bone from the rooms was burnt. In some contexts in the industrial waste area up to a third of the unidentified bone (by fragment count) was burnt, mostly to a white colour.

In all groups the low number of horncores, especially of sheep, was noted, and horncores may therefore have been deposited elsewhere as a result of hornworking.

It was observed that survival and recovery and perhaps original deposition resulted in differing proportions of bones from the head, main body and feet in the three species. For sheep, numbers of bones found was always in the rank order: main body, head then foot, and for pig was (except in the small group from Buildings R5) in the order head, body, then foot, with cattle rather more variable. Various effects (including methodological ones) may affect this result, eg the greater density of the skull bones of pig in comparison with sheep. The sample from Building R4 could be interpreted as direct food waste, which would require an explanation of the few main body cattle bones. Perhaps the main meat-bearing parts of the bovine carcase was boned before cooking.

Cattle

The stages of development of the mandibles found are shown on Table 28. The data suggest that a few cattle were slaughtered when young, but that most were adult. Of the mandibles where the third molar was in wear, many were at late wear stages (Grant's stages l and k) and often with the cement/enamel junction visible above the alveolar border. The number of adult and old cattle, plus the evidence from pathology, suggests that these include culled draught and/or plough beasts, as well as old cows (Table 29).

The evidence of slaughter age in the sheep (see below) suggests that surplus sheep may have been brought in to Prestatyn from surrounding areas, presumably indicating a demand for meat. It is likely that there was also a demand for beef, but which was evidently not met with a supply of young cattle. Most calves were apparently required for work and breeding, giving only a small number of surplus young, and indicating the importance of adult working cattle in the economy, particularly the arable economy.

Absence of the second premolar was observed in five, of twenty-two mandibles, and reduction of the posterior cusp of M_3 in two of the twenty-six mandibles (Period II).

The few cattle horncores found were all very small, and usually quite tightly curved (pl XXII). In general the measurements suggest a small type of cattle, similar to the Iron Age type, and comparable with those from other Welsh sites and South-western sites, eg Exeter, and somewhat smaller than Roman cattle from the South and East of England (eg Maltby 1981, 187). There is slight evidence for a size increase by Period IV (see the radius measurements, and the metatarsal distal breadth).

The most frequent measurements were on the

Mandibles	*Cattle Period II*	*Sheep Period II*	*Sheep Period IV*	*Pig Period II*
Dp_4 unworn	1	A		
Dp_4 in wear, M_1 unworn	1	B	1	
M_1 in wear, M_2, unworn	5	C	7.1	2	4
M_2 in wear, M_3, unworn		D	50.5	4.8	8
M_3 in wear, posterior cusp unworn	2	E	37.6	1.5	12
M_3 in wear all cusps, pre ∅g		F	12.5	3.7	4
M_3 at 9, M_2 at ∅g	11	G	12.2	1	
M_3 at 9, M_2 beyond ∅g		H	8.7		
M_3 beyond ∅g	24	I	1.1	1	28
Total	44		131	9	56

Notes: In wear – some dentine exposed (cattle, sheep), wear visible on the enamel (pigs); g – wear stage defined in Grant (1982).
For sheep, the stages follow Payne (1973).
Estimation: for cattle, six and nineteen mandibles respectively were at the latest two stages; from the M_3 alveoli and wear on M_1 and M_2, the wear-stage of ten further specimens was estimated. For sheep, incomplete mandibles (Period II N13, IV N2) were allocated to stages in the proportions observed in the complete ones (Payne, *ibid*).

Table 28 Age Data.

Cattle		*Period*	*N*	*Range*	*Mean*	*S.D.*
horncore	47/44/45/46	I		61/92/33/23.5; 86/13/51/30		
	L outer curve 47	II		55,87,90,118		
	basal circumf. 44		10	87–142	119.2	18.45
	max bas. diam. 45		11	30–56	44.9	8.91
	min bas. diam. 46		10	24–37	30.3	4.61
	47/44/45/46	IV		-/106/39/28; 92/114/42/33		
humerus	BT/HTC	I		60.3/26.8		
	B Trochlea	II		59,61.4,64,68.4		
	HTC Height of trochlea at central constriction		10	26.2–32.4	28.5	1.80
	HTC	IV		30.8,31,31.5,32.5		
radius	GL/SD	II		238 estim./34.0		
	Breadth prox			66.2,67.9,68.7,69		
	Bp	IV		70.4,72.5,80		
tibia	B distal	I		51.0,52.5		
	Bd	II	8	50.4–67.3	55.7	
astragalus	GLl/Dl/B	I		53.8/30.3/33.7; 56/-/35.8		
	GL lateral	II	26	52.0–66.3	57.8	3.06
	Depth lat		25	28.7–36.5	32.2	1.69
	Breadth dist		26	33.4–45.9	36.8	2.79
	GLl × Dl × Bd		25	51.0–111.1cm³	9.1cm³	12.59cm³
metacarpal	GL/Bp/SD/Bd/Dim	II		156/53/28.5/57.5/24.5; 165/49.7/27.4/52.8/24; 174/-/26.3/49.3/24; 181/49.3/25.0/49.9/25.5; 192/59.1/33.2/-/24.9		
	Bd		20	45.0–60.7	53.4	4.49
	Dim–anterio–posterior diameter of internal trochlea, medial condyle		19	21.5–28.9	25.4	2.03
	GL/Bp/SD/Bd/Dim	IV		163/-/28.4/53.5/24.6		
	Bd		7	49.4–57		
metatarsal	GL/Bp/SD/Bd/Dim	II		188/40.1/23.0/48.0/23.5; 191/44.4/24.6/52.1/24.1; 196/41.0/22.3/46.8/24.8; 208/46.1/25.2/51/25.6; 210/43.2/23.9/49.0/24.2		
	Breadth dist		13	44.5–55.2	49.8	3.09
	Dim		12	23.5–27.4	25.0	1.04
	GL/Bp/SD/Bd/Dim	IV		212/48/26.1/57.3/-		
			7	44.7–57.3	51.7	

Table 29 Summary of cattle measurements.

distal metacarpal and the astragalus, and these are shown on Fig 113. Both indicate a considerable range in size, notably in some small metacarpals (Bd 45 and one only 156 mm long) and the large astragalus (GLl 66.3/Dl 36.5/Bd 45.9). Sexual dimorphism is higher in the fore-limb (metacarpal) than the hind (astragalus) and the distributions do suggest two size groupings for the metacarpal, with rather more presumed females than males, and an approximately normal distribution for the astragalus. Some of the small astragali could be immature (although obviously-immature bones were not measured). The few large ones could be interpreted as males, perhaps entire bulls, or as a different, larger type of introduced cattle.

In order to check correct identification of the left and right sides in taking the 'Dim' measurement on broken metapodials, the widths of the two condyles were compared in the more complete specimens, and it was found that the medial condyle was in all cases wider than the

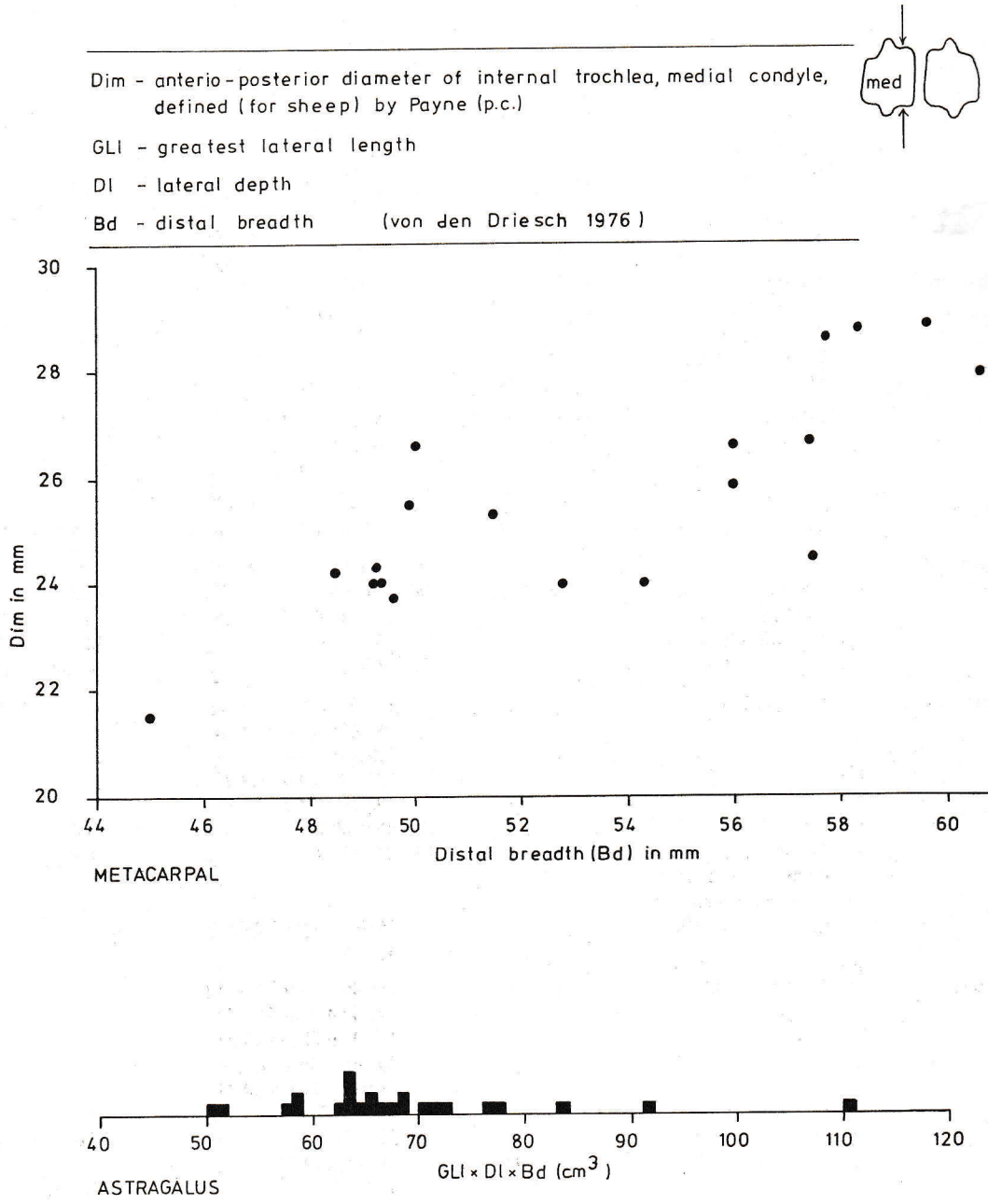

Fig 113 Cattle Metacarpal and Astragalos, Period II.

lateral. The 'Dim' measuring point proved useful, as the bones were rarely sufficiently undamaged to permit of taking a simple distal depth measurment.

Sheep and Goat

Few horncores or horncore fragments were found, but of these, most were from sheep, with one specimen of goat each from Periods II, III, IV.

Identifications based on the shape of the deciduous (milk) premolars, using Payne's observations on ovicaprid differences, suggests that sheep greatly outnumbered goats (Payne 1985). Twenty-nine mandibles were identified as sheep, mostly on at least three of Payne's distinctions (1985) and three remained of uncertain identification. Three loose dp_4's bore all three sheep-like characters and three incisors, thought to be first incisors, bore the labial groove observed in sheep. Where mandibles were at early wear stages, height and depth measurements were taken and these always fell within the *Ovis* area of

Payne's graph (1985, fig 3) (6 cases). In most of the mandibles, the deciduous teeth were well worn, with M_2 already in wear. For these older jaws the clearest morphological distinctions were the bucco-mesial ridge of dp_4 and the lack of basal swelling and interlobal pillars in dp_4.

The partial skeleton of a sheep was found in Building 4 (1264, general layer). It included some skull pieces; the neck vertebrae, some thoracic and lumbar vertebrae, the sacrum and one candal vertebra, all fully fused; both upper fore limbs, some right carpals and the (incomplete) metacarpal. The meat appears to have been used, as there were transverse marks on the atlas where the skull was removed; the thoracic and lumbar vertebrae were chopped through to one side of the midline and there were knife-marks on the distal shaft of one humerus. The measurements are given separately and are also included in the summaries (both olecranon and distal radius were fused). Measurements are at the upper end of the range from the site, so the skeleton is probably from a ram or wether. The estimated shoulder height is 65 cm (Teichert's radius factor of 4.02 quoted in von den Driesch & Boessneck 1974).

The sheep (goat) mandibles are summarised on Table 30. The sample was dominated by mandibles at stage D (sheep mostly in their second year) and, to a lesser extent stage E (the majority of which were probably in their third year). The stage F to I mandibles, the adult sheep, formed only a quarter (26%) of the total, which suggests that the sample may not be drawn from a self-sustaining flock, and that young sheep were being supplied from a wider area. The number of lambs (stages B and C – less than a year old) was low. (Age estimates are based on modern sheep including Soays and Shetlands, Jones work in progress).

The permanent anterior promolar (P_2) was absent in three cases (5.3%, N57).

When present, the amount of wear on P_2 was recorded, as this character may be relevant in studying changes in sheep. It has been observed in X-rays of modern Scottish Blackface sheep that P_2 is normally isolated, the anterior upper premolar being in occlusion with P_3 (see acknowledgements). At Prestatyn only five Period II mandibles survived with their P_2 intact. One was unworn (mandible at wear stage E), three showed enamel wear only (mandibles at stages E and F) and in one dentine was exposed

Sheep (goat)		*Period*	*N*	*Range*	*Mean*	*S.D.*
horncore	47/44/45/46	II		38/57/19.5/16; -/-/37/25.5; -/-/38/25		
horncore–scapula	Goat 45/46	IV		32.3/23.3		
	SLC	II	7	16.1 –18.6	16.9	
	GLP			27.4,27.7,28.3,30.6,31.1		
	Index:ASG÷SLC		7	1.02–1.13	1.09	
	SLC/Index	IV		18.1/1.10; 18.2/1.12		
humerus	BT	II	21	23.3–30.3	25.8	1.63
	HTC		27	11.5–14.1	12.5	0.60
	BT	IV	8	23.3–27.4	25.2	
	HTC		10	11.6–13.5	12.4	0.61
radius	BFp	I		26.6		
		II	17	22.4–29.7	25.9	0.24
	GL/BFp/SD	IV		142/25.2/14.6		
	BFp			25.2,25.6,25.8,26.7,27.0		
tibia	Bd	I		22.2,24.9		
		II	32	19.4–27.5	22.9	1.50
		IV	14	20.1–24.8	23.0	1.47
metacarpal	GL/Bp/SD/Bd/Dim	II		112/19.4/11.3/-/; 121/20.7/11.4/21.8/12.5		
		IV		138/-/12.2/24.0/12.8		
metatarsal	GL/Bp/SD/Bd	II		131.7/18.9/10.5/22.5		

partial skeleton, sheep (1264):-
scapula GLP 31.1; humerus BT 30.3, HTC 12.8; radius GL 162, Bp 32.6, BFp 28.9, SD 16.0; metacarpal Bp 22.6, Bd 24.7, Dim 13.6.

Table 30 Summary of sheep measurements.

Pig		*Period*	*N*	*Range*	*Mean*	*S.D.*
M_1		II	15	9.8–11.4	10.44	0.46
M_2	WP	AD80-160	23	12.1–13.6	12.87	0.40
(M_1 and M_2 all within mandibles, i.e. identifications certain)						
M^3	W Anterior		34	12.6–15.6	14.14	0.69
	Length		34	28.6–36.7	31.30	2.00
M_3	WA		15	15.4–18.5	16.99	0.83
	L		16	27.4–32.1	29.91	1.54
M_1	WP	IV	7	9.5–11.2	~~11.2~~ ←	10.31
M_2	WP	L3rd-4thC.	9	12.0–13.8	12.98	
M_3	WA		9	13.4–15.0	14.31	
	L		8	25.9–33.4	30.98	
M^3	WA/L	IV		16.2/26.0; 16.9/28.2; 17.3/28.8; 18.0/29.3; 17.5/30.0		
scapula	SLC	II	15	19.9–24.5	22.2	1.84
	GLP			31.7,33.0,33.0,33.6,34.6		
	SLC	IV	6	20.0–23	21.7	
humerus	HTC (Height of trochlea at central constriction, Payne & Bull *ibid*)					
		I		17.7		
	Bd/HTC	II		34.3/17.2; 36/18.7; 39.4/20.5		
	Bd/HTC	IV		34.1/17.1; 39.0/19.9		
radius	Bp	I		27.6		
	Bp	II	11	22.1–28.9	25.9	1.71
tibia	BdP (taken at 90° to the articular grooves, Payne & Bull, *ibid*)					
		I		27.7		
	BdP	II		25.6,26.4,26.4,28.1,29.1		
astragalus	GL lateral	II		37.7,38.5,40.0,40.6		
	GLl	IV	6	36.5–43.0	38.8	
metacarpal	GL/Bd	II		mc III 78.4/16.0; mc IV 73.8/16.4		
metatarsal	GL/Bd	IV		mt III 75.5/15.0		

Table 31 Summary of pig measurements.

over more than half of the anterior-posterior length of the crown (stage F).

Presence of hornlessness is demonstrated by a single piece of frontal bone, from the late first/early second century (Period II). Its occurence at this early Roman date is of note, as polled sheep are uncommon on pre-Roman sites.

The size of the sheep found were no larger than typical Iron Age sheep, and there was no evidence for a change by the later third-early fourth century (Period IV). The most frequent measurements were of the distal humerus and distal tibia. The mean distal widths of teh tibia (Period II 22.9, IV 23.0 mm) are comparable with the data from Iron Age sites quoted by Maltby (1981, 190) and smaller than most data from Romano-British sites.

The inequality in survival of different bone elements was noted in the discussion of the Buildings. It was particularly striking in comparing the large mandible sample (131 lower jaws with at least one surviving tooth) with ten metapodials, of which a total of seven were measurable.

Pig

The mandibles of pig (Table 31) suggest that many pigs were slaughtered in their second and third years (age estimates based on Payne 1982).

The four older jaws (M_3 in wear, before Grant's tooth wear stage G (1982)) and some of those with M_3 in partial wear could be considered as the breeding pigs, giving an age structure which could be from a self-sustaining group. Bone pathologies suggest at least some confinement of the pigs.

All pigs were of domestic size. Measurements were taken of all three lower molar teeth, following the work on wild pigs by Payne and Bull (forthcoming). The degree of variation in the Prestatyn material was similar to that observed in the Kizilcahaman wild pigs, suggesting a single breeding group (coefficients of variation, ie standard deviation/mean, for M_1, WP 4.4%, M_2 WP 3.1%, M_3 WA 4.9%, M_3 L 6.4%).

Measurements of the first and second molars were done on mandibles, not loose teeth. The size ranges do not overlap. If this separation is repeated on other British sites of this period, M_1 and M_2 may be separable by size alone, which would be relevant in studying age structure from sites where loose teeth predominate.

Other Species

Horses were present in small numbers (Table 32). Characteristically, their bones were less broken up than those of cattle. Height estimates are of 12–13 hands (see measurements).

Both red deer and roe were present. Antler was commoner than bone and many of the pieces were cut through, apparently with a saw. Saw marks were uncommon on bones.

The skeleton of a large, male dog was recovered from Building 4 (1421). The bones were well preserved and carefully excavated, with recovery of sesamoids, phalanges and eighteen caudal vertebrae. The animal was adult but not old. The following bones survived: fragments of skull; most of the jaws and teeth (adult dentition with

Other animals		*Period*	*Range*
Horse			
scapula	GLP	II	76, 81
radius	GL/GLl/Bp/SD/BFd		295/282/75.8/30.4/54.7
	height est		1.22 m (12 hands)
astragalus	GH/GB/BFd/LmT		52.5/53.5/46.8/51.9; 57.1/62/49.1/57.0
metatarsal	GL/GLl/Bp/SD/BFd	I	253/244/47.7/28.7/46.7
	height est		1.30 m (13 hands)
metatarsal	GL/GLe/Bp/SD/BFd	II	243/240.5/45.1/26.7/44.1
	height est		1.28 m (12.5 hands)
	BFd		40.1,44.0
Red deer antler VII 39) circ of burr 182/41) circ above burr 168			
Dog			
carnassial	M{1} length	II	21.1
mandible	cheek trowl/M{1}L	IV	80/21.8
tibia	Bd	V (3rd c)	24.8 (large)
Dog	skeleton (1421), male	II	(right side given unless damaged)
cheek tooth	row L 89.3		M{1} L 24.0, B 9.3
atlas	GB 98, BFcr 47,Fcd 42		axis LCDe 61.9, BFcr 41.3
os penis	L 105		radius GL 216,Bp 24.9,msd 17.8,Bd 30.7
scapula	SLC 31.8 GLP 40.3		ulna GL 250
humerus	GL 232, SD 16.0, Bd 44.5		femur GL 244,SD 15.5,Bd 41.8
	mid shaft diam 16.7		tibia GL 252,bp 44.7,SD=msd 16.6,Bd 28.1
metacarpals	GL II 78.2, III 89.1, IV 88.6, V 76.5		
astragalus	GL 34.3, calcaneum GL 58.1		
metatarsals	GL II 86.5, III 94.6, IV 97.5, V 86.2		
height .estimate 72 cm (28.5") (Harcourt 1974)			
Hare humerus	Bd	II	12.8
Fox humerus	Bd	II	18.4
Fowl femur	GL/Bp/SC/Bd	II	77.7/15.0/6.7/15.1; 88.4/16.7/7.3/16.7
tibrotarsus	Bd	IV	11.9
tarsomt.	GL/Bp/SC	II	81.4/13/6.9 with short spur

Table 32 Summary of other species.

slight dentine exposure on some teeth; most of the vertebrae (C7T12 L7 S Cy18) (all epiphyses fused), ribs (broken) and the os penis; all the long bones and most of the bones of the feet (all mature, ie over *c* 18 months old). There is some exostosis around the articular processes of the final thoracic vertebrae.

The specimen was identified as dog and not wolf on the basis of the lower carnassial and molar tooth row (Clason 1967). The premolar tooth row was within the range for wolf but the teeth were very spaced out. The long bones are longer than two wolves quoted by Harcourt (1974).

The length measurements for humerus, ulna, femur and tibia are all beyond the range observed in dogs of the Romano-British period by Harcourt. They add to his general thesis of the great variability in the size of dogs in this period (greater than for the Iron Age or Anglo Saxon periods). The long bones give an estimated shoulder height of 72 cm (28.5″). The hind limb bones are particularly long both in comparison with the wolf measurements and Harcourt's height estimate factors (the femur and tibia both give 75 cm; the humerus, radius and ulna give 71, 70 and 71 cm).

Other remains of dog from the site were of medium size, though one other large bone came from Period V. Many of the bones of other species were gnawed.

The other species of note is hare, by no means a numerous find – it forms 0.3% of the Period II identified sample – but fairly well distributed across the site and commoner than deer, dog or fowl. Hare is usually present on sites of this period but is generally less common than deer, dog or fowl. Numbers of hare bones were relatively high and present in most parts of the excavation at Pentre Farm, Flint (Westley & King forthcoming). It may be that the hare was rather common in the area, and it may be that hunting of the hare was a favoured pursuit. Both sites are of relatively high status.

A few bones from birds were found, viz, fowl, goose (cf Anser anser), duck (cf *Anas platyrhynchos*) and raven (*Corvus corax*) from the early Roman Period II, and fowl from Period IV. Fowl was much less common than at Pentre Farm (second century AD) (Westley & King *ibid*).

Butchery

A record of butchery marks was made for the three main species for Period II. For cattle, chopmarks were common on the mandible below the condyle, and some of the horncores were cut through. Separation of the skull may have been between the atlas and axis vertebrae; a few vertebrae were chopped through the mid line; many of the ribs (all included in the unidentified bone) were chopped, often into sections 6–12 cm long. The forelimb was separated at the distal humerus, which was often chopped through; other bones often bore lighter marks; the glenoid process of the scapula was usually undamaged. On the hind limb separation was at the hock, with distal tibia, calaneum and astragulus often chopped through. Considering the fragmented nature of the bone, rather little of it bore definite butchery marks. Several metapodia, for example, appear to have been split lengthwise but without evident chop marks.

For sheep a greater proportion of marks were light, ? knife marks rather than heavy marks chopping through the bone. The commonest site of butchery or meat removal was on the distal humerus. Knife or chopmarks were also seen on the mandible, on the skull (chopping it through roughly sagitally to remove the brain) and on the long bones particularly on the lower part of the shaft of the tibia.

On pigs, again the distal humerus and tibia were the areas most often chopped. Male canine teeth were almost always broken.

On all the bones gnawmarks, probably from dogs, were common.

Pathology

Detailed sketches and notes on the pathological bones are preserved in the archive, and the specimens are stored as one group.

Cattle

One tooth and ten bones of cattle (Periods II and IV) showed abnormalities or degenerative pathology (and see cattle section for dental variation).

Tooth. (IV, 100) M_3, wear-stage f, irregularities over the upper crown, suggestive of nutritional stress during development.

Two mandibular condyles, very pitted and irregular, probably an age-related change.

One metacarpal, five metatarsals, two centrotarsals and a second phalanx showed various degrees of degeneration of the articular surfaces and proliferation of bone around the affected joints, including

(II, 168) spavin – fusion of the centrotarsal and

tarsal 2+3 to the proximal metatarsal, a condition which is common in horses and may occur in trek oxen and draught cattle (Baker and Brothwell 1980), and

(II, 149) osteoarthritis of the distal joint of the second phalanx, with polish, grooving and pitting.

One Iron Age metatarsal and centrotarsal (1454) showed degeneration of the articular facets and exostosis (probably the active stage before fusion of the bones; once the fusion is complete and the lesion healed, such an animal can be returned to useful work).

Sheep

Tooth. Periodontal disease affected four mandibles from Period II, in a total of seventy-three fairly complete mandibles with permanent premolars. All were fully adult, three at stage G and one at H, ie as a whole, incidence was low, but most sheep at the site were young; of the older sheep, over a quarter were affected (4 of 14 fairly complete stages G to I mandibles. The bone was enlarged around P_4 and M_3 but there was no ante mortem tooth loss; in one (II, 172) there was extensive thickening of the bone from P_4 to M_3, with pitting of the bone surface.

There were three teeth of anomolous form:

(II, 177) M3 with greatly reduced posterior infundibulum, giving the tooth a triangular section,

(IV, 112) M3 with reduced posterior cusp (a trait more common in cattle than sheep,

(IV, 109) M3 with exceptionally large posterior cuŏp; the tip of the cuŏp forms two folds, on the lingual and buccal distal corners.

No pathology was observed on the bones of sheep.

Pig

Teeth. Small 'dot' depression on the upper half of the crown of: (IV, 79) P_3 and P_4, and (II, 1290) M_3 (developmental anomalies). Overcrowding of teeth was observed in four cases (all Period II), where premolars overlapped or were rotated.

Bones. (II, 1193) gross enlargement of the proximal shaft of the ulna, with an abscess drain hole; the articulation is normal; an infection, probably following injury.

(II, 1190) fractured fibula (immature); the shaft is thickened, and is not reunited with the rest of the bone.

(II, 340) another immature fibula with a small area (10 × 7 mm) of extra periosteal bone growth.

Injuries to pigs, including young ones, suggests difficulty in the control of these animals. Injuries to the fibulae may indicate tethering.

Acknowledgements

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Archive

The bones are boxed in numerical order of context number with the exception of Buildings R3, R4, R5 and the area of industrial waste, which are boxed together, as are worked and pathological bones, miscellaneous specimens of interest and the larger groups of sheep mandibles.