Ancient Monuments Laboratory
Report 81/91

FAUNAL REMAINS FROM CLOSEGATE I & II, NEWCASTLE, TYNE AND WEAR, 1988 & 1990 EXCAVATIONS.

Simon J M Davis

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Summary

The animal remains from Closegate, Newcastle, dated to the 13th to 18th centuries were recovered by sieving (5mm aperture). Most belonged to cattle, sheep and pig. Abundant fish bones (mainly herring, cod and haddock) were recovered by wet sieving (1mm aperture) a small volume of 'whole earth'. The higher ratio of fish to mammal bone recovered by this means indicates that fish probably comprised some 10 - 20% of the diet. An increasing importance of sheep over cattle during the period represented at Closegate as well as at other sites in Newcastle and elsewhere in England, may reflect the change from ox-drawn to horse-drawn ploughs, and the increasing importance of wool. Since a wide range of sheep ages is represented, the inhabitants of Newcastle probably purchased both animals bred for meat and retired wool and milk. The 13th-16th century cattle and sheep were rather small. However, the 17th-18th century sheep (some definitely dated to the end of the 17th century) were larger. This size increase may reflect post-mediaeval improvements in British farming practices.

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an Agricultural Revelation ... . This was a Good Thing...

Sellar, W.C. and Yeatman, R.J. 1930
1066 and all that. Methuen

FAUNAL REMAINS FROM CLOSEGATE I & II, NEWCASTLE, TYNE & WEAR, 1988 & 1990 EXCAVATIONS

INTRODUCTION

Closegate I (CG88) and II (CG90) are two sites, separated by some 50 metres, situated on the north bank of the River Tyne. They were excavated in 1988 and 1990 by Richard Fraser of the City of Newcastle Archaeology Unit. Closegate I involved the excavation of a section of mediaeval town wall immediately adjacent to the River Tyne. Closegate II, within the old town walls, encompassed one complete property and part of a second, and also lies adjacent to the river Tyne. According to documentary sources, the area of Closegate was owned (but not necessarily occupied) by some of the more affluent merchants of Newcastle. In the 15th and 16th centuries at least two mayors of Newcastle had their capital messuages in the area by Closegate (Fraser, unpublished interim report). The excavations at both sites confirmed that the region known as the Close lies on a broad man-made platform some 50-60 metres wide, created by dumping material through a series of five successive waterfronts dating from the 13th to the 19th centuries. The contexts of Closegate I were all landfill deposits - most the result of dumping ashy material (hearth ash and possibly domestic refuse) in bulk. Contexts encountered at Closegate II, also mostly landfill deposits, consisted of sand, gravel or stone dumps, with relatively small lenses of more organic layers occurring occasionally (Fraser pers. comm.). Most of the animal remains described herein come from the 15th - 16th centuries with some from 13th - 14th centuries and 17th - 18th centuries.

A particular interest of the bones is that they were recovered by sieving and comprise a reasonably well-dated sequence from a period which is probably not long before, or coincident with, the beginnings of selective animal husbandry, farmyard improvements, and all else that the 'Agricultural Revolution' implies. According to historical sources dealing with agricultural developments in England (Orwin, 1949) it was the end of the 18th and beginning of the 19th century that saw work on the improvement of the nation's breeds of cattle and sheep. Three men often associated with these endeavours are Robert Bakewell (1725-1795), Robert Colling (1749-1820) and his brother Charles (1751-1836). Kerridge (1967), who maintains that the Agricultural Revolution took place in England in the 16th and 17th centuries and not the 18th and 19th centuries, has suggested that the new pasture sheep were only perfected by Bakewell - their creation being the work of earlier generations of improvers. The aim of this report is, therefore, to provide a description with measurements of the bones. Some comparison is made with other assemblages already described from Newcastle.

The animal remains from Closegate will be stored in the Museum of the Society of Antiquaries, Newcastle University.

METHODS

All bone had been recovered by wet-sieving (mesh aperture 5 mm). In addition to the 5 mm sieve, a small volume of 'whole earth' (30 litres) was sieved through a Siraf tank with a 1 mm aperture (Fraser pers. comm.).

For a full description of the methods used see Davis (AML reports in prep). In brief, all mandibular teeth and a restricted suite of "regions of identification" (i.e. articular ends/epiphyses and metaphyses) of girdle, limb and foot bones (listed in tables 2 - 4) were recorded and used in counts. In order to avoid multiple counting of very fragmented regions, at

least 50% of a "region" had to be present for it to be counted. (Broken, and therefore single, metapodial condyles of caprines and cattle were counted as halves, and each of the two central pig metapodials were counted as halves.) An epiphysis is described as "fused" once spicules of bone have formed across the epiphysial plate joining metaphysis to epiphysis.

Sheep/goat teeth were assigned to the eruption and wear stages of Payne (1987), pig and cattle teeth were assigned to the eruption and wear stages of Grant (1982). Measurements taken on the cattle metapodials are illustrated in figure 1. In general, other measurements taken follow those suggested by von den Driesch (1976). Metric separation of sheep and goat metacarpals (Payne, 1969) was used to check morphological distinctions.

RESULTS and DISCUSSION (Table 1 gives a summary list of species).
Condition and recovery. Some bones are abraded (a few were probably water-rolled) and poorly preserved, while others in deeper and probably waterlogged deposits are very well preserved. A list of contexts containing water-rolled bones, badly abraded bones and beach-rolled shells is given in appendix 1.

Despite sieving, some smaller elements such as sheep carpals, incisors, premolars and phalanges are conspicuously rare (tables 2 - 4). Some of these as well as other small bones, could have been lost through the 5 mm sieve, and if retained, may simply have been missed by excavation staff charged with sorting. It is worth noting that the sheep/goat bones and teeth recovered in the Siraf tank include some of these scarce elements such as 3 incisors, 2 premolars, 2 phalanges, 1 molar, 1 metapodial condyle, (and even a malleus). Species retrieved in the Siraf tank are recorded in table 5. With such a small volume put through this operation and not knowing the total volume of earth excavated at Closegate it is impossible to estimate the original proportion of smaller skeletal elements and smaller species such as mice and small birds.

Species present and their frequencies (table 1). Most of the 1353 recorded mammal and bird remains from the 5 mm sieve collection (tables 1 - 4) belonged to sheep, cattle and pig. Of the 776 sheep/goat bones and teeth, 182.5 were identified as sheep and only 2 as goat (both from 13th-14th century contexts), suggesting that the overwhelming majority of the caprines consumed in Newcastle were sheep (see also fig 2). Of the 4 cervid bones found, one is definitely roe deer, one is definitely fallow deer, and one is probably red deer. Several equid bones and teeth are probably horse - the 17th-18th century lower molar has a "U" shaped lingual sulcus.

Rabbit bones could be distinguished from those of hare on the basis of their small size, and bones of mountain and brown hare were distinguished using specimens of these two species in the AM Lab comparative collection and criteria to be described by Paz Martinez (forthcoming).

Other vertebrate species found are listed in tables 1 - 5. Mollusc shells and crab claws are listed in table 6.

Many of the galliform bones probably belonged to either chicken or pheasant; bones of these two species being difficult to distinguish. However two exceptions are a) the proximal femur - in pheasant this bone has an air-sac foramen which is absent in chicken, and b) the tarso-metatarsus - in pheasant

this bone has a continuous posterior keel, while in chicken the keel is discontinuous. None of the 9 proximal chicken/pheasant femora found at Closegate* had air-sac foramina, and 4 chicken/pheasant tarsometatarsi had discontinuous posterior keels. It is quite likely then, that all the galliform bones belonged to chickens.

Remains of some game species were also present in small quantities. Of the sea shells (table 6) found, the large numbers of periwinkles, oysters and cockles undoubtedly represent food waste. Some of the other less common species (some appear beach-rolled) may have come from beach sand/gravel used as landfill deposit.

In terms of numbers of bones, sheep far outnumber cattle, but given the larger size of a cow, beef rather than mutton was probably more important in the diet of the people whose garbage was deposited at Closegate. Comparison of the assemblages from the three main periods (table 1) does reveal a trend with time: sheep increase slightly in relation to cattle.

Comparison of the species frequencies from Closegate with those from other sites of the same and different periods in Newcastle is difficult since most bone assemblages reported in the literature had been hand-collected, hence sheep/goat and other smaller species are under-represented. Nonetheless the results from excavations at Crown Court (Gidney, 1989), Castle Ditch (Rackham, 1981), Blackfriars (Rackham, 1987), Queen Street (Rackham, 1988) and Bastion (Rackham, 1983) when considered in chronological order (table 7) do show the same trend that we can observe for the Closegate sequence: a trend towards more sheep, particularly between the 13th and 15th centuries. The relatively lower sheep counts at Queen Street is difficult to explain but probably reflects poor recovery.

A similar increase of sheep remains has been observed elsewhere. For example in 12th century Lincoln, O'Connor (1982) correlates a fall in the percentage of cattle bones with the gradual change from the use of oxen to horses for ploughing. By this time the rigid breast harness which enabled horses to be used for ploughing had reached England from the continent (Lefebvre des Noettes, 1931:122). In addition, the increase of sheep coming into towns may well reflect the growth of the wool industry. At Closegate the tooth-wear data (see below) show that a substantial proportion of the sheep belonged to the older age groups (circa 4-6 years) which had undoubtedly been shorn of several fleeces (and ewes may have been milked too) prior to slaughter.

The small number of equid remains is worth noting and contrasts with animal-bone assemblages from contemporary rural sites such as at Raunds in Northamptonshire (Davis, in prep..).

A large number of fish bones have been identified by Andrea Bullock of the University of Southampton (table 8). The use of the 1 mm mesh for sieving has enlarged the spectrum of species found at Closegate and greatly increased the recovery of herring bones. These 1 mm sieved samples derived from "30 litre whole earth samples" (Fraser, pers. comm.). Comparison of the weight

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* these were recorded in my notes but not in tables 2 - 4 since the proximal end of the femur is not one of the "counted elements".

of large mammal bones recovered by this means with the weight of fish bones (table 9a), gives some indication of the probable actual ratio of mammal:fish, and suggests that fish were an important part of the diet - certainly much more important than is suggested by the 5 mm sieved sample alone. However, the ratio 'skeleton weight' to 'body weight' increases with animal size - a 10 fold body weight increase results in approximately a 13 fold increase in skeleton weight (Anderson, et al. 1979). Therefore the importance of fish in the diet of the inhabitants of Closegate was probably even greater than table 9 indicates. Most of the fish-bones retrieved in the 1 mm sieve at CGI derive from 15-16th century deposits, while those from CGII derive mainly from 13-14th century deposits. Comparison of these two sets of data (table 9b; but discounting the possibility of spatial variation) suggests that fish may have been more important in the earlier phases, perhaps contributing at least 10-20% of the total meat eaten.

Body part frequency (table 10, figure 3). Examination of the relative abundance of different parts of the skeleton shows that, allowing for differential preservation and recovery, most parts of the skeleton including teeth are well represented. These body-part frequencies are not typical of either primary/butchery waste (with an abundance of limb extremities such as phalanges and metapodials) or kitchen/domestic refuse (with a predominance of meat-bearing elements such as scapulae, humeri, pelves, femora and tibiae). The general impression gained is that either the animal bones from Closegate are derived from both butcher's and household waste, or quite simply that whole animal carcasses - feet included - were brought into town and hence all parts of the skeleton were discarded at Closegate. An unusually high frequency of sheep/goat distal humeri in the 15th-16th centuries is difficult to explain.

The body-parts found in the majority of individual contexts seem to reflect the overall body-part frequencies at Closegate. One exception is a large collection of bones from context 201 of CG88 (phase 5, 15th-16th century). It includes only one sheep scapula and one humerus but 15 metacarpals and 9 metatarsals of sheep. Sheep feet have little flesh attached to them but may be sold to the poor (as I have observed in Persia today) or for a special dish. A possible interpretation of context 201 then is that it derives from a poor household. The presence of only one phalanx, however, is enigmatic: either phalanges were not recovered or they were left attached to the sheepskins at the abattoir. Metapodials are much favoured for the manufacture of bone handles and other bone tools. Other interpretations of the content of context 201 are that it is simply waste derived from a butcher's stall, or an accumulation of raw material for the manufacture of bone-tools.

Many of the meat-bearing bones exhibited cut marks and many of the cattle bones had been extensively chopped. Such marks are, of course what one might expect on bones from domestic and butchery refuse. A section of a cow tibia shaft (7.4 mm thick; CGI, context 243, 15th-16th century) had been sawn to form a bone ring. There is no evidence, however, that it was used or worn. In Britain horse bones from archaeological sites do not often exhibit any signs of butchery which accords with the special status that this animal enjoys here. Hence the find at CG88 (context 249, 13th-14th century) of an equid pelvis bearing chop- marks is of some interest. One interpretation of this find is that it derives from a workshop for processing horse carcasses, such as a glue works. Another is that the horse carcass was dismembered for burial.

A consideration of the bone assemblage both in terms of the abundance of low meat-bearing bones and the scarcity of such animals as deer indicates that the bones are derived from the dwellings of the lower classes. This interpretation is at variance with the written records which indicate that the area contained the houses of many of the town's most notable inhabitants. Were the Closegate landfill deposits composed of municipal garbage originating from poorer neighbourhoods, or did the rich have a 'poor' diet most of the time? Perhaps the animals remains from Closegate derive from the servants quarters too.

Measurements (see appendix 2). The 13th - 16th century sheep bones at Closegate are rather small, and similar in size to the modern "primitive" breed, the Soay. This accords with Armitage's (1983) survey of sheep remains in England. He states that measurements of sheep bones from Mediaeval and Tudor archaeological sites reveal that sheep were only slightly larger in stature and build than the modern Soay.

A comparison of sheep measurements from the three main periods at Closegate shows an interesting change (see figure 4). While there is little evidence for any size difference between the 13th-14th centuries and the 15th-16th centuries, sheep bones from the 17th-18th centuries are somewhat larger. A size increase is most noticeable for four complete metapodials (all come from different contexts, and so are less likely to be from the same animal) which are considerably longer than metapodials from the earlier periods. The data for distal tibia breadth also show a marked size increase. The evidence, however, for other bones such as distal humerus and astragalus is little better than suggestive.

Some of the large 17th-18th century sheep bones can be dated more precisely. The large metacarpal from context 237 (CG90) is "mid - late 17th century", the other large metacarpal from context 13 (CG90) is "late 17th - early 18th century". And five of the six large sheep tibiae (those from contexts 131, 137, 138 and 156 at CG90) can be dated with some precision on the basis of documentary and archaeological information to the period 1683 - 1692 (Fraser, pers. comm.).

Measurements of sheep bones from two other contemporary post-Mediaeval archaeological sites have also provided evidence for a size increase. They are Aldgate in the City of London (Armitage, 1984), and St. Frideswide's Priory in Oxford (Stallibrass, 1988). At Aldgate several very long (and slender) sheep metatarsals ranging in length from 150 - 180 mm (even longer than those from Closegate) were found in late 17th to early 18th century contexts. At St. Frideswide's large sheep/goat bones were found in 17th century contexts and "massive cattle bones" were found even in 16th, as well as 17th, century contexts.

One possible explanation for the increased metapodial length of the 17th-18th century sheep is that this was due to castration. Castration is known to result in delayed epiphysial closure (Hatting, 1983) hence permitting continued elongation of the long-bones. However we do not know whether castration results in an increase in the width dimension of bones as well. If it does not, then the increases of both length and width (especially the tibia) suggests a real (i.e. genetic) size difference between sheep of 15th-16th and 17th-18th centuries in the Newcastle area.

According to documentary evidence (Armitage, 1983 quotes Daniel Defoe's 1724 *A tour through the whole island of Great Britain*) the largest sheep in 18th century England were the Lincolnshire and Leicestershire longwools. Sheep in other parts of the country were noticeably smaller, and graziers from these two counties would furnish London with their "large mutton in so incredible a quantity" which Armitage (1984) quoted as an explanation for the appearance of large sheep in London. But with a contemporary increase of sheep size in both the north of England and in London and Oxford, widescale transportation of different breeds around the country seems unlikely in view of the distances involved. The more probable explanation, as Stallibrass (1988) has suggested, is that the late 17th - early 18th century marks the beginnings of sheep-breed improvement, and that history does not record the early stage of this part of the Agricultural Revolution. This would seem to corroborate Kerridge's (1967) suggestion that the Agricultural Revolution took place in England earlier than the history books would have us believe. More data will be needed to substantiate this hypothesis, which is the one I favour.

Bones of cattle (and of other species) from Closegate are too few to enable a study of their size variation. The five cattle astragali from 17th-18th century contexts do not however indicate any change compared with eight astragali from the 15th-16th centuries.

The chicken bones are small and little different from present-day bantams.

Ageing (For very approximate translations of toothwear stage in sheep to actual age in years I refer to Deniz and Payne (1982) for female Angora goats from the Anatolian plateau). The counts of deciduous and permanent teeth of sheep and their assignment to wear stage (table 11) suggest that a fairly restricted range of ages was selected for slaughter. For example in the 15th-16th centuries the ratio 14:18 for dP_4:P_4 suggests that almost half the sheep brought into Newcastle were aged under 2 years (the approximate age when dP_4 is shed and P_4 erupt). However, the real proportion of juveniles was probably lower since isolated P_4s are less likely to be recovered than isolated dp_4s. A guess might be 30% lambs, given the numbers of molars. The majority of the dP_4s are in wear stages 10 - 13 which probably belonged to lambs aged 2-5 months. (The absence of M_1s in wear stages 0 - 5 is puzzling, and may be due to poor preservation.) The peaks of M_1s in wear stage 9 (1 - 3 years), M_2s in wear stage 9 (2.5 - c.7 years) and M_3s in wear stage 11 (3.5 - c.9 years) suggests that many of the adult sheep were slaughtered around the age of 2 - 5 years and indicates that Newcastle was being supplied with both lamb and prime-mutton animals from which one or several fleeces would have been shorn.

The cattle tooth-wear data for the 15th-16th centuries (table 12) show a scarcity of dP_4s in early wear stages. This suggests little veal was imported into Newcastle, which in turn may mean that cattle were not kept primarily for dairy products in the Newcastle area at that time. Cattle were probably kept as multi-purpose beasts and occasionally slaughtered for meat.

The pig tooth-wear data (table 13) show that most of the pigs were slaughtered fairly young - from a few weeks to around three years - hardly surprising for an animal usually only reared for its meat and fat.

Environmental considerations. The finds of black rat presumably reflect fairly squalid and warm conditions prevailing in the buildings at Closegate. The amphibian bones may evidence the presence of semi-permanent bodies of water in the vicinity. So too the finds of *Apodemus* sp. (woodmouse/yellow-necked mouse) and bank and field voles probably all signify the closeness of rough grass and bushes.

Pathology. Few bones exhibited signs of disease or injury. Of the cattle incisors, however, 2 in 13th-14th century deposits, 2 in 15th-16th century deposits and 4 in 17th-18th century deposits exhibited small "v" shaped notches on the lateral sides at the base of their crowns. This abnormal pattern of wear is said to be due to long grass, perhaps associated with abrasive soil, being drawn between the teeth in grazing (Miles and Grigson, 1990:494-5). No cases were observed of cattle M_3s with reduced or absent third pillars (the hypoconulid). The distal part of a cattle metatarsal from context 248 (CG88, 15th-16th century) exhibits asymmetry due to the laterad extension of the medial condyle. This phenomenon may be age and/or stress (?traction) related. In this instance, stress may be the correct suggestion as there is a small eburnated patch on the distal end of the medial trochlea.

CONCLUSIONS and SUMMARY

While a wide range of sources of animal protein was exploited, beef, mutton, and in earlier phases fish were undoubtedly the most common meats consumed by the people of Newcastle during the 13th-18th centuries. Mutton assumed greater importance with time - possibly an indirect result of the growing importance of wool and the increased use of horses as work animals. Some pork, rabbit, hare, chicken, goose and shellfish (mainly oysters and winkles) were also eaten. The amount of wild game such as deer was very small indeed which probably reflects the low status of the households from which the Closegate rubbish derived. This is at variance with the documentary records concerning the high status of the inhabitants of the Close.

The sheep bones from Closegate increased in size towards the end of the 17th century. A contemporary size-increase of this animal has also been found in London and Oxford. This is some 100 years before the time when, according to historical sources, farmers began to apply modern methods to the breeding of livestock - an endeavour associated with the Agricultural Revolution. This Revolution may, then, have commenced somewhat earlier than the history books would have us believe.

ACKNOWLEDGEMENTS

I am grateful to Richard Fraser of the Newcastle City Archaeology Unit for inviting me to study the Closegate bones, to Sebastian Payne, Sue Stallibrass, and Caroline Grigson who offered much useful advice and criticised an earlier version of the typescript, to Miguel Angel Martinez Paz for helping to identify the leporid bones, to Andrea Bullock who identified the fish remains, to Terry O'Connor who identified some of the bird bones, and to Barbara Noddle for drawing my attention to the work of Kerridge.

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Table 1

Summary of mammal and bird remains from Closegate I and II (5 mm sieve).

	Century:	13-14		15-16		17-18	
		n	%	n	%	n	%
Horse		2	2	7	1	1	1
Pig		13	10	65.5	7	8	5
Red deer		?1		-		-	
Red/Fallow deer		-		-		1	
Fallow deer		-		1		-	
Roe deer		1		-		-	
Cattle		39	31	298.5	30	44	25
Sheep/Goat		71	56	584.5	60	120.5	68
(Sheep)		(8)		(156.5)		(19)	
(Goat)		(2)		(-)		(-)	
Hare		1B		1+2B+1?		1?M	
Rabbit		2		3		4	
Subtotal:		130		964.5		179.5	
Fox		-		1		-	
Dog		2		24		3	
Cat		2		4		2	
Rat		-		2		5	
Thrush		1		-		-	
Jackdaw		2		-		-	
Corvid		1		-		-	
Teal		-		-		?1	
Duck		?2		-		1	
Goose		?1		7		-	
Chicken		2		2		-	
Galliform		6		20+?1		2	
Woodcock		1		-		?1	
Total		150		1025.5		194.5	

Key:
B = Brown hare
M = Mountain hare
Galliform = probable chicken or pheasant

Tables 2 to 4.

Counts of mammal bones and teeth from Closegate I and II (5 mm sieve). A mandible fragment with one or more teeth is counted as a mandible. Counts for loose teeth and for teeth in mandibles are given separately, the count for teeth in mandibles being in parentheses.

Note:

"Horse Incisors" includes both upper and lower teeth.

Some sheep and goat teeth and bones could be identified to species. For example SHEEP/GOAT distal metacarpals "59Sh+5" refers to the presence of 59 metacarpals which could be identified as definitely sheep and 5 which are either sheep or goat, and SHEEP/GOAT dp_4 "1G(2Sh)" refers to a single isolated goat dp_4 and two sheep dp_4s in mandibles.

Key:

Rat - *Rattus rattus* or *R. norvegicus*, the black or brown rat.

B Rat - *Rattus rattus*, the black rat.

Dama/Cerv - fallow or red deer.

F deer - fallow deer.

Mnt hare - *Lepus timidus*, the mountain hare.

Brn hare - *Lepus europaeus*, the brown hare.

F - epiphysis fused (adult).

U - epiphysis unfused (juvenile).

17th - 18th Centuries	SHEEP/GOAT	CATTLE	PIG	HORSE	DOG	OTHERS
Mandible	7 (1Sh)	2	-	-	-	Rabbit (I, P_3-M_2) Rat (M_1-M_3)
Mandibular tooth: i	- (-)	- (-)	- (-)	- (-)	-	
" " I	2 (-)	8 (-)	1 (-)	- (-)	- (-)	
" " dp_2	- (-)	- (-)	- (-)	- (-)	-	
" " dp_3	- (1Sh)	- (2)	- (-)	- (-)	-	
" " dp_4	1Sh (1Sh)	- (2)	- (-)	- (-)	-	
" " P_1			- (-)		- (-)	
" " P_2	- (1)	- (-)	- (-)	- (-)	- (-)	
" " P_3	1 (3)	2 (-)	- (-)	- (-)	- (-)	
" " $P_{3/4}$				-		
" " P_4	2 (4)	1 (-)	- (-)	- (-)	- (-)	
" " M_1	- (6)	- (1)	- (-)	- (-)	- (-)	
" " M_2	- (5)	- (-)	- (-)	- (-)	- (-)	
" " M_3	8 (5)	4 (-)	- (-)	- (-)	- (-)	
" " $M_{1/2}$	17 (-)	-	-	1		
" " C			- (-)	- (-)	- (-)	
Scapula - Coracoid U	-	1	-	-	-	
" " F	4	-	-	-	-	Rabbit:1
" " ?	3	-	1	-	-	
Humerus - dist metaph U	2	1	-	-	-	
" dist epiph U	-	-	-	-	-	
" dist F	7	1	-	-	1	?Mnt hare:1 Rat:2
Radius - dist metaph U	3	1	1	-	-	Rabbit:1 Rat:1
" dist epiph U	-	-	-	-	-	
" dist F	2	-	-	-	1	
Radiale	1	-	-	-	-	
C2+3	-	-	-	-	-	
Metacarpal - dist metaph U	2	1	1	-	-	
" dist epiph U	-	-	-	-	-	
" dist F	6Sh+1	-	-	-	-	Cat:1
Ischium	7	-	1	-	-	Rabbit:1 Rat:1
Femur - dist metaph U	2	-	-	-	-	
" dist epiph U	1	2	-	-	-	
" dist F	1	-	-	-	-	
Tibia - dist metaph U	1	1	2	-	-	
" dist epiph U	-	-	-	-	-	
" dist F	7	-	-	-	-	Dama/Cerv:1
Astragalus	4Sh+2	5	-	-	-	
Calcaneum - tuber calcis U	2	2	1	-	-	
" tuber calcis F	7	1	-	-	-	
" tuber calcis ?	-	1	-	-	-	
Metatarsal - dist metaph U	1.5	1	-	-	-	
" dist epiph U	-	-	-	-	-	
" dist F	3Sh+.5	1	-	-	-	Cat:1
Metapodial - dist metaph U	1	-	-	-	-	
" dist epiph U	.5	1	-	-	-	
" dist F	-	-	-	-	-	
Phalanx 1 - prox metaph U	3	-	-	-	-	
" prox epiph U	-	-	-	-	-	
" prox F	6	4	-	-	1	
Phalanx 3	2Sh	3	-	-	-	
TOTALS	120.5	44	8	1	3	

TABLE 2

15th - 16th Centuries	SHEEP/GOAT	CATTLE	PIG	HORSE	DOG	OTHERS
Mandible	30 (4Sh)	14	11	-	2	Rabbit (I-P_4)
Mandibular tooth: i	- (-)	- (-)	2 (-)	- (-)	-	
" " I	11 (-)	36 (-)	9 (-)	3 (-)	1 (-)	
" " dp_2	- (1)	- (-)	2 (1)	- (-)	-	
" " dp_3	1Sh (4Sh+1)	- (-)	2 (-)	- (-)	-	
" " dp_4	10Sh+1 (2Sh+1)	5 (1)	2 (3)	- (-)	-	
" " P_1			- (-)		- (-)	
" " P_2	- (-)	3 (2)	- (-)	- (-)	- (1)	
" " P_3	1 (8)	15 (4)	1 (-)	- (-)	- (2)	
" " $P_{3/4}$				-		
" " P_4	6 (12)	15 (5)	2 (-)	- (-)	- (2)	
" " M_1	- (14)	- (7)	- (2)	- (-)	1 (2)	
" " M_2	- (18)	- (5)	- (4)	- (-)	- (-)	
" " M_3	29 (13)	14 (4)	2 (4)	- (-)	- (-)	
" " $M_{1/2}$	42 (-)	28 (1)	3 (1)	1		
" " C			4 (-)	1 (-)	1 (-)	
Scapula - Coracoid U	2	-	3	-	-	
" " F	11	8	3	-	-	
" " ?	4	1	-	-	-	
Humerus - dist metaph U	9	-	1	-	-	
" dist epiph U	4	-	-	-	-	
" dist F	53	9	-	-	2	Cat:2
Radius - dist metaph U	7	1	1	-	-	
" dist epiph U	3	3	-	-	-	
" dist F	9	3	-	-	-	
Radiale	1	3	-	1	-	
C2+3	-	6	-	-	-	
Metacarpal - dist metaph U	13	2	1	-	-	
" dist epiph U	4.5Sh+.5	1	-	-	-	
" dist F	57Sh+3.5	7	-	-	1	Cat:1
Ischium	21	8	-	-	2	Rabbit:1 Hare:1
Femur - dist metaph U	3	-	2	-	-	B Rat:1
" dist epiph U	2	4	-	-	-	B Rat:1
" dist F	5	3	-	-	1	
Tibia - dist metaph U	5	-	1	-	-	
" dist epiph U	1	-	2	-	-	
" dist F	21	4	-	-	4	Brn hare:2 F deer:1
Astragalus	17Sh+1	18	3	-	-	
Calcaneum - tuber calcis U	6	3	-	-	-	
" tuber calcis F	10	7	-	-	-	
" tuber calcis ?	1	3	1	1	-	
Metatarsal - dist metaph U	15	6	-	-	-	
" dist epiph U	-	1	-	-	-	
" dist F	44Sh	12	.5	-	1	Cat:1 Rabbit:1 Fox:1
Metapodial - dist metaph U	2	1	-	-	-	
" dist epiph U	8	1.5	.5	-	-	
" dist F	5	3	.5	-	4	
Phalanx 1 - prox metaph U	7	-	2	-	-	
" prox epiph U	-	-	2	-	-	
" prox F	84	31	1	-	4	?Brn Hare:1
Phalanx 3	13Sh+1	19	1	-	-	
TOTALS	584.5	298.5	65.5	7	24	

Table 3

13th - 14th Centuries	SHEEP/GOAT	CATTLE	PIG	HORSE	DOG	OTHERS
Mandible	10 (2Sh)	3	2	-	-	
Mandibular tooth: i	- (-)	- (-)	- (-)	- (-)	-	
" " I	2 (-)	4 (-)	1 (-)	- (-)	- (-)	
" " dp_2	- (1)	- (1)	- (-)	- (-)	-	
" " dp_3	- (1Sh)	- (1)	- (-)	- (-)	-	
" " dp_4	1G (2Sh)	- (-)	- (-)	- (-)	-	
" " P_1			- (-)		- (-)	
" " P_2	- (1)	- (-)	- (-)	- (-)	- (-)	
" " P_3	- (4)	- (-)	1 (-)	- (-)	- (-)	
" " $P_{3/4}$				-		
" " P_4	- (5)	- (-)	- (2)	- (-)	- (-)	
" " M_1	- (8)	- (-)	- (1)	- (-)	- (-)	
" " M_2	- (7)	- (-)	- (1)	- (-)	- (-)	
" " M_3	1 (6)	- (2)	- (1)	- (-)	- (-)	
" " $M_{1/2}$	5 (-)	2	-	-		
" " C			1 (-)	- (-)	- (-)	
Scapula-Coracoid U	-	-	-	-	-	
" " F	3	1	-	-	-	Rabbit:1
" " ?	1	1	-	-	-	
Humerus - dist metaph U	-	-	-	-	-	
" dist epiph U	-	-	-	-	-	
" dist F	11	1	-	-	1	
Radius - dist metaph U	4	-	-	-	-	
" dist epiph U	1	-	-	-	-	
" dist F	5	1	-	-	-	
Radiale	-	1	-	-	-	
C2+3	-	-	-	-	-	
Metacarpal dist metaph U	1	2	1	-	-	
" dist epiph U	2Sh+1G	-	-	-	-	
" dist F	-	5	-	-	-	Cat:1
Ischium	7	3	-	1	-	Rabbit:1 Cat:1
Femur dist metaph U	1	1	2	-	-	
" dist epiph U	1	1	-	-	-	
" dist F	1	-	-	-	-	
Tibia dist metaph U	-	-	1	-	-	
" dist epiph U	-	-	-	-	-	
" dist F	3	-	1	-	-	Brn hare:1
Astragalus	1	-	1	-	-	
Calcaneum - tuber calcis U	1	-	-	-	-	
" tuber calcis F	-	1	-	1	-	
" tuber calcis ?	-	2	-	-	-	
Metatarsal - dist metaph U	-	-	1	-	-	
" dist epiph U	-	-	-	-	-	
" dist F	1Sh	2	1	-	-	
Metapodial - dist metaph U	-	-	-	-	-	
" dist epiph U	-	-	-	-	-	
" dist F	-	-	-	-	-	
Phalanx 1 - prox metaph U	2	-	-	-	-	
" prox epiph U	-	-	-	-	-	
" prox F	5	3	-	-	1	Roe deer:1
Phalanx 3	-	5	-	-	-	?Red deer:1
TOTALS	71	39	13	2	2	

TABLE 4

Table 5.

Vertebrate (excluding fish) remains recovered from the Siraf tank (1 mm aperture sieve) at Closegate. The parts of the skeleton which have been counted are those recorded in tables 1 to 3. Cases in which the presence of a species could be ascertained by some other element (e.g. the *Apodemus* identified by a maxilla with M^1) are recorded by a "+". NB. Mouse refers to house mouse or wood/yellow-necked mouse.

Closegate I	Century: 13-14	15-16	17-18
Amphibian (?frog)	-	8	-
Small passerine bird (cf robin)	-	1	-
Sparrowhawk	-	1	-
cf Galliform	-	-	1
cf Thrush	1	-	-
Red squirrel	1	-	-
Bank vole	-	1	-
Field vole	-	1	-
Apodemus sp.	-	+	-
?Mouse	-	3	1
House mouse	-	1	-
Rat	-	1	-
Rabbit	-	1	-
Cat	-	2	-
Dog/fox	-	2	-
Pig	-	1	-
Sheep/goat	-	14	-
Sheep	-	1	-
Cattle	-	1	-

Closegate II	Century: 13-14	15-16
Rabbit	-	1
Pig	1	-
Sheep/goat	1	1
Sheep	1	2
Cattle	1	0.5

Table 6. Numbers of gastropods, valves (for bivalves), and crab claws found at Closegate I and II, retrieved in the 5 mm sieve.

Century:	13-14th	15-16th	17-18th
Periwinkle *Littorina littorea*	-	134	4
Flat winkle *Littorina littoralis*	-	4	-
Limpet *Patella* sp.	3	6	1
Whelk *Buccinum undatum*	-	1	1
Dogwhelk *Nucella lapillus*	-	-	1
Oyster *Ostrea* sp.	41	267	66
Common cockle *Cerastoderma* sp.	1	15	4
Mussel *Mytilus edulis*	8	7	-
cf Trough shell *Mactra* sp.	-	1	-
Crab claws	-	-	2

Table 7.

A comparison of the relative frequencies of sheep/goat, cattle and pig at Closegate I and II (CG) with those of other sites in Newcastle.

Data come from the following sources: Gidney, 1989 (Crown Court); Rackham, 1981 (Castle Ditch); Rackham, 1983 (Bastion); Rackham, 1987 (Blackfriars); Rackham, 1988 (Queen Street).

Site:	--- Queen St ---		Crown Court	CG	Queen St	CG	Castle Ditch	Bastion	Black-friars	Queen St	CG
Century:	early-mid 13	late 13	13-14	13-14	mid 14 -15	15-16	15-16	16	16-18	?17/18	17-18
Phase:	1-3	4			5					6	
Sheep/Goat	28	28	30	56	33	60	60	64	72	41	68
Cattle	56	59	60	31	54	30	34	30	24	49	25
Pig	17	13	9	10	13	7	6	6	5	10	5
(n)	(145)	(670)	(1414)	(127)	(1694)	(979.5)	(1042)	(1482)	(1445)	(296)	(176.5)

Table 8. Closegate Fish remains, identified by Andrea Bullock.

		-- 5 millimetre mesh --			---------- 1 millimetre mesh ----------				
		CGI+II 13-14th	CGI 15-16th	CGI 17-18th	CGI 13-14th	CGI 15-16th	CGI 17-18th	CGII 13-14th	CGII 15-16th
Scyliorhinus	dogfish etc	1							
Galeorhinus	tope					1			
Rajidae	skates and rays	3	8		2	18	3	10	1
Anguilla anguilla	eel					21	1	10	
Conger conger	conger	2							
Clupeidae	herrings					1		6	
Clupea harengus	herring	2			52	116	9	102	1
Salmonidae	salmon family		2	1		2			
Gadidae	cod fishes	25	17	2	30	307	10	161	12
Gadus morhua	cod	20	2		2	1		1	
Melanogrammus aeglefinus	haddock	24	60	2	22	120	5	32	3
Merlangius merlangus	whiting					8			
Pollachius virens	saithe				11	11			
Molva molva	ling	7				2		1	
Merluccius merluccius	hake	2							
Sebastes viviparus	Norway haddock				1				
Triglidae	gurnards	2				2		4	
Serranidae	sea perches				1				
Trachurus trachurus	scad	1							
Ammodytidae	sandeels					10			
Bothidae	scaldfishes					2			
Pleuronectidae	right-eyed flatfishes	4			8	12		21	
Pleuronectes platessa	plaice	1				1			
Limanda limanda	dab					3			
Undetermined		58	5	1	79	486	19	781	42

Table 9a.

Closegate, sieve size and the relative importance of fish. Weights in grams of mammal and fish bone retrieved by use of a 5 mm sieve and a 1 mm sieve. The use of a 1 mm sieve increases the proportion of fish:mammal (NB all sieved samples were 'whole earth samples'.)

Closegate I

Mesh aperture	Mammal g	%	Fish g	%
5 mm	60915	99.97%	18	0.03%
1 mm	589	92.2%	50	7.8%

Closegate II

Mesh aperture	Mammal g	%	Fish g	%
5 mm	19548	99.63%	72	0.37%
1 mm	370	86.9%	48	13.1%

Table 9b.

Closegate, the relative importance of fish through time. Weights in grams of mammal and fish bone retrieved in the 1 mm sieved samples in each phase at Closegate I and Closegate II. Phases with less than 10 g of bones have been left out.

Closegate I

Century	Phase	Weight of mammal bone	Weight of fish bone	% fish by weight
17th-18th	6	13.5	0.2	1.5
15th-16th	5	489.0	18.4	3.6
15th-16th	4	28.9	2.3	7.4
15th-16th	3	29.9	7.9	20.9
13th-14th	2	16.1	6.0	27.1
13th-14th	1	5.4	6.6	55.0

Closegate II

Century	Phase	Weight of mammal bone	Weight of fish bone	% fish by weight
15th-16th	6	93.4	1.3	1.4
13th-14th	5.1	204.7	19.7	8.8
13th-14th	4	35.1	1.6	4.4
13th-14th	2	19.7	16.8	46.0

Table 10

Body-part frequencies. Counts of the different parts of the skeleton of Sheep/Goat and Cattle in the 15th-16th century and Sheep/Goat in the 17th-18th century at Closegate I and II. Data are from tables 1-3. The **MN** columns provide an approximate guide to the relative occurrences of different elements taking into account their anatomical frequency i.e. 2 "Humeri", 8 "i+I", 6 "Molars", 2 "Radii", 8 "Phalanx 1" etc. (These MN numbers would therefore be equal if whole carcasses had originally been buried and if recovery and preservational biases had had an equal effect on all parts of the skeleton.) Fractions have been rounded up. For example 16 radii must have come from at least 8 (=16/2) individuals, 59 molar teeth must have come from at least 10 (=59/6) individuals, and 19 third phalanges must have come from at least 3 (=19/8) individuals. Distal metapodials whose anatomical identity (metacarpal or metatarsal) could not be ascertained have been divided equally between the counts for distal metacarpals and distal metatarsals.

	Sh/G 15-16 cent		Sh/G 17-18 cent		Cattle 15-16 cent	
		MN		**MN**		**MN**
Mandible	30	15	7	4	14	7
i+I	11	2	2	1	36	4
dp+P	48	8	14	3	50	9
Molars	116	20	41	7	59	10
Scapula	17	9	7	4	9	5
Humerus - dist	62	31	9	5	9	5
Radius - dist	16	8	5	3	6	3
Radiale	1	1	1	1	3	2
C2+3	0	0	0	0	6	3
Metacarpal - dist	74+7	41	9+1	5	9+3	6
Ischium	21	11	7	4	8	4
Femur - dist	8	4	3	2	7	4
Tibia - dist	26	13	8	4	4	2
Astragalus	18	9	6	3	18	9
Calcaneum	17	9	9	5	13	7
Metatarsal - dist	59+7	33	6+1	4	18+3	11
Phalanx 1 - prox	91	12	9	2	31	4
Phalanx 3	14	2	2	1	19	3

Table 11.

Closegate I and II cattle mandibular teeth wear stages (Grant, 1982)

Grant Wear Stage:	a	b	c	d	e	e/f	f	f/g	g	g/h	h	i	j	j/k	k	k/l	l	m	n	o	p	?
17th - 18th centuries																						
dP_4		2																				
P_4									1													
M_1																						1
$M_{1/2}$																						
M_2																						
M_3									1				2		1							
15th - 16th centuries																						
dP_4				1										1	1		1	1	1			
P_4	1		2		4	1	2		8		2											
M_1															5		1	1				
$M_{1/2}$		1		1			2		2		2				12		6	1		1		1
M_2															5							
M_3	1		1			1		1	3				1		5	1	1	1				2
13th - 14th centuries																						
dP_4																						
P_4																						
M_1																						
$M_{1/2}$									1													1
M_2																						
M_3											1											1

Grant Wear Stage:	a	b	c	d	e	e/f	f	f/g	g	g/h	h	i	j	j/k	k	k/l	l	m	n	o	p	?

Table 12.

Closegate I and II sheep/goat mandibular teeth wear stages (Payne, 1987)

Payne Wear Stage:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	?
17th - 18th centuries																									
dP_4													2												
P_4	1					1		2		2															
M_1	1									5															
$M_{1/2}$								1	1	11															4
M_2								2		3															
M_3	1		2		1			1	1	3	1	1													2
15th - 16th centuries																									
dP_4											1	1	2	9											1
P_4	1					2	1	3	3	1		1	3		2										1
M_1										11			1		1	1									1
$M_{1/2}$	4					1		7	4	20						1									5
M_2	1							2		14			1												
M_3	1		6	1	1	1	1	4	2	3	6	12													4
13th - 14th centuries																									
dP_4										1G				1										1	
P_4								2		1		1													1
M_1			1							5		1													1
$M_{1/2}$								1	1	2															1
M_2								2	1	4															
M_3		1	1				1		1		1	2													
Payne Wear Stage:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	?

Table 13.

Closegate I and II pig mandibular teeth wear stages (Grant, 1982)

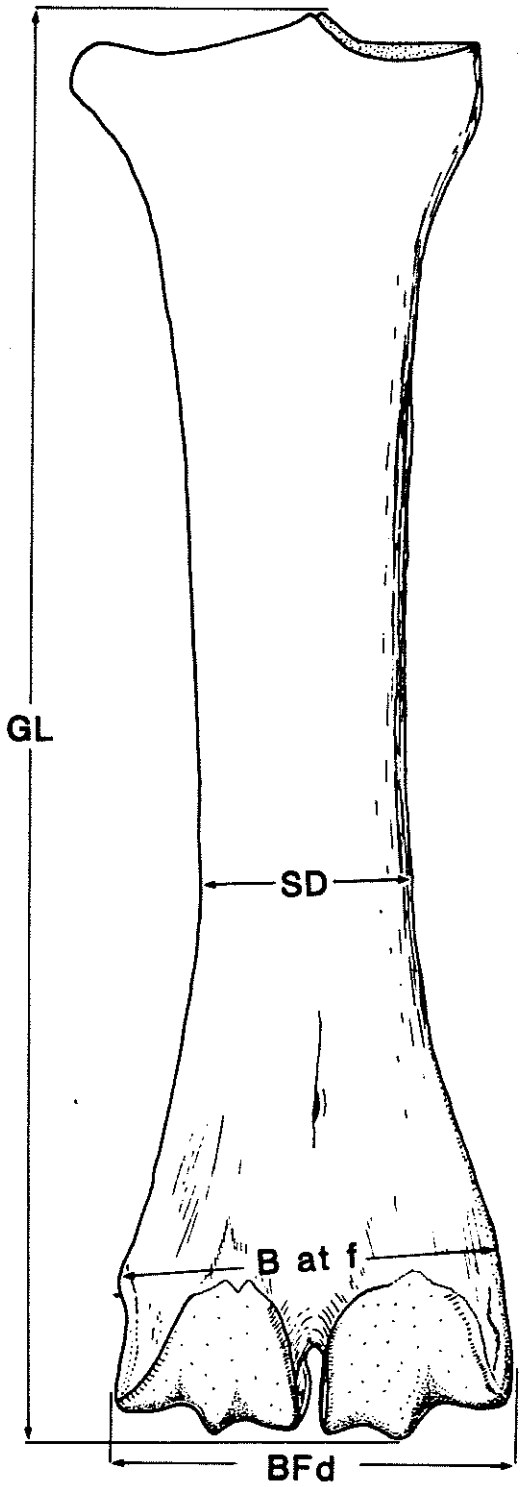
Grant Wear Stage:	a	b	c	d	e	f	g	h	i	j	k	l	m	n	?
17th - 18th centuries															
dP_4															
P_4															
M_1															
$M_{1/2}$															
M_2															
M_3															
15th - 16th centuries															
dP_4	1	1	1		1	1									
P_4		1													1
M_1	1			1											
$M_{1/2}$				1		1					1				1
M_2			1	1	2										
M_3	5	1													
13th - 14th centuries															
dP_4															
P_4					1										1
M_1														1	
$M_{1/2}$															
M_2							1								
M_3		1													
Grant Wear Stage:	a	b	c	d	e	f	g	h	i	j	k	l	m	n	?

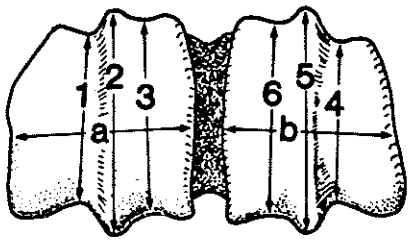
Figure 1.

Measurements of cattle metapodial. Sketch to show how the measurements were taken.

Figure 2.

Separation of sheep metacarpals from goat metacarpals at Closegate I and II (after Payne, 1969). Plot of the minimum trochlea depth against the condyle width. Measurements for each condyle are plotted separately and joined by a thin line. Medial condyles are represented by a circle and lateral ones by a square. Open symbols are unfused (juvenile) epiphyses. Lateral condyles were distinguished from medial ones by their greater distad projection. In most cases lateral condyles appear to have smaller trochlea depth. Two exceptions are probably errors. The plots for the metacarpal identified as goat are shown as diamonds.





2=Ddm
5=Ddl

a=BFdm
b=BFdl

medial condyle lateral condyle

Figure 1

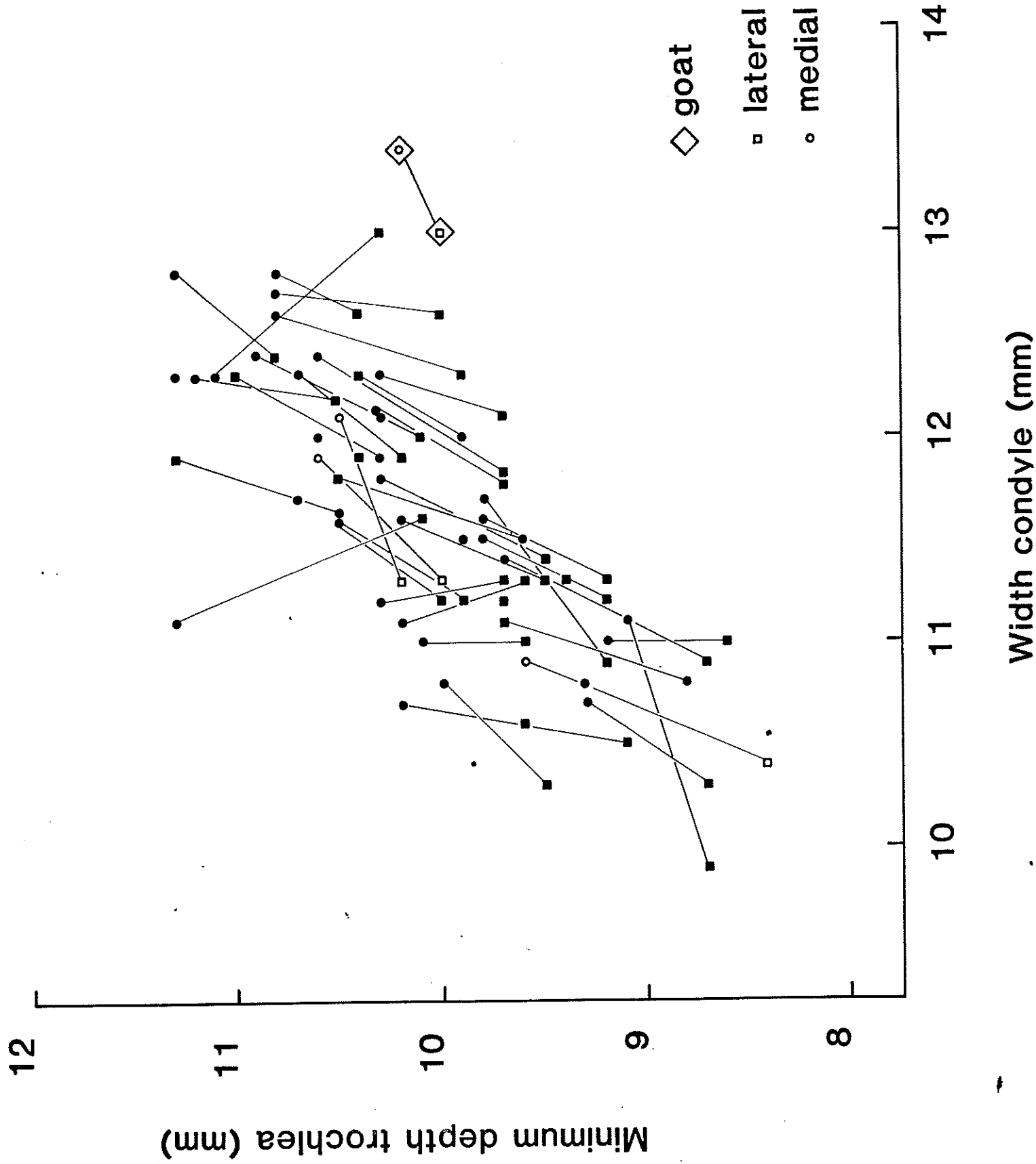

goat
lateral
medial
Minimum depth trochlea (mm)
Width condyle (mm)
12
11
10
9
8
10
11
12
13
14

Figure 2

Figure 3.

Body-part frequencies. Graphic portrayal of the MN data in table 10.
Each asterisk represents 2 MN.

	Sheep/Goat 15th - 16th century	Sheep/Goat 17th - 18th century	Cattle 15th - 16th century
Mandible	********	**	****
i+I	*	*	**
dp+P	****	**	*****
Molars	**********	****	*****
Scapula	*****	**	***
Humerus - dist	**********	***	***
Radius - dist	****	**	**
Radiale	*	*	*
C2+3			**
Metacarpal - dist	**********	***	***
Ischium	******	**	**
Femur - dist	**	*	**
Tibia - dist	*******	**	*
Astragalus	*****	**	*****
Calcaneum	*****	***	****
Metatarsal - dist	**********	**	******
Phalanx 1 - prox	******	*	**
Phalanx 3	*	*	**

Figure 4.

Variation in size of the sheep at Closegate I and II. Plots of distal humerus *minimum diameter of trochlea*, distal humerus *width of trochlea*, distal humerus *width*, metacarpal *length*, distal tibia *width*, astragalus *width*, and metatarsal *length*. The measurements are in millimetres. Each square represents a single specimen.

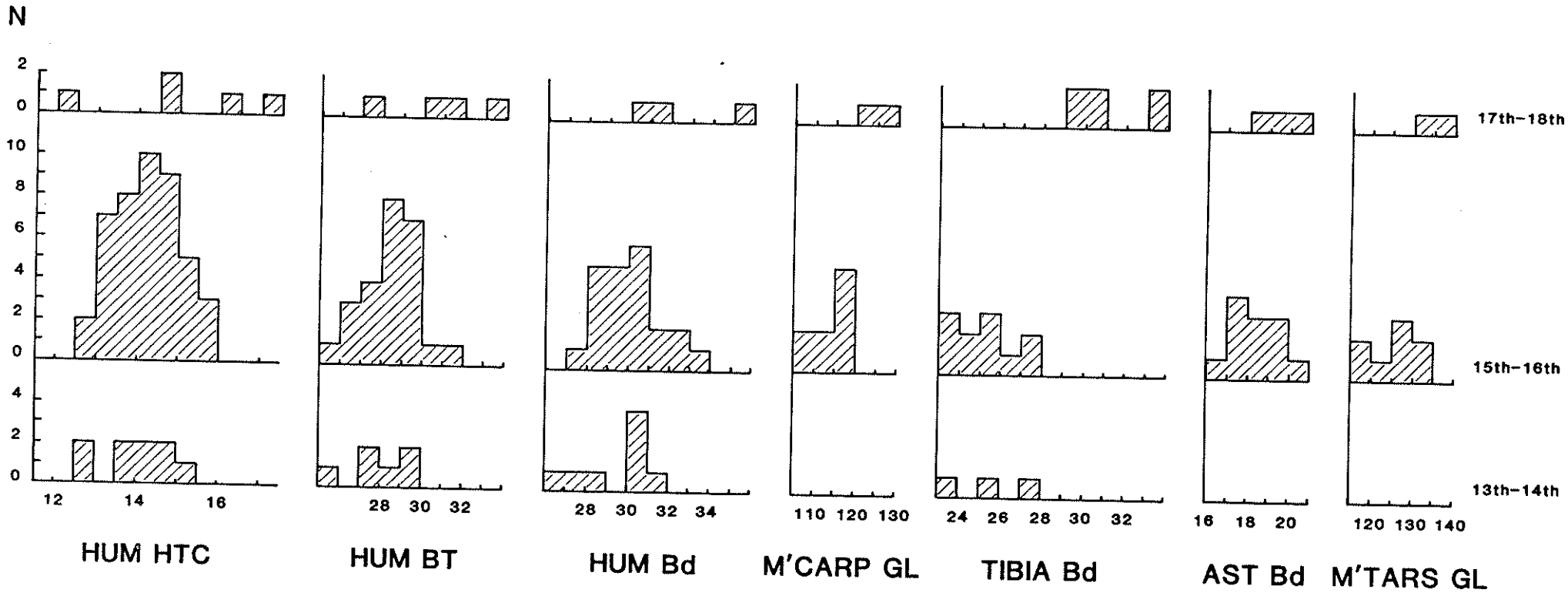

N
17th–18th
15th–16th
13th–14th
HUM HTC
HUM BT
HUM Bd
M'CARP GL
TIBIA Bd
AST Bd
M'TARS GL

Figure 4

Appendix 1.

Contexts in which bones exhibiting evidence for "water-rolling" were found:

Site	Century	Context	Phase
I	15-16	205	5
I	15-16	266	5

Contexts in which badly abraded bones were found:

Site	Century	Context	Phase
I	15-16	112	6
I	15-16	211	5
I	15-16	216	5
I	15-16	219	5
I	15-16	225	5
I	15-16	231	5
I	15-16	240	5
I	15-16	244	5
I	15-16	247	5
I	15-16	286	3
I	13-14	305	2
I	13-14	241	1
II	13-14	259	4

Contexts in which beach-shells were found:

Site	Century	Context	Phase
II	17-18	131	8.1
I	15-16	131	5
I	15-16	252	4
I	15-16	273	3
I	15-16	306	3

Appendix 2

Measurements of teeth and bones from Closegate I and II in millimetres. Approximate measurements are in parentheses.

Key:

Cont	- Context
Ph	- Phase
Sh	- Sheep
G	- Goat
Sh/G	- Sheep or Goat
Gall	- Galliform
l	- length
w	- width
HTC	- minimum diameter of the trochlea (humerus)

I, II and III refer respectively to the first, second and third "units" of a tooth.

Pig teeth are measured as in Payne and Bull (1989).

Cattle metapodials are measured as in figure 1.

Sheep and goat metacarpals are measured as in Payne (1969):

W.Con	- width of condyle
W.Troc	- minimum depth of trochlea

Closegate I and II Cattle
Lower Third Molar tooth measurements

Site	Century	Context	phase	l	wl
I	17-18	175	6	-	14.5
I	17-18	171	6	-	14.3
I	15-16	206	5	36.1	16.1
I	15-16	235	5	36.2	16.1
I	15-16	255	5	32.3	14.4
I	15-16	180	5	35.4	15.6
I	15-16	189	5	-	15.0
I	15-16	210	5	-	17.1
I	15-16	216	5	34.8	13.7
I	15-16	217	5	38.6	17.3
I	15-16	203	5	37.2	16.2
I	15-16	211	5	(35.6)	16.1
I	15-16	211	5	37.4	16.1
I	15-16	260	3	34.3	15.8
II	15-16	176	6	33.2	14.7
II	13-14	507	5.1	35.3	16.5

Closegate I and II Pig teeth measurements

Site	Century	Context	phase	dP_4 l	dP_4 wIII	M_1 l	M_1 wI	M_1 wII	M_2 l	M_2 wI	M_2 wII	M_3 l	M_3 wI	M_3 wII
I	15-16	231	5						21.6	12.4	12.9	-	13.5	-
I	15-16	194	5	17.8	8.1									
I	15-16	194	5						20.7	13.0	13.4			
I	15-16	179	5						22.3	13.1	14.2	33.4	15.5	14.7
I	15-16	179	5						22.6	13.2	14.0	33.8	15.4	14.7
I	15-16	201	5	(18.2)	8.4	17.8	10.4	10.9						
I	15-16	201	5	-	8.5									
I	15-16	201	5			17.6	10.3	10.3						
I	15-16	217	5									32.5	15.3	14.9
I	15-16	262	4	18.5	8.4									
II	13-14	349	2						20.6	13.6	14.4	34.2	17.2	15.8

Closegate I and II
Cattle Humerus measurements (all fused)

Site	Century	Context	phase	BT	HTC
I	15-16	240	5	62.1	28.9
I	15-16	215	5	-	34.7
I	15-16	247	5	-	32.7
I	15-16	247	5	-	28.3
I	15-16	217	5	-	(33.5)
I	15-16	306	3	-	(28.8)
I	15-16	260	3	65.7	-
II	15-16	518	6	-	30.0
II	15-16	176	6	-	28.8

Closegate I and II Cattle Metacarpal measurements

Site	Century	Context	phase	U/F	GL	SD	BFd	B at f	BFdm =a	BFdl =b	1	Ddm =2	3	4	Ddl =5	6
I	15-16	240	5	F			65.2	58.6	29.9	32.0	23.9	(32.9)	29.6	26.5	33.6	30.4
I	15-16	247	5	F			57.6	54.3	27.2	28.3	21.6	-	-	23.0	-	26.8
I	15-16	180	5	F			52.3	46.6	25.8	24.6	22.2	-	-	20.1	-	-
I	15-16	216	5	F			53.3	49.0	(25.3)	25.2	20.7	-	26.1	19.6	-	26.2
I	15-16	209	5	F			(54)	50.4	26.9	(25.4)	22.1	-	25.9	20.4	-	25.5
II	15-16	586	6	F			52.2	50.3	25.2	24.4	21.1	28.3	24.7	19.4	27.1	24.4
II	15-16	235	6	F	203	38.8	-	-	-	32.7	-	-	-	26.5	-	-
II	13-14	211	5.1	F			(63)	59.0	-	30.2	27.1	-	30.0	25.2	33.1	30.4
II	13-14	181	4	F			53.1	48.6	25.5	24.9	21.5	-	26.2	19.8	28.4	26.1
II	13-14	282	4	F			67.3	58.4	32.9	32.2	25.7	33.1	29.8	22.8	(30.5)	28.9

Closegate I and II Cattle Astragalus measurements

Site	Century	Context	phase	GLl	Bd	Dl
I	17-18	250	6	62.0	-	-
I	17-18	184	6	66.4	41.9	36.9
I	17-18	174	6	68.6	(43.7)	39.7
II	17-18	77	9	57.6	37.4	32.2
II	17-18	156	8.1	69.1	(42.5)	-
I	15-16	235	5	63.4	-	35.2
I	15-16	244	5	-	(41.3)	36.5
I	15-16	245	5	(65.7)	-	38.6
I	15-16	247	5	64.5	-	35.7
I	15-16	243	5	64.3	(42.7)	36.5
I	15-16	194	5	66.8	(43.6)	-
I	15-16	185	5	71.4	(48.7)	39.9
I	15-16	183	5	-	47.2	38.4
I	15-16	152	5	65.7	-	-
I	15-16	260	3	59.7	-	-
II	15-16	292	7	-	41.1	35.7
II	13-14	530	4	64.4	41.4	35.2

Closegate I and II Cattle Metatarsal measurements

Site	Century	Context	phase	U/F	GL	SD	BFd	B at f	BFdm =a	BFdl =b	1	Ddm =2	3	4	Ddl =5	6
I	17-18	197	6	F			57.0	59.0	27.2	25.9	24.7	(33.4)	29.4	23.2	(32.9)	29.9
I	15-16	222	5	F			51.5	48.0	25.3	22.9	21.2	29.4	25.3	19.6	28.1	25.2
I	15-16	248	5	F			55.6	50.0	28.6	24.4	22.9	31.4	27.3	21.5	30.2	27.4
I	15-16	217	5	F			48.2	47.6	22.5	21.7	21.4	-	25.2	20.2	27.5	25.6
I	15-16	302	4	F			46.2	42.6	(22.2)	(21.2)	20.6	-	24.4	19.4	-	25.0
I	15-16	301	4	F			46.3	43.2	22.4	20.8	20.1	28.0	25.1	19.2	27.5	25.2
I	15-16	262	4	F			60.5	57.4	27.6	28.3	24.3	(32.0)	28.8	23.0	(30.4)	29.0
I	15-16	287	3	F			(57)	55.7	27.3	-	24.1	-	28.9	23.1	-	-
II	15-16	586	6	F			56.5	50.0	25.4	27.0	22.1	31.4	29.3	23.5	32.2	28.4
II	15-16	235	6	F	227	27.5	54.6	51.7	25.6	25.1	-	-	-	21.5	29.5	27.5
II	15-16	277	4	F			(58.2)	55.8	-	26.6	24.0	(31.7)	-	21.8	30.8	28.4
II	13-14	270	1	F			55.6	52.1	26.7	25.8	23.2	(31.1)	28.3	22.1	(30.7)	28.3

Closegate I and II Sheep/Goat Humerus measurements (all distal epiphyses fused, further identification to species was not made)

Site	Cent	Cont	ph	HTC	BT	Bd
I	17-18	223	6	16.0	31.0	31.9
I	17-18	220	6	12.4	-	-
I	17-18	163	6	14.5	30.1	30.4
II	17-18	131	8.1	14.8	(27.7)	-
II	17-18	151	8.1	17.2	33.5	35.2
I	15-16	254	5	14.5	-	-
I	15-16	208	5	14.2	(26.8)	-
I	15-16	240	5	14.6	28.4	-
I	15-16	222	5	13.5	27.8	(28.6)
I	15-16	215	5	13.8	(27.7)	-
I	15-16	244	5	14.5	29.2	30.1
I	15-16	247	5	13.2	-	-
I	15-16	247	5	14.3	-	-
I	15-16	247	5	14.4	-	-
I	15-16	225	5	13.7	(28.3)	29.4
I	15-16	225	5	13.1	-	-
I	15-16	236	5	13.9	-	-
I	15-16	243	5	13.3	-	-
I	15-16	194	5	12.8	27.5	-
I	15-16	180	5	13.6	28.0	31.1
I	15-16	201	5	14.9	(28.8)	(29.4)
I	15-16	217	5	15.4	29.2	30.9
I	15-16	217	5	13.4	-	-
I	15-16	217	5	15.3	29.5	32.1
I	15-16	217	5	14.7	29.5	31.6
I	15-16	218	5	14.1	28.3	29.3
I	15-16	218	5	15.4	29.4	-
I	15-16	218	5	15.6	-	-
I	15-16	218	5	15.1	-	-
I	15-16	218	5	15.6	30.3	(32.2)
I	15-16	235	5	13.1	-	-
I	15-16	235	5	13.1	(27.7)	28.5
I	15-16	235	5	15.2	-	28.7
I	15-16	262	4	14.3	-	(29.8)
I	15-16	262	4	14.1	(28.0)	29.5
I	15-16	262	4	14.0	-	30.5
I	15-16	262	4	14.0	26.8	-
I	15-16	262	4	14.6	-	-
I	15-16	262	4	14.7	28.8	-
I	15-16	262	4	15.9	31.8	33.0
I	15-16	251	3	13.5	26.9	28.6

Closegate I and II Sheep/Goat Humerus measurements Cont.
(all distal epiphyses fused)

Site	Cent	Cont	ph	HTC	BT	Bd
II	15-16	234	6	13.2	25.9	(27.8)
II	15-16	586	6	14.8	29.4	30.8
II	15-16	176	6	14.3	28.2	30.4
II	15-16	291	7	12.7	-	-
II	15-16	291	7	14.4	29.6	30.1
II	15-16	293	7	13.5	-	-
II	15-16	292	7	14.6	-	-
II	15-16	292	7	13.8	-	28.6
II	13-14	184	5.1	15.1	29.4	31.7
II	13-14	184	5.1	14.3	29.7	30.9
II	13-14	502	5	14.1	28.4	30.9
II	13-14	502	5	12.7	27.4	28.6
II	13-14	252	5	13.8	-	27.5
II	13-14	279	4	12.7	25.6	26.2
II	13-14	282	4	14.5	-	-
II	13-14	284	4	13.7	27.8	30.1
II	13-14	182	3.1	14.7	-	30.6

Closegate I and II Sheep and Goat Metacarpal measurements

Site	Cent	Cont	ph	ID	U/F	GL	SD	BFd	Dd	W.Con med	W.Troc med	W.Con lat	W.Troc lat
I	17-18	95	6	Sh	F			(23.0)	-	11.0	-	10.6	9.6
I	17-18	220	6	Sh	F			26.7	-	12.8	10.8	12.6	10.4
II	17-18	13	9	Sh	F	126	14.2	25.7	15.6	12.4	10.6	11.8	9.7
II	17-18	237	8	Sh	F	123	13.2	23.9	-	11.1	11.3	11.6	10.1
I	15-16	243	5	?Sh	U			22.7	-	10.9	9.6	10.4	8.4
I	15-16	217	5	Sh	U			25.1	16.4	12.1	10.5	11.3	10.2
I	15-16	217	5	Sh	U			(26.5)	16.5	11.9	10.6	11.3	10.0
I	15-16	218	5	Sh	F			(24.1)	-	11.7	9.8	10.9	9.2
I	15-16	218	5	Sh	F			25.7	15.6	12.0	9.9	12.3	10.4
I	15-16	205	5	Sh	F	111		24.5	(15.1)	11.8	10.3	11.4	9.5
I	15-16	205	5	Sh	F			22.3	-	10.7	9.3	10.3	8.7
I	15-16	240	5	Sh	F			(23.7)	15.0	11.0	10.1	11.0	9.6
I	15-16	247	5	Sh	F			27.1	16.1	12.7	10.8	12.6	10.0
I	15-16	255	5	Sh	F	117	13.4	24.4	15.2	11.7	10.7	11.2	10.0
I	15-16	231	5	Sh	F	115	12.5	22.1	15.4	10.7	10.2	10.5	9.1
I	15-16	219	5	Sh	F			24.3	-	11.5	9.9	11.3	9.4
I	15-16	219	5	Sh	F	106	12.6	22.5	14.8	10.8	10.0	10.3	9.5
I	15-16	236	5	Sh	F			25.6	14.7	12.1	10.3	11.8	9.7
I	15-16	243	5	Sh	F			23.6	14.6	11.0	9.2	11.0	8.6
I	15-16	243	5	Sh	F			23.7	14.8	11.6	10.5	11.2	9.9
I	15-16	243	5	Sh	F	109		23.8	14.8	11.5	9.8	11.2	9.2
I	15-16	189	5	Sh	F			26.2	-	12.4	10.9	12.0	10.1
I	15-16	201	5	Sh	F			(26.9)	17.0	12.8	11.3	12.4	10.8
I	15-16	201	5	Sh	F			25.3	-	12.3	10.7	11.9	10.2
I	15-16	201	5	Sh	F			26.5	-	12.3	11.1	13.0	10.3
I	15-16	201	5	Sh	F			25.8	16.2	12.3	11.2	12.2	10.5
I	15-16	201	5	Sh	F			(24.9)	15.2	12.1	10.3	(11.7)	9.5
I	15-16	201	5	Sh	F			26.8	15.4	12.6	10.8	12.3	9.9
I	15-16	201	5	Sh	F			24.9	15.5	11.6	10.5	11.9	11.3
I	15-16	201	5	Sh	F			(24.8)	16.1	(12.1)	9.8	11.9	10.4
I	15-16	201	5	Sh	F			23.2	15.4	11.2	10.3	11.3	9.7
I	15-16	217	5	Sh	F	117				12.0	10.6		
I	15-16	217	5	Sh	F			23.2	15.1	10.8	8.8	11.1	9.7
I	15-16	217	5	Sh	F			24.2	15.2	11.1	10.2	11.3	9.6
I	15-16	262	4	?	U/F			25.6	15.8	12.3	10.3	12.1	9.7
I	15-16	262	4	Sh	F			24.4	-	11.5	9.6	11.8	10.5
I	15-16	262	4	Sh	F			(26.2)	-	12.3	11.3	(11.8)	10.7
I	15-16	262	4	Sh	F			(22.9)	14.7	10.8	9.3	(11.1)	10.1
I	15-16	262	4	Sh	F			24.2	-	-	-	11.2	9.7
I	15-16	260	3	Sh	F			25.7	15.9	11.9	10.3	12.3	11.0
I	15-16	267	3	Sh	F	119	13.8	24.3	14.8	11.6	9.8	11.3	9.2
II	15-16	292	7	Sh	F			23.7	-	11.1	9.1	9.9	8.7
II	15-16	338	7	Sh	F	115	12.7	23.3	14.7	11.4	9.7	10.9	8.7
II	15-16	176	6	Sh	F	114	13.1	24.1	15.4	11.6	10.2	11.3	9.5
II	13-14	502	5	G	U			28.4	18.1	13.4	10.2	13.0	10.0

Closegate I and II Sheep/Goat Tibia measurements
(all distal epiphyses fused, further identification
to species was not made)

Site	Cent	Cont	ph	Bd
II	17-18	131	8.1	33.6
II	17-18	137	8.1	30.3
II	17-18	137	8.1	29.7
II	17-18	138	8.1	30.9
II	17-18	156	8.1	33.5
I	17-18	193	6	29.4
I	15-16	218	5	24.4
I	15-16	206	5	25.8
I	15-16	206	5	25.7
I	15-16	205	5	23.7
I	15-16	235	5	26.1
I	15-16	247	5	23.7
I	15-16	236	5	27.3
I	15-16	307	4	27.1
I	15-16	260	3	23.3
II	15-16	291	7	25.4
II	15-16	586	6.0	24.6
II	13-14	502	5	27.4
II	13-14	502	5	25.1
II	15-16	277	4	23.9

Closegate I and II Sheep and Goat
Astragalus measurements

Site	Cent	Cont	ph	ID	GLl	Bd	Dl
I	17-18	95	6	Sh	28.2	18.0	15.5
I	17-18	202	6	Sh	-	19.5	-
II	17-18	131	8.1	Sh	30.6	20.4	16.7
I	15-16	208	5	Sh	27.5	17.7	15.6
I	15-16	208	5	Sh	30.5	19.7	-
I	15-16	240	5	Sh	27.8	18.7	15.6
I	15-16	244	5	Sh	27.8	17.5	(15.1)
I	15-16	244	5	Sh	23.4	16.2	(13.1)
I	15-16	247	5	?Sh	28.2	19.5	16.2
I	15-16	247	5	Sh	27.4	-	16.0
I	15-16	243	5	Sh	28.2	18.5	-
I	15-16	243	5	Sh	26.9	17.6	15.2
I	15-16	243	5	Sh	27.9	18.5	14.7
I	15-16	201	5	Sh	26.0	17.1	(14.0)
I	15-16	262	4	?Sh	29.3	20.3	16.4
I	15-16	262	4	Sh	29.4	19.2	15.4
I	15-16	260	3	Sh	25.9	-	-

Closegate I and II Sheep and Goat Metatarsal measurements

Site	Cent	Cont	ph	ID	U/F	GL	SD	BFd	Dd
I	17-18	153	6	Sh	F	137	12.6	25.2	16.2
II	17-18	151	8.1	Sh	F	134	11.0	22.0	15.2
II	17-18	233	8	Sh	F			22.4	(15.4)
I	15-16	124	5	Sh	F			24.8	-
I	15-16	205	5	Sh	F			23.7	-
I	15-16	205	5	?Sh	F			22.5	14.1
I	15-16	237	5	Sh	F			24.2	(15.7)
I	15-16	235	5	Sh	F	133		-	-
I	15-16	215	5	Sh	F			24.0	16.3
I	15-16	255	5	Sh	F			25.5	17.1
I	15-16	225	5	Sh	F			23.2	-
I	15-16	219	5	Sh	F			23.5	15.5
I	15-16	219	5	Sh	F			20.8	13.7
I	15-16	243	5	Sh	F			24.3	16.2
I	15-16	243	5	Sh/G	F	116	11.4	(22.4)	-
I	15-16	152	5	Sh	F			23.0	15.4
I	15-16	201	5	Sh	F	(127)	11.6	23.7	(15.2)
I	15-16	201	5	Sh	F			24.6	(16.4)
I	15-16	201	5	Sh	F			25.9	-
I	15-16	201	5	Sh	F			25.6	17.2
I	15-16	201	5	Sh	F			-	15.3
I	15-16	201	5	Sh	F			24.0	-
I	15-16	201	5	Sh	F			23.3	15.6
I	15-16	207	5	Sh	F			(21.2)	-
I	15-16	217	5	Sh	F	(134)	12.5	-	-
I	15-16	217	5	Sh	F			23.6	(16.0)
I	15-16	300	4	Sh	F	127	12.1	24.3	-
I	15-16	301	4	Sh	F			22.6	14.4
II	15-16	292	7	Sh	F	(118)	11.8	24.2	15.5
II	15-16	267	7	Sh	F	120	10.2	22.3	-
II	15-16	176	6	Sh	F	126	11.0	(22)	(15.3)

Closegate I and II

Red/Fallow deer distal tibia measurements
(both fused)

Site	Cent	Cont	ph	ID	Bd	Dd
I	17-18	174	6	Red/Fallow	(34.5)	(27.3)
I	15-16	217	5	Fallow	36.1	(29.1)

Closegate I and II

Horse calcaneum measurements
(tuber calcis fused)

Site	Century	Context	phase	GL
II	13-14	569	3.1	(101)

Closegate I and II carnivore measurements.

Site	Century	Cont	Ph	Ident	Bone	Measurements
I	15-16	262	4	Dog	Mandible	lP_1-P_4=49.5 lP_2-P_4=43.4 lP_4=12.9 wP_4=6.8 lM_1=(24) wM_1=9.7
I	15-16	236	5	Dog	Humerus	HTC=10.6
II	13-14	511	5	Dog	Humerus	HTC=9.4
I	15-16	301	4	Cat	Humerus	GLC=82.7 Bd=16.1 HTC=5.5
II	13-14	188	5.1	Cat	Metacarpal II	GL=23.9
I	17-18	175	6	Cat	Metacarpal IV	GL=29.8
I	17-18	161	6	Cat	Metatarsal III	GL=47.8
I	15-16	189	5	Cat	Metacarpal III	GL=30.1
I	15-16	267	3	Cat	Metatarsal IV	GL=52.1

Closegate I and II bird measurements. All specimens unless stated otherwise are osteologically mature.

Site	Century	Cont	Ph	Ident	Bone	Measurements
I	15-16	255	5	Gall	Coracoid	GL=51.4 Lm=49.3 BF=11.8
II	13-14	501	5	Gall	Scapula	GL=71.0 Dic=11.7
II	17-18	131	8.1	Gall	Humerus	GL=67.0 Bp=18.0 Bd=14.5 SC=6.3
I	15-16	217	5	Gall	Humerus	GL=67.4 Bp=18.6 Bd=14.2 SC=7.0
I	15-16	251	3	Gall	Humerus	GL=64.7 Bp=17.9 Bd=14.0 SC=6.0
II	15-16	292	7	Gall	Humerus	Bd=16.3
II	13-14	349	5.1	Gall	Humerus	Bd=14.0 SC=6.4
II	13-14	259	4	Gall	Humerus	GL=74.0 Bp=20.4 Bd=16.2 SC=7.4
II	13-14	184	5.1	Gall	Humerus	Bd=14.2 SC=6.4
II	13-14	502	5	Gall	Humerus	GL=72.6 Bp=19.3 Bd=15.5 SC=7.1
I	15-16	243	5	Chicken	Femur	GL=74.8 Bd=13.9 Bp=15.2 Dd=12.5
I	15-16	217	5	Chicken	Femur	Bp=16.7
II	15-16	292	7	Chicken	Femur	GL=78.7 Bd=15.9 Bp=16.6 Lm=73.2 SC=7.0
I	15-16	260	3	Gall	Femur	Bd=13.6
II	15-16	277	4	Chicken	Femur	Bp=14.1
II	13-14	511	5	Chicken	Femur	GL=72.1 Bd=13.9 Bp=13.9 Lm=67.5 SC=6.5 Dp=10.0 Dd=12.5
I	17-18	246	6	Gall	Tibiotarsus	GL=118.5 La=113.5 Dd=13.2 Bd=(12.8)
I	15-16	255	5	Gall	Tibiotarsus	Dd=(10.4)
I	15-16	286	3	Gall	Tibiotarsus	Bd=10.8 Dd=10.9
I	15-16	276	3	Gall	Tibiotarsus	Bd=12.2 Dd=12.4
I	15-16	262	4	Gall	Tibiotarsus	Bd=10.3 Dd=11.0
II	13-14	259	4	Gall	Tibiotarsus	Bd=(10.8)
II	15-16	234	6	Chicken	Tarsometatarsus (no spur)	GL=(71) Bd=12.1 SC=5.7
II	13-14	502	5	Chicken	Tarsometatarsus (no spur)	GL=63.2 Bd=11.3 SC=5.3 Bp=11.3
I	15-16	217	5	Goose	Tibiotarsus	Dd=18.3 Bd=(17.7)
II	17-18	156	8.1	cf Mallard	Femur	GL=55.3 SC=5.2 Bp=(13.9) Lm=53.3
II	17-18	131	8.1	cf Teal	Tarsometatarsus	Bd=5.9
II	13-14	334	4	cf Mallard	Tarsometatarsus	GL=48.4 Bp=10.8 SC=5.3 Bd=10.5
II	17-18	146	8.1	cf Woodcock	Tibiotarsus	GL=(69) Bd=6.6
II	13-14	334	4	Woodcock	Tibiotarsus	GL=68.3 Bd=6.6 La=65.7 Dd=6.3
II	13-14	502	5	cf Turdus sp	Humerus	GL=27.1 Bp=9.0 Bd=6.6 SC=2.5
II	13-14	259	4	Jackdaw (juv)	Humerus	GL=47.2 Bd=10.8 SC=4.4
II	13-14	283	4	Jackdaw (juv)	Femur	GL=39.0 Lm=36.6 Bd=7.6 SC=3.3 Bp=7.4