ANCIENT MONUMENTS LABORATORY

REPORT

3876

SERIES/No CONTRACTOR

AUTHOR Jennie Coy May 1982

TITLE The animal bones, Level IV report for Dwer monograph

THE ANIMAL BONES

Jennie Coy, Faunal Remains Project, University of Southampton

There were 1,743 animal bone fragments. Phases and species represented are given in Table 1. Information was recorded using the Ancient Monuments Laboratory's computer coding scheme (Jones n.d.) and is housed at the Faunal Remains Project. An earlier Level III Archive Report is also available (Coy n.d.). The present account mainly concentrates on the two collections of any size - one mostly from the first century A.D. ditches (Phase 1 + 2) and the second from more variable contexts of the third and fourth centuries A.D. (Phase 7).

Species Represented

Most common were bones of the three major domestic species - cattle, sheep, and pig. There was a small amount of horse bone. As all caprid remains identifiable to species were definite sheep all 'sheep or goat' categories were included in the 'sheep' row in Table 1. As 'cattle-sized' fragments were mostly small fragments of unidentifiable long bone or fragmentary ribs there is a faint possibility that these contain a few fragments from horse or red deer. Similarly the fragments from 'sheep-sized' animals may include pig fragments although the pig's distinctive anatomy makes this less likely.

The native red deer, Cervus elaphus, was represented in Phase 7 and roe deer, Capreolus capreolus, and red fox, Vulpes vulpes, in Phase 1+2.

Domestic fowl bones were mostly in Phase 7 and there were a few bones of other birds throughout. Fish appeared in few contexts

	Phase 1+2	Phase 3	Pha 4/5/6	Phase 7	TOTAL
MAMMALS					
horse	9	1	5	12	27
cattle	101	46	42	181	370
sheep	132	41	35	175	383
pig	238	44	45	79	406
red deer *Cervus elaphus*	-	-	-	6	6
roe deer *Capreolus capreolus*	1	-	-	-	1
fox *Vulpes vulpes*	5	-	-	-	5
cattle-sized	75	26	27	57	185
sheep-sized	135	82	26	68	311
BIRDS					
domestic fowl	1	-	-	16	17
swan *Cygnus* sp.	1	-	-	2	3
mallard/domestic duck *Anas platyrhynchos*	6	2	-	5	13
Duck, *Anas* sp.	1	-	-	1	2
white-tailed sea eagle *Haliaeetus albicilla*	1	-	-	-	1
curlew *Numenius arquata*	1	-	-	1	2
guillemot *Uria aalge*	-	1	-	-	1
greenshank, *Tringa nebularia*		1	-	-	1
unidentified bird	-	-	-	1	1
FISH					
* common eel *Anguilla anguilla*	-	1	-	-	1
gilthead sea bream *Sparus aurata*	-	-	2	-	2
unidentified fish	5	-	-	-	5
TOTAL	712	245	182	604	1,743

TABLE 1 Phase Divisions and Species Representation (no. of fragments)

* There were also remains of small eels found in the shell deposits (see separate mollusc report)

and were probably not often preserved.

Specific Percentages of Cattle, Sheep, and Pig

On the basis of fragments identified to species (or to ovicaprid) there was a significantly different species representation in Phase 1 + 2 and Phase 7 (Table 2). Chi-squared testing of original frequencies showed them as highly unlikely to occur by chance ($p<0.001$, chi-squared = 108 on 6 d.f.).

The most significant values contributing to this result were the high value for pig fragments in Phase 1 + 2 and the low value in Phase 7, where pig was replaced as major contributor to fragment counts by cattle.

Including 'C-size' and 'S-size' counts as well as specifically identified fragments it is clear that small ungulates (sheep, pig, 'S-size') always form the major fragment totals throughout the occupation (range 58.5 -74.0%) but in Phase 7 the large ungulate representation is 42.5%, compared with 26% for Phase 1+2. This presumably mirrors the relative percentages of pig and cattle shown in Table 2 for the species identifiable bones.

Together these figures suggest a significant change in diet or husbandry between the earliest and latest phases with an enormous decrease in the significance of pig , some increase in cattle, and to a less significant extent an increase in sheep. The assumptions that must be made to come to such conclusions will be discussed after a brief diversion on the anatomical elements represented; a subject intricately related to any comparisons of specific percentages.

Anatomical Elements of Cattle, Sheep, and Pig

The anatomical parts of the three major species are given for the two larger samples in Tables 3 and 4.

Bones identified to species were used to

TABLE 2

Specific Percentages for the Three Major Species

	PHASES			
	1+2	3	4,5,6	Z
no. fragments	(471)	(131)	(122)	(435)
cattle	21%	35	34	42
sheep	28%	31	29	40
pig	51%	34	37	18
	100%	100	100	100

compare the number of fragments from heads and feet (including distal radius and distal tibia) with those from the rest of the body which carry the major meat masses. This rough index served to pinpoint the rather high values for head and foot bones for sheep in Phase 7 and for pig in Phase 1+2.

Discussion of a Possible Change in Animal Husbandry

An individual bovine would provide several times the amount of meat provided by a pig. Estimates for meat yield of cattle compared with pig range from about 1:3 for Manching (Boessneck et al 1971, 9) to 1:6.6 for Gussage (Harcourt 1979, 155)

Even taking the latter the results suggest that in Phase 1+2 pork was a significant source of food, whereas in Phase 7 beef was overwhelmingly the most important mammalian food.

But this is to make a number of assumptions:

1. that these bones are the remains of animals used for food
2. that fragment counts relate directly to the number of animals, with no differential degrees of fragmentation or preservation for the different species, or for different phases
3. that collections are representative of the economy of the phase and are comparable.

To deal with the first assumption - it is beyond doubt that there were bones from butchered and processed carcases of the three major species, in all contexts . There was no butchery on any of the horse bones. There was no evidence for whole or partial skeletons of the three major species.

Burning was more common for Phase 1+2 than for Phase 7 and butchery very slightly so, although the last phase had a higher proportion of loose teeth which are unlikely to show butchery.

TABLE 3

Mammalian Bones in Phases 1 and 2 (Numbers of fragments)

	horse	cattle	sheep	pig	roe	c-size	s-size	totals
orn core	-	1	3	-	-	-	-	4
ranium	-	11	11	42	-	1	2	67
axilla	-	-	3	24	-	-	-	27
andible	-	12	15	41	-	1	-	69
ertebra	-	6	7	5	-	8	11	37
ibs	-	5	1	1	-	20	40	67
scapula	-	-	6	7	1	4	3	21
umerus	-	4	8	4	-	2	2	20
adius	1	5	14	4	-	-	2	26
ulna	-	2	3	2	-	-	-	7
pelvis	-	8	7	4	-	-	1	20
femur	-	3	4	9	-	1	5	22
tibia	-	4	12	8	-	1	9	34
fibula	-	-	-	3	-	-	-	3
carpal/tarsal	-	10	2	6	-	1	1	20
metapodial	-	9	19	3	-	2	-	33
phalanx	-	5	1	4	-	-	-	10
loose teeth	8	15	14	70	-	-	-	107
other	-	1	2	1	-	34	59	97
TOTALS	9	101	132	238	1	75	135	691

TABLE 4

Mammalian Bones in Phase 7 (Numbers of fragments)

	horse	cattle	sheep	pig	red deer	c-size	c-size	totals
antler	-	-	-	-	2	-	-	2
horn core	-	4	4	-	-	-	-	8
cranium	2	28	23	11	-	3	-	67
maxilla	-	5	3	3	-	-	-	11
mandible	-	9	22	6	-	-	-	37
vertebra	-	10	2	7	-	4	2	25
rib	-	3	-	-	-	12	29	44
scapula	-	10	1	1	-	1	2	15
humerus	-	1	5	4	-	-	-	10
radius	-	7	8	2	1	1	2	21
ulna	-	2	1	3	-	-	-	6
pelvis	-	8	6	1	-	2	1	18
femur	-	5	1	3	-	1	5	15
tibia	-	4	4	9	-	1	4	22
carpal/tarsal	1	2	1	6	1	-	-	11
metapodial	4	13	12	5	-	1	-	35
phalanx	1	5	10	3	2	-	-	21
loose teeth	4	65	69	15	-	-	-	153
other	-	-	3	-	-	31	23	57
TOTALS	12	181	175	79	6	57	68	578

These criteria demonstrate that this is a typical domestic assemblage where the bones are likely to be remains of meals and carcase preparation. The degree of fragmentation of the deposits is also confirmation that carcases were heavily utilised.

Assumption two is more controversial as the amount of material from this site is too small for secure conclusions. King has suggested that overall fragment counts do relate in a rough way to the calculated minimum number of individuals (King 1978, 208). The relationship between calculated minima and actual number of animals represented is more obscure for such a small bone collection. King also confirmed that pig often shows a smaller number of bones per individual than sheep or cattle when minimum numbers are calculated, something already known from Wessex Iron Age settlements (e.g. Coy 1969, 47) and assooiated with differential loss of post-cranial elements. Pig at Ower certainly seemed to present a high proportion of non-meat bones (mostly jaws, head bones, and loose teeth) in Phase 1+2 (81%) and this may mean that it was underestimated in importance at least in that phase, if fragment counts were used.

The degree of fragmentation of the major long bones was compared for the three major species. Only the Phase 1+2 sample was large enough to be useable and this showed no significant differences in the fragmentation pattern of the different species. The fragmentation pattern in Phase 1+2 and Phase 7 was generally similar. Samples from the other phases were too small for valid analysis. The fragmentation pattern was not significantly influenced by excessive fragmentation, in either of these phases, to small unidentifiable fragments. There was, however, a slightly higher value for such unidentifiable fragments in Phase 1+2.

There is some evidence that Phase 7 contains a slightly higher proportion of eroded bone than Phase 1+2. The slightly acid nature

of the soil could have been a factor in some contexts. The pH of the soil would also vary with the amount of bone and mollusc waste deposited . Erosion may also explain why there were several associations of obviously related maxillary teeth with no sign of maxillary bone. It may also explain the large number of loose teeth in some of these collections.

Apart from the relative scarcity of pig post-cranials, which is not confined to acid sites, there is no suggestion that erosion has affected different species in different ways.

The problems raised in assumption 2 are very big ones and an important part of the overall studies of Wessex bones taking place. They can only be elucidated by the detailed study of large accumulations of carefully collected samples. Large Iron Age samples have certainly demonstrated that depositional and preservational factors as discussed here do influence results obtained for specific ratios, anatomical elements, and age groups (e.g. Maltby 1981, 166).

In order to test the third assumption a context by context analysis of the material took place and some points from this are highlighted in the following discussion.

Context by Context Discussion

It is interesting to compare individual contexts with overall phase results.

In Phase 1+2 there are 525 mammal bones from the rectilinear enclosure and 166 which come from residual material from this and from the ring ditch. There are no significant differences between the two deposits in terms of species and anatomical elements represented.

Other criteria relating to preservation (e.g. percentage of loose teeth, percentage of unidentifiable long bone fragments)

were tested. The value for large ungulate unidentifiable fragments was noticeably higher in the rectilinear enclosure than for the phase as a whole but otherwise differences were minor.

Phase 3 contained too small a sample to study in depth but it was generally badly preserved with high values for loose teeth. It showed the highest proportion of small ungulate fragments, presumably linked with slow build-up of this deposit where bones may have been exposed over long periods.

There were 108 bones in Phase 4,5,6 contexts thought to be later contamination of earlier ditches. This small sample showed a higher proportion of pig bones than in the phase as a whole (47%) but this could be bias due to the small sample.

Material in the briquetage feature [388] and kiln/oven [540] was very fragmentary and probably highly residual.

The Phase 7 potter's yard, [147], produced 120 fragments which give specific percentages of cattle, sheep, and pig, respectively, of 39%, 32%, and 29%. This is rather higher for pig than the phase average but again sample size was very small (82 species-identified bones). Other Phase 7 values were not unlike the phase figures except that loose teeth formed 50 % of total sheep fragments and 29% of pig fragments. The building collapse material in context [564] produced 192 bones, most of which were in O.P. [568]. This particular collection was very interesting as it contained much of the highly fragmentary small ungulate material in this phase. Here 70% of all species-identified fragments were sheep, 87% of these being non-meat bones. In addition 91% of unidentified fragments were from small ungulates - a highly significant value. This shows how small deposits can vary and this one in particular with its concentration on sheep extremities is unrepresentative of the whole phase, where cattle form 42% of the total fragment count.

Quite different was the midden/rubbish material in context 706/707 in which 82% of the 184 fragments were from cattle - with a high proportion of cranial fragments and teeth.

Results for contexts within Phase 7 were thus remarkably variable and did not present the consistency of those forming Phase 1+2. It is therefore difficult to compare bones from the two phases with any sense of security in the data. The midden/rubbish collection with its concentration on cattle has a big effect on the Phase 7 figures. The very high sheep values in the building collapse material likewise contribute in large measure to the relatively high value for sheep.

The Phase 7 deposits may not therefore be so representative of the contemporary economy as those from Phase 1+2 as the high value of loose teeth for cattle and sheep and the two rather odd deposits discussed above suggest that this is poorly-preserved and biassed material. There is also very slight evidence that the bones from Phase 1+2 provide better evidence of useage, such as charring and butchery, than 7, and there is slightly more erosion and dog-gnawing in Phase 7 which may militate against pig.

These deposits were not good ones for the preservation of animal bone and any conclusions drawn about the animal economy must be treated with caution for this reason and because of the small samples involved. Maltby's recent work on the Iron Age bone assemblages from Winnall Down, Hampshire, show how different results may be obtained for different context types, notably pits and ditches (Maltby n.d.).

Age and Sex of the Domestic Animals

Pig jaws and canines gave a ratio of male to female of approximately 3:1. There could be some preservational bias to explain the high frequency of male lower canines as they are larger and stronger than all others. We must assume that

preservation of young pigs has been poor as the breeding of pigs nearby would normally have produced a proportion of bones of new-born or very young pigs.

Using Grant's system for recording tooth wear (Grant 1975, 437) and including all estimates of age made from loose teeth the pigs represented included 22 older than Grant stage 30 and 18 younger than this. This gives a figure of 55% for the older group. Such animals would be at least 2 and more likely 2½ years old according to tooth eruption data from wild pigs. The material in Phase 1+2 produces a figure of 71% for pigs over stage 30.

Only 24 age estimations of cattle could be made for the whole site from jaws and loose teeth. The distribution of these was fitted to the provisional figures given by Maltby for Iron Age and Roman material (Maltby 1981, 181) and could easily fit into either pattern.

Grant wear stages could be estimated for 30 mandibles or loose teeth of sheep. This limited evidence fitted data given by Maltby for the Iron Age (Maltby 1981, 173). There were no really young mandibles.

The preservational aspect of the material casts some doubt on any conclusions relating to age structure. That very young or foetal material could survive in some layers is evident for all but Phase 3. There were parts of two sheep (or goat) foetal skeletons in both O.P. 249 and 269 in Phase 1+2 and occasional finds of porous and unfused long bone, mostly from animals skeletally immature but over one year. It is interesting that these have survived in this soil but it is likely that these immature finds are chance ones in a favourable context and that we should not attach too much importance to the age structure evidence for what is a small and biassed sample. The good age reached by some of the animals was

clear. There was some fairly mature pig jaw material in Phase 1+2 and the same for cattle in Phase 7. The butchery evidence suggests that these were eaten.

Ageable horses were 14 and 6-10 years respectively.

Size of the Domestic Mammals

There were not many pig bone measurements, apart from a good sample of third molar teeth. Upper third molars (24) ranged from 25.4 to 32.8 with a mean of 29.3mm. This corresponds almost exactly with the figures for Saxon Hamwic. A more detailed comparison was possible for Ower lower third molars with other sites of the Roman Period; Iron Age Gussage All Saints, Dorset ; and Saxon Hamwic. Table 5 gives a summary. The overall analysis suggested great similarity in modal groups and ranges between the three periods, with perhaps more odd larger individuals in the Roman Period. The Ower measurements fit better with the large samples from Gussage and Hamwic which are assumed from their low standard deviations and coefficients of variance to represent consistent and, probably domestic, populations. There is no suggestion at Ower, unlike Fishbourne and Frocester, that wild pig with its longer jaws and teeth is represented.

No attempt was made to compare Early and Late Roman material within these small samples. Other pig measurements from Ower were scarce but fitted the ranges of the Gussage Iron Age material.

The cattle were typical of the size found on Wessex Iron Age sites with withers' heights calculated from three metapodial bones at 107, 111, and 114cm respectively. There are some bones from stocky individuals and a number of individual bones were near the Gussage maximum. Detailed comparison with other Wessex material of the Roman Period will be possible when more of this has been processed.

TABLE 5 Total Lengths of Pig Lower Molar (mm)

site	reference	period	no.	range	mean	s.d.	c.v.
Gussage	Harcourt 1979	I.A.	18	30 - 35	33	-	-
Ower		Rom	9	28 - 35	31	2.4	7.8
Puckeridge	Croft 1979	Rom	9	31 - 35	33	1.2	-
Shakenoake IV	Cram 1973	Rom	8	29 - 40	35	3.8	10.7
Shakenoak V	Cram 1978	Rom	16	30 - 38	34	2.4	7.1
London 1	Armitage pers. comm.	Rom	4	26 - 33	31	-	-
London 2	Armitage pers. comm.	Rom	12	27 - 37	31	3.0	9.5
Frocester	Noddle 1979	Rom	19	28 - 38*	33	-	-
Fishbourne	Grant 1971	Rom	c.50	29 - 38* (modal group 30-32)			
Hamwic	Bourdillon & Coy 1980	Sax	51	25 - 34	31	2.0	6.3

* Not included in the statistics are suspect wild boar from Frocester and Fishbourne with length of M_3 respectively 43 and 44 mm.

Sheep produced few useful measurements but withers' heights calculated fit the Gussage range. These were values of 62cm in Phase 1 (from metacarpus); and 52 (humerus), 54 (metacarpus), and 60 (metacarpus) in Phase 7. The Gussage range was 53 - 64 cm.

A horse metacarpus in Phase 4,5,6 (O.P. 265) gave a withers' height of 122 cm.

Birds and Fish

Of the domestic fowl bones, two leg bones were by the evidence of their medullary bone, from hens in lay and the only tarso-metatarsus found was also of a hen. There was no evidence from anatomy that the ducks were domestic but many of their bones were charred and presumably these represented food remains. The sea eagle bone came from O.P. 296 (Phase 1+2). This impressive bird was a breeding species in coastal and lake districts until the 19th century and is now only an occasional visitor.

The evidence for fishing at Ower was poor. Of the fish bones retrieved by normal excavation listed in Table 1, the eel dentary was larger than one in the Faunal Remains Project from a fish weighing 1 kg and the two premaxillaries of gilthead sea bream, on the basis of the measurements described by Boessneck and von den Driesch (1979, 55), probably exceeded 40 cm in length. The bulk samples examined for molluscan remains (see Mollusc report) produced a very few eel vertebrae from the rectilinear enclosure in Phase 1+2.

Conclusion

This is a very small sample of bone from which to reconstruct diet or animal husbandry practices. Assuming, however, that these specific ratios reflect the real situation there is evidence that pig was of major importance in the earliest phase of occupation and that pigs were domestic and often mature.

The lack of pig post-cranials alluded to earlier may be more than outweighed by the increase in fragment numbers caused by the inclusion of loose teeth.

These problems of interpretation are symptomatic of the widely diverse methods used for assessing specific ratios by archaeozoologists. It was difficult to compare Ower results with those for the Dorset Iron Age at Gussage as there minimum numbers of individuals were used to calculate relative meat weights. Even so, pig was clearly relatively unimportant at Gussage. In the same way comparisons with Fishbourne, although superficially useful (the early Roman pig there represents from 34 to 43% of the major domestic bones), were treated with caution as these fragment counts excluded shaft fragments and loose teeth. Counts from Puckeridge were more comparable (although ribs and vertebrae were not identified to species) and produced a figure of 35% for pig in Group 1 (A.D. 40 - A.D.70).

Results for Ower, Fishbourne, and Puckeridge therefore showed a far higher proportion of pig than the levels discussed by King (1978, 216) who used 10 % pig as the cut off when contrasting 'Romanised' and 'native' settlement assemblages. King hypothesised a trend towards pig and cattle keeping and away from sheep in the latter half of the Roman Period, linked with increasing woodland useage and establishment of orchards. King also suggested that assemblages rich in pig were more likely to be 'Romanised' and to occur in the area of river valleys or heavier soils. Work on Roman London supports this trend towards beef and pork eating (Philip Armitage, personal communication).

Fishbourne and Puckeridge assemblages, being from 1st or 2nd centuries A.D., do not really fit into this 'Romanisation' theory, although they could both be used as evidence for an environmentally influenced husbandry. The area of the South Coast around Fishbourne, for example, is currently graded 1 or 2

in the Agricultural Land Classification of England and Wales. Recent work at the Iron Age 'banjo' settlement at Groundwell Farm, Blunsdon St Andrew, Wiltshire, gave values for pig of up to 42% using an identical methodology to that for Ower (Coy 1982,). 'Native' sites can therefore produce high figures for pig and in this case there could have been nearby marshland.

Ower Phase 1+2 fits neither the cultural nor the environmental hypothesis. It is too early to fit any Late Roman trend towards pig and cattle keeping (which would involve some previous manipulation of the environment). It is also a heathy and apparently poor area for woodland with Grade 3 or 4 soils, although this does not necessarily mean that there was not extensive woodland or scrub cover in Roman times. The poor land may even have delayed the development of arable agriculture or the keeping of sheep and cattle until the later Roman Period.

Unless we are to assume that the pig carcases were brought to Ower cultural explanations related to the Roman taste for pork must be discarded. There is no real evidence at Ower for a concentration of butchery waste (heads and feet) other than normal domestic processing. The high value for teeth of all the major species in one deposit or another should rather be seen as an expression of exposure to air and soil water affecting subsequent preservation of bone.

The environmental and cultural factors leading to a choice of pig keeping are often too narrowly defined. Groundwell results show that there is no reason why native tastes for pork should not have developed. Access to marshy areas and, in the case of Ower, possibly to saltmarsh, may have been as important as to the woodland so often postulated. The present day surroundings at Ower are a mixture of grazing land with oak (this may well be the only tree species able to survive intensive cattle grazing - Oliver Rackham,

personal communication ; heathland; and a coastal area much influenced by recent changes in the topography of Poole Harbour.

Pigs are diversivores and can flourish in a variety of habitats, including farmyards. Their advantages are prolificity (a combination of short gestation, litter size, and rapid growth), adaptability, and intelligence. A pig can be kept in the house complex, is smaller than a cow, and certainly more sensible than a sheep. We can only assume that a combination of cultural and environmental factors led to a concentration on pig-keeping in the earliest phase of occupation at Ower, and that this later declined in relation to the keeping of cattle and sheep.

Acknowledgements

Mr Graham Cowles of the British Museum (Natural History) identified the fragmentary coracoid bone of the sea eagle, Sarah Colley of the Faunal Remains Project identified the fish bones.

References

Boessneck,J. A.,von den Driesch, A., Meyer-Lemppenau, U., & Wechsler-von-Ohlen,E.,1971, Die Tierknochenfunde aus dem keltischen Oppidum von Manching, Die Ausgrabungen in Manching, 6, Wiesbaden.

Boessneck, J., & von den Driesch, A., 1979, Die Tierknochenfunde aus der Neolithischen Siedlung auf dem Fikirtepe bei Kadiköy am Marmarameer, Inst. f. Palaeoanatomie, Munich

Bourdillon, J., & Coy,J., 1980, The animal bones. In Excavations at Melbourne Street, Southampton, 1971-76 (P.Holdsworth) Council for British Archaeology, Research Report 33, pp. 79-121

Coy, J.P., 1969, Report on the animal bones from the North-West and North-East entrances of Bury Wood Camp Wilts Arch & Nat Hist Mag, 64, 47-8.

Coy, J.P.,1982, The Animal Bones. In

(C. Gingell)

Wilts Arch & Nat Hist Mag, , .

Coy, J.P., n.d., Animal bones from the excavations at Cleavel Point, Ower, Dorset, 1978. Unpublished report to the Ancient Monuments Laboratory No. 3592.

Croft, P., 1979, The mammalian bones from feature 1. In Excavations at Puckeridge and Braughing 1975-79 (C.Partridge) Hertfordshire Archaeology, 7, 73- 92.

Cram, C.L., 1973, The animal bones. In Excavations at Shakenoak Farm, near Wilcote, Oxfordshire. Part IV: Site C (A.C.A. Brodribb, A.R.Hands, & D.R. Walker) Oxford: pr ivately printed pp. 145-164

Cram, C.L.,1978, The animal bones. In Excavations at Shakenoak Farm, near Wilcote, Oxfordshire. Part V:Sites K and E. (A.C.C.Brodribb, A.R.Hands, & D.R. Walker) British Archaeological Reports pp117-178

Grant, A., 1971, The animal bones. In Excavations at Fishbourne 1961-1969 (B.Cunliffe ed) Society of Antiquaries Research Report 27; vol II, pp. 377-388

Grant, A.,1975, Appendix B: the use of tooth wear as a guide to the age of domestic animals. In Excavations at Portchester Castle, vol.I. Roman (B. Cunliffe ed). Society of Antiquaries Research Report 32, pp.437-450

Harcourt, R.A.,1979, The animal bones. In Gussage All Saints: an Iron Age settlement in Dorset (G.J.Wainwright). D.O.E. Archaeological Report 10. pp. 150-160

Jones R.T., n.d., Computer Based Osteometry. Data capture user manual I. Unpublished report to the Ancient Monuments Laboratory No. 3342.

King, A., 1978, A comparative survey of bone assemblages from Roman sites in Britain. Institute of Archaeology Bulletin 15,pp.207-232.

Maltby, J.M.,1981, Iron Age, Romano-British and Anglo-Saxon animal husbandry - a review of the faunal evidence. In The environment of man: the Iron Age to the Anglo-Saxon period (M.Jones and G. Dimbleby eds) British Archaeological Reports British Series 87

Maltby, J.M.,n.d., The animal bones from Winnall Down, Hampshire. R.17, M3 Motorway Rescue Excavations. Hants Field Club

Noddle, B.A.,1979, The animal bones. In Frocester Court Roman villa: second report (H.S.Gracie & E.G.Price) Transactions of the Bristol and Gloucestershire Archaeological Society,97,pp51-60