Bartlemas Chapel Excavations 22 September - 4 November 2011
Human Remains - Preliminary Assessment

Introduction
The Hospital and Chapel of St Bartholomew in Cowley, Oxford were founded c. 1126 by
Henry 1 for 12 lepers and a chaplain. This report represents a preliminary assessment and
quantification of the human remains discovered during excavation within the grounds of the
Chapel.

The Nature of the Assemblage
The assemblage comprised three types: inhumations, intact burials which were uncovered, but
not lifted and therefore only a limited, visual examination was possible; re-interred
disarticulated bone reburied in charnel pits, representing the remains of more than one
individual, and fragments of bone recovered from 'cemetery soils'. In the latter case it is
supposed that human bone from disturbed burials had built up around and within the fills of
extant graves, indicating that some intercutting and disturbance had occurred. The reduced
scientific value of disarticulated skeletal remains is acknowledged (Mays *et al.* 2004, 4-5),
however for the purpose of this study, post-cranial metrics have been used to assign the most
probable gender to individual long bones from the charnel pits. The age of the adults and the
aetiology of the some of the recorded pathologies has not been possible to determine.
A summary of the inhumations is given in Appendix 1, quantification of the disarticulated
human remains, including metrical analysis where appropriate, is given in Appendix 2.
Observed pathologies and non-metric traits are given in Appendix 3.

Method
The remains have been examined in accordance with English Heritage Guidelines (Mays *et.
al*. 2004), and the guidelines and standards laid down in Brickley and McKinley (2004) for
disarticulated and co-mingled remains. Metrical analysis was carried out according to the
methods described in Brothwell (1988) and Bass (1987).

The visual matching of paired bones from charnel pits based on consistency in size,
morphology, robusticity, age, muscoskeletal stress markers and taphonomic processes was
possible in some cases, in particular those from Charnel Pit 1.

Sex and Stature
Few of the inhumations had survived or were sufficiently exposed to estimate the sex of the
individual. **SK 1** had strong brow ridges and a prominent mental eminence, coupled with a
robust skeleton, and was probably male.

Charnel pits
Considerable variation was noted in both the size and robusticity of the long bones recovered
from the charnel pits, and the recorded post-cranial metrics suggest that both men and
women were buried in the cemetery. Stature was estimated from femoral length. This showed
adult height ranged from approximately 4ft 111/2in for the individual with rickets, to 6ft. The
time period represented by these remains is unknown.

Context/Bone ID	Approximate Height
1026/1	111/2"
1026/2	0"
1026/3	5'31/2"
1015/1	0"

Immature individuals

Two child burials **SK5** and **SK6/7**, to the west of the chapel, were positioned south-east–north-west, with heads to the south-east. Deviation from the normal burial rite is unusual but is not unknown. At the Quaker Burial Ground at Kingston upon Thames only 10 per cent of the burials were made on a west-east alignment (Bashford and Pollard 1998: 159). Topographic features such as walls, paths and trees were all considered factors in their orientation, and similar features may have been factors. These graves were also shallower than **SK1** to the north-west (**SK5:** 67.9m OD legs; **SK6/7**: 67.88m OD legs, c.f. **SK1** 67.7m OD legs, up-slope of the children's graves with a 0.15m difference in modern ground height), which might indicate a more hurried burial. Medieval ecclesiastical records from Hereford Cathedral suggest un-baptised children were excluded from cemeteries and had to be buried hurriedly and in secret in consecrated ground. Excavations revealed a wide variety of orientations for the burials there (Shoesmith 1980: 51). Further interpretation of the burials of the Bartlemas children might be possible once dating evidence becomes available.

SK9 was very poorly preserved, and the skull and jaw crushed, making an assessment of the tooth roots possible. Based on dental wear and the stage of dental eruption (Schour and Massler 1940) **SK9** was c. 14-16 years at the time of death.

Amongst the bones recovered from Charnel Pit 3, were a right femur, left and right tibia and right humerus. Based on the level of epiphyseal fusion these appear to be from one individual, estimated to have been aged at between 16-21 years old.

An unfused epiphysis from a right proximal tibia (1015/18) was recovered from Charnel Pit 2 providing evidence for the remains of one further immature individual.

Intercutting and disturbance

Intercutting between graves was observed in both Trench 1 and 2. In Trench 1 in the east of the Chapel, the distal ends of the femurs of **SK 1** were truncated by the grave cut of **SK12 [1052]**. This most probably occurred at a time before comprehensive records were kept and suggests the grave was unmarked; it might also indicate a well-used and crowded cemetery. It is probable that the *in situ* lower limb bones and feet of **SK1** were removed at this time.

In Trench 2 the grave of **SK13 [2067]** appears to have been cut by that for SK11 **[2061].** The majority of the post-cranial skeletons lay under the baulk and the extent of the disturbance is uncertain.

Cemetery Soils

A small amount of human bone was recovered from the soils in Trench 2 and 3, and this has most likely derived from the inadvertent disturbance of earlier burials.

Charnel Pits

The disturbance of burials and their re-deposition in charnel pits was commonplace in medieval cemeteries where the need for new graves outstripped the graveyard space. Three charnel pits were excavated, **1024, 1027** and **1040**. Charnel pits 1 **[1027]** and 2 **[1024]** were located against the Chapel wall beneath the eaves on the north and south sides. In the medieval period, burial beneath the eaves drip of the church or chapel roof was sometimes requested, because it was believed the rainwater was sanctified by its contact with the roof (Daniell 1997: 92), and this might represent a continuation of this belief. Similarly Charnel Pit 3 against the wall in the east of the Chapel might have been located, possibly originally as a grave, to be close to the altar.

Charnel Pit 1: [1027], fill (1026)

Charnel Pit 1 comprised mainly long bones, including clavicles, most of which had survived intact. The bones appear to have been carefully stacked within the pit and based on the size of the bones, levels of epiphyseal fusion, and pathologies, they represent the remains of at least three adults. The skull from a large dog was also recovered from the pit.

Notable amongst these is the remains of an individual with rickets which had possibly been used as an anatomical specimen **(1026/1)**. Holes, approximately 5mm in diameter had been drilled into the neck of each femur midway between the head and the greater trochanter. Distally holes were drilled on the articular surface between the intercondylar fossa and the patella surface. The right tibia had similarly been drilled between the condyles, and centrally on the left and right distal articular surfaces. The shaft only of the left tibia had survived, but was identified as most probably belonging to this individual based on the size and colour of the bones and a bowing of the bone indicative of rickets. No metal staining was evident in the vicinity of the drilled holes and it is uncertain if or by what means the bones were attached. It is unknown whether this individual represents an original re-interment or the disposal of an unwanted anatomical specimen during the opening of the charnel pit.

Charnel Pit 2: structure [1024]; filled by (1007), (1015)

This appears to be the reuse of a stone lined grave. Unlike Charnel Pit 1, the bones were less formally deposited and intermixed with animal bone. A minimum number of five individuals were represented. A number of the long bones had evidence for non-specific infection.

Charnel Pit 3/disarticulated remains in backfill of construction trench: cut [1040], fill (1034)

This pit contained only a small number of bones from a minimum of two individuals. The majority of the bones are those of a young person in their late teens or early twenties.

Drain and Soakaway

Machine stripping for the drain and soakaway **(1053)** and **(1054)** disturbed a number of bones, most probably from further charnel pits.

Copper alloy staining

No grave goods were observed with any of the *in-situ* burials, however a blue/green stain was found on the surface of one of the three clavicles recovered from charnel pit 1 (1026/11). This might have resulted from a shroud pin or brooch fastened at the shoulder.

Pathologies

Periosteal new bone

Periostitis was the most common condition observed with both active (woven bone and inflammatory pitting) and healing (lamellar bone) periosteal lesions present. Periostitis results from infection of the periosteal membrane which covers the bone and may be caused by trauma or non-specific infection. None of the bones showed signs of direct trauma and therefore infection is considered the most probable cause.

Rickets

Rickets is a metabolic condition which results from a deficiency in vitamin D which is required for the body to absorb calcium and phosphorus. The vitamin is found in fish oil and animal fat, however the majority of vitamin D is derived from exposure to ultraviolet light in sunlight. A lack of the vitamin results in softening and weakening of the bone leading to deformation of the weight bearing bones when walking and crawling commences in childhood. It was a common disease in England in the 17th and 18th centuries (Fildes 1986). This condition was observed in **(1026/1)** the possible anatomical specimen.

Schmorl's Nodes

Schmorl's nodes are indentations or pressure defects on the superior or inferior surfaces of the vertebra caused by the herniation of the intervertebral disc into the end plate of the vertebral body, and are caused by physical stress on the spine. They occur most often in the lower thoracic and lumbar regions (Rogers & Waldron, 1995). Schmorl's nodes were identified on thoracic and lumbar vertebrae from context **(1015)** and thoracic vertebrae from context **(3015).**

Flared Metaphysis

Flared metaphysis of the left humerus were observed on (1026/7). During growth and maturation healthy bone grows through resorption of the external cortex near the metaphysis and deposition of tissue endosteally (Buikstra & Ubelaker, 1994). This is most likely to be a biochemical adaption to activity related stress on the joint

Osteoma

A small button osteoma approximately 5 mm in diameter was observed on the right side of the frontal bone of SK1. An osteoma is a small benign bony tumour which would have most probably been symptomless in life.

Osteoarthritis (OA)

Eburnation is the most significant expression of OA. It is caused by bone on bone contact which creates a shiny, ivory-like appearance on the joint surface. Osteophytes (new bone) might also form around the joint margin or on the surface of the joint as the bone attempts to repair itself.

Eburnation and changes to the joint contour were observed on a scapula and clavicle (1026/9) most probably from the same individual, presenting as OA of the acronioclavicular joint of the shoulder, and on the distal joint surface of a femur from context **(1000F)**

Dental pathologies
Enamel Hypoplasia
Enamel hypoplasia in the form of linear vertical groves on the surfaces of the incisors was observed in **SK1** and **SK9**. The defects result from deficiencies in enamel development believed to relate to periods of malnutrition or serious illness, which result in a cessation in the development of the teeth during childhood (Hillson, 1979). The formation of the permanent dentition occurs between the ages of 1-7. Based on the position of the hypoplastic lines, these events would have occurred in the latter of these years in both individuals (Reid & Dean, 2000).

Edentulism
Edentulism results from tooth loss primarily caused by dental decay and gum disease (periodontitis). Edentulism limits the types of food that can be eaten and can affect with the nutritional status and well-being of an individual. The left arc of the mandible of **SK12** lacked teeth and showed evidence for complete remodelling of the bone. A further possible example was found in the entire maxilla of **(1015/19).**

Dental calculus
Calculus or mineralized dental plaque produces a hard clay-like substance on the teeth. The observed level of calculus was low, with only slight accumulations observed on **SK1** and on teeth recovered from **(1015),** and slight-medium on teeth from contexts **(1016)** and **(3002).**

Dental caries
Dental caries or cavities are caused by the demineralisation of the tooth enamel, cementum and dentine of the tooth, by organic acids produced through the fermentation of dietary carbohydrates by some plaque bacteria. Dental caries was exceptionally low, with only a single slight carious lesion observed in a right lower second molar from context **(3005).**

Leprosy: see also Anthea Boylston's article
Leprosy, or Hansen's Disease, can be a mutilating and debilitating disease, which in historical times resulted in ostracism from both family and society to the extent that in some parts of Europe lepers were considered legally dead. It was a diagnosis that was not given lightly. Today, drugs are able to control, if not yet eradicate, the disease but in the past the only control was through isolation. Leprosy is caused by the Mycobacterium *M. leprae,* an intracellular organism that introduces both pathological change, and clinical disease to the body. The body's immune response to invasion by the bacilli is responsible for a wide variety of clinical symptoms and deformities. Infection involves the skin, mucous membrane, soft tissues and nerves, particularly those in the nasal region and hands and feet, resulting in a loss of feeling in these areas.

The progression of the disease can take many decades before changes occur in the skeleton (the only part that now remains for us to examine) and if an individual is highly resistant to the infection changes in the bone may never occur. Where change does occur, only changes to the facial bones and the small bones of the hands and feet are caused by *M. leprae*, all other bony changes result indirectly from trauma or other bacteria.

The facial changes to the skull are very distinctive, and include absorption of the anterior nasal spine, rounding and widening of the nasal aperture, and erosion of the alveolar margin - often resulting in the loss of the front teeth, and thinning and pitting of the hard palate. These changes have been termed *facies leprosa* (Møller-Christensen *et al.* 1952).

Erosive bone changes in the hands begin in the distal phalanges (finger tips), where the bone is resorbed along the shaft affecting the length and/or width. If the bone is completely eroded it will result in shortening of the fingers. The disease may progress as far as the middle and proximal phalanges, but the metacarpal and carpal bones (hand and wrist bone) remain untouched, producing a 'mitten hand'. In the feet the metatarsals and sometimes the tarsal bones are also affected. The distal phalanges thin and, as with the fingers, may disappear entirely, resulting in shortening of the toes. Usually the fifth metatarsal sees the most pronounced change becoming thin and pointed. These changes are exclusive to advanced cases within the lepromatous and borderline lepromatous groups and result from the direct infection by *M. leprae,* with the degree of destruction directly related to the duration of the disease (Rogers and Waldron, 1989).

No direct evidence for leprosy was found either amongst the inhumations or from the bone recovered from the charnel pits. However, two maxillae from the cemetery soils did reveal evidence of rhinomaxillary syndrome. The loss of feeling in the hands and feet caused by leprosy could have resulted in serious injury and infection. Three foot bones from context **(1015) SK3** showed convincing evidence of leprosy with septic arthritis of the first metatarsophalangal joint and infective changes to the other metatarsals. Secondary infection, probably due to invasion by pathogenic bacteria was observed in a number of the long bones recovered from the charnel pits, in particular Charnel Pit 2.

It is now possible to detect the presence of lipids of *M. leprae* in bone (Gernaey, Minnikin 2000) and from *M. leprae* in DNA (Rafi I. 1994). These methods might offer the opportunity to detect leprosy in cases where conclusive evidence for bone change did not occur.

Paula Levick
We are grateful to Anthea Boyleston for her comments and help

Appendix 1: The Inhumations

The bone from the majority of the intact burials was in good condition with little surface abrasion. The burials were made supine in an extended position and the majority were on a west-east alignment. The burials appear to be uncoffined and no grave goods were observed with any of the burials.

SK 1: Cut [1017], Fill (1016). Grave stone-lined (bordered by faced limestone in the north and west, and stone and mortared rubble in the south), c. 68.03m OD.
Burial position: extended, supine, west-east. Head rotated to north. Left arm across stomach, right arm extended along body. Femurs truncated across lower shaft by grave cut for SK 12.
Bone cortical surface: 1-2
Observations: Robust skeleton with strong brow ridges and jaw line (?male).
Pathology: Button osteoma on right side of frontal bone, approx. 5 mm in diameter. All teeth appear to be in very good condition, slight calculus. Hypoplasia on upper incisors.

SK 2: Cut [2065], fill (2022). Short stretch of grave cut seen in north-facing section of sondage, c. 67.75m OD. Lower limb bones discovered in sondage; the sondage was further extended to expose hands and feet. Skull not exposed.
Burial position: extended, supine, west-east.
Bone cortical surface: 1

SK 3: Structure [1024] (stone-lined grave): Fills 1007, 1015. Charnel pit 2

SK 4: Cut [1027], Fill (1026). Charnel pit 1

SK 5: Cut [2037], Fills (2038), (2027).
Burial position: Extended, supine southeast-northwest. Lower body only exposed, upper body in baulk, c.67.70m OD
Bone cortical surface: 1-2
Observations: juvenile c. 6-7 years (Maresh, 1970). No epiphyseal fusion of long bones. L femur diaphyseal length 270 mm (measured in-situ).
Associated finds: Tudor pottery (Tudor Green) in grave fill.

SK 6: Cut [2063], Fill (2053) (post-cranial skeleton) and SK7: Cut [2052], Fill (2047) (skull only). Head disturbed by later stonework and originally recorded as two skeletons, SK6 and SK7, c. 67.88m OD.
Burial position: Extended, supine, southeast-northwest. Skeleton disturbed - hands probably resting on stomach, head forward on chest.
Bone cortical surface: 1
Observations: juvenile c. 4-5 years (Maresh, 1970). No epiphyseal fusion of long bones. R femur diaphyseal length 224 mm, L femur diaphyseal length 229 mm (measured in-situ).

SK 8: Cut [1054] (soakaway c 67.76m OD: Fragmentary and badly disturbed post-cranial skeleton (femur and tibia).
Burial position: extended, supine, west-east.

SK 9: Cut [1054] (soakaway) c 67.57m OD. Fragmentary and badly disturbed post-cranial skeleton. Skull badly crushed in section. Teeth loose in fill (RI1 RI2 RM2 RP^3 RI^2 LC^1 LP^3 LP2 LI2 LM2 LM3 LI2)
Burial position: extended, supine, west-east. Arms extended along body.
Observations: Juvenile or young adult c. 15-23 years (based on dental eruption).
Pathologies: Dental enamel hypoplasia.

SK 10: Cut [1054] (soakaway) c 67.46m OD. Fragmentary and poorly preserved post-cranial skeleton only exposed.
Burial position: Extended, supine, west-east.

SK 11: Cut [2061], Fill (2057).
Burial Position: West-east, possibly disturbed, c. 67.52m OD.
Observations: Skull and small number of post-cranial bones only exposed, remainder in baulk. Cut grave of SK13

SK 12: Cut [1052]
Burial position: Skull and mandible exposed, west-east with head rotated to south, c.68.05m OD. Observations: Strong bow ridge, ?male. Left arc of mandible exposed and appeared edentulous where visible. The position of the lower jaw suggests a chin strap might not have been used. Probably older adult. Grave cuts SK 1.

SK 13: Cut [2067], Fill (2066). Skull only (remainder in baulk), sufficient to determine west-east burial, c. 67.50m OD. Cut by grave for SK11

Appendix 2: Charnel pits and 'cemetery soils'

Metrical Analysis

The human bone recovered from the charnel pits and 'cemetery soils' represents a number of individuals.

Table 1: Charnel Pits

Charnel Pit 1 - Cut 1027 MNI = 3		
Context	**Cortical Bone Surface**	**Observations** **(d)=damaged, (I)=indeterminate sex**
1026/1(a)	1-2	Individual with rickets, possible anatomical specimen: R. femur (d); FeL1 399mm; FeL2 399mm; FeD1 27.88mm; FeD2 31.73mm. Drill holes proximal and distal; linea aspiera more pronounced than left femur.
1026/1(b)	1-2	L. femur: FeL1 395mm; FeL2 395mm; FeD1 26.90mm; FeD2 32.18mm; FeD$_s$ 39.92mm (s?); FeE1 71mm (s?); possible cut marks below gt. trochanter. Drill holes proximal and distal.
1026/1/(c)	1-2	R tibia (d): 75%, TiD1 27.00mm; TiD2 20.44mm; distal fragments recovered with evidence of drill holes; rickets, ?? new bone
1026/1(d)	1-2	L. tibia (d): shaft fragment, bowing
1026/2(a)	1	R. femur (d): FeL1 402mm; FeL2 399mm; FeD1 22.62mm; FeD2 27.78mm; FeD$_s$ 39.88mm (s?).
1026/2(b)	1	L. femur: FeL1 394mm; FeL2 394mm; FeD1 24.51mm; FeD2 27.73; FeE1 69.06mm (s?); FeD$_s$ 38.81mm (s?)
1026/3(a)	1	R. femur (incomplete 75% proximal): FeD1 32.30mm; FeD2 28.89mm; FeDs 46.51mm (I).
1026/3(b)	1	L. femur: FeL1 429mm; FeL2 422mm; FeD1 30.20mm; FeD2 32.12mm; FeE1 82mm; FeD$_s$ 46.85mm (I). Robust
1026/4	1	L tibia: TiL1 370mm; TiB1 73.69mm; TiD1 30.86mm; TiD2 27.02mm
1026/5	1	L tibia (d): TiL1 321mm; TiD1 29.92mm; TiD2 22.83mm.
1026/6(a)	1	L. humerus (d): HuD1 21.65mm; HuD2 21.39mm (s?); bi-epicondylar width 55.14mm.
1026/6(b)	1	R. humerus: HuL1 301mm; HuD122.46; HuD2 21.87 (s?); biepicondylar width 57.96mm; HuD5 45.00mm

1026/7	1	L. humerus (d); bi-epicondylar width 63.07mm
1026/8	1	R. tibia (d): mid-shaft fragment, r. proximal and distal fragments, probably same bone.
1026/9	1	R. clavicle (d): path. acromio-clavicular surface
1026/10	1	R. clavicle (d): with ? fracture at lateral
1026/11	1	L. clavicle: CiL1 159mm (cs'); copper staining anterior surface
1026/12	1	R. scapula: path. acromio-clavicular surface – possibly from same individual as 1026/9.
1026/13	1	Other: l & r rib fragments; Os coxae - ilium and acetabulum, sciatic notch damaged, ?male. Age c. 30-35 (Lovejoy *et al.* 1985)

Charnel Pit 2 – 1024 (Structure) MNI 5

Context	Cortical Bone Surface	Observations
1007	-	L. femur (d) 30% proximal; L. tibia 50% midshaft fragment; l. humerus (shaft only); 50% proximal l. ulna; 50% proximal l. radius; ?radius mid-shaft fragments; 4 rib fragments; vertebrae (spinous process); long bone shaft fragments (26g); femur & tibia condyle fragments
1015/1(a)	2	R. femur: $_{FeL1,}$ 516mm; FeL2 510mm; FeD1 28.83mm; FeD2 39.40mm; FeE1 76.74mm (cs'); FeDs 44.57mm (I); Robust, pronounced linea aspiera, plaque
1015/1(b)	2	L. femur: $_{FeL1,}$ 515mm; FeL2 512mm; FeD1 28.25mm; FeD2 35.92mm; FeE1 76.28mm (cs'); FeDs 43.78mm (I); Robust, pronounced linea aspiera, enthesopathy. plaque
1015/2(a)	2	R. femur (d): 50% proximal; FeD1 24.35mm; FeD2 34.44mm; FeDs 45.34mm (I); roughening\enthesis below gt. trochanter.
1015/2(b)	2	L. femur (d): 60% proximal; FeD1 26.15mm; FeD2 32.43mm; FeDs 44.98mm (I); pronounced linea aspiera and roughening below gt. trochanter.
1015/3	1-2	L. femur (d): shaft only and l. trochanter; FeD1 32.17mm; FeD2 33.953mm; v. pronounced linea aspiera; fe staining distal/anterior surface
1015/4	2	L tibia: TiL1 421mm; TiB1 72.96mm; TiD1 36.57mm; TiD2 22.67mm

1015/5	-	L. tibia (d): 40% distal fragment, mid-shaft fragment (probably same individual); squatting facet
1015/6	-	L. tibia (d) : 30% distal fragment
1015/7(a) 1015/7(b)	1-2 -	L. fibula: 90% distal fragment R. fibula: 30% distal fragment
1015/8(a) 1015/8(b)	2 2	R. humerus: HuL1 364mm; HuD1 24.07mm; HuD2 18.66mm; HuD5 48.09mm (♂); bi-epicondylar width 67.75mm L. humerus (d): HuL1 356mm; HuD5 48.27mm (♂); biepicondylar width 65.10mm
1015/9	2	R. radius: RaL1 286mm, marginal ostephytes
1015/10	1	R. radius: 60% shaft fragment
1015/11	2	L. ulna: UiL1 302mm.
1015/12	1	L. ulna: 40% proximal fragment
1015/13	2	L. ulna: 60% proximal fragment
1015/14	1	R. ulna: 50% proximal fragment
1015/15	-	Radius left articular facet x 2
1015/16	-	R. fibula: 20% distal fragment
1015/17	-	Fibula: mid-shaft fragments
1015/19	-	Palatine process
1015/20	-	R. scapula fragment; GIL1 39.95mm (♂); L. acromion fragment R. glenoid fossa & acromium fragment
1015/21	1	L os coxae (d): Age 50+; sciatic notch (d) (??male); acetabular crease
1015	-	Femur: l & r condyle fragments
1015	1	Skull: L& R zygomatic;
1015	4	L os coxae (d) acetabulum R. os coxae (d) acetabulum Fragments, ilium and ischium, acetabulum
1015	1	Mandible: Adult, prob. male; l. ascending ramus missing; RC1, LC1, RM1-RM3, LM1-LM3; pulp cavity exposed; uneven wear LM1 labial; slight calculus†; medium alveolar resorption†; age 45+
1015	-	Mandible: fragment r. coronoid process - gracile

1015	-	Sacral segment (d): l. ala and body fragment; ?S-4 fragment; Vertebrae (d): C-4, C-5, C-6, 3 x C bodies; T-1, ?T-2, L- 4, L5, spinous process with LF; articular facets; vertebral fragments, hyoid fragment.
1015	-	Hand: capitate; triquetral fragment; r. 1st, 4th, l. 3rd, 4th, 5th metacarpals; l. 2nd 5th proximal phalanges, l 3rd intermediate phalange
1015	-	Foot: 1st metatarsal; 2 other phalanx metatarsals
1015	-	Rib fragments
1015	-	Shaft fragments (176g)

Charnel Pit 3 – 1040 MNI 2 (Possibly disturbed grave)

Context	Cortical Bone Surface	Observations
1034/1	2	L. femur (d): 80% proximal fragment; FeD1 28.53mm; FeD2 38.73mm; FeD$_s$ 52.23mm (♂); robust, enthesopathy along linea aspeira
1034/2(a)	1	R. femur (d): 50% proximal, femoral head absent (unfused)*; Fed1 23.27mm, FeD2 31.45mm; fusion line on greater trochanter (late adolescent); distal fragment probably same individual, condyles absent (?unfused); gracile
1034/2(b)	1	L. proximal tibia (d): 80%; condyles absent (?unfused)*; gracile.
1034/2(c)	1	R. proximal tibia (d): 80% condyles absent (?unfused)*; gracile.
1034/2(d)	1	R. humerus: proximal and distal frags probably same bone, head absent (unfused); gracile. Supracondylar process

*Probable juvenile c.16-18 yrs (based on fusion of gt. trochanter.). Surfaces very abraded but slight traces of billowing visible on epiphyseal surfaces |
| 1034/3 | - | Fibula: mid-shaft fragment |
| 1034 | - | Other: R. talus: cuneiform (d); ?cuboid fragment; hand 2nd intermediate phalanx; rib fragment; occipital fragment; vertebrae (d) T-7. |

†Brothwell, 1981

Table 3 – Human remains recovered during watching briefs

Drain east of chapel (1053) MNI 2 (based on preservation of bone)		
Context No.	**Cortical Bone Surface**	**Observations**
1053/1	4	Femur: l. trochanter & proximal shaft fragments (30%)
1053/2	1	Femur: 50% mid shaft fragment
1053/3	1	Femur: 30% mid shaft fragment
1053/4	1	L. radius (d): 60% distal and proximal
1053/5	1	Tibia: 50% mid shaft fragments
1053/6	1	Fibula (d): 30% distal fragment
1053/7	1	L. fibula (d) : 20% distal fragment
1053/8	1	R. Radius (d): 20% distal fragment
1053		Other: rib fragment; humeral head and shaft fragment; acetabulum fragment; pubic symphysis age 50+; hand metacarpals l. 3rd, l. 5th, r. 2nd

Soakaway (1054)		
1054	1	Skull fragments: frontal, parietal; r. patella (d) , femur – proximal shaft fragments; shaft fragments (75g); fragment of femoral or humeral head; r. rib fragment; l. humerus (d) 25% mid-shaft; hand: l. 5th prox. phalange (d)

Table 4: 'Cemetery Soils'

Context	Cortical Bone Surface	Observations
Trench 1		
1000/Sect: B		L. clavicle (distal fragment)
1000/Sect: C		L parietal; calcaneus fragments; r. clavicle
1000/Sect: D		L 1st rib; rib mid-shaft frag; r. patella (approx. 50%)
1000/Sect: E		4 rib frags; scapula frag: ulna shaft frags
1000/Sect: F		R. femur (d) distal fragment, robust, pronounced roughening on popliteal surface around adductor tubercle L. tibia (distal surface); vertebrae (d) ?L-5.
1001		Vertebrae - body fragments (lumbar), cervical C-7; tooth RM^2.
1002		Skull – frontal bone fragments; cervical vertebrae, spinous process

1010 – Overlies SK1		Skull fragments: parietal, temporal, zygomatic, sphenoid; R. humerus distal shaft fragment; vertebral fragments - spinous process (d) (thoracic), cervical (d); hand distal phalanx; r. radius (articular surface); ?cuboid fragment; rib fragments
1016 – Fill of grave cut for SK1		L. maxilla fragment – LP^1, LP^2, LM^1, LM2, M^3 lost post-mortem, slight-medium calculus, M^2 broken (?ante-mortem); tooth wear 33-45yrs†; 3 x fragments cervical vertebrae; fragment parietal; 2 rib fragments. Bone fragments (8g)
1019		R. radius fragment (head and tuberosity); fragment l. tibia - distal articular surface; foot, 2 proximal phalanges.
1049/1 1049		Humerus mid shaft fragment Other: l. femur (condyles only);?fibula fragments, skull frags – temporal, occipital, parietal; long bone frags (35g); C-1;
Trench 2		
2000		Skull fragment (parietal); 20% distal l. ulna.
2003		Skull fragment
2034		Shaft fragment ?ulna
2052		Ulna fragments (distal)
2057		Rib midshaft fragments; thoracic vertebrae fragments
Trench 3		
3000		R. radius - head and tuberosity, shaft fragment
3002		Skull fragments; maxilla fragment, LI^2, LP^3, LP^4; RM2 slight calculus; RI1 medium calculus, uneven wear hand: l. 1st proximal phalanx.
3003		Hand: l. 5th distal phalanx
3005		Skull: temporal, (petrous, mastoid process, fragment zygomatic), L. mastoid (scored 3); occipital ?male, parietal; Teeth: RM2 RM3, RM^3, LI2 R. scaphoid; l. 5th metacarpal; 4 rib fragments; clavicle midshaft fragment; ?humerus shaft fragments
3013		Os coxae (ilium), skull and rib fragments
3015		Vertebrae x 3 - cervical (d), ?C-6, thoracic body, cervical body fragment.

Appendix 3: Pathologies and Non-Metric Traits Table 5 – Pathologies

Context	Pathology
1000F	R. femur distal fragment: arthritis- eburnation medial condyle, slight
1007	L. tibia, mid-shaft fragment: periostitis – woven and lamellar bone
1007	? radius, mid-shaft fragment: periostitis – woven and lamellar bone
1015/2(a) 1015/2(b)	R. femur: enthesophytes on greater trochanter L. femur: woven bone distal anterior shaft, enthesophytes on greater trochanter
1015/4	L. tibia: woven bone on distal anterior surface
1015/5	L. tibia: periostitis – pitting, woven and lamellar bone across shaft surface
1015/7(a) 1015/7(b)	L. fibula: periostitis - woven bone on distal anterior surface R. fibula: periositis – woven bone on distal posterior surface
1015/16	R. fibula: distal fragment only, periostitis – pitting, woven bone
1015/17	Fibula shaft fragments: periostitis – woven and lamellar bone.
1015	Vertebrae: T-1, ?T-2. Schmorl's node superior; L- 4, superior/inferior L-5, superior
1015/19	Maxilla alveolar process: Edentulous. Inflammatory pitting on the roof of the mouth and slight pitting on the alveolar process
1015	Foot: 1st metatarsal – erosive lesions and bony spurs; metatarsals woven bone and knife-edge re-modelling
1015	LM1 labial, slight calculus†; medium alveolar resorption†
1026/1 (a-d)	L & R femur, L & R tibia: - rickets
1026/7	Humerus: distal flared metaphysis
1026/8	R. tibia (shaft only): new bone on medial and lateral surfaces
1026/9	R. scapula: arthritis - eburnation and osteophytes on acromion. R. clavicle: arthritis - eburnation and osteophytes on the lateral surface (probably same individual)
1034/2(d)	R. humerus: enlarged nutrient foramen, small area of new bone in region of nutrient foramen
1034/	Fibula, mid-shaft fragment: periostitis – woven and lamellar bone
1049/1 1049	Mid-shaft fragments, possibly fibula, periostitis – woven and lamellar bone.
1053/5	Tibia shaft fragments: periositis - pitting and woven bone
1054	R. humerus: cortical defect for pectoralis major
3005	L. mastoid: enthesopathy Teeth: RM2 RM3, RM^3, LI2 , slight calculus; RM2 small carious lesion mesial
3015	Thoracic vertebrae. Schmorl's nodes superior and inferior surface
SK 1	Dental enamel hypoplasia. Linear horizontal defects on incisors. Position 2, severity 2. (Brickley and McKinley 2004: 39)

SK9	Dental enamel hypoplasia. Linear horizontal defects on incisors (3 events). Position 2 and 3, Severity 2 (Brickley and McKinley 2004: 39).

Table 6: Non-Metric Traits

Context	Non-Metric Traits
1015	L. ox coxae, acetabular crease
1034/2c	Humerus, supracondylar process
1034	R. talus, inferior talar articular surface, two surfaces
1015/5	Tibia, lateral squatting facet
1015/1(a and b)	L & R femur, plaque formation
1026/1 (a-d)	L & R femur, plaque formation

References*

Bass, W.M. 1995. *Human Osteology. A Laboratory and Field Manual*. 4th Edition. Missouri Archaeological Society.

Buikstra, J.E. and Ubelaker D.H. (eds.) 1994. *Standards for Data Collection from Human Skeletal Remains* (Fayetteville)

Brickley M. and McKinley J.I. 2004. *Guidelines to the Standards for Recording Human Remains*. IFA Paper No. 7

Brothwell, D. 1981. *Digging up Bones*. London, British Museum

Daniell, C. 1997. *Death and Burial in medieval England 1066-1550*. Routledge.

Fildes, V.A. 1986. 'The English Disease': infantile rickets and scurvy in pre-Industrial England', in J. Cule and T. Turner (eds), *Child care through the centuries*. British Society for the History of Medicine, 121- 34.

Gernaey A. and Minnikin D. 2000. 'Chemical Methods' in Palaeopathology', in Cox M & Mays S. (eds), *Human Osteology: in Archaeology and Forensic Science*. Greenwich Medical Media Ltd, 239-53.

Hillson, S.W. 1979. 'Diet and dental disease', *World Archaeology*. 2(2), 147-62

Lovejoy, C.O., Meindl, R.S., Pryzbeck, T.R. and Mensforth, R. 1985. 'Chronological metamorphosis of the auricular surface of the ilium: a new method for the determination of skeletal age at death', *American Journal of Physical Anthropology* 68: 15-28

Mays, S, Brickley, M and Dodwell, N 2004. *Human Bones from Archaeological Sites: Guidelines for producing assessment documents and analytical reports*. Centre for Archaeology Guidelines English Heritage/BABAO, London.

Moller-Christensen V, Bakke S.N., Melson R.S., and Waaler A.E.1952. 'Changes in the anterior nasal spine and the alveolar process of the maxilla in leprosy', *International Journal of Leprosy* 20(3): 335–340.

Rafi A. Spigelman M. Stanford J. Lemma E. Donoghue H. and Zias J. 1994 'DNA of *Mycobacterium leprae* detected by PCR in ancient bone', *International Journal of Osteoarchaeology*, 4: 287-290

Reid , D.J. and Dean, M.C. 2000.' The Timing of Linear Hypoplasias on Human Anterior Teeth', *American Journal of Physical Anthropology* 113: 135-139.

Rogers, J. And Waldron, T. 1995. *A Field Guide to Joint Disease in Archaeology.* Chichester: Wiley.

Rogers J, Waldron T. 1989. 'Infections in palaeopathology: the basis of classification according to most probable cause', *Journal of Archaeological Science,* 16: 611-25.

Schour, I and Massler M. 1940. 'Studies in tooth development in growth pattern of human teeth', *Journal of the American Dental Association* 27.

Shoesmith, R. 1980, *Hereford City Excavations 1: Excavations at Castle Green.* Council for British Archaeology Research Report 36.