The mammal bone

George W I Hodgson, Catherine Smith and Angela Jones

Introduction

The bulk of the mammal bone assemblage was identified by Dr G W I Hodgson and Angela Jones both during the excavation and and immediately after it took place. The first draft of the mammal report was written by Dr G W I Hodgson in 1979–80, with the assistance of Angela Jones. Subsequently, the data tables were compiled from 1980 onwards by Catherine Smith in the light of continuing revisions of the site phasing. Further identifications, text revisions and additions were undertaken from 1995–6 onwards by Catherine Smith, following the death of Dr Hodgson in 1986.

The material described consists of animal remains recovered during the 1975–77 excavations (OS NO 118923) under the direction of Nicholas Q Bogdan. The total assemblage of animal remains from a site is a sample of what is buried. The word sample is used in this context throughout this report. The samples under discussion were hand-excavated from primary deposits. In addition, eight samples, containing only a small number of bones, were retrieved from soil collected primarily in order to investigate for botanical remains. The archaeological features from which the bones were recovered dated mainly from the 12th–14th centuries. The material examined consisted of bone, tooth and antler fragments, although a few pieces of horn were also retrieved. The assemblage which they represent is a large one by Scottish standards and constitutes a useful reference of bone size ranges for domestic animals in a Scottish medieval context.

Illus 3 *Skeleton of four-year old male Soay sheep used for comparison with medieval material*

Illus 4 *Sheep (above) and goat (below) scapulae: note differences in morphology of scapula neck.*

Methodology

Identification

The washed, labelled material was identified to particular bone and species by direct comparison with modern defleshed specimens (Illus 3). No attempt was made to identify, record or enumerate rib fragments or vertebrae other than the first two cervical (neck) vertebrae. In cases where there was uncertainty as to species the help of experts in other institutions was sought. Acknowledgement is made at the relevant place in the text.

Boessneck's (1964, 1–129) criteria were applied to the sheep and goat remains in order to try to distinguish them. These criteria may be applied only to certain long bones; often with eroded archaeological material it is impossible to make use of them (Illus 4, 5). The collection of comparative material which was used for reference included several of the rarer Scottish breeds of sheep but only a restricted range of domestic and feral goat bones, perhaps tending to bias identification of long bones towards sheep and away from goat. Since most of the sheep and goat bones (with the major exception of horn cores) could not be distinguished, the relative abundance of the long bones of these two species may not be accurately reflected and there may be a bias towards sheep.

Identification of some canid long bones as fox is tentative and some could have come from gracile dogs rather than foxes.

Measurement

Measurements were taken in accordance with the scheme recommended by von den Driesch (1976) and are expressed in millimetres.

Nomenclature

Vernacular names are used when referring to domestic animals (for example cattle, sheep, goat, etc) and, following the policy outlined by Armitage and Clutton-Brock (1976, 1–2), no attempt is made to relate the animal remains to distinct breeds found in Scotland at the present day. Osteological names and terms are those used by McFadyean (1884), Sissons (1964), Cornwall (1974) and von den Driesch (1976).

Interpretation of the samples

The bone assemblages are the result of the interaction of several agencies, as well as human activity, and are, in consequence, biased samples of some of the animals with which man interacted. In some cases the bones originated from living areas, whilst others come from refuse dumps. Bones from refuse areas (middens and pits) predominate at this site, therefore the bones from large animals may be better represented than those from small animals (see Uerpmann 1973, 308 for discussion). The refuse deposits seem to be a mixture of domestic and industrial or commercial rubbish, therefore it is unwise to use them solely as a guide to diet (Alcock 1979 pers comm). The middens would be exposed to depletion by dogs, cats and wild scavengers such as foxes, rats, crows, ravens and buzzards (see The bird bone).

The interpretation of the assemblage of bones from medieval Scottish burghs is complicated by several factors: the royal burghs and later, all burghs, had a unique legal status which brought with it a double commercial monopoly. Firstly, there was a monopoly on the export of cattle hides, wool and woolfells. Further, there was a monopoly against the agricultural hinterland as regards the slaughter and selling of animals. The nature of the legal status of the burghs, and of the monopolies which they enjoyed, is explored in detail later. Sufficient at this stage to note that the remains

Illus 5 *Sheep (above) and goat (below) metatarsals and metacarpals.*

of animals found in Scottish medieval burghs are not necessarily those of animals eaten by the in-habitants. Within the broad time period to which a sample may be ascribed, national and burghal prosperity may have dramatically altered, bringing about marked changes in the standard of living of the people. These changes may not be reflected by the sample as a whole. Standards declined from the relatively prosperous times of the 12th century due to wars between Scotland and England. Perth was occupied by the English from 1296 to 1313 and used as a garrison town. Later, it was controlled by the adherents of Edward Balliol from 1332 and was only retaken for the Scots in 1339 (Bogdan and Wordsworth 1978, 7).

In the 12th century Scottish burghs, the nobility and artisans often lived 'cheek by jowl', thereby producing a mixture of domestic refuse from rich and poor families. Two unpaired gilt spurs from the site are described as being of a type that would have been worn or earned by a knight (Illus 6, 7, 8) (see Fascicule 2, The metalwork). Fragments of silk textiles attributed to the 12th–13th centuries are associated with wealthy rather than artisan households (see Fascicule 3, The textiles).

Illus 6 *Gilded copper alloy spur with animal head decoration, Context 5014, A11316.*

Illus 7 *Detail of underside of decorated spur.*

Illus 8 Copper alloy prick spur, Context 7299, A04–0551.

Both of these finds were found in close proximity to hundreds of cattle horn cores which are presumed to be commercial waste.

Behind the frontages of the burghal tofts there were often local industries, leading to a mixture of domestic and commercial waste. Finally, we have insufficient documentary evidence of the rules or customs concerned with the clearance of middens in Perth in the 12th–14th centuries.

Species present

The hand-excavated mammal remains represent the following species; cattle, goat, sheep, pig, horse, dog, cat, red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), fox (*Vulpes vulpes*) and hare (*Lepus capensis*). In addition, three bones of small mammal were retrieved from the soil samples.

The mammalian remains are, for the most part, from domestic animals, which along with birds, fish, shellfish and crustaceans may well have been used as food. Dogs and cats may have been kept as working animals, for example as hunters, ratters, mousers, guards or to herd animals, as well as pets. Some of them may have lived as semi-wild (feral) animals loosely associated with the community and surviving mainly as scavengers. Olsen (1979 pers comm) has drawn attention to the fact that medieval towns had high ratios of dogs to men; thus a large dog population in a town would contribute towards the removal of individual bones of large animals as well as complete carcasses of small mammals from medieval middens, causing a bias both in the particular species reported and the relative frequencies of species to one another.

Relative frequency of species

Tables 1–11 show the numbers of bones identified as to bone and particular species. (These tables exclude twenty pieces of cattle horn sheath and an almost entire foetal lamb). From these data the minimum number of animals for each species present may be estimated, thus allowing the relative frequency of the species to be established. This information may lead to a better understanding of the availability of certain meats and of the dietary habits and preferences of the people. Many workers have argued against the use of 'minimum numbers of animals present' on the grounds that it may be misleading, but on a large site it does give an indication of the proportion of animals represented. This site seems to yield evidence of animals being slaughtered and butchered at or near to it. Parts of these carcasses would, presumably, be moved to other parts of the burgh, and, if they turned up in subsequent excavations, the use of 'minimum numbers' could lead to an overestimate of the total number of animals involved. The minimum numbers of animals present are shown in Table 12.

Since those minimum numbers which were estimated on the basis of the number of horn cores present may have been inflated by the presence of horn cores imported on to the site, these figures were re-estimated using long bones only. These new minimum numbers are shown in Table 13, along with estimates for samples of animal bones recovered from other medieval sites in the burghs of Aberdeen, Elgin and Perth (Hodgson and Jones 1979, 1982) where the relevant data were available.

On the basis of minimum numbers of animals, the relative frequencies of cattle with respect to sheep which were present contrast with those at St Ann's Lane, Perth, and at Elgin High Street, and in six of the main deposits from the medieval levels at High Street, Edinburgh reported on by Chaplin and Barnetson (1978,234), where goats were largely absent and sheep outnumbered cattle. The higher numbers of cattle with respect to sheep at Perth High Street may be due to commercial activity in connection with the export of hides.

Alcock (1979 pers comm) doubts the validity of such comparisons, on the grounds that like is not being compared with like, that is, if for a given species the same bone is not used to estimate minimum numbers at each site. King (1978, 208) sought to demonstrate that inter-site comparisons of frequencies of species, based on several criteria, are still valid. To test the point, the minimum numbers of animals present have been estimated on the basis of selecting for each species a bone which is common to all of the sites chosen. These estimates are shown in Table 14. Alcock's criticism seems to be sustained because the cattle:pig ratios in Table 13 are, with one exception, much lower than those in Table 14. On the basis of comparing the same bone for a given species, the three sites within the burgh of Perth have significantly higher cattle:pig ratios than any of the sites in the other two burghs. This may well reflect Perth's importance as a centre for the export of hides.

Alternatives to the 'minimum number of animals present' method of investigation are either to compare the total number of bones present for each species or to compare their weights. The weighing method was not adopted because the bones from part of the site appear to have been eroded in the soil while those from other areas of the site are unaffected and weigh more heavily in consequence. Comparisons of the percentages which each species contributes to the total number of bones recovered from a given site are not necessarily exact because it is difficult to identify rib and vertebra fragments as to species. Comparison between sites is also made difficult because of lack of general agreement on which species to include and whether loose teeth and butchers' chips (small unidentified fragments) should be counted. Some workers report only upon a sample of the bones recovered from a site, thus adding to the difficulties.

In spite of such problems, inter-site comparisons have been made (for example Proudfoot 1961, 109–15; Hodgson 1968, 135–9; Noddle 1975a, 250–260, Hodgson 1980, 3–32) and these have shed some light on preferences for certain meats and the availability of certain species. For example, at seven out of eight medieval sites in England and Wales located south of the Wash but outside of London, Noddle (1975a, 251) found cattle bones to be most numerous while sheep were the second most numerous at four of these sites. Armitage (1982) in reporting on five medieval sites within the City of London, states that 'the meat in the diet is mostly cattle and sheep'. Some northern English medieval sites at Pontefract and Wharram Percy (Ryder 1961) and Tynemouth (Hodgson 1967) have however produced evidence of sheep bones being more numerous than those of cattle.

Noddle (1975a, 258) has extended inter-site comparisons to include ten European medieval sites; at two of them pig bones are the most numerous while sheep and goat remains are in the majority at only a single site. The scarcity of pig bones relative to those of sheep/goat and cattle at British medieval sites is striking. Noddle (ibid, 250) has sought to relate this to the relative decline in woodland in which pigs were kept but it is as likely that many of the medieval sites excavated and reported on do not reflect the eating pattern of the labouring people in rural areas. Often, urban sites are those in which the inhabitants were fairly wealthy or where the by-products of cattle, sheep and goat would be fashioned and marketed and therefore more liable to occur. In addition, Clutton-Brock (1979, pers comm) has pointed out that the numbers of pig bones give no indication of the quantity of bacon and boned salt pork eaten.

It may be that because of the unique commercial status of the Scottish burghs in relation to the marketing of meat and export of hides, skins, wool and wool-fells that a comparison of relative frequencies of animals present for Scottish and English and European sites is not justified. In a purely Scottish context, however an inter-site comparison is useful.

Table 1 *Number of cattle bones identified.*

		number of fragments			
		left	**right**	**left/right**	**total**
horn core		508	561	684	1753
skull				6	6
maxilla		236	222	80	538
mandible		270	234	270	774
atlas				140	140
axis				192	192
scapula		148	125	226	499
humerus	proximal	24	20	13	57
	distal	149	144	14	307
	shaft			20	20
	entire		1		1
radius	proximal	108	90	11	209
	distal	122	123		245
	shaft			26	26
	entire	1	2		3
ulna		107	105	1	213
metacarpal	proximal	126	150	22	298
	distal	263	193	40	496
	shaft			3	3
	entire	29	31		60
innominate		140	136	197	473
femur	proximal	64	54		118
	distal	72	72	27	171
	shaft			141	141
	entire	1	2		3
patella		18	13		31
tibia	proximal	83	79	16	178
	distal	151	168	31	350
	entire	1			1
astragalus		169	166		335
calcaneum		214	184		398
tarsal/carpal				335	335
metatarsal	proximal	118	140	5	263
	distal	242	212	54	508
	shaft			1	1
	entire	32	41		73
metapodial				107	107
1st phalange				1655	1655
2nd phalange				793	793
3rd phalange				798	798
total		3396	3268	5908	12572

note Tables 1–10 include all bones of medieval date, whether provenanced or unprovenanced

Table 2 *Number of sheep/goat bones identified.*

		number of fragments			
		left	**right**	**left/right**	**total**
horn core		30	26		56
skull				106	106
maxilla		146	149	3	298
mandible		371	376	24	771
atlas				70	70
axis				59	59
scapula		142	167	34	343
humerus	proximal	22	10		32
	distal	112	121		233
	shaft			7	7
	entire	1	1		2
radius	proximal	85	89		174
	distal	46	29		75
	shaft			25	25
	entire	15	16		31
ulna		32	45		77
metacarpal	proximal	119	130		249
	distal	11	5	22	38
	shaft			14	14
	entire	41	40		81
innominate		107	80	50	237
femur	proximal	24	17		41
	distal	54	48		102
	shaft			7	7
	entire	2	3		5
tibia	proximal	28	46		74
	distal	195	170	17	382
	shaft			37	37
	entire	2	1		3
astragalus		17	24		41
calcaneum		21	27		48
tarsal/carpal				12	12
metatarsal	proximal	107	125		232
	distal	11	12	28	51
	entire	41	49		90
metapodial		31	35	98	164
1st phalange				111	111
2nd phalange				9	9
3rd phalange				3	3
total		1813	1841	736	4390

note excludes skeleton of 1 foetal lamb

Table 3 *Number of goat bones identified.*

		number of fragments			
		left	right	left/right	total
horn core		352	354	16	722
skull				7	7
axis				4	4
scapula		19	20		39
humerus	proximal	2	3		5
	distal	7	14		21
radius	proximal	10	4		14
	distal	2	4		6
metacarpal	entire	12	10		22
innominate		40	50		90
femur	proximal		1		1
	distal	1			1
tibia	proximal	6	2		8
astragalus		5	8		13
calcaneum		2	1		3
metatarsal	entire	1	1		2
metapodial				18	18
total		459	472	45	976

Table 4 *Number of pig bones identified.*

		number of fragments			
		left	right	left/right	total
skull				14	14
maxilla		69	73	3	145
mandible		106	117	2	225
atlas				13	13
axis				10	10
scapula		38	37	2	77
humerus	proximal	1			1
	distal	66	61		127
	entire	1	1		2
radius	proximal	67	60		127
	distal	8	1	5	14
	entire	23	19		42
ulna		50	78		128
innominate		26	23	38	87
femur	proximal	9	16		25
	distal	4	17		21
	entire	4	2		6
tibia	proximal	7	6		13
	distal	45	63	2	110
	entire	28	41		69
fibula				29	29
astragalus		8	19		27
calcaneum		24	34		58
metapodial				218	218
1st phalange				35	35
2nd phalange				11	11
3rd phalange				2	2
total		584	668	384	1636

Table 5 *Number of horse bones identified.*

		number of fragments			
		left	right	left/right	total
skull				1	1
maxilla		1			1
mandible		2	4		6
atlas				1	1
axis				4	4
scapula		2	6		8
humerus	proximal	8	3		11
	distal	2	9		11
	entire	2	2		4
radius	proximal	2	2		4
	distal	1	9		10
	entire	3	7		10
ulna		1			1
metacarpal	proximal	2	1		3
	entire	8	3		11
innominate			2		2
femur	distal	3			3
	entire		1		1
tibia	proximal		5		5
	distal	7	5		12
	entire	1	3		4
astragalus		3	6		9
calcaneum		2	3		5
metatarsal	proximal	1	2		3
	entire	6	4		10
splint				19	19
1st phalange				19	19
2nd phalange				15	15
3rd phalange				7	7
total		57	77	66	200

Table 6 *Number of red and roe bones identified.*

		number of fragments			
		left	right	left/right	total
antler tine*				2	2
maxilla			1 roe		1
mandible			1		1
radius	distal	1			1
ulna			1		1
metacarpal	proximal	2			2
	entire	2	1		3
tibia	proximal	1	4		5
metatarsal	proximal	1	1		2
	distal	1			1
	entire		5		5
2nd phalange				1	1
total		8	14	3	25

note: unless stated otherwise, all bones are from red deer
*antler tines and offcuts listed in the worked bone catalogue are not included in this table

Table 7 *Number of dog bones identified.*

		number of fragments			
		left	**right**	**left/right**	**total**
skull				10	10
maxilla		7	5		12
mandible		12	8		20
atlas				3	3
axis				2	2
scapula		10	7		17
humerus	proximal		3		3
	distal	5	1		6
	entire	12	8		20
radius	proximal	1			1
	distal	1			1
	entire	6	4		10
ulna		2	3		5
metacarpal	i			2	2
	ii	1	3		4
	iii	3	3		6
	iv	3	2		5
	v	2	2		4
innominate		8	5		13
femur	proximal		1		1
	dist		1		1
	entire	6	11		17
tibia	proximal	2	1		3
	distal	4	1		5
	entire	11	6		17
fibula				2	2
astragalus			1		1
calcaneum				1	1
tarsal/carpal				1	1
metatarsal	ii	1			1
	iii			3	3
	iv	3	4		7
	v	3			3
1st phalange				5	5
2nd phalange				5	5
os penis				1	1
total		103	80	35	218

Table 8 *Number of cat bones identified.*

		number of fragments			
		left	**right**	**left/right**	**total**
skull				17	17
maxilla		3	2		5
mandible		16	13		29
atlas				6	6
axis				5	5
scapula		10	14		24
humerus	proximal	1			1
	distal	10	4		14
	shaft				
	entire	12	19		31
radius	entire	9	8		17
ulna		9	18		27
innominate		24	22		46
femur	proximal		4		4
	distal		1		1
	entire	29	27		56
tibia	proximal	2			2
	distal	6	1		7
	entire	23	24		47
fibula				5	5
astragalus		2	2		4
calcaneum		1	2		3
tarsal/carpal				12	12
metatarsal	entire			21	21
1st phalange				14	14
2nd phalange				13	13
3rd phalange				2	2
total		157	161	95	413

Table 9 *Number of dog/fox bones identified.*

		number of fragments			
		left	**right**	**left/right**	**total**
atlas				1	1
axis				1	1
scapula		2	1		3
humerus	entire	2	1		3
radius	entire	4	4		8
ulna		2	2		4
femur	entire	3	4		7
tibia	proximal	3			3
	distal	1			1
	entire	13	4		17
metapodial				3	3
1st/2nd phalange				5	5
total		30	16	10	56

Table 10 *Number of hare bones identified.*

		number of fragments			
		left	**right**	**left/right**	**total**
maxilla		1	1		2
mandible			2		2
axis				1	1
scapula		1	2		3
humerus	distal	2			2
	entire		1		1
	distal	2			2
	entire	2	1		3
ulna		1			1
innominate		6	2		8
femur	entire	1			1
tibia	proximal	3			3
	entire	1			1
metatarsal				2	2
total		20	9	3	32

Table 11 *Total number of mammal bones identified.*

species	**number of fragments**
cattle	12,572
sheep/goat	4390
goat	976
pig	1636
horse	200
red deer*	25
roe deer	1
dog	218
cat	413
dog/fox	56
hare	32
small mammal	9
total	20,528

Table 12 *Minimum numbers of animals present, based on most frequently occurring bones.*

species	**minimum number (MNI)**	**based on:**
cattle	561	right horn core
	292	left distal and entire metacarpal
sheep/goat	197	left distal and entire tibia
goat	354	right horn core
	20	right scapula
pig	117	right mandible
horse	16	right distal and entire radius
red deer	5	right entire metatarsal
roe deer	1	right maxilla
dog	17	left entire and distal humerus
cat	31	right proximal and entire femur
dog/fox	16	left proximal and entire tibia
hare	6	left innominate

Table 13 *Minimum numbers of animals from selected sites in Scottish medieval burghs, estimated on the basis of the most numerous long bones (ie excluding horn cores and mandibles).*

	minimum numbers (MNI)					
site	**cattle**	**sheep/goat**	**goat**	**pig**	**horse**	**red deer**
Perth						
PHSAE	292	197	20	117	16	5
Canal Street I (Phase III)	5	3	1	1	1	
St Ann's Lane	17	21		9	1	
Meal Vennel (Phases 1-3)	15	8	6	4	1	1
Aberdeen						
Queen Street	16	9	6	12	1	1
42 St Paul Street	29	13	16	7	3	2
45-47 Gallowgate (Phases I-II)	7	6	1	2	1	1
53-59 Gallowgate (Phases I-III)	14	9	4	7	2	1
Gallowgate Middle School (Phase 2)	8	6	2	3	1	2
Elgin						
High Street	6	8	1	6	2	1

Table 14 *Minimum numbers of main meat producing mammals from selected Scottish medieval burghs, estimated on the basis of bones common to all of the sites.*

site	**cattle (L distal metacarpal)**	**sheep/goat (L distal tibia)**	**pig (R distal humerus)**
Perth			
PHSAE	292	197	62
Canal Street I (Phase III)	5	1	1
St Ann's Lane	13	4	2
Aberdeen			
Queen Street	8	4	6
42 St Paul Street	6	6	4
Elgin			
High Street	2	3	1

A comparison of the relative frequency of the main food forming animals based on the totals of bones identified for each species (excluding vertebrae other than the two neck vertebrae, ribs and loose teeth) is shown in Table 15.

These data indicate high rates of consumption of beef and mutton and low rates of consumption of pork and venison at all of the sites reviewed. It is interesting to compare fragment count data from this site with that from a site on the south side of Perth High Street, at 80–86 High Street (Smith 1997). Here, cattle numbers were strikingly lower when compared with the numbers of sheep/goats; indicating a possibility that there was a genuine preference for mutton on this site. However, this apparent contrast could be reflecting fluctuations in the hide and woolfell trade, since it is known from documentary sources that the level of trade did not remain constant throughout the medieval period (Lynch 1988, 269).

Size of animals

A summary of the size ranges of bones listed by species is included on theCD insert accompanying this volume.

Several authors have sought to compare the bone size ranges of selected bones of cattle and sheep from archaeological sites in an attempt to detect the possible effects of domestication, selective breeding and selective culling (Jewell 1962, 80–90; Hodgson 1968, 145–156). The parts of the bones for which size ranges have been compared are usually those which are well preserved, occur in relatively large numbers and which offer good measuring points. Such bones were often selected on these common-sense criteria and are those whose measurements yield data in which variance values are low. The difficulties inherent in comparing the relative frequencies of animals present at different sites have been discussed earlier. These same difficulties plus the fact that there is no overall agreement on which measurements to publish makes comparison of bone size ranges between sites difficult. In a Scottish context it is interesting to note that most of the measurements of animals from sites in Elgin (Hodgson and Jones, 1979), Edinburgh (Chaplin and Barnetson 1978), Inverness (Hodgson and Smith 1982), Inverkeithing (Hodgson and Smith 1983) and Aberdeen (Hodgson and Jones 1982b; Smith and Hodgson 1984; Smith and McCormick, 2001) fall within the size ranges of the Perth High Street material. For example, only six measurements of cattle bones and four of sheep from Elgin and Edinburgh extend the size ranges for Perth and these by only trivial amounts. Similarly, the vast majority of measurements taken from the medieval material from other sites excavated within the burgh of Perth, at St Ann's Lane, (Hodgson and Jones 1978), Kirk Close, South Methven Street, Canal Street II (Smith and Hodgson 1987, 199) 80–86 High Street, Meal Vennel, King Edward Street and Mill Street (Smith, 1997, Smith, 1996a; Smith, 1995a) also fall within the range of the large Perth High Street sample.

In a British context a comparison of the lengths and widths of cattle metacarpal and radii and of the lengths and widths of sheep metapodials (cannon bones) for the medieval levels at Perth, Southampton (Noddle 1975, 339), Walton, Aylesbury (Noddle 1976, 278–282), King's Lynn (Noddle 1977, 386–396) and Baynard's Castle (Armitage 1978, pers comm) shows that at Perth there were cattle with leg bones which were narrower and shorter and sheep with leg bones which were narrower than any reported from the other sites. The lengths of sheep metapodials at Perth significantly extend the length ranges published for medieval sheep.

Some authors have preferred to compare the estimated heights of cattle at the withers rather than the actual bone sizes (Fock 1966, 73; Armitage 1978, 52). The latter suggests that multiplying the metacarpal length by a factor of 6.13 gives the most reliable estimate of withers height for oxen. Assuming that most of the non-juvenile metacarpals from this site came from castrates (see discussion of sex and characteristics of meat producing mammals, below), the range of withers heights is 95.6cm–113.4cm. This compares with a range of 104.3cm–151.1cm for oxen at Baynard's Castle, London and 106.8cm–112.7cm for a collection of Northumbrian Chillingham bulls. Sheep withers heights calculated using Teichert's (1975) factors ranged from 46.76cm–65.83cm.

Thus, at Perth we have evidence of cattle which were shorter in stature and more gracile than their English counterparts and of sheep which were much more 'spindly legged'. On the same basis of comparison the data for cattle and sheep from medieval Lund in modern-day Sweden (Bergquist and Lepiksaar 1957, 30–45) fall within the size ranges for Perth except that some of the cattle and sheep metacarpals and some of the sheep metatarsals from Lund are longer.

It is difficult to compare the bone size of pigs from different sites because pig bones are seldom found intact due to a number of factors including butchery and the culling of a high proportion of individuals while still osteologically immature. Few data relating to the size of mature pig bones are available from medieval sites. The size of pig metapodials is reported on from Baynard's Castle (Armitage 1978, pers comm) and Walton, Aylesbury (Noddle 1976, 282–3). The lower length limits for these bones are extended considerably by the Perth material. This suggests the presence in medieval Scotland of smaller, lighter boned pigs than those found in England.

Withers heights of pigs may be calculated from the length of the astragalus, after the method of Teichert (1969, quoted in von den Driesch and Boessneck, 1974). Thus withers heights at the site covered the range of 55.5cm to 82.3cm, based on a total of 24 astragali (Smith, 2000a). The maximum height estimation is only exceeded in Scottish animals by a withers height of 88.6cm obtained from a medieval pig astragalus from medieval Phase 14 at Castle Park, Dunbar (ibid).

Penny, presumably referring to the post-medieval period, refers to large droves of small Highland swine

Table 15 *Percentages of food forming mammals from medieval sites in Perth, Elgin and Aberdeen, based on fragment count*

site	cattle	sheep/goat	goat	pig	horse	red/roe deer
Perth						
High Street (PHSAE)	63.5	22.2	4.9	8.3	1.0	0.1
80–86 High Street[1]	51.8	37.1	*	10.6	0.1	0.4
St Ann's Lane[2]	57.6	32.8	*	8.9	0.4	0.2
South Methven Street[3]	81.5	17.3	*	1.2		
Kirk Close[3]	76.1	18.7	*	4.8	0.2	0.1
Mill Street[4]	62.7	26.3	4.1	3.8	3.0	0.2
King Edward Street[4]	62.6	23.3	2.8	10.5	0.5	0.3
Kinnoull Street[4]	63.1	29.3	*	7.6		
Blackfriars House[4]	67.1	21.4	*	11.4		
Scott Street[5]	66.7	27.8	0.2	3.0	2.1	0.2
Canal Street I[6]	58.2	32.1	0.1	5.8	3.6	
Canal Street II[3]	67.7	27.1	*	3.4	1.8	
Canal Street III, Phases 1–5[7]	66.0	28.1	*	4.5	1.3	0.1
Meal Vennel, Phases 1–5[5]	69.7	20.6	2.0	6.4	1.0	0.3
Elgin						
High Street[8]	56.0	22.3	10.3	7.2	3.5	0.7
Aberdeen						
Queen Street[9]	58.1	24.9	1.8	13.8	0.2	1.2
42 St Paul Street[9]	69.1	17.2	2.2	8.4	1.6	1.5
45–75 Gallowgate[10]	63.0	27.6	1.0	7.1	0.8	0.6
45–47 Gallowgate[11]	61.3	25.6	0.9	10.2	0.7	1.4
Gallowgate Middle School, Phase 2[10]	54.9	32.1	4.5	7.6	0.2	0.7
16-18 Netherkirkgate Phases 1–4[10]	58.0	29.2	0.3	10.9	0.3	1.2
Rattray Castle[12]	49.9	34.2	*	11.1	1.9	2.9

notes * indicates that sheep and goat are expressed as one figure
antler fragments which are cast or not seen to be attached to skulls are omitted

sources 1 Smith 1997 2 Hodgson and Jones 1982a 3 Smith and Hodgson 1987
4 Smith1995a 5 Smith 1996a 6 Hodgson & Jones 1984 7 Smith 1996b 8 Hodgson and Jones 1979 9 Hodgson and Jones 1982b 10 Smith and McCormick 2001 11 Smith and Hodgson 1984 12 McCormick nd

being driven to the Andersmass Fair (held on the feast day of St Andrew) at Perth and remarks that 'this small kind have entirely disappeared' (1836, 137) (Illus 9). This type of pig, shown in contemporary illustrations as a small, bristly backed, hairy animal with a long snout and curly tail, probably lingered on in some parts of the Northern Isles of Scotland until the early part of the 20th century, but is now entirely extinct (Smith, 2000a).

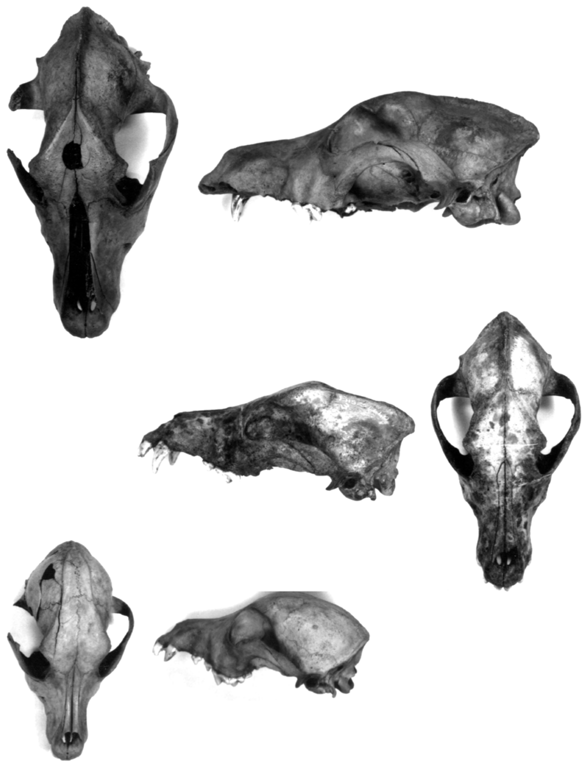
The horse remains from Perth range in size from those which compare almost exactly with bones from a modern Northumbrian pit pony to bones which approach the size of a modern small horse. Horses from other urban medieval sites in Scotland have been shown to have stood somewhat under 14:2 hands height and are thus classed as ponies in modern terms; for example, two animals from 80–86 High Street, Perth, one from Whitefriars, Perth and another from Castle Street, Inverness, showed very little variation in size, standing between approximately 13:1 and 13:2 hands height (Smith 1998).

According to John Major (*History*, 39) in his 16th-century History of Greater Britain, hundreds of unbroken horses were brought to Saint Johns (Perth) to be sold. He says of them 'they are of no great size, and are thus not fitted to carry a man in heavy armour to the wars, but a light-armed man may ride them at any speed where he will. More hardy horses of so small a size you shall no where find'. It seems that although small in stature the Perth horses were indeed ridden, as indicated by two unpaired spurs found on the site and thought to have belonged to a wealthy owner, perhaps a knight (Illus 6–8).

The horses from Perth may have been similar to the sturdy garrons of the Highlands, renowned for their activity and stamina (Grant 1961, 86). The ideal height for the garron was (and still is) considered to be about 14:1 hands high, and shortness of the cannon bone (metapodial) is a preferred feature (Fraser 1980, 85; 45). The medieval ponies of Scotland seem to have been very similar to this type.

Ten skulls of adult dogs were recovered; of these, nine were almost as long and wide as those of a modern adult fox-hound. The same skulls were also long and narrow in the muzzle. One dog skull was noticeably smaller than the others, had a rounded dome and lacked a sagittal crest; the specimen had its upper molars fully developed and was thus not a juvenile. This skull may represent a pet or lap dog (Illus 10, lower images). Thus there are apparently at least two different types of dog present. Clutton-Brock (1977, pers comm) and Harcourt (1974, 172–173) have cautioned against trying to relate the remains of animals from historic sites to distinct modern breeds. It was possible, however, to estimate shoulder heights for some of the intact long bones, using Harcourt's (1974) factors. Based on the humerus, there would appear to have been dogs at Perth High Street which ranged in height from approximately

Illus 9 *Conjectured appearance of the Scots sow, the unimproved pig prevalent in Scotland from the Iron Age to the Early Modern period. (Drawing by Maureen Rooney Mitchell)*



Illus 10 *Three dog skulls from PHSAE: frontal and lateral views.*

Illus 11 *Skull and long bones of bow-legged dog*

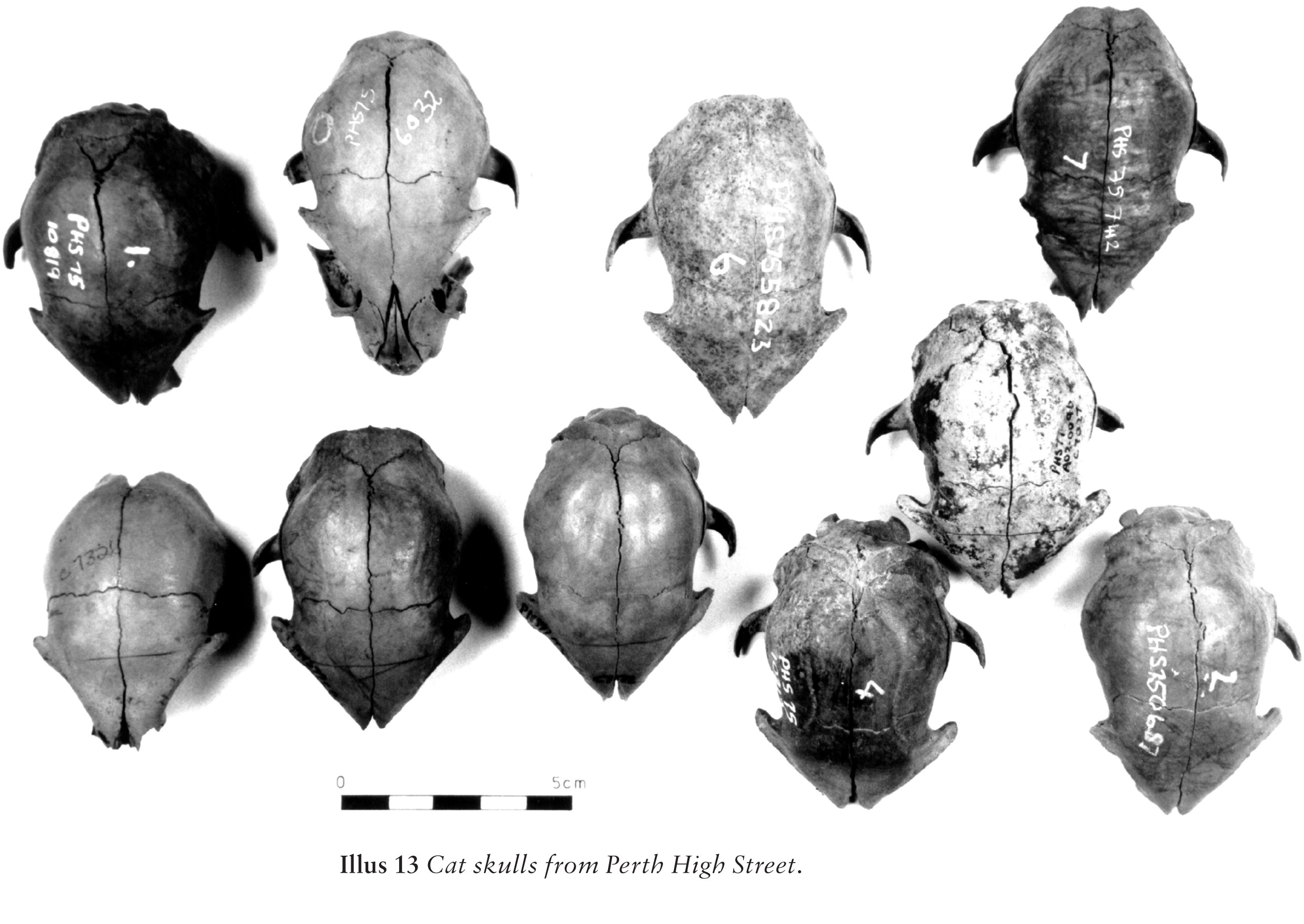
23cm to 59cm. Dogs found at other medieval sites within the burgh of Perth have mainly been found to fall within these height ranges, as at 80–86 High Street, Perth (Smith, 1998). However one larger animal, with a height of 63.7 cm estimated from the humerus, was found in a medieval context at Meal Vennel, although this example may have been unusually large (ibid). A substantially complete dog skeleton found in a cesspit at Mill Street and dating to the post-medieval period was of a very similar size and type to the medieval dogs from the High Street (Smith, 1995a).

Most of the canine bones from Perth High Street have dimensions which are indicative of working dogs (Illus 11) while a few indicate the presence of a smaller type of animal which may have been pets or lap dogs, although they could also have been ratters or even turnspits (Illus 12).

Seventeen cat skulls were found and examined (of which a selection is shown in Illus 13). None of these appears to have come from large wild cats (*Felis silvestris*) but it is impossible to state whether the feline remains came from truly domestic or feral animals. Cat long bones from the site are typical of those from sites in medieval urban Scotland, being altogether more slender in their mid-shaft dimensions than modern day domestic animals (Illus 14) (Smith 1998, 873).

Red deer bones are few in number (Illus 15), possibly because venison was not legally available to the general public since the hunting and killing of deer was controlled by law. The antler fragments are poorly developed and the metapodials are much shorter and narrower than those reported from Northern sites in Roman times (Hodgson, 1977, 24), although it is important to note that they are still much larger than their modern day counterparts on the hills of Scotland (Illus 16). This diminution in size from the Roman to the medieval period may reflect either a change in nutritional status due to loss of preferred habitat as deafforestation progressed in Scotland, or it may be due to the best carcasses going direct to the aristocracy. Red deer of a similar size to those from this site have been found at the urban medieval sites at King Edward Street, Perth, and at Gallowgate Middle School, Aberdeen (Smith, 1995a; Smith and McCormick 2001).

Illus 12 *Partial skeleton of small dog, Context 5019, A10702 and A10696, Phase IIa*



Illus 13 *Cat skulls from Perth High Street.*

Illus 14 *Cat tibiae from Perth High Street.*

Illus 15 *From left: red deer distal tibia and roe deer maxilla.*

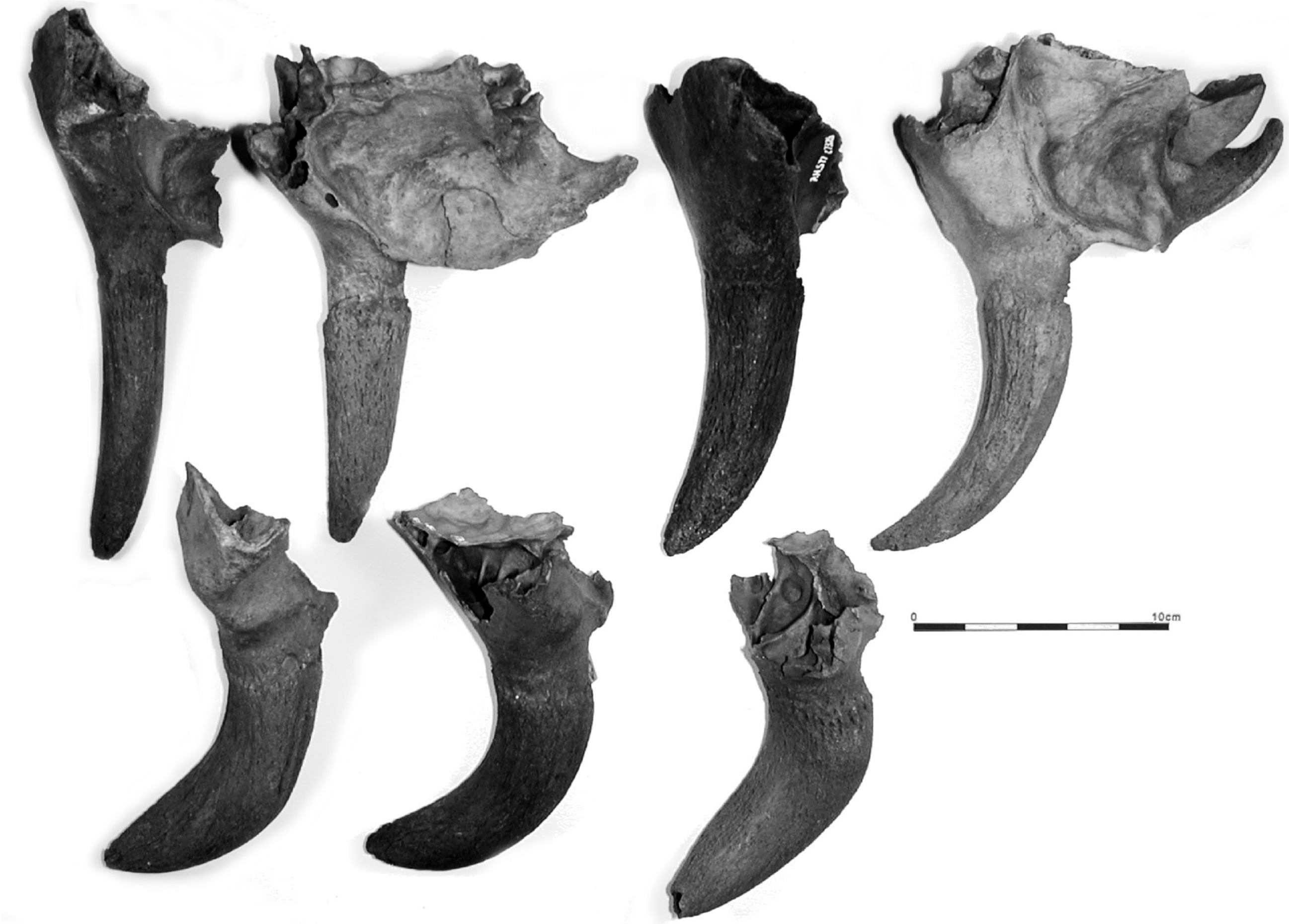
Illus 16 *Modern red deer stag (Camperdown Country Park, Dundee).*

Sex and characteristics of meat producing animals

Cattle

Statistical methods of distinguishing the sexual status of cattle from their metapodials (Howard 1963, 91–4; Mennerich 1968, 132–156) seem to be of doubtful general value; the results derived from Scottish medieval material were inconclusive (see Hodgson 1980, 30–32).

Attempts to discern discrete groups which may be attributed to sexual status, by plotting the scatter of selected measurements derived from cattle horn cores, were also inconclusive (ibid). The scheme for identifying the sex of cattle by classifying adult horn cores, proposed by Armitage and Clutton-Brock (1976, 332), was more useful. On this basis, most of the horn cores from the site appear to have come from oxen or cows (Illus 17, 18). About 4% were attributable to bulls. On the evidence of a grant of grazing by Helen de Morville to the Cistercian monks of Melrose Abbey in the reign of William the Lion (1165–1214), the medieval stocking ratio of bulls to fertile cows was maintained at 1:40 (Barrow 1979, pers comm; *Melrose Liber*, no 82).

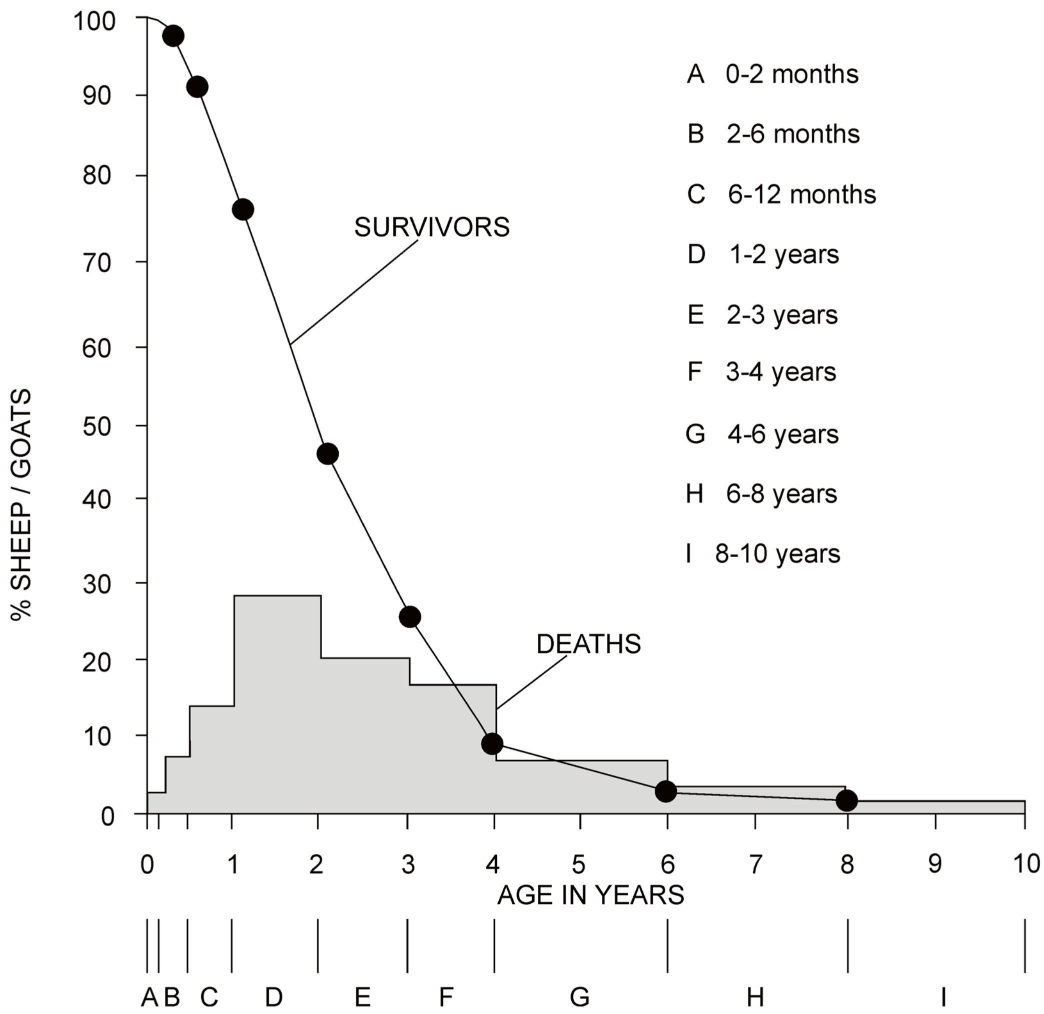


Illus 17 *Cattle left horn cores, showing variations in outer curvature.*

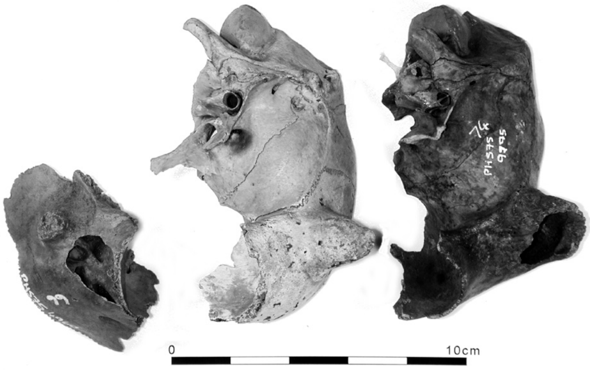
Illus 18 *Cattle right horn cores, showing variations in outer curvature.*

	A	B	C	D	E	F	G	H	I
% DEATHS	2.2	6.9	14.6	29.2	20.7	16.9	6.4	3.0	0.1
% SURVIVORS	97.8	90.9	76.3	47.1	26.4	9.5	3.1	0.1	0

n = 638



Illus 19 *Culling pattern of sheep/goats at Perth High Street (1975–77) medieval layers. (After Payne [1973])*



Illus 20 *Sheep skulls showing some horn core variations, with scur type on far left.*

Illus 21 *Sheep skull with robust horn cores.*

Illus 22 *Polycerate sheep skull.*

Illus 23 *Jacob sheep.*

Sheep

The sex of the sheep can be inferred from a culling curve (Illus 19) derived from a study of sheep/ goat mandibles. The curve for Perth High Street is interpreted as evidence of sheep being raised to produce meat and woolfells. This implies that male lambs were reared as castrates or wedders to an age well beyond the lamb stage, until they reached the optimum for meat and woolfell production. Helen de Morville's grant of pasture to the monks of Melrose Abbey makes it clear that large flocks of wedders (castrated males) were raised well into maturity, that is, until the age of three to four years (Barrow 1979, pers comm). It seems that in medieval Scotland, male sheep were castrated, despite the assertion to the contrary of John Major in 1521 (*History*, 38).

The sheep from the site were small, spindly-legged animals, probably of a variety of breeds. Their horn cores ranged in size from mere swellings (scurs) to large robust structures (Illus 20, 21). Dr M L Ryder (pers comm) has remarked on the close resemblance of one skull to that of a modern 18 month old Shetland ram.

One specimen was a four-horned (polycerate) type (Illus 22), while all the others were either polled or two-horned. The four-horned varieties of sheep are geographically associated with the Western seaboard of Scotland (Ryder 1978, pers comm) and are represented by the Jacob (Illus 23) and St Kilda breeds today. The archaic breed of Highland sheep referred to by Grant (1961, 78) appears to have been four-horned in the 16th century. In an archaeological context, polycerate sheep have been reported at Roman sites on Hadrian's Wall (Hodgson 1977, 22). They have also been found in small numbers at medieval Scottish sites, in Edinburgh, at 16–18 Netherkirkgate, Aberdeen and Rattray Castle (Chaplin and Barnetson 1974; Smith and McCormick, 2001; Hamilton-Dyer et al 1993, 204.

Illus 24 *Goat horn cores showing variations in size related to sexual dimorphism.*

Goats

Two distinct types of goat horn cores have been recovered from the site (Illus 24). One group consists of specimens which are massive in size, being both long and having a large basal circumference, while the other group is composed of specimens which are long but smaller in basal circumference. It is assumed that the former group represent males and castrates, while the latter group represent females (Illus 25). Both types of horn core are curved and untwisted; the bone is well formed as if the animals had been well fed.

John Woolliams of the Animal Breeding Research Organisation, Roslin, Midlothian, has established that the differences between the two groups of goat horn cores are statistically very significant. His colleague, Dr M L Ryder, interprets these differences as being due to difference in sex rather than of breed. Noddle (1977, 397), using a different statistical treatment, has demonstrated the presence of three groups of goat horn cores from medieval material at King's Lynn, which she attributes to females, male castrates and entire males.

Horses

Too few horse bones were recovered to allow for an analysis of metrical data derived from them in regards to the sex of the animals. Their small size has been remarked upon. According to John Major (*History*, 39), it was the practice in 16th century Scotland to geld most male animals and there seems no reason to doubt this. The Gaelic-derived name for the hardy Highland ponies, 'garron', correctly describes a gelding, and

Illus 25 *Female goat skull.*

although the term is now applied to all Highland ponies (Fraser 1980, 16), it provides further evidence for the practice of 'cutting' the animals.

Age of animals at death

Yealland and Higgs (1966, 140–142) have demonstrated that a knowledge of the age of death of domestic animals may lead to an understanding of the economy of a site. The killing of younger animals has been taken to indicate a plentiful supply of meat, a preference for younger, more tender meat or an inability or lack of incentive to raise young animals through adverse conditions such as drought in summer or cold in winter, when pasture and fodder might be in short supply. Noddle (1975b, 332) has argued that knowledge of the age of animals on slaughter is of less use in an urban setting than in a rural one. In the latter it tells us something of the standards of animal husbandry while in the former it may only reflect market pressures for meats and by-products. It is argued (see Economy of the burgh, below) that cattle and sheep at Perth High Street were not raised primarily for meat. During the lifetime of the animals, oxen would provide traction; horses, transport; sheep, wool and milk; and goats, milk, while at death they would provide meat and by-products. Some of these by-products may have commanded a greater market price in proportion to a single carcass than did the meat or fat which derived from it. The factors which influenced the age at which animals were slaughtered may have included: ability to husband animals; cost and availability of fodder in relation to financial return for meat and by-products; and fertility of female breeding stock. These factors would not necessarily remain constant but would vary with weather, political change, trade, economic climate and even with fashion.

Data have been published giving the ages at which teeth erupt and at which the articulatory ends of long bones (epiphyses) fuse (Silver 1969; Ewbank et al 1964, 424; Payne 1973, 299; Noddle 1974, 198–200). The ages of tooth eruption and epiphyseal fusion for modern domestic animals are usually younger than those quoted in historical sources. This may be due to the effects of improved animal nutrition and husbandry and the results of animal breeding. For these reasons the later date ranges quoted by Silver (1969, 285ff) are used. However, a cautionary note may be sounded: because of the variability in timing of epiphyseal fusion between animals of the same biological age, Noddle (1984, 24) has advocated using great care when estimating chronological age by these means, and suggests that if dental and fusion evidence do not agree, the former should be given greater credence.

Cattle: evidence from tooth eruption

Cattle lower jaws (strictly speaking, half mandibles) were examined for the presence of deciduous molars and for the state of wear of the third permanent molar. According to Silver (1969, 296), the presence of the third deciduous molar (dm_3), and the first molar (M_1) being visible in the crypt of the jaw but not yet in wear, would indicate that the animal was less than nine months old. Silver (ibid), quoting a 19th century source, suggests that the third permanent molar erupted between four and five years. Grigson (1974, 358) assumes that if the third accessory pillar (fifth cusp) of this tooth is in wear, the animal is about five years of age. The percentages of cattle in age groups based on these observations are shown in Table 16. These data show little evidence of the slaughter of calves for veal or calfskin production. Evidence from other sites within the burgh of Perth (for example Meal Vennel, Scott Street, Mill Street and King Edward Street) agrees well with the findings from the High Street, in that the great majority of the cattle were adult or immature/adult animals while calves were only rarely found.

Armitage (1978, 57) reports much higher percentages of juveniles from two sites at medieval Baynard's Castle, London. There, between 40–46% were juveniles and between 54–60% were adults. He argues that in medieval England there was no real incentive to rear fat cattle for food markets and that draught oxen were simply culled. In medieval Scotland the Crown and the merchant burgesses derived an income from the export of cattle hides. The animals concerned could only be slaughtered under strict burgh rules, thus we may be dealing with the remains of animals which were raised until the age of four to satisfy the needs of that export trade, rather than animals which were cropped at an optimum age or weight for their meat.

Table 16 *Percentage of cattle assigned to age group on the basis of dental evidence.*

	<9 months	9 months–4 years	4–5 years	>5 years	Total
n	14	26	26	150	216
%	6.5	12.0	12.0	69.4	99.9

note only 216 of the 774 cattle mandibles recorded were complete enough to be assessed

Cattle: epiphyseal fusion evidence

Selected long bones (radius, metacarpal, tibia and metatarsal) were examined to assess their age by determining the degree of fusion of their distal epiphyses (Silver 1969, 285–286). The frequencies of fused epiphyses and estimates of age are shown in Table 17. This evidence indicates that most cattle were successfully overwintered for two or more winters, and that 86% of the cattle survived beyond the age of three and a half years.

Table 17 *Frequencies of selected cattle bones having fused distal epiphyses and estimates of their ages.*

bone	number of distal epiphyses examined	%	age
radius	248	86.3	>3½ years
metacarpal	547	92.5	>2 years
tibia	319	90.0	>2 years
metatarsal	566	90.8	>2¼ years

Sheep and goats: evidence of tooth eruption and wear

Payne (1973) proposed a method of investigating the culling (or kill-off) patterns for sheep up to the age of ten years at slaughter. This technique of mandibular assessment was applied to 638 sheep and goat lower jaws dating to the 12th–14th centuries. Unfortunately, it was not possible to distinguish between sheep and goat mandibles, therefore both species are included in this analysis.

Illus 19 shows the cull pattern for the sheep at the site. It corresponds closely with the cull pattern obtained for a Roman site at Vindolanda in Northumberland (Hodgson 1977, 16) and that proposed for a closed flock of sheep on upland pasture in Britain in the 20th century (T Oliver 1977, pers comm). The results also compare favourably with culling patterns determined for other medieval sites in Perth, at Mill Street and King Edward Street (Smith, 1995a). It seems likely that the killing sequence would be:

i the slaughter of prime lamb and kids (probably tup hogs or uncastrated males) in the first year between weaning and first shearing

ii the killing of shearling tups in the second, third and fourth years along with barren ewes in the third and fourth years

iii the slaughter of breeding ewes and female goats between the fifth and seventh years as progressively they became barren, poor mothers or broken mouthed.

The old sheep (nine to ten years old) would almost certainly have been 'lead wedders', that is, male castrates allowed to live to an advanced age because of their ability to lead the flock to shelter and to herbage. We know little about the husbandry of medieval goats, but it seems likely that most of the males would have been castrated and that the goat equivalent of 'wedders' and 'lead wedders' would have existed.

The Perth High Street killing curve appears to indicate that the animals were being reared primarily for meat and wool-fells rather than for wool or milk. This is unexpected in view of the well established wool trade at Perth. However, data from a rural medieval site in Aberdeenshire, Rattray Castle, (McCormick nd) indicated that the majority (63%) of the sheep were killed between the ages of four to eight years. Rural communities in the hinterlands would appear to have sent their youngest animals to the burgh markets, while keeping the older animals in order to maintain wool production (Smith and McCormick, 2001). Older animals may not have been sent for sale at Perth, although their wool most certainly was.

Pig: evidence of tooth eruption

Silver (1969, 298) has published 18th century data regarding the eruption ages of the teeth of domestic pig, but cautions that only a very general reliance can be placed on eruption dates as an indication of age. From these data it is possible to propose a four-stage scale to study the culling pattern of medieval pigs:

age	dental characteristics
<1 year	no molars erupted; deciduous teeth present
1.5–2 years	M2 erupted but M3 not yet visible
2–3 years	M2 in wear; M3 erupting but not in wear
>3 years	M3 in wear

The results appear in Table 18. On the basis of this dental evidence, 71% of the pigs survived into their third year and 23.5% survived three or more years, in contrast to the results noted at medieval Baynard's Castle, London, where Armitage (1978) reports higher percentages of young pigs (26.2–36.4%) being slaughtered in their first year and lower percentages (10.8–18.2%) of pigs surviving past the age of three years.

Table 18 *Frequencies of pig mandibles, classified by probable.*

number of mandibles	%	probable age
32	14.8	<1 year
31	14.3	1½ to 2 years
103	47.5	2-3 years
51	23.5	>3 years

Selected pig long bones were assessed as to age on the basis of the absence of certain epiphyses (Silver 1969, 283–286). The results are shown in Table 19. The osteological evidence derived from the fusion of distal epiphyses on certain long bones differs from that derived from mandibular evidence. This may be for the reasons discussed above, but may also be in part due to differing survival rates for bones of young animals, which are more fragile with respect to the denser bones of older ones; younger bones tend to be less resistant to decay and so would be lost to the archaeological record. However it is still surprising to find that many of the pigs survived to an apparent age of at least three years, since once a pig has reached an optimum size, there is no economic advantage, other than in its capacity for breeding, in keeping it alive. Pigs, however, did appear to have been kept well into maturity at many other medieval sites in Scotland (for example Hodgson 1983, 14; Smith and Hodgson 1987, 198; Smith 2000a).

Horse

The incisor teeth of horses reveal valuable clues as to age (Silver 1969, 293). Seven specimens are reported on in Table 20. The animals ranged in age from five to eleven years old.

Table 19 *Frequencies of selected pig long bones, classified by probable age.*

bone	number examined	number lacking distal epiphyses	age inference
radius	65	60	92.3% younger than 3½ years old
tibia	144	99	68.8% younger than 2 years old
metapodial	109	72	66.1% younger than 2½ years old

Table 20 *Age assessment of horse maxillae and mandibles.*

specimen	accession/ context number	characteristics	estimated age
skull	A10446 C3835	incisors triangular; corner incisor hooked posteriorly	5–7 years
premaxilla	A3786 C2761	canines absent, corner incisor is triangular but lacks posterior hook	11 years
mandible	A4406 C1080	permanent corner incisor in wear, inner wall no longer level with jaw, canines blunt but star absent from incisors	5 years
L mandible	A3284 C3506	molars in similar state of wear as specimen A4406, therefore assumed to be of similar age	5 years
L mandible	A0749 C2001	molars in similar state of wear as specimen A4406, therefore assumed to be of similar age	5 years
R mandible	A02–1406 C7358	third molar in wear; but molars less worn than specimen A4406, therefore assumed to be younger	4½ half years
R mandible	A02–0112 & 0113 C7035	as specimen A02–1406	4 ½ years

Dog and cat

Dental evidence indicated that three of the canine mandibles came from puppies. Analyses of the frequencies of canine and feline long bones lacking epiphyses, with estimates of their probable ages, are given in Tables 21 and 22. On this evidence few puppies or young dogs died, while roughly equal numbers of kittens and adult cats died. This contrast possibly reflects the relative worth of the two species in medieval Perth. It may also provide an indication that young cats, or at least their skins, were a commodity in the fur trade (Smith 1998).

Red deer

Two out of six cervine metatarsals lacked distal epiphyses and probably come from young adults. Mature deer were also killed. There is no evidence for red deer calves having been killed.

Abnormal bones

Unfortunately, at the time of writing of the original animal bone report, few notes were made regarding abnormalities. A full re-examination of the bones was neither possible nor indeed desirable, given the vast quantity of bone which had been recovered and the rather chequered history of the material itself, some having doubtless been mislaid in the intervening years. However during the interval between the original report having been written and the deposition of the bulk of the material in the National Museums of Scotland annexe (then located at Newbattle), some additional observations were made on bones which were readily available for study. This material consisted mainly of the sheep/goat mandibles, the cattle tarsals and cattle first phalanges (from the first season of excavation) as well as a sample of the cattle bones in the keeping of the National Museums of Scotland.

Abnormal sheep/goat mandibles

All of the sheep/goat mandibles in which the cheek teeth still remained were re-examined for signs of dental disease. Eleven specimens (1.6%) were noted in which a degree of alveolar recession, indicating the presence of periodontal disease, had occurred. The most commonly affected area was located between the first and second molars (four cases), or between the third and fourth premolars (four cases). All of the sheep/goats in which this condition was observed were over the age of about two years in modern terms (that is over Payne's (1973) stage E, while five were over the age of about 6 years (that is Payne's stage H). The rate of periodontal disease at Perth High Street was slightly lower than at Meal Vennel, Perth, where about 2.4% of the population was affected.

Table 21 *Frequencies of selected canine long bones lacking epiphyses and their probable ages.*

	bones lacking epiphyses		
bone	proportion	%	age
humerus (proximal)	1/19	5.3	<15 months
femur (distal)	1/18	5.6	<18 months

Table 22 *Frequencies of selected feline long bones lacking epiphyses.*

	bones lacking epiphyses	
bone	proportion	%
humerus (distal)	4/45	8.9
radius (distal)	5/10	50.0
femur (distal)	29/54	53.7
tibia (proximal)	42/68	61.8

It is possible that dental disease such as this played a part in selecting which animals to cull. However, evidence of an economically important disease of sheep, broken mouth, was not found among the Perth High Street specimens (or for that matter, at any other site in Perth). This is not to say that this disease did not occur in the High Street material, indeed it is very likely that it did, since more than two-thirds of the sheep slaughtered in the UK at the present day are suffering from broken mouth (Henderson 1990, 580). However, the reason for the absence of evidence at the High Street and other sites is because the part of the jaw specifically affected by the disease is the oral end, which bears the incisor teeth. This part of the jaw is not well preserved under archaeological conditions. Animals suffering from broken mouth are unable to feed efficiently because the incisors become loose and drop out; the sheep thus become unthrifty and are usually weeded out from the flock. Modern veterinary repair may be effected by applying a splint around the incisors but there is no evidence that this remedy was available to medieval shepherds (Ewesplint, US Patent 4412818, 1983).

Slight congenital abnormalities (which are not harmful to the animals in life) were also observed. In one mandible, the fifth cusp (third pillar) of the third molar was reduced (C7079). This condition is found regularly in archaeological ruminant material (Andrews and Noddle 1975) and has been observed in cattle from Meal Vennel, Perth, and 53–59 Gallowgate, 16–18 Netherkirkgate and Gallowgate Middle School, Aberdeen.

A further sheep/goat mandible from the site also displayed what may have been a congenital abnormality, in that it lacked its second premolar (C5061; A12,260). Examination of the alveolar bone indicated no signs of resorption of the tooth socket, which would have been expected had the tooth ever been present. The condition of congenital absence of the second premolar has been reported by Andrews and Noddle (ibid) as occurring fairly frequently in archaeological material. It has also been observed in Scottish medieval cattle at 80–86 High Street, Perth and both sheep/goats and cattle at Canal Street III, Perth and 16–18 Netherkirkgate, Aberdeen.

Abnormal cattle phalanges

A 60% sample (consisting of 991 of the excavated 1,655 cattle first phalanges) was available for inspection for abnormalities. The most common abnormality in the material was the presence of more-or-less small depressions or lesions in the articular surfaces, of the type described by Baker and Brothwell (1980, 109–114). Type 1 depressions consisted of oval marks in the proximal and distal articulations, mainly orientated in an antero-posterior direction, while Type 2 consisted of narrow slits of variable length between the facets (ibid). Of the sampled phalanges, 240 bones, or 24.3%, were affected by depressions of these two types. At King Edward Street, Perth, 29% of the cattle phalanges were thus affected, and at Kinnoull Street, 30%. Similar abnormalities have been observed at medieval urban sites in Aberdeen, for example at 16–18 Netherkirkgate, Gallowgate Middle School and 53–59 Gallowgate. They are probably non-pathological in origin and would have conferred no ill effects on the affected animals.

However, other anomalies observed in the High Street phalanges were probably pathological: the most extreme cases probably represented the results of changes caused by osteoarthritis. Baker and Brothwell (1980, 115) consider that at least three out of the following list of four changes must be observed in order to confirm a diagnosis of osteoarthritis:

i grooving of the articular surface of the bone
ii eburnation or 'polishing' of the bone extension of the articular surface by new bone formation
iii exostoses around the periphery of the bone

Given these criteria, it was thought that osteoarthritis had been present in eight of the cattle first phalanges from the site, corresponding to 0.8% of the sample. A further 23 phalanges showed evidence of exostoses or extended articular facets, which may have been due to osteoarthritis, but may have had some other aetiology.

Two phalanges were affected by bony proliferations on their anterior shafts rather than the articular surfaces, which may have corresponded to the disease 'ring bone', a term more commonly used with respect to horses (ibid, 120). Ring bones are thought to be caused by concussion of the animal's foot against hard surfaces, or to faulty conformation of the limbs and thus may well have been an occupational hazard of draught oxen also. Diseases such as osteoarthritis and ring bone, if severe, would have caused lameness, and animals suffering from these conditions would be more likely to be selected for culling than healthy beasts.

Abnormal cattle tarsals

All of the cattle naviculo-cuboid and lateral cuneiform tarsals from the 1975 season of excavation were available for observation. In cattle, these tarsals form the hock joint of the hind limb and are often the site of an arthropathy known as spavin, in which exostoses typically form around the inner, lower aspect of the joint (Baker and Brothwell 1980, 117). A substantial number of the cattle naviculo-cuboids displayed a variety of bony changes, some of which were probably the manifestations of spavin (Illus 26). The symptoms most commonly seen in the material included combinations of the following:

i lipping or bony exostoses
ii porosity or increased vascularisation, appearing as circular pits, usually at the anterior edge of the bone, near its articulation with the lateral cuneiform, and occasionally having a honeycomb appearance
iii interarticular lesions, particularly on the distal surface

Illus 26 *Ankylosed cattle metatarsal and naviculo-cuboid tarsal, lateral view.*

iv fusion of the naviculo-cuboid with the lateral cuneiform, to the extent that the junction between the two bones becomes obliterated. While it is conceivable that in some cases such fusion may be congenital, in the presence of the above symptoms it seems more likely to be pathological

v complete fusion of the proximal metatarsal with the naviculo-cuboid and lateral cuneiform

One hundred and fourteen cattle naviculo-cuboids were observed. Of these, 25 showed some combination of the above symptoms, with the worst affected showing at least three different symptoms, in other words, 21.9% of the total were diseased. Two of these tarsals also exhibited grooving and eburnation as well as exostoses, and so could be more properly considered to be symptomatic of osteoarthritis, but the remainder were thought to represent animals suffering from spavin to a greater or lesser degree.

Of the lateral cuneiform tarsals examined (12 examples), nine showed some degree of abnormality ranging from small interarticular lesions (which may have been, like those seen in the cattle phalanges, non-pathological) to deeper, more extensive interarticular lesions and associated lipping. The proximal articulations of these small tarsals, that is, the junction with the distal aspect of the naviculo-cuboid, were affected in four out of twelve cases (33.3%) while the number affected distally, at the articulation with the metatarsal, was seven out of twelve cases (58.3%).

Similarly affected tarsals have been found at other medieval sites in Perth, for example at Meal Vennel, Mill Street, King Edward Street and Scott Street and at Ayr, Harbour Street (Smith, unpublished). The frequency of occurrence of fusion of the lateral cuneiform with the naviculo-cuboid was highest at Meal Vennel, where 11 out of 55 cases were noted (20%) as compared with Perth High Street where only seven out of 114 tarsals showed complete fusion (6.1%).

The exact cause of spavin is not known, but a variety of factors have been cited, such as heavy work on hard surfaces and faulty conformation of the leg. Affected animals may exhibit only a slight degree of lameness and if allowed a period of rest, in which time the joint may ankylose (as in the six examples above), the animal will still be useful for slow work (Baker and Brothwell 1980, 119). It is likely, then, that some plough oxen, as represented by these diseased tarsals, were present in the High Street material, as well as at other sites in Perth.

A number of cattle metatarsals displayed arthritic changes which may also have been related to hard work. Four of these could be classified as being osteoarthritic (C7024; C7326; C2404, A3204; C9021, A02 0454).

Other abnormal bones: evidence of trauma

Several cattle bones showed signs of traumatic damage, for example, the lateral processes of two vertebrae displayed evidence of healed fractures (C7335; C7185). A cattle skull fragment bore evidence of what was probably a healed, depressed fracture, in which a roughened circular depression on the right frontal bone, near the base of the horn core, corresponded with a bulge on the internal, cranial surface (Illus 27). This damage may well be evidence of rough handling of the animal, or even the result of a failed attempt at pole-axeing, but could also represent the end result of aggression between animals known to bear substantial horns.

A smooth swelling on the medial portion of a cattle metatarsal shaft (C7140, A02–733) was probably an ossified haematoma (Illus 28). Such modification to the bone can occur following a blunt impact to the bone (ibid, 83) such as may have followed a kick from another beast, for example on a plough team.

Illus 27 *Cattle skull fragment showing lesion on frontal bone.*

Illus 28 *Diseased cattle metatarsals, posterior distal view (from left): possible ossified haematoma on shaft; osteoarthritis.*

Abnormal pig bones

Two bones of pig, a right scapula and left tibia, showed changes which were probably due to osteomyelitis (C9051, A02–0355; C9095, A02–0204). The glenoid of the scapula (the articulation with the humerus) was surrounded by a heavy band of exostoses. This new bone growth was perforated by three large sinuses, through which it could be seen that necrosis, (destruction of the original bone) of the neck of the scapula had taken place. In the tibia, there was massive expansion of the shaft above the distal end of the bone. The new bone growth was mainly rough and porous, although there were also some denser areas present. A line in the new bone formation may represent a break in the bone, perhaps a pathological fracture which often accompanies osteomyelitis. Such infection is often haematogenous (blood-borne) and commonly affects the radius, ulna and tibia (ibid, 64). Both of these pigs must have been very lame indeed.

Abnormal dog and cat bones

All of the dog and cat bones were available for study and were re-examined for abnormalities. The dental health of the dogs was generally good. Only one case of ante-mortem tooth loss was detected, a left mandible in which the alveolus (root hole) for the second premolar had been filled in with new bone (C2166, A4640). Two other cases of missing teeth were probably congenital in origin, since there was no apparent roughening of the alveolar bone; these teeth had failed to develop and had never been present. These were a right maxilla with absent first premolar and a right mandible with a missing third molar (C0547, A7522; C0206, A1737). Both the first premolar and the lower third molar are insignificant teeth in dogs and their absence is relatively common both in archaeological and modern material. Other congenital dental anomalies observed were examples of tooth crowding, resulting in rotation of the teeth in the lower jaw (C2166, A4640; C3696, A7690; u/s). The dog long bones were mainly free from visible disease, with the exception of a skeleton of a very small individual (C5019, A10702 and A10696) (Illus 12). The long bones, vertebrae and ribs of this tiny animal showed various symptoms of osteoarthritis, including lipping, grooving and eburnation of articular surfaces, particularly in the spine. There was also localised osteoporosis, most noticeable in the lower fore limbs. Unfortunately the skull and teeth of the animal were not retrieved, but it was very likely that it had been elderly. This, together with the small size of the animal, and its obvious osteoarthritis, make it tempting to suggest that it may have been a cossetted pet rather than a working dog. Indeed, its disposal in a pit rather than on an open midden may reflect its worth to its owner (Pit 5259) (Smith, 1998).

As with the dogs, cat dental health was good, perhaps because of the young age at which many of the cats had died. Tooth crowding, of the first molar against the fourth premolar, was however observed in five mandibles.

A few long bones of cat demonstrated the results of trauma. A radius, associated with a partial skeleton, was probably fractured (C2714, A2125) while three tibiae displayed bony lumps on the posterior aspect of the shaft which probably indicate a response to traumatic damage of the musculature and periosteum (C2419, A3149; C3597, A6822; u/s). Such injuries perhaps reflect the precarious existence of cats within the medieval burgh.

In addition, there were several instances of exostoses and/or eburnation in the joints of long bones, particularly in a misshapen femur head, indicating a defective hip joint (C2430, A3961/3396).

Distribution of bones over the site

Various archaeological features such as middens, buildings, pits and paths were identified at the site (see Fascicule 1). The distribution of mammal and bird bones over the site was studied with respect to these groupings, the data being included on the CD insert accompanying this volume.

The frequency of occurrence of different parts of the skeleton of cattle and sheep/goat was compared for selected context groups. Data Tables 3.1.1–3.2.34 (see CD insert) show the numbers and percentages of cattle and sheep/goat bones which would be expected if a whole animal carcass was recovered, compared with actual numbers and percentages found. The context groups chosen were middens from which at least 50 cattle bones had been recovered as well as all buildings on the site. Other features which contained fewer than 50 identified bones in total were not further analysed, since the sample numbers were considered too small to be statistically reliable.

When the frequency of occurrence of cattle horn cores (Illus 17, 18) is examined, it is obvious that although there are fluctuations with time, it is always higher than expected. The pattern appears to be one of high frequencies in the early phases, for example 18.4% in midden M2.1b (Phase Ic) where the total number of cattle bones (n) was 54, increasing with time throughout Period II (late 12th century), then dropping by Phase IVb (4.5%; n=200). In Period V (14th century), there are notable differences in the contents of the middens. Although midden M8a (Phase Va,Vaa) contained only 4.7% cattle horn cores, the overall sample was large (n=889). This relatively low horn core frequency contrasts with the situation in M4a (Phase Vaa–Vc) as well as in M3a (Phase Vb–Vc) where the horn core frequencies were 30.7% (n=199) and 40.4% (n=193) respectively. In some instances, the frequencies of mandibles are almost equal to, or exceeds that of horn cores, which perhaps indicates that the horn cores were still attached to skulls when they arrived on site.

In the case of goat horn cores, frequencies also fluctuate with time. They were particularly plentiful in midden M4a (Phase Va,Vb), where 32.9% of the sheep/goat bones (n=79) were identified as goat horn cores, and in M3a (Phase Vc; 33.8%, n=71). It has already been noted that cattle horn cores were also plentiful in M4a and M3a. The frequencies of sheep/goat mandibles are also consistently higher than expected. However, as sheep and goats could not be distinguished, it cannot be determined whether whole goat heads, or even carcasses, rather than detached horn cores, were imported to the site.

As regards other skeletal elements of cattle, sheep and goats, it is apparent that although all parts of the carcass were well represented at the site, lower meat yielding bones from the lower limbs (metapodials and phalanges) were plentiful in all periods. This trend is particularly noticeable in midden M8a (Phase Va,Vaa) from which large quantities of phalanges were recovered, accounting for just over 31% of the total cattle bones from this feature (cattle n= 889). It is possible to account for the presence of these numerous toe bones in several ways: they may have been brought to the site attached to cattle hides; they may have been the detritus of butchery; or they may have been the remains of industrial processes such as hoof-boiling in order to make glue or neatsfoot oil.

Animals in the economy of the burgh

Duncan (1973, 30–50) has drawn a profile of Perth in the century from 1130 to 1230 and has emphasised its relationship with the nation, the surrounding countryside, and the trading and manufacturing industries within its boundaries. In tracing the burgh's development from a settlement of the eleventh century where ships came up the Tay to unload, to its status as the second town in Scotland, Duncan attributes some of the impetus for this change to royal patronage and a small active business community. The activities of these merchant burgesses were mainly concerned with the manufacture of cloth and leather goods, the import of wine and grain and export of wool, hides, skins and salmon.

Before interpreting the meaning of the osteological evidence it is necessary to understand the legal status of the royal burghs as regards the marketing of cattle, sheep and their products, and to understand the laws governing the killing of game (that is, deer, wild boar and hare) in medieval Scotland, and how these evolved.

Legal status of the burghs

Dickinson (1961) has examined the role of the burgh in the mercantile revolution which led to the change from a self-supporting agricultural Scottish economy to an organised trading economy. During this change the agricultural products of wool, woolfells (sheepskins with wool attached), skins and hides were exchanged for manufactured goods, for luxuries and for raw materials in which Scotland was deficient. This trading was in the hands of the burgesses of the new burghs which had been deliberately created by the king.

The trading privileges enjoyed by the burghs have been discussed by Keith (1913, 454–71), Ballard (1916, 16–29), Grant (1930, 383) and Dickinson (1961, 112). These privileges were enshrined in the charters granted to the burghs. Innes (1868, XXXV), in discussing the oldest burgh charters in Scotland, which date from the reign of William the Lion (1165–1214), advances other charter evidence to show that they point 'plainly to a previous burghal organisation'. Specifically a writ of David I dated 1124x1127 refers to a toft in the burgh of Perth, (Barrow 1999, no 19) yet the earliest extant burghal charter is that granted by William the Lion to Perth in 1209 (*RRS*, ii, no 467; Duncan 1974, 41). This latter charter shows the double nature of the monopoly involved. Firstly, it involved a monopoly of trade against the agricultural hinterland of the Sheriffdom of Perth and secondly, it was a monopoly against foreign merchants concerned with exports and imports. Grant (1930, 358–406) has discussed the effects of this double monopoly on the economic life of Scotland. Later, in the reign of David II (1329–1371) the privileges as regards foreign trade were summarised and made applicable to all the burghs of Scotland. In short, the charters granted to the burghs (and therefore to the burgesses) the power to control all exports and imports and to control the selling of agricultural and craftsmen's produce from the surrounding countryside by allowing such produce to be sold only at legal fairs within the burghs.

The new status of being a burgh was largely a legal concept in that the burgesses enjoyed special laws and privileges, and that the laws of the burghs were different from the law of the land. In return for these privileges the king received useful revenue in hard cash (Dickinson 1961, 112–13). Barrow (*RRS*, i, 52) has reviewed the sources of revenue available to Malcolm IV (1153–1165). Included in these are tribute or cain in cash or kind, enjoyed by the king by virtue of his regality, and customs duties. The same author cites an example of a charter attributed to David I which refers to his cain at Perth and which is further evidence of a burghal organisation before William the Lion's charter to Perth (ibid, 54; *APS,* i, 358; Barrow 1999, no 127).

Laws governing the hunting and killing of game

Gilbert (1975) has traced the origin and evolution of hunting reserves in medieval Scotland and has examined the interaction of their development and the economic activities of the common people. Historically, prior to the 12th century, Scottish kings had favourite hunting areas rather than actual hunting reserves.

The principle of Roman law that game was *res nullius*, that is, that it belonged to whoever killed it, regardless of where or on whose land it was killed, was probably current in Scotland before the 12th century, although it was not universally accepted. In the 1130s David I established forests as hunting reserves in

Scotland. The king created Royal Forests, probably by proclamation, and Baronial Forests by the process of free forest grant. Legally, the king had the right to reserve all greater game to himself but this was never seriously enforced and did not, in Gilbert's view, limit the operation of *res nullius*. A subject with free forest grant could only have a forest (reserve) on his own land and then only by royal grant. The owner of a forest legally controlled everything on or above the ground.

A body of forest law developed: this may first have been written down by the mid-14th century and is reflected by several later sources (*APS*, i, 749, 652; Skene 1613). This body of law incorporated many of the rights exercised and regulations imposed on royal and baronial forests. The reservation of game by the creation of royal forests or by the grant of free forest referred to greater game, later known as venison, and which consisted of red deer, roe deer and wild boar. Lesser game was reserved by the grant of free warren, and this applied to fox, rabbit, marten, wild cat and hare.

Gilbert (1975) argues that the right given to anyone to hunt anywhere (*APS*, i, 652, c31, *Quoniam attachiamenta*) refers only to freemen hunting outside reserves (forests and warrens) and applies only to lesser game. He correlates the increase in the proportion of the population having the right to hunt in the 14th century as due to a decline in serfdom, with increased interest on the part of landowners of that time in creating reserves. Such reserves, deer parks and rabbit warrens, in which game could be more easily controlled and preserved, were created on the basis of property rights rather than that of royal grant. It appears, therefore, that the hunting activities of the common people were affected by a limitation of the principle of *res nullius* and by a reduction in the number of places in which they could hunt. In some areas this situation may have been reached long before the act of 1621 (*APS*, iv, 629, c31) which resulted in landowners being the only people with the right to hunt from that date. The erosion of the rights of the common people to hunt game and the lack of opportunities for them to do so may explain in part the relative absence of the remains of wild boar and deer in the Perth High Street assemblage. There is also the possibility that in the lowlands of Scotland the increased economic activity near the burghs in the 13th and 14th centuries destroyed the natural woodland habitat of game and created a shortage (Gilbert 1979, pers comm). Depletion of game stocks would give additional incentive to landowners to create deer parks where the animals could be conserved.

Evidence of animal based industries

By-products from common animals which would have been in demand in medieval Scotland would include hides and skins either for export as such, or for production of leather goods and parchment for home consumption; wool and hair for textiles, grease and tallow to make candles, tapers, soap and lubricants; dairy products from the milk of sheep, goats and cows; offal, blood, and bone as food for people and dogs and cats; gut and sinew; bone, antler, hoof and horn for ornaments, keepsakes and personal and household goods; goose feathers to make flights for the bolts of cross-bows; dogs' dung for use in bating or puering leather prior to the actual tanning process (Forbes 1966, 4).

The evidence of animal based industries at Perth is sixfold:

i the large number of horn cores present
ii the large amount of animal hair present
iii carcass analysis reveals the presence of a high proportion of low meat yielding bones
iv the customs accounts
v the evidence of maps and place names
vi the presence of tools and artefacts believed to be associated with skinning and tanning

Evidence of the horn cores

The large numbers of cattle (1,753) and goat (722) horn cores and the almost complete absence of the skulls from which they came is indicative of commercial waste from a horner's industry (Illus 29, 30). Armitage and Clutton-Brock (1976, 329) have reviewed the many uses to which horn was put in European towns before the industrial revolution and have thereby demonstrated its value as a commodity. They argue that ox horn was probably preferred to cow simply because it was larger and that the discarded horn cores can appear either among general urban refuse or more rarely as a single collection of industrial waste. The horn cores of cattle and goat at Perth High Street seem to have been dumped amongst general town refuse. At only one other site in Perth has such a relatively high proportion of cattle horn cores been discovered; at South Methven Street 53% of the cattle bones from the town ditch were in fact horn cores and are presumed to be industrial waste (Smith and Hodgson 1987, 197).

The large number of goat horn cores present at sites in Perth (Illus 24, 29) is in sharp contrast to that found at the excavations of medieval levels at High Street, Edinburgh (Chaplin and Barnetson 1978, 234), Elgin (Hodgson and Jones, 1979) and Aberdeen (Hodgson and Jones, 1981). Prummel (1979, 1983) has reported large numbers of cattle and goat horn cores from the early medieval port of Dorestad and the mid medieval town of Den Bosch in the Netherlands. In both cases there is a relative absence of the post-cranial bones of the two species as is the case at Perth High Street. The same author speculates that the preponderance of horn cores compared with other bones may be due to the importation of loose horns or to the practice of sending hides to a tannery with horns still attached to them. None of the Perth goat horn cores display the rectangular holes reported by Prummel (1983) and Noddle (1977, 397), although one example has been pierced through by a transverse perforation (The worked bone; Cat No 78, A0238).

Illus 29 *Male and female sawn goat horn cores.*

Illus 30 *Sawn cattle horn cores.*

The cattle horn cores from Perth High Street are curious in that several of them have been sawn through, mainly at the base, although a few have been sawn twice, once at the base and again near the tip (Illus 30). This contrasts with the situation at a medieval horner's shop at York where the cattle horn cores were found still mainly attached to the skull (Ryder 1977 pers comm). Sawn cattle horn cores have also been found at other sites in Perth, for example at Kirk Close (Smith and Hodgson 1987, 197) as well as Aberdeen (Smith 2001) and it is believed that such care in removing the horns is further evidence of their use in horning, rather than trading the hides with the horns attached.

Evidence of the hair

Ryder (1977, pers comm) has suggested that the large amount of animal hair found at Perth High Street is indicative of the presence of a skinner's workshop nearby. Hair from horse, pig, ox and goat is reported from the site, along with textiles made from wool and goat hair (see The textiles).

Evidence of the carcass analysis

Chaplin (1971) drew attention to the need to study the relative frequencies of bones of high meat value and those of low meat value as a means of distinguishing bones deriving from domestic refuse from those which formed commercial debris. Chaplin and Barnetson (1974, 230) have interpreted the presence on the same site of equivalent numbers of high and low meat yielding bones to indicate that the slaughter, carcass dressing, butchering and consumption of meat occurred on or near the area excavated. This appears to have been the case in the medieval levels of the High Street and Tron Kirk sites in Edinburgh which they reported on. Anatomical distribution analysis has been applied to medieval sites at Aylesbury, Southampton and King's Lynn by Noddle (1975b, 322; 1976, 271–6; 1977, 385) although she has cautioned against too numerical an interpretation on the grounds that certain bones and parts of bones survive cooking and burial in soil better than others.

The situation at Perth High Street is difficult to interpret, probably because the bone remains may be a mixture of both domestic refuse and commercial waste. The femur and humerus are bones of high meat yield representing the leg and shoulder joints respectively while the metacarpal and metatarsal bones are of low meat yield. (Tables 1 and 2 show the frequency of these bones for cattle and sheep; see also CD insert: Animal bone data for carcass analyses of bones found in middens and buildings). If the frequencies of the left distal ends of cattle femora and humeri are compared, it can be seen that low meat yield bones outnumber high meat yield bones by between two and three to one (metatarsal:femur = 274/73 = 3.75, and metacarpal:humerus = 292/149 = 1.96). These ratios indicate that commercially valuable meat joints were moved from the site after slaughtering, carcass dressing, and butchering; in other words, there was commercial marketing of beef. Alternatively the relative abundance of low meat yielding metapodials may be due to industrial processes associated with animal by-products. The theory that joints of meat were dispersed from the site is apparently contradicted by the large numbers of shoulder blades and pelvic fragments that are present. These bones are associated with heavy musculature and therefore with meat but the explanation of their presence may lie in the fact that the blade of the shoulder joint and the aitch-bone of the haunch were boned out by medieval butchers before the joints were sold. Unfortunately, the surviving records of the Flesher Incorporation at Perth do not start until 1603 and even these late records shed little light on butchery practice, being more concerned with the Fleshers' properties within the town.

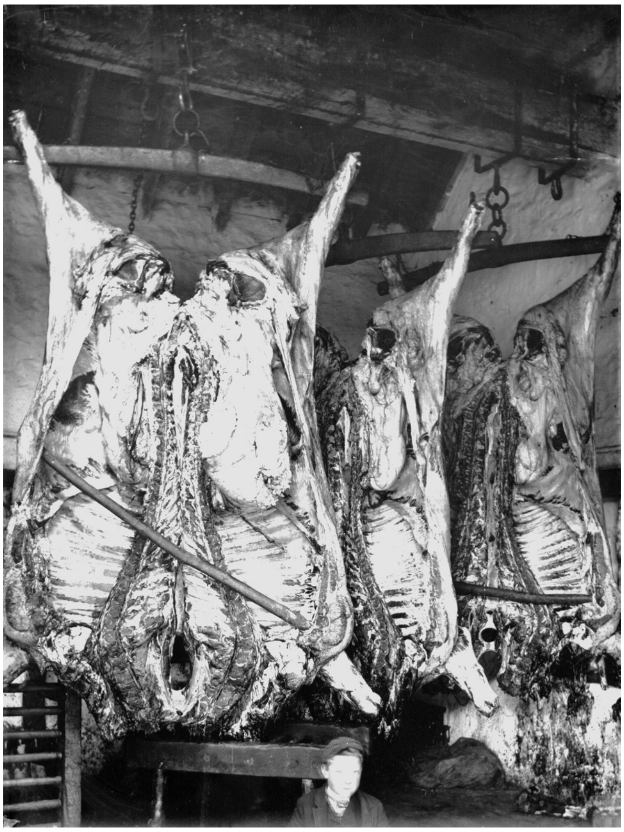
The low numbers of cattle toe bones, astragali and calcanea are difficult to reconcile with the large numbers of metapodials; both types of bone being in the low meat yield category. Possibly the low numbers of toe bones (phalanges) is due to the production of 'neatsfoot' oil. Along with the phalanges, the whole hoof was used to produce this oil, which was employed as a lubricant for leather. Horns and hooves were distilled to produce liquor of ammonia and sal ammoniac (Jackman 1978, pers comm).

An alternative explanation for the relative lack of cattle phalanges may be that the hides were sold by weight with the feet on. Noddle (1977, 381) cites evidence of this practice in medieval Germany and suggests that the comparative rarity of cattle toe bones at a medieval site in King's Lynn is due to it. There was a thriving export trade in hides at Perth and trade links existed with the Baltic, the Low Countries and with Germany. However, documentary evidence from the Exchequer Rolls indicates that hides were sold according to size, quality and number, being reckoned in dacres and lasts (ten hides to the last, twenty lasts to the dacre; Guy 1986, 64) rather than by weight. There would therefore be no reason to include either the feet or horns as a 'make-weight'.

The preponderance of low meat yielding bones at Perth High Street may be construed as evidence that we are dealing with poorer people, perhaps craftsmen rather than merchant burgesses, and that the high meat yield joints were sold to people from a better-off part of the burgh. If this is so, and the evidence for it is slender, it is not to argue that there was a lower level of nutrition because lower prestige meats such as spare rib, offal and marrow bone for stock have high nutritional values. The cattle sized vertebrae are frequently split longitudinally indicating that sides of beef were dealt with rather than whole carcasses. This splitting of carcasses into sides may have been a preliminary to the butchering into joints discussed above. Illus 31 shows split carcasses in a19th-century butcher's shop.

A similar comparison of sheep/goat long bones of high and low meat yields is not possible because of difficulties in distinguishing between distal metacarpals and distal metatarsals. A comparison of the numbers of proximal ends of the humerus, femur and metapodials would be invalid because the heads of sheep humeri and femora are small and easily eroded and so can be lost to the archaeological record. Chaplin and Barnetson (1978, pers comm) found it convenient to use mandibles (jaw bones) as being indices of 'low meat yield cuts' but this may not be appropriate here for several reasons: firstly it was not possible to distinguish sheep from goat mandibles; secondly in times of high meat prices in Britain in the modern period, the muscles associated with jawbones have been carefully cut out by butchers for use in making mince and sausage meat and thirdly if the mandibles were discarded while still attached to the skull, a different, industrial aspect of the economy, rather than a domestic one, may be represented. If however the sheep/goat jaw bones are indeed treated as an index of low meat yield, there is *prima facie* evidence of the removal of shoulders and legs of mutton from the site, that is, of commercial retail of mutton.

An analysis of the skeletal remains of pig has not been attempted because bones from young animals are readily eroded by cooking and by burial in soil.



Illus 31 *Cattle carcasses split into equal sides of beef; 19th century Perth butcher's shop (copyright Perth Museum and Art Gallery)*

Evidence of the Customs Accounts

The customs duties were of two kinds, the toll or *parva custuma* paid on produce which was brought for sale at the burgh market either from the country or abroad and included harbour duties on ships arriving in port, and the great customs or export dues paid on wool, woolfells, skins and hides which were traded overseas (Dickinson 1961, 114). The *parva custuma* or petty custom was regulated by two codes, *Assisa de tolloneis* and *Custume portuum,* and was levied by the provosts of the burghs, whereas the great custom was collected for the king by special officials or *custumarii.* The 19th-century editors of the Exchequer Rolls have argued that Scotland enjoyed virtual free trade in imports until the end of the 16th century and that the rates of custom specified from time to time in the *Assisa de Tolloneis* (see *APS*, i, 668, Appendix iii, for example) are burghal taxes trifling in amount compared with the great custom on the same articles (*ERS* i, pp xcv–xcviii).

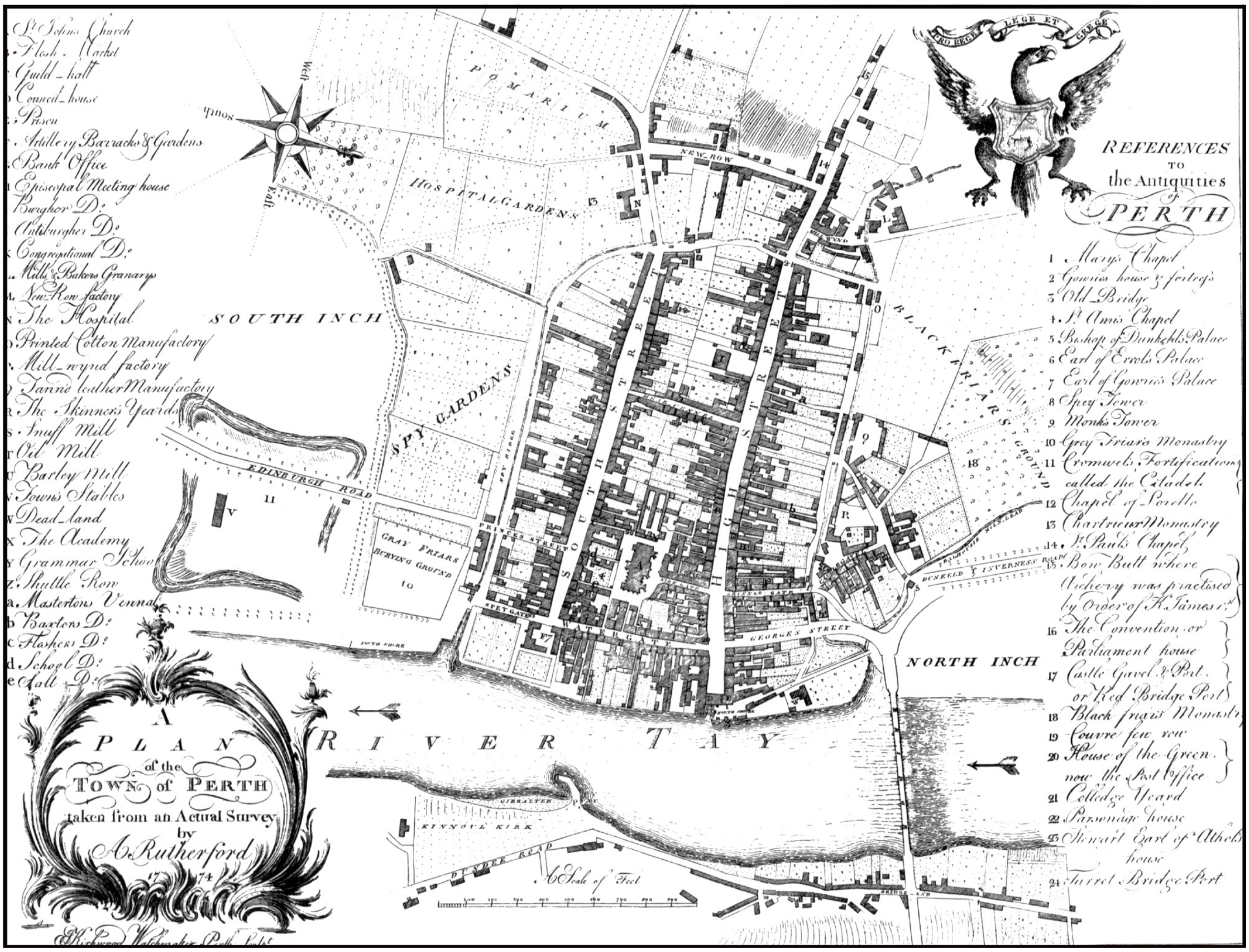
The accounts of the *custumarii* are recorded in the Exchequer Rolls only from 1327, but the references in a charter of David I's reign to cain (levied on ships and merchants bringing imports to Scotland) is evidence that royal revenues were derived from trade much earlier than this (Barrow 1999, no 127). Sometimes these accounts reveal the actual rate of custom to be levied on each article at that time (*ERS*, i, pp xcix).

These great customs formed a substantial part of royal revenue and it was therefore in the interest of the crown to encourage export (Mackinnon 1920, 88). In times of national economic crisis, for example, the raising of the ransom for King David II, the royal revenue was increased by trebling and later quadrupling the rate of duty to be levied. Webster (1975, 169) points out that the revenue recorded in the Customs accounts depends exactly on the amount of customable material passing through the ports and that these records may therefore be used as economic evidence of trade patterns. Grant (1930, 353) has used this evidence to estimate the relative importance of the various burghs in relation to the export of certain commodities and showed that by 1379 Perth and Dundee were fourth equal in importance as regards the export of hides.

During the late 14th–early 15th centuries, wool and woolfells together accounted for over 90% of customs receipts, and during this period (1327–1431), Perth exported an average of about 2.6 tonnes per year, the national average for the whole of Scotland being about 52 tonnes (Stevenson and Torrie 1988, 191).

Evidence of maps and place names

Rutherford's map of the 'Town of Perth' dated 1774 gives further indirect support for the contention that there was a well developed commercial meat trade in Perth (Illus 32). Place names within close proximity to the site include Fleshers' Market and Fleshers' Vennel while other names in the town are Skinners' Yard and Skinner Gate. A legend on the map reads 'Tanned Leather Manufactory'.



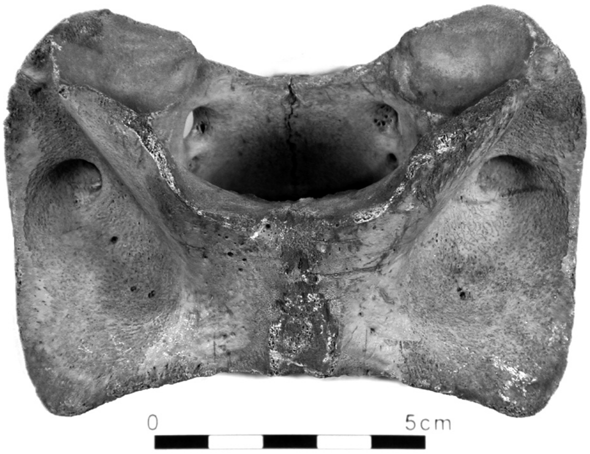
Illus 32 *Rutherford's 1774 map of Perth.*

Evidence of tools and artefacts

Several tools recovered from the site have been identified as scrapers which may have been used in the preparation of hides and skins. Reference to 'bemys knyffis', dating to 1550, is made in the Perth Guildry Book (Stavert 1993, 207). This is taken to mean beaming knives (also known as scudding knives), which are specialised tools with curved blades used to remove hair, epidermis and any adhering subcutaneous flesh and fat from the skins (Serjeantson 1989, 133–5); an example is shown in a 16th century panel depicting the martyrdom of St Bartholomew, patron saint of the Perth Glover Incorporation (Illus 33).

Illus 33 *St Bartholomew, patron saint of the Perth Glover Incorporation, with the beaming knife used in his martyrdom; 16th-century painted wooden panel taken from St John's Kirk. (Copyright Perth Museum and Art Gallery)*

Illus 34 *19th century butchers at work in Mr Paton's shop, Perth. (Copyright Perth Museum and Art Gallery)*



Illus 36 *Cattle cervical vertebra (atlas), showing knife marks on ventral aspect.*

Illus 35 *Cattle radii, innominate and humerus showing hack marks made by axes or cleavers.*

Direct evidence of the types of tools used also came from the bones themselves; saws were used only infrequently at Perth High Street, as has been found to be the case at other medieval urban sites in Scotland, and were generally reserved for removing valuable parts of the carcass such as horns or antlers. Heavy butchery, as until recently, (Illus 34) was usually performed using axes or cleavers, as shown by chop marks on the bones (Illus 35), while meat was removed from the bone by means of metal knives, which have left traces in the form of fine cuts (Illus 36).

Some of the dog and cat bones from Perth High Street showed evidence of fine knife cuts which were probably inflicted during skinning (CD Insert: Animal bone data). There is evidence from other sites within the town that skinning took place; for example, at Meal Vennel, a pit contained the skeletons of three dogs and a cat. One of these dog skeletons showed evidence of knife cuts (on the tibia) and it is likely that all four of these animals had been skinned (Smith 1996a; Smith 1998). At Whitefriars, Perth, cut canine bones have been recovered from both pre- and post-Reformation contexts (Smith 1989, mf 13:F2). Similarly, at 53–59 Gallowgate, Aberdeen, one butchered dog bone was found amongst the contents of a tan pit (Smith 2001).

Some documentary evidence exists to show that dog skins were imported into England from Scotland in the 17th century, along with skins of wild cat, domestic cat, otter, hare, rabbit, polecat, fox and deer (PRO Customs 3 Vol 1, 48; Smout 1963, 218). More particularly, in the records of the Merchant Guildry of Perth, an entry for the year 1552 details a list of skins which include 'hertis hird hidis, lamb skynnis, gatis, cunyng skynnis (and) cattis', in other words, deer, lamb, goat, rabbit and cat (Stavert 1993, 216).

Meat supply and contribution of meat to the diet

The relative frequencies of food forming species may by themselves give a misleading impression of the extent to which different meats were available or were preferred. Several authors have drawn attention to the need to consider carcass weights or the yields of meat from the carcasses of different species (Yealland and Higgs 1966; Chaplin 1971). Such estimates will depend on the ages at which the animals were slaughtered. Obviously a young lamb will normally yield less than an older sheep of the same breed, therefore the ages at which the animals were slaughtered have to be considered. Young animals may not have been killed merely to supply a market demand for the tender meat of lamb, veal or piglet, but may have been culled when young because of an inability to overwinter them successfully or because of a lack of financial incentive to do so. At Perth and other burghs concerned with the export of hides and skins, meat was a secondary product, and the animals were probably raised until they were at an optimum as regards hide quality rather than meat production. Evidence has been considered which indicates that at Perth the animal remains are a mixture of animal based industry and food production, therefore it may be misleading to interpret these remains in terms of meat yield (Alcock pers comm). However, because hides had to be brought to market along with the carcass from which they came (which in the majority of cases, probably meant on the hoof) (*APS*, ii, 543) we can assume that the meat was indeed eaten, probably within the burgh itself.

Estimates of carcass weights of domestic animals vary according to time and author but accepting Yealland and Higgs' (1966, 140) estimates of cow 900 lbs, horse 800 lbs, sheep 125 lbs and pig 200 lbs for a medieval site in England, and assuming that goats had carcass weights similar to those of sheep, it is possible to arrive at some estimate of the relative contribution of each species to the meat supply of the site, based on the minimum numbers present. (Estimates of minimum numbers are presented in Table 13.) The estimates used are based on long bones rather than on horn cores, since if horn cores were imported into Perth without the carcasses which grew them, the calculation of meat yield would be distorted. The contribution of species to meat yield is shown in Table 23.

There is little direct evidence as to the actual live or carcass weights of the animals concerned. The need to estimate more accurately the meat yield of animal species at archaeological sites has been reviewed (Smith, B D 1975, 99) while Noddle (1973, 377–89) has tried to devise a method for cattle by extrapolating from observed relationships between bone size and carcass weight in modern cattle. Chaplin (1971, 134) proposed a scheme to overcome the absence of carcass weights by assigning to each species a sheep equivalent (SE) value in terms of dressed carcass weights. If we apply these SE values, (cattle=12 SE, pig=2 SE, goat=1 SE) and make the assumption that the dressed carcass weight of a sheep was 25 lbs, then the relative contributions of each species to the diet may be estimated (see Table 25).

It appears therefore that beef was the major source of meat at Perth, this being supplemented by mutton and to a lesser extent, pork, along with venison, hare, rabbit, poultry, game birds, fish, and shellfish. There is a possibility that other animals such as horses were eaten in medieval Scotland, although some writers dispute this; for example, Armitage (1978, 33) argues that it was not eaten in late medieval England, while Clason (1967, 60) advances evidence to suggest the Christian church opposed its consumption. Certainly there had been a Papal ban on the eating of horsemeat in the early 8th century (Harris 1986, 96), but it is unlikely that this was still current in Scotland in the 12th to 14th centuries. The evidence of chopped horse bones at other sites in Perth, such as Meal Vennel and Mill Street, as well as at sites in the burghs of Inverkeithing, Inverness and Aberdeen, (Hodgson and Smith 1983; Hodgson and Smith 1982; Smith 1998) presents a strong case for consumption of the meat, although it is possible that this could have been prepared as food for dogs rather than as for humans.

Table 23 *Percentage contribution to meat yields by species, based on minimum numbers shown in Table 13.*

site	% contribution to meat yield				
	cattle	sheep/goat	goat	pig	horse
Perth					
PHSAE	80.6	7.6	0.8	7.2	3.9
St Ann's Lane	74.5	12.8		8.8	3.9
Canal Street I	75.0	6.3	2.1	3.3	13.3
Meal Vennel	80.1	5.9	4.5	4.7	4.7
Aberdeen					
Queen Street	73.9	5.8	3.9	12.3	4.1
42 St Paul Street	77.9	4.8	6.0	4.2	7.2
45–47 Gallowgate	75.2	9.0	1.5	4.8	9.6
53–59 Gallowgate	73.1	6.5	2.9	8.1	9.3
Gallowgate Middle School	75.0	7.8	2.6	6.3	8.3
Elgin					
High Street	57.9	10.7	1.3	12.9	17.2

Table 24 Percentage contribution to meat yield by species, excluding horse.

Site	% contribution to meat yield, excluding horse			
	cattle	sheep/goat	goat	pig
Perth				
PHSAE	83.8	7.8	0.8	7.5
St Ann's Lane	77.6	13.4		9.1
Canal Street I	86.5	7.2	2.4	3.8
Meal Vennel	84.1	6.2	4.7	5.0
Aberdeen				
Queen Street	77.1	6.0	4.0	12.9
42 St Paul Street	83.9	5.2	6.4	4.5
45–47 Gallowgate	83.2	9.9	1.7	5.3
53–59 Gallowgate	80.6	7.2	3.2	9.0
Gallowgate Middle School	81.8	8.5	2.8	6.8
Elgin				
High Street	69.9	12.9	1.6	15.5

Table 25 *Percentage contribution to meat yields based on Sheep Equivalent Units, based on minimum numbers shown in Table 13.*

site	% contribution to meat yield			
	cattle	sheep/goat	goat	pig
Perth				
PHSAE	88.6	5.0	0.5	5.9
St Ann's Lane	84.0	8.6		7.4
Canal Street I	90.0	4.5	1.5	3.0
Meal Vennel	89.1	4.0	3.0	4.0
Aberdeen				
Queen Street	83.1	3.9	2.6	10.4
42 St Paul Street	89.0	3.3	4.1	3.6
45–47 Gallowgate	88.4	6.3	1.1	4.2
53–59 Gallowgate	86.2	4.6	2.1	7.2
Gallowgate Middle School	87.3	5.5	1.8	5.5
Elgin				
High Street	77.4	8.6	1.1	12.9

Since it is not always clear as to whether horse flesh was eaten by humans (rather than dogs) in the medieval period, the relative contribution of the main domestic mammalian species, excluding horse, is presented in Table 24.

Whether dogs themselves were eaten is similarly uncertain, since cut marks on some of the bones may indicate skinning rather than consumption for food; however when the burgh of Perth was besieged, or during periods of food shortage and dearth, the incentive to do so must have been great. During famine conditions in early 17th century England, dogs, cats and horses were all resorted to as a source of food (Thomas 1983, 116). The sentimentality which surrounds animals regarded as pets at the present day would not have prevailed in such conditions (Smith 1998, Smith 2006).

Discussion

It is worth reflecting that we have no accurate method of assessing the size of the human population of the Scottish burghs in early times. Russell's (1948, 358) study of British medieval populations cites comparison of rents paid to the king in 1327. On this basis Perth was third in importance to Berwick and Aberdeen but it will be realised that several of the border burghs would be out of the reckoning because of the wars with the English (Edward III did not acknowledge Robert Bruce as King of Scotland until 1328). Froissart reported in 1385 that Edinburgh consisted of only some 400 dwellings (1867, ii, 314). However, a text by an unknown author who travelled to Scotland with Edward I in 1296, refers to 'Saynt Johns' (Perth) as being 'a metely goode toune'(Hume Brown 1978, 4). Estienne Perlin in 1551–2 describes the Scottish seaports, which would include Perth, as being 'petites villes et bourgardes' (ibid, 75).

Whichever criterion is used to assess the size of the population of the Scottish medieval burghs, they appear to have been small even before the plague pandemic of the mid 14th century, known as the Black Death (Tyler 1882), and consisted of a probable maximum of 1,500 to 2,000 people.

The dilemma posed by the animal remains described in this report is why, during the 12th–14th centuries, should so few people at Perth be associated with the remains of so many cattle, sheep and goats? The answer most probably lies in part, in the fact that cattle were raised to satisfy an export trade in hides in which the king and the merchant burgesses had a pecuniary interest. By the same reasoning the sheep remains can be explained as being the waste produced by the export of woolfells and the remnants of meals. The ages of the animals on slaughter may reflect something of the rival claims of the enterprises of a thriving retail meat trade and its considerable by-products industry although it may be preferable to consider the hides, wool and woolfells as the primary products, while meat itself is the by-product.

The substantial quantity of goat remains present at Perth in a 12th–14th century context is more difficult to understand. Later in the 17th century there was a massive export trade in goat and kid skins from animals reared mainly in the Highlands, as shown, for example by the Mar and Kellie estate papers relating to customs returns for all Scottish ports. In the three years between 1611 and 1614, 1,226 kid skins and 16, 321 goat skins were exported (*HMC*, Mar and Kellie, 71). This large scale production of goats grew up in spite of repeated attempts to discriminate against goats by legislation over the centuries (Skene 1609, 18, c.5; Innes 1868, i, 179). Goats, having a hard palate, are able to eat almost any kind of vegetation and because of this became a major cause of denudation of the Scottish forests – hence the need to discriminate against them. It is not possible to estimate the size of this export trade at various ports in mid-medieval times from the Exchequer Rolls for no great custom was levied on the goatskins at this time, although the rate of the petty custom is listed from time to time (*APS,* i, 668, Appendix ii, *Assisa de tolloneis*). It is tempting to explain the medieval goat remains found at Perth simply as being the beginnings of this export trade, despite the lack of documentary evidence for it; but the explanation may lie in the production of cheap meat for home consumption.

Grant (1930) has discussed the dilemma facing the central government; that of having to ensure that the people had food and other necessaries at reasonable prices while at the same time having to sustain an export trade of raw materials which was both the basis of Scotland's commerce and a source of royal revenue. Even in the relatively prosperous times of the 12th century, attempts were made to establish a natural system of fixing food prices so that the cost of living was fairly stable (*APS*, i, 675–9; see also discussion of this legislation by Innes in the preface of the same volume). Later, after 1292, in an economy progressively ruined by the cost of wars and the ravages of invasion, inflation was rife. Concern by the central government for the meat and commodity supplies for the home market is reflected in the banning of the export of hide and skins in 1483, 1555 and 1561 (*APS,* ii, 166, *APS,* ii, 496; Burton 1877), the introduction of compulsory meatless market-days in 1584 (*APS,* iii, 353, Item 12), and the prohibition of the export of sheep and nolt (cattle) in 1592 (*APS,* iii, 577, c. 11).

Whether the shortages of meat stemmed entirely from inflation or were due in part to the rival demands of the hide export trade or were sometimes due to the chance coincidence of bad winters and disease among livestock (Lawrie 1910, iii, 15) is difficult to assess but very real shortages there undoubtedly were. The records of the Privy Council make repeated references to 'the greit derth' and to 'exorbitant prices' (see Burton, 1877, 94; 114; 200–1). It is difficult to understand why there should be a meat shortage at a time of large scale production of cattle hides. Paradoxically a demand for hides would not necessarily have produced a glut of cheap meat. In practice, because of the monopoly the merchant burgesses exerted over the beef and mutton producers in the hinterland, the animals would have been raised to an optimum for hide production and not for meat. The time of slaughter of animals would thus largely be at the dictate of the export trade rather than the market forces of supply and demand for meat and may have been linked to the arrival and departures of ships as well as to seasons thus causing an erratic supply of meat resulting in gluts and shortages. Perhaps rising inflation and the ravages of war caused beef to be priced out of the market for many poor people.

It seems reasonable to suppose therefore that goats, which are easier to nourish than cattle or sheep because they can eat rough pasture, and which are quick to grow and easy to tend, would fill this gap in the meat market. Penny (1836) reports 'before the plantations huge flocks of goats were brought down from the Highlands to Perth to be sold at a tryst'. These animals were apparently used to supply the home market for he states that the flesh was much prized as hams while the skins were used to make saddles, side packs and soldiers knapsacks. If Penny's use of the word plantations refers to the 'Planting Act' of 1457 (*APS*, ii, 51, c. 27) which sought to encourage the planting of hedges for shelter or broom for cattle fodder it may be that he is referring to large scale goat production in a medieval context. However, Barrow (1979 pers comm) doubts whether Penny can be referring to the Planting Act of 1457 and suggests that he is referring to more recent 'improvement' plantations of the 18th and early 19th centuries. If this is so it remains to be established that the goat horn cores described from medieval Perth were from animals which were eaten locally.

As well as being a source of cheap meat, goats also produce milk for human consumption. Goats' milk came to be perceived as more 'healthy' than cows' milk since it is less frequently affected by bovine tuberculosis and was eventually considered to be itself a cure for consumption (Campbell 1965, 183–4; Smith forthcoming).