CHAPTER 1

INTRODUCTION

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THE SCOPE OF THE VOLUME

The first volume of *New Visions of the Countryside of Roman Britain* was devoted to a study of the rural settlements of Roman England and Wales and their constituent buildings (Smith *et al.* 2016). A typology of settlements was developed, and the combination of the distribution and density of the various types in relation to the natural environment led to the establishment of a framework of eight regions, by which to give better focus to variation in settlement morphology, architecture, agricultural practice and rural economy, religious behaviour and individual identity, across the two nations that encompass Roman Britain south of Hadrian's Wall.

This, second, volume considers the rural economy of Roman Britain through the lenses of the principal occupations of agriculture and rural industry. It has two main concerns, the documentation of what is currently known of agricultural and industrial production in the countryside, and an exploration of the contribution that material culture can make to our understanding of how those resources moved across the province to feed and support military and civil populations and the development of towns and infrastructure between the mid-first century A.D. and the beginning of the fifth century A.D. At the same time, the classification and regional appraisal of rural settlement that is at the heart of Volume 1, *The Rural Settlement of Roman Britain*, has enabled this study to provide a social context for rural production and consumption. This now includes data from selected defended small towns across the Roman province, which were unavailable for the previous study.

This is the first time that the evidence from the countryside has been brought together in this way, with previous studies taking a broader approach to the economy of Roman Britain, some using qualitative ceramic evidence as a proxy for the economic pull of the Roman army on the northern frontier (e.g. Fulford 1989a; 2004). Following a review of methodologies in this chapter, arable and pastoral farming are, at the outset, treated separately. Chapter 2 draws together the archaeobotanical and material culture evidence for the cultivation and processing of both the major cereal crops of spelt wheat and barley and minor crops, such as flax, legumes, oats and rye. The evidence for viticulture and horticulture is also reviewed. Chapter 3 considers the evidence provided by faunal remains for stock-raising, focusing mainly on the principal domesticates of cattle, sheep (goat), pig and horse, but also reviewing the evidence for poultry. Together all this empirical evidence justifies the assertion that 'Quite certainly the production of food remained the mainstay of economic life in Britain throughout' (Fulford 2004, 312).

The two strands of arable and pastoral farming are then brought together in Chapter 4 to develop an overview of farming in the round, focusing particularly on case studies in the Central Belt and South regions. Chapter 5 synthesises the evidence for craft and industry associated with rural settlements, revealing how much activities such as iron- and pottery-making took place across the landscape and settlement hierarchy, integrated with agricultural activities, rather than in the better known centres associated with their production, such as Alice Holt Forest or the New Forest (pottery) and the Weald or the Forest of Dean (iron).

Making allowances for the effect of the differential distribution of fieldwork, particularly since the implementation of PPG16 in 1990, we can nevertheless see areas of more or less intensive agriculture and rural industry across *Britannia*, with the former in some regions, notably the North and West, appearing not to develop much, if at all, beyond subsistence farming. However, what we cannot yet readily infer from these data is the scale of production – the area of land under cultivation at any one time, the volume of cereals produced, the numbers of animals raised, the amount of iron smelted, the numbers of pots produced, etc. – or where they were consumed, because the provenance of most of these commodities is difficult to characterise (Fulford 2004, 313). In a general sense, however, a surplus of foodstuffs was produced sufficient to support the population of the province, including the military establishment, by the second half of the second century A.D., if not earlier, through to the late fourth or early fifth century. In the fourth century, but quite possibly earlier, written sources attest the export, though not necessarily annually, of a surplus of grain of unknown volume to the Continent, perhaps made possible by the reduction in size of the army in Britain (see Bidwell, Ch. 7). With its focus on production in the countryside, this volume logically builds on Volume 1, which explores social and regional differentiation among rural settlements, where the development of the villa is the best expression of the concentration of wealth in the hands of a small proportion of the provincial population. This leaves Volume 3 to investigate the impact the production of surplus had on people and their way of life in the countryside.

In order to develop a better understanding of the development of agricultural production and rural industry, and the movement of those resources in support of the Roman army and urban communities, two chapters consider the contributions that material culture can make to this question. Chapter 6 assesses the insights that coin loss in the countryside gives us into the development of monetary exchange and the marketing of the products of agriculture and rural industry, while Chapter 7 uses pottery as the principal medium for assessing some of the inferences that may be drawn from the changing distributions of manufactured goods in the countryside from local, regional and provincial-wide perspectives. While coinage gives us insight into the conversion of a proportion, at least, of rural produce into money and, with its independent dating, the development over time of monetary exchange across the province, pottery can be analysed as a proxy for the movement of perishables and other goods and commodities whose provenance is difficult or impossible to determine. Coins, as products for the most part of mints outside the province, until the late third century when regional mints began to be established across the empire, allow generalised insight into the development of the marketing of rural production, but pottery, with its ubiquity and multiplicity of production sites often associated with distinctive, mass-produced wares, susceptible to quantification, is, potentially, a more sensitive indicator of local, regional and provincial patterns of consumption and their change over time. Indeed, the last 20–30 years have seen a great increase in the number of quantified pottery assemblages and some of these data are exploited in Chapter 7. Of course, the extent to which pottery can be used as a mirror of the movement of perishables and of other goods and commodities difficult or impossible to provenance to their point of origin remains debatable.

A common theme to two of the contributions to Chapter 7 is the likelihood that London was the starting point of the distribution of the wares under consideration across Britain. Brindle's analysis of the changing distribution and social context of imported amphorae and samian in the countryside recalls that of the coin data in the previous chapter and integrates well with Allen's analysis of the provincial-wide distribution of a particular type of whetstone with a southern British provenance. The remaining three contributions to the chapter take regional approaches, all of which have provincial-wide implications. Bidwell considers the evidence of traded pottery in relation to the supply of the Roman army in the north of Britain. Here, with the insights provided by the Vindolanda tablets into some of the detailed requirements for supplies of food and materials of an auxiliary garrison on the northern frontier at the turn of the first and second centuries, and how some of them were met, including from distant sources to the south, we have a complementary source to that provided by the ceramic evidence (cf. Bowman 2003, 65–81). While we must avoid making one-to-one correlations between the sources of particular manufactured articles and those of food and other perishables, it is difficult not to conclude that distantly sourced material goods found on the northern frontier do correlate to some extent with distantly sourced foodstuffs and other perishables. What this means is that a proportion of the food and other perishable goods, such as leather, as well as the means of transport, by ox or horse-drawn cart, continued to be drawn from farms in the south and midlands of the province until the later third and fourth century. Even in the fourth century, when there is evidence of greater agricultural activity in the North-East region, there is still a contribution from the South and Central Belt regions.

Among other approaches taken through the quantitative analysis of pottery in Chapter 7, Rippon assesses the social and cultural factors that may influence the distribution patterns of several, selected small-scale industries located in eastern England. Timby, on the other hand, considers the totality of the pottery assemblage from the rural settlements that meet her selection criteria to take an inclusive approach to the evidence of ceramic assemblages from the west of the Central Belt region in Gloucestershire, South Gloucestershire and Bristol. Her principal questions focus on the changing distributions and patterns of consumption of local, regional and imported wares in relation to the type and perceived status of the settlements within her study area. Here, again, there are links across to all the other contributions to the chapter and to the evidence provided by the coins in Chapter 6.

Together, the two material culture chapters, with the inferences that can be deduced from them of the growing production and movement of goods and commodities through the agriculturally productive lands of the province from the late first/early second century onwards, provide a context for the changes in farming settlements and agricultural regimes documented in the preceding chapters and in Volume 1, *The Rural Settlement of Roman Britain*.

Whether through taxation or the payment of premium prices to ensure the food security of the Roman army, one consequence of the pull of foodstuffs and other goods to the northern frontier or across the Channel to the Continent was that they were not available to the local and regional communities of the midlands and south or the civil populations of the north and west. There is considerable evidence for the stagnation of Roman Britain during the third and fourth centuries A.D., perhaps best exemplified by the end of the establishment of new towns across most of the province by the turn of the second and third centuries and, at the same time, by the fossilisation of individual towns within their newly erected defensive circuits. While other factors, including population decline after its second-century peak (Smith and Fulford 2016, 416), may have contributed to this stagnation, the bleeding of basic resources from the agricultural heartland of the province, stultifying the possibilities of more local, urban development, is perhaps the most fundamental.

EVIDENCE AND METHODOLOGIES

The analyses conducted within this volume have utilised a wide range of evidence, including archaeobotanical and faunal remains, along with coins, tools, industrial debris and other forms of material culture. These have been assessed against a backdrop of settlement and architectural data analysed and presented in Volume 1 (Smith *et al.* 2016). Much of this evidence was collected as part of the initial phase of data gathering, from both published and unpublished reports, and the data are archived on the project database, which is available online at http://dx.doi.org/10.5284/1030449. However, in order to address more detailed research questions, new data have been sourced, particularly with regard to coins, plant and animal remains. For pragmatic reasons, much of these new data relate to case study areas in various regions of England and Wales, rather than the Roman province as a whole, though they ably demonstrate the marked variation inherent in the economic structure of the Romano-British countryside. Below is a brief methodological consideration of some of the most important types of evidence that underpin many of the chapters in this volume.

PLANT REMAINS

As the focus of this project is upon site-based excavations, the emphasis of the analysis presented in Chapters 2 and 4 is on plant macrofossils rather than on pollen, molluscs and soils, which are more widely recovered through landscape investigations. The study of plant macrofossils has produced a wealth of evidence for food and farming over the last 40 years, although the types of plant remains recovered are strongly influenced by biases in preservation, sampling, recovery, identification, quantification and reporting. Three major modes of preservation are commonly encountered in rural Roman Britain – charred, waterlogged and mineralised.

Charred plant remains are the most ubiquitous. When plant remains are heated in a reducing atmosphere they are largely converted to carbon through dextrinization and Maillard reactions (Charles *et al.* 2015), making them resistant to decay. Charring can occur in a range of circumstances, from food preparation and waste disposal, to accidental and purposeful destruction by fire (Van der Veen 2007). Charred plant remains are usually dominated by cereals, as they come into regular contact with heat during crop processing. More robust items are more likely to survive the charring process, namely cereal grains, chaff and nutshell, with rachis internodes and culm nodes generally under represented (Boardman and Jones 1990). Charred plant remains will usually survive in all soil conditions encountered in Britain, and are only broken down by physical erosion, namely wetting and drying, especially in clay-rich soils. The endurance of charred plant remains can, however, lead to problems of residuality and contamination, which can only be solved through radiocarbon dating (Pelling *et al.* 2015).

Plant remains are preserved when deposited in permanently waterlogged anoxic conditions, in areas of standing water or organic refuse. Typically a diverse range of plant remains is preserved, including delicate plant remains and taxa derived from settlement vegetation and activities and plant foods (Kenward and Hall 2008). Waterlogging preferences plant remains with a more lignified composition, rarely preserving cereal grains and pulses (Tomlinson and Hall 1996).

Several types of plant mineralisation can occur (Jacomet and Kreuz 1999, 62), but the most common in rural Roman Britain is calcium-phosphate mineralisation, in latrine pits where phosphate and calcium together with a fluctuating water table are present (Carruthers 2000). The range of taxa preserved depends on the extent of decay and the physical characteristics of seeds (McCobb *et al.* 2001). Mineralised plant remains are very rare in rural Roman Britain, but when they are present they can provide direct evidence for human or animal diet. Plant microfossils, namely starch and phytoliths, can also provide information on diet and agriculture, but there has been very little study of Romano-British rural sites.

Charred plant remains and charcoal are recovered through the flotation of whole earth samples, but the quality of data recovered relies on sufficient large samples being taken per site phase, ideally at least 30 samples per phase producing 300–500 items (Van der Veen *et al.* 2007). Smaller waterlogged samples are usually processed by the wash-over method (Campbell *et al.* 2011). Sampling for macroscopic plant remains began to be widely implemented in the late 1970s, initially in the Upper Thames Valley (Robinson 1992), although at different points in different regions. The sizes of flots and meshes used in flotation, as well as the retention and sorting of residues, are key for ensuring comparable data.

The standard techniques of flot assessment, sorting and identification under low-power microscopy, and with the assistance of a modern seed reference collection (Campbell *et al.* 2011), have remained unchanged for decades. While the increased prevalence of archaeobotanists working in isolation increases the risk of errors (Van der Veen *et al.* 2007), the wide chronological and spatial coverage of specialists working today ensures that this is unlikely to cause specific biases in data. There are several oft-repeated errors pertinent to the Roman period; the confusion of short-grained spelt wheat grains with free-threshing wheat, and of basal spelt rachis with free-threshing wheat rachis (Campbell and Straker 2003), which must be kept in mind when investigating crop choice. As long as fully quantified accurate data are published, a suite of analytical techniques can be applied. The interpretation of charred plant remains relies on comparison with ethnographic models of cereal processing (Hillman 1981) and autecological analysis of arable weed seeds (see Van der Veen 1992 for a good example). Interpretation is often based on qualitative observations, with rigorous analysis limited to research-based excavations or large developer-funded excavations (e.g. Campbell 2008a). The interpretation of waterlogged data relies on the recognition of indicator groups of taxa representative of specific activities (Kenward and Hall 1997), and consideration of the modern habitats in which plants grow. Overall, difficulty lies in separating evidence for food consumption from horticulture, and determining the scale at which these activities were taking place.

The current state of Roman archaeobotany in Britain has received recent criticism (Van der Veen *et al.* 2007; Robinson 2015), though several research council-funded PhDs have produced synthetic works focusing on agriculture (e.g. Parks 2012; Lodwick 2015a), while Van der Veen *et al.*'s work has highlighted the significance of new plant foods and opened up new research paths (Van der Veen *et al.* 2008; Orengo and Livarda 2016). In contrast, far less synthetic work has taken place on charcoal and waterlogged wood (but see Huntley 2010).

FAUNAL REMAINS

Over the past 30 years, zooarchaeology has become an increasingly accepted part of archaeological research. The economic importance of animals in Roman Britain would have been wide ranging, and the analysis of their bones provides important information on strategies of livestock husbandry, the consumption of meat, dairy and eggs, and the manufacture and use of animal by-products, such as leather, woollen items, and objects made of bone, antler, and horn (Grant 2004; Maltby 2016).

In order to provide a comprehensive overview of the available evidence, zooarchaeological data have been recorded on the project database wherever animal bones have been reported from an excavation, regardless of the size of the assemblage or the level of preservation of the remains. Although only domesticated farm animals are covered in this volume, the following methodological section covers all types of zooarchaeological data recorded by the project. Aspects of animal exploitation, such as hunting, pet-keeping, and the ritual uses of animals, will be examined in Volume 3, though the methods of data collection and analysis for these subjects are included here to explain how the animal bone dataset was treated as whole.

Small or poorly preserved assemblages were not discriminated against at this stage, because although they are less useful for understanding the economy of a settlement, they may still contain important cultural or ecological information. The distribution of well-preserved animal bone assemblages varies across England and Wales, and is heavily biased by the acidity of local soils. A map of these is shown in Chapter 12 of Volume 1 (Smith and Fulford 2016). In general, animal bone assemblages are well represented in the south and east of England, but are far rarer in Wales, in the north-west, and in Devon and Cornwall, where pH values tend to be lower.

A wide range of methods has been developed to study animal bones, enabling zooarchaeologists to generate multiple sets of data from each assemblage (cf. Grant 1982; Grayson 1984; Lauwerier 1988; Lyman 1994; 2008). Standardised data pertaining to identification, quantification, and ageing have been recorded on the database, while other aspects of the assemblages, including butchery, bone measurements, sex profiles, and pathology, are detailed in summary form.

The dataset

From the outset, it should be recognised that there are many pitfalls involved in faunal analysis, particularly when comparing assemblages from different sites. Different excavation methods, such as the use of wet and dry sieving (see below), and local preservation conditions can have a significant impact on the proportions of different species identified in animal bone assemblages. Therefore, a critical evaluation of the evidence is required to understand patterns in animal bone data as representations of livestock farming practices.

The animal bone dataset collected by the project contains in excess of 940 assemblages, which include more than 100 specimens of bone identified to species. These assemblages derive from over 680 rural settlements. A considerable number of sites have produced assemblages covering different occupation phases, thus allowing for the examination of chronological patterns of animal exploitation.

These data do not include faunal assemblages from major towns or military sites. However, these sites probably had a considerable economic impact on farming practices in their rural hinterlands, and they are considered in this volume to complement the analysis of data from rural settlements. For useful overviews of the animal bone evidence from towns and military sites the reader should refer to Maltby (2010; 2015), King (1999b), and Stallibrass and Thomas (2008). Data from a number of assemblages from defended 'small towns' have been collected in this project and these have been considered here. There are also a number of animal bone assemblages that have been excavated from important religious sites, both shrines and temples. These assemblages will not form a major part of this chapter, but they will figure more prominently in the third volume of this series, which considers the ritual and religious exploitation of animals. For an existing overview of animal bones from Roman temples in Britain the reader is referred to King (2005).

Dating and phasing

The vast majority of animal bone assemblages are dated by associated material culture, usually pottery, though less frequently radiocarbon dating is used. In many, usually older, reports faunal assemblages are dated simply as 'Roman', potentially covering nearly four hundred years of farming activity. Fortunately, the situation has improved markedly over the past 10–15 years, particularly in developer-funded archaeology. To examine changes in livestock husbandry over time, well-dated faunal samples are phased as either Late Iron Age, Late Iron Age/Early Roman, Early Roman, Mid-Roman, or Late Roman, corresponding to the dating scheme set out in TABLE 1.1. Inevitably, there will be a small degree of overlap between each of the phases, though this is expected to be minimal and will not adversely affect broad chronological patterns. Animal bone assemblages that are dated as 'Roman' are not considered in chronological analyses, but do feature in other analyses, such as differences between site types.

TABLE 1.1: PHASING OF ANIMAL BONE ASSEMBLAGES

Phase	*Date range of assemblages*
Late Iron Age (LIA)	100 B.C.–A.D. 50
Late Iron Age/Early Roman (LIA/ER)	A.D. 1–A.D. 150
Early Roman (ER)	A.D. 50–200
Mid-Roman (MR)	A.D. 100–300
Late Roman (LR)	A.D. 200–400

Identification

Due to their economic importance, cattle, sheep, and pigs are the most frequently encountered animals in Romano-British assemblages, usually accompanied by smaller quantities of horse, goat, dog, and chicken bones, while cat remains are rarer still, as are bones from wild mammals, birds and fish. However, distinguishing between some species is not always straightforward, and zooarchaeologists are normally reliant on good reference collections of modern comparative specimens.

Goat bones are largely inseparable from those of sheep, being most easily identified by the shape of their horncores, or from the morphology of their foot bones (Boessneck 1969; Rowley-Conwy 1998). In most cases, zooarchaeologists simply refer to bones as 'sheep/goat' or 'ovicaprid', to indicate that they cannot be distinguished any further. Nonetheless, where these two species have been distinguished on Roman sites, sheep tend to be found in greater numbers (e.g. Maltby 2010, 268, fig. 2.217). It can therefore be assumed that most ovicaprid bones probably derive from sheep. The main exception to this is the religious shrine/temple site at Uley in Gloucestershire, where large numbers of goats were selected for slaughter over many years (Levitan 1993). Notwithstanding this rare example, ovicaprid bones will commonly be referred to in this volume as sheep rather than sheep/goat, though it must be kept in mind that a proportion will derive from the latter.

Bones of horses, mules, and donkeys are also difficult to differentiate (Johnstone 2005). Although they are rare, examples of mule and donkey bones have been identified in Romano-British assemblages, and it is thought that they may been introduced to Britain in the late Iron Age (Johnstone 2008; see Ch. 3, p. 124).

Bones from wild mammals, wild birds, and fish, are frequently recovered from large samples of animal bone, though usually in small numbers. The bones of some wild mammals are difficult to distinguish from those of their domesticated relatives, such as dogs and wolves (Pluskowski 2006), and pigs and wild boars (Payne and Bull 1988; Owen *et al.* 2014). Remains of red deer, roe deer, and hare are quantified independently in the database, with antler and bone specimens also kept separate. However, due to the large number of wild animal species, their remains are recorded as either 'other wild mammals', 'wild fowl', or 'fish', with details of the species present provided in the general summary. The presence of egg shell and marine molluscs is also recorded where they have been specified in reports. As mentioned above, hunting and wild animal exploitation will feature in Volume 3.

Quantification

Zooarchaeologists have always desired to know how representative different animal species are by their remains, and numerous techniques have been developed to quantify faunal assemblages. These range from the simple counting and weighing of bones, to more complex calculations such as MNI (minimum number of individuals) (cf. Lyman 2008). NISP data, or the 'number of individual specimens', are used in this study. This is a simple counting method and is commonly used by zooarchaeologists. However, it is worth remembering that NISP data are also prone to variation where recording methods differ, such as techniques that take account of different zones of each bone (Dobney and Rielly 1988; Serjeantson 1996), or rapid recording methods where only particular parts of bones are counted (Davis 1992). Variations in soil preservation, fragmentation, and recovery strategies (i.e. sieving) can also have a dramatic effect on the relative frequencies of different animals identified in assemblages (Baker and Worley 2014, 11–16, 27–8). Poorer conditions will normally bias against the recovery of bones from smaller taxa, such as birds and fish, or from neonates/infants.

When synthesising data from different assemblages, zooarchaeologists have seldom agreed on what a minimum sample size should be (King 1978; Davis 1987, 46; Hambleton 1999, 39–40). In this study, calculations of the relative frequency of different taxa use assemblages with 100 identified specimens or more. Preliminary analysis of the animal bone dataset in this study has shown that there is very little difference in the mean percentages of cattle, sheep/goat, and pig, between samples that take 100, 200, and 400 identified specimens as minimum bone counts. The pooling of large quantities of data can mitigate against potential issues of small sample sizes.

The relative frequencies of the main domesticates in this chapter are calculated as a percentage of the total number of bones of cattle, sheep, pigs, and horses. Horses are included here because they commonly form a significant proportion of most assemblages. Also, the inclusion of horse bones can counteract the under-representation of sheep and pigs, since assemblages will tend to be biased towards cattle bones because they are larger and more robust, and will tend to preserve better as a result. To analyse chronological or spatial patterns in the proportions of different livestock, the relative frequency of each animal is calculated as the mean value of all the percentages from each assemblage. For example, if the numbers of cattle bones were calculated as 43 per cent, 48 per cent, and 67 per cent of the total number of cattle, sheep, pig and horse bones from three sites, the mean per cent NISP value would be calculated as (43+48+67)/3=52.67. The same calculation for sheep, pig and horse bones would then provide relative frequency values, against which each can be compared. Adding together the percentages of each taxon, instead of the total number of bones, mitigates against particularly large samples that are dominated by one species.

Associated bone groups

Articulated groups of animal bone present another issue for quantifying faunal assemblages. These are sometimes referred to in the literature as 'associated bone groups' or 'ABGs', and are generally defined as two or more elements found in articulation, ranging from limbs to whole skeletons (Hill 1995; Morris 2011). The manner in which these deposits are quantified can have a dramatic effect on the proportions of different taxa found in an assemblage. In large assemblages, a few articulated bones may not have much of an impact. On the other hand, if a site contained several animal burials, and all the bones of the skeletons were counted individually, this would significantly increase the frequency of bones in favour of those animals. In this study, associated bone groups have been recorded separately from the main assemblage. Where these types of deposit have been identified on a site, each has been counted as an individual specimen rather than the total number of bones present. In this way, articulated remains can be examined independently of the overall assemblage. These types of deposit will feature more heavily in Volume 3 in relation to the treatment of animals, particularly in relation to ritual practices.

Ageing animals

Numerous techniques for ageing animal remains have been developed, and many are suitable for examining herd management strategies in ancient livestock populations (cf. Silver 1969; Payne 1973; Getty 1975; Grant 1975; 1982; G.G. Jones 2006; Zeder 2006; Jones and Sadler 2012). It is likely that slaughter patterns would have differed between urban and rural sites in Roman Britain. Maltby (1979, 89), for example, identified a high incidence of lamb and piglet bones in early Roman deposits at Exeter and suggested that they represented a pattern of intensive, livestock slaughtering, undertaken to feed the large urban population. However, differences between individual farmsteads and between regions may also be detectable. While most farmers were probably engaged in mixed-farming practices, an emphasis on meat production, dairying, wool production, or traction should carry different signatures in livestock mortality profiles. We must also consider social and ritual practices in decisions regarding when to slaughter an animal, such as feasting and sacrifice, particularly if its age was an important factor.

Ageing data are recorded by zooarchaeologists from two types of evidence: epiphyseal fusion and dental eruption/wear. Epiphyseal fusion occurs in different bones of the skeleton when an animal reaches certain ages (Silver 1969; Getty 1975). Ageing by bone development is less accurate than dental eruption/wear as it can only show that an animal is younger or older than a specific age. Although epiphyseal fusion data can provide relatively detailed age profiles on single sites when large sample sizes are present, it is prone to different reporting styles in bone reports and it is comparatively unsuitable for synthesising different datasets.

Although epiphyseal fusion data have not been collected in the project database, incidences of neonatal livestock bones and examples of juvenile horse and chicken bones have been collected. The presence of neonatal livestock is a prerequisite for the evidence of livestock breeding, and these bones are an important resource for identifying breeding practices on rural sites.

Dental ageing data have been collected in this study, specifically from tooth-wear patterns which are more commonly recorded by zooarchaeologists than eruption timings. Although the recording of dental wear is also prone to inter-worker variation, the results from different reports can be formulated to coincide on a standard basis. The criteria for dental ageing used in this study is updated from the system devised by Hambleton (1999, 64–7), and these are set out in TABLES 1.2, 1.3, and 1.4 for cattle, sheep/goat, and pigs respectively. Here, we have employed a system of relative age stages, which are used to group livestock ageing data from ‘neonate’ to ‘elderly’. Although it is difficult to directly associate relative age classes with the absolute ages of animals, recent studies of modern livestock teeth, where the age at death of the animal is known, are now refining our understanding of mortality patterns in ancient populations (e.g. G.G. Jones 2006; Jones and Sadler 2012). Tooth-wear patterns in modern populations may not be the same as those in the past, when husbandry practices, diet, and environmental conditions may have been different. However, these recently collected data are included here to provide an estimation of the ages at which livestock were killed in the past.

Biometric data

Biometric data, or bone measurements, provide the opportunity to examine changes in animal body size, which can reflect important developments in breeding and husbandry practices. Biometric data were not collected as part of the original remit of the project. However, additional data were later collected by M. Allen and these will be uploaded as summary tables, with source references, to the online data archive. In this volume, biometric data are analysed using the range (upper and lower values) and means (average value) of samples from different sites. Only assemblages with a high degree of dating resolution are included in these analyses, and a minimum sample size of five measurements is used from each phase of a site. This is a particularly small sample size and the vast majority of datasets include a minimum of ten measurements.

Estimated shoulder heights of livestock – generally known as withers’ heights – are calculated using standard conversion values (Von den Driesch and Boessneck 1974). This is done by multiplying the greatest or lateral length of a particular element by its corresponding factor. For example, the withers’ height factor for sheep metacarpals (front foot bone) is 4.89. Therefore, if a sheep metacarpal measured 120 mm across its greatest length, it would calculate as: 120.0 × 4.89 = 586.8. The result is an estimation of the distance between the foot of the animal and the top of its shoulder, which in this case would be 0.59 metres.

TABLE 1.2: CATTLE TOOTH WEAR STAGES

			Cattle		
Age category	*Grant MWS (1982)*	*Maltby stage (1979)*	*Halstead stage (1985)*	*O'Connor age class (1988)*	*Jones/Sadler age estimates (2012)*
neonatal	0–3	–	A	neonatal	foetal to a few days
juvenile	4–16	1–2	B–C	juvenile; immature	0–18 months
immature	17–36	3–4	D–E	subadult 1 & 2; adult 1 & 2	16–36 months
sub-adult	37–43	5	F–G	adult 3	34 months–6.5 years
adult	44–47	6	H	elderly	5–10 years
elderly	48+	6	I	elderly	8–20+ years

TABLE 1.3: SHEEP/GOAT TOOTH WEAR STAGES

		Sheep/Goat		
Age category	*Grant MWS (1982)*	*Maltby stage (1979)*	*Payne stage (1973)*	*G.G. Jones age estimates (2006)*
neonatal	0–2	–	A	0–1 months
juvenile	3–18	1	B–C	1–12 months
immature	19–28	2–3	D	10–24 months
sub-adult	29–37	4–5	E–F	20 months–4.5 years
adult	38–41	6	G	4–e.9 years
elderly	42+	6	H–I	e.6–13+ years

TABLE 1.4: PIG TOOTH WEAR STAGES
(*Hambleton's suggested ages are based upon data from Higham 1967 and Bull and Payne 1982)

		Pig		
Age category	*Grant MWS (1982)*	*Maltby stage (1979)*	*Hambleton stage (1999)*	*Hambleton suggested age**
neonatal	0–1	–	A	0–2 months
juvenile	2–17	1–2	B–C	2–14 months
immature	18–32	3–4	D	14–21 months
sub-adult	33–42	5	E	21–27 months
adult	43–46	6	F	27–36 months
elderly	46+	6	G–I	adult/old adult

All the estimated shoulder heights used in this chapter have been taken directly from zooarchaeological reports; no attempt has been made to calculate new withers' data from recorded long bone measurements. Alongside estimated shoulder heights, lengths and breadths of selected bones have also been compared to further examine variations in livestock stature.

MATERIAL CULTURE

Coins

The analyses on coinage presented in Chapter 6 are derived, ultimately, from the influential methods adopted by the numismatists Richard Reece and John Casey, who developed chronological groupings of coins to explore differences in coin loss between different types of sites, and across different areas (e.g. Casey 1986; 1988; Reece 1991; 1995). Reece arranged coins into 21 chronological groups, based on their period of issue, and, using coin lists from 140 excavated sites in Britain, established a provincial pattern of coin loss against which coin profiles from individual sites could be compared (Reece 1991). Reece's broad provincial pattern recognised low levels of coin loss before A.D. 260, high coin loss from A.D. 260 to 296, a dip between A.D. 296

and 330, a peak between A.D. 330 and 348, and generally high levels of coin loss in the fourth century (Reece 1995, 179). Reece's approach has subsequently been adapted and developed by others, notably by Philippa Walton (2012), who applied Reece's approach to data collected by the Portable Antiquities Scheme (PAS) (as well as a further group of excavated sites). Walton recognised a broadly similar provincial pattern to Reece, although the increased size of her dataset enabled her to produce a series of new, regional patterns of coin loss, demonstrating variation in the way that coins circulated in different parts of Roman Britain (see Ch. 6).

Although the chronological coin groupings used by Casey (1988) and Brickstock (2004) are sometimes used by coin specialists, it is fair to say that Reece's division of coins into 21 periods is now the most widely accepted approach for comparing Roman coins from different sites in Roman Britain, and is the method adopted by most (British) coin specialists (Walton 2012, 12). The PAS uses Reece period numbers for coins where possible, and this is also the method adopted for the purposes of this study. The project database contained a table dedicated to the recording of coins and this included boxes to enable recording of the total number of coins recovered, as well as numbers for Iron Age coins, and for Roman coins for each of Reece's 21 periods. The Reece period boxes were extended to include coins up to A.D. 565 in the event that fifth- or sixth-century A.D. coins were present, although in practice these additional boxes were seldom used. In addition, boxes were provided to record numbers of broadly dated but unidentified coins, divided into those of first/second century and third/fourth century date. Pragmatism meant that denominational data for coins was not routinely recorded on the full project database, although for the purposes of the analyses in Chapter 6 a sub-dataset was created for each of the three case study areas, which incorporated additional data on denominations and the presence of 'barbarous radiates'/contemporary copies of coins. A free-text field facilitated recording of general information about the coins, including circumstances of discovery (such as whether a metal detector was used to aid recovery), whether hoards were present, or any other general comments on the assemblage. While hoards were noted, quantified (where possible) and summarised in the free-text field, these were not included in the individual Reece period coin boxes. For the purposes of establishing presence/absence of coins on sites coin hoards were included, but these were not included in the Reece period analyses.

While coins were entered into the database using Reece periods, as coins are often relatively infrequent finds at Romano-British rural sites, especially those dating from the Iron Age and early Roman period, analysis and presentation utilising the full range of 21 Reece periods proved to be of fairly limited use, with the resultant graphics somewhat cumbersome. For this reason, for the purposes of the main analyses undertaken in Chapter 6 Reece periods were conflated and coins are presented and discussed using aggregated chronological groups, in a similar way to that adopted by Reece himself in some of his earlier publications (e.g. 1972; 1974; 1991), where he explored patterns of coin loss using four broad phases: phase A, coins up to A.D. 260; B, coins dating from A.D. 260-296; C, coins dating from A.D. 296-330; and D, coins of A.D. 330–402. Here, two further phases have been added; one to facilitate incorporation of Iron Age coins in the discussion, and, following Moorhead (2015), Reece's phase D has been divided into two, to allow for the marked distinctions between some sites in terms of the numbers of coins recovered of the mid-fourth and late fourth century A.D.

The phases used for analysis in this volume are thus:

IA – Iron Age coins
A – Roman coins to A.D. 260 (Roman Republican and the Augustan System)
B – Roman coins A.D. 260–296 (The Radiate period)
C – Roman coins A.D. 296–330 (The Tetrarchy and Early Constantinian period)
Di – Roman coins A.D. 330–364 (Mid- and Late Constantinian period)
Dii – Roman coins A.D. 364–402 (Houses of Valentinian and Theodosius)

While these broadly dated groups formed the principal components of analysis for coins, a small number of analyses focused on individual Reece periods or narrower groups of periods, where greater chronological resolution was required; where this was undertaken this is noted in the text.

The coins from the dated groups were explored using two methods of analysis. Firstly, the relative frequency of coins of each group was calculated by considering them as a proportion of the total number of identifiable coins. This was undertaken for every site where a minimum of ten dated coins have been recovered. However, because Iron Age coins have a considerably narrower distribution than Roman coins, these were separated and are discussed independently. While their frequency was assessed by considering them as a proportion of all coins recovered, they were removed from the total for the generation of mean percentages for Roman coins. This was to avoid the skewing effect that regional concentrations of Iron Age coins (particularly in the east) can have on the statistics for Roman coins. This approach has also been applied to a series of groups of coins that have been combined to explore regional variation in the chronology and social distribution of coin use.

The above method has allowed broad differences in the proportions of coins of different phases to be identified, although it provides little information about the actual frequency with which coins have been recovered from excavated sites. For this reason a parallel method has also been incorporated. This considers the frequency of coins recovered from each phase by dividing the number of coins by the area subject to archaeological investigation, where this information is provided in reports or can be calculated by trench dimensions (number of coins per hectare). This method aims to account for the wide variation in the scale of investigations in different parts of England and Wales, and indeed, within discrete regions, allowing variation in the *frequency* of coins of different periods to be compared across different regions.

For the purposes of this latter analysis, only sites with known areas of excavation have been included. It is acknowledged that this is a fairly coarse method of assessing coin frequency, as there is a wide range of variables that are likely to impact on the recovery of coins, including the type of archaeological investigation (e.g. watching brief, evaluation or full excavation), sampling strategy during the excavation (i.e. the volume of earth subject to careful excavation), the depth of stratigraphy and, importantly, whether a metal detector is used on site. However, at a coarse level the method does allow for the exploration of broad and meaningful patterns in the frequency of coins recovered from different classes of Romano-British sites.

Other artefacts

As with coins, the project database included dedicated tables for the recording of basic information about pottery and brooches and another for all ‘other finds’. Each of the data tables included boxes for quantification of objects as well as a free-text field to record further information about the finds assemblages. In the ‘other finds’ table, in particular, this free-text field was used extensively to provide more detailed information about the types of object recorded in the broad functional categories. For instance, where a number of objects were entered into the ‘agricultural tools’ category, the free-text-field was used to identify the different types of object included; these could then be located within the database by means of a text search.

The brooch data have not been utilised to any great extent here, and are reserved for detailed consideration in Volume 3, yet the pottery and ‘other finds’ data tables have contributed to various aspects of this volume. Pottery has been discussed by various contributors in Chapter 7, and as all of these contributions utilised additional data not recorded by the project, the different approaches adopted are discussed by the individual authors there. Data recorded in the ‘other finds’ category formed an important component of several of the chapters in the volume, most notably during the discussion of arable farming in Chapter 2, rural industry in Chapter 5 and markets and exchange in Chapter 6. Whereas in Volume 1 analysis of material culture was largely restricted to exploring the social distribution of 20 broad functional groups of objects (see Smith *et al.* 2016, appendix 3), together with some types of pottery, more refined analyses of the social and geographical distributions of particular types of object have been undertaken here, including of various types of agricultural equipment in Chapter 2, stone objects, evidence for glass manufacture and textile production equipment in Chapter 5, and weighing equipment in Chapter 6. For the most part the analysis of these other aspects of material culture has centred on consideration of the geographical distribution of objects by mapping them in GIS, alongside an assessment of their social distribution, which chiefly took the form of a simple determination of presence/absence by different settlement type.