • Phase Y   | early 6 <sup>th</sup> – late 6 <sup>th</sup> century AD | market place       |
| • Phase Z   | early 6 <sup>th</sup> – late 7 <sup>th</sup> century AD | palatial residence |

Several possible interpretations of the Phase Z activity have been proposed. These include the palatial seat of a *tyrannus*, who controlled the former territory of the Cornovii, or possibly a bishopric of the western British church (White & Barker 1998: 121-126). These are not necessarily mutually exclusive.

Three broad avenues of research have been explored in the analysis of the vertebrate remains:

- the ‘nature’ of *Viroconium*
- the ‘economic geography’ of *Viroconium* and its hinterland
- the ‘cultural identity’ of *Viroconium*’s population

Due to the nature of zooarchaeological analysis much of the proceeding discussion has centred on ‘economic’ reconstruction. This chapter attempts to consider the more ‘sociological’ components, especially the ‘cultural identity’ of the early medieval population.

### 12.2. The ‘nature’ of *Viroconium*

The frequency of animal bones recovered from the baths basilica excavations appears to reflect the changing nature of the site. The numbers of identified bone fragments (Tables 30-31) steadily increases throughout the period of activity. In all likelihood, the baths basilica in its capacity as a public building (Phases T-V – W) would have been subject to comparatively small amounts of refuse deposition. Very few bone fragments were recovered from the ‘building yard’ phase (Phase X). Presumably, the baths basilica at this point was not a central focus of activity in the settlement, being used more for storage than anything else. The largest concentrations of bone fragments come from Phases Y-Z. This is partly due to the necessity of ‘making-up’ areas of subsidence (see Chapter 1) with dump material before constructing new buildings, but is also the result of the baths basilica becoming a renewed focus of activity: Phase Y – the market place; and Phase Z – ‘the ‘great rebuilding’. Both phases would have produced waste material from commercial activities initially and direct habitation later due to the nature of the respective phases. Overall, the increase in bone frequency reflects the changing function of the baths basilica site (whether *in-situ* activity or dumping from adjacent activity), rather than the longevity of individual phases because both public building and high status residence phases lasted approximately 150 years.

Species composition (Tables 30-31) would seem to confirm the existing archaeological interpretation of the baths basilica site as developing from a typical late Romano-British urban settlement to a high status early medieval residence. The general composition of the assemblage conforms to that expected for a late Romano-British urban assemblage: domestic mammals dominated the assemblage, ranging between 79 – 92%; wild mammals were the second most numerous category and ranged between 2 – 10%; domestic birds ranged between 2 – 6%; wild birds ranged between 2 – 3%.

The relative proportions of the major domesticates also hint at high status activity at the baths basilica site (Figures 28a-b; Tables 30-31 & 33a-b). The baths basilica ultimately conforms to the Romanised urban (dominated by cattle with greater quantities of pig) – indigenous rural (a greater reliance on sheep) cuisine dichotomy identified by King (1978, 1984, 1991, 1999a & 1999b). However, the proportions of cattle and pig from the baths basilica are greater and sheep/goat slightly lower than King's (1999a: 180, Table 3) overall averages. These discrepancies could simply be the result of methodological differences. Alternatively, the higher proportions of cattle may be partly a legacy of *Viroconium* having been a military garrison, which would have also conferred high status. As previously noted (see Chapter 6), the Roman military became dominated by Germanic peoples, whose gastronomic heritage included a high beef component (see King 1984: 198 & 1999a: 182 & 189). The descendants of the military garrison at *Viroconium* may have inherited this tradition, and the higher than 'normal' consumption of pork may reflect the fact that the assemblage derived from a central *insula* containing public buildings. King (1999a: 161) suggested high pork consumption was indicative of high status-cuisine, aping the classical diet.

A diachronic pattern also emerges. Based on MNE values (Figure 28a; Tables 33a), the proportions of cattle essentially remain constant at 56 – 60%, pig increase from 16% in Phase W to 25% in Phase Z and sheep decrease from 25% in Phase W to 16% in Phase Z, so that pig becomes more numerous than sheep. It is unlikely that the supplanting of sheep by pig as the second most numerous domesticate resulted from a heightened *Romanitas* because the switch occurred between the late 4<sup>th</sup> and 6<sup>th</sup> centuries AD. It would therefore appear that the baths basilica increasingly becomes the focus of high-status dining, if particular species can be used as cultural/status indicators (see Chapter 2).

Epiphyseal fusion and mandibular tooth data from the baths basilica site indicate that the majority of cattle were slaughtered when adult or elderly, which implies generalised exploitation (i.e. for a balanced mixture of primary and secondary products) and the mass marketing (quantity possibly over quality) of beef at *Viroconium* (Figures 37-38; Tables 43-44). However, in the later phases, particularly Phases Y and Z, there is a distinct increase in the proportions of pre-adult animals. A similar situation has been noted at several other late Romano-British sites, including intramural Colchester (Luff 1993: 57), Exeter (Maltby 1979: 30-31 & 90) and the General Accident site, York (O'Connor 1988: 86). A more specialised beef-trade, therefore, developed in later Roman Britain, and evidence from the baths basilica indicates this continued into the 7<sup>th</sup> century AD. At Colchester, an increased supply of young beef was not observed in the later extramural areas (Luff 1993: 57). The forthcoming publication on the Winchester suburbs (Maltby forthcoming) also indicates the same pattern. This implies a connection to social differentiation and access to control resources: extramural areas inhabited by the lower echelons of society were supplied with older beef, while high status intramural areas consumed younger beef.

Conversely, pig mortality gives little indication of gourmet cuisine, most individuals being slaughtered at or around two years of age, the optimum for volume of meat production (Figures 89-90; Table 71-72). High-status classical (and later Saxon) cuisine often involved the consumption of suckling piglets and their presence was noted at the baths basilica. However, this does not provide irrefutable evidence for high-status cuisine because several articulated skeletons were observed, which might denote natural mortalities from a breeding population. Mutton appears to have been the principle motivation behind sheep husbandry since most were killed before three – four years with a peak between one – three years. A number of specimens were killed between two – six months, although no diachronic pattern was evident. There may have been consumer demand for lamb, but as with piglets this does not necessarily imply high-status activity. Flocks were often kept in towns and it has been suggested that surplus lambs were slaughtered to ‘free-up’ ewe’s milk for human consumption and several neonatal lambs were noted from the baths basilica (see Chapter 9).

Putting aside the possibility that municipal waste collection occurred at *Viroconium*, anatomical distributions might imply that slaughtering and butchery took place in close proximity to the baths basilica throughout: all body parts were represented (Figures 31, 83 & 114; Tables 37, 65 & 84). *Viroconium* was supplied with whole carcasses, rather than prepared joints of meat. A diachronic pattern is also evident. In the earlier phases, lower utility body parts, such as mandibles and lower limb elements, were over represented. This denotes general butchery waste with the higher utility elements having been transported elsewhere for consumption (meat-on-the-bone). During the public building phases (Phases T – V – W) contemporary refuse was brought in to make-up ground and for building platforms (see Chapter 1). The later phases demonstrated a different pattern. However, there was less differentiation between low and high utility body parts. This also mirrors the archaeological interpretation. One of the major commodities traded by the market (Phase Y) would have been meat and high-status dining would have taken place at the palatial hall (Phase Z). This would have resulted in greater frequencies of high utility elements being deposited (meat-off-the-bone), such as humerus and femur.

Barker *et al.* (1997: 195-201) conducted a functional analysis of the artefacts from two Phase W floor-foundation deposits (C527 from the north portico and D1569 from the nave). They concluded that while individual deposits were homogenous in character they were distinctive from one another. Because the baths basilica lacked the rubbish pits identified at other Romano-British urban centres, Silchester (Boon 1974: 90) for example, it was proposed that municipal waste collection took place at *Viroconium* (Barker *et al.* 1997: 195). Waste disposal within Roman towns and cities was organised by the *ordo*, and at *Viroconium* this responsibility may have been assumed by whatever authority resided at the Phase Z complex.

To meet the requirements of urban victualling, a large-scale butchery industry developed during the Romano-British period (Maltby 1979: 87, 1984a: 199, 1985a: 20 & 27, 1989: 75 & 1994: 89). This trade almost certainly employed skilled professionals. However, it has been suggested that this trade was characterised by unnecessary and superfluous butchery, which has been described as ‘crude’ (Serjeantson 1989: 4) and lacking ‘finesse’ (Done 1986: 144-145). Seetah (2002: 67-68), who conducted experimental butchery to replicate urban Romano-British techniques, has challenged this interpretation. Any ‘crudeness’ would have resulted from external pressures, such as economic demand, rather than poor butchery technique; efficiency and economy of effort were the primary concerns (Seetah 2002: 5). A

rural-urban distinction, especially on earlier sites, has been identified. Knives were more commonly used on rural sites and cleavers more so on urban sites (Maltby 1985, 1989 & 1994; Thawley 1982: 217). It is thought that rural knife use was essentially a continuation of indigenous Iron Age butchery practices (Maltby 1981a: 149-152; Wilson 1978: 119-122). The majority of butchery marks at the baths basilica site were heavy chops (Figures 49-53; Tables 47, 75 & 94). This indicates most carcase reduction was carried out using the ubiquitous Romano-British cleaver, which was well suited to the task in hand. Most butchery centred on the dismemberment of carcasses and their division into small portions suitable for cooking (Figures 44-48; Tables 48, 76 & 95). Detailed analysis of cattle butchery from the baths basilica, using Maltby's (1989) Romano-British butchery study and classification, demonstrates mass repetition of certain butchery marks, such as the severing of the femur head (Figure 50). This might indicate that butchery was conducted on an industrial-scale in close proximity to the baths basilica or that municipal waste from large-scale butchery was being dumped nearby.

Barker *et al.* (1997: 230) suggested the one permanent building within the shell of the baths basilica during Phase Y was a municipal office, where taxation in kind was collected. Late Romano-British taxation in kind, or *annona*, developed as the moneyed economy and ability of officials to collect taxes started to disintegrate (see Jones 1964: 448-462). In addition, one possible late Romano-British use of the *frigidarium* was as a granary (Barker *et al.* 1997: 236); Wright (1872: 121) discovered large quantities of grain in the structure. The former 'baths service area' had a series of substantial buildings constructed on it. These may have had agricultural or industrial uses, and may have been storage facilities for collected *annona* (Barker *et al.* 1997: 236). In addition to the storage of agricultural products, a certain amount of crop processing also appears to have occurred. Bushe-Fox (1913: 6-7) excavated a corn-dryer in *insula* 8. The archaeobotanical evidence from the baths basilica provided evidence for both processing and storage of the finished product (Charles *et al.* 1997: 340). The composition of the Phase Y (and Phase Y-Z) vertebrate assemblage, in terms of anatomical distributions, mortality profiles and butchery evidence supports this interpretation: whole carcasses and possibly live animals were present and were being dismembered and processed into joints of meat for cooking. However, because the composition of the Phase Y assemblage is not significantly different from the remainder this remains tentative.

The archaeobotanical evidence slightly contradicts the overall impression that the later phases centred around high status activity, be it tax collection or palatial residence. Relatively high quantities of rye were identified (Charles *et al.* 1997: 339). Pliny considered rye a low status dietary supplement (see White 1970: 339). However, this may simply reflect the baths basilica as a collection of all forms of agricultural produce or alternatively rye may have been used as fodder for high-status horses.

In many respects, the early medieval archaeology from the baths basilica mirrors that from many post-Roman villa sites, in terms of social function not agricultural production. The plan of Building 10 clearly parallels many late Roman villas from the Continent (see Chapter 1), for instance. As with the 'great rebuilding' (Phase Z) at the baths basilica, late Romano-British and post-Roman villa activity is generally associated with high status residence; supposedly the urban elite abandoned the cities for their villa estates (Higham 1992: 47 & 56-59; Millett 1992: 203) and this trend may have continued with the inappropriately named 'squatter' occupation of some villa sites into the 5<sup>th</sup> century AD (Esmonde-Cleary 1989: 134).

Craft working of animal by-products was a very important economic function of most Romano-British and medieval (plus later) urban centres (see Cherry 1991; Deschler-Erb 1997; MacGregor 1989, 1991 & 1999; Reed 1972; Serjeantson 1989). This trade centred on the acquisition of raw materials, plus the production and trade of horn, antler, bone and leather objects. Increasingly, the importance of marrow fat products at Romano-British urban centres has also been recognised (Dobney 2001: 39-40; Dobney *et al.* 1996: 27; Maltby 1979: 39; Saint-Germain 1997; Stokes 2000: 69). Despite this, anatomical distributions and butchery evidence from the baths basilica suggest little craft activity. No large-scale 'industrial' craft working has been identified in the city (White & Barker 1998: 56), although there is some evidence to suggest tanning was occurring in close proximity to the baths basilica. A series of pits (A196, A241, A244, A252, A318, A332, A332-1a and A345) and adjoining gullies (A332, A332-1, A333 and A336), dating to Phase Y, were discovered between the precinct wall and the north-south street on the eastern side of *insula* 5. The presence of a dog coprolite from soakaway A345 supports the tanning interpretation (Barker *et al.* 1997: 122-124). Because tanning is a particularly unpleasant process, it would presumably have been located away from the public buildings and central *insulae*. It is interesting to note that the industrial activity is contemporary with the use of the baths basilica as a market place, lending further support to it being a centre of commerce.

A cattle market (*forum boarium*) within *Viroconium* has been tentatively identified: a large rectangular enclosure, measuring 168m by 152m, north of the baths has been known about since the advent of aerial photography in the 1950's (White & Barker 1998: 92). It would be interesting to carry out further fieldwork to determine whether or not the possible *forum boarium* actually served that purpose and, if so, how long that function persevered. Archaeological features identified at Exeter mirror the possible *forum boarium* at *Viroconium*. Fourth century AD features excavated at Exeter's Guildhall site have been interpreted as stockyards and enclosures, and may represent cattle husbandry within the city itself. Maltby (1979: 90) interpreted these features as possible evidence for the stagnation and even collapse of Romano-British redistribution and marketing systems, in contrast with the overall interpretation of late Romano-British and early medieval *Viroconium*. If Phase Y of the baths basilica represents a collection point for *annona* (and centralised control), it certainly reflects the evolution of classic Roman infrastructure, but in no way does it signify a collapse, quite the opposite in fact.

O'Connor (1988: 86) also suggested that an economy based on the multi-purpose exploitation of cattle (with no specific emphasis placed upon meat, milk or traction) may be indicative of the absence of large-scale centralised marketing. This is not the case at *Viroconium*. Anatomical distributions and butchery evidence suggest large-scale carcase processing. The architectural evidence from Phases Y and Z may also support the view that many activities (including victualling) were centrally organised, i.e. the composition of the building platforms and dumps having derived from municipal collection. The later Roman and early medieval baths basilica at *Viroconium* functioned differently to other late Romano-British urban centres. The control of the agrarian economy and maintenance of distribution networks may have fluctuated greatly from region to region in the later Romano-British and early medieval periods. This fits well with the gradual and progressive de-centralisation of the administrative (and military) system in Britain during the later empire. Britain was divided into four provinces in the early 4<sup>th</sup> century AD (*Britannia Prima*, *Britannia Secunda*, *Maxima Caesariensis* and *Flavia Caesariensis*), with the addition of *Valentia* at the end of the century (see Salway 1993: 217-218).

### 12.3. The 'economic geography' of *Viroconium* and its hinterland

All the evidence provided by the vertebrate remains from the baths basilica confirms that the site was a major consumer of agricultural produce throughout its history. Inferring the nature of agricultural production from the point of consumption is particularly complicated (see O'Connor 2003: 79-83). In the case of *Viroconium*, because so few sites within its hinterland have been excavated and bone preservation in the region is poor, it is necessary to work from this problematic database. The earlier phases (Phases T-V and W) conform to the pattern normally identified at other late Romano-British urban centres. The later phases (Phases X to Z) also conform to this pattern, although there are subtle differences, some of which arguably reflect changes in the agricultural economy and control of resources/hinterland (see below). In regard to the pastoral economy, the principal demand from the settlement was for meat, which must have surpassed all others, although secondary products may have been of some importance (judging from the mortality profiles from the baths basilica). It has to be remembered that mortality profiles derived from 'consumer' assemblages will likely under-represent the secondary products contribution.

Victualling was organised around beef. In the earlier phases (Phase T-V and W), cattle dominate the baths basilica assemblage, followed by sheep and then pig (Figures 28a-b; Tables 30-31 & 33a-b). This situation continues essentially unchanged into the early medieval period, despite the changing function of the baths basilica itself. One of the few possible changes in the procurement and supply of meat to the settlement is that sheep were replaced by pig as the second most common domesticate (Figures 28a-b; Tables 30-31 & 33a-b). As discussed above, this may reflect changing tastes, rather than changes in the agrarian economy or the ability to control resources. This interpretation becomes more likely, if cattle mortality profiles are considered (Figures 37-38; Tables 43-44): the later phases contain higher frequencies of immature individuals, indicating relatively gourmet consumption (see above), thus demonstrating no decrease in the ability to control resources supplied from the hinterland. All anatomical elements are represented in the assemblage indicating that either whole carcasses or live animals were introduced to the town (Figures 31, 83 & 114; Tables 37, 65 & 84). In all likelihood, the latter scenario is correct and live cattle and sheep were driven to *Viroconium* for slaughter. When mortality profiles are considered, it appears though live cattle, and the majority of sheep, were driven to the city for slaughter, whereas pigs were bred within the city itself (Figures 37-38, 89-90 & 120-121; Tables 43-44, 71-72 & 90-91). Pig mortality profiles indicated the presence of a breeding population, whereas there is only tentative evidence for the presence of very young sheep within *Viroconium* (articulated skeletons, etc).

The vast majority of cattle, pig and sheep butchery evidence derives from dismemberment, using the ubiquitous Roman cleaver (Figures 43-48; Tables 47, 75 & 94). The reliance upon cleaver butchery remains unchanged throughout, notwithstanding increased knife butchery in the later phases (see above). This suggests that a more labour-intensive butchery technique was adopted along-side traditional urban butchery techniques at the baths basilica. No obvious functional reason for this has presented itself; metallurgical techniques remained unchanged, as did the general conformation of the livestock. Therefore, a changing cuisine reflecting shifting cultural proclivities may be responsible. As victualling appears to have become a more consumer-led affair with younger and more delectable animals finding their way to the urban market, it is not unreasonable to surmise that an increasingly discerning population also demanded better quality cuts of meat (indicating direct control of resources). As Seetah (2002) has aptly demonstrated, typical urban Romano-British butchery techniques centred on rapidity to meet the

demands of a mass market. Increased cutting and filleting fits well with the overall archaeological interpretations of Phases Y and Z (see above).

There appears to be a shift in the sex composition of cattle supplied to *Viroconium* between the earlier and later baths basilica phases. Based on the morphology of the pelvis and metacarpal shape indices, cows dominate the assemblage throughout (Figures 39-40; Table 45). Large numbers of cows and smaller numbers of males appear to be the norm in Romano-British urban assemblages (Grigson 1982: 10-12); the results from Colchester (Luff 1993: 58-59, Figures 4.11-4.13), Exeter (Maltby 1979: 33-34, Figures 5-6) and Portchester Castle, Dorset (Grant 1975: 401) seem to confirm the preponderance of cows on Romano-British sites. Varro (*Rerum Rusticarum* II.10-12; Hooper & Ash 1993: 374-375) suggested a ratio of two bulls (one yearling, the other a two year old) to 70 cows, and Columella (*De Re Rustica* VI.24.3; Forster & Heffner 1968: 185) gave a ratio of one bull to 15 cows for the breeding herd. However, the husbandry regimes behind these ratios were not implicitly stated. Presumably, sex ratios would have been more equal in many cases, if males were reared to adulthood for mature beef or as oxen (see below).

At *Viroconium*, the frequencies of male cattle increase in the later phases (Figures 39-40). In all the baths basilica phases, and particularly the later phases, pathological condyle splaying almost exclusively affects larger individuals (Figures 41-42). Exploitation of cattle as draught animals is the principal cause of this condition. Oxen (and to a lesser extent cows) are traditionally used as draught animals because bulls are difficult to control and are potentially dangerous. However, there is some evidence to suggest bulls were used as draught animals in the Roman period; Bartosiewicz *et al.* (1997: 96) quoted Ferdière (1988) – a late 3<sup>rd</sup> century AD mosaic from Cherchel, Algeria depicts men having to control ploughing bulls with sticks and whips.

If higher proportions of male draught animals were being supplied to *Viroconium* in the later phases this implies either a change in the agrarian economy or the inability to control resources. Interestingly, Bartosiewicz *et al.* (1997: 119 & 121) concluded that only older animals that were exclusively utilised for draught exploitation produce observable osteomorphological deformations. This has obvious implications for beef quality, so is unlikely to reflect a consumer-led change in the marketing of beef. This would appear to contradict the interpretation put forward above that increased beef marketing/heightened consumerism resulted in greater frequencies of pre-adult cattle from the later phases at the baths basilica (see below). If pensioned-off plough oxen were being supplied to *Viroconium* it might indicate that the inhabitant's ability to control resources was not all pervasive.

This increase in immature cattle has also been noted at several other late Romano-British sites, such as intramural Colchester (Luff 1993: 57), Exeter (Maltby 1979: 30-31), the General Accident site, York (O'Connor 1988: 86). Maltby (1979: 90) offered an alternative explanation suggesting that the increase of pre-adult cattle may be due to a downturn in arable agriculture and grain production. Maltby (1979: 90) concluded, after considering the possibility that stockyards may denote cattle husbandry within Exeter,

*'... it can be argued that the redistribution of food surpluses was on a more limited scale and that the urban and rural dichotomy in animal products may not have been as significant in this period. It is unlikely, however, that there was a complete collapse of the redistribution and marketing systems at that time. Nevertheless the late Roman period may have been a time of agricultural decline in the area.'*



However, castration may have delayed post-cranial fusion and the increased prime-beef supply in the later baths basilica phases suggests effective consumer-led demand, rather than a passive by-product of regional farming, so the frequencies of oxen cannot be used as a measure of arable production. The bath basilica archaeobotanical evidence indicates no obvious down turn in the arable economy (Charles *et al.* 1997: 339-341).

Even if there was some form of stagnation in the agrarian economy in *Viroconium's* hinterland during the early medieval period, it did not extend to animal husbandry practices. All the biometrical evidence obtained for the major domesticates demonstrates no decrease in size between the late Romano-British and early medieval periods (Figures 54-59, 97-103 & 127-132; Tables 56-61, 77-81 & 96-100). However, as the *Viroconium* animals were unimproved indigenous types a distinct and identifiable decrease in size might not be readily apparent, if the agrarian economy stagnated. The minor domesticates also demonstrate no change (Figures 151-157). However, it has to be borne in mind that livestock from *Viroconium* essentially represent unimproved indigenous pre-Roman Iron Age types, when compared to contemporary assemblages from central and southern England (Figures 68-79, 109-111 & 140-148). So, despite *Viroconium* being the fourth largest Roman city in Britain, its agrarian economy apparently was not subject to the same agronomic or economic influences that affected other regions (especially the east – west dichotomy). This may well be due to *Viroconium's* location on the periphery of the empire. Almost all the evidence for breed improvement during the Romano-British period comes from the south and south east of England. For the most part, these improvements may have occurred through advances in husbandry techniques, i.e. selective breeding. In some instances, this process may have been 'jump-started' by imported continental stock in the early Romano-British period, for example at Great Holts Farm, Essex (Albarella 1997: 6).

The continued persistence of unimproved livestock types at *Viroconium* cannot be due to harsh environmental conditions. There would have been no need for smaller and hardier animals because Shropshire has always been considered excellent cattle country due to the richness of its low-lying pasture (see Robinson 1916). Despite the region being more than capable of producing an agricultural surplus, a settlement the size of *Viroconium* would have put considerable strain on the agrarian economy in its hinterland. If *Viroconium* was as densely populated as the recent geophysical surveys suggest (White & Barker 1998: 71) victualling demands on the hinterland would have been substantial. This strain would have been further exaggerated because Chester may have also been competing for the same resources (up to the early 5<sup>th</sup> century AD). Conceivably, *Viroconium* would have been supplied with livestock from a wide geographical area. This may have even encompassed the Welsh Marches and northern Wales. One can almost envisage an early progenitor of the post-medieval Welsh cattle droves via Oswestry (see Bonser 1970; Colyer 1976; Hughes 1988) existing in the late Romano-British and early medieval periods.

Middle Saxon Southampton (Hamwic) also provides an interesting comparison regarding possible rural – urban supply and redistribution networks. The large homogenous bone assemblages from Hamwic consisted almost exclusively of adult and elderly domestic animals. Anatomical distributions indicated that animals were driven to the settlement 'on-the-hoof' and that craft working was a central activity. The meat supply was adequate, but uninspired: a repetitive diet based on animals past their prime. From this, Bourdillon (1988: 183 & 1994: 122) inferred that the Hamwic population was totally detached from agricultural production and had no direct control over the victualling of the town. It has been suggested

that middle Saxon Hamwic represented a settlement of artisans beholden to the king of Wessex, who resided at Winchester. The king of Wessex ensured Hamwic was supplied with animals, which formed taxation in kind under the feudal system (Bourdillon 1988: 190-191). Hamwic was then compared to two other emporia-type settlements from northern Europe to consider supply and distribution further: Viking Haithabu and Carolingian Dorestad (see Bourdillon 1988: 188 & 1994: 123-124). To summarise, Haithabu was supplied with butchered meat from special large farms and Dorestad had large farms on its periphery, making it virtually self-sufficient. All three cases differ in some respect from the situation at early medieval *Viroconium*, where an élite was in residence and victualling was centrally organised through commercial activity, and possibly taxation in kind (as suggested by the archaeological and animal bone evidence). The evidence from the baths basilica suggests there may have been similar elements to the early medieval examples cited above: a large population detached from agricultural production, possibly supplied with an adequate, but basic diet (adult and elderly cattle, and adult sheep). Overall, early medieval *Viroconium* gives the impression that there was a small high status component (with a liking for young beef, suckling piglet, hunted game and meat-off-the-bone). Also there was a larger 'proletariat', which maintained or was supplied with a typical late Romano-British urban diet (mature beef and mutton, butchered with the ubiquitous cleaver). As White & Barker (1997:125) surmised, the possible church at the *frigidarium* implies a congregation was present.

The probable barbary ape from Phase Y-Z suggests that during the early medieval period long distance trade routes well beyond *Viroconium's* immediate hinterland were maintained for reasons other than the acquisition of basic commodities. The Navan Fort barbary ape has been interpreted as further evidence for a sea-trade route between northern Ireland and the western Mediterranean world. Raftery (1997: 123) thought it extremely unlikely that a barbary ape would have been transported overland because such a journey would have been detrimental to its physical well-being. Its health would have been a principal concern because it must have been a valuable commodity (however, the modern trade in exotic animals demonstrates that this is not necessarily the case). It is tempting to explain the presence of the *Viroconium* specimen in similar terms. If the date of the baths basilica specimen is correct, it would have either travelled up the River Severn or arrived at the post-Roman port and trading centre of Meols (see Chapter 1). The ape would have originated from north Africa because they were not introduced to Gibraltar until later (Fiedler *et al.* 1979: 382). If this interpretation is correct, it would confirm the post-Roman importance of *Viroconium* and its ability to control resources through long-distance trade, as evidenced by other finds categories (see Chapter 1), such as the Palestinian amphora (Barker *et al.* 1997: 237; White & Barker 1998: 128).

Villas in Cornovian territory certainly underwent redevelopment during the 4<sup>th</sup> century AD (White & Barker 1998: 110). As previously mentioned, the only extensively excavated late Romano-British villa excavated within *Viroconium's* hinterland is Whitley Grange (see Chapter 1). Whitley Grange does not conform to a villa centred on agricultural production. It was a sumptuous building with courtyard, baths, colonnade and good quality mosaics. White & Barker (1998: 111) have interpreted it accordingly, '... it was a 'holiday cottage'. The wealthy owner of the site could ride out from Wroxeter, on horseback, and perhaps spend time with friends hunting and fishing ...'.

However, '... by no stretch of the imagination can it be called a farm' (White & Barker 1998: 111). Some support for this view can be derived from the work of the late Tony Maguire who carried out a GIS

analysis of the occurrence of enclosures in *Viroconium's* hinterland in relation to *-leah* placenames (Maguire 2003). Names ending in *-ley* are indicative of woodland clearance in the Anglo-Saxon or later period (Gelling 1978: 126-128). Maguire's (2003) analysis demonstrated that the distributions of *-leah* names and enclosures were virtually mutually exclusive in Wroxeter's hinterland and thus Whitley Grange is unusual in being a Romanised settlement in woodland. From this Maguire (2003) concluded that the Whitley Grange villa was located in a wooded environment so as to provide hunting grounds. Adjacent late 4<sup>th</sup> century AD villas at Cruckton, Lea Cross and Yarchester have all produced fine mosaics, thus hinting at similar high status use (White & Barker 1998: 112). Presumably, some of the late villas within *Viroconium's* hinterland must have been connected to agricultural production, unless they were completely superimposed on the landscape and the hitherto even more invisible indigenous settlement types generated all the produce.

On the Continent in particular, late villa estates appear, in some instances, to have been the basis for the development of medieval villages. A particular type of double courtyard villa found in Gaul (and Germany), especially in Picardy and Aquitaine, suggest the patron-client form of social structure found in the region during the late Iron Age was perpetuated in the Roman period (King 1990: 95). This was the main means of organising agricultural production and may have continued into the early medieval period (Harmand 1988; King 1990: 95). However, the directness of this transition has been questioned along similar lines to the continuity debate regarding late Romano-British towns and early medieval settlements (see Percival 1992). The high status residence at the baths basilica may have fulfilled a similar central place function with regard to the numerous farmsteads in the hinterland (see Chapter 1), although this cannot be substantiated.

## **12.4. The 'cultural identity' of *Viroconium's* population**

As demonstrated above, the agrarian economy, supply and marketing of agricultural produce at *Viroconium* appear to have suffered no ill-effects with the 'official' demise of the western Roman empire in the early 5<sup>th</sup> century AD. Therefore, other explanations have to be sought for changes in the composition of the vertebrate assemblage.

### **12.4.1. 'You are what you eat'**

The preferred choice of cuisine for any individual or group is culturally defined, rather than 'agronomically' determined. The expression 'cultural' obviously encompasses a broad range of social constructs, including ethnicity, social stratification and religious proclivities, as Gerritsen (2000: 170) stated, '*... food and eating habits often function as a lens, a means of analysing broader social and cultural patterns and processes*'. However, identifying these societal constructs is considerably more difficult than simply reconstructing modes of production and redistribution (see Teuteberg 1986: 12). Chapter 2 discusses these issues at some length and considers how they might be elucidated from archaeological food residues. The following section discusses dietary cultural changes at *Viroconium*.

### **12.4.2. Changing fashions**

No society remains static; social structures develop and fashions evolve whether they are architectural, personal or culinary. Understanding such changes has often been hampered by the intransigence of traditionally defined historical epochs and their associated material cultures (see Cool 2000: 54;

Esmonde-Cleary 2000: 89; Jones 1997: 27 & 29), and the late Romano-British and early medieval transition is no exception. When attempting to understand this paradigm, it is essential to take a holistic approach. No specific finds category can be analysed in isolation, if this transitional period is to be fully understood, therefore an integrated method is a necessity (however, this has not always been achieved). The need for an integrated approach extends to zooarchaeology (Maltby 2002; O'Connor 2003: 213; Stallibrass 2000: 79).

Early post-Roman finds assemblages are particularly difficult to identify for a variety of reasons (see Chapters 1). To summarise, the 'use-life' of late Romano-British artefacts may have had greater longevity than previously thought, intrinsically datable finds are not so abundant and the architectural evidence becomes more ephemeral, as stone structures fell out of favour. Cool (2000) identified certain trends when considering the functional composition of early 4<sup>th</sup> to mid 5<sup>th</sup> century AD finds assemblages from northern Britain. In the late 4<sup>th</sup> century AD new types emerged, such as penannular brooches and beads, and other types became significantly more popular, such as bone bracelets, black finger rings and counters/spindle whorls of Samian pottery, whereas others decline, such as hair pins. There appears to be a distinct shift towards the colours black and red. Black jewellery is very unusual in the earlier Romano-British period and, although broken Samian was widely available from the mid 2<sup>nd</sup> century AD, its popular re-use did not emerge until much later (Cool 2000: 53-54). Conceivably, the black and red trend extends to the baths basilica vertebrate assemblage. It may be the case that animals, such as mole, badger (notwithstanding the possibility they were intrusive), red fox, black grouse and the corvids, were deliberately hunted because of the colour of their pelts/feathers. This is difficult to substantiate because of the problems of quantifying their relative importance, and certain other species with similar colourings, such as crane, only occur in the earlier phases. Conceivably, changing fashions incorporated more fur products than previously; hence the butchered red fox, badger and otter specimens occur in either Phase Y or Z. This must remain tentative, due to the small numbers of specimens involved.

Ravens are an especially interesting case-in-point. Raven remains are regularly encountered in small, but probably significant, numbers on many Romano-British sites. Conceivably, their presence may be due to scavenging and their commensal habits. However, Parker (1988: 203) suggested they may have been kept as pets. Ravens also appear to have played a ritual role in Roman society, for instance at the mid 5<sup>th</sup> century AD cemetery near Lugnano, Teverina, Italy. A total of 47 mostly neonatal inhumations were discovered with at least 12 puppies, a toad skeleton and a raven's claw (Soren *et al.* not dated). This ceremonial aspect apparently extended as far as Britain: Dunstable, Bedfordshire (Jones & Horne 1981: 69), Elms Farm, Heybridge, Essex (Johnstone & Albarella 2002: 41), Portchester Castle, Hampshire (Eastman 1975: 414), Sheepen Hill, Colchester, Essex (Luff 1982: 63) and The Lanes, Carlisle, Cumbria (Connell & Davis forthcoming: Table 1). In two cases (Dunstable and Sheepen Hill), white-tailed eagle (*Haliaeetus albicilla*) remains accompanied them. It is not inconceivable that ravens were therefore kept as pets or for ceremonial purposes at *Viroconium*. The latter use would clash with *Viroconium's* supposed Christian status in the early medieval period. Temples were despoiled in the 4<sup>th</sup> century AD and a possible church has been identified at the *frigidarium* (Barker *et al.* 1997: 237-238 & 124-125; White & Barker 1998: 107-108). However, *Viroconium's* Christian community may have been small and may have taken some time to become established because of its peripheral location, isolation from the principal ports and army centres (White & Barker 1998: 107-108).

As outlined above, the proportion of non-domestic species demonstrates a slight increase in the later phases: wild mammals increase from 2% of the total assemblage in Phase T-V to 10% in Phase Z and wild birds increase from 2% in Phase T-V to 3% in Phase Z. This is particularly evident when deer are considered (deer remains expressed as a proportion of their respective cattle, pig and sheep/goat assemblages): Phase T-V <1%, Phase W 1%, Phase X 2%, Phase X-Y 2%, Phase Y 3%, Phase Y-Z 3% and Phase Z 3%. By concentrating on deer, the possibility of accidental inclusions (a problem with smaller species of mammals and birds) is avoided. Despite falling below the 5% threshold noted by King (1978: 216), there is a steady increase. The agrarian economic downturn/increased wild resource exploitation explanation for the 4<sup>th</sup> and 5<sup>th</sup> centuries AD, postulated by Grant (1981: 208), Jones (1978: 304-308) and Rostovtzeff (1958: 476-477), can largely be discounted (see below), so other explanations have to be sought.

The increased frequency of deer remains at *Viroconium* is not an isolated phenomenon. King (1978: 216) stated that the proportion of deposits that include deer remains increases from 39% in the 1<sup>st</sup> century AD, through 53% in the 2<sup>nd</sup> century AD and 71% in the 3<sup>rd</sup> century AD, to 79% in the 4<sup>th</sup> century AD. Villa sites, especially, often show a definite increase in the frequency of deer remains. At Chalk villa, deer bones increase from 5% to 13% during the final phase of occupation in the 4<sup>th</sup> century AD (Eastham 1972: 142). While at Latimer villa the frequency of deer bones increases from 4% to 19% by the late 3<sup>rd</sup> century phase. The two post-Roman phases at Latimer produced frequencies of 14% and 21% (Hamilton 1971: 164, Table 8). The increased utilisation of wild resources in the late Romano-British and early medieval periods therefore denotes something other than hunting out of necessity because the pastoral economy was still more than capable of supplying *Viroconium* (see above).

Grant (1981: 209) also considers changing cultural attitudes towards hunting and accepts that hunting for purely social reasons, such as status and pleasure, was an important factor in the exploitation of deer in pre-Roman Iron Age and Roman Britain. However, Grant (1981: 209) infers that hunting fell out of favour in the Romano-British period, as the indigenous aristocracy adopted Classical lifestyles, quoting the low number of deer remains at Fishbourne (Grant 1971: 378, Table 1) as evidence. Grant (1981: 210) concluded that:

*'We might be seeing important cultural differences between, for example the Romanised Britons and the Romans themselves, but also evidence that although medieval deer hunting was ostensibly a luxury, it may have fulfilled an important economic function that was not necessary or appropriate in Iron Age or Roman Britain'.*

More recent research suggests that the dichotomy between Roman and medieval attitudes towards hunting may be more imagined than real, for example hunting appears to have been actively pursued at Chedworth villa, Gloucestershire (Hammon 2002). The relative scarcity of deer remains on Romano-British sites may have occurred because the hunted deer were dismembered where they were killed. However, Grant (1981: 209) considered this an unlikely possibility, claiming that transporting a whole carcass would have been easier: the East Coker mosaic shows a deer strung underneath a pole by its legs being carried by two men (see Burke 1978: 72, Figure 57; Scott 1977: 204, Figure 87).

The range of dog types in the later baths basilica phases may also be evidence for the development of a hunting mentality. Small dogs are most frequent in Phases Y and Z. This confirms the trend identified by Clark (1995: 13 & 17): small dogs were especially common in the 4<sup>th</sup> – 5<sup>th</sup> centuries AD. This

continued into the 6<sup>th</sup> – 7<sup>th</sup> centuries AD. However, the ‘miniature’ dogs identified at the baths basilica were stocky robust individuals, quite different from the ‘house’ or ‘lap’ dog. These individuals gave the impression of being terrier-type dogs (all specimens were robust, and all the femurs demonstrated characteristic ‘bowing’ – Terry O’Connor pers. comm.). Perhaps they were deliberately bred for ratting and badger baiting, etc. Tentatively, Phase Y produced a particularly large dog (although wolf has yet to be completely discounted; see Chapter 10). It is tempting to think this individual was akin to a modern wolf- or deer-hound.

Cut marks indicative of filleting increase, as do high utility elements. An increase in the proportion of cut marks might represent a shift away from typical Romano-British butchery techniques. As previously stated there is no utilitarian or functional reason why there should be an increase in knife-use and filleting meat-off-the-bone (see above). It would therefore appear as though changing butchery patterns were also due to changing tastes. Tentatively, this might gain credence because the small numbers of butchered red fox, badger and otter specimens all occur in either Phase Y or Z. It is interesting to note that all the butchered specimens of equid, dog and cat also occur in these phases. According to Simoons (1994: 187), the Romans (from the Italian peninsula) were disgusted by the thought of eating horse-meat, but this sentiment was obviously waning at *Viroconium*.

## 12.5. Summary

The extraordinary nature of the late Romano-British and early medieval activity at *Viroconium’s* baths basilica has produced an equally singular vertebrate assemblage. The uniqueness of the assemblage is principally due to:

1. The physical size of the assemblage, and its resultant datasets, placing it in the upper spectrum of British vertebrate assemblages
2. Its ability to aid the interpretation of the archaeological evidence from the site
3. The extreme paucity of vertebrate assemblages recovered from the region because of the underlying geology
4. The chronological period that the material covers which provides a rare opportunity to consider a transitional period for which there is little empirical evidence

The information potential and interpretative value of the baths basilica assemblage is thus considerable. The baths basilica vertebrate assemblage is therefore important locally, regionally and nationally.

This study has been partially successful in redressing the criticism that to understand societal change it is crucial to develop perspectives and hypotheses that go beyond the simple reconstruction of production and distribution (see Gerritsen 2000; Hamilakis 1999; Hastorf 1991; Meadows 1994; Parker-Pearson 2000). Gosden’s (1999) gloomy protestation that it may not be possible to overcome the dichotomy between ‘nature’ and ‘culture’ was almost certainly overly pessimistic.

The culinary habits of *Viroconium’s* population appear to have remained virtually unchanged in the early medieval period. This was despite the massive social, political and economic upheaval affecting Britain as a whole. However, the consumption of animal products is only one aspect of cuisine. Other facets of late Romano-British cuisine would have been greatly affected by the transition, such as the continental trade in wine and olive oil. Undoubtedly, the predominant reason for *Viroconium’s* unchanged ‘meat’ cuisine will have been because agricultural production was localised and so would have suffered less

during this turbulent period. However, other social factors would have also had a bearing on the situation.

It has been claimed that the dietary and culinary practices of any society are particularly 'resilient and conservative' (Hesse 1986: 17) and undergo '*... subtle change in a prolonged and almost imperceptible fashion*' (Teuteberg 1986: 11). Modern ethnographic studies have generally supported this supposition, for instance the work of Tangires (1998) and Theodoratus (1981) on the dietary trends of Greek immigrants to America, and Ziemann's (1998) study of cuisine in eastern Germany pre- and post-reunification in 1989. The former German Democratic Republic (GDR) is an interesting case (see Chapter 2). After the initial fall of the GDR there was a rush for everything western, but with regard to food this soon dissipated and people switched back to their former diet. Ziemann (1998: 271) concluded,

*'Consumers are reverting to familiar tastes and regional products and specialities. Nostalgia and feelings of local identity, as well as the desire to support their own economy, can be seen as the main reasons ...'*

The continuity debate has plagued the study of late Romano-British urbanism in British archaeology for the last 25 years (see Chapter 1). In some respects the obsession of some researchers with endlessly debating how long Roman institutions and administrative structures persisted beyond the mid 4<sup>th</sup> century AD has hampered the advancement of our understanding of the late Romano-British – early medieval transition. A fixation with semantic arguments (i.e. what constitutes continuity?) and no consensus on how far the concept of *Romanitas* had permeated through the indigenous population add additional confusion. This situation has been further compounded by the dearth of post-Roman archaeology (or our inability to identify it positively). Consequently, five broad models have developed (see Chapter 1), to summarise:

1. Roman Britain gradually declined and ceased to exist by AD 450 (stagnation of the economy and social structures); late 4<sup>th</sup> century AD Germanic migration led to the Saxon dominance of England by the 7<sup>th</sup> century AD (see Alcock 1973; Frere 1967; Millett 1992)
2. Roman Britain prospered until AD 400 and dramatically collapsed around AD 430, with no overlap between a functioning Romano-British province and the evolution of the Anglo-Saxon kingdoms (see Bassett 1989; Casey 1979; Esmonde-Cleary 1989 & 2001)
3. Roman Britain started to transform from the 3<sup>rd</sup> century AD, classical urbanism had floundered by the 4<sup>th</sup> century AD (urban centres becoming 'administrative villages'), *Romanitas* was a short-lived trend and the indigenous population gradually adopted Germanic fashions (see Faulkner 2000; Reece 1988 & 1996)
4. Some aspects of the Roman administrative system persevered into the 5<sup>th</sup> century AD and Britain became divided into an eastern half, dominated by Christian elites, and the west/north, centred on un-Romanised pagan aristocracies (see Higham 1992 & 1999)
5. Britain between the 4<sup>th</sup> and 6<sup>th</sup> centuries AD underwent the same religious, cultural, political, social and economic transition as did continental Europe, i.e. Late Antiquity (the emergence of the Frankish kingdoms and the continuance of the eastern Roman empire, etc) (see Dark 1994 & 2000a)

Analysis of the baths basilica vertebrate assemblage and reconstruction of *Viroconium's* agrarian economy and victualling provides the opportunity to assess these models. As discussed previously, pastoral farming in *Viroconium's* hinterland appears to have been largely unaffected by the passing of Roman institutions and administrative structures. Husbandry practices were constant throughout because the size of the major domesticates did not alter (Figures 54-59, 97-103 & 127-132). The composition and nature of the animals reaching *Viroconium* would indicate that the distribution network, encompassing the

road system, was either maintained or remained functional for the period in question. Both aspects suggest that neither the first nor second model is correct because the agrarian economy apparently continued unimpeded into the 6<sup>th</sup> and 7<sup>th</sup> centuries AD; cessation of activity at *Viroconium* certainly was not ‘... *nasty, brutish and short*’ to quote Esmonde-Cleary (1989: 161). However, such models have tended to centre on the coin evidence, imported goods and indigenous potteries, such as those producing Oxford and Nene Valley wares, and may therefore not be wholly applicable. Conversely, the proposed development of the *annona* system at *Viroconium* would support the view that Roman political and economical institutions had ceased to exist.

In some respects, the evidence provided by the vertebrate remains cannot be used to evaluate the third model. However, the wider archaeological evidence from the baths basilica would outwardly support the proposition that the classical urban ideal was superseded by the ‘administrative village’ within Romano-British towns, albeit later than the 3<sup>rd</sup> – 4<sup>th</sup> century AD date suggested.

The increased proportion of younger cattle (Figures 37-38) and the increased consumption of pork (Figure 28a-b) at the baths basilica supports the interpretation of the ‘great rebuilding’ as a high status residence. Combined with the fact that the distribution network appears to have remained largely intact (see above) and that institutions or persons in residence were able to control the hinterland, it would seem that *Viroconium* has some commonality with the fourth model. Whether or not the early medieval settlement at *Viroconium* represented a Christian or pagan presence remains to be seen, and cannot be explored directly through the vertebrate remains. However, the possible church within the *frigidarium* may attest the former (see above). Additionally, activity at the baths basilica might push the 5<sup>th</sup> century AD date for the continuation of Roman institutions beyond that date. With the possibility that early medieval *Viroconium* maintained trade links with the continent (via the port at Meols or the River Severn), hence the probable barbary ape, it would appear that something akin to ‘Late Antiquity’, as outlined in the fifth model, did indeed exist in parts of Britain. However, 5<sup>th</sup> – 7<sup>th</sup> century AD activity at the baths basilica hardly constitutes the high developed situation that emerged on the continent. Perhaps the old adage that is often applied to Norse activity between the 8<sup>th</sup> and 10<sup>th</sup> centuries AD has parallels with the disintegration of Roman Britain; to paraphrase: ‘*different groups, doing different things, in different places at different times*’. No one model is adequate to explain myriad responses to the demise of Roman Britain and the eventual emergence of Anglo-Saxon England.

Overall, it is possible to ally various constituents of the scenario postulated at early medieval *Viroconium* (and its reconstructed animal economy) to all of the perspectives outlined above. As the evidence remains inconclusive in this respect, it may therefore be necessary to develop new models regarding the late Roman – early medieval transition in Britain. Perhaps the degree of fragmentation caused by the social and economic upheavals of the 4<sup>th</sup> and 5<sup>th</sup> centuries AD caused very different regional responses, which generalised perspectives cannot hope to encompass (see below). Collapse and transition may have occurred side-by-side. The demise of the Soviet bloc provides a modern analogy; Poland and Hungary underwent a gradual transition that pre-dated 1989 and are subsequently prospering 15 years later, whereas Russia and Bulgaria collapsed more suddenly and have not fared so well (decreased life expectancy, no real improvement in quality of life, etc).

People have tended to regard the history of Britain as a single entity, although it is becoming increasingly obvious that this was not the case. Britain was divided into four provinces in the early 4<sup>th</sup> century AD



(*Britannia Prima*, *Britannia Secunda*, *Maxima Caesariensis* and *Flavia Caesariensis*), with the addition of *Valentia* at the end of the century (see above). These sub-divisions exacerbated the diversity of development. Diocletian's reorganisation happened for a number of reasons: partly military (it would spread forces more widely though thinly across the regions which would in turn prevent revolts), partly economic (more efficient tax-gathering, especially since taxes had been commuted into payment in kind - *annona*). Regardless of the precise motivations, it is necessary to realise that the reforms also had unintended consequences. The new provinces each had their own army and governor, both of whom were answerable to higher echelons in London. However, devolved power, combined with the time-lag in communications, meant it was inevitable that these regions developed a certain degree of administrative autonomy which can only have increased with time.

During the 5<sup>th</sup> century AD, pressures on the frontiers began to overwhelm the authorities and superstructure; Imperial control was crucially weakened. Consequently, individual provinces began to organise their own affairs. In the east of Britain (*Maxima Caesariensis/Valentia*), the threat was from Germanic folk movements and in the west (*Britannia Prima*) it was from the Irish. Thus, when each province (and conurbation) came under pressure, each had to find its own solution. *Viroconium* may have employed Irish mercenaries, as evidenced by the early Christian tombstone of Cunorix with its Irish formula (Barker 1997: 237-238). In some respects, the east – west division within Britain mirrored the empire-wide situation, with the eastern Roman empire effectively abandoning the west.

As a consequence, 'Roman Britain' virtually collapsed as a single entity because the provinces had to develop their own responses to particular crises. Acting independently of the others, it was only a matter of time before each fell. However, *Britannia Prima* survived longest; it retained its overall cohesion throughout the 5<sup>th</sup> century AD (as at *Viroconium*, for example) and only began to fall apart in the sixth. The first stage in this process is that the province fragments into smaller units, some more Romanised than others, e.g. the 'Kings' of Bath, Gloucester and Cirencester defeated at the battle of Dyrham. Often these smaller sub-kingdoms were opposed to each other as much as to the Germanic immigrants: the Rowe Ditch, Herefordshire and Wats Dyke, Cheshire both belong to this era and are, significantly, aligned to prevent traffic coming from the west, not the east (Roger White pers. comm.). All the available evidence, including the vertebrate assemblage, would seem to indicate that *Viroconium* and its hinterland was one of the more successful (and more Romanised) polities. Ultimately, the survivors of this process gradually coalesced into the Welsh Kingdoms, notably Powys and especially Gwynedd. A power-struggle ensued between Powys and Gwynedd, which eventually overcame and absorbed early medieval *Viroconium*. The latter survived as an independent kingdom until it was finally conquered by Edward I in 1282.

## 12.6. Conclusions

The baths basilica assemblage was ideal for attempting to elucidate a zooarchaeological consideration of the late Romano-British – early medieval transition for two principle reasons. Firstly, archaeological investigation at the baths basilica identified extensive late Romano-British to early medieval deposits which appeared to demonstrate definite continuity of habitation and, secondly the excavations produced one of the largest vertebrate assemblages ever produced in Britain.

The late Roman *civitas* and early medieval settlement at *Viroconium Cornoviorum* is almost unique in Britain. It is virtually the only urban site where direct continuity between the late Roman and early medieval periods is clearly evident. It is perhaps the best evidence for the existence of a form of continental 'Late Antiquity' in Britain that currently exists, and cannot be easily dismissed by those sceptical to the concept of a form of continental 'Late Antiquity' existing in post-Roman Britain. The nature of activity is equally astounding. The sequence of events at *Viroconium* demonstrated how the central *insulae* and public buildings were completely transformed in-character to a private residence with restricted access. Conversely, the nature of the early medieval settlement illustrated that *Viroconium's* inhabitants perceived themselves as the rightful inheritors of Roman authority in the region. They actively demonstrated, and even promoted, their continued *Romanitas* into the 7<sup>th</sup> century AD (Roman architectural styles, etc).

The baths basilica site produced almost 800 'museum' boxes of animal bone (and the other *Viroconium* excavations have produced a similar quantity); 1600 'museum' boxes forms a very large assemblage! Because the assemblage has yet to be boxed by context it is not known exactly how many boxes constitute the sample considered in this thesis. The author feels it might represent approximately two-thirds (i.e. 528 'museum' boxes) of the baths basilica assemblage. Using a fairly draconian 'diagnostic zone' system (see Albarella & Davis 1994; Davis 1992) to record the chosen sample for this thesis almost 24000 fragments were recorded. To extrapolate, the entire *Viroconium* bone assemblage might produce something in the realm of 72000 specimens. A more inclusive 'every identifiable fragment' method would produce several times that number of identified specimens.

The research aims of this study were to elucidate the 'nature', the 'economic geography' and the 'cultural identity' of the baths basilica. In these aims this study has been largely successful. Analysis of the assemblage has demonstrated that the change in activity at the baths basilica (public building to private residence) caused some changes to waste disposal practices. The later phases of activity saw the consumption of meat and subsequent disposal of high utility elements on-site, where previously they were transported elsewhere. The demise of the Roman empire had virtually no effect on the site economy, husbandry practices and the ability to control resources (distribution networks, etc). The agrarian economy of the region appears to have carried on despite the upheaval and disruption of the Roman administrative system. This would indicate that the pastoral economy was effectively autonomous. The projection of the inhabitants' *Romanitas* into the early medieval period appears to have been more than just *realpolitik* (the pragmatic legitimation of their right to succeed and rule in place of the Roman administration) because in addition to architectural styles and continued use of Roman metalwork, etc, classic Romano-British cuisine and dietary habits persisted. This constituted a Germanised version of the Classical Mediterranean diet. Beef, followed by pork and then mutton dominated the diet. The most noticeable dietary trend to be modified was not what was consumed, but how it was consumed. There was a distinct shift from consuming meat-on-the-bone to meat-off-the-bone between the late Romano-British and early medieval periods, as evidenced by the disposal of high-utility elements and increased knife use to fillet meat from the bone. In addition, the early medieval phases saw *Viroconium's* inhabitants exploit wild resources to a greater extent than before. This occurred not for subsistence reasons (see above), but for cultural ones. Tentatively, the very late Romano-British population seemed

to acquire a hitherto undeveloped liking for hunting, which continued into the early medieval period and beyond.

This thesis has demonstrated how zooarchaeological data can (and should be) utilised to explore wider archaeological and historical questions. Specialist contributions should not merely be relegated to the back of reports as appendices; they should be integrated in and form part of wider synthesis. By carefully assessing material, formulating sampling strategies and applying appropriate methods it is possible to answer preconceived research questions. Rather than simply being a reaction to excavations producing animal assemblages, zooarchaeology can be instrumental in the advancement of archaeological knowledge and theory. Ideally this factor should be taken into consideration at the project design stage (i.e. the retrieval of suitable assemblages to address specific questions), but as the baths basilica analysis has proven in certain circumstances this is still achievable retrospectively.

## 12.7. Future research

Analysis of the baths basilica vertebrate assemblage contained within this thesis is far from exhaustive. The dataset could be utilised to explore and elaborate other aspects of the late Romano-British and early medieval occupation of the site. For instance, with the exception of splayed cattle metapodials no detailed consideration of pathology has been attempted. However, during the recording of the assemblage any specimen displaying pathology was noted on the database and separated out. It will therefore be possible to conduct a detailed cataloguing and description of these conditions in future. This might further elucidate our understanding of husbandry practices and the attitudes towards animals of *Viroconium's* inhabitants. It would also be an interesting exercise to explore the composition of individual building platforms from the early medieval settlement (Phase Z) in an attempt to identify differences between them, and even likely function. Such an undertaking would require considerable effort because the original excavation records held at Atcham (Shropshire) would have to be consulted. A detailed comparison between the baths basilica assemblage and any suitable contemporaneous Continental assemblages might aid our understanding of the extent to which 'Late Antiquity' actually existed in post-Roman Britain.

This study has also demonstrated several other areas where further research would greatly aid our understanding of *Viroconium* (and post-Roman Britain as a whole) and the research questions explored in this thesis. Re-analysis of the assemblage from the adjacent baths and *macellum* site excavated by Webster would be invaluable. Assessment of this material (see Chapter 2) demonstrated that the assemblage is of a comparable size to the baths basilica assemblage. Even with the possibility that the uppermost late Romano-British deposits contain hitherto unidentified early medieval material, such a large assemblage has considerable information potential. In addition, if the vertebrate assemblage from the legionary fort (also excavated by Webster) was also analysed, an unbroken sequence from the earliest Roman activity (mid 1<sup>st</sup> century AD) to the cessation of early medieval occupation (late 7<sup>th</sup> century AD) would exist. The resultant dataset would be of great interpretative value. It is evident that analysis of the baths basilica assemblage was hampered because no analogous material was available from the peripheral *insula* of the city and from sites in its hinterland. Bearing in mind the caveat that soil conditions are not conducive to bone preservation, it would be an invaluable exercise to conduct further excavations on carefully targeted sites.

One interesting result of the analysis was the discovery that hunting for purely social reasons appeared to have developed in the later Romano-British period. The author would like to develop this avenue of research further. An initial step would be to conduct a survey of all very late Romano-British assemblages to confirm whether or not this trend was widespread, as suggested by King's (1978) research. A wider synthesis could then be developed building on the recent work for the Anglo-Saxon (Dobney *et al.* forthcoming) and Anglo-Norman (Sykes 2001 & forthcoming) periods. A common method to both pieces of research was to look at individual species as indicators of social status. Such an approach could easily be applied to late Romano-British (and any available post-Roman) sites with their wide range of function and social status.

Perhaps the most important aspect of any future work is to disseminate the baths basilica dataset in a format readily accessible by other researchers. To this end, this thesis should be edited for publication as quickly as possible after examination and any subsequent corrections. An edited version of the analysis of the baths basilica vertebrate assemblage would probably suit a 'British Archaeological Report' (BAR) publication. The thesis could also be digitally archived with the 'Archaeological Data Service' (ADS) through their 'E-thesis project' initiative (Kilbride 2003). In addition, a CD-Rom/DVD should be prepared containing the actual database and summary spreadsheet tables cataloguing all the raw data, which will be available on request.

## Bibliography

- Aird P M 1985 'On distinguishing butchery from other post-mortem destruction: A methodological experiment applied to a faunal sample from Roman Lincoln', in Fieller N R J, Gilbertson D D & Ralph N G A (eds) *Palaeobiological investigations: Research design, methods and data analysis. Symposia of the Association for Environmental Archaeology no. 5B* (International Series 266). Oxford: British Archaeological Reports. 5-35
- Albarella U 1997 *The Roman mammal and bird bones excavated in 1994 from Great Holts Farm, Boreham, Essex* (Ancient Monuments Laboratory Report 9/97). London: English Heritage
- Albarella U 1998 'Book review: Dobney, K.M., Jacques, S.D. & Irving, B.G. 1996. Of butchers and breeds: Report on vertebrate remains from various sites in the city of Lincoln (Lincoln Archaeological Studies 5). Lincoln: City of Lincoln Archaeology Unit'. *Environmental Archaeology: The Journal of Human Palaeocology* 2, 73-4
- Albarella U 1998 'The animal bones', in Ellis P, Hughes G, Leach P, Mould C & Sterenburg J (eds) *Excavations alongside Roman Ermine Street, Cambridgeshire, 1996: The archaeology of the A1(M) Alconbury to Peterborough road scheme* (British Series 276). Oxford: British Archaeological Reports. 98-104
- Albarella U 2003 'Animal bone', in Germany M (ed) 'Excavations at Great Holts Farm, Boreham, Essex, 1992-94'. *East Anglian Archaeology* 105. 193-200
- Albarella U 2003 'Tanners, tawyers, horn working and the mystery of the missing goat', in Murphy P & Wiltshire P (eds) *The environmental archaeology of industry* (Symposia of the Association for Environmental Archaeology 20). Oxford: Oxbow Books. 71-86
- Albarella U & Davis S 1994 *The Saxon and medieval bones excavated 1985-1989 from West Cotton, Northamptonshire* (Ancient Monuments Laboratory Report 17/94). London: English Heritage
- Albarella U & Davis S J M 1996 'Mammals and birds from Launceston castle, Cornwall: Decline in status and the rise of agriculture'. *Circaea, The Journal of the Association for Environmental Archaeology* 12
- Alcock L 1963 *Dinas Powys, an Iron Age, Dark Age and early medieval settlement in Glamorgan*. Cardiff: University of Wales Press
- Alcock L 1973 *Arthur's Britain: History and archaeology, AD 367-634*. Harmondsworth: Penguin
- Alcock L 1982 'Cadbury Camelot: A fifteen year perspective'. *Proceedings of the British Academy* 58, 355-88
- Alcock L 1987 *Economy, society and warfare among the Britons and Saxons*. Cardiff: University of Wales Press
- Allison E P 1985 *An archaeozoological study of bird bones from seven sites in York*. York: University of York. Unpublished PhD thesis
- Allison E P 1995 'The bird bones', in Phillips D & Heywood B (eds) *Excavations at York Minster volume 1: From Roman fortress to Norman cathedral. Part 2 the finds*. London: Royal Commission on the Historical Monuments of England/Her Majesties Stationary Office. 556-8
- Almond R 2003 *Medieval hunting*. Stroud: Sutton Publishing
- Andrews P 1990 *Owls, caves and fossils*. London: Natural History Museum
- Andrews P 1997 *Excavations at Hamwic vol 2: Excavations at Six Dials*. London: Council for British Archaeology
- Andrews P & Nesbit Evans E M 1983 'Small mammal bone accumulations produced by mammalian carnivores'. *Paleobiology* 9, 289-307
- Antia D D J 1979 'Bone-beds: A review of their classification, occurrence, genesis, diagenesis, geochemistry, palaeoecology, weathering, and microbios'. *Mercian Geologist* 7, 93-174
- Armitage P 1984 'A system for ageing and sexing the horn cores of cattle from British post-medieval sites (17th to early 18th century) with special reference to unimproved British longhorn cattle', in Wilson B, Grigson C & Payne S (eds) *Ageing and sexing animal bones from archaeological sites* (British Series 109). Oxford: British Archaeological Reports. 37-54
- Armitage P, West B & Steedman K 1984 'New evidence of Black rat in Roman London'. *The London Archaeologist* 4, 375-83
- Armitage P L & Clutton-Brock J 1976 'A system for classification and description of the horn cores of cattle from archaeological sites'. *Journal of Archaeological Science* 3, 329-48

- Armour-Chelu M 1997 'Appendix 8: Faunal remains', in Barker P, White R, Pretty K, Bird H & Corbishley M (eds) *The baths basilica Wroxeter: Excavations 1966-90* (Archaeological Report 8). London: English Heritage. 350-64
- Arnold C J & Davies J L 2000 *Roman and early medieval Wales*. Stroud: Sutton Publishing
- Ashdown R R 1993 'The avian bones', in Williams R J, Green H S & Zeepvat R J (eds) *Pennyland and Hartigans: Two Iron Age sites in Milton Keynes* (Buckinghamshire Archaeological Society Monograph 4). Aylesbury: Buckingham Archaeological Society. 154-8
- Babendererde C 1976 *Vergleichende morphometrische Untersuchungen rezenter Rotfuchse (Vulpes vulpes) und haushunde (Canis lupus f. familiaris)*. Kiel: Universität Kiel. Unpublished Realschullehrer-Examensarbeit thesis
- Baker P 2004 *The sheep project: A pilot study of age and biometric data from a sample of unimproved Shetland wethers and rams* (Centre for Archaeology Report 66/2004). Portsmouth: English Heritage
- Barker P, White R, Pretty K, Bird H & Corbishley M 1997 *The baths basilica Wroxeter: Excavations 1966-90* (Archaeological Report 8). London: English Heritage
- Barnes I, Dobney K M & Young J P 1998 'The molecular palaeoecology of geese: Identification of archaeological goose remains using ancient DNA analysis'. *International Journal of Osteoarchaeology* 8, 280-7
- Barnes I, Young J P W & Dobney K M 2000 'DNA-based identification of goose species from two archaeological sites in Lincolnshire'. *Journal of Archaeological Science* 27, 91-100
- Barrett J C 1989 'Afterward: Render unto Caesar', in Barrett J C, Fitzpatrick A P & MacInnes L (eds) *Barbarians and Romans in north west Europe* (International Series 471). Oxford: British Archaeological Reports. 235-41
- Bartosiewicz L 1987 'Cattle metapodials revisited: A brief review'. *Archaeozoologia* 1, 47-51
- Bartosiewicz L, van Neer W & Lentacker A 1997 *Draught cattle: Their osteological identification and history* (Annalen Zoölogische Wetenschappen 281). Tervuren: Koninklijk Museum voor Midden-Afrika
- Bartram L E & Marean C W 1999 'Explaining the "Klasies Pattern": Kua ethnoarchaeology, the Die Kelders Middle Stone Age archaeofauna, long bone fragmentation and carnivore ravaging'. *Journal of Archaeological Science* 26, 9-29
- Bassett S R (ed) 1989 *The origins of Anglo-Saxon kingdoms* Leicester: Leicester University Press
- Bassett S R 1990 'The Roman and medieval landscape of Wroxeter', in Barker P (ed) *From Roman Viroconium to medieval Wroxeter*. Worcester: West Mercian Archaeological Consultants Ltd. 10-2
- Bassett S R 1992a 'Medieval ecclesiastical organisation in the vicinity of Wroxeter and its British antecedents'. *Journal of the British Archaeological Association* 145, 1-28
- Bassett S R 1992b 'Church and diocese in the West Midlands: The transition from British to Anglo-Saxon control', in Blair J & Sharpe R (eds) *Pastoral care before the parish*. Leicester: Leicester University Press. 13-40
- Baugh G C (ed) 1989 *A history of Shropshire, volume 4: Agriculture*. Oxford: The Institute of Historical Research/Oxford University Press
- Baxter I L 1993 'An eagle *Haliaeetus albicilla* (L.) skull from Roman Leicester, with some speculations concerning the palaeoecology of the Soar Valley'. *Circaea, The Journal of the Association for Environmental Archaeology* 10, 31-7
- Baxter M 2003 *Statistics in archaeology*. London: Arnold
- Behrensmeyer A K 1978 'Taphonomic and ecologic information from bone weathering'. *Paleobiology* 4, 150-62
- Behrensmeyer A K, Gordon K D & Yanagi G T 1986 'Trampling as a cause of bone surface damage and pseudo-cut marks'. *Nature* 319, 768-71
- Bell M 1989 'Environmental archaeology as an index of continuity and change in the medieval landscape', in Aston M, Austin D & Dyer C (eds) *The rural settlement of medieval England*. Oxford: Blackwell. 269-86
- Berry R J 1991 'House mouse *Mus domesticus*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 239-47
- Biddle M 1976 'Towns', in Wilson D M (ed) *The archaeology of Anglo-Saxon England*. London: Methuen. 99-150
- Binford L R 1978 *Nunamuit Ethnoarchaeology*. London: Academic Press

- Binford L R 1981 *Bones: Ancient men and modern myths*. London: Academic Press
- Bishop M 1990 'Appendix: Analysis of the animal bones' (30-32), in Makepeace G A & Bishop M 'The Romano-British settlement at Staden near Buxton: The 1984 and 1985/86 excavations'. *Derbyshire Archaeological Journal* 109, 17-33
- Blandford P R S & Walton K C 1991 'Feral ferret *Mustela furo*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 405-6
- Blandford P R S & Walton K C 1991 'Polecat *Mustela putorius*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 368-405
- Blandford W T 1898 *The fauna of British India - birds*. London: Taylor & Francis
- Blank T H 1984 'Pheasants and partridges', in Mason I L (ed) *Evolution of domesticated animals*. London: Longmans. 311-5
- Blumenschine R J & Marean C W 1993 'A carnivore's view of archaeological bone assemblages', in Hudson J (ed) *From bones to behaviour: Ethnoarchaeological and experimental contributions to the interpretation of faunal remains* (Centre for Archaeological Investigations Occasional Paper 21). Carbondale: Southern Illinois University. 273-300
- Blumenschine R J, Marean C W & Capaldo S D 1996 'Blind tests of inter-analyst correspondence and accuracy in the identification of cut marks, percussion marks, and carnivore marks on bone surfaces'. *Journal of Archaeological Science* 23, 493-507
- Bocheński Z M, Tomek T, Boev Z & Mitev I 1993 'Patterns of bird bone fragmentation in pellets of the tawny owl (*Stix aluco*) and the eagle owl (*Bubo bubo*) and their taphonomic implications'. *Acta Zoologica Cracov* 36, 313-28
- Boessneck J 1969 'Osteological differences between sheep (*Ovis aries* Linné) and goat (*Capra hircus* Linné)', in Brothwell D R & Higgs E S (eds) *Science in archaeology: A comprehensive survey of progress and research*. London: Thames & Hudson. 331-58
- Boessneck J, Driesch A von den, Meyer-Lemppenau U & Wechsler-von Ohlen E 1971 *Das Tierknochenfunde aus dem Oppidum von Manchin* (Die Ausgrabungen in Manching 6). Wiesbaden: Franz Steiner Verlag
- Böhme G 1977 'Zur Bestimmung quartärer Anuren Europas an Hand von Skelettementen'. *Wissenschaftlich Zeitschrift der Humboldt Universität zu Berlin Math-Nat.* 26, 283-300
- Bonser K J 1970 *The drovers: Who they were and how they went: An epic of the countryside*. London: Macmillan
- Boon G C 1974 *Silchester: The Roman town of Calleva*. Newton Abbott: David & Charles
- Bourdillon J 1988 'Countryside and town: The animal resources of Saxon Southampton', in Hooke D (ed) *Anglo-Saxon settlements*. Oxford: Blackwell. 177-95
- Bourdillon J 1994 'The animal provisioning of Saxon Southampton', in Rackham J (ed) *Environment and economy in Anglo-Saxon England* (Research Report 89). York: Council for British Archaeology. 120-5
- Bourdillon J & Andrews P 1997 'The animal bone', in Andrews P (ed) *Excavations at Hamwic: Volume 2: Excavations at Six Dials* (Research Report 109). London: Council for British Archaeology
- Bourdillon J & Coy J 1980 'The animal remains', in Holdsworth P (ed) *Excavations at Melbourne Street, Southampton 1971-76* (Research Report 33). London: Council for British Archaeology. 79-121
- Boyce C C 1991 'Water vole *Arvicola terrestris*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 212-8
- Brain C K 1967 'Hottentot food remains and their bearing on the interpretation of fossil bone assemblages'. *Scientific Papers of the Namib Desert Research Station* 32, 1-11
- Brain C K 1976 'Some principles in the interpretation of bone accumulations associated with man', in Isaac G & McCown E (eds) *Human origins*. California: Benjamin
- Brain C K 1981 *The hunters or the hunted? An introduction to African cave taphonomy*. London: University of Chicago Press
- Bramwell D & Noddle B A 2000 'Bird remains', in Price E (ed) *Frocester: A Romano-British settlement, its antecedents and successors volume 2: The finds*. Stonehouse: Gloucester & District Archaeological Research Group. 245-6
- Bramwell D & Webster G 1985 'Bird bones' (96-97), in Webster G, Fowler P, Noddle B & Smith L 'The excavation of a Romano-British rural establishment at Barnsley Park, Gloucestershire, 1961-1979: Part III'. *Transactions of the Bristol & Gloucestershire Archaeological Society* 103, 73-100

- Brickstock R & Casey J 1997 'Appendix 3: Roman coinage', in Barker B, White R, Pretty K, Bird H & Corbishley M (eds) *The baths basilica Wroxeter: Excavations 1966-90* (Archaeological Report 8). London: English Heritage. 264-8
- Brooks D A 1986 'A review of the evidence for continuity in British towns in the 5th and 6th centuries'. *Oxford Journal of Archaeology* 5, 77-102
- Brooks D A 1988 'The case for continuity in fifth-century Canterbury re-examined'. *Oxford Journal of Archaeology* 7, 99-114
- Brothwell D 1997 'Interpreting the immature chicken bones from the Romano-British ritual complex on West Hill, Uley'. *International Journal of Osteoarchaeology* 7, 330-2
- Brothwell D R 1976 'Further evidence of bone chewing by ungulates: The sheep of North Ronaldsay'. *Journal of Archaeological Science* 3, 179-82
- Brown O 2004 'Tearing birds apart'. *ZOOARCH* [on-line]. Chilton, Didcot: JISCmail  
<http://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=ind0410&L=zooarch&P=R1801&I=-1>  
[accessed 3/11/04]
- Buckland-Wright J C 1987 'The animal bones', in Sparey Green C, Davies S M & Ellison A (eds) *Excavations at Poundbury, Dorchester, Dorset 1966-1982 volume 1: The settlements* (Dorset Natural History & Archaeological Society Monograph Series 7). Dorchester: The Friary Press. 129-32
- Burke J 1978 *Life in the villa in Roman Britain*. London: Batsford
- Burrow I 1981 *Hillfort and hill-top settlement in Somerset in the first to eighth centuries AD* (British Series 91). Oxford: British Archaeological Reports
- Burrows K 2000 *Archaeozoological analysis of a sample of animal bone from the insula 5 portico deposits at Roman Wroxeter*. Sheffield: University of Sheffield. Unpublished MSc thesis
- Bushe-Fox J P 1913 *Excavations on the site of the Roman town at Wroxeter, in 1912* (Research Report 1). Oxford: Committee of the Society of Antiquaries of London
- Bushe-Fox J P 1914 *Second report on the excavations on the site of the Roman town at Wroxeter Shropshire in 1913* (Research Report 2). Oxford: Committee of the Society of Antiquaries of London
- Bushe-Fox J P 1916 *Third report on the excavations on the site of the Roman town at Wroxeter Shropshire 1914* (Research Report 4). Oxford: Committee of the Society of Antiquaries of London
- Buteux S, Gaffney V, White R & Van Leusen M 2000 'Wroxeter Hinterland Project and geophysical survey at Wroxeter'. *Archaeological Prospection* 7, 69-80
- Callou C 1997 *Diagnose différentielle des principaux éléments squelettiques du Lapin (genre Oryctolagus) et du Lièvre (genre Lepus) en Europe occidentale* (Fiches d'ostéologie animale pour l'archéologie série B: Mammifères 8). Paris: Centre de Recherches Archéologiques du Centre National de la Recherche Scientifique
- Caple C E & Warren S E 1982 'Technical observations on the method of production and the alloy composition of the late and post-medieval wound-wire-headed pins', in Aspinall A & Warren S E (eds) *Proceedings of the 22nd Symposium on Archaeometry*. Bradford: University of Bradford. 273-83
- Casey J 1989 'Coin evidence and the end of Roman Wales'. *Archaeological Journal* 146, 320-9
- Casey P J (ed) 1979 *The end of Roman Britain: Papers arising from a conference, Durham 1978* (British Series 71). Oxford: British Archaeological Reports
- Casteel R W 1979 'Taxonomic abundance and sample size in archaeological faunal assemblages', in Kubasiewicz M (ed) *Archaeozoology 1: Proceedings of the 3rd International Zooarchaeology Conference*. Szczecin: Agricultural Academy
- Chadderton J (ed) 2000 *The legionary fortress at Wroxeter: Excavations by Graham Webster, 1955-85 volume 2* (Archaeological Report 9). London: English Heritage
- Chanin P 1991 'Otter *Lutra lutra*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 424-31
- Chapman N G & Putman R J 1991 'Fallow deer *Dama dama*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 508-18
- Charles M, Colledge S & Monk M 1997 'Appendix 6: Plant remains', in Barker P, White R, Pretty K, Bird H & Corbishley M (eds) *The baths basilica Wroxeter: Excavations 1966-90* (Archaeological Report 8). London: English Heritage. 324-49



- Cherry J 1991 'Leather', in Blair J & Ramsay N (eds) *English medieval industries: Craftsmen, techniques, products*. London: The Hambledon Press. 295-318
- Cherry J F 1978 'Questions of efficiency and integration in assemblage sampling', in Cherry J F, Gamble C & Shennan S (eds) *Sampling in contemporary British archaeology* (British Series 50). Oxford: British Archaeological Reports. 293-320
- Chitty G & Warhurst M 1977 'Ancient Meols: A collection of finds from the Cheshire shore in Merseyside County Museums'. *Journal of the Merseyside Archaeology Society* 1, 19-42
- Chomsky N 1994 *World orders, old and new*. New York: Columbia University Press
- Clark K M 1995 'The later prehistoric and protohistoric dog: The emergence of canine diversity'. *Archaeozoologia* 7, 9-32
- Clark K M 2000 'Dogged persistence: The phenomenon of canine skeletal uniformity in British prehistory', in Crockford S J (ed) *Dogs through time: An archaeological perspective. Proceedings of the 1st ICAZ symposium on the history of the domestic dog. Eighth congress of the International Council for Archaeozoology (ICAZ98) August 23-29, 1998 Victoria, B.C., Canada* (International Series 889). Oxford: British Archaeological Reports. 163-9
- Clason A T & Prummel W 1977 'Collecting, sieving and archaeological research'. *Journal of Archaeological Science* 4, 171-5
- Clutton-Brock J 1991 'Extinct species', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 571-5
- Cochrane G W G 2003 'Artefact attribute richness and sample size adequacy'. *Journal of Archaeological Science* 30, 837-48
- Cohen A & Serjeantson D 1996 *A manual for the identification of bird bones from archaeological sites*. London: Birkbeck College, University of London
- Colyer R J 1976 *The Welsh cattle drovers: Agriculture and the Welsh cattle trade*. Cardiff: University of Wales Press
- Connell B & Davis S J M forthcoming *Animal bones from Roman Carlisle, Cumbria; The Lanes (2) excavations, 1978-1982* (Centre for Archaeology Report draft). Portsmouth: English Heritage
- Cool H E M 2000 'The parts left over: Material culture into the fifth century', in Wilmott T & Wilson P (eds) *The late Roman transition in the north: Papers from the Roman Archaeology Conference, Durham 1999* (British Series 299). Oxford: British Archaeological Reports. 47-66
- Cott H B 1946 'The edibility of birds'. *Journal of Zoology, London* 116, 371-530
- Cott H B & Benson C W 1970 'The palatability of birds, mainly based upon observations of a tasting panel in Zambia'. *Ostrich Supplement* 8, 357-84
- Courty M, Goldberg P & Macphail R 1989 *Soils and micromorphology*. Cambridge: Cambridge University Press
- Cowan D P 1991 'Rabbit *Oryctolagus cuniculus*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 146-54
- Cowles G 1993 'Birds', in Woodward A & Leach P (eds) *The Uley shrines: Excavation of a ritual complex on West Hill, Uley, Gloucestershire: 1977-9* (English Heritage Archaeological Report 17). London: English Heritage/British Museum Press. 263-4
- Coy J 1981 'The animal bones' (106-110), in Silvester R J 'An excavation on the post-Roman site at Bantham, South Devon'. *Proceedings of the Devon Archaeological Society* 39, 89-118
- Coy J 1989 'The provision of fowls and fish for towns', in Serjeantson D & Waldron T (eds) *Diet and crafts in towns: The evidence of animal remains from the Roman to post-medieval periods* (British Series 199). Oxford: British Archaeological Reports. 14-25
- Coy J P 1977 *Bones of birds and non-domestic species from Melbourne Street sites I, IV, V, VI and XX of Saxon Southampton (Hamwih)* (Ancient Monuments Laboratory Report 2323). London: English Heritage
- Crabtree P 1990 'West Stow, Suffolk: Early Anglo-Saxon animal husbandry'. *East Anglian Archaeology* 47
- Crabtree P J 1989 'Sheep, horses, swine and kine: A zooarchaeological perspective on the Anglo-Saxon settlement of England'. *Journal of Field Archaeology* 16, 205-13
- Crabtree P J 1991 'Roman Britain to Anglo-Saxon England: The zooarchaeological evidence', in Crabtree P J & Ryan K (eds) *Animal use and culture change* (Museum of Archaeology and Anthropology Research Papers in Science and Archaeology Special Supplement 8). Philadelphia: University of Philadelphia

- Crabtree P J 1994 'Animal exploitation in East Anglian villages', in Rackham J (ed) *Environment and economy in Anglo-Saxon England* (Research Report 89). York: Council for British Archaeology
- Cram L 2000 'Varieties of dog in Roman Britain', in Crockford S J (ed) *Dogs through time: An archaeological perspective. Proceedings of the 1st ICAZ symposium on the history of the domestic dog. Eighth congress of the International Council for Archaeozoology (ICAZ98) August 23-29, 1998 Victoria, B.C., Canada* (International Series 889). Oxford: British Archaeological Reports. 171-80
- Cunliffe B & Davenport P 1985 *The temple of Sulis Minerva at Bath* (Oxford University Committee for Archaeology Monograph 7). Oxford: Oxford University Committee for Archaeology, Institute for Archaeology, University of Oxford
- Dark K 2000 *Britain and the end of the Roman Empire*. Stroud: Tempus
- Dark K 2000 'The late Roman transition in the north: A discussion', in Wilmott T & Wilson P (eds) *The late Roman transition in the north: Papers from the Roman Archaeology Conference, Durham 1999* (British Series 299). Oxford: British Archaeological Reports. 81-8
- Dark K R 1994 *Civitas to kingdom: British political continuity 300-800*. Leicester: Leicester University Press
- Dark P 2000 *The environment of Britain in the first millenium AD*. London: Duckworth
- David B 1990 'How was this bone burnt?' in Solomon S, Davidson I & Watson D 'Problem solving in taphonomy'. *Tempus* 2, 65-79
- Davis S 1987 'Espesial study 1: The dentition of an Iron Age pony' (52-55), in Ashbee P & Hook P 'Warsash, Hampshire excavations, 1954'. *Proceedings of the Hampshire Field Club and Archaeological Society* 43, 21-62
- Davis S 1987 *The archaeology of animals*. London: Batsford
- Davis S J M 1980 'Late Pleistocene and Holocene equid remains from Israel'. *Zoological Journal of the Linnéan Society* 70, 289-312
- Davis S J M 1988 *Animal bones from Dodder Hill, a Roman fort near Droitwich (Hereford and Worcester), excavated in 1977* (Ancient Monuments Laboratory Report 140/88). London: English Heritage
- Davis S J M 1992 *A rapid method for recording information about mammal bones from archaeological sites* (Ancient Monuments Laboratory Report 19/92). London: English Heritage
- Davis S J M 1996 'Measurements of a group of adult female Shetland sheep skeletons from a single flock: A baseline for zooarchaeologists'. *Journal of Archaeological Science* 23, 593-612
- Davison A, Birks J D S, Griffiths H I, Kitchener A C, Biggins D & Butlin R K 1999 'Hybridization and the phylogenetic relationship between polecats and domestic ferrets in Britain'. *Biological Conservation* 87, 155-61
- Davison A, Griffiths H I, Brookes R C, Maran T, MacDonald D W, Sidorovich V E, Kitchener A C, Irizar I, Villate I, González-Esteban J, Ceña J C, Ceña A, Moya I & Miñano S P 2000 'Mitochondrial DNA and palaeontological evidence for the origins of endangered european mink, *Mustela lutreola*'. *Animal Conservation* 4, 345-55
- de Moulins D 1996 'Sieving experiment: The controlled recovery of charred plant remains from modern and archaeological samples'. *Vegetation History & Archaeobotany* 5, 153-6
- Degerbøl M 1970 'The urus (*Bos primigenius* Bojanus) and Neolithic domesticated cattle (*Bos taurus domesticus* Linné) in Denmark'. *Kongelige Danske Videnskabernes Selskabs Skrifter* 17, 1-177
- DeGusta D & Vrba E 2003 'A method for inferring paleohabitats from the functional morphology of bovid astragali'. *Journal of Archaeological Science* 30, 1009-22
- Deschler-Erb S 1997 'Bone, antler, tooth and ivory: Raw materials for Roman artifacts', in Kokabi M & Wahl J (eds) *Anthropozoologica: Proceedings of the 7th International Conference for Archaeozoology, ICAZ, Constance, September 1994 25-26*. Paris: L'Homme et l' Animal, Société de Recherche Interdisciplinaire/Centre National de la Recherche Scientifique. 73-8
- Dixon P 1996 'The cities are not as populated as they once were', in Rich J (ed) *The city in Late Antiquity*. London: Routledge. 145-60
- Dobney K 2001 'A place at the table: The role of vertebrate zooarchaeology within a Roman research agenda for Britain', in James S & Millett M (eds) *Britains and Romans: Advancing an archaeological agenda* (Research Report 125). York: Council for British Archaeology. 36-45
- Dobney K, Hall A & Kenward H 1999 'It's all garbage. a brief review of Roman bioarchaeology in the four English *colonia* towns', in Hurst H (ed) *The coloniae of Roman Britain: New studies and a review*. Journal of Roman Archaeology Supplementary Series 36. 15-36

- Dobney K & Jaques D 2002 'Avian signatures for identity and status in Anglo-Saxon England', in Bocheński Z M, Bocheński Z & Stewart J R (eds) *Proceedings of the 4th meeting of the ICAZ Bird Working Group, Kraków, Poland, 11-15 September, 2001* (Acta zoologica cracoviensia 45). Kraków: Institute of Systematics and Evolution of Animals, Polish Academy of Sciences
- Dobney K, Jaques D, Barrett J & Johnstone C forthcoming *Farmers, monks and aristocrats: The environmental archaeology of an Anglo-Saxon estate centre at Flixborough, north Lincolnshire, England*. Oxford: Oxbow
- Dobney K, Jaques D, Carrott J, Hall A, Issitt M & Large F 2000 'Biological remains' (148-82), in Ottaway P 'Excavations on the site of the Roman signal station at Carr Naze, Filey, 1993-94'. *The Archaeology Journal* 157, 79-199
- Dobney K, Jaques D & Johnstone C 1999 *A protocol for recording vertebrate remains from archaeological sites* (Reports from the Environmental Archaeology Unit, York 99/15). York: English Heritage
- Dobney K, Kenward H K, Ottaway P & Donel L 1998 'Down but not out: Biological evidence for complex economic organisation in Lincoln in the late 4<sup>th</sup> century'. *Antiquity* 72, 417-24
- Dobney K, Kenward H & Roskams S 1997 'All mixed up and somewhere to go? Confronting residuality in bioarchaeology', in De Boe G & Verhaeghe F (eds) *Method and theory in historical archaeology: Papers of the "Medieval Europe Brugge 1997" conference* (I A P Rapporten 9). Zellik: Instituut voor het Archeologisch Patrimonium. 81-7
- Dobney K M, Jaques S D & Irving B G 1996 *Of butchers and breeds: Report on vertebrate remains from various sites in the City of Lincoln* (Lincoln Archaeological Studies 5). Lincoln: City of Lincoln Archaeology Unit
- Dobney K M & Rielly K 1988 'A method for recording archaeological animal bones: The use of diagnostic zones'. *Circaea, The Journal of the Association for Environmental Archaeology* 5, 79-96
- Done G 1986 'The animal bones from areas A & B', in Millett M & Graham D (eds) *Excavations on the Romano-British small town at Neatham, Hampshire, 1969-79* (Hampshire Field Club Monograph 3). Gloucester: Hampshire Field Club & Archaeological Society. 141-7
- Done G 1993 'Animal bone from Anglo-Saxon contexts', in Jones M U & Jones W T (eds) *Excavations at Mucking volume 2: The Anglo-Saxon settlement* (Archaeological Report 21). London: English Heritage/British Museum Press. 74-9
- Easterbee N 1991 'Wild cat *Felis silvestris*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 431-7
- Eastham A 1971 'The bird bones', in Cunliffe B (ed) *Excavations at Fishbourne 1961-1969 volume II: The finds* (Reports of the Research Committee of the Society of Antiquaries of London 27). London: The Society of Antiquaries of London. 388-93
- Eastham A 1972 'Appendix B: Animal remains' (141-142), in Johnstone D E 'A Roman building at Chalk, near Gravesend'. *Britannia* 3, 112-48
- Eastham A 1975 'The bird bones', in Cunliffe B (ed) *Excavations at Portchester Castle volume I: Roman* (Reports of the Research Committee of the Society of Antiquaries of London 32). London: Society of Antiquaries of London. 409-15
- Eastham A 1976 'The bird bones', in Cunliffe B (ed) *Excavations at Portchester Castle volume II: Saxon* (Reports of the Research Committee of the Society of Antiquaries of London 33). London: Society of Antiquaries of London. 287-96
- Edmonds M R 1995 *Stone tools and society: Working stone in Neolithic and Bronze Age Britain*. London: B T Batsford
- Edwards N & Lane A 1988 *Early medieval settlements in Wales AD 400-1100, a critical reassessment and gazetteer of the archaeological evidence for secular settlements in Wales*. Bangor/Cardiff: Research Centre Wales University College North Wales Bangor/Department of Archaeology University College Cardiff
- Ellis P (ed) 2000 *The Roman baths and macellum at Wroxeter: Excavations by Graham Webster, 1955-85 volume 1* (Archaeological Report 9). London: English Heritage
- Elyot T 1549 *Castel of helth*. London
- English Heritage 1991 *Management of archaeological projects*. London: English Heritage

- English Heritage 2002 *Environmental archaeology: A guide to the theory and practice of methods, from sampling and recovery to post-excavation* (Centre for Archaeology Guidelines 1). Portsmouth: English Heritage
- Esmonde-Cleary A S 1989 *The ending of Roman Britain*. London: B T Batsford
- Esmonde-Cleary S 2000 'Summing up', in Wilmott T & Wilson P (eds) *The late Roman transition in the north: Papers from the Roman Archaeology Conference, Durham 1999* (British Series 299). Oxford: British Archaeological Reports. 89-94
- Esmonde-Cleary S 2001 'The Roman to medieval transition', in James S & Millett M (eds) *Britains and Romans: Advancing an archaeological agenda* (Research Report 125). York: Council for British Archaeology. 90-7
- Evans J 1990 'From the end of Roman Britain to the "celtic west"'. *Oxford Journal of Archaeology* 9, 91-103
- Evans J & Millett M 1992 'Residuality revisited'. *Oxford Journal of Archaeology* 11, 225-40
- Faulkner N 2000 *The decline and fall of Roman Britain*. Stroud: Tempus
- Ferdière A 1988 *Les campagnes en Gaule Romaine, tome 2: Les techniques et les productions rurales en Gaule*. Paris: Editions Errance
- Fielder W, Gewalt W, Grzimek B, Heinemann D, Herter K & Thenius E 1979 *Tierleben: Enzyklopädie des Tierreichs* (Band 10). München: Deutscher Taschenbuch Verlag
- Finn F 1915 *Indian sporting birds*. London: Francis Edwards
- Flower B & Rosenbaum E 1958 *The Roman cookery book: A critical translation of 'The art of cooking' by Apicius*. London: Harrap
- Fock J 1966 *Metrische Untersuchungen an Metapodien einiger Europäischer Rinderrassen*. München: Universität München. Unpublished Realschullehrer-Examensarbeit thesis
- Forster E S & Heffner E H 1968 *Columella: On Agriculture: Volume 2: Books 5-9* (Loeb Classical Library). London: William Heinemann Ltd
- Fowler P J 1971 'Hill-forts, A.D. 400-700', in Hill D & Jesson M (eds) *The Iron Age and its hill-forts: Papers presented to Sir Mortimer Wheeler on the occasion of his eightieth year at a conference held by the Southampton Archaeological Society, 5th-7th March, 1971* (University of Southampton Monograph 1). Southampton: Southampton University Archaeological Society/Department of Archaeology, University of Southampton. 203-13
- Frere S S 1967 *Britannia: A history of Roman Britain*. London: Routledge & Kegan Paul
- Gaffney C & Gaffney V 2000 'Non-invasive investigations at Wroxeter at the end of the twentieth century'. *Archaeological Prospection* 7, 65-7
- Gaffney C, Gater J, Linford P, Gaffney V & White R 2000 'Large-scale systematic fluxgate gradiometry at the Roman city of Wroxeter'. *Archaeological Prospection* 7, 81-100
- Gaffney V, White R & Buteux S forthcoming *Wroxeter, the Cornovii and the urban process: Final report on the work of the 'Wroxeter Hinterland Project' and 'Wroxeter Hinterlands Survey', 1994-1999*. London: English Heritage
- Gamble C & Bailey G N 1994 'The faunal specialist as excavator: The impact of recovery techniques on faunal interpretation', in Luff R & Rowley-Conwy P (eds) *Whither environmental archaeology* (Oxbow Monographs 38). Oxford: Oxbow Books. 81-90
- Gelling M 1978 *Signposts to the Past. Placenames and the history of England*. London: Dent & Sons
- Gelling M 1992 *The West Midlands in the early Middle Ages*. Leicester: Leicester University Press
- Genov P V 1999 'A review of the cranial characteristics of the wild boar (*Sus scrofa* Linnaeus 1758), with systematic conclusions'. *Mammal Review* 29, 205-38
- Gerrard F 1979 *Meat technology*. Hove: Wayland
- Gerritsen F 2000 'Of calories and culture: Introduction to an archaeological dialogues special section on food and foodways'. *Archaeological Dialogues* 7, 169-72
- Gidney L 1999 'The animal bones', in Connor A & Buckley R (eds) *Roman and Medieval occupation in Causeway Lane, Leicester* (Leicester Archaeology Monograph 5). Leicester: University of Leicester Archaeological Services, School of Archaeological Studies, University of Leicester & Leicester City Museum Service for the Inland Revenue. 310-29
- Gifford D P 1981 'Taphonomy and paleoecology: A critical review of archaeology's sister disciplines', in Schiffer M B (ed) *Advances in archaeological method and theory volume 4*. New York: Academic Press. 365-438

- Gifford-Gonzalez D P 1991 'Bones are not enough: Analogues, knowledge, and interpretive strategies in zooarchaeology'. *Journal of Anthropological Archaeology* 10, 215-54
- Gilchrist R 1988 'A reappraisal of Dinas Powys: Local exchange and specialized livestock production in 5th to 7th century Wales'. *Medieval Archaeology* 32, 50-62
- Gillam J P 1979 'Romano-Saxon pottery: An alternative explanation', in Casey P J (ed) *The end of Roman Britain* (British Series 71). Oxford: British Archaeological Reports. 103-18
- Going C J 1992 'Economic 'long waves' in the Roman period? A reconnaissance of the Romano-British ceramic evidence'. *Oxford Journal of Archaeology* 11, 93-117
- Goody J 1982 *Cooking, cuisine and class: A case study in comparative sociology*. Cambridge: Cambridge University Press
- Gosden C 1999 'Introduction', in Gosden C & Hather J (eds) *The prehistory of food: Appetites for change*. London: Routledge. 1-9
- Grant A 1971 'The animal bones', in Cunliffe B (ed) *Excavations at Fishbourne 1961-1969 volume II: The finds* (Reports of the Research Committee of the Society of Antiquaries of London 27). London: The Society of Antiquaries of London. 377-88
- Grant A 1975 'The animal bones', in Cunliffe B (ed) *Excavations at Portchester Castle volume I: Roman* (Reports of the Research Committee of the Society of Antiquaries of London 32). London: Society of Antiquaries of London. 378-406
- Grant A 1976 'The animal bones', in Cunliffe B (ed) *Excavations at Portchester Castle volume II: Saxon* (Reports of the Research Committee of the Society of Antiquaries of London 33). London: Society of Antiquaries of London. 262-87
- Grant A 1981 'The significance of deer remains at occupation sites of the Iron Age to the Anglo-Saxon period', in Jones M K & Dimbleby G W (eds) *The environment of man: The Iron Age to the Anglo-Saxon period* (British Series 87). Oxford: British Archaeological Reports. 205-12
- Grant A 1982 'The use of tooth wear as a guide to the age of domestic ungulates', in Wilson B, Grigson C & Payne S (eds) *Ageing and sexing animal bones from archaeological sites* (British Series 109). Oxford: British Archaeological Reports. 91-108
- Grant A 1989 'Animals in Roman Britain', in Todd M (ed) *Research on Roman Britain: 1960-89* (Britannia Monograph Series 11). London: Society for the Promotion of Roman Studies. 135-46
- Grayson D K 1981 'The effects of sample size on some derived measures in vertebrate faunal analysis'. *Journal of Archaeological Science* 8, 77-88
- Grayson D K 1984 *Quantitative zooarchaeology: Topics in the analysis of archaeological faunas*. Orlando: Academic Press
- Green F J & Lockyear K 1994 'Seeds, sherds and samples: Site formation processes at the Waitrose site, Romsey', in Luff R & Rowley-Conwy P (eds) *Whither environmental archaeology?* (Oxbow Monograph 38). Oxford: Oxbow Books. 91-104
- Greene K 2000 'Technological innovation and economic progress in the ancient world: M.I. Finley reconsidered'. *Economic History Review* 53, 29-59
- Greenfield H J 1988 'Bone consumption by pigs in a contemporary Serbian village: Implications for the interpretation of prehistoric faunal assemblages'. *Journal of Field Archaeology* 15, 473-9
- Grigson C 1982 'Porridge and pannage: Pig husbandry in Neolithic England', in Bell M & Limbrey S (eds) *Archaeological aspects of woodland ecology* (International Series 146). Oxford: British Archaeological Reports. 297-314
- Grigson C 1982 'Sex and age determination of some bones and teeth of domestic cattle: A review of the literature', in Wilson B, Grigson C & Payne S (eds) *Ageing and sexing animal bones from archaeological sites* (British Series 109). Oxford: British Archaeological reports. 7-23
- Guilbert G 1981 'Hillfort functions and populations: A sceptical viewpoint', in Guilbert G (ed) *Hillfort studies: Essays for A.H.A. Hogg*. Leicester: Leicester University Press. 104-19
- Gulde V 1985 *Osteologische Untersuchungen an Tierknochen aus dem römischen Vicus von Rainau-Buch (Ostalbkreis)* (Materialhefte zur Vor-und Frühgeschichte Baden-Württembergs 5). Stuttgart: Theiss
- Gwinup T & Dickinson F 1973 *Greek and Roman authors: A checklist of criticism*. Metuchen, New Jersey: The Scarecrow Press
- Halstead P 1992 'Demi and the DMP: Faunal remains plus animal exploitation in the Late Neolithic Thessaly'. *Annual of the British School at Athens* 87, 29-59

- Halstead P, Collins P & Isaakidou V 2002 'Sorting sheep from goats: Morphological distinctions between the mandibles and mandibular teeth of adult *Ovis* and *Capra*'. *Journal of Archaeological Science* 29, 545-53
- Haltenorth T & Diller H 1977 *Säugetiere Afrikas und Madagaskars*. München: Bayerischer Landwirtschaft Verlag
- Hambleton E 1999 *Animal husbandry regimes in Iron Age Britain: A comparative study of faunal assemblages from British Iron Age sites* (British Series 282). Oxford: British Archaeological Reports
- Hambleton E & Maltby J M in prep *Archaeozoological interpretations from the animal bone assemblages from excavations at Caerwent*. Bournemouth: Bournemouth University. Unpublished report
- Hamilakis Y 1999 'The anthropology of food and drink consumption and Aegean archaeology', in Vaughan S J & Coulson W D E (eds) *Palaeodiet in the Aegean: Papers from a colloquium held at the 1993 meeting of the Archaeological Institute of America in Washington D.C* (Wiener Laboratory Monograph 1). Oxford: Oxbow/Wiener Laboratory. 55-63
- Hamilton R 1971 'Animal remains', in Branigan K (ed) *Latimer: Belgic, Roman, Dark Age and early modern farm*. Bristol: Chess Valley Archaeological & Historical Society. 163-6
- Hammon A. 1998. *Whitley Grange: Assessment of the animal bones*. Birmingham: Birmingham University Field Archaeology Unit. Unpublished report
- Hammon A 2001 'Residuality'. *ZOOARCH* [on-line]. Chilton, Didcot: JISCmail  
<http://www.jiscmail.ac.uk/cgi-bin/wa.exe?A2=ind0109&L=zooarch&P=R2325>  
 [accessed 16/1/02]
- Hammon A. 2002. *Chedworth Roman villa: Garden courtyard and lower courtyard excavations. Report on the vertebrate remains*. Sheffield: University of Sheffield. Unpublished report
- Harcourt R A 1970 'Animal bones' (56-61), in Rahtz P 'Excavations on Glastonbury Tor, Somerset, 1964-9'. *Archaeological Journal* 127, 1-81
- Harcourt R A 1974 'The dog in prehistoric and early historic Britain'. *Journal of Archaeological Science* 1, 151-75
- Harman M 1996 'The animal bones', in Darling M & Gurney D 'Caister-on-Sea: Excavations by Charles Green 1951-5'. *East Anglian Archaeology* 60. 233-238 & Figures 166-167 & Tables 47-54
- Harmand J 1988 'La maison de ferme et le manoir en Gaule romaine'. *Latomus* 47, 294-317
- Hastorf C A 1991 'Gender, space, and food in prehistory', in Gero J M & Conkey M W (eds) *Engendering archaeology: Women and prehistory*. Oxford: Basil Blackwell. 132-59
- Hatting T 1983 'Osteological investigations on *Ovis aries* L'. *Dansk Naturhistorisk Forening* 144, 115-35
- Hawkes S C & Dunning G C 1961 'Soldiers and settlers in Britain, fourth to fifth century: With a catalogue of animal ornamented buckles and related belt-fittings'. *Medieval Archaeology* 5, 1-70
- Hayes G 1983 'A guide for differentiating mammalian carnivore taxa responsible for gnaw damage to herbivore long bones'. *Paleobiology* 9, 164-72
- Hesse B 1986 'Animal use at Tel Miqne-Ekron in the Bronze Age and Iron Age'. *Bulletin of the American School of Oriental Research* 264, 17-27
- Hesse B & Wapnish P 1985 *Animal bone archaeology*. Washington: Taraxacum Press
- Higgs E & Greenwood W 1979 'Faunal report', in Rahtz P (ed) *The Saxon and medieval palaces at Cheddar: Excavations 1960-62* (British Series 65). Oxford: British Archaeological Reports. 354-62
- Higham C F W 1967 'Appendix: Stock rearing as a cultural factor in prehistoric Europe'. *Proceedings of the Prehistoric Society* 33, 84-106
- Higham C F W 1968 'Faunal sampling and economic prehistory'. *Zeitschrift für Säugetierkunde* 33, 297-305
- Higham C F W 1969 'The metrical attributes of two samples of modern bovine bones'. *Journal of Zoology* 157, 63-74
- Higham N 1992 *Rome, Britain and the Anglo-Saxons*. London: Seaby
- Higham N 1993 *The origins of Cheshire*. Manchester: Manchester University Press
- Higham N 1999 'Imperium in early Britain: Rhetoric and reality in the writings of Gildas and Bede', in Dickinson T & Griffiths D (eds) *The making of kingdoms* (Anglo-Saxon Studies in Archaeology & History 10). Oxford: Oxford University Committee for Archaeology, Institute for Archaeology, University of Oxford

- Higham N J 1994 *The English conquest. Gildas and Britain in the fifth century*. Manchester: Manchester University Press
- Higham N J 1995 *An English empire. Bede and the early Anglo-Saxons kings*. Manchester: Manchester University Press
- Hill D H 1977 'Continuity from Roman to medieval: Britain', in Barley M W (ed) *European towns: Their archaeology and early history*. London: Council for British Archaeology/Academic Press. 293-302
- Hines J 1996 'Britain after Rome: Between multiculturalism and monoculturalism', in Graves-Brown P, Jones S & Gamble C (eds) *Cultural identity and archaeology: The construction of European communities*. London: Routledge. 256-270
- Hingley R 1989 *Rural settlement in Roman Britain*. London: Seaby
- Hinton D A 1990 *Archaeology, economy and society: England from the fifth to the fifteenth century*. London: Routledge
- Hodgson G W I 2002 'A barbary ape from the 1958-9 bypass excavations (Site 433)', in Wilson P R (ed) *Cataractonium: Roman Catterick and its hinterland. Excavations and research, 1958-1997 part II* (Research Report 129). York: Council for British Archaeology. 415
- Hooke D & Burnell S 1995 *Landscape and settlement in Britain AD 400-1066*. Exeter: University of Exeter Press
- Hooper W D & Ash H B 1993 *Cato: On Agriculture; Varro: On agriculture: Books 1-3* (Loeb Classical Library 283). London: Harvard University Press
- Hoskins W G 1955 *Sheep farming in Saxon and Medieval England* (Department of Education of the International Wool Secretariat. London
- Howard M 1963 'The metrical determination of the metapodials and skulls of cattle', in Mourant A E & Zeuner F E (eds) *Man and cattle: Proceedings of a symposium on domestication at the Royal Anthropological Institute 24-26 May 1960* (Royal Anthropological Institute Occasional Paper 8). London: Royal Anthropological Institute of Great Britain and Ireland. 91-100
- Hughes P G 1988 *Wales and the drovers*. Carmarthen: Golden Grove Editions
- Huntley J P & Stallibrass S 1995 *Plant and vertebrate remains from archaeological sites in northern England: Data reviews and future directions* (Research Report 4). Durham: Architecture and Archaeological Society of Durham & Northumberland
- Jackson D 1999 'Variation in the size distribution of hillforts in the Welsh Marches and its implications for social organisation', in Bevan B (ed) *Northern exposure: Interpretative devolution and the Iron Ages in Britain* (Leicester Archaeology Monographs 4). Leicester: School of Archaeological Studies. 197-216
- James S R 1989 'Hominid use of fire in the Lower and Middle Pleistocene'. *Current Anthropology* 30, 1-26
- James S R 1997 'Methodological issues concerning screen size recovery rates and their effects on archaeofaunal interpretations'. *Journal of Archaeological Science* 24, 385-97
- Jenkins R 1997 *Rethinking ethnicity: Arguments and explorations*. London: Sage
- Johnson E 1989 'Human modified bones from early southern Plains sites', in Bonnicksen R & Sorg M H (eds) *Bone modifications*. Orono: University of Maine Centre for the Study of the First Americans. 431-71
- Johnstone C & Albarella U 2002 *The Late Iron Age and Romano-British mammal and bird bone assemblage from Elms Farm, Heybridge, Essex (site code: HYEF93-95)* (Centre for Archaeology Report 45/2002). Portsmouth: English Heritage
- Jones A H M 1964 *The later Roman empire 284-602: A social, economic and administrative survey*. Oxford: Basil Blackwell
- Jones A H M 1978 *The decline of the ancient world*. London: London Group Ltd
- Jones A K G 1982 'Bulk-sieving and the recovery of fish remains from urban archaeological sites', in Hall A R & Kenward H K (eds) *Environmental archaeology in the urban context* (Research Report 43). London: Council for British Archaeology. 79-85
- Jones A K G 1983 'A comparison of two on-site methods of wet-sieving large archaeological soil samples'. *Science & Archaeology* 25, 9-12
- Jones E V & Horne B 1981 'Analysis of skeletal material' (69-72), in Matthews C L 'A Roman cess-pit with skeletons'. *Bedfordshire Archaeological Journal* 15, 63-73
- Jones M J 1993 'The latter days of Roman Lincoln', in Vince A (ed) *Pre-Viking Lindsey*. Lincoln: City of Lincoln Archaeology Unit. 14-28

- Jones M L 1984 *Society and settlement in Wales and the Marches 500 BC to AD 1100* (British Series 121(i)). Oxford: British Archaeological Reports
- Jones R T & Serjeantson D 1983 *The animal bones from five sites at Ipswich* (Ancient Monuments Laboratory Report 3951). London: English Heritage
- Jones R T, Langley P & Wall S 1985 'The animal bones from the 1977 excavations', in Hinchliffe J & Green C S 'Excavations at Brancaster 1974 and 1977'. *East Anglian Archaeological* 23. 129-174
- Jones S 1997 *The archaeology of ethnicity: Constructing identities in the past and present*. London: Routledge
- Jones W H S 1963 *Pliny: Natural History: Volume 8: Books 28-32* (Loeb Classical Library). London: William Heinemann Ltd
- Jones W H S 1966 *Pliny: Natural History: Volume 7: Books 24-27* (Loeb Classical Library). London: William Heinemann Ltd
- Kenyon K M 1948 *Excavations at the Jewry Wall site, Leicester* (Reports of the Research Committee of the Society of Antiquities of London 15). London: Society of Antiquities of London
- Kierdorf U 1994 'A further example of long-bone damage due to chewing by deer'. *International Journal of Osteoarchaeology* 4, 209-14
- Kilbride W 2003 'E-thesis project: An invitation to collaborate'. *Archaeological Data Service*. [on-line] York: University of York  
<http://ads.ahds.ac.uk/project/theses.html>  
[accessed 21/11/04]
- King A 1978 'A comparative survey of bone assemblages from Roman sites in Britain'. *Institute of Archaeology Bulletin* 15, 207-32
- King A 1990 *Roman Gaul and Germany*. London: British Museum Publications
- King A 1991 'Food production and consumption - meat', in Jones R F L (ed) *Roman Britain: Recent trends*. Sheffield: J.R. Collis Publications/Department of Archaeology and Prehistory, University of Sheffield. 15-20
- King A 1999 'Diet in the Roman world: A regional inter-site comparison of the mammal bones'. *Journal of Roman Archaeology* 12, 160-202
- King A C 1984 'Animal bones and the dietary identity of military and civilian groups in Roman Britain, Germany and Gaul', in Blagg T F C & King A C (eds) *Military and civilian in Roman Britain: Cultural relationships in a frontier province* (British Series 136). Oxford: British Archaeological Reports. 187-218
- King A C 1999 'Animals and the Roman army: The evidence of the animal bones' in Goldsworthy A & Haynes I 'The Roman army as a community'. *Journal of Roman Archaeology Supplement* 34, 200-11
- Kirk J C 1935 'Wild and domestic cat compared'. *The Scottish Naturalist* 216, 161-
- Klein R G, Cruz-Urbe K & Milo R G 1999 'Skeletal part representation in archaeofaunas: Comments on "Explaining the 'Klasies pattern': Kua ethnoarchaeology, the Die Kelders Middle Stone Age archaeofauna, long bone fragmentation and carnivore ravenging" by Bartram and Marean'. *Journal of Archaeological Science* 26, 1225-34
- Kratochvil Z 1969 'Species criteria on the distal section of the tibia in *Ovis ammon f. aries* L. and *Capra aegagrus f. hircus* L'. *Acta Veterinaria (Brno)* 38, 483-90
- Kratochvil Z 1973 'Schadelkriterien der wild- und hauskatze (*Felis sivelestris silvestris* Screb. 1777 und *F. s. f. catus* L. 1758)'. *Acta Scientiarum Naturalium Brno* 7, 1-50
- Laflin S, Roper A, Symonds R P & White R H 1993 'Analysis of pottery from Wroxeter Roman city', in Andresen J, Madsen T & Scoller I (eds) *Computing the past. Computer applications and quantitative methods in archaeology. Computer Applications in Archaeology conference 1992*. Aarhus: University of Aarhus. 389-403
- Laing L 1990 *Celtic Britain and Ireland, AD 200-800: The myth of the Dark Ages*. Dublin: Irish Academic
- Langenwaller P E 1980 'The archaeology of 19th century Chinese subsistence at the Lower China Store, Madera County, California', in Schuyler R L (ed) *Archaeological perspectives of ethnicity in America*. Farmingdale, New York: Baywood Publishing Company. 102-12
- Lauwerier R C G M 1986 'A meal for the dead: Animal bone finds in Roman graves'. *Palaeohistoria* 25, 183-93
- Lauwerier R C G M 1986 'The role of meat in the Roman diet'. *Endeavour* 10, 208-12



- Lauwerier R C G M 1988 *Animals in Roman times in the Dutch Eastern River area* (Nederlandse Oudheden 12/1). Amersfoort: Project Oostelijk Rivierengebied
- Lauwerier R C G M 1993 'Bird remains in Roman graves'. *Archaeofauna* 2, 75-82
- Lauwerier R C G M & Hessing W A M 1992 'Men, horses and the Miss Blanche effect: Roman horse burials in the cemetery at Kesteren, the Netherlands'. *Helinium* 32, 78-109
- Layard E L & Sharpe R B 1875-1884 *The birds of South Africa*. London: B Quaritch
- Levitan B 1982 *Excavations at West Hill, Uley: 1979. The sieving and sampling programme* (Occasional Papers 10). Bristol: Western Archaeological Trust
- Levitan B 1989 'The vertebrate remains from Chichester cattlemarket', in Down A (ed) *Chichester excavations* (Chichester Civic Society Excavation Committee 6). Chichester: Phillimore. 242-76
- Levitan B 1993 'Vertebrate remains', in Woodward A & Leach P (eds) *The Uley shrines: Excavation of a ritual complex on West Hill, Uley, Gloucestershire: 1977-9* (English Heritage Archaeological Report 17). London: English Heritage/British Museum Press. 257-301; Microfiche 2 A3-G5
- Levitan B M 1983 'Reducing the work-load: Sub-sampling animal bone assemblages'. *Circaea, The Journal of the Association for Environmental Archaeology* 1, 7-12
- Liebeschuetz W 1996 'The end of the ancient city', in Rich J (ed) *The city in Late Antiquity*. London: Routledge. 1-49
- Lister A 1996 'The morphological distinction between bones and teeth of fallow deer (*Dama dama*) and red deer (*Cervus elaphus*)'. *International Journal of Osteoarchaeology* 6, 119-43
- Livingston S D 1989 'The taphonomic interpretation of avian skeletal part frequencies'. *Journal of Archaeological Science* 16, 537-47
- Locock M, Currie C K & Gray S 1992 'Chemical changes in buried animal bone: Data from a post-medieval assemblage'. *International Journal of Osteoarchaeology* 2, 297-304
- Loreille O, Vigne J-D, Hardy C, Callou C, Treinen-Claustre F, Dennebouy N & Monnerot M 1997 'First distinction of sheep and goat archaeological bones by the means of their fossil mtDNA'. *Journal of Archaeological Science* 24, 33-7
- Luff R 1982 *A zooarchaeological study of the Roman north-western provinces* (British Series 137). Oxford: British Archaeological Reports
- Luff R 1993 *Animal bones from excavations in Colchester, 1971-85* (Colchester Archaeological Report 12). Colchester: Colchester Archaeological Trust/English Heritage
- Lyman R L 1988 'Was there a last supper at Last Supper Cave?' (81-104), in Grayson D K 'Danger Cave, Last Supper Cave, and Hanging Rock Shelter: The faunas'. *American Museum of Natural History Anthropological Papers* 66, 1-130
- Lyman R L 1999 *Vertebrate taphonomy*. Cambridge: Cambridge University Press
- Lyman R L & O'Brien M J 1987 'Plow-zone zooarchaeology: Fragmentation and identifiability'. *Journal of Field Archaeology* 14, 493-8
- MacDonald D & Barrett P 1993 *Mammals of Britain and Europe* (Collins Field Guide). London: Harper Collins Publishers
- MacDonald K 1992 'The domestic chicken (*Gallus gallus*) in sub-Saharan Africa: A background to its introduction and its osteological differentiation from indigenous fowls (Numidinae and *Francolinus* sp.)'. *Journal of Archaeological Science* 19, 303-18
- MacGregor A 1985 *Bone, antler, ivory and horn. The technology of skeletal materials since the Roman period*. London: Croom Helm
- MacGregor A 1989 'Bone, antler and horn industries in the urban context', in Serjeantson D & Waldron T (eds) *Diet and crafts in towns: The evidence of animal remains from the Roman to the post-medieval periods* (British Series 199). Oxford: British Archaeological Reports. 129-46
- MacGregor A 1991 'Antler, bone and horn', in Blair J & Ramsay N (eds) *English medieval industries: Craftsmen, techniques, products*. London: The Hambleton Press. 355-78
- MacGregor A, Mainman A J & Rogers N S H 1999 *Craft, industry and everyday life: Bone, antler, ivory and horn from Anglo-Scandinavian and medieval York* (The Archaeology of York: The Small Finds 17). York: York Archaeological Trust/Council for British Archaeology
- Macphail R I 1981 'Soil and botanical studies of the "Dark Earth"', in Jones M & Dimpleby G (eds) *The environment of man: The Iron Age to Anglo-Saxon period* (British Series 87). Oxford: British Archaeological Reports. 309-31
- Macpherson H A 1897 *A history of fowling*. London: D Douglas

- Maguire A 2003 *Wroxeter hinterland -leah placenames and woodland*. Birmingham: University of Birmingham. Unpublished MA extended essay
- Maltby J M 1979 'The animal bones' (182-185), in Heighway C, Garrod A & Vince A 'Excavations at Westgate St., Gloucester, 1975'. *Medieval Archaeology* 23, 159-213
- Maltby J M 1979 *The animal bones from Exeter 1971-1975* (Exeter Archaeological Reports 2). Sheffield: Department of Archaeology & prehistory, University of Sheffield
- Maltby J M 1981 'The animal bones' (110-118), in Davis S M 'Excavations at Old Down Farm, Andover part II: Prehistoric and Roman'. *Proceedings of the Hampshire Field Club & Archaeological Society* 37, 81-163
- Maltby J M 1984 'The animal bones', in Fulford M (ed) *Silchester defences 1974-80* (Britannia Monograph Series 5). London: Society for the Promotion of Roman Studies. 199-211
- Maltby J M 1985 'Assessing variations in Iron Age and Roman butchery practices: The need for quantification', in Fieller N R J, Gilbertson D D & Ralph N G A (eds) *Palaeobiological investigations: Research design, methods and data analysis: symposia of the Association for Environmental Archaeology no. 5B* (International Series 266). Oxford: British Archaeological Reports. 19-30
- Maltby J M 1985 'Patterns in faunal assemblage variability', in Barker G & Gamble C (eds) *Beyond domestication in prehistoric Europe*. London: Academic Press. 33-74
- Maltby J M 2002 'Animal bones in archaeology: How archaeozoologists can make a greater contribution to British Iron Age and Romano-British archaeology', in Dobney K & O'Connor T (eds) *Bones and the man: Studies in honour of Don Brothwell*. Oxford: Oxbow. 88-94
- Maltby M 1981 'Iron Age, Romano-British and Anglo-Saxon animal husbandry - a review of the faunal evidence', in Jones M & Dimbleby G (eds) *The environment of man: The Iron Age to the Anglo-Saxon period* (British Series 87). Oxford: British Archaeological Reports. 155-203
- Maltby M 1984 'Animal bones and the Romano-British economy', in Grigson C & Clutton-Brock J (eds) *Animals and archaeology: 4. Husbandry in Europe* (International Series 227). Oxford: British Archaeological Reports. 125-38
- Maltby M 1989 'Urban-rural variations in the butchering of cattle in Romano-British Hampshire', in Serjeantson D & Waldron T (eds) *Diet and crafts in towns: The evidence of animal remains from the Roman to the post-medieval periods* (British Series 199). Oxford: British Archaeological Reports. 75-106
- Maltby M 1994 'The meat supply in Roman Dorchester and Winchester', in Hall A R & Kenward H K (eds) *Urban-rural connexions: Perspectives from environmental archaeology* (Oxbow Monograph). Oxford: Oxbow Books. 85-102
- Maltby M 1997 'Domestic fowl on Romano-British sites: Inter-site comparisons of abundance'. *International Journal of Osteoarchaeology* 7, 402-14
- Maltby M 1997 'Environmental evidence: Animal bone' (155-163), in Holbrook N & Thomas A 'The Roman and Early Anglo-Saxon settlement at Wantage, Oxfordshire. Excavations at Mill Street, 1993-4'. *Oxoniensia* 61, 107-79
- Maltby M forthcoming *Feeding a Roman town: Environmental evidence from excavations in Winchester, 1972-1985* (Winchester Museum Service Archaeology Report 4). Winchester: Winchester Museum Service
- Manning J & Morris I (eds) 2003 *The ancient economy: Evidence and models*. Stanford, California: Stanford University Press
- Manning W H 1985 *Catalogue of the Romano-British iron tools, fittings and weapons in the British Museum*. London: British Museum Publications
- Marean C W 1991 'Measuring the post-depositional destruction of bone in archaeological assemblages'. *Journal of Archaeological Science* 18, 677-94
- Marean C W & Bertino L 1994 'Intrasite spatial analysis of bone: Subtracting the effect of secondary carnivore consumers'. *American Antiquity* 59, 748-68
- Marean C W & Spencer L M 1991 'Impact of carnivore ravaging on zooarchaeological measures of element abundance'. *American Antiquity* 56, 645-58
- Markham G 1633 *Country contentments: Or, the husbandman's creations*. London: John Harrison
- Martin T J 1986 *A faunal analysis of Fort Ouiatenon, an eighteenth century trading post in the Wabash Valley of Indiana*. Ann Arbor: Michigan State University. Unpublished PhD thesis

- Marvin G 2001 'The problem of foxes: Legitimate and illegitimate killing in the English countryside', in Knight J (ed) *Natural enemies: People - wildlife conflict in anthropological perspective*. London: Routledge. 189-211
- Matthews K J 1999 'The Iron Age of north-west England and the Irish Sea trade', in Bevan B (ed) *Northern exposure: Interpretative devolution and the Iron Ages in Britain* (Leicester Archaeology Monographs 4). Leicester: School of Archaeological Studies. 173-95
- McGovern T H 2004 'Tearing birds apart'. *ZOOARCH* [on-line]. Chilton, Didcot: JISCmail <http://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=ind0410&L=zooarch&P=R1876&I=-1> [accessed 3/11/04]
- Meadow R 1981 'Early animal domestication in South Asia: A first report on the faunal remains from Mehrgarh, Pakistan.' in Härtel H (ed) *South Asian archaeology 1979*. Berlin: Dietrich Reimer Verlag
- Meadow R H 1981 'Animal bones - problems for the archaeologist together with some possible solutions'. *Paléorient* 6, 65-77
- Meadows K I 1994 'You are what you eat: Diet, identity and Romanisation', in Cottam S, Dungworth D, Scott S & Taylor J (eds) *TRAC 94: Proceedings of the fourth annual Theoretical Roman Archaeology Conference: Held at the Department of Archaeology, University of Durham, 19th & 20th March 1994*. Oxford: Oxbow Books. 133-40
- Medlock R C 1975 'Faunal analysis', in Schiffer M B & House J H (eds) *The Cache River archaeological project: An experiment in contract archaeology* (Arkansas Archaeological Survey Research Series 8). Fayetteville: Arkansas Archaeological Survey. 223-42
- Meek A & Gray R A H 1911 'Animal remains' (220-267), in Foster R H & Knowles W H 'Corstopitum: Report on the excavations in 1910'. *Archaeologia Aeliana* 7, 143-286
- Mennell S 1985 *All manners of food: Eating and taste in England and France from the Middle Ages to the present*. Oxford: Basil Blackwell
- Miles A E W & Grigson C 1990 *Colyer's variations and diseases of the teeth of animals*. Cambridge: Cambridge University Press
- Miller E & Hatcher J 1978 *Medieval England: Rural society and economic change 1086-1348*. London: Longman
- Miller L B S & Rhodes M 1980 'Leather', in Jones D M & Rhodes M (eds) *Excavations at Billingsgate Buildings, Lower Thames Street, London* (Special Paper 4). London: London & Middlesex Archaeological Society. 95-8
- Millett M 1992 *The romanisation of Britain: An essay in archaeological interpretation*. Cambridge: Cambridge University Press
- Mongin P & Plouzeau M 1984 'Guinea fowl', in Mason I L (ed) *Evolution of domesticated animals*. London: Longman. 322-5
- Moore R, Stone J & Tattersall H 1983 *The meat buyers guide for caterers*. London: Northwood Books
- Moran N C & O'Connor T P 1992 'Bones that cats gnawed upon: A case study in bone modification'. *Circaea, The Journal of the Association for Environmental Archaeology* 9, 27-34
- Moran N C & O'Connor T P 1994 'Age attribution in domestic sheep by skeletal and dental maturation: A pilot study of available sources'. *International Journal of Osteoarchaeology* 4, 267-85
- Morris E 1985 'Prehistoric salt distributions: Two cases from western Britain'. *Bulletin of the Board of Celtic Studies* 32, 336-79
- Morris M G 1985 'The animal bone', in Mason D J P (ed) *Excavations at Chester. 26-42 Lower Bridge Street 1974-6: The Dark Age and Saxon periods* (Grosenor Museum Archaeological Excavation & Survey Reports 3). Chester: Chester City Council Grosenor Museum. 67
- Mulkeen S & O'Connor T P 1997 'Raptors in towns: Towards an ecological model'. *International Journal of Osteoarchaeology* 7, 440-9
- Munro J H 1994 *Textiles, trade and towns: Essays in the economic history of late medieval England and the Low Countries*. Aldershot: Variorum
- Munson P J 2000 'Age correlated differential destruction of bones and its effect on archaeological mortality profiles of domestic sheep and goats'. *Journal of Archaeological Science* 27, 391-407
- Munson P J & Garniewicz R 2003 'Age mediated survivorship of ungulate mandibles and teeth in canid ravaged faunal assemblages'. *Journal of Archaeological Science* 30, 405-16
- Myres J N L 1956 'Romano-Saxon pottery', in Harden D B (ed) *Dark-Age Britain. Studies presented to E. T. Leeds with a bibliography of his works*. London: Methuen. 16-39

- Napier P H & Jenkins P D 1997 'Monkey skull and mandible of the Iron Age found at Site B', in Waterman D M & Lynn C J (eds) *Excavations at Navan Fort 1961-71, County Armagh* (Northern Ireland Archaeological Monographs 3). Belfast: The Stationary Office for the Department of the Environment, Northern Ireland. 120-1
- Neal D S 1974 *The excavation of the Roman villa in Gadebridge Park, Hemel Hempstead 19638*. (Reports of the Research Committee of the Society of Antiquaries of London 31). London: Society of Antiquaries of London
- Nicholson R A 1992 'Bone survival: The effects of sedimentary abrasion and trampling on fresh and cooked bone'. *International Journal of Osteoarchaeology* 2, 79-90
- Nicholson R A 1993 'A morphological investigation of burnt animal bone and an evaluation of its utility in archaeology'. *Journal of Archaeological Science* 20, 411-28
- Nicholson R A 1996 'Bone degradation, burial medium and species representation: Debunking the myths, an experiment-based approach'. *Journal of Archaeological Science* 23, 513-33
- Nicholson R A 1998 'Bone degradation in a compost heap'. *Journal of Archaeological Science* 25, 393-403
- Noddle B 1985 'The animal bones' (82-96), in Webster G, Fowler P, Noddle B & Smith L 'The excavations of a Romano-British rural establishment at Barnsley Park, Gloucestershire, 1961-1979: Part III'. *Transactions of the Bristol & Gloucestershire Archaeological Society* 103, 73-100
- Noddle B 1992 'Animal bone', in Rahtz P, Woodward A, Burrow I, Everton A, Watts L, Leach P, Hirst S, Fowler P & Gardner K *Cadbury Congresbury 1968-73: A late/post-Roman hilltop settlement in Somerset* (British Series 223). Oxford: British Archaeological Reports. 185-9
- Noddle B 1994 'The under-rated goat', in Hall A R & Kenward H K (eds) *Urban-rural connexions: Perspectives from environmental archaeology* (Oxbow Monograph 47). Oxford: Oxbow Books. 117-28
- Noddle B A 2000 'Large vertebrate remains', in Price E (ed) *Frocester: A Romano-British settlement, its antecedents and successors volume 2: The finds*. Stonehouse: Gloucester & District Archaeological Research Group. 217-43
- Noe-Nygaard N 1977 'Butchering and marrow fracturing as a taphonomic factor in archaeological deposits'. *Paleobiology* 3, 218-37
- O'Connor T 1983 'Aspects of site environment and economy at Caerleon fortress baths, Gwent', in Proudfoot B (ed) *Site, environment and economy* (International Series 173). Oxford: British Archaeological Reports. 105-13
- O'Connor T 2000 *The archaeology of animal bones*. Stroud: Sutton Publishing
- O'Connor T P 1986 'The animal bones', in Zienkiewicz J D (ed) *The legionary fortress baths at Caerleon volume II: The finds*. Cardiff: The National Museum of Wales
- O'Connor T P 1988 *Archaeological bone samples recovered by sieving: 46-54 Fishergate, York, as a case study* (Ancient Monuments Laboratory Report 190/88). London: English Heritage
- O'Connor T P 1988 *Bones from the General Accident site, Tanner Row* (The archaeology of York: The animal bones 15/2). London: York Archaeological Trust/Council for British Archaeology
- O'Connor T P 1989 'Deciding priorities with urban bones: York as a case study', in Serjeantson D & Waldron T (eds) *Diet and crafts in towns: The evidence of animal remains from the Roman to the post-medieval periods* (British Series 199). Oxford: British Archaeological Reports. 189-200
- O'Connor T P 1991 *Bones from 46-54 Fishergate* (The archaeology of York: The animal bones 15/4). London: York Archaeological Trust/Council for British Archaeology
- O'Connor T P 1993 'Birds and the scavenger niche'. *Archaeofauna* 2, 155-62
- O'Connor T P 2003 *The analysis of urban animal bone assemblages: A handbook for archaeologists* (The archaeology of York: Principles and methods 19/2). London: York Archaeological Trust/Council for British Archaeology
- Olsen S L & Shipman P 1988 'Surface modification on bone: Trampling versus butchery'. *Journal of Archaeological Science* 15, 535-53
- Orton C 2000 *Sampling in archaeology*. Cambridge: Cambridge University Press
- Parker A J 1988 'The birds of Roman Britain'. *Oxford Journal of Archaeology* 7, 197-226
- Parker-Pearson M 2000 'Eating money: A study in the ethnoarchaeology of food'. *Archaeological Dialogues* 7, 217-32
- Payne S 1969 'A metrical distinction between sheep and goat metacarpals', in Ucko P & Dimbleby G (eds) *The domestication and exploitation of plants and animals*. London: Duckworth. 295-305

- Payne S 1972 'Partial recovery and sample bias: The results of some sieving experiments', in Higgs E S (ed) *Papers in economic prehistory: Studies by members and associates of the British Academy major research project in the early history of agriculture*. Cambridge: Cambridge University Press. 49-64
- Payne S 1973 'Kill-off patterns in sheep and goats: The mandibles from Asvan Kale'. *Anatolian Studies: Journal of the British Institute of Archaeology at Ankara* 23, 281-303
- Payne S 1975 'Partial recovery and sample bias', in Clason A T (ed) *Archaeozoological studies: Papers of the archaeozoological conference 1974, held at the Biologisch-Archaeologisch Instituut of the State University of Groningen*. Amsterdam/New York: Elsevier Publishing Company/North-Holland Publishing Company. 7-17
- Payne S 1985 'Morphological distinctions between the mandibular teeth of young sheep, *Ovis*, and goats, *Capra*'. *Journal of Archaeological Science* 12, 139-47
- Payne S 1987 'Reference codes for the wear states in the mandibular cheek teeth of sheep and goats'. *Journal of Archaeological Science* 14, 609-14
- Payne S 1992 *Some notes on sampling and sieving for animal bones* (Ancient Monuments Laboratory Report 55/92). London: English Heritage
- Payne S & Bull G 1988 'Components of variation in measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains'. *Archaeozoologia* 2, 27-66
- Payne S & Munson P J 1985 'Ruby and how many squirrels? The destruction of bones by dogs', in Fieller N R J, Gilbertson D D & Ralph N G R (eds) *Palaeobiological Investigations: Research design, methods and data analysis: Symposia of the Association for Environmental Archaeology no. 5B* (International Series 266). Oxford: British Archaeological Reports. 31-48
- Percival J 1992 'The fifth-century villa: New life or death postponed?' in Drinkwater J & Elton H (eds) *Fifth-century Gaul: A crisis of identity?* Cambridge: Cambridge University Press. 156-66
- Perkins D & Daly P 1968 'A hunters' village in Neolithic Turkey'. *Scientific American* 219, 97-106
- Pickering T R 2002 'Reconsideration of criteria for differentiating faunal assemblages accumulated by hyenas and hominids'. *International Journal of Osteoarchaeology* 12, 127-41
- Pollard S H M 1966 'Neolithic and Dark Age settlements on High Peak, Sidmouth, Devon'. *Proceedings of the Devon Archaeological Society* 23, 35-59
- Pretty K 1989 'Defining the Magonsëte', in Bassett S R (ed) *The origins of Anglo-Saxon kingdoms*. Leicester: Leicester University Press. 171-83
- Pretty K 1997 'Appendix 1: Small finds', in Barker B, White R, Pretty K, Bird H & Corbishley M (eds) *The baths basilica Wroxeter: Excavations 1966-90* (Archaeological Report 8). London: English Heritage. 249-58
- Prummel W 1997 'Evidence of hawking (falconry) from bird and mammal bones'. *International Journal of Osteoarchaeology* 7, 333-8
- Prummel W & Frisch H-J 1986 'A guide for the distinction of species, sex and body side in bones of sheep and goat'. *Journal of Archaeological Science* 13, 567-77
- Rackham D J 1982 'The smaller mammals in the urban environment: Their recovery and interpretation', in Hall A R & Kenward H K (eds) *Environmental archaeology in the urban context* (Research Report 43). London: Council for British Archaeology
- Rackham D J 1995 'Animal bone from post-Roman contexts', in Phillips D & Heywood B (eds) *Excavations at York Minster Volume 1: From Roman fortress to Norman cathedral. Part 2 the finds*. London: Royal Commission on the Historical Monuments of England/Her Majesties Stationary Office. 533-55
- Rackham H 1997 *Pliny: Natural History: Volume 3: Books 8-11* (Loeb Classical Library 353). London: Harvard University Press
- Raftery B 1997 'Implications of the monkey bones from Site B', in Waterman D M & Lynn C J (eds) *Excavations at Navan Fort 1961-71, County Armagh* (Northern Ireland Archaeological Monographs 3). Belfast: The Stationary Office for the Department of the Environment, Northern Ireland. 121-4
- Rahtz P, Woodward A, Burrow I, Everton A, Watts L, Leach P, Hirst S, Fowler P & Gardner K 1992 *Cadbury Congresbury 1968-73: A late/post-Roman settlement in Somerset* (British Series 223). Oxford: British Archaeological Reports
- Randall J 1908 'Industries', in Page W (ed) *The Victoria history of Shropshire volume 1*. London: Archibald Constable. 415-82

- Ratjen H & Heinrich D 1978 'Vergleichende Untersuchungen an den Metapodien von Füchsen und Hunden'. *Shriften aus der Archäologisch-Zoologischen Arbeitsgruppe* 4
- Redding R W 1984 'Theoretical determinants of a herder's decisions: Modelling variation in the sheep/goat ratio', in Grigson C & Clutton-Brock J (eds) *Animals and archaeology: 3. Early herders and their flocks* (International Series 202). Oxford: British Archaeological Reports. 223-41
- Reece R 1980 'Town and country: The end of Roman Britain'. *World Archaeology* 12, 77-92
- Reece R 1988 *My Roman Britain* (Cotswolds Studies 3). Cirencester: Cotswold Studies at the Apple Loft
- Reece R 1989 'Models of continuity'. *Oxford Journal of Archaeology* 8, 231-6
- Reece R 1996 'The end of the city in Roman Britain', in Rich J (ed) *The city in Late Antiquity*. London: Routledge. 136-44
- Reece R 1999 *The later Roman Empire: An archaeology AD 150-600*. Stroud: Tempus
- Reed R 1972 *Ancient skins, parchments and leathers*. London: Seminar Press
- Reitz E & Honerkamp N 1983 'British colonial subsistence strategy on the south eastern coastal plain'. *Historical Archaeology* 17, 4-26
- Reitz E J 1985 'Comparison of Spanish and aboriginal subsistence on the Atlantic coastal plain'. *Southeastern Archaeology* 4, 41-50
- Reitz E J & Wing E S 1999 *Zooarchaeology*. Cambridge: Cambridge University Press
- Revel J-F 1984 *Culture and cuisine: A journey through the history of food*. New York: Da Capo Press
- Richardson H D 1851 *Domestic fowl and ornamental poultry*. London
- Richardson J in press 'The animal bone', in Powlesland D *Excavations at West Heslerton, East Yorkshire* (Archaeological Report). London: English Heritage
- Richmond I A 1963 'The Cornovii', in Foster I L & Alcock L (eds) *Culture and environment: Essays in honour of Sir Cyril Fox*. London: Routledge & Kegan Paul. 251-62
- Rivet A L F 1958 *Town and country in Roman Britain*. London: Hutchinson
- Rivet A L F 1982 'Viae aviariae?' *Antiquity* 56, 206-7
- Roberts W I 1982 *Romano-Saxon pottery* (British Series 106). Oxford: British Archaeological Reports
- Robinson G W 1916 *A survey of the soils and agriculture of Shropshire*. Shrewsbury: Shropshire County Council/W B Walker
- Rostovtzeff M 1957 *The social and economic history of the Roman empire*. Oxford: Clarendon Press
- Rowley T 1972 *The Shropshire landscape*. London: Hodder & Stoughton
- Rowley T 1986 *The landscape of the Welsh Marches*. London: Joseph
- Russell J C 1958 'Late ancient and medieval population'. *Transactions of the American Philosophical Society* 48, 1-152
- Sadler P 1991 'The use of tarsometatarsi in sexing and ageing domestic fowl (*Gallus gallus* L.), and recognising five toed breeds in archaeological material'. *Circaea, The Journal of the Association for Environmental Archaeology* 8, 41-8
- Saint-Germain C 1997 'The production of bone broth: A study in nutritional exploitation', in Kokabi M & Wahl J (eds) *Anthropozoologica: Proceedings of the 7th International Conference for Archaeozoology, ICAZ, Constance, September 1994 25-26*. Paris: L'Homme et l' Animal, Société de Recherche Interdisciplinaire/Centre National de la Recherche Scientifique. 153-6
- Salway P 1981 *Roman Britain*. Oxford: Clarendon
- Salway P 1993 *The Oxford illustrated history of Roman Britain*. London: Oxford University Press
- Sato Y, Tsutsui Y, Shishido H, Yamagishi N & Furukawa R 1988 'Kinetic analysis on walking behaviour of cows', *Livestock environment III: Proceedings of the 3rd International Livestock Environment Symposium, Toronto, Canada, 25-27 April 1988* (American Society of Agricultural Engineers Publication 88-1). Toronto: American Society of Agricultural Engineers. 171-88
- Schiffer M B 1996 *Formation processes of the archaeological record*. Salt Lake City: University of Utah Press
- Schmid E S 1972 *Atlas of animal bones for prehistorians, archaeologists and Quaternary geologists*. Amsterdam: Elsevier
- Schmitt D N & Juell K E 1994 'Towards the identification of coyote scatological faunal accumulations in archaeological contexts'. *Journal of Archaeological Science* 21, 249-62
- Scott A F 1977 *Everyone a witness: Commentaries of an era: The Roman age*. London: White Lion Publishers

- Scott E M 1996 'Who ate what? Archaeological food remains and cultural diversity', in Reitz E J, Newsom L A & Scudder S J (eds) *Case studies in environmental archaeology*. New York: Plenum Press. 339-58
- Seetah K 2002 *Techniques and implement use in urban Romano-British cattle-butcherery*. Bournemouth: Bournemouth University. Unpublished MSc thesis
- Selby P J 1833 *Illustrations of British ornithology*. Edinburgh
- Selvaggio M M & Wilder J 2001 'Identifying the involvement of multiple carnivore taxa with archaeological bone assemblages'. *Journal of Archaeological Science* 28, 465-70
- Serjeantson D 1989 'Animal remains and the tanning trade', in Serjeantson D & Waldron T (eds) *Diet and crafts in towns: The evidence of animal remains from the Roman to the post-medieval periods* (British Series 199). Oxford: British Archaeological Reports. 129-46
- Serjeantson D 1989 'Introduction', in Serjeantson D & Waldron T (eds) *Diet and crafts in towns: The evidence of animal remains from the Roman to the post-medieval periods* (British Series 199). Oxford: British Archaeological Reports. 1-12
- Serjeantson D 1996 'The animal bones', in Needham S & Spence T (eds) *Runnymede Bridge research excavations, volume 2 refuse and disposal at Area 16, Runnymede 2*. London: British Museum. 194-223
- Serjeantson D 2004 'Tearing birds apart'. ZOOARCH. [on-line] Chilton, Didcot: JISCmail <http://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=ind0410&L=zooarch&P=R2028&I=-1> [accessed 3/11/04]
- Serpell J & Paul E 1994 'Pets and the development of positive attitudes to animals', in Manning A & Serpell J (eds) *Animals and human society: Changing perspectives*. London: Routledge. 127-44
- Shaffer B S & Baker B W 1999 'Comments on James' methodological issues concerning analysis of archaeofaunal recovery and screen size correction factors'. *Journal of Archaeological Science* 26, 1181-2
- Shaffer B S & Sanchez J L J 1994 'Comparison of 1/8" and 1/4" mesh recovery of controlled samples of small-to-medium sized mammals'. *American Antiquity* 59, 525-30
- Shipman P 1988 'Actualistic studies of animal resources and hominid activities', in Olsen S L (ed) *Scanning electron microscopy in archaeology* (International Series 452). Oxford: British Archaeological Reports. 261-85
- Shipman P & Rose J 1983 'Early hominid hunting, butchering, and carcass-processing behaviours: Approaches to the fossil record'. *Journal of Anthropological Archaeology* 2, 57-98
- Sidell E J 2000 'Dark earth and obscured stratigraphy', in Huntley J P & Stallibrass S (eds) *Taphonomy and interpretation* (Symposia of the Association for Environmental Archaeology 14). Oxford: Oxbow Books. 35-42
- Silver I A 1969 'The ageing of domestic animals', in Brothwell D R & Higgs E S (eds) *Science and archaeology: A comprehensive survey of progress and research*. London: Thames & Hudson. 283-302
- Simon A 1944 *A concise encyclopaedia of gastronomy; section IV birds and their eggs*. London: Food & Wine Society
- Simoons F J 1994 *Eat not this flesh: Food avoidances from prehistory to the present*. London: University of Wisconsin Press
- Simpson G G, Roe A & Lewontin R C 1960 *Quantitative zoology*. New York: Harcourt, Brace & Company
- Smith C 1977 'The valleys of the Tame and the middle Trent - their populations and ecology', in Collis J R (ed) *The Iron Age in Britain: A review*. Sheffield: Department of Archaeology & Prehistory, University of Sheffield. 51-61
- Smith I & Halstead P 1989 'The animal bone from medieval and post-medieval Doncaster', in Buckland P C & Magilton J R (eds) *The archaeology of Doncaster 2* (British Series 202). Oxford: British Archaeological Reports. 432-46
- Snow D W, Perrins C M, Gillmor R, Hillcoat B, Roselaar C S, Vincent D, Wallace D I M & Wilson M G 1998 *The birds of the western Palearctic: Concise edition. Volume 1: Non-passerines*. Oxford: Oxford University Press
- Snow D W, Perrins C M, Gillmor R, Hillcoat B, Roselaar C S, Vincent D, Wallace D I M & Wilson M G 1998 *The birds of the western Palearctic: Concise edition. Volume 2: Passerines*. Oxford: Oxford University Press

- Soren D, Fenton T & Birkby W not dated 'The Late Roman infant cemetery near Lugnano in Teverina, Italy: Some implications'. *College of Humanities* [on-line]. Tuscon, Arizona: University of Arizona  
<http://www.coh.arizona.edu/lugnano/lugnano%20article.htm>  
 [accessed 10/6/02]
- Sorrell A 1981 *Reconstructing the past*. London: Batsford Academic & Educational
- Stahl P W 1996 'The recovery and interpretation of microvertebrate bone assemblages from archaeological contexts'. *Journal of Archaeological Theory & Method* 3, 31-75
- Staines B W 1991 'Red deer *Cervus elaphus*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 492-504
- Stallibrass S 1982 *The animal bones from Castleford site 1 excavations 1977-78*. Sheffield: University of Sheffield. Unpublished report
- Stallibrass S 1992 *A comparison of the measurements of Romano-British animal bones from Periods 3 and 5, recovered from excavations at Annetwell Street, Carlisle* (Ancient Monuments Laboratory Report 133/91). London: English Heritage
- Stallibrass S 1993a *Animal bones from excavations in the southern area of the The Lanes, Carlisle, Cumbria, 1981-1982* (Ancient Monuments Laboratory Report 96/93). London: English Heritage
- Stallibrass S 1993b *Animal bones from Old Grape Lane, trenches A and B, The Lanes, Carlisle, 1982* (Ancient Monuments Laboratory Report 93/93). London: English Heritage
- Stallibrass S 2000 'How little we know, and how much there is to learn: What can animal and human bones tell us about the late Roman transition in northern England?' in Wilmott T & Wilson P (eds) *The Late Roman transition in the north: Papers from the Roman Archaeology Conference, Durham 1999* (British Series 299). Oxford: British Archaeological Reports. 73-80
- Stallibrass S 2002 'An overview of the animal bones: What would we like to know, what do we know so far, and where do we go from here?' in Wilson P R (ed) *Catteractonium: Roman Catterick and its hinterland. Excavations and research, 1958-1997 part II* (Research Report 129). York: Council for British Archaeology. 392-415
- Stallibrass S M 1990 'Canid damage to animal bones: Two current lines of research', in Robinson D E (ed) *Experiment and reconstruction in environmental archaeology: Symposia of the Association for Environmental Archaeology no. 9 Roskolde, Denmark, 1988*. Oxford: Oxbow Books. 151-65
- Stamper P A 1989a 'Domesday Book to 1300', in Baugh G C (ed) *A history of Shropshire, volume 4: Agriculture*. Oxford: The Institute of Historical Research/Oxford University Press. 26-71
- Stamper P A 1989b 'Early agriculture', in Baugh G C (ed) *A history of Shropshire, volume 4: Agriculture*. Oxford: The Institute of Historical Research/Oxford University Press. 20- 6
- Stanford S C 1980 *The archaeology of the Welsh Marches*. London: Collins
- Stokes P R G 2000 'The butcher, the cook and the archaeologist', in Huntley J P & Stallibrass S (eds) *Taphonomy and interpretation* (Symposia of the Association for Environmental Archaeology 14). Oxford: Oxbow Books. 65-70
- Stone R D & Gorman M L 1991 'Mole *Talpa europaea*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 43-9
- Sutcliffe A J 1973 'Similarity of bones and antlers gnawed by deer to human artifacts'. *Nature* 246, 428-30
- Sutherland J A 1967 *Understanding farm animals (an introduction to the science of animal production)*. London: Angus & Robertson
- Swatland H 2000 *Meat cuts and muscle food*. Nottingham: Nottingham University Press
- Sykes N forthcoming 'Hunting for the Anglo-Normans: Zooarchaeological evidence for medieval identity', in Pluskowski A (ed) *Just skin and bones? News perspectives on human - animal relations in the historic past* (British Series). Oxford: British Archaeological Reports
- Sykes N 2004 'The introduction of fallow deer to Britain: A zooarchaeological perspective'. *Environmental Archaeology: The Journal of Human Palaeocology* 9, 75-83
- Sykes N J 2001 *The Norman conquest: A zooarchaeological perspective*. Southampton: University of Southampton. Unpublished PhD thesis
- Symonds R P 1997 'Appendix 4: Roman pottery', in Barker B, White R, Pretty K, Bird H & Corbishley M (eds) *The baths basilica Wroxeter: Excavations 1966-90* (Archaeological Report 8). London: English Heritage. 269-310



- Tangires H 1998 'Where's the lamb?' Greek-Americans in the restaurant business in the U.S.A', in Lysaght P (ed) *Food and the traveller: Migration, immigration, tourism and ethnic food: Proceedings of the 11th Conference of the International Commission for Ethnological Food Research, Cyprus, June 8-14, 1996*. Nicosia, Cyprus: Intercollege Press, Cyprus/Department of Irish Folklore, University College Dublin. 207-18
- Tapper S C 1991 'Brown hare *Lepus europaeus*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 154-60
- Taylor K D, Fenn M G & Macdonald D W 1991 'Common rat *Rattus norvegicus*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 248-55
- Temin P 2001 'A market economy in the early Roman empire'. *Journal of Roman Studies* 91, 169-81
- Teuteberg H J 1986 'Periods and turning-points in the history of European diet: A preliminary outline of problems and methods', in Fenton A & Kisbán E (eds) *Food in change: Eating habits from the Middle Ages to the present day*. Edinburgh: John Donald Publishers Ltd/National Museums of Scotland. 11-23
- Thawley C R 1982 'The animal remains', in Wachter J S & McWhirr A D (eds) *Early Roman occupation at Cirencester* (Cirencester Excavations 1). Cirencester: Cirencester Excavation Committee. 211-27
- Theodoratus R J 1981 'Greek immigrant cuisine in America: Continuity and change', in Fenton A & Owen T M (eds) *Food in perspective: Proceedings of the Third International Conference on Ethnological Food Research, Cardiff, Wales, 1977*. Edinburgh: John Donald Publishers Ltd. 313-23
- Thomas D H 1969 'Great Basin hunting patterns: A quantitative method for treating faunal remains'. *American Antiquity* 34, 392-401
- Thompson H V & Worden A N 1956 *The rabbit*. London: Collins
- Thomson R 1981 'Leather manufacture in the post-medieval period with special reference to Northamptonshire'. *Post-Medieval Archaeology* 15, 161-75
- Tomber R 1991 'Methods for investigating deposit homogeneity'. *Journal of Roman Pottery Studies* 4, 59-68
- Tomek T & Bocheński Z M 2000 *The comparative osteology of European corvids (Aves: Corvidae), with a key to the identification of their skeletal elements*. Krakow: Institute of Systematics and Evolution of Animals, Polish Academy of Sciences
- Toynbee J M C 1973 *Animals in Roman life and art*. London: Thames & Hudson
- Turner A 1984 'Sub-sampling animal bone assemblages: Reducing the work load or reducing the information?' *Circaea, The Journal of the Association for Environmental Archaeology* 2, 69-75
- University of Southampton 2003 'Animal Bone Metrical Archive Project'. *Archaeological Data Service* [on-line]. York: University of York  
<http://ads.ahds.ac.uk/catalogue/specColl/abmap/index.cfm>  
[accessed 10/10/03]
- van der Veen M & Fieller N 1982 'Sampling seeds'. *Journal of Archaeological Science* 9, 287-98
- van Mensch P J A 1974 'A Roman soup kitchen at Zwammerdam?' *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek* 24, 159-65
- van Wijngaarden-Bakker L 1990 'Replication of butchering marks on pig mandibles', in Robinson D E (ed) *Experiment and reconstruction in environmental archaeology: Symposia of the Association for Environmental Archaeology no.9 Roskilde, Denmark, 1988*. Oxford: Oxbow Books. 167-74
- Velander K A 1991 'Pine martin *Martes martes*', in Corbet G B & Harris S (eds) *The handbook of British mammals*. Oxford: Blackwell Scientific Publications. 368-76
- Villa P & Courtin J 1983 'The interpretation of stratified sites: A view from underground'. *Journal of Archaeological Science* 10, 267-81
- von den Driesch A E 1976 *A guide to the measurement of animal bones from archaeological sites* (Bulletin 1). Cambridge, Massachusetts: Peabody Museum of Archaeology & Ethnology, Harvard University
- von Stubbe M not dated 'Mustela lutreola (Linné, 1761) - Europäischer Nerz', in von Niethammer J & Krapp F (eds) *Handbuch der Säugetiere Europas band 5: Raubsäuger - carnivora (Fissipedia) Teil II: Mustelidae 2, Viverridae, Herpestidae, Felidae*. Wiesbaden: Aula Verlag. 627-34
- von Wolsan M 1993 'Mustela putorius Linnaeus, 1758 - Waldiltis europäischer Iltis, Iltis', in von Stubbe M & Krapp F (eds) *Handbuch der Säugetiere Europas band 5/II, carnivora 2 (Fissipedia)*. Wiesbaden: Aula Verlag. 699-769

- Wacher J 1995 *The towns of Roman Britain*. London: B T Batsford
- Wacher J S 1974 'Villae in urbibus?' *Britannia* 5, 282-4
- Wainwright G J 1967 *Coygan Camp*. Cardiff: Cambrian Archaeological Association
- Webster G 1991 *The Cornovii*. Stroud: Sutton
- West B 1982 'Spur development: recognizing caponized fowl in archaeological material', in Wilson B, Grigson C & Payne S (eds) *Ageing and sexing animal bones from archaeological sites* (British Series 109). Oxford: British Archaeological Reports. 255-61
- West B 1985 'Chicken legs revisited'. *Circaea, The Journal of the Association for Environmental Archaeology* 3, 11-4
- West B 1988 'Birds and mammals', in Cowie R & Whytehead R L 'Two Middle Saxon occupation sites at Jubilee Hall and 21-22 Maiden Lane'. *Transactions of the London & Middlesex Archaeological Society* 39. 150-4
- Whimster R 1989 *The emerging past: Air photography and the buried landscape*. London: Royal Commission on the Historical Monuments of England
- White K D 1970 *Roman farming*. London: Thames & Hudson
- White P, Webster G, Johnson S, Barker P & Brown P (eds) 1976 *Wroxeter Roman city: Work in progress 1975*. London: Department of Environment. Unpublished report
- White R 1997 'Appendix 11: List of contexts, by site and phase, division into categories A, B, and C', in Barker B, White R, Pretty K, Bird H & Corbishley M (eds) *The baths basilica Wroxeter: Excavations 1966-90* (Archaeological Report 8). London: English Heritage. 371-4
- White R 1997 'Appendix 4: Roman pottery: Pottery distribution', in Barker B, White R, Pretty K, Bird H & Corbishley M (eds) *The baths basilica Wroxeter: Excavations 1966-90* (Archaeological Report 8). London: English Heritage. 312-8
- White R & Barker B 1998 *Wroxeter: Life and death of a Roman city*. Stroud: Tempus
- Wilkes J J 1986 *Diocletian's palace, Split* (Occasional Publication 2). Sheffield: Department of Archaeology & Prehistory, University of Sheffield
- Wilkinson J L & Barker P A 1997 'Appendix 10: Human skull fragments', in Barker P, White R, Pretty K, Bird H & Corbishley M (eds) *The baths basilica Wroxeter: Excavations 1966-90* (Archaeological Report 8). London: English Heritage. 368-70
- Williams J P 2001 *Small mammals in archaeology: A taphonomic analysis of barn owl (Tyto alba) nesting and roosting sites*. Sheffield: University of Sheffield. Unpublished PhD thesis
- Wilson B 1978 'The animal bones', in Parrington M (ed) *The excavation of an Iron Age settlement, Bronze Age ring-ditches and Roman features at Ashville Trading Estate, Abingdon (Oxfordshire) 1974-76* (Oxfordshire Archaeological Unit Report 1/Research Report 28). Oxford: Oxfordshire Archaeological Unit/Council for British Archaeology. 110-39
- Wilson D M 1959 'Almgren and chronology'. *Medieval Archaeology* 3, 112-9
- Wing E S & Quitmyer I R 1985 'Screen size for optimal data recovery: A case study', in Adam W H (ed) *Aboriginal subsistence and settlement archaeology of the Kings bay locality* (Reports of Investigation 2). Gainesville: Department of Anthropology, University of Florida. 49-58
- Wright N 1995 *History and literature in Late Antiquity and the early medieval west: Studies in intertextuality*. Aldershot: Variorum
- Wright T 1872 *Uriconium; an historical account of the ancient Roman city, and of the excavations made upon its site at Wroxeter, in Shropshire, forming a sketch of the condition and history of the Welsh border during the Roman period*. Shrewsbury & London
- Yalden D 1999 *History of British mammals*. London: T & A D Poyser
- Yule B 1990 'The "Dark Earth" and late Roman London'. *Antiquity* 64, 620-8
- Zeuner F E 1963 *A history of domesticated animals*. London: Hutchinson
- Ziemann M 1998 'The impact of German reunification on nutritional behaviour in the former German Democratic Republic', in Lysaght P (ed) *Food and the traveller: Migration, immigration, tourism and ethnic food: Proceedings of the 11th Conference of the International Commission for Ethnological Food Research, Cyprus, June 8-14, 1996*. Nicosia, Cyprus: Intercollege Press, Cyprus/Department of Irish Folklore, University College Dublin. 264-73