SMR REPORT 68A

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YSGOL TWM O'R NANT

DENBIGH, CLWYD

HUMAN BONE REPORT

PHILIP A. BOOCOCK AND CHARLOTTE A. ROBERTS

MAY 1994

Calvin Wells Lab, Department of Archaeological Sciences,
University of Bradford

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1 : INTRODUCTION

The following report consists of the analysis of bone excavated from a disused lime kiln at Ysgol Twm O'r Nant, Denbigh. The deposit was found to consist of both animal and human bone, representing at least 170 individuals, both males and females, ranging in age between infants and elderly adults. The bone was in a highly fragmented condition.(See appendix 3 for animal bone count).

2: METHODS

2.1 :Minimum Numbers Of Individuals

The Minimum Numbers Of Individuals (MNI) represents the minimum number of individuals necessary to account for all of the skeletal elements in an assemblage of bone. It is calculated by separating each element into side, end and age group. The MNI is calculated as the element with the greatest count. The methodology used follows that of White (1991).

2.2 : SEX DETERMINATION

The assessment of biological sex relies on the fact that there are skeletal differences between males and females. The pelvis provides the most accurate method of assessing the sex of an individual. Methods used include those of Phenice (1969). The skull also presents sexually dimorphic features which can be used in the determination of biological sex. Methods used follow White (1991). Because of the nature of this site very few articulated skeletons and intact pelves or skulls were found.

Because of this, the most abundant source of data comes from metrical measurement of the femoral head, femoral bicondylar width, humeral head and radial head (Ubelaker, 1989). This method relies on a certain amount of sexual dimorphism within a population, though as humans are not totally skeletally dimporphic one will find a degree of overlap. Femoral heads greater than 48mm in diameter probably belong to males, whereas a diameter of less than 43mm probably comes from a female. For the humerus the figures are 47mm and 43mm respectively (Stewart, 1979). When the minimum diameter of the radius head is greater than 23mm the individual is probably a male, less than 21mm they are probably female (Berrizbeta, 1987). However it must be emphasised that this method only provides indirect evidence of biological sex.

2.3 : AGE DETERMINATION

Methods used to assess the age of the material included dental wear (Miles, 1963; Lovejoy, 1985; Bouts and Pot, 1989), degenerative changes on the pubic symphysis (Katz & Suchey, 1986) and degenerative changes on the auricular surface (Lovejoy *et al*, 1985). As dentitions were more abundant than both pubic syphyses or auricular surfaces dental wear provided the most abundant source of data. Tooth wear can be quite idiosyncratic, the degree of wear being dependant on type of diet and presence or absence of opposing dentition. Because of this it was decided to employ the following broad age groups : Young Adult (18-25 years), Middle Adult (26-45 years) and Mature Adult (46+).

For subadults it is possible to assign closer age groupings. Assessments of age were made using dental development and epiphyseal union. For bones whose epiphyses had not fused it was only possible to assign an age of less than the age of fusion. It was not possible to calculate ages from diaphyseal length due to the incompleteness of the long bone shafts. Age ranges were calculated combining male and female data. Data for dental development and epiphyseal fusion follows Ubelaker (1989).

2.4 : STATURE

For intact bones the stature was calculated using the method of Trotter (1970). Where sex could be determined with some probability from metrical data the appropriate calculations were made.

2.5 : NON-METRIC TRAITS

Any non-metric variations were noted following the definitions of Berry & Berry (1967) and Finnegan (1978).

3 : RESULTS

3.1 : MINIMUM NUMBER OF INDIVIDUALS

A figure of 170 individuals is derived from the number of petrous temporal bones found in the deposit. Unfortunately, due to the fact that the petrous temporal completes its development relatively early in life, it was not possible to provide an age breakdown. The one exception to this was the remains of one temporal in which the tympanic ring was not completely formed. This individual was aged between 1 and 2.5 years (Weaver, 1979). The cranial fragment count can be seen in Table 1. From the relatively high frequency of cranial fragments

it could be suggested that relatively intact skulls were being placed in the deposit.

The frequency of post-cranial elements is shown in Table 2. It must be noted that there is a marked predominance towards the larger bones, such as femora and tibiae, which may reflect either factors related to collection, deposition and preservation of more robust elements. The MNI for the long bones is 108 (74 adults, 34 subadults).

As expected, the frequency of ribs, hand and foot elements (Table 3) and vertebrae (Table 4) was low. These elements are small and relatively fragile and were thus less likely to be deposited and more likely to be subject to diagenetic factors. The pelves were highly fragmented; the frequency of pelvic elements is shown in Table 3. The MNI for pelvic elements is 65.

The dentition was highly fragmented, with a great number of teeth lost post-mortem. The remains of at least 52 adult dentitions, 8 sub-adult and 16 ambiguous dentitions were found (see Tables 5 & 6).

3.2 : DEMOGRAPHIC DATA

3.2.1 : Sex

The major source of evidence for biological sex for this site comes from the metrical measurements of long bones. Only bones which were sufficiently well preserved could be used for this assessment. From Table 7, it can be seen that there is a reasonable amount of dimorphism in this population, though there is some overlap. These results suggest that the assemblage consisted of remains representing both males and females. Figure 1 shows the distribution of the femoral head diameters. This distribution shows that there are few individuals at the extreme male and female ends, with the majority of the population being distributed between. On the graph two peaks can be seen, one at the female end (diameters of less than 43mm) and at the male end (above 48mm). Figure 2 shows the distribution of humeral head diameters. Once again peaks can be seen at the male and female ends. A breakdown of the means and standard deviation for metrical data can be found in Appendix 1.

Assessment of sex based on pelvic fragments was also carried out, though there is less data. From Table 8 it can be seen that there were at least 7 males and 6 females. From the few intact crania it was possible to determine biological sex in 6 cases. Three of these individuals were probably male and three were probably female.

TABLE 1 : CRANIAL FRAGMENT COUNT

	RIGHT	LEFT
TEMPORAL	160	170
ZYGOMATIC	57	61
ORBIT	137	122
CRIBRA ORBIT.	18	23
'% CRIBRA	13.1	18.9

TABLE 2 : LONG BONE COUNT

		ADULT		SUBADULT		INDETERMINATE	
		RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
FEMUR	PROXIMAL	65	58	34	28	0	2
	DISTAL	64	74	17	16	0	0
TIBIA	PROXIMAL	47	53	16	16	0	0
	DISTAL	64	63	8	6	0	0
HUMERUS	PROXIMAL	23	24	10	8	0	0
	DISTAL	58	72	7	9	0	0
RADIUS	PROXIMAL	35	27	1	3	0	0
	DISTAL	21	24	2	3	0	0
ULNA	PROXIMAL	44	46	0	3	1	1
	DISTAL	15	11	1	1	0	0
FIBULA	PROXIMAL	14	13	0	0	0	0
	DISTAL	32	21	1	1	0	0

TABLE 3 : FRAGMENTARY BONE COUNT

		ADULT		SUBADULT		INDETERMINATE	
		RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
SCAPULA		34	26	4	1	0	0
CLAVICLE		4	5	1	0	0	0
HANDS :	MC2	2	0	0	0	0	0
	MC3	2	1	0	0	0	0
	MC4	0	1	0	0	0	0
FEET :	CALCANEUM	7	7	0	0	0	0
	TALUS	4	1	1	0	0	0
	NAVICULAR	0	1	0	0	0	0
	MT1	2	1	0	0	0	0
	MT2	2	0	0	0	0	0
	MT3	1	0	0	0	0	0
	MT4	1	0	0	0	0	0
	MT5	0	1	1	0	0	0
RIB HEADS		27	17	1	1	0	0
PELVIS :	ILIUM	39	51	6	13	0	1
	ISCHIUM	30	35	2	3	0	0
	PUBIS	12	3	3	1	0	0

TABLE 4 : VERTEBRAE

VERTEBRAE	NUMBER	SCHMORL'S NODES	OSTEOPHYTES
CERVICAL	3	2	0
THORACIC	13	2	1
LUMBAR	33	5	7
SACRAL :			
S1	21	0	0
S2-S5	6	0	0
COMPLETE	5	0	0

TABLE 5 : NUMBER OF TEETH

	ADULT			
	MANDIBLE		MAXILLA	
	RIGHT	**LEFT**	**RIGHT**	**LEFT**
INTACT TEETH	98	76	47	71
PM LOSS	241	217	206	215
AM LOSS	70	82	18	28

TABLE 6 : NUMBER OF DENTITIONS

	ADULT		SUBADULT		INDETERMINATE	
	MAXILLA	**MANDIBLE**	**MAXILLA**	**MANDIBLE**	**MAXILLA**	**MANDIBLE**
RIGHT	36	22	8	8	8	7
LEFT	40	21	8	5	16	5
COMPLETE	0	29	0	0	0	2
MNI	**40**	**51**	**8**	**8**	**16**	**9**

TABLE 7 : METRICAL DATA FOR SEX ATTRIBUTION

BONE	MALE	FEMALE	?
FEMUR:			
R.HEAD	11	13	12
L.HEAD	16	7	6
R.BCW	11	8	0
L.BCW	8	10	2
HUMERUS:			
R.HEAD	6	9	3
L.HEAD	10	5	2
RADIUS:			
R.HEAD	3	3	1
L.HEAD	5	0	0

R.BCW = Right Bicondylar Width.
L.BCW = Left Bicondylar Width.

TABLE 8 : PELVIC SEX ESTIMATES

SIDE	MALE	FEMALE	?
RIGHT	6	6	25
LEFT	7	1	43

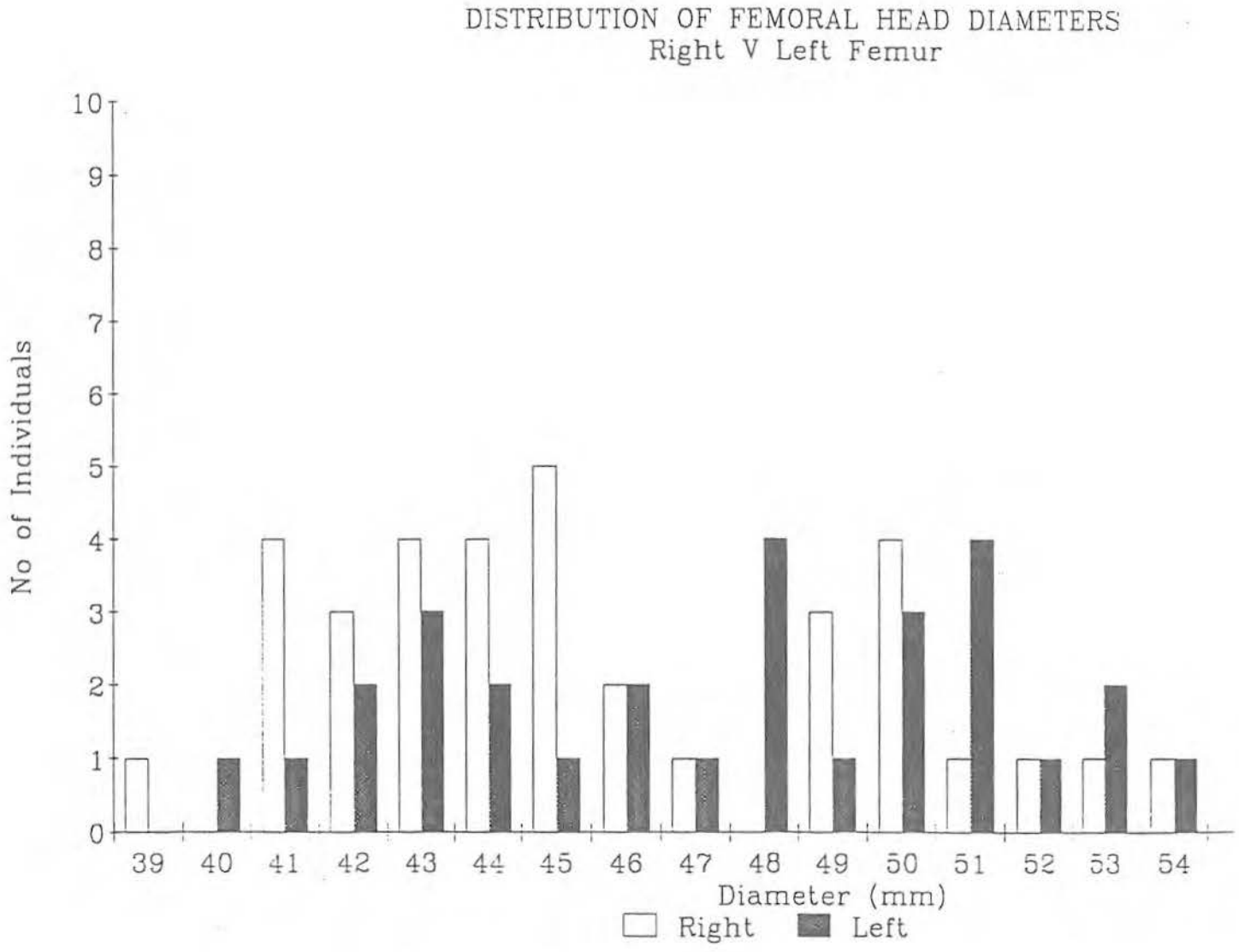

DISTRIBUTION OF FEMORAL HEAD DIAMETERS
Right V Left Femur
No of Individuals
0
1
2
3
4
5
6
7
8
9
10
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
Diameter (mm)
Right
Left

Figure 1

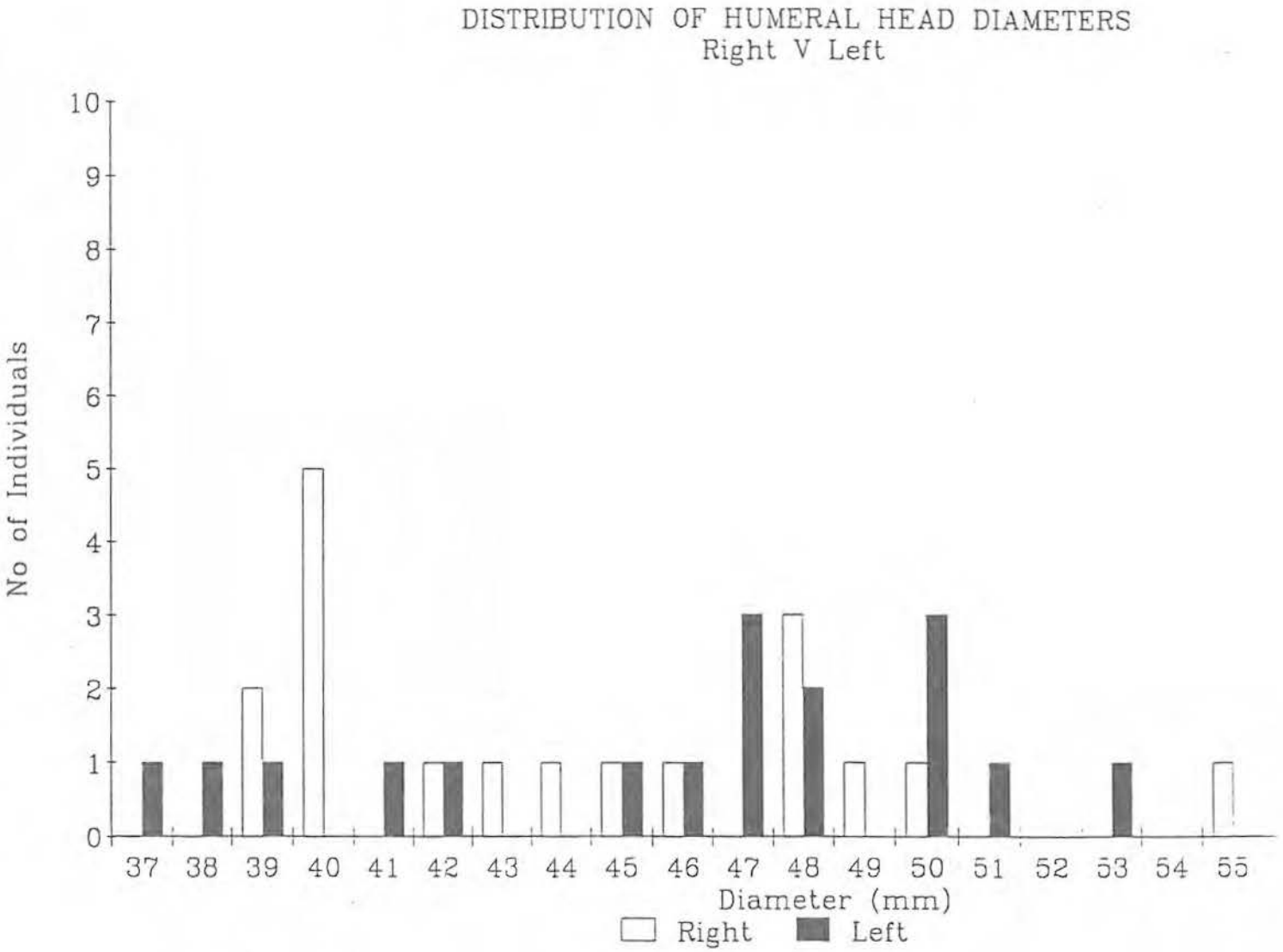

DISTRIBUTION OF HUMERAL HEAD DIAMETERS
Right V Left
No of Individuals
0
1
2
3
4
5
6
7
8
9
10
37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55
Diameter (mm)
Right
Left

Figure 2

3.2.2 : Age Determination

The remains found can be separated into two broad categories : adult and sub-adult. Adult is defined by either complete epihyseal fusion and fusion line obliteration, or eruption and occlusion of the third molars. Subadult is split into two groups : juvenile, where there is no epiphyseal fusion and adolescent, where there is epiphyseal fusion but the line of union is still visible.

For adults the most abundant source of evidence came from dental wear. Because of a more abrasive diet in archaeological populations one can use tooth wear to assess the approximate age of an individual. Because of the state of preservation many jaws could not be placed into the age categories employed in this report. As a result there was one further category : "Adult", where no specific adult age category could be applied due to lack of intact teeth. From Table 9 it can be seen that the deposit consisted of the remains of both young, middle aged and mature adults, though speculation as to the relative numbers is impossible due to the nature of the preservation.

Age estimates for subadults were calculated from epiphyseal fusion and dental development. Because there is variation between individual bones in the onset of union each element should be considered in isolation. The data recorded for epiphyseal union of the long bones can be found in Tables 10-14.

Dental development is useful in assessing the age of juveniles, the epiphyses of whom have not yet fused. The age data from subadult dentitions can be seen in Table 15.

From the above data it can be seen that the subadult sample consisted of both young and adolescent children. Unfortunately due to the fact that many of the subadult bones were broken it was not possible to assess age using bone length measurements. Further data from the one identifiable subadult temporal suggests that the burial population included very young children, as well as elderly individuals.

TABLE 9 : DENTAL WEAR (NUMBER OF INDIVIDUALS)

	YOUNG	MIDDLE	MATURE	ADULT	MNI
MAXILLA	9	10	4	17	40
MANDIBLE	15	16	4	16	51

TABLE 10 : FEMORAL SUBADULT AGE DISTRIBUTION (NUMBER OF INDIVIDUALS)

	< 14 YEARS		13-18 YEARS	
	RIGHT	LEFT	RIGHT	LEFT
PROXIMAL	34	25	0	3
DISTAL	17	14	0	2

TABLE 11 : TIBIAL SUBADULT AGE DISTRIBUTION (NUMBER OF INDIVIDUALS)

	< 14 YEARS		14-18 YEARS	
	RIGHT	LEFT	RIGHT	LEFT
PROXIMAL	14	16	2	0
DISTAL	6	6	2	0

TABLE 12 : HUMERAL SUBADULT AGE DISTRIBUTION (NUMBER OF INDIVIDUALS)

	<10 YEARS		<14 YEARS		13-18 YRS	14-21 YRS
	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
PROXIMAL	1	1	8	6	1	1
DISTAL	5	6	1	3	3	0

TABLE 13 : RADIAL SUBADULT AGE DISTRIBUTION (NUMBER OF INDIVIDUALS)

	YEARS		
	PROX(<13)	DIST(<16)	16-21
RIGHT	1	2	0
LEFT	3	2	1

TABLE 14 : ULNAR SUBADULT AGE DISTRIBUTION (NUMBER OF INDIVIDUALS)

	YEARS	
	PROX(<14)	DIST(<15)
RIGHT	0	1
LEFT	3	1

TABLE 15 : SUBADULT DENTAL AGE

		AGE IN YEARS			
		4-8	6-12	12-18	17-21
MAXILLA	RIGHT	0	5	2	0
	LEFT	2	4	2	1
MANDIBLE	RIGHT	1	6	1	0
	LEFT	0	5	0	0

3.3 : Stature

Very few adult bones were sufficiently complete to be used for stature estimation. The following stature estimates are derived from combined right/left measurements of the intact femora. Where sex could be determined by metric data the stature was included in the appropriate average. Where sex could not be determined, stature was calculated for both sexes and included in the appropriate groups. The results were as follows :

Average Male Stature = 1.68m (N=7).
Average Female Stature = 1.59m (N=6).

These figure for male stature appears to be slightly lower than from other monastic sites, for example the average male stature at Merton Priory was 1.74m (Waldron, 1985) and Blackfriars, Ipswich 1.73m (Mays, 1991b). Comparabale data for other burial sites include St Andrews, Fishergate, York at 1.71m (Stroud & Kemp, 1993) and St Nicholas Shambles, London at 1.73m (White, 1988). The average female stature at Denbigh is reasonably comparable to data from both types of site, for example the average female stature at St Andrews, Fishergate was 1.59m and that at Guildford friary, Surrey was 1.58m (Henderson, 1981). However, the sample from Denbigh is very small and thus it is impossible to draw any conclusions.

3.4 : Non-Metric Traits

A number of cranial and post-cranial non-metric traits were observed. Cranial traits include metopism (3 cases), wormian bones and supra-orbital foramen. Post-cranial traits include septal aperture (4 cases), presence of third trochanter (1 case) and exostoses in the inter-trochanteric fossa. Because of the fragmentary nature of the material and current debate over the value of non-metric traits, further discussion will not be made.

4 : PALAEOPATHOLOGY

4.1 : INTRODUCTION

A number of pathological conditions were noted on the remains excavated from Denbigh. These conditions included trauma, dental disease, congenital abnormalities, non-specific infection, degenerative joint disease and a possible case of treponemal infection. Unfortunately, because the remains are disarticulated, it is not possible to see the systemic affect of the disease process in an individual, that is to say each pathological specimen must be considered as belonging to a separate individual, and thus the possibility of

specific diagnosis is limited because distribution patterns cannot be observed.

In order to assess the frequency of certain pathological conditions in the Denbigh population it is necessary to compare the data from this site with others. Two types of site have been chosen : monastic sites, such as Whitefriars and Blackfriars, Ipswich (Mays 1991a, 1991b), and non-monastic sites, such as St Nicholas Shambles, London (White, 1988)

4.2 : DENTAL PATHOLOGY

4.2.1 : Dental Caries.

The frequency of dental caries present in the adult dentition was 8.2% (32/388 teeth), and that of the juvenile dentition 2.7% (2/75 teeth). The frequency of adult caries is about half that found by Mays at Whitefriars, Ipswich (15.1%) (Mays, 1991a) , though was roughly comparable with the 10.4% found at Blackfriars, Ipswich (Mays, 1991b). The frequency of caries at Denbigh is half way between the 12.1% of carious teeh found at St Andrews, Fishergate and the 5.5% found at St Nicholas Shambles, London. Details of tooth preservation can be found in Appendix 2.

4.2.2 : Ante-Mortem Tooth Loss

In the adult dentition the frequency of ante-mortem tooth loss was 14.5% (198/ 1369 tooth sockets). This figure is close to the figure of 15.8% found by Mays at Whitefriars and the 11.4% found at St Andrews, Fishergate. The causes of ante-mortem tooth loss include caries and periodontal disease. (See also Appendix 2).

4.2.3 : Dental Calculus

A majority of the teeth examined had evidence of "flecks" of calculus. Due to the nature of the burial context any quantification of the presence of calculus would be difficult due to the expected high frequency of post-mortem damage to these depositis.

4.2.4 : Dental Abscess

There were 5 dental abscesses in the dentitions, one mandibular and three maxillary adult dentitions, and one juvenile dentition. The frequncy of adult dental abscess was 0.3% (4/1369 tooth positions). This figure is low compared to most other sites. The frequency of abscess at Blackfriars, Ipswich, for example, was 5.5%, and at St Andrews, Fishergate the frequency was 4.5% (period 6). The low figure for the Denbigh sample may in part be due

to the poor preservation of many of the remains. The frequncy of abscess in the sub-adult sample was 0.6% (1/158 tooth positions)

4.2.5 : Supernumary Teeth

There was one example of a mandible with a deciduous canine retained between the left permanent canine and the first premolar.

4.3 : STRESS INDICATORS

4.3.1 : Introduction

A number of pathological features which present themselves on the skeleton are thought to be caused by physiological stress, either as the result of malnutrition or infection. The two mosst common conditions studied are cribra orbitalia and enamel hypoplasia.

4.3.2 : Cribra Orbitalia

Cribra Orbitalia, which presents itself as porosity in the orbits, was found in 15.8% (41/259) of orbits (see Table 1). The link between cribra orbitalia and anaemia has been stressed by Stuart-Macadam (1987). There have been a number of suggestions as to the cause of this anemia, including diets low in iron. Recently it has been suggested that iron stores may be sequestrated within the body as a defence against infection, and thus cribra orbitalia may occur as a secondary consequence of infective disease (Stuart-Macadam, 1992).

The frequency of cribra seen in the Denbigh population is close to the 15.3% (35/229 individuals) seen at Jewbury, York (Lilley *et al*, forthcoming). The frequency at Blackfriars, Ipswich was 23% of individuals (n=41) (Mays, 1991). The total frequency of cribra orbitalia at St Andrews, Fishergate was 28.7% (43/150 individuals) for a combined sample of both periods

4.3.3 : Enamel Hypoplasia

Enamel hypoplasia is a disruption in the normal formation of dental enamel, manifesting itself as pits, lines and grooves in the enamel. Occasionally more severe forms where the whole crown is malformed can be seen. The suggested causes of these disruptions have included vitamin, protein and mineral deficiencies, as well as being the results of bouts of infectious disease. However, much of the evidence is conflicting (Dobney,

1991). Hypoplastic defects can also be associated with specific diseases, such as tuberculosis and syphilis.

In the adult dentition the frequency of enamel hypoplasia was 4.9% (19/388) of teeth. The frequency of hypoplasia in the subadults was 5.3% (4/75) of total teeth, which in all cases is represented by hypoplasias on developing permanent dentition. At Jewbury 45.7% (150/328) of individuals show evidence for hypoplastic teeth, whilst at Blackfriars the frequency is 35.8% (N=53) of individuals (Mays, 1991b). One problem faced when trying to compare the Denbigh frequency is that the calculation is based on number of teeth, not number of individuals showing hypoplastic lines. The second factor is that there are relatively few incisors, canines and premolars in the Denbigh sample. These teeth are often easily lost postmortem.

Attention must be drawn to the remains of one maxillary dentition, the molars of which demonstrate grossly abnormal enamel formation, which has resulted in abnormal wear patterns (see Plate 1). Such gross defects are often seen in individuals with specific chronic infections, such as congenital syphilis, though any conclusions as to the aetiology of this specimen must remain pure speculation.

4.4 : CONGENITAL ABNORMALITIES

There are 4 possible cases of spinabifida occulta from Denbigh. This condition results from an incomplete bony fusion of the sacral spinous process. The resulting hiatus is of no significance to the individual, being covered by cartilage and skin, in life (Ortner & Putschar, 1981) (see Plate 2).

4.5 : ENTHESOPATHIES

Enthesopathies are bony lesions at the sites of insertion of muscle tendons or ligaments. The characteristic pattern seen is one of roughened areas of new bone formation. The site of the enthesopathy can be used to indicate which muscle(s) may be responsible, and thus potentially an activity pattern associated with that particular muscle. However, these lesions may merely represent robust individuals.

Many of the muscle markings found on the Denbigh sample were quite pronounced, perhaps reflecting a less sedentary lifestyle than we have today. Very pronounced muscle insertions were seen on the linea aspera of 9 femora (5 right and 4 left). This area corresponds to the insertion of the adductor group of muscles, responsible for adduction of the femora (the motion of bringing a leg stretched out sideways towards the body).

Another frequently occurring exostosis was the presence of a spur of bone on the posterior surface of the olecranon of the ulna. This is caused by overextension of the *Triceps brachii* muscle, today seen in occupations such as blacksmiths, woodcutters and basketball players (Dutour, 1986). This condition was found on 7 ulnae (4 right and 3 left). One proximal radius had an enthesopathy on the tuberosity. This corresponds with the insertion of *Biceps brachii*, the principle flexor of the elbow, and is today found in individuals who carry heavy objects with outstretched hands, such as bakers (*ibid*).

On the medial end of one right clavicle there was a cortical defect associated with the insertion of the costo-clavicular ligament.

4.6 : OSTEOCHONDRITIS DISSECANS

Osteochondritis dissecans is a condition which presents as small "punched out" lesions on the articular or joint surfaces of dry bones. Two cases were noted in the Denbigh population. One was on the lateral condylar articular surface of a right distal femora; the other was found on the glenoid cavity of a right scapula.

This condition more commonly occurs in the adolescent and in individuals over 40 years of age (Loveland *et al*, 1980). It occurs as the result of necrosis of a localised area of bone. A number of aetiologies have been suggested including trauma and obstruction of the arteries supplying the articular cartilage. Wells (1974) comments that the condition is quite common on the knee but is rare in the glenoid cavity. The symptoms of the condition include pain and swelling (Loveland, *ibid*).

4.7 : TRAUMA

4.7.1 : Introduction

The remains from Denbigh contain individuals who had suffered a number of injuries, including dislocations, fractures and blade injuries. Each type of injury requires separate consideration.

4.7.2 : Fractures

One individual suffered a severe midshaft compound fracture of the femora, resulting in 3 distinct segments of bone. There has been shortening of the bone, with the midshaft segment overlaping against the proximal and distal shaft segment, which have united. The fracture has completely healed. Radiographically 3 distinct shaft

segments are seen. A midshaft fracture of the femur is rare in palaeopathology. Today this injury is generally associated with major violence, such as in a road traffic accident. From the level of healing it is obvious that this individual survived for many years after the injury, though would have no doubt suffered decreased mobility.

There is one possible case of a condylar fracture to a right distal femur. The distal part of the shaft is flattened antero-posteriorally. The lateral condyle has been displaced superiorally. Thickening of the cortex is seen radiographically on the lateral aspect of the shaft. Both visually and radiographically the fracture appears completely healed. The medial condyle has been broken post-mortem.

There are 2 examples of fractures of the tibia. One, represented by a shaft fragment and distal end, consists of a simple, transverse mid-shaft fracture. There has been displacement of the proximal part of the bone laterally, though no shortening appears to have occurred. Cortical thickening is seen on the lateral aspect of the bone, radiographically; this perhaps represents a biological mechanism to reduce the displacement. The fracture is well healed. The second example consists of a spiral fracture of the shaft, with overlapping of the two shaft fragments. Fractures of the tibia are quite common palaeopathologically.

The proximal ends of a right tibia and fibula have fused together at their articulation. There is postmortem damage to the rest of the proximal ends of both bones. These changes could possibly have resulted from a fracture to the proximal end of the fibula (Boyleston, pers.comm).

One adult ulna possessed a callus on the distal end, suggestive of a well healed fracture. There had been no displacement and the bone is well healed. A fracture of the distal ulna, a Parry fracture, can be caused in the action of defending oneself from a blow.

4.7.3 : Dislocations.

Two dislocations were seen in the Denbigh assemblage : a shoulder dislocation and a partial dislocation of the hip joint. The shoulder dislocation presents the classic pattern of a long-standing dislocation. On the anterior aspect of the glenoid fossa there has been the creation of a new articulation, with the development of a bony ridge surrounding this new articulation. The glenoid cavity has undergone change, with the formation of granulation tissue. Because of the mobility of the shoulder joint dislocation of the shoulder is more common in palaeopathology than of the femur (Merbs, 1989), though they are easier to reduce. Once the humerus has

been dislocated for more than a few weeks initiation of the changes seen above occurs (see Plate 4).

One hip joint had lesions suggestive of a partial dislocation (subluxation) of the hip. On the acetabulum there is an area of porosity and eburnation on the superior surface. On the superior rim of the acetabulum there is an osteophytic projection, 34mm in length and a rim of bone surrounding the edge of the acetabular notch. On a corresponding femoral head there is an area of porosity and eburnation on the antero-superior aspect. There is osteophytic lipping on the inferior surface of the femoral head, and a raised bulge of bone inferior to the fovea.

4.7.4 : Blade Injury

One fragment of cranial vault has a groove running across the frontal and parietal bones, suggestive of being produced by a blade. The cut, passing through the thickness of the diploe, starts on the right coronal suture and passes diagonally onto the left parietal. The cut extends for 5cm before being interrupted by an opening in the bone. The rest of the parietal is missing. At the area which corresponds to bregma there is an area of thickened, pitted bone, suggesting some localised infection. The edges of the cut are smooth and there is formation of bone on the left parietal area of the cut, all suggestive of healing (see Plate 5).

One major complication of this type of injury is the introduction of infection into the brain. The evidence in this case suggests that the individual survived long enough for the healing process to advanced.

4.7.5 : Localised Trauma

There are two examples of localised trauma to the distal tibia. One has a swelling, covering an area of c 30mm, on the interosseous border, posterior to the fibula notch. This area corresponds with the insertion of the interosseous membrane and probably represents trauma to the membrane (Roberts, pers.comm). The other consists of a swelling on the postero-medial border of the distal tibia. Radiographically this swelling presents as a continuation of the normal cortical bone, with no obvious defects.

4.8 : INTERNAL FRONTAL HYPEROSTOSIS

From the Denbigh assemblage there are examples of fragmented frontal bones which show thickening on the endocranial surface, representing at least 2 indiviuals. In cross-section the bone looks very cancellous in appearance. These features are suggestive of internal

frontal hyperostosis, a condition normally seen in post-menopausal women, and thought to be the result of changes in the level of pituitary hormones (Ortner and Putschar, 1981).

4.9 : JOINT DISEASE

4.9.1 : Osteoarthritis

In dry bone osteoarthritis is characterised by changes in the shape of joint contours, pitting and eburnation (polishing) on the articular surfaces of joints, caused by degeneration of the articular cartilage and eventual bone to bone contact. Osteoarthritis is generally a disease whose onset occurs in middle age (Steinbock, 1976).

There were eight bones in the Denbigh deposit which showed evidence for eburnation. For two of these the degeneration was associated with a partial dislocation of the hip. Details of these cases can be seen below :

BONE	SIDE	END	DESCRIPTION
Femur	L	P	Eburnation on antero-superior surface of head covering 45 X 25.5 mm. Osteophytes on inferior margin of head. Associated with subluxation of the hip.
Femur	L	D	Eburnation covering 15 X 15mm on lateral articular surface.
Femur	L	D	Eburnation, pitting and grooving on medial condyle.
Radius	L	D	Eburnation and porosity on the scaphoid articular surface.
Radius	R	P	Eburnation on medial portion of radial head.
Pelvis	L	-	Porosity and eburnation on the superior aspect of the acetabulum. Associated with the partial dislocation.
Pelvis	L	-	Porosity and eburnation on superior surface of acetabulum.
Pelvis	L	-	Porosity and eburnation on superior surface of acetabulum.

The earlier stages of the disease are characterised by lipping of the joint contours (Steinbock, 1976). Lipping of the joint contour was seen on 3 femoral heads, 2 femoral condyles and 3 humeral heads.

4.9.2 : Spinal Joint Disease

Table 4 provides details for the numbers of affected vertebrae. In this sample two types of vertebral joint disease were seen. The first type, Schmorl's nodes, characterised by depressions in the surface of the vertebral body, are caused by herniation of the central part of the intervertebral disc, the nucleus pulposus, through the surrounding annulas fibrosus. Vertebral osteophytes are projections of the bone protruding from the side of the vertebral body. They are caused by the nucleus pulposus pressing against the anterior longitudinal ligament, thus inducing osteophyte formation (Steinbock, 1976).

Because of the small number of vertebrae found quantification of the results is not possible.

4.9.3 : Diffuse Idiopathic Skeletal Hyperostosis

Two sets of vertebrae from the Denbigh deposit, which may belong to either one or two individuals, were found fused together. One set consits of 2 thoracic vertebrae on which osteophytes have formed on the right side of the vertebral bodies. These osteophytes are of "molten wax" appearance. The apophyseal joints are unfused and the disc space appears normal. The other set consists of 3 thoracic vertebral bodies which are fused together in the same manner as above. It may be that these vertebrae come some individual(s) suffering DISH (Diffuse Idiopathic Skeletal Hyperostosis) which is quite commonly seen on monastic sites. However, because of the preservation and disarticulated nature of the material any such diagnosis is speculation.

4.10 : NON-SPECIFIC INFECTION

4.10.1 : Introduction

The term non-specific infection is given to a series of bone infections caused by bacteria such as *Streptococcus* and *Staphylococcus*. Often these infections can be associated with specific diseases, such as syphilis, or they may occur on their own. Because of the disarticulated nature of these remains each bone must be considered in isolation.

Non-specific infections are classified in terms of their location on the bone. Periostitis is defined as infection of the membrane surrounding the bone, the periosteum, and is characterised by new bone which is superficial to the original bone cortex (Ortner and Putschar, 1981). Osteitis is defined as infection of the cortex, whilst

osteomyelitis is an infection of the medullary cavity of the bone, which may result in perforation of the cortex by cloacae for the draining of pus. Whilst there is discrete infection it is often the case, at least in this sample,that all regions of the bone can be affected. General symptoms of infection include fever, pain and swelling.

4.10.2 : Periostitis

Periostitis can occur either as a disease in its own right, as the result of trauma or as secondary periostitis as part of a specific disease syndrome, such as syphilis (Ortner and Putschar, 1981). Periostitis occurred on its own on 21 fragments of bone (2 distal humeri; 1 right distal and 1 right proximal ulna; 2 right proximal, 1 right distal, 3 left proximal and 2 left distal tibiae; 5 tibial shaft fragments, and 4 fibula fragments). Periostitis also occurred on 6 bone fragments in association with osteomyelitis (on 1 right distal humerus, 3 left tibia shafts, 1 distal tibia and 1 ulna shaft fragment). The extent of the infection on these bones ranged from localised areas of well remodelled periostitis to plaques of new bone covering the cortex of the entire shaft.

A good illustration of periostitis is seen on a right distal tibia, the shaft of which is covered by layers of periosteal new bone on all aspects (see Plate 6)

4.10.3 : Osteomyelitis

Osteomyelitis occurs as the result of bacteria invading bone. Bacteria can enter bone either by direct infection from wounds, by extension of infection from adjacent soft tissues, or by haematogenous spread from a remote focus of infection (Ortner and Putschar, 1981). In the Denbigh sample the latter routes were probably the most likely cause, though the exact means of spread would be difficult to ascertain in such a disarticulated sample.

There were 7 cases of osteomyelitis in the Denbigh assemblage (1 right distal humerus; 1 left distal radius; 1 left distal tibia ; 3 tibial shaft fragments, and 1 ulna shaft fragment). A classic case of osteomyelitis can be seen on the shaft of a left tibia. On the distal third of the shaft there is a "swelling", 7cm in length, which is perforated by 6 small openings (cloacae) for the draining of pus. There is evidence for active periosteal bone formation in the area surrounding the cloacae, no doubt caused by the escaping pus (see Plate 7).

The majority of the examples do not have cloacae. Plate 8 illustrates this type on a tibial shaft fragment. The shaft is greatly increased in width and there is evidence for periosteal reaction, with pitting and remodelling new

bone formation, on all aspects of the shaft. The medullary cavity of the bone has been completely obliterated by bone formation on the endosteal surface of the cortex.

4.10.4 : Sinusitis.

Evidence for sinusitis was observed in 12% (12/100) of adult/ indeterminate maxillary sinuses and in 6.3% (1/16) of sub-adult sinuses. Sinusitis is characterised by pitting and new bone formation within the sinus. It is most commonly caused as the result of secondary bacterial infection following an upper respiratory tract infection, such as the common cold, or as the result of the spread of dental infection from the maxillary dentition. As no diseased teeth were observed in close relation to infected sinuses it appears that this was not the route of infection.

The frequency of sinusitis was much lower than the frequency of 54.9% (73/133 individuals) observed by Boocock (1993) in remains from the cemetery of St James and St Mary Magdalene, Chichester. This discrepancy could be explained by the presence of a lower rate of respiratory tract infection in the rural Denbigh population. However, post-mortem damage may account for a reduction in frequency in the Denbigh assemblage.

4.11 : TREPONEMATOSIS

One fragmented cranial vault presented lesions which are suggestive of treponematosis. The vault is preserved as a complete frontal and fragments of both parietals. On the frontal bone the lesions represent those of caries sicca (Hackett, 1976). On the endocranial surface there is pitting. On the anterior portion of the left parietal there is evidence for clustered pits, associated with more general pitting. Towards the posterior part of the left parietal there appear to be circumvallate cavitations. On the inner surface there is pitting and what appear to be perforations running along the line of the sagittal suture. The changes seen on the right parietal occur mostly on the posterior portion. In this area there is caries sicca and lesions associated with earlier stages of the disease. The whole of the diploe is thickened and has the appearance of pumice stone (see Plate 9).

Hacket (1976) comments that the lesions of caries sicca are the most characteristic bone change of treponematosis. In addition to the cranial vault, the long bones are also involved, especially the tibia. Changes seen in the long bones are those of bone formation, both on he periosteum and in the cortex, resulting in thickening of bone. A number of bones seen in the Denbigh deposit showed evidence of long-standing

infection not inconsistent with a diagnosis of treponematosis. For reasons outlined previously it is difficult to make specific associations between bones.

The bone changes of syphilis represent the tertiary stage of the disease, usually appearing 2-10 years after initiation of the infection (Ortner and Putschar, 1981).

5 : DISCUSSION

The remains excavated from Ysgol, Twm o'r Nant, Denbigh were in a highly fragmented condition, with only a few intact bones. From the figures obtained from the MNI tables it can be seen that there is quite a discrepancy between cranial and post-cranial elements. Whilst this discrepancy was expected for some of the smaller and less robust elements one should expect to see greater survival of the larger leg bones. To some extent there is greater survival of the femora and tibiae. One possible reason for the discrepancy between cranial and post-cranial elements is differential collection during deposition. Certainly this would explain the lack of smaller skeletal elements.

Whilst it is suggested that relatively intact crania were deposited this does not account for differences in the frequency of particular cranial bones. This discrepancy could possibly be as a result of the depositional environment.

The amount of age and sex data obtainable was limited by the general state of preservation of the bones. Where there was sufficient preservation metrical analysis of the femoral head etc was able to provide an assessment of biological sex in about 2/3 of cases. Whilst dental attrition provided the most abundant data for aging, the general lack of tooth preservation provided one major problem.

One area which demonstrates the potential of charnel deposits came from the study of the pathological lesions on the bones. Whilst we must acknowledge the major stumbling block of disarticulation, there is still a wealth of data that can be gleaned from the study of individual bones.

A number of bones were seen that demonstrate either major trauma or long term infection. Certainly in the cases of major trauma (femoral fracture and blade injury) some degree of care must have been provided for these individuals in order for them to survive and recover from their injuries. Other individuals, with evidence for long-standing infection, would no doubt have had symptoms commensurate with their conditions. Whilst it appears that some of these individuals were cared for, whoever

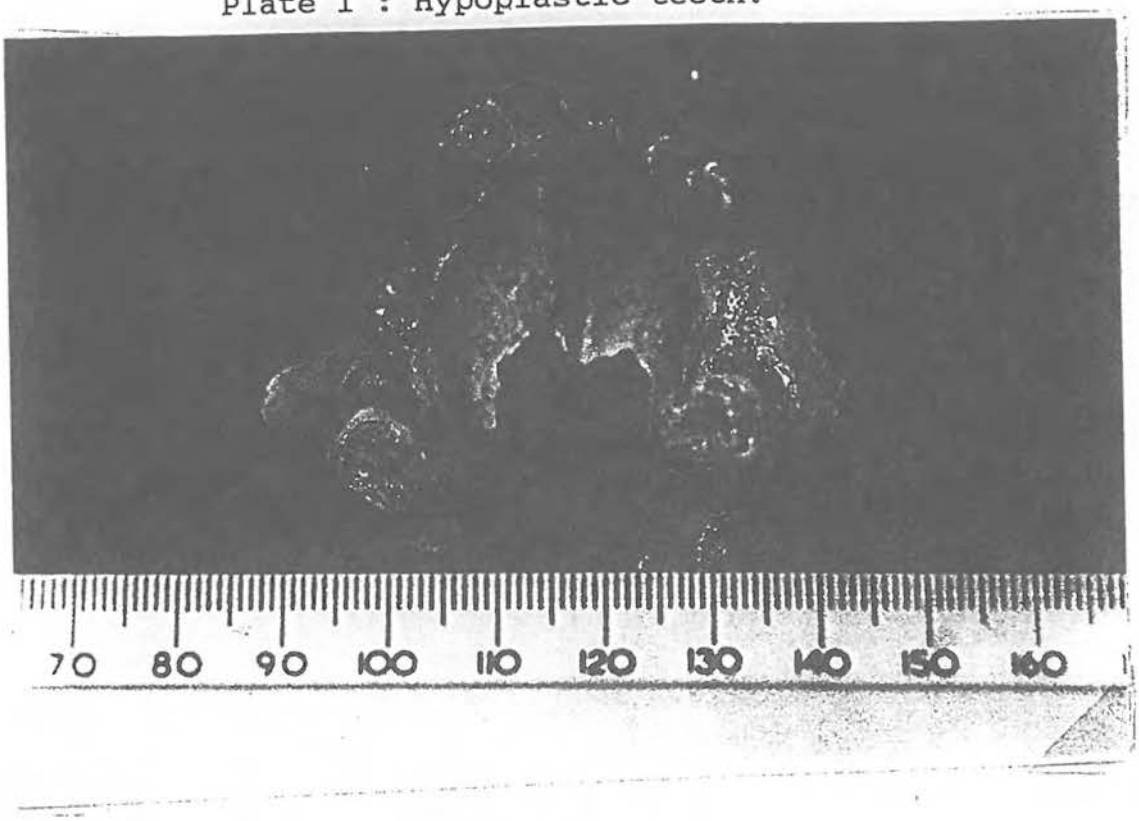
was caring for these individuals must remain open for speculation.

Potentially the most exciting case excavated from the site was the fragments of skull with lesions suggestive of treponematosis. There is great debate as to the origin of treponematosis, with ideas being polarised between a Pre-Columbian New World origin or one in the Old World. Radio carbon dating will be essential in order to confirm or deny a pre-Columbian date. Further research must be undertaken in order to ascertain the importance of this find.

Pathological lesions found on remains previously excavated from this site included cribra orbitalia, arthropathy, fracture and non-specific infection (Manley, 1988). These findings are similar to the pathological lesions noted during this investigation, with one or two notable additions.

The deposit of human bone from Ysgol Twm o'r Nant, Denbigh provided a surprising amount of information. The excavation and analysis of charnel deposits provide a valuable resource in the study of the past.

Plate 1 : Hypoplastic teeth.



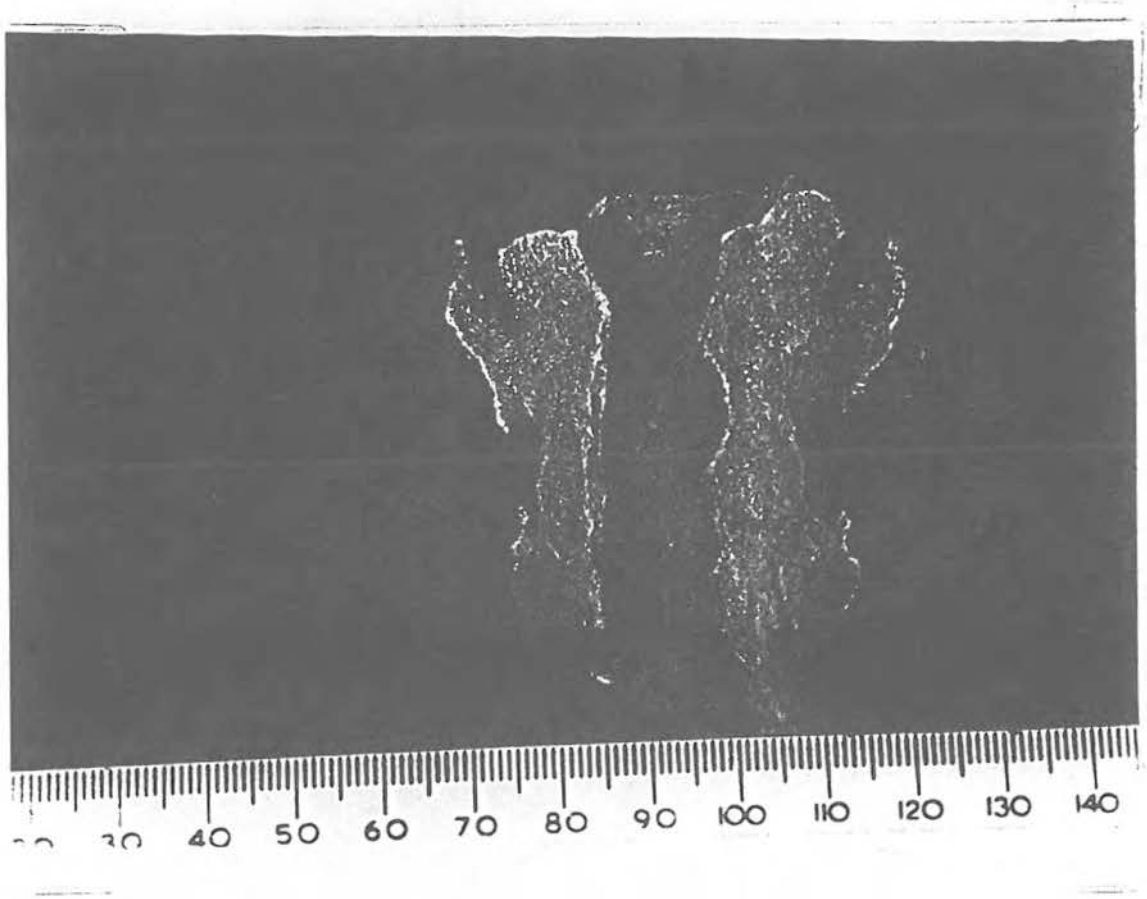
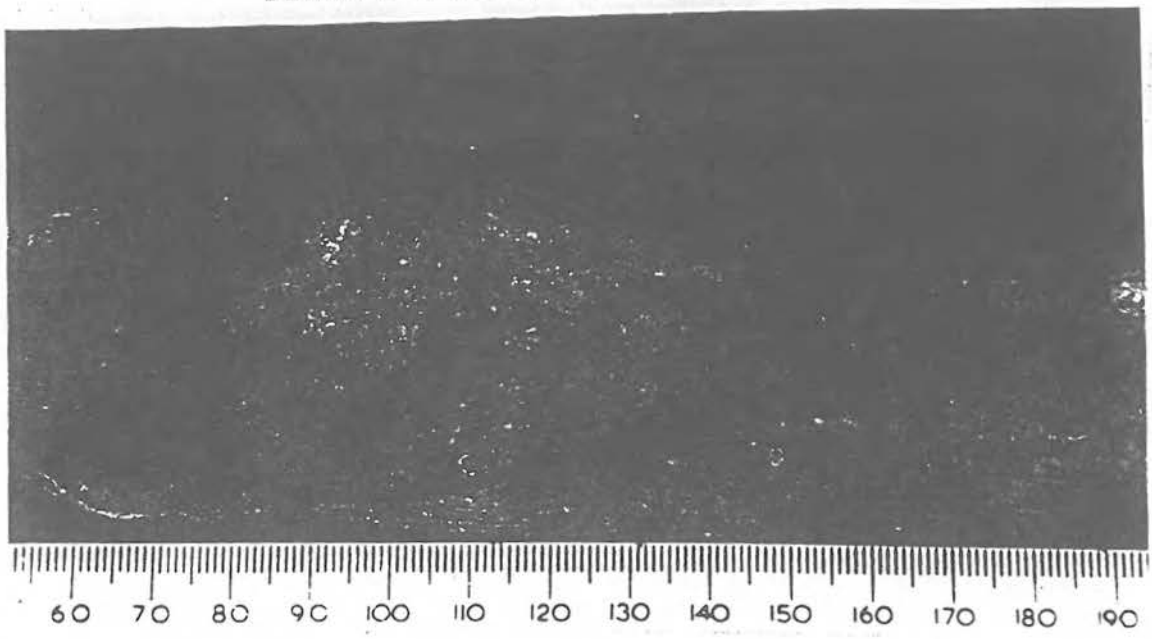


Plate 2 : Spina bifida.

Plate 3 : Femoral fracture.



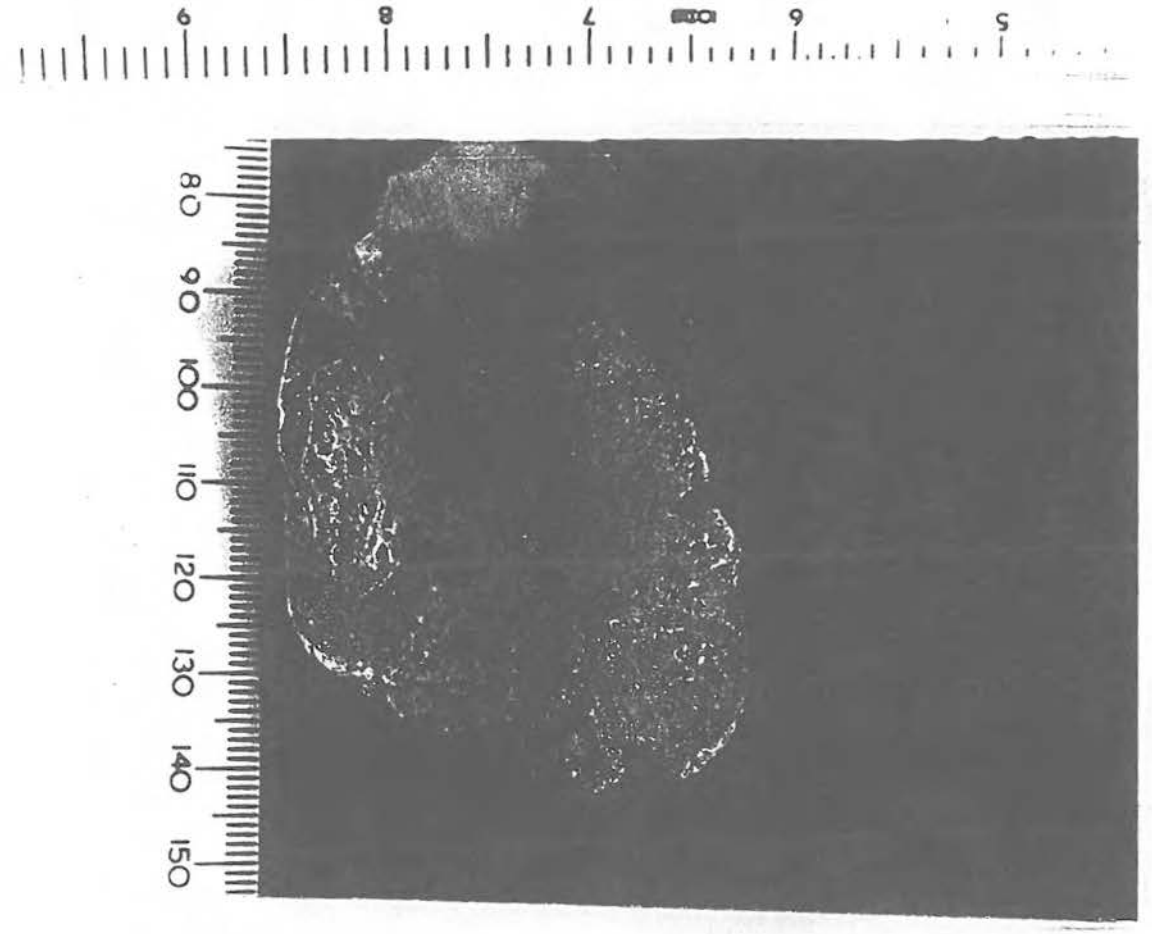
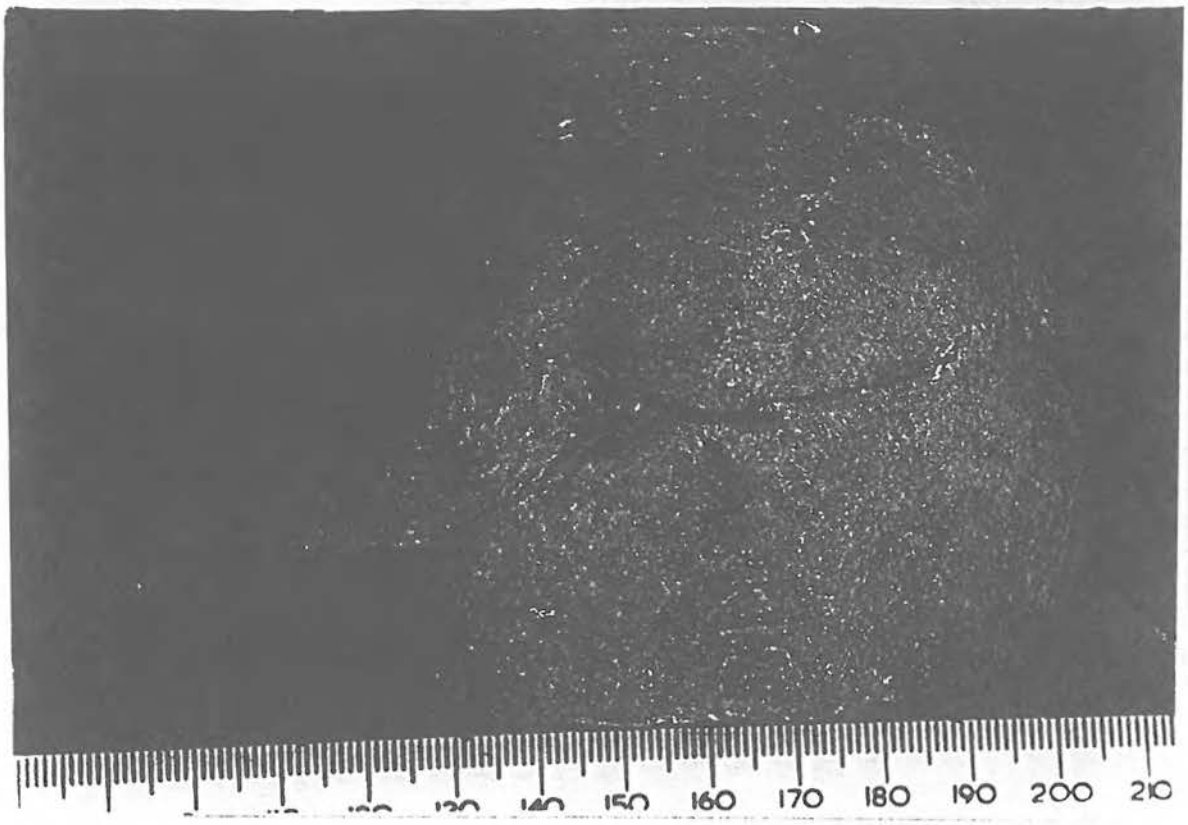


Plate 4 : Shoulder dislocation.

Plate 5 : Blade injury.



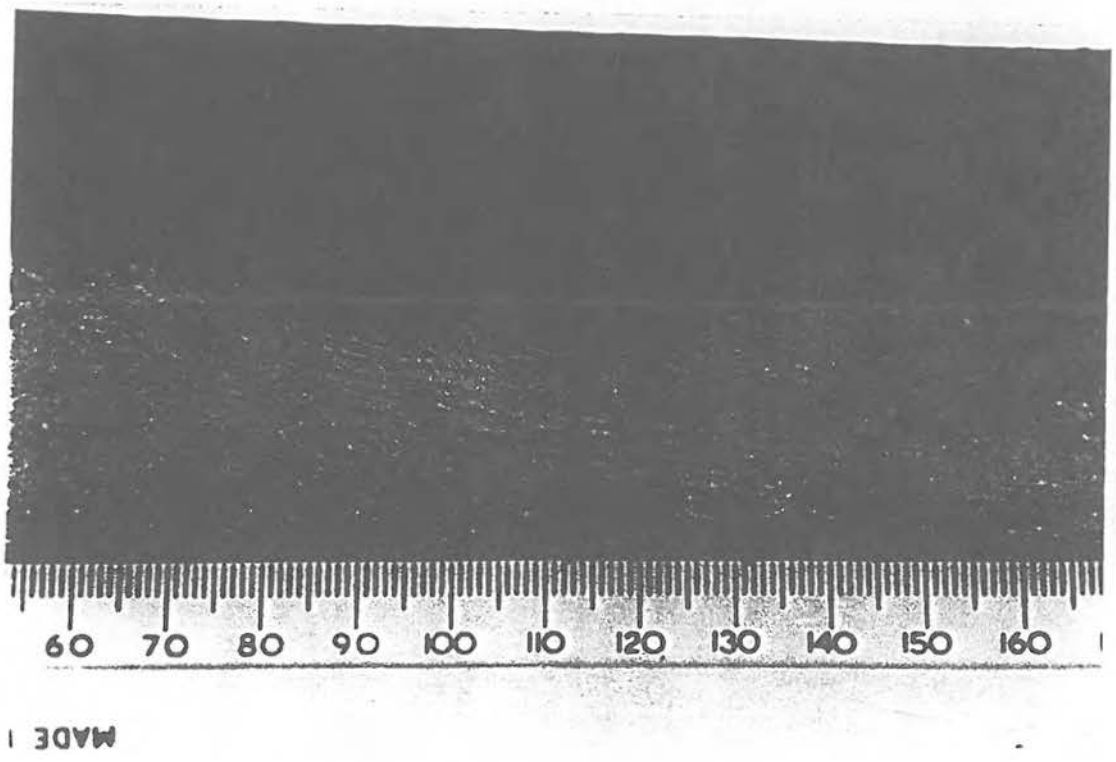
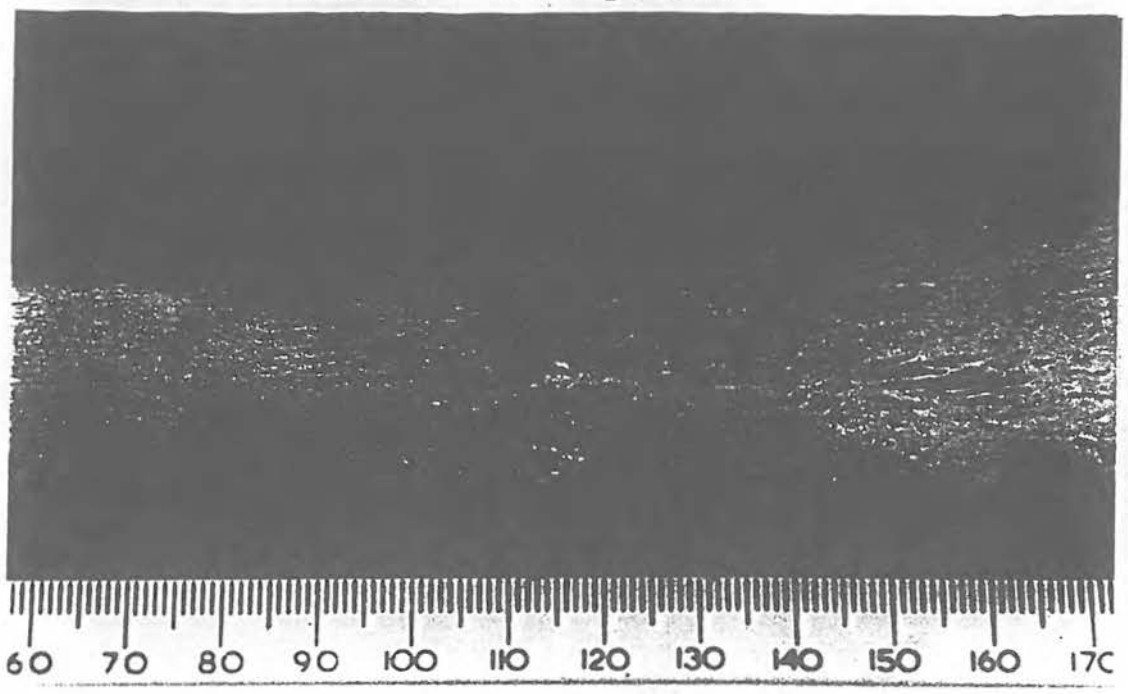


Plate 6 : Periostitis.

Plate 7 : Osteomyelitis.



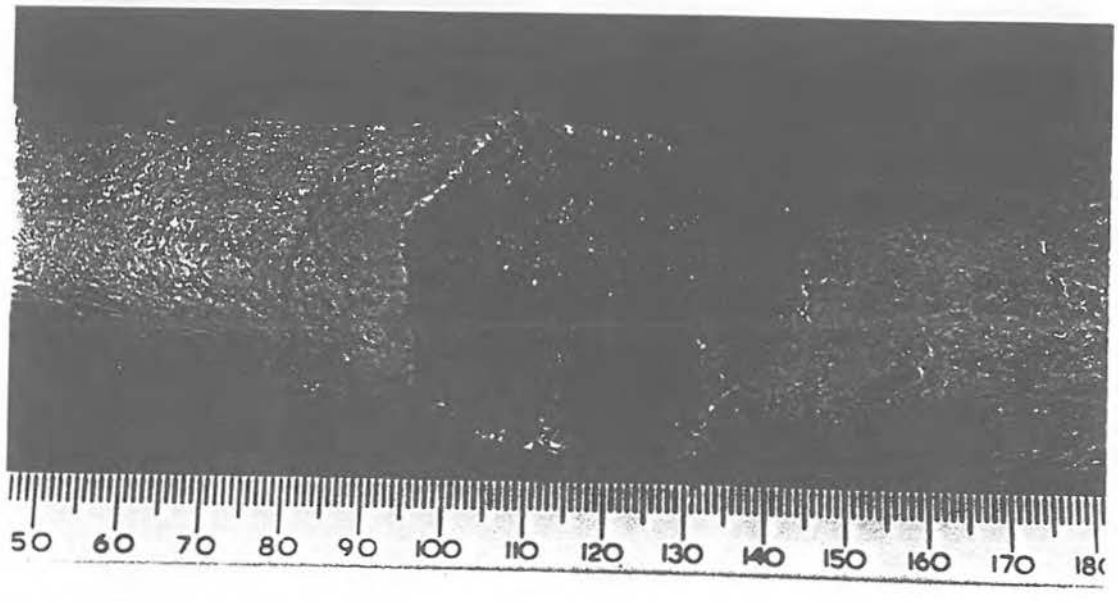


Plate 8 : Osteomyelitis (without cloacae).

Plate 9 : Treponematosis.

APPENDIX 1 : METRICAL DATA

MEASUREMENT	MEAN	ST.DEV	MIN	MAX	NUMBERS
R.FEMORAL HEAD	45.4	4.1	38	54.2	36
R.FEMORAL BCW	78	5.6	69.5	89.1	19
L.FEMORAL HEAD	47.3	4	40.4	53.8	29
L.FEMORAL BCW	76.1	5	69.2	87.8	20
R.HUMERUS HEAD	44.2	4.7	38.5	54.9	18
L.HUMERUS HEAD	45.8	4.7	37.4	53.1	33
R.RADIUS HEAD	21.9	3	17.7	26.1	7
L.RADIUS HEAD	23.7	0.6	23.3	24.7	5

KEY:
BCW = BICONDYLAR WIDTH

APPENDIX 2 : TOOTH COUNT AND DENTAL DISEASE PREVALENCE

PERMANENT MANDIBULAR DENTITION

TOOTH	RIGHT	HYPOPLASIA	CARIES	LEFT	HYPOPLASIA	CARIES
I2	0	0	0	2	0	0
I2	2	0	0	5	0	0
CANINE	4	0	0	6	0	0
PREMOLAR 1	7	0	1	8	0	0
PREMOLAR 2	14	0	1	11	0	1
MOLAR 1	28	1	4	19	0	1
MOLAR 2	36	2	5	19	0	1
MOLAR 3	18	0	1	18	0	0
TOTAL	109	3	12	88	0	3

In addition there were the following teeth which could not be full identified

Molars = 3, Incisor = 1, Canine = 1 and Premolar = 1

Total number of teeth = 202

PERMANENT MAXILLARY DENTITION

TOOTH	RIGHT	HYPOPLASIA	CARIES	LEFT	HYPOPLASIA	CARIES
I1	1	0	0	3	0	0
I2	2	0	0	3	0	0
CANINE	8	2	0	7	1	0
PREMOLAR 1	9	0	1	16	6	1
PREMOLAR 2	16	0	0	20	2	4
MOLAR 1	19	2	3	24	1	2
MOLAR 2	12	0	3	23	2	2
MOLAR 3	8	0	1	8	0	0
TOTAL	75	4	8	104	12	9

In addition there were the following teeth which could not be fully identified :
Molars = 1, Canines = 2, premolars = 3 & Incisors = 1

Total number of teeth = 186

SUB-ADULT DENTITION

MANDIBLE

TOOTH	RIGHT	HYPOPLASIA	CARIES	LEFT	HYPOPLASIA	CARIES
DECID. I1	2	0	0	1	0	0
DECID I2	1	0	0	0	0	0
D. CANINE	1	0	0	0	0	0
P. CANINE	2	0	0	0	0	0
PREMOLAR 1	1	0	0	1	0	0
D.MOLAR 1	1	0	0	1	0	0
D.MOLAR 2	5	0	0	4	0	0
P.MOLAR 1	5	0	0	4	0	0
P.MOLAR 2	1	0	1	2	0	0
TOTAL	19	0	1	12	0	0

In addition there were a number of teeth which could not be fully identified :

Deciduous molars = 1, permanent premolars = 1 (with enamel hypoplasia), permanent first molars = 4 & permanent third molars = 1.

D = Deciduous dentition. P = Developing permanent dentition.

MAXILLA

TOOTH	RIGHT	HYPOPLASIA	CARIES	LEFT	HYPOPLASIA	CARIES
D.CANINE	2	0	0	0	0	0
D.MOLAR 1	2	0	0	3	0	0
D.MOLAR 2	4	0	0	2	0	0
P.MOLAR 1	6	1	0	4	0	1
P.MOLAR 2	4	0	0	2	0	0
P.MOLAR 3	1	0	0	0	0	0
TOTAL	19	1	0	11	0	1

In addition there were a number of teeth which could not br fully identified:

Premolars = 1, permanent molars = 4 (one with enamel hypoplasia) &
Canine = 1 (with enamel hypoplasia)

D = deciduous dentition. P = developing permanent dentition.

APPENDIX 3 : ANIMAL REMAINS

Recovered from the same deposit as the human bone were a number of animal bones, representing cattle, sheep and deer. Methods of identification followed Hilson (1992). The identifiable bones were as follows :

SHEEP

Adult

1 right distal humerus
1 left distal humerus
2 right proximal radii
1 left proximal radius
1 left distal tibia
1 left proximal metatarsal
1 left talus

Juvenile

1 right distal tibia

CATTLE

Adult

1 right metatarsal
1 left metatarsal
2 right proximal metacarpal
1 right acetabulum
2 left acetabulae
1 right radius
1 cubo-navicular
1 left tibia
1 proximal right femur
3 vertebrae
1 distal phalanx
1 right proximal phalanx
1 left proximal phalanx
1 right glenoid cavity
1 fragment of right maxilla
1 fragment of right mandible

Juvenile

1 right distal radius
1 right metatarsal

DEER

Adult

1 proximal left radius
1 right metatarsal

SUMMARY

The above figures suggest that the remains of at least 3 cattle (2 adult, 1 juvenile), 3 sheep (2 adult, 1 juvenile) and 1 deer were deposited with the human remains. Evidence for gnawing, seen as pits and grooves on the surface of the bones, was seen on a number of the bones.

I would like to thank Dr T.P O'Connor for his advice during the analysis of these remains.

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