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Human remains from Boys Hall Balancing Pond, Sevington, Kent

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1 INTRODUCTION

Five deposits of cremated human bone contained within pottery vessels were located during excavation in the south-eastern corner of the site (see Hayden 2000). All these cremation burials have been dated to the late Iron Age-early Roman period. Charcoal in four of these deposits was identified as oak predominantly (Challinor 2000).

The cremated bones from all contexts had originally been placed in vessels. Due to truncation (ploughing) at a later date, all the vessels from the cremation burials were damaged. Only the base of the pot from cremation burial context 39 survived. No cuts could be identified for the pits that contained the vessels in which most of the cremated bone was found. This limited the archaeological potential of the cremated remains.

2 MATERIALS AND METHODS

2.1 Materials

All the cremation burials were examined during the preparation of the assessment report (see Boyle 2000). While it was not possible to identify any of the bone fragments in four deposits, the preliminary analysis of cremated bone context 44 suggested the possible presence of two adults, one male and one female individual (Table 1).

Table 1: Summary of cremated human bone (after Boyle 2000, table 10)

Context	Context type	Period	Weight (g)	Identifiable fragments	Colour	Minimum number of individuals
39	Pot and fill	*c.* AD 50-250	18	None	White	?
40	Charcoal layer	*c.* AD 43-100	7	Skull vault	White	?
44	Fill of pot	*c.* AD 43-100	1361	Skull vault, mandible, third molars, mastoid, rib, radius, ulna, fibula	White	2? (male and female?)
45	Fill of pot	LIA-AD 70	22	None	White	?
48	Fill of pot	LIA-AD 70	21	Long bone- upper limb	White	?

The assessment report indicated that the cremation burial (context 44) was the only one that contained substantial and well preserved human remains to merit further analysis (Boyle

2000). Thus, this deposit is the focus of the present report. The aim was to ascertain the minimum number of individuals (MNI) represented by the cremated bone sample, the demographic profile of those individuals as well as any information regarding lifestyle as suggested by pathological lesions and other osteological indicators.

2.2 Methodology

The cremated bone deposits were recovered as bulk soil samples and were subsequently wet-sieved. Cleaning allowed for a better identification of skeletal or dental elements, colour and fracture line patterns, and facilitated the observation for presence and absence of non-metric traits and palaeopathological lesions.

Analysis was undertaken in accordance with the 'Specialist Study Package 6' of the *CTRL Section 1 Project Design* and McKinley (1994, 2004). Human bones were sorted from any charcoal, artefacts and faunal remains. The samples were filtered through a sieve of 10 mm and another of 4 mm. Bone fragments were recorded according to these fraction categories (>10 mm, 10-4 mm) as well as 4-2 mm.

Where possible, each fragment was identified and classified into anatomical regions (e.g. neurocranium, splanchnocranium, upper limb and lower limb). The bone element, side, age, sex and presence or absence of non-metric traits and pathology were also recorded when permitted. The presence of any specific anatomical landmark (e.g. orbit, *linea aspera*) was annotated. Bone fragments were weighed to the nearest 0.5 g. Skeletal remains were classified as 'unidentified' if the specific element they represented was unclear. Most of these fragments were portions of trabecular bone structure. The colour of the bone fragments and fracture pattern were also recorded. Measurements of fragment size were taken on long bones over 10 mm in length. Average thickness of the cranial vault bones was also measured using a sliding calliper to the nearest 0.01 mm.

Material smaller than 4 mm was not sorted and analysis at this level only focused on the general colour and bone elements represented. Any identifiable fragments such as dental crowns, hand and foot bones and other fragments that may provide additional useful data such as the MNI count and age determination were also noted. All data were entered onto a Microsoft Excel spreadsheet.

Methods employed to record MNI, age, sex, metric data and pathology are described in more detail below. All observations were made macroscopically.

Minimum number of individuals

MNI was calculated by counting the presence of repeated bone elements if any (e.g. left proximal femur). Differences according to age and sex were also taken into account.

Estimation of biological age and sex

When preservation allowed, standard methods for age-at-death and sex determination were employed following the guidelines set out by Ferembach *et al.* (1980), Buikstra and Ubelaker (1994) and Brickley and McKinley (2004). Methods for estimating biological age include, for juveniles, the observation of the stage of dental development (Moorrees *et al* 1963; Ubelaker 1989) and epiphyseal fusion (see Scheuer and Black 2000). In adult individuals, general observations of cranial suture closure were only used as a complementary aid. This method is unreliable on its own (e.g. see Key *et al.* 1994; Lynnerup and Jacobsen 2003), and was only employed in order to confirm a young adult or an old adult age. The spheno-occipital synchondrosis was employed to give a minimum adult age to a skull, assuming fusion is complete by about the age of 21 years or even later (Genovés 1962, 57, 73; McKern 1970, 51).

When possible, individuals were classified into one of the following age categories (Table 2):

Table 2: Age categories employed in this analysis

Age category	Age
Neonate	0-6 months
Infant	7 months-5 years
Juvenile	5-12 years
Adolescent	13-18 years
Subadult	<18 years
Young Adult	18-25 years
Mature Adult	25-45 years
Older Adult	> 45 years
Adult	> 18 years
Unknown	Unknown

These age groups only refer to the biological age as inferred from the skeleton. These may not necessarily correlate with chronological age and should not be confused with the social perception of age in this late Iron Age-Roman community in Britain. Also, the identification of biological or skeletal sex must not be confused with gender. Misuse of these terms might lead to misconceptions when interpreting the funerary rite and burial customs.

Biological sex was estimated only for adult individuals when possible. This involved the observation of morphological traits of the pelvis (for example, the sciatic notch and the pubic symphysis) and the skull (for example, the glabella and the mastoid process). It must be borne in mind, however, that the process of cremation may have affected the morphology of traits used in sex determination.

The following skeletal sex categories were employed (Table 3):

Table 3: Categories employed in sex determination

Sex category	Definition
F	Female
F?	Possible female
Ambiguous	Ambiguous traits
M?	Possibly male
M	Male
?	Unknown

Each trait that was observed was assigned to one of the categories in Table 3. Later, an average was estimated from all the scored traits.

Metric data and non-metric traits

Metrical analysis involved measuring cranial vault thickness as well as the length of long bone fragments. These may be employed to estimate biological sex, stature and to explore degrees of fragmentation, although several problems are inherent in the approach (see McKinley 2000b). Measurements were taking with a sliding calliper to the nearest 0.01 mm.

Non-metric traits are minor variants in the skeleton, some of which have been used to find about biological distance between populations. Some traits, therefore, such as the Inca bone, are highly heritable and have been used to indicate genetic relationships, whilst others, such as torus auditivus, may be environmentally produced (Brothwell and Zakrzewski 2004, 28). Skeletal non-metric traits were recorded following the guidelines set out by Berry and Berry (1967), Hauser and De Stefano (1989) and Buikstra and Ubelaker (1994). Non-metric traits in a particular anatomical location were merely scored here as present or absent.

2.3 Palaeopathology

Absence and presence of pathological lesions were recorded when possible. Observing the presence or absence of palaeopathological lesions provides information about the health status of an individual or of a population. However, this is dependent on completeness of the bone as well as surface preservation. Pathological lesions were described with reference to osteological and palaeopathological texts, such as Ortner and Putchar (1981) and Aufderheide and Rodríguez-Martín (1998).

With regard to osteoarthritis (OA), every joint surface was scored for the presence or absence of this pathological condition. In palaeopathology, presence of OA is characterised by pitting in the articular surfaces, bone growth (osteophytes) in the margins, joint contour deformation and eburnation (Ortner and Putschar 1981; Rogers and Waldron 1995; Rogers 2000). When eburnation is absent, the literature recommends that a positive diagnosis of OA requires the presence of at least two of the remaining criteria (e.g. osteophytes and sub-chondral pitting).

Surface colour , fracture pattern and texture

For all fragments, colour, fracture pattern and surface texture were recorded to explore the cremation process. Colour may indicate the temperature at which the body was burnt, although this also depends on how much soft tissue is around the bone. On human cremated bone, different temperatures are correlated with different colours. These range from orange (200ºC), through to black (300ºC), grey (600ºC) and finally white at a temperature usually between 700ºC and 800ºC (Shipman *et al.* 1984; Holden *et al.* 1995). Examination of the type of colour and its distribution in the skeleton may allow an understanding of how the body was laid on the cremation pyre. The whiter the bone, the closer the body part to the heat centre, while colours such as blue, black and grey may reveal a further distance from the main heat focus, unless they represent areas with more muscle mass. In addition, fracture patterns and surface texture may indicate whether a body was burnt with its flesh or whether only the dry skeleton was selected for the pyre after decomposition or defleshing of the soft tissue. As opposed to dry bones, burning a skeleton covered with flesh produces curved transverse fracture lines, irregular longitudinal splitting, twisting and marked warping (Ubelaker 1989; Buikstra and Ubelaker 1994). Finally, weathering was recorded according to the stages set out by Behrensmeyer (1978) but modified by Buikstra and Ubelaker (1994).

3 RESULTS

The results indicate one male adult individual represented by most anatomical areas and cremated when the body was complete with its soft tissue. Some pathological lesions such as *cribra orbitalia* and porotic hyperostosis provide some insight into the life and living conditions of this individual during the late Iron Age-Roman period around modern Sevington, Kent.

3.1 Preservation and completeness

Amongst the human cremated bone from context 44, the most represented bone fragments were those from the skull vault such as the frontal, parietal and occipital bones, as well as those representing the shaft of the major upper and lower limb long bones. Skeletal landmarks were identified in the frontal bone fragments such as portions from both orbits and from the glabella. Some parietal fragments revealed the coronal and sagittal sutures and amongst the occipital fragments there was part of the rim for the foramen magnum. The temporal bones were represented particularly by the petrous pyramid. Fragile facial bones, such as the sphenoid and maxilla, were rarely present or could not be identified.

The mandible was well represented. Parts of the body, the ascending ramus and the posterior part of the mental eminence were present. The left mandibular ramus displayed eight sockets, from the second incisor to the third molar, with teeth lost *post-mortem.* Only the socket for the lower left second molar had the tooth's roots present *post-mortem.* The socket for the lower right third molar was also available for observation and this tooth had also been lost *post-mortem.* A number of loose alveolar fragments indicated at least three further alevoli, probably from the mandible, with the teeth also having been lost after death. In total, eleven sockets were observed. Teeth were loose and very fragmented due to the cremation process. Ten crown fragments were recovered but were too segmented to facilitate any identification. Apart from the lower second molar roots in the socket, eight loose root fragments representing at least four different teeth were present. These appear to have belonged to an upper first incisor, two lower molars and one upper molar.

Vertebrae and ribs were very fragmented and not complete. The dens of the axis, many vertebral bodies and many spinous processes were absent. Equally, no head, neck areas or ends of ribs were identified.

Shoulder and pelvic girdles were poorly represented. Some body portions of the scapula and some clavicle shaft fragments represented the shoulder girdle. With regard to the pelvis, few ilium parts, a portion of a sciatic notch and few fragments of the anterior sacrum were all that was available.

All the major long bones were present, although many of the epiphyses were missing *post-mortem.* Humerus, radius, ulna, femur, tibia and fibula shaft fragments were clearly identified. The largest long bone fragment was 60.86 mm and belonged to an ulna.

Two portions of patella were present.

No hand bones were identified. With regard to foot bones, a fragment of a metatarsal bone and the head of an intermediate foot phalanx were identified.

Many fragments (43.9%) could not be identified. These came largely from the sorted 4-2 mm sieve size, which were largely long bone fragments. Other common unidentified fragments were portions of trabecular bone.

No sternum was identified and neither were any elements such as the hyoid bone, carpals, metacarpals, hand phalanges and tarsals.

Figure 1 illustrates the identified skeletal elements represented in the cremation burial 44:

Figure 1. Cremation burial 44 from Boys Hall Balancing Pond (ARCBHB99)

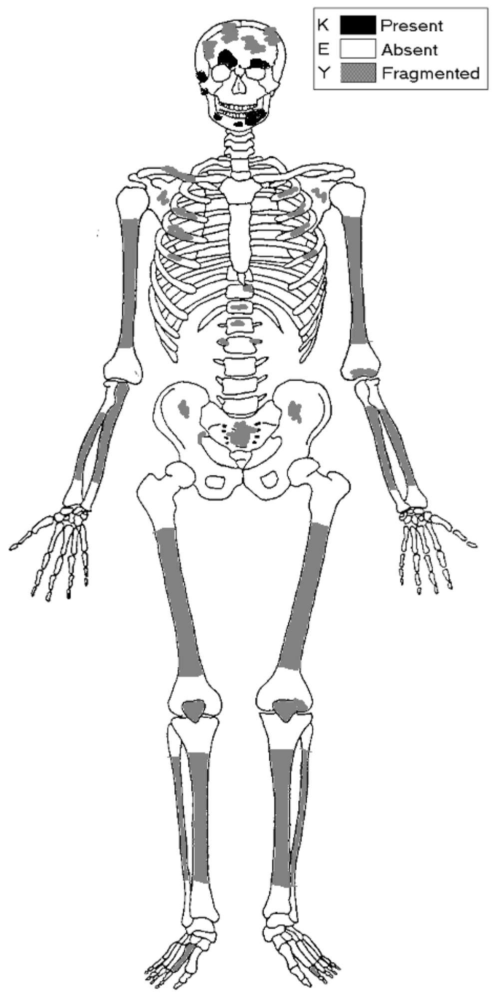


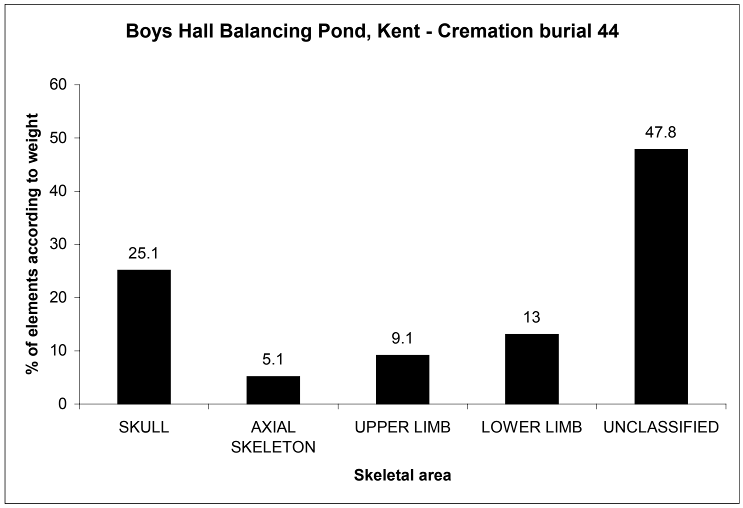
Table 4: Weight count of the different anatomical groups

CREMATION BURIAL 44	
BONE ELEMENT	**WEIGHT (g)**
CRANIAL VAULT (Neurocranium)	274
FACIAL BONES (Splanchnocranium, excluding mandible)	2.5
MANDIBLE	24.5
TEETH	2
HYOID	0
STERNUM	0
RIBS	29
VERTEBRAE	23
SHOULDER GIRDLE	5
PELVIS	10
UPPER LIMB BONES	105
LOWER LIMB BONES	154
HAND BONES	0
FOOT BONES	1
LONG BONE UNIDENTIFIED (>4 mm)	42
PATELLAE	2
UNIDENTIFIED FRAGMENTS	529
TOTAL WEIGHT	**1203 g**

The total weight for the human cremated bone is 1203g[1]. The total long bone weight was 301g and accounted for a minimum of 25% of the total bone sample. When the bones are grouped into skull, axial, upper limb and lower limb the weight count is 303g, 62g, 110g and 157g respectively. With regard to percentages the distribution is illustrated in Figure 2. These percentages are calculated by taking the weight of the bone fragments grouped according to skeletal area (e.g. skull), divided by the total weight of that particular bone assemblage (1203g). It is clear that the skull and long bone fragments are the most represented element, although this is relative to the actual weight of the skeletal elements rather than completeness (for instance, ribs are lighter than long bones).

[1] As can be observed in Table 1, the weight for this cremation burial is slightly heavier in the assessment report (Boyle 2000). The discrepancy lies since the 4-2mm had not been sorted and this previous weight included some soil residues.

Figure 2. Percentage of element representation according to weight



3.2 Minimum number of individuals

No repeated human bone elements were identified in the cremated bone sample. In addition, there were no obvious differences between bone fragments with regard to age and sex. Therefore, a minimum of one individual was identified in this human cremated bone from context 44[2].

3.3 Age distribution

The clearest indicator that this individual was an adult (>18 years of age) was the presence of the sockets for the left and right third molars, which appear to have been fully erupted and lost *post-mortem*. The pattern of eruption of the third molar is usually between the ages of 17 and 22, with a peak at 17-18 years, but eruption can be as late as 35 years (McKern 1970, 42-43).

In addition, a portion of the distal epiphysis of a humerus indicates it had fused to the shaft, providing a minimum age of 15-17 years (see Scheuer and Black 2000).

Rather more subjectively, the dimensions and robusticity of the bones suggest an individual over the age of 15 years.

Considerable tooth loss may be regarded as an indicator of old age (>45 years). Despite several factors, for example cultural practices, that may influence tooth loss in younger adults, mandibles or maxillae with over 50% of teeth lost *ante-mortem* have been assigned by some to the older age categories (Miles 2001; Mays 2002; also see Wols and Baker 2004). If tooth loss can be considered as an indicator of the older age category (>45

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[2] It is worth noting that the assessment report mentions the possibility of two adult individuals in this cremation burial 44, a male and a female.

years), the skeleton from cremation burial 44 did not show any signs (regeneration) of *ante-mortem* tooth loss in the 11 sockets that were observed. Hence, this adult may not be regarded as an old adult.

The hypothesis that this was not an old individual could also be correlated with the open stage, as opposed to obliteration, of the coronal, sagittal and lambdoid sutures.

In summary, the cremated remains seem to belong to an adult individual between 18 and 45 years of age.

3.4 Estimation of biological sex

There was limited evidence available with which to estimate the sex of this skeleton. The left and right supraorbital ridges from the frontal bone indicate a male trait (score 5 in Buikstra and Ubelaker 1994), while the size of the right mastoid process indicated a possible male (score 4). In addition, the dimensions of the long bones and robusticity subjectively indicate a male individual. Thus, this adult individual can be classified as a possible male.

Cranial vault thickness (see Gejvall, 1969) was not taken into account since this could only be measured at random points in very few fragments.

3.5 Metric data and Non-metric traits

Fragments longer than 10 mm were more frequent (594g) than those between 10-4 mm (427g) and 4-2 mm (182g) (Table 5). The longest shaft fragment was 60.86 mm and was from an ulna. The next longest fragment was 59.83 mm from a femur, followed by 48.82 mm from a tibia.

Table 5: Percentage of bone fragments larger than 10 mm, between 10-4 mm and smaller than 4 mm.

Context 44		
Fragment size	**Weight**	**Percentage of human bone sample (1203 g)**
>10 mm	594 g	49.3%
10-4 mm	427 g	35.4%
4-2 mm	182 g	15.1%

Only one non-metric trait, the supraorbital notch, could be scored for presence or absence. A supraorbital notch was present medially in both left and right orbits.

3.6 Palaeopathology

Most of the recovered fragments could be observed for pathological changes. Several pathological lesions were identified and these include *cribra orbitalia* and porotic hyperostosis, periostitis and osteoarthritis.

Porotic hyperostosis and cribra orbitalia

Porotic hyperostosis was evident on three fragments (2.0%) out of 143 observed in the >10 mm assemblage. This was characterised by pitting on the ectocranial surface and the expansion of the diplöe which was visible in sagittal the cross-section of the three fragments. Also present was *cribra orbitalia* in the form of pitting on fragments of both the left and the right orbital roofs. These lesions were classified as type 2 according to Stuart-Macadam's (1989, 1991) classification system.

Non-specific infection

In the human bone from cremation burial context 44 at Boys Hall Balancing Pond, periostitis was present in the form of new bone formation (striae) on two tibia fragments (11g). These fragments accounted for 4.4% (2/45) of the >10 mm tibial shaft fragments examined.

No such lesions were observed on any other bones, for example in 29g of rib. When these lesions are present in ribs, they are usually indicative of pulmonary inflammation, which commonly occurs in lung infection, particularly tuberculosis (Roberts *et al.* 1998; Aufderheide and Rodríguez-Martín 1998, 137).

Osteoarthritis

OA was present in fragments of vertebral articular facets in the Boys Hall Balancing Pond cremation burial. Marginal osteophytes and contour deformation were clearly observed in one facet out of five incomplete ones which were available for observation. Due to poor preservation, no vertebral bodies could be examined. It is worth mentioning, in addition, that laminae from two different vertebrae revealed signs of syndesmophytes, between 1-3 mm in size (following Campo 1997).

Marginal osteophytes and slight contour deformation characteristic of OA were also evident in a fragment of a possible proximal epiphysis of an ulna. The only other joint surface that was available for observation, the head of an intermediate foot phalanx, was not affected by any joint disease.

Dental pathology

A total of 11 empty sockets had survived and included eight sockets clearly belonging to the mandible. The remaining three, loose and fragmented alevoli, were also probably from the mandible. None of these sockets showed evidence for *ante-mortem* tooth loss and neither were any periapical lesions present on the eight complete sockets observed from the mandible.

Gross dental caries has a key role in the development of *ante-mortem* tooth loss. Thus, although no complete teeth survive it is possible to say that none had been lost during life as a result of dental caries or abscesses. Caries and abscesses are heavily influenced by a diet high in carbohydrate and poor oral hygiene. Without knowing the precise age of the individual and without the complete dental crowns, however, more detailed information on diet cannot be obtained.

Further observations

Although cranial and post-cranial fragments were small, no *ante-mortem* or *peri-mortem* trauma was identified.

Two portions of patella were recovered and displayed marked enthesophytes.

3.7 Other material

During analysis of the human cremated bone from context 44, 2g of pyre debris (charcoal) and 1g of burnt faunal remains were found. Of interest are two human cremated bone fragments which had metal adhering to them. One of these was a cranial vault fragment with a slight green stain and some traces on the ectocranial surface. The other specimen had a larger amount of metal which appeared to be iron, imbedded in a bone fragment probably from a maxilla.

Iron staining on bone has been identified on the remains of other early-mid Roman cremations from the CTRL area (e.g. see Witkin and Boston this volume). The small fragments of burnt animal bone may have been part of food and drink offerings during the cremation (e.g. see Lindsay 1998).

No further pyre goods and no grave-goods were found in these truncated cremation burials.

3.8 Pyre technology and mortuary ritual

There was no apparent preference with regard to the presence or absence of skeletal elements in the cremation burial from context 44. The relatively high proportion of cranial fragments was largely due to the ease of identification of those elements, while the small quantity of fragments from the axial skeleton was most likely the result of preservation rather than deliberate exclusion.

Colour variation

At Boys Hall Balancing Pond, the predominant colour in the human cremated bone was white, with some cranial and long bone fragments having some different shades of grey and blue. It had an overall homogenous colour indicating successful complete or intense combustion of all the organic component of the bone. This generally occurs at temperatures above 700 degrees centigrade (Holden *et al.* 1995). Table 6 indicates the percentage of colour distribution according to weight in the human cremated bone 44. The predominant colour was white with hues of grey and blue. Overall, fragments that were only white added to 369g. Adding all the remaining white fragments with hues of blue and/or grey together, weighed a total of 829 g of fragments presented this colour. Fragments with a darker colour ranging from deep blue through to grey and black only accounted for 5g and included in shaft fragments belonging to the humerus and the tibia. A breakdown of the different colour according to skeletal element is included in the Appendix.

Table 6: Percentage of fragments according to weight that presented a particular colour

Skeletal area	Colour					
	White + grey	White	White + blue	White + blue/grey	Dark blue + black	Dark blue + grey
Skull	86.5g	102g	55.5g	59g	0g	0g
Axial	23g	22g	13g	4g	0g	0g
Appendicular	167g	60g	34g	26g	4g	1g
Unidentified	361g	185g	0g	0g	0g	0g
TOTAL	637.5g	369g	102.5g	89g	4g	1g
% of 1203g	52.9%	30.6%	8.5%	7.3%	0.3%	0.08%

Thus, it seems that the body was cremated at a high temperature, over 600ºC.

Further observations

Further information on the funerary rite is limited due to the truncation affecting the material and the limited sample size. However, the clear curved cracking and warping of some of the larger bone fragments suggests that the bodies were cremated while fleshed. Further, the fragments displayed the typical fracture patterns and fragmentation as described by Reverte (1986) for fleshed cremations.

Collection of the bones seems to have been undertaken with care because there has clearly been an attempt to select as many bones as possible including small fragments such as dental crowns and roots. Furthermore, more than 60% of the bones in the skeleton are represented, bearing in mind that many must have been lost during truncation.

With regard to further taphonomic changes, only about two cranial vault fragments and four upper limb fragments revealed some polishing of the bone surface.

4 DISCUSSION

4.1 Biological information

The analysis of human cremated bone from burial 44 has identified a minimum of one adult individual, between 18-45 years of age-at-death and probably male. No repeated bone fragments were found and there were no obvious differences in the size of bones with regard to age or sex that were convincing enough to indicate a second individual, as suggested in the assessment report by Boyle (2000). The classification of the individual as an adult is a safe conclusion based on the eruption of the third molar. The sex diagnosis was based on the morphological observation of the supraorbital ridges and one mastoid process. Although the traits were typical of a male individual, further traits would have been necessary in order to increase the reliability of the diagnosis.

The only metric data that could be obtained was fragment size. Fragment size represents the measurements taken by the human osteologist during analysis. Factors that affect fragmentation include the cremation itself, collection and burial of the human remains, deliberate fragmentation by the mourners or grave diggers, taphonomic factors such as soil characteristics and ploughing, and also the much later process of archaeological excavation and post-excavation processing (McKinley 1994). It is possible that the human cremated bone was fragmented deliberately in order to fit into the vessel. However, later truncation may also be taken into account.

Although the information retrieved here on non-metric traits is of limited value, it nevertheless contributes to the non-metric trait record for human remains in the area.

4.2 Health status

Analysis of pathological lesions from cremated assemblages is usually descriptive in nature and rarely does this form part of skeletal prevalence rates. Data on the Boys Hall Balancing Pond cremation burial from context 44 was very limited but nevertheless contributed to the palaeopathological record for the region. At a later date, it may also be pooled with other limited pathological data derived from other cremation burials in the area.

Porotic hyperostosis and cribra orbitalia

The aetiology of porotic hyperostosis and c*ribra orbitalia* is multifactorial. Anaemia seems a possible cause of these skeletal abnormalities (Stuart-Macadam 1991, 1998). The condition is present when the number of red blood cells or the level of haemoglobin is below normal (Larsen 1997, 10). Anaemia will negatively affect the work capacity and cognition of a person, as well as his or her immune system causing them to feel fatigued and weak (Stuart-Macadam 1998, 46). Anaemias can be genetic but they can also be acquired as a result of conditions leading to low iron availability (Larsen 1997). Particular attention has been given to the possible role of iron deficiency anaemia on these lesions (Holland and O'Brien 1997; Polo *et al.* 1999). Iron-deficiency anaemia may appear in relation to poor diet and inadequate nutrition, for example when there is reliance on a food staple that inhibits iron absorption (El-Najjar *et al.* 1976; Blom *et al.* 2005, 166).

Other contributing factors must be considered however (see Wapler *et al.* 2004). Pathogen load, the number of micro-organisms in the environment, could play a major role (Stuart-Macadam 1992). The risk of parasite infestation is associated with sedentism, eating raw meat and fish, sanitation, a staple food based on cereals, population aggregation, contaminated water, plagues, agricultural activity in relation to pathogenic organisms in the soil, zoonoses, population movement and inefficient waste disposal, amongst other factors

(Kent 1986; Larsen 1997, 10, Lovell 1997; Stuart-Macadam 1998; Walker 1986). Agricultural activity, cereal cultivation and living alongside domesticated animals are all features of late Iron Age Britain (Roberts and Cox 2003, 94-96).

Periostitis

Periostitis is a non-specific lesion characterised by inflammation around the surface of the bone or periosteum. This basic inflammatory response may be caused by bacterial infection via the blood stream or even by direct traumatic injury to the bone (Ortner and Putschar 1981). The presence of periostitis can be associated with malnutrition, poor sanitation and general living conditions. However, interpreting the presence as well as the absence of periostitis is complex and not straightforward (see Wood *et al.* 1992; Ortner 1998). Furthermore, periosteal bone formation is not restricted to infections (Ortner and Putschar 1981, 129; Pinheiro *et al.* 2004).

In the present example from Boys Hall Balancing Pond, it is not surprising to find periostitis on the tibia since this bone is most commonly affected in archaeological assemblages (Ortner and Putschar 1981, 132). Although the reason for this predominance is unclear, it is probably related to the fact that it is more susceptible than other bones to direct trauma, being surrounded by less muscle mass and fat.

A number of factors could explain the presence of periostitis in the human cremated bone from context 44, including contaminated water and infections transmitted from other animals.

Osteoarthritis

Osteoarthritis (OA) is the most common of all articular diseases (Ortner and Putschar 1981, 419; Roberts and Manchester 1995, 105). The variation in patterns and prevalence of OA throughout the world may be a reflection of different lifestyles and occupations (Roberts and Manchester 1995, 107). Its aetiology is multifactorial, ‘wear and tear’, obesity, inheritance and trauma being among the possible causative factors.

4.3 Efficiency of cremation

In the cremation of a single cremated individual, considerable variation in bone colour may be found in different elements of the skeleton. Colour changes on burnt bone depend on the temperature of the firing, oxygen supply, the size of the pyre, the duration of exposure and proximity of the body to the flames, the amount of soft tissue, position of the corpse, and movements of body parts during the cremation (McKinley 2000a and 2000b). The age of the individual (in relation to body mass) and some bone diseases may affect the speed of full combustion (Reverte 1986, 136). In addition when interpreting the temperature and speed of combustion, it must be acknowledged that apart from fatty tissue, body hair and clothing may have an effect too (Gómez 1996, 61).

Most of the bone from cremation burial 44 was white in colour and this was homogeneous throughout the skeleton reflecting a successful cremation at a temperature over 600-700ºC.

4.4 Pyre technology and funerary practice

Surface texture

Surface texture of the cremated remains revealed transverse, longitudinal and curved checking and splitting. Many skeletal elements showed signs of warping As opposed to burning dry bone, these patterns are evidence that the bone was 'green' or covered with flesh during the cremation.

Weight of bone for burial

Investigations in modern crematoria have found that the average bone weight of a cremated adult individual is approximately 1000-2400 g (McKinley 2000a, 269). A modern cremated female body weighs on average 1615.7g and a male body an average of 2283.5g (McKinley 1993). Predictably, individuals of smaller and more gracile build, such as children, or those older individuals with osteoporosis will have a lower bone weight and possibly poorer bone survival (McKinley 2000b, 404).

The total weight of the cremated human bone from burial 44 was 1203g. This is smaller than expected for a completely preserved adult male. However, it must be borne in mind that the burials were not completely preserved due to later truncation such as ploughing.

Funerary practice

The information on the funerary practice was very limited due to the small sample size of the burial area, and because of the lack of information obtained from the other cremation burials which were disturbed at a later date.

With regard to context 44, after the cremation the human remains appear to have been collected with care by the grave-diggers or the mourners. Among the identified fragments, most skeletal elements and small fragments such as tooth crowns and dental roots were represented. This presence of most skeletal elements and particularly of the smaller fragments may reflect a degree of care when collecting the bones, especially bearing in mind that some may have been lost during ploughing of the land at a later date.

Some of the human cremated remains may have been crushed deliberately in order to be able to place them inside the pottery vessel.

5 CONCLUSION

A minimum of one adult individual, older than 18 years and younger than 45 years of age, was identified. The individual was likely to be male according to the skeletal indicators.

Some pathological lesions have indicated the presence of living conditions perhaps associated with inadequate nutrition and an environment which would have facilitated the spread of infections

The corpse of this person had been cremated at full combustion (probably >700) due to the predominantly white colour of the cremated bones. During cremation some pyre goods may have been present as evidenced by the burnt faunal bones and the fragments of metal. The presence of most skeletal elements and small fragments such as dental roots and crowns indicated that care was taken at the funeral to collect the bones. Some crushing of the bones may have taken place in order to fit the cremated bones into the urn..

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7 SUMMARY CATALOGUE

ARC BHB 98

CONTEXT NUMBER

44

Urned cremation burial

SKULL (identified fragments):

14 frontal bone fragments, 12 parietal fragments, 5 occipital fragment, 9 temporal and 112 vault fragments over >10 mm. Several vault fragments under 10 mm. Portions of left and right orbits are present. Among the temporal fragments, these include part of temporal squama, petrous pyramid, mastoid process and posterior zygomatic arch and part of the external auditory meatus.

Five fragile bones such as maxilla and sphenoid.

Mandible: 11 fragments mostly from the whole body, with 8 alveoli corresponding to the left I2, C, P1, P2, M1, M2, M3 and the right M3. The remaining three alveoli were found loose.

Teeth: 18 fragments including 10 root fragments and 8 segments of crows. These are mainly molar roots from upper and lower jaw as well as an identified central upper incisor root.

AXIAL SKELETON (identified fragments):

Vertebrae: 32 small fragments mostly comprising the transverse process, laminae and only a few body fragments.

Rib: >50 shaft fragments.

Innominate: 11 fragments from iliac body, iliac crest and acetabulum.

Sacrum: 2 fragments of anterior part.

UPPER LIMB (identified fragments):

Scapula:7 fragments of the body.

Clavicle: 2 shaft fragments.

Humerus: 21 shaft fragments.

Ulna: 14 shaft fragments, 1 portion of olecranon. Right ulna identified.

Radius: 13 shaft fragments. Right radius identified.

LOWER LIMB (identified fragments):

Femur: 16 shaft fragments (*linea aspera* visible in 1 fragment), 1 distal epiphysis fragment.

Patella: 2 anterior fragments.

Tibia: 45 shaft fragments including the anterior border. Right tibia identified.

Fibula: 9 shaft fragments.

Foot bones: 1 shaft fragments of a metatarsal and the head of an intermediate phalanx

AGE: Adult

SEX: Male?

PATHOLOGY SUMMARY: Porotic hyperostosis in the skull vault and *cribra orbitalia* in both orbits, periostitis in tibia and osteoarthritis in some vertebral facets and in the olecranon of an ulna.

PYRE GOODS: 2 cranial fragment with metal staining and metal adhered onto them.

CREMATION SUMMARY: All white except 4 long bone fragments which are dark blue/grey/black. Extensive fragmentation but most of the bulk in the >10 mm category.

COMMENTS: The residue contained a small amount of unidentifiable bone fragments from each fraction but especially the 2 mm fraction. There were also 13 burnt non-human animal fragments and 22 charcoal fragments.