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Iron Age, Romano-British and Anglo-Saxon Animal Husbandry - A Review of the Faunal Evidence

To review the evidence for animal husbandry over a period that covers the majority of two millennia should be a daunting task. After all, the collection and recording of animal bones began, albeit spasmodically, in the late nineteenth century and a few detailed analyses of certain aspects of faunal studies were published (e.g. Pitt-Rivers 1892). It is therefore sad to relate that the past century has seen so little advance in our knowledge of the pastoral economy in Britain between the Iron Age and the Saxon periods. The lack of progress has placed severe limitations upon any attempts to synthesize the information from any of the periods. Richard Bradley was accurate with this assessment of the prehistoric data:

> "Despite a widespread reluctance to take any notice of bones, these remain the most informative evidence of pastoral activity. Few sites have been dug with any attempt to secure adequate samples, and for fewer still are there any figures for species composition, meat weight, age or sex. Little attention has been paid to the social, ritual or purely physical factors which can impede understanding of this material, and the majority of the acceptable data relates to a limited period and a limited region" (Bradley 1978: 35).

The best information in fact comes from iron age sites in southern England. Yet it is interesting to note that a recent review of this period for southern Britain included only ten sites which possessed detailed published bone reports (Champion 1979: 427). Even those included several that by modern standards are limited in scope. Among them are reports from Stanwick, Yorkshire (Fraser 1954) and the iron age levels of Coygan Camp in south Wales (Westley 1967), which consist of brief summaries of the species present but few other details. Similar limitations are found in the short faunal reports from Sutton Walls, Herefordshire (Cornwall 1953) and the hill fort at Rainsborough, Northamptonshire (Banks 1967). Much more information was published about the animal bones from the hill fort at Grimthorpe (Jarman et al. 1968), including a list of the bone elements identified to the major species, a summary of the metrical analysis of sheep and cattle bones and a discussion of the ageing data. Unfortunately only

735 fragments from all deposits were assigned to species and this and all the other reports mentioned above were based on small samples of less than 1,000 fragments identifiable to species thus limiting the amount of detailed information that could be acquired from them. The other sites listed by Champion produced larger samples but in som cases the reports are limited. The animal bones from the late iron age village at Glastonbury (Bulleid & Gray 1917) preserved extremely well in the deposits and in areas were found in great quantities. Not all the bone, however, was used in the analysis and the sample wa selected mainly for complete and measureable bones. The report was concerned principally with this metrical analysis.

Over 1,300 fragments were identified to the major domestic species from the bones recovered from the excavations at Hawk's Hill, Surrey (Carter et al. 1965). The report included a summary of the results of ageing of the teeth of cattle and sheep. On the other han no list of bone elements was published nor any details of metrical analysis. The report from Eldon's Seat, Encombe, Dorset (Cunliffe & Phillipson 1968) did include a more detailed record of the types of bone fragments represented. It also summarised the ageing evidence from the mandibles. In addition there is a brief discussion of possi butchery practices but this analysis lacks any consideration of the role of preservation in the formation of the faunal sample and the possibility of lateral variation of the material. The lack of intra-site analysis can also be raised as a criticism of the report from the hill fort of Croft Ambrey, Herefordshire (Whitehouse & Whitehouse 1974). Nor is there any record of the types of bone identified in the substantial iron age sample, although three methods of quantification were employed to obtain relative frequencies of the major species. The report did include, however, a detailed analysis of tooth ageing data, particularly of sheep/goat, a discussion of butchery methods and a list of each measurement taken.

The most comprehensive faunal analysis listed by Champion was that of the material from the excavations of the Ashville Trading Estate, Abingdon, Oxfordshire (Wilson 1978). The substantial sample was examined in much greater detail than many of the earlier reports and the analysis included discussions on preservation of the material; the intra-site analysis of bones recovered from pits and ditches; an examination of the frequencies of different parts of the carcass; a detailed discussion of ageing evidence; a summary of the metrical analysis; an excellent discussion of the ageing data and a detailed record of any observed pathology and complete or partial skeletons.

To the above list we may add the report from late iron age level at Hardingstone, Northamptonshire (Gilmore 1969) and the one for the bones from the early iron age promontory fort at Budbury, Wiltshire (Westley 1970), which included 2,500 fragments identified to species, although the report contained little other information. More recent reports have appeared notably for the hill fort at Winklebury (Jones, 1977). This report included a breakdown of fragments into elements of the body and a detailed discussion of the butchery evidence. The largest published iron age sample to date belongs to Gussage All Saints, Dorset (Harcourt 1979), in which 15,500 fragments were identified. The report included a summary of metrical analysis of the major species, a comparison of two methods of ageing data, an assessment of the relative meat weights represented for each species and a discussion of pathological and butchery evidence. Unfortunately once again there was no detailed intra-site analysis nor any quantification of the types of bone represented in any of the periods.

In addition to these reports there are several smaller samples of limited value and several more important assemblages as yet unpublished that will be incorporated into this review. Even with these, however, the data base for the Iron Age is very limited.

At first sight the picture from the Romano-British period appears more optimistic. In his comparative survey King (1978) was able to list over 90 sites which had some quantification of Roman material. With the addition of several reports since then, we have over 100 sites where evidence of animal bones is available. However, although we possess a good quantity of sites, the quality of the samples themselves leaves much to be desired. Most of the reports are little more than cursory appendices with a minimum of detail and are often divorced from the discussion of other aspects of the site. Of the reports listed by King only a dozen are based on more than 2,000 fragments identified to species and once again several of these are recorded and discussed inadequately. Three of them (Rotherley, Woodyates and Woodcuts all on Cranbourne Chase, Dorset) were excavated in the late nineteenth century and their faunal reports were concerned mainly with metrical analysis (Pitt-Rivers 1892). The same can be said of the Corstopitum (Corbridge) report (Meek & Gray 1911). The published reports of the large samples from Old Winteringham and the villa at Winterton, Lincolnshire (Higgs & Greenwood 1976) contain few details other than the number of fragments identified. The early reports from the villa at Shakenoak Farm, Oxfordshire (Brodribb et al 1968; 1971; 1972) suffer from the same limitation, although the later reports by Cram (1973; 1978) are much more comprehensive and the analyses of intra-site variability, ageing data, measurements, butchery and pathology are accompanied by detailed tabulations of the data.

The Romano-British levels from Coygan Camp contained over 4,700 fragments identified to species and the brief report lists these fragments according to locality but only gives few other details (Westley 1969). The report on over 2,000 identifiable fragments from the early Roman fortress at Longthorpe, near Peterborough included a full list of the measurements taken, the number of the different skeletal elements represented and a brief discussion of butchery and ageing evidence (Marples 1974). The 1970-1975 excavations at Vindolanda produced a large sample of bone and the analysis of it contained a detailed breakdown of the skeletal elements,,a summary of ageing data, metrical analysis of some of the more commonly recovered bones and some discussion of the pastoral economy of the settlement (Hodgson 1977). The report from Fishbourne (Grant 1971) is broadly similar in range and detail. The report from Portchester Castle (Grant 1975) examined the largest Romano-British faunal collection published to date (nearly 29,000 fragments were identified Apart from only a brief summary of the metrical data, the rest of the analysis covers aspects of species representation, butchery, ageing and pathology in impressive detail.

Since King's publication several other fairly substantial Romano-British faunal samples have been analysed from excavations at Exeter (Maltby 1979), the fort at Watercrook, Cumbria (Fifield 1979), Dorchester, Oxfordshire (Grant 1979), Nazeingbury, Essex (Huggins 1978) and Frocester Court, Gloucestershire (Noddle 1979). In additio several important collections are being studied but even when these are published, the body of data is still depressingly small considering the number of excavations that have taken place on such sites. Our combined knowledge derived from archaeological data and classical sources is still meagre, as is demonstrated in several comparatively recent general reviews of the period (e.g. Wacher 1980; Rivet 1964). Applebaum (1972) in his more detailed study of Romano-British agriculture relied heavily on a few small faunal samples for the basis of his evidence of the pastoral economy.

Information about the animal bones from the Anglo-Saxon period has been enhanced by the recednt publication of the first of the reports from Hamwih (Southampton), which with nearly 50,000 fragments identified to species comfortably exceeds the previously published data of this date (Bourdillon & Coy 1980). The analysis covers comprehensively aspects of quantitative analysis, ageing, metrical data, butchery and pathology. The saxon levels at Portchester Castle produced another large sample of nearly 23,000 fragments subdivided into three phases and published in similar detail to their Roman counterparts (Grant 1976).* Apart from these reports the archaeologic evidence for animal husbandry is once again poor. Clutton-Brock (1976) has compared aspects of faunal assemblages from five sites in southern England (North Elmham, Thetford and Sedgeford in Norfolk, Sandtun, Kent and Mawgan Porth, Cornwall) paying particular attention to species representation and metrical analysis of the major domesticates. Noddle (1975) has also produced a comparative survey of saxon and medieval material from eight sites in southern England, including North Elmham, Hereford and New Wintles of saxon date. Bone reports with some quantification have been produced for Dinas Powys (Cornwall & Haglund-Calley 1963; Alcock 1975), Maxey (Seddon et al. 1964), Shakenoak Farm (Brodribb et al. 1968; 1972), Glastonbury Tor (Harcourt 1970), Cadbury Congresbury (Noddle 1970), Whitehall (Chaplin 1971), Walton, Aylesbury (Noddle 1976), Cheddar (Higgs et al. 1979), St. Peter's Street, Northampton (Harman 1979), Yeavering (Hope-Taylor 1979), Durham (Rackham 1979) and Ramsbury (Coy 1980 in press). Considering the diversity of settlement type, the large timespan and the wide geographical range of these sites, the number of samples is again limited. In addition some of these samples are small or not easily comparable. Some documentation of the saxon period concerning pastoral husbandry has survived but the evidence again is piecemeal (e.g. Finberg 1972).

* The substantial animal bone assemblage from North Elmham Park Norfolk has recently been published in full (Noddle 1980).

It is clear therefore that the data base for this study is a poor one. What questions can such material answer? What sort of hypotheses can be tested? It should already be apparent that there are severe limitations imposed by our insufficiently detailed knowledge of temporal, regional, ecological and settlement variability. No area of England or Wales can claim to have an adequately sampled sequence of animal bones that take these important variables into account. In addition, it will be shown that various archaeological and methodological problems exist in the interpretation of the material that have rarely been considered in attempted reconstructions of pastoral economies, whether of a single settlemen region or period. Inevitably, therefore, the questions we can attempt to answer at the moment are of a limited nature. There is now at least sufficient evidence to observe the presence or absence of various domestic species in these periods. To some extent it is possible to monitor the fluctuations in species representation, observe trends in the exploitation of the principal domestic animals and examine changes in stock size. In some cases it is possible to reassess assumptions that have been made about these topics in the light of more recent evidence. In some instances we can at least begin to place the observed changes(and evidence of stability) into a temporal and regional framework and begin perhaps to construct more sophisticated models to explain developments in the pastoral economy by relating the archaeozoological evidence to other aspects of archaeological and historical evidence. The rest of this article will therefore attempt to review our present knowledge of the major aspects of the faunal record and in conclusion will try and suggest ways this information can be used in the development and testing of models of a more general nature.

The Domestic Stock

The apparently simple question of what domestic species were kept in the Iron Age, Romano-British and Anglo-Saxon periods is not as straightforward as it seems. There can be no doubt about the importance of cattle and sheep throughout and to a lesser extent pig, horse and dog. The problem lies with the possible presence of other domestic species, in particular the goat, the donkey, the mule and domestic poultry.

The Goat

In most general reviews of the periods involved where animal husbandry receive a mention, goats are regarded as one of the principal domestic species kept (e.g. Bradley 1978: 35; Wacher 1980: 109; Finberg 1974: 77). Has this been demonstrated archaeologically The problem for the archaeozoologist has always been the difficulty of distinguishing the bones of goat from sheep from fragmentary material. It has been shown, however, that several bones can be assigned to species provided the diagnostic features have survived. (Boessneck et al. 1964; Boessneck 1969). Metrical analysis particularly on the metapodia has been used successfully to separate the species (e.g. Payne 1969). Of course not all fragments can be distinguished and the recording of fragments designated as "ovicaprine" or "sheep/goat" will remain a feature of faunal reports Nevertheless, it should now be possible to obtain some idea of whether goats were present in any numbers at least from the larger samples. Certainly from excavations of iron age sites in England, the present evidence would suggest that goats were kept at most in very small numbers. Although goat was represented in all three phases at Gussage All Saints, Dorset, only 25 specimens were identified in a sample of over 15,000 fragments and many of these were horn cores that had been sawn from the skull (Harcourt 1979: 153). At Eldon's Seat, Dorset no caprine features were noted on 12 horn cores and 96 metapodia (Cunliffe & Phillipson 1968: 227). Further east in Hampshire, several samples covering all periods of the Iron Age, notably from Winklebury (Jones R. 1977:60), Winnall Down (Maltby n.d.1), Balksbury 1973 (Maltby n.d.2) and the banjo enclosure in Micheldever Wood (Coy n.d.) all produced negligible amounts of goat bones in substantial samples. No goat bones were identified from Hawk's Hill, Surrey compared to 18 positively identified as sheep (Carter et al. 1965:41). From the Ashville excavations the presence of goat was indicated by a single humerus fragment and none of the horn cores recovered were assigned to goat (Wilson 1978: 111). Only sheep were identified at Grimthorpe (Jarman et al.1968:182). The situation at Croft Ambrey is less clear. Horn cores and a complete skeleton of goat were identified together with several other fragmentary bones. However, the authors assumed that the majority of the ovicaprine sample belonged to sheep, using the samples from Eldon's Seat and Grimthorpe as parallels (Whitehouse & Whitehouse 1974: 215). Finally, only about half a dozen goat horn cores were selected for measurement from the large ovicaprine sample from Glastonbury (Bulleid & Gray 1917: 659). None of the largest iron age samples investigated to date have therefore produced substantial number of goat bones and several have no evidence of the species at all. It is possible that more goats were kept but were not utilised for meat and therefore are not found in deposits containing bones mainly derived from butchery and cooking waste but this is perhaps unlikely. It certainly seems that goats were exploited for meat only rarely and in some cases may not have been kept at all.

In the Roman period the pattern is similar, although goats are generally slightly better represented. Again, restricting the review to the larger samples, metrical analysis of sheep and goat metacarpi distinguished two specimens of goat from 19 of sheep at Vindol (Hodgson 1977: 11). All eight distal metapodia on which metrical analysis was undertaken at Watercrook, Cumbria belonged to sheep (Fifield 1979: 309). Only one incomplete skull of goat was idenfified at Corstopitum (Meek & Gray 1911: 119). Apart from these military sites in northern England goat bones have been found only rarely elsewhere. The villa at Shakenoak Farm, Oxfordshire produced some evidence of goat. Indeed it was stated on the basis of the number of horn cores identified that sheep and goats were kept in the proportion of six goats to two sheep (Cram 1978: 123). This would be unusual and the metrical proportions of the few complete metapodia (Cram 1978: 152-153) are all more typical of sheep than goat. Reliance on horn core evidence alone in distinguishing the two species can bias the results towards goat since all goats possess horns whereas some sheep do not. In addition the larger goat horns may have been more highly valued for working and the distribution of their horn cores may be influenced by this factor. The Roman deposits at Exeter produced six goat horn cores and ten of sheep. Of the measureable distal metapodia on the other hand, only one belonged to goat and 12 to sheep (Maltby 1979: 41).

In the excavations of the early Roman fort at Longthorpe no goat bones were identified in a ovicaprine sample of nearly 600 bones (Marples 1974: 123). A minimum of six goats were identified from two late Roman wells at Tripontium, Warwickshire but this assemblage was unusual and included several complete skeletons of various species (Noddle 1973).

Classical references to the importance of goats in Britain appear to be restricted to Diocletian's price-fixing edict, which referred to the birrus Britannicus - a cloak reputed to be made from goat's hair (Rivet 1964: 123). The archaeological evidence suggests that goats were still of little importance in Roman Britain. They certainly provided very little of the meat diet.

The Anglo-Saxon period does at least provide some documentary evidence for the keeping of goats (Finberg 1972: 497, 515) but references are rare (Finberg 1974: 77). Archaeological evidence would suggest that they continued to play only a small role as meat producers, although it is conceivable that they were kept mainly for their milk and skins and not butchered for meat. Goat bones were found consistently in small numbers at Hamwih (Bourdillon & Coy 1980: 111) but there is no evidence that large numbers of goats were exploited at any of the settlements excavated to date.

A wider selection of samples may reveal regional variation in the goat's distribution or importance but as the evidence now stands it would be misleading to regard the goat as a principal stock animal in any of the periods.

Mule and Donkey

Most equid bones found on archaeological sites have been identified as horse. There is perhaps evidence, however, that both mules and donkeys were present from at least Roman times. A mandible of a mule has been identified from second century levels from the excavations at the Billingsgate Buildings in the City of London. Although this specimen may have belonged to an imported animal, its presence is interesting since there is good documentary evidence for the mule's employment as a draught animal and a beast of burden in the Roman Empire (Armitage & Chapman 1979). Donkey has also been recorded occasionally on Romano-British sites, for example at Tripontium (Noddle 1973) and possibly at the villa at

Frocester Court, Gloucestershire (Noddle 1979: 52). Because of the similarities of the skeletons of ponies, donkeys and mules, it is possible that mules and donkeys have been misidentified in some samples. Future studies of equid material should have regard for their possible occurrence.

Poultry

The problem of differentiating the bones of the various species of poultry and their respective wild versions makes this discussion rather difficult. More research is needed on the metrical analysis and morphological distinctions of their skeletons before a clear picture can emerge. Bird bones are fragile and do not survive well but the rare occurrence of bird bones including possible domesticates on iron age sites (Table 1) is probably significant, since all the sites listed contained some deposits that preserved bone well. Only Winklebury contained substantial numbers of domestic fowl bones but these include the bones of two skeletons (Jones, R. 1977: 64). On all the other iron age sites on which bird bones have been quantified, those of domestic species were rare or absent and there is no certainty even that they belonged to the domesticated varieties. Julius Caesar mentioned that the Britons kept chickens and geese but had a taboo on eating their flesh (Rivet 1964: 125). Certainly there is as yet very little archaeological evidence that poultry was eaten by the iron age inhabitants of southern England. They may have provided eggs and feathers but contributed very little, if at all to the meat diet.

In all the major Romano-British samples examined to date only domestic fowl were present consistently in any numbers (Table 1). Once again it is not clear how many of the few bones of geese or duck that have been found belonged to domesticated birds. This situation had changed by the Anglo-Saxon period. In addition to domestic fowl, domestic geese have been found in quantity in most of the larger samples. Domestic duck/mallard has, however, been rarely found with the possible exception of Portchester Castle (Eastham 1976). Domestic geese were also mentioned in some documentary records (Clutton-Brock 1975: 388). The keeping or at least the eating of geese appears on present evidence to have begun on a large scale only in this period. A greater regional and chronological selection of

Table 1

Recorded Occurrences of Bones of Poultry

Site	Source	Fowl	Goose	Duck
a) Iron Age				
Ashville	Bramwell (1978)	R	A	R
Balksbury 1973	Maltby (n.d.2)	A	R	R
Budbury	Westley (1970)	R	R?	A
Glastonbury	Bulleid & Gray (1917)	A	?	A
Gussage All Saints	Harcourt (1979)	R?	R?	R?
Winnall Down (R17)	Maltby (n.d.1)	A	R	R
Winklebury	Jones (1977)	P	A	A
b) Romano-British				
Baylham House	Maltby (n.d.3)	R	R	R
Coygan Camp	Westley (1967)	R	R	?
Exeter	Maltby (1979)	P	R	R
Fishbourne	Eastham (1971)	P	R	R
Frocester Court	Bramwell (1979)	P	R	R
Longthorpe	Marples (1974)	P	R	R
Portchester Castle	Eastham (1975)	P	R	R
Shakenoak Farm	Marples (1972, 1973)	P	R	R
Watercrook	Fifield (1979)	R	A	A
c) Anglo-Saxon				
Durham	Rackham (1979)	P	P	A
Hamwih	Bourdillon & Coy (1980)	P	P	R
Hereford	Noddle (1975)	R	R	?
North Elmham	Noddle (1975)	P	P	?
Portchester Castle	Eastham (1976)	P	P	P
Ramsbury	Coy (1980 in press)	P	R	R

Fowl = domestic fowl; Goose = domestic goose/grey lag goose (*Anser anser*); Duck = domestic duck/mallard (*Anas platyrhynchos*); A = absent; R = rare (less than 1% of identified fragments of all species) P = present (more than 1% of identified fragments).

samples should be able to clarify the areas and date of this development.

Quantitative Assessments of Species Representation

The interpretation of the relative number of animal bones of different species has frequently been a principal component of faunal studies. Its main objectives have been the estimation of how much each species contributed to the meat diet and the assessment of the relative numbers of the different stock kept. There have been several attempts to generalise about the changes in the composition of the domestic herds in a region or within a period and these are worthy of consideration here.

Cunliffe (1978: 183-185) has stated that in broad terms there appears to have been a gradual increase in the numbers of sheep relative to cattle during the first millenium in southern England. He compared the bone samples from the Cranbourne Chase sites of South Lodge Camp, Martin Down Camp and the Angle Ditch, in which the percentage of cattle varied between 48-67% (Pitt-Rivers 1898) and the late iron age village at Glastonbury (Bulleid & Gray 1917) where sheep bones were reported to outnumber cattle by a ratio of 17 to 1. Cunliffe also noted that the percentage of sheep increased in the later phase at Eldon's Seat (Cunliffe & Phillipson 1968). He linked the increase of sheep with the spread of downland arable in the iron age and the need to manure this land to maintain large scale grain production. In addition Cunliffe suggests that the large variation in the relative number of pig bones on iron age sites may be a reflection of ecological variation. The more suitable habitats for pigs would have been near woodlands rather than the open downland Hence pig bones in assemblages on settlements on downlands were low.

Bradley (1978: 37-38) also pointed out the variability of pig remains on iron age sites citing Glastonbury and Croft Ambrey as extreme examples of low and high representation of the species in relation to sheep and thus questioned Clark's (1947) hypothesis that sheep gradually replaced pigs throughout prehistoric Britain as the woodlands were cleared. Like Cunliffe, Bradley suggests that regional and environmental factors were important considerations in the pig's importance. He also considered that there was a general increase in the proportion of sheep from the later Bronze Age to the later Iron Age.

* Subheading   Problems of Quantification (a) methodological

The most comprehensive survey of Romano-British faunal material has been published by King (1978). His main conclusions from data from over a hundred sites can be summarised as follows. There was a distinct trend away from the keeping of sheep in the Roman period, probably due to the presence of more settlements in areas more suitable for cattle and pigs. Assemblages with more than 30% sheep bones were limited mainly to the lowland area of England and to dry, light soils. Secondly, the more "Romanised" settlements such as villas, roadside settlemants, towns and forts tended to have fewer sheep than the native sites which maintained the iron age pattern. Pig bones were more common on "Romanised" settlements than on native sites, again partially indicating the presence of more settlements near woodland but also the probable influence of taxation and other cultural factors, such as the Romans' high regard for pork. Many military deposits contained high proportions of cattle bones and, finally, Anglo-Saxom faunal material was not markedly different from Roman except for the high proportion of pig bones on a few sites. There was a trend which saw the increase in the proportion of sheep again towards the high levels attained in the Middle Ages.

In her comparison of faunal samples from five Anglo-Saxon sites, Clutton-Brock (1975) contrasted the apparent importance of pigs as seen in the documentary sources and their poorer representation om archaeological sites. She suggested that their carcasses may have been commonly boned and salted for bacon and their bones were thus not found among other kitchen waste. She also concluded that cattle and sheep became gradually more important during the period.

* These are examples of broad comparisons of species representation. More limited assessments have often been made of data from different phases of one site or between the material from a few contemporary sites. How reliable are these comparisons? It is important to emphasise that the methods used in the estimations of the relative abundance of each species from archaeological samples need not necessarily produce the same results. At Hamwih, for example, cattle provided 52.5% of the domestic stock fragments, 72.1% of the weight of the identified bones and 31.4% of the minimum number of individuals estimated from the mandibles (Bourdillon & Coy 1980: 84-85). Corresponding fluctuations in the percentages of other species were found. Similar variations in results have been noted

from samples from Portchester Castle (Grant 1975: 379-382) and Exeter (Maltby 1979: 6). None of the methods necessarily reflect accurately the proportion of different species kept. Indeed, as Bourdillon & Coy (1980: 86) have pointed out, any ratios derived from archaeozoological data reflect only the dead animals. Any reconstruction of the living herds must also take into account the age structures and life expectancies of the different species. Nevertheless, although absolute reconstructions are probably impossib employing these methods of quantification, comparisons of relative proportions of animals can theoretically be attempted provided the methods of analysis used are compatible. This has not always been the case. The use of the Glastonbury data to emphasise the importance of sheep in the late Iron Age is particularly unfortunate in this respect. A close consideration of the Glastonbury report reveals that the bones used in the estimation of species representation were selected from a much larger total sample (Bulleid & Gray 1917: 642). Particular interest was paid to the metrical analysis of complete skulls and longbones. Of the 181 bones of cattle recorded, a high proportion can be accounted for in the measurement tables and it is clear from the discussion of cattle in the text that complete limb bones were preferentially selected. Yet it was previously stated that most of the cattle bones were fragmentary (Bulleid & Gray 1917: 652-654, 641). It is also clear that a large number of the 3,013 sheep bones were complete, although many belonged to immature animals and were not subsequently used in the metrical analysis. Unlike cattle, "one noticeable feature amongst the limb-bones is the almost entire absence of breakages for the purposes of extracting the marrow"(Bulleid & Gray 1917: 655). The bias in the selection of complete bones would therefore have favoured sheep and it is misleading to compare the relative percentages of species represented in the Glastonbury sample with those from elsewhere, where more fragmentary material was counted. Similarly, Payne (1974b: 79-80) has noted that the methods of counting bones vary between individual faunal analysts and these methods are not always explained, thus making direct comparisons between the samples difficult.

Payne (1974a; 1975) has also demonstrated that poor recovery techniques can bias faunal samples towards the collection of large mammal bones. Although the results from sieving experiments from

* Subheading:- Problems of Quantification ~~methodological problems~~. (b) Intra-site variability.

Greece were much more dramatic than for example, Hamwih (Bourdillon & Coy 1980: 82-83), the possibility that poor or hurried rescue excavation may have biased some samples in favour of cattle and horse in relation to sheep, pig and smaller species must still be taken into consideration in the comparison of results.

* Another problem in assessing the importance of individual species is that of variation of samples within a settlement. By whatever means quantification is done most excavations produce a tiny fraction of the bones originally deposited and recoverable from a settlement. This can result in misleading interpretations of species representation. [illegible] The case of the multiperiod settlement on Winnall Down (R17) near Winchester, Hampshire is a good example of where such factors can be shown to be important. The site was excavated and rigorously sampled by the M3 Archaeological Rescue Committee under the direction of Peter Fasham. Phase 3 of the settlement was dated from the seventh century to early third century B.C. and consisted of a subrectangular enclosure ditch with a single entrance, approximately 25 pits and a few postholes and scoops scattered mainly within the enclosure and a large area of quarry scoops and pits to the north of the enclosure. The ditch was excavated at regular intervals by 31 sections and in total 78.5 metres representing 29.4% of the circuit were removed. 21 of the pits produced animal bones and the quarry produced a large number of fragments scattered in its area.

Table 2

Bone Fragments of Major Domesticates from Phase 3 Deposits of Winnall

Species	Ditch	Pits	Quarry	Others	Total
Cattle	297(61.4%)	142(25.0%)	245(50.9%)	15	699(44.4%)
Horse	51(10.5%)	50(8.8%)	60(12.5%)	4	165(10.5%)
Sheep/Goat	105(21.7%)	314(55.4%)	148(30.8%)	22	589(37.4%)
Pig	31 (6.4%)	61(10.8%)	28(5.8%)	3	123(7.8%)

Table 2 lists the simple fragment counts including shaft fragments and loose teeth of the major domesticates (excluding bones belonging to partial skeletons) for all deposit types. Overall, cattle fragments outnumbered sheep but there was a large range of variation in their percentages in the different deposits. Cattle were much better represented in the quarry and ditch than in the pits. The contrast between the feature types was shown reasonably consistently in the individual pits and ditch sections, although two pits produced abnormal samples (Maltby n.d.1). The reasons for the variations were a combination of differential preservation and disposal practices. Sheep/goat and pig bones survived less well in the ditch, which contained a higher percentage of eroded bones than the pits. The sample of sheep/goat from the ditch was dominated by loose teeth and shaft fragments of tibia and radius, whereas the more fragile parts of the skeleton were much under-represented. Cattle bones survived better in the ditch than sheep/goat bones because most of them belonged to mature animals and were thus more resiliant to erosion. In addition there was evidence that the ditch was used in places as a depository for cattle bones that had been stripped of meat and then dumped. The bones from the quarry were of a different nature again being poorly preserved and containing a high proportion of unidentifiable fragments, loose teeth and other dense fragments of all species, whereas the more porous and less hardy elements were under-represented compared to other feature types (Maltby n.d.1).

This example shows how much intra-site variability can effect the overall representation of species. The final fragment percentages (Table 2) were dependent on the amount excavated from the different deposits. Had all the ditch been excavated, for example, and the densities and types of bones from the excavated samples been typical of the rest of the ditch, the estimated overall percentage figures would have changed to 53.1% cattle, 10.5% horse, 29.4% sheep/goat and 7.1% pig, representing a 8.7% increase in cattle and a 8% reduction in sheep/goat. Similar variations would be found using other methods of quantification. The problems are compounded if these results are compared to the Phase 4 deposits (Middle Iron Age) , from which the vast majority of the bone either different patterns of waste disposal or presenting different conditions of post-depositional preservation.

was recovered from pits. Excluding skeletons, nearly 4,600 bones were recovered from 83 pits. Of the majpr species, 29% of the fragments belonged to cattle, 9% to horse, 53% to sheep/goat and 10% to pig. As in the previous phase, there was a fair degree of variation in the faunal assemblages in the pits. There was a tendency for outlying pits to contain higher proportions of cattle and horse bones, although any intra-site comparisons in this phase are hindered by the problem of not knowing which pits were open contemporaneously. Was there any change in the relative numbers of animals kept? Overall, the proportion of sheep/goat fragments increased in the latter phase but, if only the contents of the pits are compared, there was very little difference in species representation. Clearly more detailed examination of the bone types represented is needed before the question can be resolved (Maltby n.d.1). The example does illustrate, however, the problem of using percentages of bone fragments in comparisons of species representation on one site, where there is clear evidence that different contexts are reflecting

There are several other instances where it can be shown that differential deposition of bones has biased samples in favour of a particular species. The late first century A.D. deposits from the infill of the legionary ditch at Exeter produced a concentration of cattle bones consisting predominantly of mandible, skull and metapodia fragments deposited as waste from primary butchery of cattle carcasses. This assemblage contrasted markedly from other samples recovered elsewhere in Roman Exeter and was heavily biased towards cattle (Maltby 1979: 11). A similar concentration of cattle jaws, skull and metapodia was found in an early second century A.D. pit at Aldgate in London. As at Exeter, the horn cores and most of the meat bones had been removed elsewhere (Watson 1973). A preponderance of cattle horn cores and metapodia and, to a lesser extent, other cattle bones was discovered in late fourth century levels at Angel Court, London (Clutton-Brock & Armitage 1977). Cattle horn cores dominated a fourth century A.D. sample from Kingston Hill Farm, Oxfordshire (Wilson 1976). A pit from a second century military deposit at Little Chester, Derbyshire contained a high proportion of smashed bones of young cattle (Askew 1961). This assemblage has been interpreted as the remains of bones broken up in the production of bone grease and has parallels with military sites on the continent (King 1978: 225). Concentrations of pig metapodials and phalanges thrown away in quantity as waste have biased samples from Roman Exeter (Maltby 1979: 11-13) and Nazeingbury, Essex (Huggins 1978). These examples all provide an interesting insight into butchery and marketing practices and there are other cases where redistribution of carcasses can be demonstrated (Payne this volume). They are all clear cases where the bones recovered do not represent a cross-section of the animals kept. Of course, they can be regarded as atypical samples and omitted from calculations of species representation but we are then faced with the problem of deciding what constitutes a typical sample. The number of bones of each species recorded is dependent upon the method of quantification used, excavation techniques, preservation conditions, discard practices, butchery practices, redistribution of the carcasses and the ages of the animals exploited. All these processes impede the translation of the faunal data into realistic statistics of species present. To understand bone samples better, we have to take all these factors into consideration by studying the types of bone represented and by taking note of the effects of intra-site variability.

The possible incompatibility of the contents of faunal samples has to be considered particularly when the assemblages from different sites are compared. The problem of sample variability is illustrated in Tables 3-4. These list the principal elements recorded for cattle and sheep/goat respectively in a selection of samples. In order to standardize the figures, the number of fragments of each element is expressed as a percentage of the most commonly occurring element. It is clear that there is a wide range of variation in the composition of the samples of both species and few are very similar. The reasons for the variability can be attributed to one or a combination of the processes outlined above. Whatever the causes, is it correct to compare the total number of fragments obtained from such heterogeneous assemblages and assume that a comparison of the overall fragment figures will reflect the

* Insert subheading Methodological problems. (c) Inter-site variability

Table 3

Variation of Major Cattle Fragments from a Selection of Iron Age, Romano-British and Anglo-Saxon Samples

Sample/Source	MRP	Jaw	Scp	Hum	R/U	Fem	Tib	Mc	Mt	Tar	P[illegible]
Exeter GS 55-75 A.D.	29	100	86	66	48	72	69	41	48	31	
" GS 100-200 (Maltby	34	100	50	77	85	50	94	32	41	21	[illegible]
" CC 200-300 1979)	23	100	57	13	35	35	22	39	13	35	[illegible]
" GS 300-400	58	100	86	66	72	88	85	31	64	50	[illegible]
" TS 300-400	84	100	56	31	32	33	52	45	41	41	[illegible]
Winnall Down Ph.4 (Maltby	110	100	47	51	72	41	56	21	30	35	[illegible]
Phase 6 n.d.1)	91	100	52	52	55	45	46	30	55	68	[illegible]
Winklebury (Jones R. 1977)	69	100	68	29	57	41	52	25	39	29	6[illegible]
Baylham House 120-200 Pits	115	100	37	57	55	43	69	33	48	36	[illegible]
← Layers(Maltby n.d.3)	54	100	13	59	52	48	82	17	59	54	[illegible]
Longthorpe (Marples 1974)	170	33	21	14	16	14	17	26	12	22	1[illegible]
Shakenoak Farm Site K Gp.J	37	57	54	22	60	11	30	46	46	78	1[illegible]
Site K Gp.O (Cram	63	40	21	14	44	8	16	54	64	73	1[illegible]
Site K Gp.Q 1978)	51	45	20	18	49	4	28	37	55	100	9[illegible]
Site K Gp.S	60	40	18	7	32	5	33	30	28	78	1[illegible]
Brancaster (Wall pers comm).	226	73	52	17	35	18	21	44	47	29	1[illegible]
Vindolanda (Hodgson 1977)	445	49	77	20	31	12	20	49	64	57	1[illegible]
Hamwih (Bourdillon & Coy 1980)	1294	82	75	61	77	59	69	36	38	64	1[illegible]
Minimum percentage		33	13	7	16	4	16	17	12	21	2[illegible]
Maximum percentage		100	86	77	85	88	94	54	64	100	1[illegible]
Mean		79	49	37	50	35	48	35	44	50	7[illegible]
Standard deviation		27	24	23	18	24	26	10	16	23	2[illegible]

MRP = number of fragments of most represented bone. Other figures are percentages of most represented bone. Jaw = mandible; Scp = scapula; Hum = humerus; R/U = radius/ulna; Fem = femur; Tib = tibia; Mc = metacarpus; Mt = metatarsus; Tar = tarsals/carpals; Phl = phalanges.

Table 4

Variation of Major Sheep/Goat Fragments from a Selection of Iron Age, Romano-British and Anglo-Saxon Samples

Sample/Source	MRP	Jaw	Scp	Hum	R/U	Fem	Tib	Mc	Mt	Tar	Phl
Exeter GS 55-75 A.D.	29	42	38	42	66	62	100	24	69	10	14
GS 100-200 (Maltby	68	51	12	22	62	32	100	29	49	6	3
CC 200-300 1979)	17	6	12	35	65	59	76	12	24	100	59
GS 300-400	70	16	27	39	73	57	100	26	39	4	4
TS 300-400	19	79	32	37	58	21	100	32	21	0	0
Winnall Down Ph.4 (Maltby	138	100	23	35	85	50	83	51	65	26	33
Phase 6 n.d.1)	114	100	6	20	46	13	75	34	50	11	18
Winklebury (Jones, R. 1977)	175	100	24	33	83	55	98	39	57	35	84
Baylham House 120-200 Pits	133	56	17	35	38	41	100	35	46	1	5
Layers (Maltby n.d.3.)	88	73	18	34	48	25	93	51	100	15	6
Longthorpe (Marples 1974)	44	64	55	93	91	61	100	86	61	48	75
Shakenoak Farm Site K Gp.J	29	100	0	0	24	4	35	28	41	0	[illegible]
Site K Gp.0 (Cram	26	85	0	4	31	0	42	58	100	4	4
Site K Gp.Q 1978)	14	100	0	36	29	0	50	57	79	21	21
Site K Gp.S	21	48	0	14	29	0	19	100	76	0	0
Brancaster (Wall pers.comm)	88	100	33	41	65	14	60	47	80	16	49
Vindolanda (Hodgson 1977)	96	100	70	34	54	23	45	47	33	7	5
Hamwih (Bourdillon & Coy 1980)	890	64	66	59	100	57	83	45	45	30	24
Minimum percentage		6	0	0	24	0	19	12	21	0	0
Maximum percentage		100	70	93	100	62	100	100	100	100	84
Mean		71	24	34	58	33	76	45	58	19	23
Standard deviation		30	22	20	23	23	27	22	23	24	27

MRP = number of fragments of most represented bone. Other figures are percentages of most represented bone. Jaw = mandible; Scp = scapula; Hum = humerus; R/U = radius/ulna; Fem = femur; Tib = tibia; Mc = metacarpus; Mt = metatarsus; Tar = tarsals/carpals; Phl = phalanges.

variation in the relative numbers of each species eaten or kept? It is possible that in some cases such variability may not have biased the figures but this has never been demonstrated satisfactorily. It may be possible to monitor large scale change in species representation by such methods but any subtler variations are difficult to interpret, since, as we have seen, fragment percentages can be affected greatly by other factors. Grayson (1980 and Dennell (1980) are perhaps correct in their suggestion that we should abandon attempts to be too precise in this type of quantification and be satisfied with obtaining some order of ranking of species instead. Certainly the usual methods of analysis are unlikely to produce much more accurate results. There is a need to develop a better understanding of the nature of faunal samples. Ethnoarchaeological studies have shown the complexities involved in the formation of bone assemblages (Maltby 1980). Our interpretations of such material to date have been oversimplistic and our methods inadequate. In this respect much of the debate about the relative merits of fragment analysis or minimum numbers analysis is irrelevant because neither method on its own is suitable to deal with this type of data. To obtain an accurate assessment of species representation, we either have to use only those bone elements that were butchered, distributed, disposed of and preserved in similar ways. Alternatively some kind of weighting of the figures has to be devided. In either case, the correct procedure is first to establish how the samples have been formed before any attempt is made to interpret species composition.

How does this criticism affect the general statements that have been made about species representation cited above (p.12-13)? Most of those comparisons rely on figures produced by different faunal analysts, who often did not take such considerations into account. Since in some instances details of bone elements are not given nor in most cases are there any discussions of preservation or intra-site variability, it is impossible to be certain whether the samples used in the generalisations are directly comparable. Accordingly the theory that sheep became more important during the Iron Age remains essentially untested. The variation in the number of pig bones in iron age assemblages may be an accurate indicator of the amount of woodland available for pannage. It would, however, be comforting to establish that no other factors, particularly differential preservation, were involved in this variability. Several of King's (1978) conclusions about Romano-British assemblages may well stand the test of time and more detailed comparisons of the material. Certainly the abundance of cattle and pig bones on some types of site looks at least superficially to be interesting and worthy of further research.

It is, however, apparent that the results of species quantification have been unsatisfactory. General comparisons have employed figures of species representation that have been produced by inadequate sampling and methodology. This is the major area of faunal studies where old assumptions need to be cast aside and replaced by a new approach. Not until then shall we be able to improve on the vague and sometimes misleading statements that have been made about stock numbers.

The Exploitation of Domestic Stock

It is believed that animal bone studies can establish the principal reasons why the various domestic species were kept and how intensively they were exploited. Cattle, for example, can be bred mainly as working animals, or as dairy producers or simply as providers of meat or a combination of all three, The kill-off patterns and the relative numbers of males, females and castrates kept will vary according to the particular regime of husbandry practised. By studying the ageing and sexing evidence of faunal samples, it is possible to investigate these topics. Once again there are problems in transforming the archaeozoological data into general statements about herd structures and exploitation patterns. ← Nevertheless some general patterns have begun to emerge from the ageing data of the major domestic species.

Sheep

Sheep produce meat, skins, manure, milk and wool. The relative importance of each plays some part in the manner in which they are husbanded. Both Cunliffe (1978: 183) and Bradley (1978: 36-37), using the published evidence available to them, concluded that sheep were exploited mainly for meat in some areas during the Iron Age and principally for wool in others. Rivet (1964: 123-124) and Applebaum (1972: 214-215) emphasised the importance of wool production on sheep rearing in the Romano-British period and Clutton-Brock (1975: 382) has suggested that large numbers of sheep were kept to provide enough wool for profitable trading in the Anglo-Saxon period.

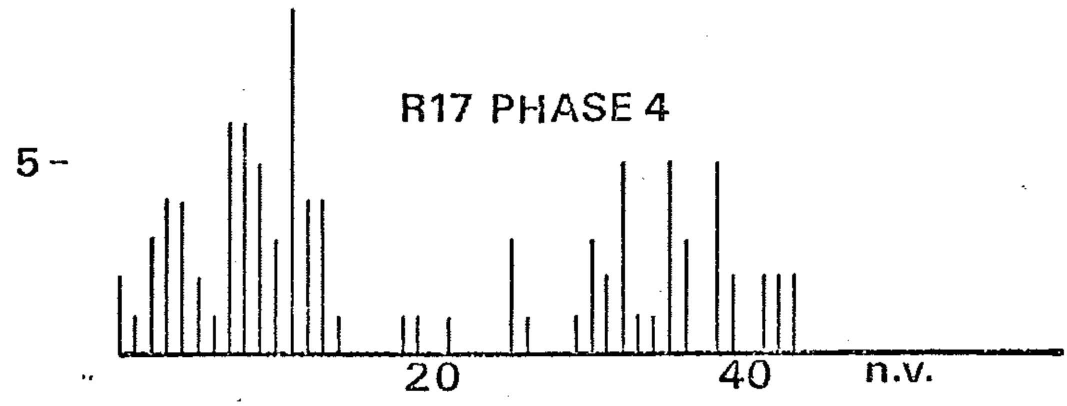
Payne (1973) has shown that the kill-off patterns of sheep populations raised principally for wool, meat or milk should be quite different from each other. A substantial number of ewes and wethers would be allowed to reach maturity if wool production was predominant, to enable several annual growths of the fleece to be collected. On the other hand, only the animals selected for breeding would be required to reach maturity in a system that intensively exploited sheep for meat and the emphasis would be on the fattening and culling of young animals. Theoretically it should be possible to relate the ages of the bones found on archaeological sites to the regime of exploitation, although as Payne has pointed out, flocks are not usually kept for a single product, particularly in subsistence economies.

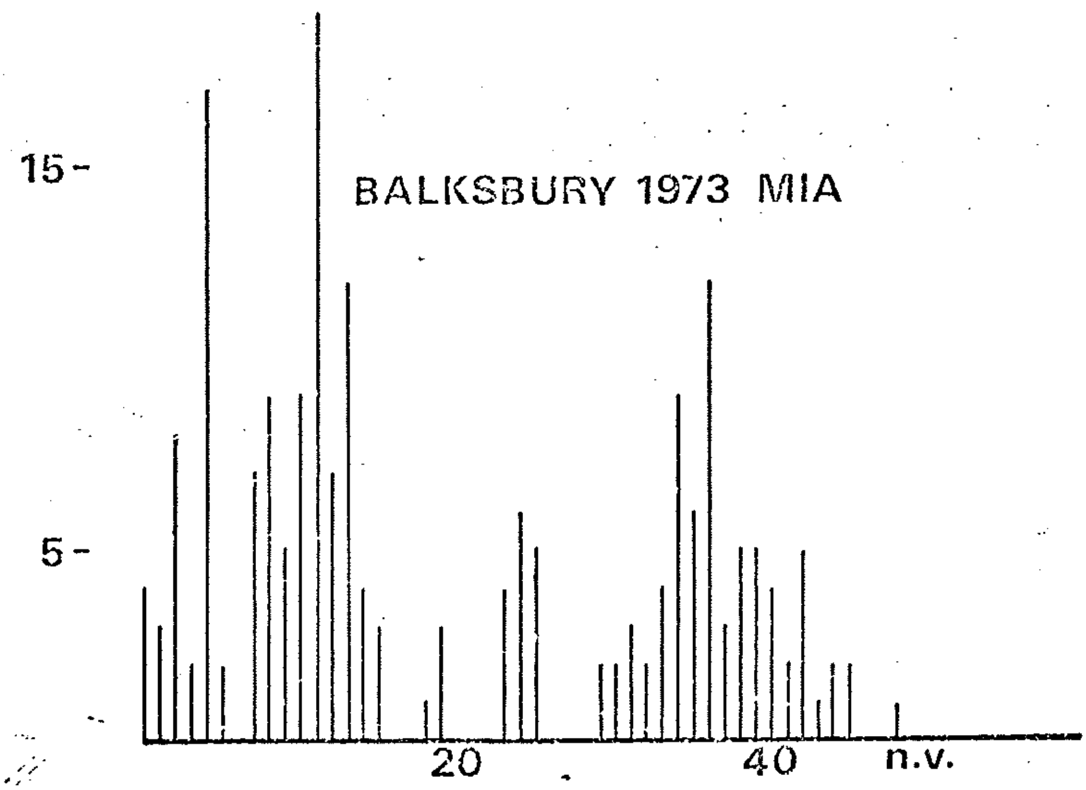
Several methods of ageing analysis have been used on British faunal assemblages in recent years. Those which employ epiphyseal fusion data will not be considered here, since differential preservation plays a dominant role in the survival of the fusion points and makes this method of analysing age structures most unreliable. This leaves the various methods of analysing age through the evidence of tooth eruption and wear. Three methods have been used quite frequently. Ewbank et al. (1964) divided the tooth eruption sequence of complete mandibles into 26 stages. Payne (1973) employed the evidence of tooth wear as well as eruption in his recording method and for overall analysis divided the dental development into eight stages. Grant (1975) also used both the evidence of eruption and wear of the mandibular cheek teeth. By giving numerical values to each of five stages of eruption and 15 wear stages of the molars and by adding together the scores for each molar, an overall numerical value (n.v.) can be obtained for the mandible. A high numerical value indicates a lot of wear on the teeth and implies that the mandible belonged to a mature animal.

None of these methods provide an absolute estimate of age. We have only an imprecise knowledge of the rates of dental development of sheep in these periods. Modern estimates are derived from improved breeds whose development is much faster than the sheep studied here, although by how much is unclear. Little is known of variation in the tooth eruption of sheep during the periods themselves. Most studies have used estimates derived from the data of Silver (1969), which may not be totally applicable. Nevertheless the ageing methods do provide an opportunity to observe relative changes in the number of mandibles at the different stages of development. There are some problems in comparing the results of the three methods and Hamilton (1978) has found that the methods produced results that differed by upto 10% in the estimations of cumulative mortality rates when applied to the same sample. Although sheep and goat mandibles are very difficult to tell apart, the dominance of sheep on all these sites is so great (see above p.7-9) it seems reasonable to consider that the vast majority of the mandibles belonged to sheep.

Several samples from iron age settlements in southern England have now been examined. The analysis of two middle iron age samples from Hampshire, Winnall Down and Balksbury (material from the 1973 excavations directed by Geoffrey Wainwright) have produced very similar results (Figure 1). The diagram shows the number of mandibles scoring each of Grant's (1975) numerical values and includes estimated values from incomplete molar rows. It is important to emphasise that these values do not represent equal lengths of time. Changes in the toothwear stages of older mandibles are generally slower, although that is somewhat of an oversimplification. As a guide, the first molar is in wear by c. n.v. 8, the second molar at c. n.v. 18 and the third molar at c. n.v. 30. In both samples, therefore, there was a concentration of very young mandibles, very few that were assigned values of 15-30 and then a broad concentration of older mandibles with fully erupted tooth rows. Several points need to be made about these samples. On both sites they were recovered almost exclusively from pits and contexts that preserved the mandibles extremely well. It is certain that had the samples derived from deposits that were less favourable to bone preservation, the survival rate of the youngest and most fragile jaws would have been seriously impaired. Secondly,

Fig 1





it is uncertain whether these samples, although quite substantial, represent an accurate cross-section of the sheep kept by the inhabitants of the settlements. It is possible that there was redistribution of stock or carcasses between settlements. It is also conceivable that the mandibles in these pits were biased towards these age groups because of the particular disposal strategies employed by the inhabitants. A wider range of samples from contemporary neighbouring settlements is required to test these possibilities.

Assuming for the time being, however, that the samples are representative, what inferences can be drawn about sheep husbandry? The concentrations of young mandibles include those belonging to neonatal mortalities and those of lambs with their first molar not fully erupted or only in an early stage of wear. Absolute ageing is problematic but, even allowing for very slow eruption rates, it seems likely that the majority of these mandibles belonged to animals that died under a year old. Given the poor quality of the stock, a high rate of neonatal deaths is to be expected. Payne's models (1973: 282-284) allow for upto 30% of the lambs born each year to die of natural causes. High rates of young mortalities were prevalent in England in the Middle Ages (Miller & Hatcher 1978: 217). The older lambs represented at Winnall Down and Balksbury, although they were butchered for meat, were certainly not kept alive long enough to reach an optimum age and weight for culling for meat. In fact there were very few sheep of that age, as the low number of mandibles with numerical values of 15-30 indicates (Figure 1). Superficially, the observable age pattern fits more closely to Payne's model of milk exploitation, in which in addition to natural mortalities a high percentage of the flock are slaughtered in their first year leaving a few rams but mainly ewes for breeding purposes and their milk. Alternatively, it is possible to view the ageing pattern as evidence for a very low level of efficiency in sheep husbandry, in which only the stock selected for breeding were allowed to mature. This may indicate that there was a shortage of winter fodder for sheep or at least no incentive nor necessity to overwinter a significant proportion of the stock. In either case, although wool would have been provided by the older animals, the apparently high rates of immature mortalities suggest that wool production was not of primary importance in the exploitation of sheep at these settlements.

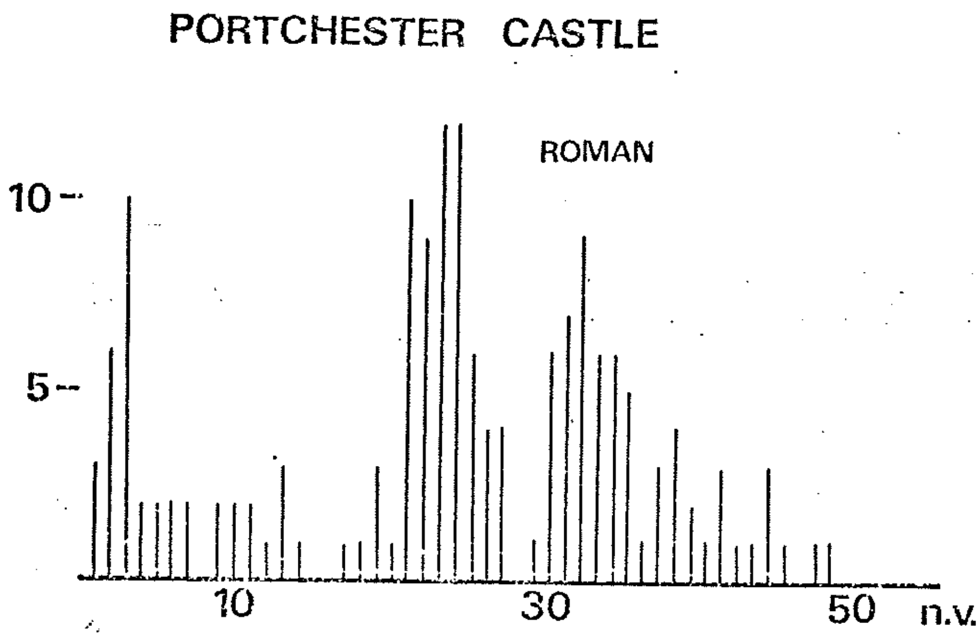
The smaller samples from the earlier iron age deposits from Winnall Down and Balksbury produced similar results to the one described above and these have parallels with other samples from southern England. The large samples from Phases 1-2 at Gussage All Saints contained a high proportion of sheep mandibles with, at most, only the first molar in wear, a low percentage of jaws with only the first and second molars in wear and a larger group with fully erupted tooth rows (Harcourt 1979: 152). The sample from Croft Ambrey contained a larger number of adult sheep but again a low number of mandibles at the stage when only the first and second molars are in wear (Whitehouse & Whitehouse 1974: 218-219). Similar results were obtained from the samples from Ashville and the late iron age deposits at Barton Court Farm, Oxfordshire (Hamilton 1978: 129).

Of the other large iron age samples, those from Eldon's Seat and Hawk's Hill cannot be compared directly with these since the data were grouped in a different way. The analysis of the mandibles from Barley, Hertfordshire, produced rather different results (Ewbank et al. 1964). Although mandibles of first year animals and adult stock still formed the largest groups, c.20% of the sheep represented by complete mandibles were killed between the early wear stages of the second and third molars. Two late iron age samples from southern England also contained a higher percentage of mandibles of this age. At Gussage All Saints, 21% of the mandibles were at this stage of development (Harcourt 1979: 152) and the excavations of the banjo enclosure in Micheldever Wood, Hampshire produced roughly equal numbers of these and those of the youngest age group (Coy n.d.). Whether these samples provide evidence for a change in sheep husbandry that resulted in the culling of relatively more second and third year animals remains to be tested on other sites in the area.

Obviously the number of iron age samples is inadequate to provide information about the possibility of local, regional or temporal variation. The samples that have been examined so far do, however, have certain common traits. In all of them the number of first year mortalities represented is high compared to samples from later periods. Such jaws are small and fragile and are likely to be under-represented. Apart, perhaps from the samples from Barley, Gussage All Saints and Micheldever Wood, all the iron age sites have produced few mandibles of sheep killed at an age when they would have provided a lot of meat for the amount of fodder they required. Efficient meat production was not, it seems, a characteristic of iron age sheep husbandry. How important wool production was depends on the interpretation of the relative number of young and old animals represented in the samples. Certainly all the adult animals could have provided wool and the occurrence of spindle whorls and loomweights at many sites testifies to textile manufacture. However, if first year mortalities were as high as suggested at sites such as Balksbury (Figure 1), the emphasis would have been more on the maintenance of a viable breeding stock rather than large scale wool production. Other sites have produced a greater proportion of adult animals. If it could be demonstrated that this was not merely a reflection of poorer preservation of the young mandible the case for the importance of wool would be strengthened. If not, an alternative hypothesis would regard sheep husbandry to be of a low standard, geared towards subsistence activities only, providing meat, milk, manure and wool but not at a commercial level.

Romano-British deposits have revealed fairly consistently a change in emphasis in sheep exploitation. The mandibles from Portchester Castle (Grant 1975) provide a good example (Figure 2). The number of mandibles with numerical values of 20-30 is high. A lot of the animals represented therefore were killed between the early wear stages of the second molar and the full eruption of the third molar. This corresponds roughly to Stages D and E in the method of Payne (1973: 293). If ageing estimates are correct, the sample shows an emphasis on the kill-off of second and third year animals for their meat. Much fewer first year animals are represented apart from some neonatal mortalities which were recovered mainly from wells (Grant 1975 397-398). Samples from all types of Roman settlement have produced similar concentrations of mandibles of this age. These include urban centres such as Exeter (Maltby 1979: 42), military sites, for example Vindolanda (Hodgson 1977: 16), villas, for example Shakenoak Farm (Cram 1978:128-135) and other rural sites, for example, Balksbury (Maltby n.d.2). Generally fewer concentrations of mandibles belonging to first year mortalities have been found, although some early Roman sites have produced them in some numbers, for example, Winnall Down (Maltby n.d.1) Baylham House, Suffolk (Maltby n.d.3) and the military deposits at Margidunum, Nottinghamshire (Harman 1969: 101). The change in emphasis to the culling of second and third year animals may therefore have been a gradual one, although there is a need to study a much wider range of samples before the pattern can be better understood. Redistribution of stock and animal products undoubtedly

fig 2

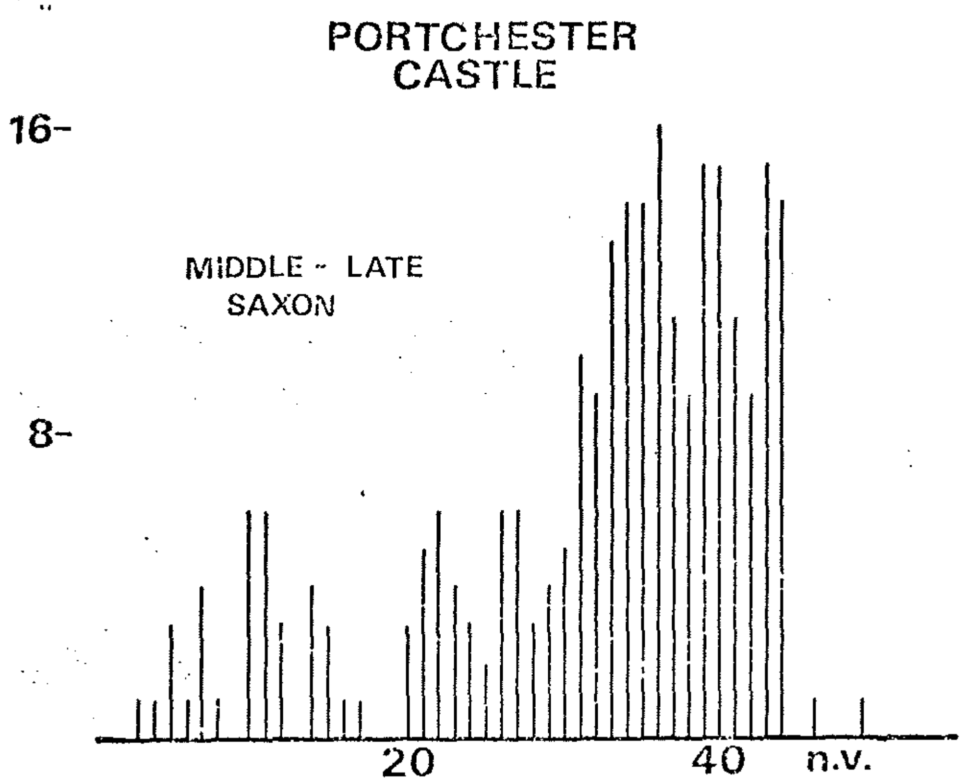


took place in this period and it is conceivable that certain age classes will be found more commonly at some settlements than others. Nevertheless the present incomplete evidence suggests that meat production became more important in sheep management and there was a greater level of efficiency in sheep farming. A few samples have produced a relatively high number of mature animals, notably the villa at Barton Court Farm (Hamilton 1978: 129), the later levels at Fishbourne (Grant 1971: 384) and, to a lesser extent, Shakenoak Farm (Cram 1978: 128-135) and the Romano-British levels at Balksbury (Maltby n.d.2). Once again it will be interesting to observe whether this pattern is typical of rural settlements and whether urban and military centres tended to attract a higher proportion of younger animals raised principally for their meat.

It is uncertain how important wool production became in the Romano-British period. Apart from the examples listed above, there is no evidence that adult animals were kept in numbers significantly above the level required to maintain the breeding stock, although investigations of other villa and rural assemblages may alter the picture. Change of emphasis in sheep farming may have occurred within the period but there is insufficient material to test this.

Evidence from Anglo-Saxon sites is even more limited but it can be shown that wool production became more important in some areas during the latter part of the period. The sample from the middle-late Saxon deposits at Portchester Castle (Figure 3) included a concentration of mandibles with numerical values of over 30, indicating that the majority belonged to mature animals. The smaller sample from the late Saxon period at Portchester was similar (Grant 1976: 278). The contrast between this sample and the one from the Roman occupation of the fort (Figure 2) is marked. If these jaws accurately reflect the kill-off pattern, meat production was now only a secondary consideration to wool production. Of course it is again possible that the sheep represented at Portchester Castle do not contain a cross-section of the sheep kept in the area. It is interesting to note, however, that the urban deposits at Hamwih also produced a large proportion of mature animals (Bourdillon & Coy 1980: 87). Most of the mandibles from the late Saxon ironworking site at Ramsbury, Wiltshire also belonged to mature animals (Coy in press). Several other samples, particularly from North Elmham, Norfolk (Noddle 1975: 257), the urban deposits from the St. Peter's Street excavations, Northampton (Harman 1979: 331),

fig 3



Walton, Aylesbury (Noddle 1976: 277) and Durham (Rackham 1979: 53) have produced high percentages of adult sheep. Only the sample from Sedgeford, Norfolk has not produced this pattern (Clutton-Brock 1976: 382). Although the number of samples is small, they have been derived from a wide range of settlement types in several parts of the country. It is tempting to equate this evidence with a large scale increase in the importance of wool production to enable extensive wool and cloth trading to take place. The origins of this development may lie in the early Saxon period but there is as yet little information about samples of that date, although a vast sample from West Stow, Suffolk is currently being studied. It is therefore possible to see long term changes in sheep exploitation. Once the possibility of regional, ecological and cultural variability has been investigated the pattern will be better understood. At present there seems to have been an underlying trend from a low level of subsistence husbandry in the Iron Age, through improvements and emphasis on better meat production during the Romano-British period, to the development of wool production as the most important component of sheep husbandry by the late Saxon period.

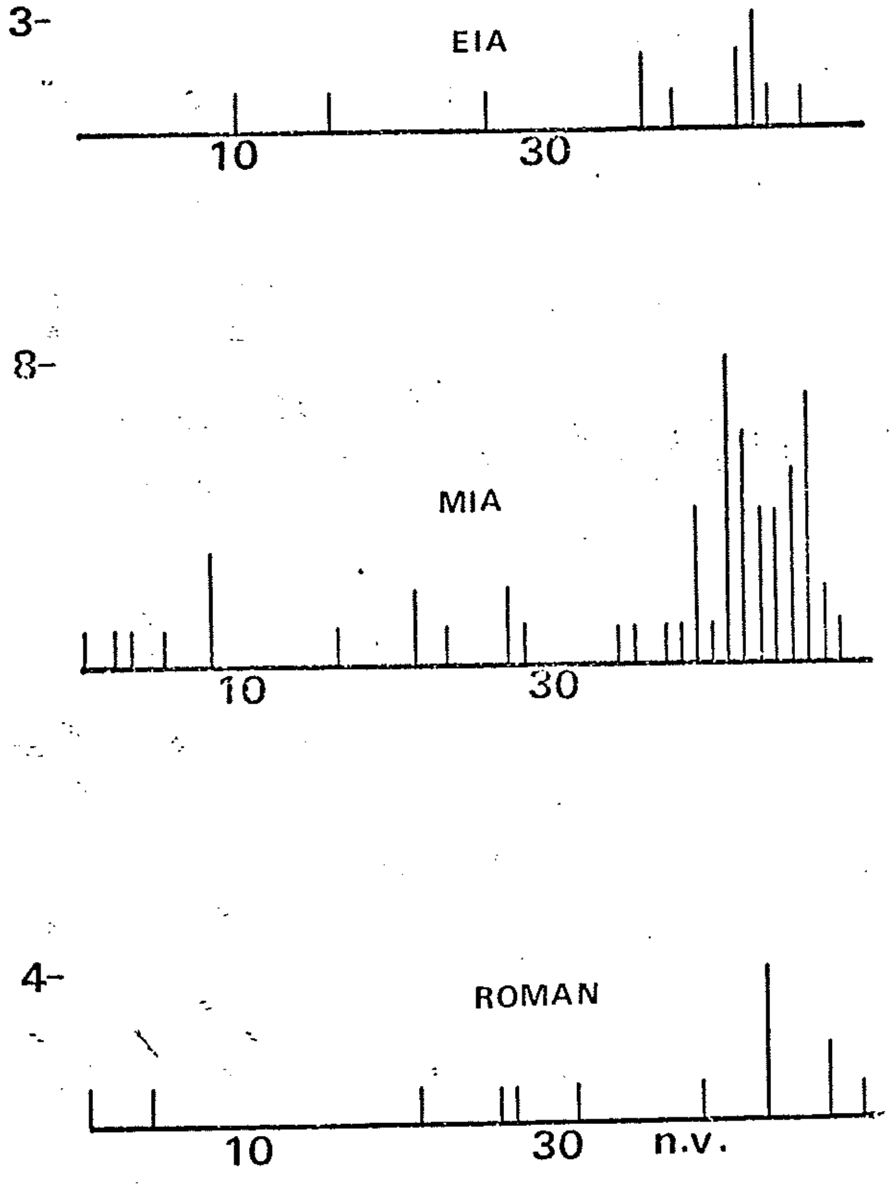
Cattle

Analyses of the herd structures of cattle in iron age faunal samples have been limited by the fact that most of the largest and best studied assemblages have produced comparatively little ageing and sexing data. The picture of cattle exploitation is therefore very restricted. To take the evidence of tooth eruption and wear only, a few samples have produced a relatively large number of immature mandibles. In particular the sample from Phase 1 (Early Iron Age) at Gussage All Saints contained a very high percentage (36%) of jaws with at most only the deciduous premolars and first molar in wear (Harcourt 1979: 151). Many of these must have belonged to calves under a year old and some were neonatal mortalities. Apart from these, most of the mandibles belonged to adult animals. Only 24 mandibles could be examined from the Ashville excavations (Hamilton 1978: 132), using the method of Grant (1975). Most of these had numerical values of less than 20 and accordingly did not have the second molar fully erupted. Sexing of the metapodia and distal radius suggested that most of the adult animals were cows (Wilson 1978: 135). Although mandibles of young calves were represented in both the early and middle iron age samples from Balksbury, the majority had n.v. of over 30 (Figure 4) and most of these had fully developed tooth rows, belonging to animals at least five years old and probably substantially older in many cases. A similar pattern was discerned from the iron age samples from Winnall Down (Maltby n.d.1) and Eldon's Seat, Dorset (Cunliffe & Phillipson 1968: 229). Another pattern of ageing appears in two late iron age samples. At Barton Court Farm, Oxfordshire, there was a concentration of mandibles with the first two molars in wear but the third molar unerupted (Hamilton 1978: 132), belonging to animals under three years of age on modern estimates (Silver 1969: 296). A small sample from first century A.D. deposits from the excavations at Baylham House, Suffolk (Maltby n.d.3) also contained a number of mandibles at a similar stage of development, indicating the culling of young cattle for meat. Other iron age faunal assemblages are difficult to compare because the methods of ageing are not fully explained. The variability of these samples could be the result of a combination of factors and it is premature to suggest significant changes in cattle husbandry during the Iron Age. Other factors such as regional variability, redistribution of stock, differences in disposal strategies and possible sampling, preservation and recovery biases could be involved. These factors cannot be examined on the existing data. A high kill-off of young calves and a predominance of adult cows in some assemblages may imply that dairying was an important element of cattle husbandry in some communities but much more sexing evidence is required before we can place any confidence in such statements.

Evidence from the Romano-British period is better documented, although the same limitations apply with regard to the possible explanations for the observed patterns. At least two recurring patterns can be observed from the studies of mandibular tooth eruption. The first contains mandibles of cattle of all ages, although mature

fig 4

BALKSBURY 1973

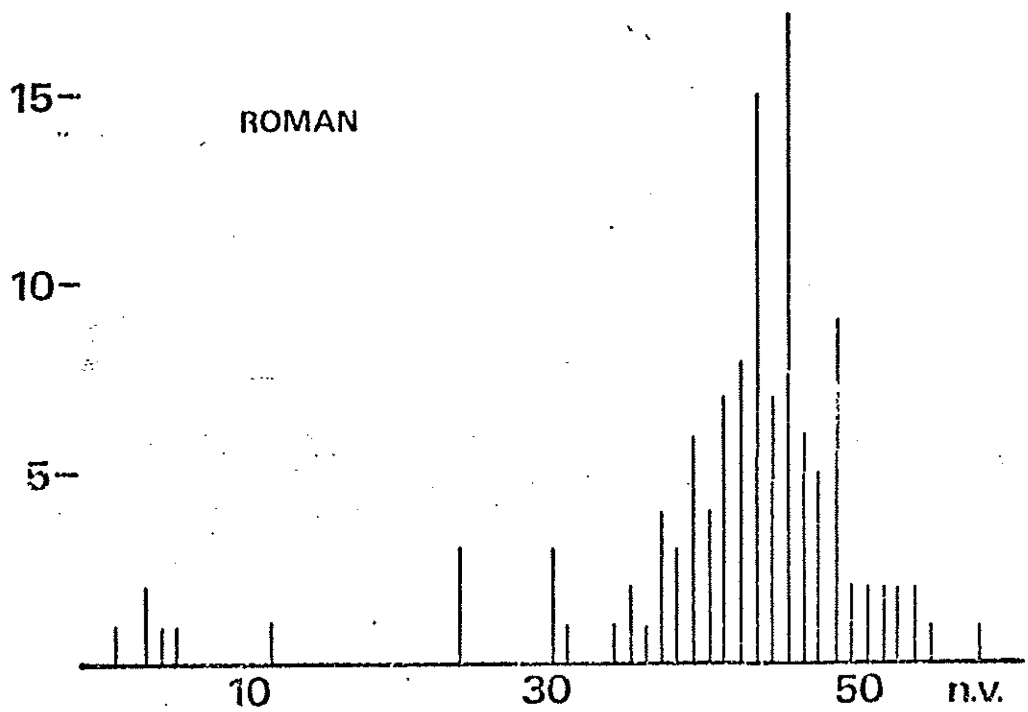


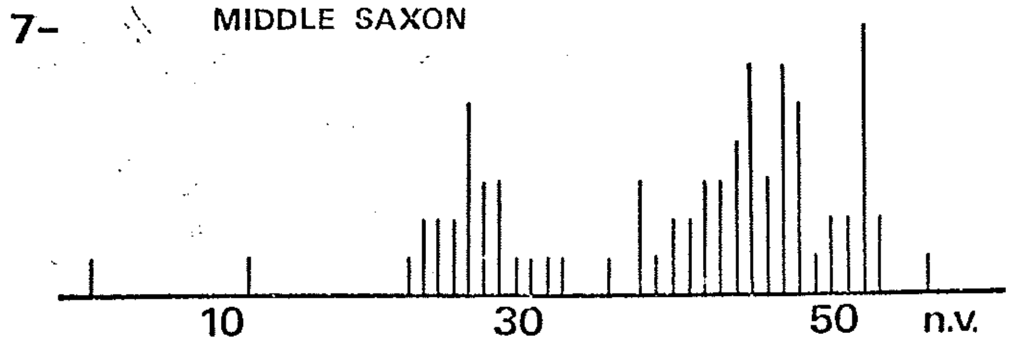
individuals usually predominate. Examples can be found on villa and other rural sites. At Barton Court Farm a sample of 34 mandibles of Roman date included 16 which did not have the third molar erupted, including five of young calves (Hamilton 1978: 132). The mandibles from Sites C and K at the villa at Shakenoak Farm, Oxfordshire, dated mainly to the third and fourth centuries, contained 12 mandibles with at most the third molar in an early stage of wear and only six mandibles with fully erupted tooth rows (Cram 1973; 1978). The even smaller sample from Fishbourne also contained a relatively large number of immature cattle (Grant 1971: 385). The second century deposits at the roadside settlement at Baylham House, Suffolk included eight cattle mandibles that had not reached the stage when the third molar was fully erupted. 13 other jaws had fully erupted tooth rows. The late Roman deposits at Balksbury produced ten mandibles with fully erupted tooth rows but seven that had not reached dental maturity (Figure 4). Small samples of cattle mandibles from the roadside settlements of Margidunum, Nottinghamshire (Harman 1969: 101) and at Scole, Norfolk (Jones, G. 1977: 210) also contained a relatively high proportion of immature specimens. Finally, the fourth century deposits from several sites in Exeter showed the presence of a significant number of immature cattle (Maltby 1979: 30, 155). Most of the young cattle represented in these samples were of a reasonable size for culling for meat, although not always fully grown. In most cases these were animals not required for breeding, working or dairying that were fattened for slaughter for their meat and hides.

The second pattern of ageing is typified by the collection of mandibles from the Roman levels at Portchester Castle (Grant 1975). The great majority of the mandibles recovered in the large sample belonged to adult animals and included very few jaws with numerical values of under 35 (Figure 5). Most of the cattle were therefore over five years of age and some had heavy toothwear which indicates that quite old animals were slaughtered. The predominance of mature cattle recurs in several other samples derived from military and urban sites. From the north of England, a large percentage (78.9%) of the 147 ageable mandibles from the excavations at Vindolanda possessed the third molar in wear (Hodgson 1977: 12). 132 ageable mandibles from deposits dated to the first to third centuries at

Fig 5

PORTCHESTER CASTLE





Exeter included only 10 that definitely did not have the third molar in wear (Maltby 1979: 155-156). Analysis of the mandibles of fourth century date from the excavations at Angel Court, Walbrook in London produced similar results (Clutton-Brock & Armitage 1977: 92). Of the 155 mandibles of late Roman date examined from the excavations at 1, Bleachfield Street, Alcester, Warwickshire, under the direction of Paul Booth, only 10 did not have the third molar in wear (Maltby n.d.4). Attempts to distinguish the sexes of the adult cattle by metrical analysis of the metapodia have been made on several of the samples and in each case it appears that cows were more commonly represented (Grant 1975: 401; Maltby 1979: 33-34; Clutton-Brock & Armitage 1977: 92), although the reliability of the various techniques of metrical analysis has yet to be established.

The evidence from all the Romano-British samples investigated to date would suggest that most cattle were allowed to reach maturity and it is unlikely that they were all raised simply for their meat, even allowing for slow rates of growth. Working and dairy cattle were probably important elements in the economy. Explanation of the variation in the number of immature cattle represented remains tentative. It is interesting, however, that the heaviest concentrations of adult cattle have so far appeared only on military and urban settlements. Organisation of cattle marketing and the need to provision these centres with meat may have resulted in the supply of particular types and age groups of cattle. Most of the other settlements may have been more self-sufficient and therefore their deposits included a higher percentage of immature cattle not required for breeding or working but also not in demand for redistribution to other centres. In Exeter, the increase in the number of immature cattle in the fourth century deposits coincided with evidence for a change in the settlement pattern and the presence of stock enclosures associated with houses within the walls, perhaps indicating an increase in the farming element of the population (Maltby 1979: 90). The evidence may also imply that there was a collapse of the former supply network of cattle brought to the town for slaughter. Most of the other settlements which contained higher proportions of immature animals were villas, rural settlements or settlements that did not need to be supplied with a large number of cattle brought in for slaughter from elsewhere. The possible dichotomy between the cattle represented on rural, urban and military sites remains a topic for further investigation.

Of the few Anglo-Saxon samples examined, the age distribution of the mandibles from the middle-late saxon levels at Portchester Castle (Grant 1976: 276) appears typical. Most cattle were mature, some having heavy wear on the teeth and including a high proportion of working, dairy and breeding stock. There was, however, a smaller but substantial group of mandibles in which the third molar was not erupted. These probably belonged to immature animals killed for their meat possibly between three and four years of age. (Figure 5). A similar distribution occurred in the large sample of mandibles from Hamwih and the sexing evidence suggested that the majority of the immature specimens were males not required for breeding or working (Bourdillon & Coy 1980: 105-108). Another example of this age distribution has been discovered in the sample from the St. Peters Street excavations in Northampton (Harman 1979:33

Cattle provided the most meat in all periods and it is clear that they were also much valued as beasts of burden and possibly as dairy animals. Improvements of ageing and sexing methods and the availability of a wider range of samples should enable a more detailed and accurate assessment of the relative importance of these bovine products to be made. Cattle were undoubtedly the most valuable of the domestic stock, although possibly not always the most numerous. Their importance may have resulted in the herds being regarded as objects of visible wealth and social prestige. Cattle trading no doubt took place in all periods and there is evidence from the Romano-British period at least of large-scale redistributior The mechanisms and control of such trade remain to be considered in more detail.

Pigs

The number of alternative exploitation strategies for domestic pigs is limited by the fact that almost all their value lies in their meat and lard. Their high reproduction rates enable a substantial kill off of young animals to take place and consequently relatively few animals are required to reach maturity. Thus the presence of large numbers of immature bones is to be expected and indeed is a feature of all the larger quantified assemblages under review. What is less certain is how intensive this exploitation was, how quickly the stock were fattened for slaughter, whether there were seasonal peaks in the culling of pigs and whether fattening processes relied solely on pannage or whether some sty husbandry was practised.

Evidence from the Iron Age is flimsy but there seems to have be no great intensity of pig exploitation on the settlement at Ashvill where 37% of 30 mandibles had the third molar in wear (Wilson 1978: 135) nor at Gussage All Saints, where between 33-47% of the mandibles had also reached that stage of development (Harcourt 1979: 153). The Roman liking for suckling pig is well known (White 1970: 318-320 and on some Romano-British sites it has been argued that there was a relatively high percentage of first year mortalities (Maltby 1979: 5 Grant 1971: 383). The better representation of pigs on most "Romanised" sites (King 1978: 216) may also be significant here. Ye even at Exeter and Fishbourne the proportion of mandibles with the third molar in wear was quite high and such jaws must have belonged to pigs at least two years old and possibly older, if reported nineteenth century tooth eruption rates are more accurate than modern estimates (Silver 1969: 298-299). At Portchester Castle, the pig mandibles from both the Roman (Grant 1975: 398) and saxon assemblages (Grant 1976: 279-280) included many with the permanent premolars just coming into wear and the third molar erupting and als a fair proportion with the third molar in an early stage of wear. Possibly most of these were second and third year cullings and there was certainly no very intensive kill off of younger pigs, althou the smaller jaws may be under-represented. Similarly 26.6% of the pig mandibles from Hamwih had all the cheek teeth in wear (Bourdillon & Coy 1980: 112). Refinement of the ageing methods may lead to further information about the peak periods of slaughter but, apart from a few of the Romano-British assemblages, it appears that most pigs were not killed until at least their second year and the intensity of pig husbandry was never particularly high by modern standards.

Horse

The presence of horse bones is attested from archaeological sites throughout the periods under consideration. Indeed, there is now abundant evidence that horsemeat made an important contribution to the diet in at least some parts of England during the Iron Age. Horse bones butchered for meat have been recorded, for example, at Ashville (Wilson 1978: 119, 122, 125), Tollard Royal, Dorset (Bird 1968: 147), Winnall Down (Maltby n.d.1) and Balksbury (Maltby n.d.2) On some of these sites horse bones are very well represented and the importance of horses as working and riding animals has been pointed out by several authors (e.g. Harding 1974: 87; Bradley 1978: 38). Certainl most horse bones recovered on iron age sites belonged to mature animals and examinations of toothwear have shown that many of them were over 10 years of age. Meat production was not the primary purpose of their exploitation. The lack of immature specimens at Gussage All Saints led Harcourt (1979: 158) to suggest that no breeding of horses was practised but that they were rounded up periodically when certain animals were selected for training. As horses are not suitable for working until three years of age, this type of round-up would have saved the expense of rearing and feeding the foals and allowed the processes of natural selection to take place. This hypothesis remains to be tested against a wider range o samples and several other explanations could account for the absence of very young horse bones from iron age deposits. Nevertheless the importance of horses primarily as transport animals and secondarily as producers of meat appears consistent.

The poor representation of horse on Romano-British and Anglo-Saxon settlements may simply be the result of the decline in the horse's importance as a producer of meat. Certainly few horse bones have been found in Romano-British deposits in assemblages derived mainly from butchery waste and records of butchery on horse bones are rare. This does not necessarily imply that horses had become less important. Occasional discoveries of butchered horse bones hav been made on Anglo-Saxon sites, for example, at Sedgeford, Norfolk (Clutton-Brock 1976:383) and Hamwih (Bourdillon & Coy 1980: 105) but again, where found, adult horses predominated the samples and their value as transport and pack animals continued to be the predominant feature of their exploitation.

For example, Champion (1978: 384) has pointed out that the evidence for the production of horse gear at Gussage All Saints implies that a special was resident there. It is not beyond the bounds of possibility that there were also specialist horse-breeders on some settlements. If so, only adult horses may have been redistributed to other settlements.

Metrical Analysis

Measurement of bones have been made in attempts to make assessments about the relative sizes of the stock, to distinguish between the sexes and to monitor the possible importation of new stock. Unfortunately, because of the haphazard nature of many of the studies and the variation of measurements taken by different analysts such work has not produced the results that it has the potential to obtain. The advent of archival and computer recording and some attempts at standardisation of the measurements taken (e.g. von den Driesch 1976) will improve the situation. For the time being, however, any analysis of past work is limited to comparisons of particular measurements. Single measurements are themselves unreliable because a combination of genetic, nutritional and sex factors can produce variations in size. Only by the study of several measurements from one bone and by comparisons of measurement from different bones will we be able to obtain a better understanding of the stature and variety of the domestic stock. That, however, is for the future. This review will concentrate on an assessment of the evidence to date.

Cattle

Earlier studies of prehistoric and early historic cattle bones from Britain have been made. Jewell (1963) emphasised the diminutive form of iron age cattle and showed that similar small cattle were present during the Roman period. He also noted that bones of larger cattle appeared in the latter period and concluded that a larger breed of cattle was imported. Hodgson (1968) found that the same trends were apparent in the samples he compared. These surveys can now be supplemented by data obtained from more recent excavations. Metrical analysis of the maximum length of the astragalus from iron age, Romano-British and Anglo-Saxon samples (Table 5) confirm the appearance of larger cattle in the Romano-British period. Apart from the small sample from Corstopitum and the two samples from Exeter, all the Romano-British assemblages produced a higher mean measuremant than the iron age samples. Although the Romano-British and Anglo-Saxon samples contained some astragali as small as those from iron age sites, they also included others than were significantly larger than any found in the earlier

Table 5

Metrical Analysis of the Maximum Length of Cattle Astragali

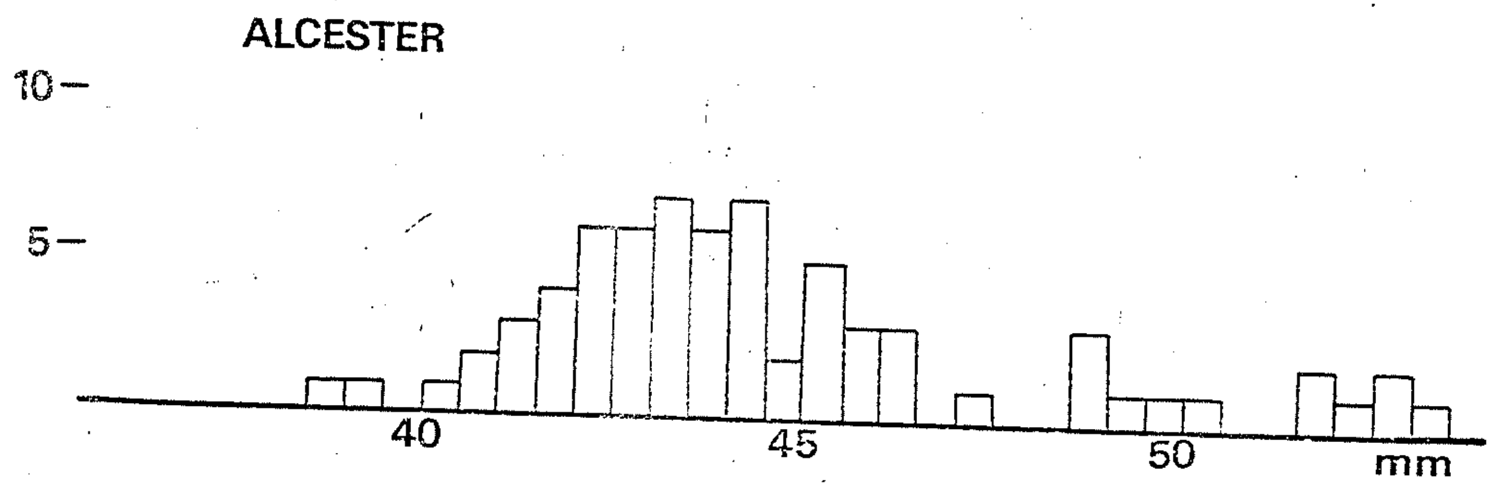
Site	Date	N	Range	Mean	Source
Exeter	55-300	14	50.7-59.6	55.2	Maltby (1979)
Catcote	Iron Age	14	51-63	57.0	Hodgson(1968)
Gussage All Saints	Iron Age	54	54-62	57.0	Harcourt (1979)
Winnall Down	MIA	7	53.1-61.0	57.3	Maltby (n.d.1.)
Croft Ambrey	Iron Age	20	55-63	57.7	Whitehouse (1974)
Balksbury 1973	MIA	12	55.0-63.1	57.9	Maltby (n.d.2)
Appleford	Iron Age	8	55-60	58.0	Wilson (1978)
Winnall Down	EIA	8	55.8-61.6	58.0	Maltby(n.d.1)
Corstopitum	Roman	9	53-63	58.0	Hodgson (1968)
Exeter	300-400	18	54.3-62.0	58.3	Maltby (1979)
Ashville	Iron Age	18	53-64	58.5	Wilson (1978)
Barley	Iron Age	13	54.1-62.1	58.5	Jarman et al. (196
Grimthorpe	EIA	8	56.3-61.5	59.5	Jarman et al. (196
Hamwih	Mid Saxon	167	49.2-71.5	60.9	Bourdillon & Coy(1
Baylham House	100-200	10	56.0-65.8	61.3	Maltby (n.d.3)
Alcester	Late Roman	30	53.9-67.6	61.4	Maltby(n.d.4)
Shakenoak Farm	Late Roman	44	53-72	61.6	Cram (1978)
Winnall Down	Early Roman	16	56.1-68.4	61.6	Maltby (n.d.1)
Ramsbury	Mid Saxon	6	51.5-66.5	61.9	Coy (1980 in press)

All measurements in millimetres. EIA = Early Iron Age; MIA = Middle Iron Age.

assemblages. The same trend can be observed on other bones.. Although most of the Romano-British samples listed in Table 5 are dated to the latter part of that period, there is some evidence that larger cattle were present in some areas during the early years of occupation. The astragali from Winnall Down, Hampshire, included large specimens only in Phase 6 deposits dated to the first and second centuries A.D. (Fasham pers. comm.). None of the astragali from the iron age features (Phases 3 and 4) attained the size of the largest Romano-British specimens (Figure 6). More late iron age material is required for comparison but the present evidence suggests that the appearance of larger cattle did coincide with the Roman invasion. The possibility of the importation of cattle is therefore strong, although much more detailed analyses than these are needed to confirm this. Improvements in the size of the native stock may also have occurred during the Romano-British period but there may have been regional variations. Comparisons of the cattle bones from Exeter and most other Romano-British assemblages illustrate the small size of cattle brought for slaughter there. Comparisons of the maximum proximal width of metatarsi from Exeter and Alcester demonstrate this (Figure 7). Regional variation in the size of cattle in Roman Britain can therefore be demonstrated. Very small samples of measured cattle bones from Dinorben (Gardner and Savory 1964) and Coygan Camp (Westley 1967: 193) in Wales also produced no evidence for the presence of large cattle. It is possible that there were environmental constraints on the size and type of cattle kept in some parts of Britain but the explanation may be more complex than this. It has been shown that large cattle appeared in Roman occupied territory in central and eastern Europe but were not found in contemporary settlements outside the area of Roman occupation (Bökönyi 1974: 128-133; Boessneck and von den Driesch 1978: 31-33). There were also variations in the number of large cattle found at different types of settlement within the Roman provinces (Bökönyi 1974: 130). The degree of Roman influence on cattle farming in Britain may therefore account for the variability in cattle size observed in faunal samples. South-west England may have been outside the area where larger cattle were introduced or bred.

Sheep

The most common measurement taken consistently on ovicaprine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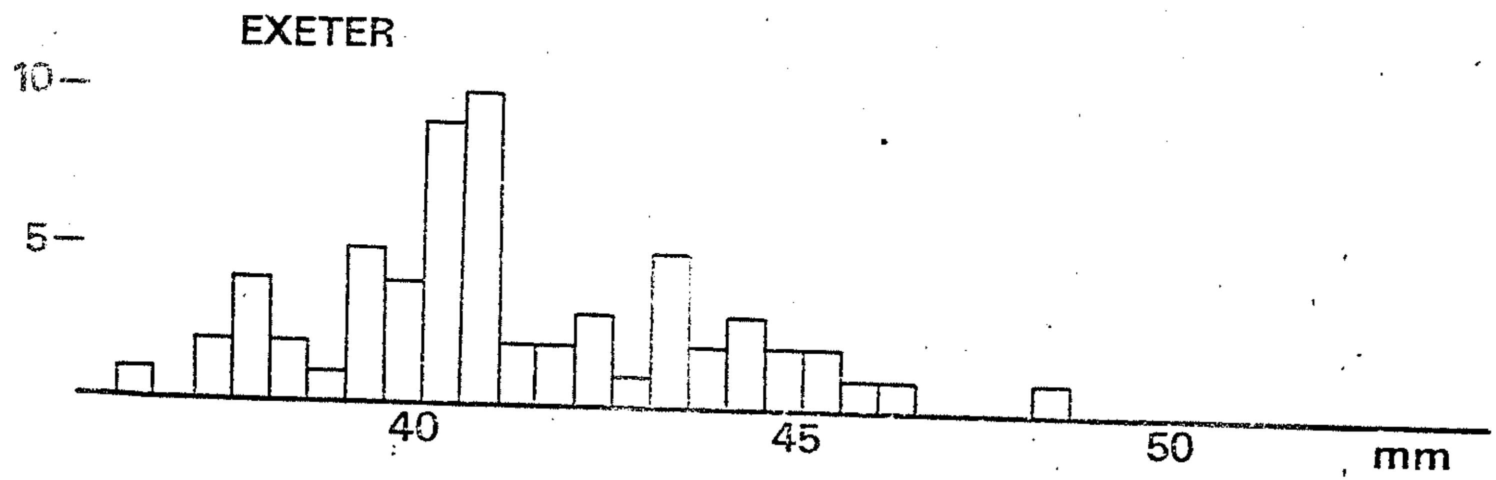
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assemblages has been the maximum distal width of the tibia. The significance of this measurement as an indicator of size has yet to be adequately demonstrated and the size of the bone is [illegible] an extent determined by sexual dimorphism (Noddle 1980: 396). Nevertheless there has been some consistency in the results obtained to date. Table 6 shows the range and means of distal tibiae measurements from 25 samples. Apart from the small sample from Grimthorpe, the means from the iron age samples fall at the lowest end of the scale, with very few specimens measuring more than 25 mm. Specimens of this size and larger have been found more commonly in Romano-British and Anglo-Saxon samples, although the smallest specimens were as small as the earlier ones. The means from the Romano-British samples fall between 22.8-25.5 mm. Six of the seven samples with the highest means in the list originated from Anglo-Saxon sites in East Anglia and southern England (25.2-[illegible] mm.). Other measurements of sheep bones support these observations, indicating an increase in the average size of sheep in the Romano-British and Anglo-Saxon periods. Possible introductions of stock could have taken place in both periods but improvements in the existing stock by better husbandry could also account for the variability. There is some evidence for an increase in the size of sheep within the Romano-British period on some sites. The average size of distal tibiae increased, for example, at Alcester and Frocester Court, although these samples are far from adequate (Table 6).

There is certainly evidence for regional variation in sheep size in the Romano-British and Anglo-Saxon periods. The bones from Exeter showed only marginal increases in mean size and were consistently smaller than most of the specimens from late Roman Alcester, for example (Figure 8). Sheep in the south-west may have continued to be smaller after the Romano-British period, if the small Dark Age sample from Mawgan Porth, Cornwall is typical (Table 6

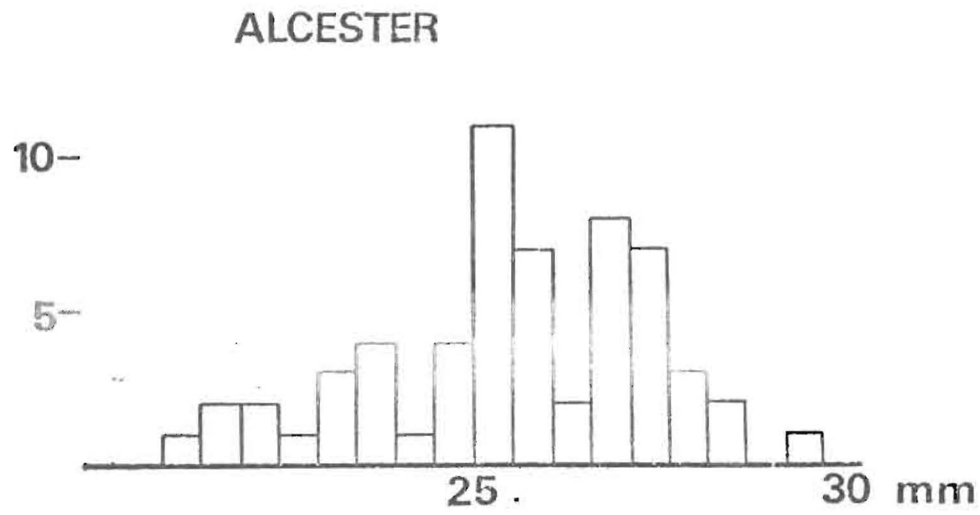
The initial incrdase in size of some of the flocks in the Romano-British period may have parallels with the developments in cattle husbandry. The introduction or development of larger stock in some areas may be an indication of the rather nebulous concept of "Romanisation". If so, there may be a parallel with the situation in the Roman provinces of central and eastern Europe, where similar changes in sheep size took place (Bökönyi 1974: 178).

Table 6

Metrical Analysis of the Maximum Distal Width of Sheep Tibiae

Site	Date	N	Range	Mean	Source
Winklebury	Iron Age	20	16.9-23.9	21.2	Jones, R. (1977 archi
Winnall Down	MIA	12	21.1-23.7	22.3	Maltby (n.d.1)
Barley	Iron Age	11	19.9-26.0	22.3	Jarman et al. (1968)
Balksbury 1973	MIA	19	20.4-24.0	22.4	Maltby (n.d.2)
Mawgan Porth	C9-11th.	7	21.0-25.0	22.6	Clutton-Brock (1976)
Winnall Down	EIA	7	21.3-24.0	22.7	Maltby (n.d.1)
Croft Ambrey	Iron Age	10	21.0-24.0	22.7	Whitehouse (1974)
Balksbury 1973	Roman	7	21.0-27.3	22.8	Maltby (n.d.2)
Frocester Court	100-300	12	20.0-25.0	22.8	Noddle (1979)
Exeter	55-100	21	21.3-25.8	23.1	Maltby (1979)
Exeter	100-300	30	21.4-25.9	23.3	Maltby (1979)
Alcester	100-200	9	21.1-26.0	23.6	Maltby (n.d.4)
Exeter	300-400	15	22.3-27.0	23.9	Maltby (1979)
Winnall Down	Early Roman	8	21.9-25.6	23.9	Maltby (n.d.1)
Grimthorpe	EIA	5	22.0-25.5	24.0	Jarman et al. (1968)
Frocester Court	Late Roman	13	23.0-27.0	24.0	Noddle (1979)
Shakenoak Farm	Late Roman	26	22.0-28.0	24.5	Cram (1978)
Baylham House	100-200	22	21.6-28.8	24.5	Maltby (n.d.3)
Sedgeford	Mid Saxon	29	22.0-28.0	25.2	Clutton-Brock (1976)
Alcester	Late Roman	59	21.2-29.4	25.5	Maltby (n.d.4)
Ramsbury	Mid Saxon	12	22.7-28.0	25.9	Coy(1980 in press)
Hamwih	Mid Saxon	267	21.8-30.0	25.9	Bourdillon & Coy(19
North Elmham	Mid Saxon	191	23.0-29.0	26.1	Noddle(1980)
North Elmham	Late Saxon	71	22.0-29.5	26.2	Noddle (1980)
Thetford	Late Saxon	13	21.0-29.9	26.3	Clutton-Brock (1976)

All measurements in millimetres. EIA = Early Iron Age; MIA = Middle Iron Age.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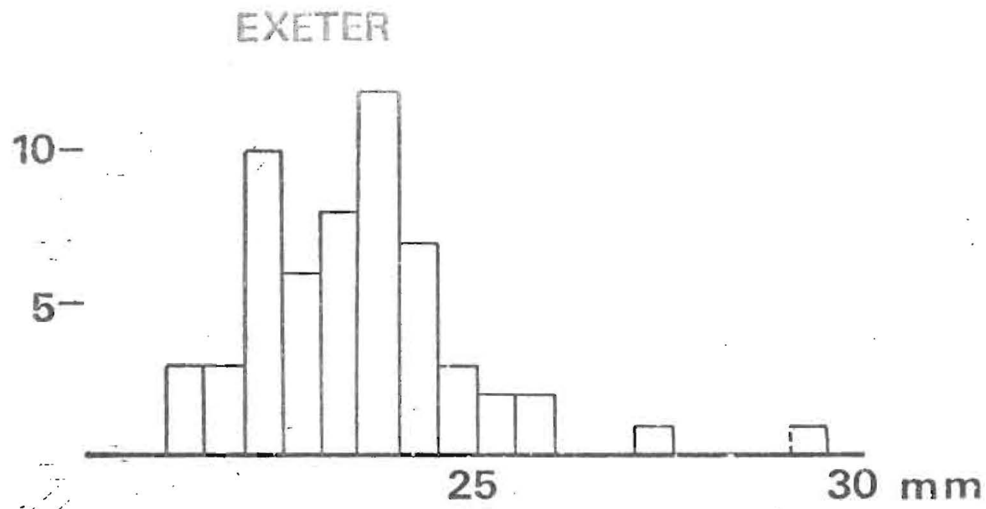
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Horse

Iron age samples have consistently produced evidence for the keeping of small ponies ranging from 10-14 hands high. Examples have come from Ashville (Wilson 1978: 135), Gussage All Saints (Harcourt 1979: 153) and Winklebury (Jones, R. 1977: 64). Metrical analyses of horse bones of Romano-British and Anglo-Saxon date have been limited by their rare occurrence on most sites. At present it seems that the smallest ponies represented in the iron age samples do not appear on later sites and some bones of larger horses have been recovered, although few appear to have been over 14 hands (e.g. Wilson 1978: 117-118; Bourdillon and Coy 1980: 104-105; Clutton-Brock 1976: 383).

Dogs

Harcourt's (1974) review of the evidence for dogs on British archaeological sites included an extensive survey of metrical analysis. More recent studies have tended to support his observations. Measurements of iron age specimens revealed relatively little range in variation in the shape of the skulls and estimates of shoulder heights using conversion factors from the lengths of limb bones ranged between 32-58 cm., mostly in the upper range, on material derived from 28 sites (Harcourt 1974: 163). The range has been increased slightly by the discovery of a partial skeleton of a dog in a late iron age deposit at Ashville that had an estimated shoulder height of 60 cm. (Wilson 1978: 125). Although articulated skeletons of dogs appear more frequently on iron age sites than those of other species, there is no doubt that dog meat was consumed at some settlements. Butchery marks on dog bones made during the disarticulation of the skeleton and the stripping of meat have been observed, for example, at Ashville (Wilson 1978: 122), Winnall Down (Maltby n.d.1) and Balksbury (Maltby n.d.2). The latter two sites also produced a relatively large number of bones of very young puppies, a phenomenon that also occurred at Gussage All Saints (Harcourt 1979: 154). It is possible that the numbers of dogs were controlled by killing some of the newborn puppies, although natural neonatal mortality could have accounted for some of these deaths.

The Roman period saw a significant increase in the variation of the types of dog kept. Estimates of shoulder heights ranged from

24-72 cm. and skull shapes showed much greater variation (Harcourt 1974: 164-166). The smallest dogs were regarded as lap dogs and the largest as hunting dogs. The variation in skull shape appears to have decreased in the Anglo-Saxon period, if the specimens from the 11 sites examined by Harcourt are typical. The range in shoulder heights was similar (23-71 cm.) but the majority of specimens belonged to large individuals.

Conclusions

Methodological Questions

It is obvious that any conclusions derived from faunal studies are handicapped by the lack of suitable data. Whatever aspect has been considered, the same problems have been found. There is a limited number of adequate samples and there are substantial gaps in our knowledge in some periods and regions. Incompatibility of archaeozoological techniques has made inter-site comparisons difficult. There has been a general lack of understanding or consideration of the problems of the formation of faunal samples and studies of intra-site variability have been few and far between. Finally, and perhaps most disturbing, there is the inadequacy of many of the past and current archaeozoological methodologies to deal efficiently with the data.

The number of samples will increase significantly during the next decade. This will improve the situation only if they are studied in a more rigorous way. Attempts to come to terms with differential preservation of animal bones and other aspects of intra- and inter-site variation must be made. Taphonomic studies have begun to investigate some of these problems (e.g. Binford and Bertram 1977) and the potential complexities of the derivation of animal bones on archaeological sites have been demonstrated in several ethnoarchaeological studies (e.g. Binford 1978). In this country, attempts at studying faunal samples in such detail are in their infancy. They involve much more rigorous recording and analysis of animal bones than has commonly been the case. These may be time-consuming and laborious tasks, yet they are necessary. Any bone recovered from a site has been the subject of several modifications of natural or cultural origin. Understanding of the composition of the herds and their exploitation cannot be achieved from animal bones without such studies. They involve the careful analysis of each bone fragment recovered to obtain information about preservation, butchery and gnawing. It is also hoped that more research will be undertaken to obtain more reliable estimates of ageing, sexing and the types of animals kept. More detailed metrical analyses have a part to play in the latter studies but other approaches, such as those of chemical analysis and observations of morphological criteria on bones (Noddle 1978) may also prove of value. Brothwell (this volume) has already shown the potential information that can be derived from the study of pathological data. It is important to draw upon as many lines of investigation as possible, in order to make full use of the inherently imperfect data studied by faunal analysts.

From Appendix to Integration

The purpose of this article has been to show the state of progress of faunal studies and to point put the limitations. Faunal analysis is a specialism within archaeology. Its independence, reflected by the inclusion of separate animal bone appendices in many site reports, is understandable and to a certain extent justified. It is the lack of integration of faunal evidence with the rest of the archaeological record that has been the major drawback of much previous work. Faunal analysis, for example, is only one source of information that can be drawn upon to study pastoral husbandry. Bradley (1978: 45-53), for example, has discussed the evidence available from the artefacts, field evidence and facilities that may have been associated with pastoral activities in the prehistoric period. Nor should pastoral farming be looked at in isolation from arable farming but few attempts have been made to integrate faunal and floral data from British sites. A notable exception has been the work at Gatcombe (Branigan 1977), where there has been an attempt to assess the potential agricultural output from the villa estate and a consideration of the operation of the complex internal ahd external economies of the estate. To be fair, several current projects are making concerted efforts along similar lines.

For it is indeed the integration of faunal studies that is urgently required. It is hoped that even the limited faunal analyses to date have shown - or at least have the potential to show -

changes and developments in stock-keeping practices within regions and through time. Explanations of these changes obviously cannot be made without reference to other aspects of the archaeological and historical records. In the same way, developments in pastoral farming have to be studied within the framework of broader models or hypotheses. The pastoral economy had a bearing upon and was affected by many environmental, economic and behavioural factors. The relationship between these factors can be complex. As Clarke (1978: 116) asserted:-

> "The dynamic equilibrium between the economic subsystem and the other subsystems is stabilized by continually adjusting the mutual values and states of these networks. The economy must be kept as nearly as possible in equilibrium with the information and constraints from taboos, social organisation and division of labour by age and sex, individual personalities, and the available capacity or range of variety of material culture."

Whether or not one studies such processes in terms of culture systems, the underlying principle remains the same. The attitude that there are two types of archaeology - "environmental" and "cultural"—is unnecessarily divisive, since the two elements have always been incontrovertibly linked.

It is already possible to show how the results of faunal analysis can provide useful information about many wider issues. In a recent volume the impact of the Roman invasion on native British communities was discussed and various lines of investigation were pursued by several authors, including pottery studies, industry and trading patterns, coinage, urban development and rural settlement patterns (Burnham and Johnson 1979). Similar studies on animal bones could shed light on the impact the invasion had upon the pastoral economy. The need to supply the troops of the invading army, the possible introduction of new stock and the introduction of new farming techniques may all have had significant repercussions on husbandry practices. There is already some evidence for changes in the exploitation patterns of sheep and cattle in the Romano-British period. In addition, the appearance of some larger stock and evidence for the supply of specific age groups of cattle to some military and urban settlements may all be seen to be direct or indirect consequencies of the Roman invasion, although the details of the mechanisms involved in those developments need to be ascertained. How great Roman influence was in different parts of the province has also to be determined. It is interesting to note, for example, that the apparent absence of larger sheep and cattle in the south-west peninsula occurs in an area where there are virtually no villas (Fox 1973: 171-174; Wacher 1980: 123) and thus supports the view that "romanisation" had little impact in that area (Rivet 1964: 116). In areas where villas and native settlements are both found, it should be possible to develop the work of King (1978) to test whether the apparent dichotomy in wealth and power of the inhabitants of Roman Britain in the late first and second centuries (e.g. Todd 1978: 204-205) is also reflected in the faunal remains.

The relationship between other developments in settlement patterns and animal husbandry has not as yet been investigated in detail. For example, the changes observed in the settlement pattern in some parts of England in the late Iron Age (Miles, this volume) may coincide with changes in species exploitation but again too few samples of that date have been analysed. Similarly, it should be possible to use faunal analyses to test the models for change in late Roman Britain. Reece (1980) has suggested that in the fourth century town life in the true sense of the word had virtually disappeared and that there was a change from the town-based economy prevalent in the second century to a villa and village-based economy in the fourth century. Such fundamental changes in settlement and economic patterns must also have had some impact on the agricultural basis of the economy. As Reece points out (1980: 78), towns contained a large element of population not directly involved with agricultural production but engaged in administration or trading activities. There was therefore a greater need for the organisation of food supplies. In support of this, analysis of faunal material of first and second century date in Exeter produced evidence for large-scale butchering of cattle carcasses and concentrations of cattle and sheep killed at specific ages for their meat. In contrast, the fourth century deposits from Exeter have so far revealed no comparable large-scale butchery evidence, a greater range of cattle killed at different ages and evidence for stock enclosures within the city walls. All these factors may indicate the collapse of the former system of supply (Maltby 1979). Examination of faunal material from other urban sites ought to be able to test how typical the samples from Exeter are.

The above are just a few examples taken from the Romano-British period to show how faunal analysis can be incorporated into testing more general hypotheses. There are many more examples, some of which derive from observations made on aspects of faunal studies discussed earlier in this review. Space precludes detailed examination of these topics, and in any case the present limited available data make several alternative explanations possible. It is hoped, however, that the current position of faunal studies has been shown. Some of the basic groundwork towards the understanding of the relative representation, introduction and exploitation of different domestic species has been done. It remains, on the one hand, to broaden our knowledge of the many poorly represented regions, periods, settlement types and the less common domestic species. More important, however, is the incorporation of faunal studies into the wider framework of prehistoric and early historic studies and to develop methodologies better equipped to cope with these broader issues. To do this we need to develop a planned regional approach to faunal studies. It will then be possible to compare the data from different types of site against a common background of environment and agricultural potential. It will also be possible to tackle the problems of sample variability constructively, so that all samples, including quite small ones, have significance. In some areas such regional projects have begun and only by the integration of such multiperiod research with other aspects of the archaeological record will questions relating to the development of animal husbandry be answered.

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