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THE HUMAN SKELETAL REMAINS FROM FISHMONGER'S SWALLET, ALVESTON, GLOUCESTERSHIRE: EVIDENCE FOR ANTHROPOGENIC MODIFICATION

by

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ABSTRACT

Human skeletal remains have been recovered from an area of mud and rock sediment in Fishmonger's Swallet, Alveston, Gloucestershire (ST 6331 8720) on several occasions. This report examines those excavated by the Hades Caving Club (HCC), up to and including the visit by the Time Team in August 2000. These disarticulated and fragmented bones have all been assessed macroscopically (2001), and the single bone clearly exhibiting indications of deliberate human modification was subject to more recent microscopic analysis (2005). The percentage of the deposit that has been examined for human remains is unknown.

Dating from the late Iron Age, this assemblage comprises disarticulated and fragmentary remains from adults. No juveniles are represented. The minimum number of individuals represented by non-repeated diagnostic fragments of the left femur is five. There are indicators suggesting that there are possibly six females and five males represented by the assemblage. However, with commingled remains it is impossible to be sure as some of the diagnostic skeletal elements could be from the same individual. Evidence suggests that one probable female died below the age of twenty-five years and one adult in old age.

Evidence of peri-mortem trauma is present in the cranial remains of a young adult female. She would appear to have been victim to at least one blunt force blow to the head with further blows from a bladed weapon. Recent damage to the skeletal remains prevents a more confident diagnosis. No evidence of dental disease was observed in the limited dentition represented, however, a partial mandible exhibited signs of a healed dental abscess. Other evidence of disease in this assemblage was limited with one cervical vertebral body showing signs of severe degenerative joint disease and a possible case of Paget's disease.

The condition of all the human bones is fragmentary and some are eroded. Many exhibit evidence of breakages occurring at some stage in antiquity, others of more recent damage, possibly incurred during recovery. Ten bones exhibit indications of animal scavenging and one of anthropogenic peri-mortem modification (a partial femoral shaft) which suggests the bone was deliberately defleshed and split. Some fragments were stained black externally. The cause of this has not been explored scientifically but it is possible that this could be manganese staining or bacterial change arising from recent contamination.

INTRODUCTION

This discussion is based upon an assessment report that was prepared for Videotext Productions Ltd. in April 2001. Further microscopic analysis was undertaken in 2005. This specifically examined evidence for peri- and post-mortem modification in the assemblage (Loe and Cox, 2005). As there are several different areas of inquiry involved in this analysis, the methods used for each are followed directly by the results before moving onto the next.

This assemblage was recovered in two parts more than twenty years ago and in a manner that would not be acceptable were the same to take place today. At that time 'cave archaeology' barely existed as a discipline (Last, 2003) and very little was understood about optimum recovery, sampling and recording methods. Consequently, should this recovery have occurred more recently, recovery, sampling and recording would be more efficient and systematic. Likewise, analysis presented here was undertaken in part with no budget shortly after the Time Team excavation in 2000, with further work in 2005. Clearly, analytical approaches (e.g., Bello and Soligo, 2008; Bello and Galway-Witham, 2019) and diagnostic criteria (e.g., Knusel and Robb, 2016) have also progressed since then but what is described here outlines the most appropriate methodology available at that time.

For the historical background to work at this site, see Hardwick, 2022 (this volume); for the geological context, see Hardwick and Tringham, 2022 (this volume) and for a discussion of the radiocarbon dating of the material see Brickling, *et al,* 2022 (this volume).

AIMS, OBJECTIVES AND MATERIAL

Aims and objectives:

The aim of this analysis was to provide an assessment of the human skeletal material recovered from Fishmonger Swallet by Time Team's archaeologists (which included that retrieved during wet-sieving) and prior to that date by the HCC.

Objectives included the following:

- Creating an inventory of the elements.
- Recording their condition and fragmentation.
- Assessing anthropological characteristics, specifically the minimum number of individuals represented, and where possible biological sex, age at death, pathology and trauma[1].
- Assessment of peri-and post-mortem modification reflecting the burial environment, faunal activity and anthropogenic modification.

Recovery:

The recovery of these remains is discussed fully by Hardwick (2022, this volume) and is not considered in detail here. The only pre-treatment of the assemblage undertaken prior to analysis was to wash specimens gently in clean water and air dry them at ambient room temperature.

Results and discussion:

No complete human bones were recovered from this assemblage. The number of identifiable recovered fragments of each skeletal element is recorded in Table 1 (n=205). Comment on the condition of the human bone is based upon macroscopic observation as no histological sections have been undertaken for this purpose. Generally, the material survived in disarticulated, fragmentary and eroded condition. The majority of the long bone fragments are cylinders, rather than flakes, and skull fragments are large. Some diaphyses are virtually complete. The majority of breaks are transverse and either recent or much older; none are peri-mortem other than those to the female skull and femur discussed below. Some of the material was covered in a black film. This might have been caused by bacterial action relating to untreated sewage that was leaching into the swallet from a nearby septic tank and soak-away. Alternatively, it might indicate magnesium staining from water percolating through limestone as is seen at nearby Gough's Cave and the Charterhouse Warren Farm Swallet (Collet, 2018). The faunal remains are similarly affected (Peto, *et al*., 2022 this volume).

The bones generally lack diagnostic landmarks, and most are too fragmented to be more specific. Cranial fragments are represented most often with no distinct regions or landmarks represented more than once. Reflecting the fragmentary and incomplete nature of the

[1] Assessment of such characteristics as ancestry were not considered given the highly fragmentary nature of the assemblage and the problems inherent in determining ancestry from partial remains (O'Connell, 2017).

individual elements it is impossible to meaningfully assess from them just how many individuals are represented. The authors are confident that three cranial fragments are from the same skull as they refit accurately. The minimum number of individuals represented by this assemblage is five as suggested by the five non-replicate fragments of left femur. It is entirely possible that this assemblage represents more than five individuals, but because of the fragmentary and eroded nature of the material it is impossible to be more precise. Figure 1 is a working shot taken on site in 2000. It indicates the range of fragmentation, colour and condition.

Table 1. *Survival of skeletal elements.*

Skeletal element	N	Skeletal element	N	Skeletal element	N	Skeletal element	N
Cranium	82	Scapula un-sided	1	Carpals un-sided	1	Left tibia	3
Zygomatics	0	Sternum	0	Left metacarpals	1	Right tibia	0
Maxilla	0	Manubrium	0	Left metacarpals	1	Tibia un-sided	6
Mandible	3	Left rib	0	Right metacarpals	0	Left fibula	0
Cervical vertebrae	2	Right rib	1	Metacarpal un-sided	1	Right fibula	0
Thoracic vertebrae	3	Rib un-sided	1 9	Left proximal phalanges	0	Fibula un-sided	1
Lumbar vertebrae	1	Left humerus	1	Right proximal phalanges	0	Left tarsals	2
Vertebrae unident.	3	Right humerus	1	Un-sided proximal phalanges	2	Right tarsals	3
Sacrum	0	Humerus un-sided	9	Left medial phalanges	0	Left metatarsals	1
Left innominate	3	Left radius	2	Right medial phalanges	0	Right metatarsals	1
Right innominate	1	Right radius	0	Left distal phalanges	0	Left proximal phalanges	0
Innominatum un-sided	6	Radius unsided	2	Right distal phalanges	0	Right proximal phalanges	0
Left clavicle	0	Left Ulna	2	Left femur	5	Left medial phalanges	0
Right clavicle	0	Right ulna	2	Right femur	4	Right medial phalanges	0
Clavicle un-sided	1	Ulna un-sided	12	Femur un-sided	15	Left distal phalanges	0
Left scapula	0	Left carpals	0	Left patella	1	Right distal phalanges	0
Right scapula	0	Right carpals	0	Right patella	0	Individual teeth	10
						Total	**205**

Note: Further bone fragments have come to light since 2005 and are not included in this list.

Figure 1. *The bone assemblage being collected during the Time Team intervention.*

As is clear from Table 1, very few of the smaller bones of the skeleton (e.g., metatarsals and metacarpals) were recovered during either recovery exercise. The lack of small human bones is not unusual in archaeological assemblages (Von Endt and Ortner, 1984) as diagenetic processes often destroy smaller bones. However, at Alveston, a large number of small (as well as larger) human bone fragments and intact small animal and rodent bones were recovered and as such the paucity of small human bones, such as metatarsals and metacarpals is anomalous. During the Time Team intervention, all excavated sediments were wet sieved and as such it is not the case that smaller bones were not recovered. These findings may be of no significance and could simply reflect chance, or they might indicate that complete human bodies were not entering the cave.

That no human skeletal element survived intact may, in part, reflect several different forces. These include turbation within the swallet caused by fluctuating ground water, the possible spring activity inferred by the 1959 description (see below), and the impact of rainwater and sediment entering the system from above. The faunal material was also highly fragmentary, with few diagnostic bones remaining for ageing and sexing methods. There were partial long bones but few complete, and some complete bones such as pelves. (Peto, *et al.*, 2022, this volume).

The condition of both the human and faunal remains may also reflect faunal impacts (trampling, scavenging), natural dispersal via terrain and slope, and anthropogenic modification (human remains) prior to their deposition in the swallet. Further, it is not impossible that rodents and/or small mammals may have entered the system by some mechanism and been responsible for in-situ damage and dispersal therein (for example, Behrensmeyer 1984; Oliver 1989; Olsen and Shipman 1988).

ANTHROPOLOGICAL ASSESSMENT

Biological sex - methodology

The adult pelvis has always been considered the most sexually dimorphic part of the human skeleton and consequently the most reliable component to examine for the determination of biological sex. This is because the female pelvis has undergone evolutionary modification to allow successful parturition (Cox and Scott, 1996), thus differentiating it from that of the male (Mays and Cox, 2000). As early as the 1950s, Stewart (1954) documented that an adult pelvis could be used to correctly assign sex in 90-95% of cases, and Krogman and Isçan (1986) also maintain that the percentage accuracy afforded by examination of the pelvis alone reaches 95%. That said, it is worth noting that more recent work on early twentieth century battlefield assemblages of known age shows that young adult males may not necessarily exhibit classical male pelvic characteristics (Loe *et al*., 2014); this could skew interpretation and results.

The skull is the next most reliable area of the skeleton for determining sex. In males, both face and skull undergo growth in response to hormonal influences consequential of puberty. The female retains the gracile form. Observation by the first author based on her work examining WWI soldiers suggests that in young adult males (i.e., post-puberty / late teens), while usually (but not always, *ibid*, 102) the pelvis appears to have undergone modification reflecting biological sex, the skull and face take longer to produce the post-pubertal growth characteristic of the male (*ibid*). Consequently, in males aged between approximately fourteen and the late teens, the pelvis may appear male while the skull often retains the more gracile female form. When only the skull survives this can cause incorrect attribution. Walker (1995) also considers that it is difficult to obtain an accurate sex determination in males below thirty from the skull, while the older (possibly post-menopausal) female skull becomes more male in character. When examining mature adults, many authors feel secure in claiming 80% accuracy for sex identification from the adult cranium alone (St. Hoyme and Isçan, 1989) increasing this to 90% if the mandible is included (Krogman and Isçan, 1986). Utilisation of these two skeletal elements achieves near to 98% accuracy (*ibid*) in attrition cemetery samples that are strongly dimorphic (Molleson and Cox, 1993).

Despite this, it should be considered that absolute differences seldom exist between the sexes and many intermediate forms are found as a measure of the variation in sexual dimorphism between, and within, samples and populations (Mays and Cox, 2000). Having expressed these words of caution, generalisations can be made regarding sex estimation. Numerous authors have described the sexually dimorphic traits observed in the pelvis and the skull (including Bass, 1987; Buikstra and Ubelaker, 1994; Krogman and Isçan, 1986; Mays,1998; St. Hoyme and Isçan,1989; Steele and Bramblett, 1988; Ubelaker, 1989; White and Folkens, 2000).

Biological sex - results

The results are shown in Table 2 below. In this report, sex has been tentatively ascribed based on the presence of a single sexually dimorphic characteristic, and without any knowledge of the individual's age. It should be stressed that when analysing complete or almost complete skeletons, this would not be acceptable and that the results shown in Table 2 are at best probable values. Where the innominate is shown this refers to the presence of a wide sciatic notch, and in two cases a classically female pre-auricular sulcus (Cox and Scott, 1992). With the cranium, this generally reflects the area of the supraorbital ridges though in one case it also includes the occipital region. With the mandible, gonial flaring is diagnostic. These are the only sexually dimorphic characteristics that survive in this assemblage.

Table 2. *Sex estimation*

Skeletal indicator	N - ? Male	N - ? Female
Innominate R	1	2
Innominate L	0	3
Cranium	2	1
Mandible	2	0

Table 2 suggests that five males and six females may be represented by this assemblage. It is not, however, impossible that some of the above may represent the same individual, so these figures must be seen as possible overestimates. Further, as the age of individuals is unknown, accuracy may be compromised.

Estimation of age at death - methodology

In assigning an age at death for an individual surviving in skeletal form we are attempting to determine chronological age from physiological changes reflective of either developmental (in juveniles) or degenerative (in adults over the age of thirty) changes. Clearly, the former is a linear and relatively predictive progression, but, importantly, the latter is neither. Age at death estimation for mature adults is largely dependent on degenerative changes (which will occur at differing rates between and within different populations and samples) affecting joints (with limited mobility) of the skeleton. Variables that increase the complexity of this area of research, and application, include random individual variation in maturation and degeneration. These variables are compounded by various factors including the systematic and unquantifiable effects of environmental, nutrition, and endocrine and genetic factors affecting development and senescence (Cox, 2000).

At present, there are several osteological methods employed to address age at death estimation in modern adults. These include pubic symphysis degeneration (Brooks and Suchey, 1990), auricular surface morphology (Buckberry and Chamberlain, 2002, Lovejoy *et al*., 1985; Osbourne *et al*. 2004) and changes to the sternal ends of ribs (Isçan and Loth, 1984; Isçan *et al*., 1985). Other methods such as cranial suture closure have been discredited (see discussion in Cox, 2000, Garvin, 2008) There is an increasing body of research that suggests that all methods used for ageing those over the age of thirty are increasingly inaccurate (*ibid*). However, the evidence does suggest that for young adults below the age of thirty, a greater degree of confidence is appropriate. When ageing young adults, weight is given to such aspects of skeletal development as fusion of the medial clavicle (Webb and Suchey, 1985; Black and Scheuer, 1996), fusion of the iliac crest (Scoles *et al*, 1988), and fusion of the ventral rings of the vertebrae (Albert and Maples, 1995). The sacrum is also useful in that if spaces are still detectable between all the segments, then the individual is usually younger than 20 years (Scheuer and Black, 2000). If the space is only retained between the first and second sacral vertebrae, then this tends to suggest that the individual is less than 27 years of age (*ibid*). In this analysis, the ages ascribed to fusion follow Scheuer and Black (*ibid*).

Age at death - results

In this assemblage, given the nature of the remains, there is little to be gained by attempting to assess age systematically as no individuals are represented *per se*. Interestingly, no infant or juvenile remains were recovered and while this could reflect that none entered the swallet, or have yet been recovered, it might reflect that such bones are more prone to aggressive diagenetic processes than most adult bones (see Bello *et al*., 2006). This issue remains unclear without further excavation. Subadult remains from earlier dates have been recovered at nearby Mendip cave sites (Bello *et al*., 2006; Walker *et al*., 1988).

Where an age is suggested by any of the remains recovered to-date, it is noted in the catalogue (Appendix 2). The scant ageing evidence surviving in this material suggests that one individual died aged below 25 (trauma victim) and that the two exhibiting disease processes associated with increased age possibly represent older individuals of forty-five plus.

Pathology

Evidence on the skeleton of disease affecting an individual during life rests upon the existence of a chronic or long-term condition (e.g., tuberculosis) eliciting a skeletal response. Acute disease (of short duration and quick resolution such as typhus) leaves no skeletal indicators (Roberts, 2000). Similarly, evidence for trauma occurring some time prior to death is recognised by the fact that fractures, dislocations, sharp or blunt force trauma will all heal, and evidence of healing can be recognised in bone. Trauma occurring shortly before or at the time of death is recognised by characteristic fracture patterns as seen on 'green' or collagen rich bone (Loe and Cox, 2005; Raul *et al*., 2008, Loe 2016). Evidence of trauma associated with some types of weapon or implement can often be inferred by the manner in which bone breaks and the characteristics of associated lesions in bone (Boylston, 2000, Byers, 2005, Berryman and Symes, 1998, Loe 2016, 2017).

Figure 2. *Long bones exhibiting possible Pagetic changes.*

Disease

Two different disease processes were observed. Three cranial and five long bone fragments (four from a left and right femur and one from a humerus) display the macroscopic changes characteristic of Paget's disease (see Figure 2). Given the rarity of this condition in the archaeological record it is assumed that these bone fragments are from the same individual, however, that cannot be proven. Paget's disease is a condition usually affecting the quality of life of people aged over 60 years. However, it takes decades to become symptomatic and can be found in individuals aged over 40. Its prevalence today in England and Wales is 0.3% in individuals over the age of 55 (van Staa *et al*, 2002). The condition affects bone and its impact on the cranium produces a range of motor and behavioural symptoms. Vertebral kyphosis results in bowing of load bearing long bones causing a reduction in stature and a simian-like gait (Aufderheide and Rodriguez Martin, 1998).

In this assemblage three cranial fragments (context D 300) exhibit characteristic macroscopic changes. The diploe is much thicker than normal reflecting sclerotic bone formation and cortical reduction. The five long bones show characteristic thickening of the cortex and reduced medullary cavity. It is unknown if these are derived from the same context, if they do then this could indicate that they represent the same individual. However, the long bone fragments have been radiographed and do not exhibit the marbling that is considered to characterise Paget's disease. While Rogers *et al*. (2002) argue that radiography alone is sufficient for a reliable diagnosis, others (Bell and Piper, 2000) consider that the only way to be confident about a diagnosis for Paget's disease is through histological analysis. It would be recommended that this should be undertaken. Unfortunately, the location of the long bone fragments examined on site and x-rayed by the Department of Radiology, Bristol Royal Infirmary are presently unknown so have not been available for histological examination. The above comments are taken from observations recorded on site by the first author.

The only other evidence of disease is from Time Team context A600 / A-600. This is a single eroded cervical vertebral body (possibly cervical vertebra 7). This is extremely porotic and lipped suggesting the presence of severe degenerative joint disease, possibly spondylosis deformans, affecting the lower neck.

Trauma

No evidence of healed ante-mortem trauma was observed in this assemblage. Evidence of peri-mortem trauma was apparent in the cranium of an adult recovered by HCC in 1996 (Figure 3). An incomplete but relatively intact cranium was recovered. The parietals and occipital are still intact, but the frontal region survives in three separate parts. Neither temporal bones or the zygomatic regions survive. The endocranial sutures of this individual are all open and spheno-occipital synchondrosis is incomplete. There is no evidence of disease or healed trauma affecting this skull.

As noted above the occipital and parietal bones are still intact and contiguous bone from the frontal region survives in three pieces. The left frontal region survives in one piece, this bone being fractured approximately along the metopic line. This fragment also includes a depth of approximately 12 mm of the left parietal along the axis of the coronal suture running from bregma for 56 mm (unfortunately the right-angle corner adjacent to bregma has been broken off in the recent past). This fracture tails off laterally rejoining the coronal suture and running to the temporal region. The fracture line running almost centrally through the frontal bone runs almost straight for 85 mm from bregma where it deviates to the right at 45° for 8 mm. It then runs straight down to the nasal articulation – almost along the metopic line. The cleanness of this fracture (both endo and ectocranially) suggests that it occurred when the bone was either still living or still highly collagenous (i.e., shortly after death). Two scenarios explaining its presence are possible. Firstly, it might reflect a powerful blow to bregma (supported by a radiating fracture running at 45° from 10 mm posterior of bregma from the sagittal suture onto the right parietal for c.50 mm). Unfortunately, as bregma is largely missing this possibility cannot be assessed. Secondly, it might be a blade weapon injury that has sliced through the bone to the point of the deviation to the right whereupon it becomes a radiating fracture. There is, however, no evidence of a blade impact in terms of a weapon signature at any point along the fracture line. The fracture runs at 90° to the surface and the trabeculae are not flattened inwards, neither is there any internal bevelling. While the latter point does not support it, characteristics otherwise indicate a blow to bregma as the probable cause.

Figure 3. *Cranium showing evidence of peri-mortem trauma. Viewed from above.*
Photo by courtesy of Cardiff University.

Further to that, there are two further fractures affecting the right frontal area. What appears to be either a blade injury or radiating fracture consequent to a blow to the head runs almost horizontally along the right frontal bone. It butts against the fracture line described above, therefore post-dating it, and runs c30 mm above the postulated supraorbital region (missing on this side). The line loses definition as it runs towards the temporal bone suggesting that the blow was directed to the front of the head rather than to the side.

This fracture is butted against by a third, which clearly post-dates the second. This fracture arches superiorly and laterally from that just described and stops at the coronal suture. Unfortunately, the bone from where this fracture line might project (i.e., beyond the suture) is missing (recent damage). This fracture, unlike the previous two which cleanly bisect the bone, only cuts through the outer table and does not penetrate the diploe. The force behind the blow clearly caused the diploe to fracture posteriorly from the cut and superiorly towards the sagittal suture. The inner table fracture line is typically ragged and bevelled and characterises internal bevelling associated with non-penetrative trauma.

If the trauma described above was inflicted during life, there can be no doubt that it would have caused death. It is possible, however, that the blows were inflicted soon after death, as the lines of all three fractures are characteristic of being inflicted upon collagenous bone (Barker *et al*, 2008; Loe and Cox, 2005; Raul *et al*., 2008). If they are post-mortem, they took place within a short period of time after death.

Dental and oral health

The dental condition of an individual reflects, amongst other things, the type of diet eaten, the practice (or not) of oral hygiene (Hillson, 1996, 2005) and contemporary dentistry (Whittaker, 2003, Loe *et al*, 2014).

There were only ten surviving permanent teeth available for examination. The limited surviving alveolar support and dentition does not facilitate quantitative analysis in this assemblage. The ten teeth recovered all appear to be free of carious lesions. One partial mandible with a surviving right first and second molar shows severe occlusal attrition and alveolar resorption. Another incomplete mandible from the same context has what appears to be an abscess possibly associated with the crypt of the lateral incisor. However, no teeth survive from this structure and the bone is eroded and broken (post-mortem damage) at this point, so this diagnosis remains tentative.

PERI- AND POST-MORTEM MODIFICATION

Several bones had been modified following death, when they were still fresh, or before they had completely mineralised, evidenced by surface alterations associated with faunal and anthropogenic activity. The following sections present observations on faunal activity, made during the initial assessment of the bones and detailed observations on the split femur, taken from Loe and Cox (2005).

Methods

Assessment of modifications considered surface features and peri-mortem bone breakage. Surface features are alterations to the bony cortex that are the result of human (e.g., tool marks), faunal (e.g., gnawing) and environmental (e.g., sediment abrasion) activity. These may occur on the sub-periosteal surface of the bone, penetrate the bony cortex or the medullary cavity of long bones and the endocranial surface of the skull. They may be broadly classified as pits and striations.

These are the most frequently observed alterations on bone that has been modified by human, animal and environmental agencies (Shipman, 1981). They were considered with reference to Blumenschine *et al*., (1996); Blumenschine and Selvaggio, (1988); Hurlburt, (2000); O'Sullivan, (2001) Shipman and Rose, (1983) and Shipman (1981), and involved recording factors such as the location, orientation, frequency, concentration, direction, profile, texture, plan, internal appearance and colour of features. Features were described and identified by employing the criteria summarised in Appendix 1. For the femur, they were also described with reference to the zone of bone affected, after Knusel and Outram (2006)[2] which primarily aim to identify the actor (human or animal) and the effector (e.g., tool or tooth).

Observations were made using a 10x hand lens and, for surface features on the split femur, a stereo light microscope up to 50x magnification.

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[2] Since this analysis was undertaken further work in this area has taken place, see for example Bello and Soligo (2008).

Bone breakage refers to fracture morphologies and fragmentation patterns and may be the result of many factors including deliberate breakage, trampling, sediment pressure, weathering, and excavation and post-excavation damage. Breakage was assessed in the present assemblage with reference to Villa and Mahieu, (1991).

The timing of anthropogenic alterations was considered. That is, bone breakage and surface features will display characteristic changes depending on whether they occurred when the bone was fresh (i.e., the protein had survived), or mineralised (i.e., the protein had decayed), This was undertaken by employing the criteria published in the citations above, which refer to surface texture, the colour of the exposed surface and fracture outline.

Table 3. Skeletal elements afected by gnawing.

Skeletal element	N Affected	% affected
Femur shaft	6	25 (n=24)
Tibia shaft	2	22 (n=9)
Humerus shaft	2	18 (n=11)
Total	10	5 (n=205)

Faunal activity

Macroscopic evidence of faunal scavenging, by animals or rodents, was observed on ten bone fragments (Table 3). This included multiple bowl or 'U' shaped pits and uni-directional, 'U' shaped striations, consistent with tooth punctures and tooth scores, respectively. The majority of modifications involved lower limb bones. As this analysis was undertaken at assessment level, the location of the gnawing on the bones was not recorded.

Anthropogenic activity

A fragment of right femoral shaft (Figure 4) was longitudinally split, with fracture margins that are characteristic of peri-mortem breakage, including a helical break at the distal end (Villa and Mahieu, 1991). Although much of the assemblage was fragmented, assessment did not identify any other bones which had been broken in this way, although systematic analysis of all fragments would be needed to confirm this.

Like much of the human and faunal assemblage, the external surface of femur fragment was blackened. This might reflect manganese (Mn) staining as seen on some Mendip sites (e.g., Charterhouse swallet, Collett, 2018)[3] or by bacterial activity within the burial environment reflecting that a nearby septic tank flows into the stream that enters the swallet. This external staining usefully made modern fractures easy to identify (see differences in Figure 4).

Three primary groups of surface features were identified on the femur fragment, and all of these have peri-mortem characteristics. The first group, located on the medio-posterior aspect and very proximal end of the middle portion of the diaphysis, is represented by three unidirectional, sub-parallel, elongate, grooves, ranging from about 4 mm to 7 mm long and about 1 mm wide (Figure 4a). These grooves have a transverse orientation in relation to the long axis of the bone and have blunt, straight margins. They cut into the bone and have 'v' shaped profiles that are shallow and wide. They lack the clean internal appearance of marks made with metal tools and they have no distinct apex. One wall is comparatively steep, the other comparatively sloped. Both walls tend to be concave, and both contain uni-directional

3 Manganese is a common mineral associated with limestone deposits and it can be inferred that it will leach in solution from percolating groundwater and water movement (Collett, 2017) through the matrix reacting with calcium carbonate.

sub-parallel striations that run in the same direction as the main groove. They tend to be more apparent on one wall than the other and give an overall impression of shallow interconnected grooves (Walker and Long, 1977, 608). Sub-parallel transverse micro-striations flank the outside margins of the two outer grooves. These features are consistent with a diagnosis of cuts made with a stone tool (see Appendix 1).

Just below these is a deeper striation measuring approximately 3 mm long and 0.1 mm wide (Figure 4a). This cuts into the bone, has a sharp and narrow 'v'-shaped profile and runs obliquely from superior left to inferior right. This striation also has straight margins of which one is comparatively sharp, the other comparatively flaked. Unlike the grooves, this feature is uniform and has a well-defined apex. Sub-parallel micro-striations are present on the surface of one wall and the uniform depth and spacing of these, may indicate that they represent a cut mark made by a metal tool (see Appendix 1). However, this surface feature also has an abraded internal appearance, indicating that it could represent a cut mark made with a stone tool (Greenfield, 2000).

The second group comprises a dense patch (approximately 11 mm long and 4 mm wide) of superficial, unidirectional, parallel, micro-striations (Figure 4b). These occupy an oblique orientation, running from superior right to inferior left. These are located on the middle portion of zone six on the medio-posterior surface. They are very straight and are within 5 mm from the fracture margin. Their morphology and location (Knusel and Outram, 2004), within 5 mm of the fracture margin, are consistent with striations resulting from percussion abrasion (Blumenschine and Selvaggio, 1988). It is unlikely that these represent cut marks because they are shallow and narrow. Tooth scores are unlikely because, although shallow, they are not broad, do not have a 'u' shaped profile and are not located on a prominent area of the bone where it is easy for a rodent to latch on. Sediment abrasion is unlikely because this tends to result in striations that are multi-directional and have an uneven thickness, whereas these are transverse, unidirectional and even. Scraping marks are possible because they are dense, straight, parallel, and shallow. However, such marks are usually orientated parallel to the longitudinal axis of the bone (Blumenschine and Selvaggio, 1991), which in the present example is not the case.

The last group of surface features is located on the middle portion of zone six on the lateral aspect of the shaft and is represented by two shallow sub-circular scooped areas, which are polished and smooth (Figure 4c). Their dimensions, along the longitudinal and transverse axes of the bone, are approximately 4 mm by 4 mm and 9 mm by 8 mm respectively. They may have occurred because of removing the periosteum to facilitate fracturing the bone, their location adjacent to the fracture margin strengthening this interpretation (Outram, *pers comm.*). This practice has been documented among the Nunamiut of north central Alaska who, by scraping bone with a stone tool, performed this task when the intended method of breakage was through the central area of the bone shaft (Binford, 1978,153). The Fishmonger scoops are highly polished suggesting that, in this instance, removal was undertaken with a bladed instrument.

To summarise, the morphological features of these three groups most closely resemble those of:

1. cut marks (possibly with stone and metal implements),
2. percussion abrasion, and
3. defleshing.

Based on these observations, it may be hypothesised that the actor was human and the effector was a metal and/or stone tool. Intentionality may be implied because of the combina

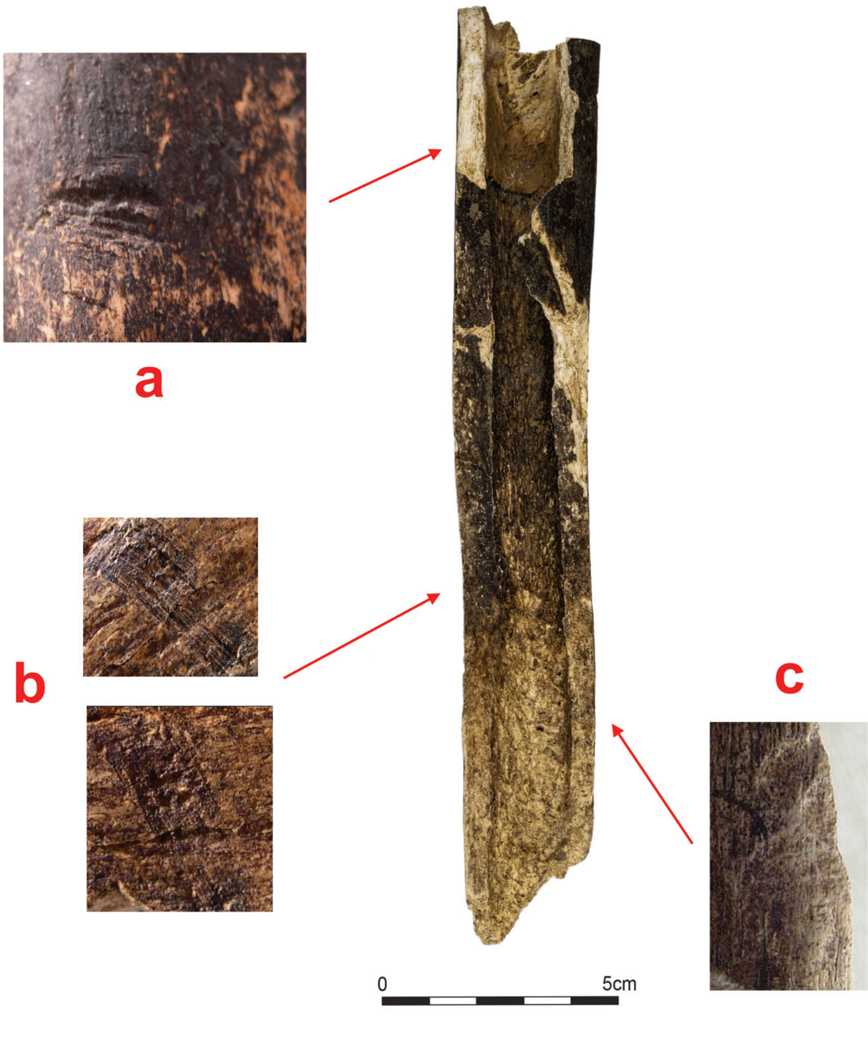

Figure 4. *Human femur with indications of post-mortem modification. a: cuts made with metal or stone tool; b: striations resulting from percussion abrasion c: scoops from removal of periosteum using a bladed tool.*

Composite image: Louise Loe and Cardiff University.

-tion of cut marks and fracture patterns and the occurrence of a longitudinal break and percussion abrasion.

The level of accuracy with which this interpretation may be regarded rests on the broader context of the features. Preliminary observations, however, are possible. For example, the first group of features (Figure 4a) is in the area of attachment for *M. pectineus*, indicating that they may be associated with the removal of this muscle. Further, if the characteristic features of percussion striations were given consideration (Appendix 1), then the second group of features would seem to fulfil these by their association with a peri-mortem fracture margin, and their presence on a large mid-shaft fragment. Further, no surface features that may be attributed to faunal and/or environmental activity were identified. Therefore, minimal or no exposure prior to deposition and/or exposure to an unstable burial environment is implied.

Longitudinally split fragments are described by Villa and Mahieu (1991:43) as 'elongate splinters' and may be indicative of a long bone shaft being deliberately split by humans. However, longitudinal breaks are not unique to human activity but can also be a natural response of diaphyseal bones to transverse sediment pressure in which the fracture front follows the orientation of the haversian systems and collagen fibre bundles (Trinkhaus, 1985, 206). Longitudinal breakage has also been documented as a part of weathering (Behrensmeyer, 1978 Table 5, in Buikstra and Ubelaker 1994) and carnivore scavenging processes (Binford, 1981). In addition, helical fracture patterns are not confined to anthropogenic behaviour. This is demonstrated by controlled experiments that have examined fracture patterns resulting from trampling by animals (Haynes, 1986). However, for a long bone to split longitudinally by whatever process, the ends of the bone have first to be removed and that implies either intent or an extraordinary series of unintended events.

The fracture morphology of the femur fragment alone is not conclusive evidence for deliberate breakage by humans; it is only evidence that the fracture occurred when the bone was fresh (Johnson, 1985), and after the ends of the bone had been removed. Deliberate breakage by humans can only be identified in cases where the fracture is accompanied by surface features, namely percussion marks.

DISCUSSION

The character of an assemblage will, when combined with intrinsic and extrinsic characteristics (Von Endtt and Ortner, 1984, Willey *et al*., 1997; Cox and Bell, 1999, Sorg and Haglund, 2002, Brickley and McKinley, 2004, Knusel and Robb, 2016), determine in part the likely survival of skeletal elements and their condition. For this assemblage, which is not the result of a planned archaeological strategy, it is presently impossible to assess character. This is exacerbated by the fact that we do not know the percentage of the overall deposit that this assemblage represents. However, no evidence has been recovered to suggest it is an attrition cemetery of any kind, nor a mass fatality deposition site. It is presently not known if the human remains were deliberately deposited within the system as intact individuals during a short time period, or if they found their way there, in whole or in part, via natural processes over a longer period (e.g., dispersal from elsewhere and gravity) (Andrews and Cook, 1985, 678). They could also represent an aggregation of bone from more than one event (*ibid*, 688). Without a modern systematic excavation of the swallet and its environs, this remains unknown. The condition of the assemblage as it currently stands may offer some indications as to the character of the swallet as a deposition site.

With such limited demographic data retrievable for the Alveston assemblage, it is meaningless to speculate on the significance of the age or sex distributions. That said, the lack of juveniles or infants represented could reflect preservational factors as younger individuals are less likely to survive than older ones (Bello *et al*., 2006).

Peri-and post-mortem modification (taphonomic change)

The study and understanding of taphonomic change to human skeletal material have progressed rapidly since the pioneering work of Haglund and Sorg (1997) in the late 1990s. It is now widely accepted that the condition of human bone at the point of recovery reflects factors both intrinsic to the individual being buried (e.g., age, sex, weight, health, disease, etc), funerary rites and processes undertaken prior to final disposal, and the burial environment or final deposition site into which they are placed. This analysis included consideration of different types of modification. Specifically, depositional impacts in the burial environment, faunal activity and human modification.

The Alveston assemblage is one about which very little is known in respect of any of the above, and as such the role played by such factors and forces is difficult to understand. It is however clear from the remains recovered to date that there is evidence of peri-and post-mortem modification in various forms.

In Britain, studies in which bone modification is the sole focus, while increasing in number over the last twenty years, nevertheless remain limited in the published literature and papers that focus on modifications affecting the post-cranial skeleton remain negligible. As a result, the extent and range of peri- and post-mortem surface modification in human skeletal collections that are curated in this country remains largely unknown and as such contextualising the results from Alveston is problematic.

At the time of the Time Team investigation of Fishmonger's swallet, the paucity of published work (Cox, 2001; O'Sullivan, 2001; Schulting and Wysocki, 2002; Smith and Brickley, 2004; Wysocki and Whittle, 2000) identifying evidence for anthropogenic alterations, highlighted the fact that the analysis of this and other aspects of peri- and post-mortem modification were a neglected area of anthropology in the U.K.

Exceptions included work by Cook (1986) on possible cut marks on a prehistoric skull from Gough's cave (not far from Alveston), studies of cut marks found on Roman neonatal bones from Poundbury Camp, which possibly reflect embryotomy (Molleson and Cox, 1988) and a prehistoric mandible from Millin Bay, Co. Down (Murphy, 2003). There were several published reports on cranial tool marks relating to trepanation (McKinley, 1992; Roberts and McKinley, 2003; Wells, 1974, Parry, 1952), scalping and defleshing (Mays and Steele, 1996), decapitation (Boylston *et al*., 2000; Harman *et al*., 1981) and sharp weapon injuries (Novak, 2000; Wells, 1981). Cut marks to the skull as the result of edged weapons had received the most attention in the literature at that time (Anderson, 1996; Boylston *et al*., 2000; Novak, 2000).

Burial environment

The fragmented and incomplete nature of the recovered human and faunal remains is likely to reflect, at least in part, the turbation and potential for damage caused by deposition, deliberate or otherwise, amidst the dynamic environment within the swallet.

We have some understanding of the dynamic forces at work affecting this area, at least for recent years and this may or may not have been similar two thousand years ago. There are several swallets in the area, and of relevance to the condition of this assemblage is the following description of the Alveston swallet from 1959 (Alveston's Women's Institute, 1959; 130):

'...is one of several 'whirly holes'..., now dry but some years ago with water that swirled round with the force of the springs feeding it. ...about five years ago a farmer had great difficulty...in extricating a cow from one. ... no longer merits the description of 'frightful chasms' given to them ... more than one hundred years ago.' Aside from depicting the dynamic forces of the swallet it is clear from this description that animals at least can fall into swallets.

The faunal and human assemblages recovered from nearby Forty Acre Farm (ST6375 8753) Swallet was examined in 1977-8. The composition of this much smaller assemblage included fragments of cattle, horse, rabbit, deer and human leg (n=5 fragments) (Clarke and Levitan, 1987). Also nearby (ST 6144 8503) is the Alveston Bone Fissure, a remnant cave system, which became a pitfall for animals as long ago as the Eemian inter-glacial (Taylor, 1973). Excavation in 1960-63 reported casualties including cave lion and hyena, wolf, straight tusked elephant and steppe rhinoceros. None of these fossils bore evidence for animal scavenging or abrasion, suggesting they may have fallen to their deaths after the cave roof collapsed. Some retained their anatomical relationships suggesting that this much earlier feature was not subject to such extreme turbation as Fisherman's swallet. This is a useful example of a different outcome in a similar deposition site.

Faunal activity

Full assessment of the impact of faunal scavenging requires specific examination and analysis of teeth mark patterns to the extremities of the bones and the cortical surfaces that does not form a part of this assessment. Blumenschine and Marean (1993) found that most tooth marks on experimentally gnawed animal bones were inconspicuous, that is, not visible to the naked eye. It has subsequently been argued that systematic dedicated examination of elements under magnification is essential if surface features indicative of tooth marks are to be recorded accurately (Blumenschine *et al*., 1996). Work on Bronze Age remains recovered from the palaeo-channel at Eton (O'Sullivan, 2001) supports this argument and suggests that features could be missed unless surfaces are inspected microscopically.

Considering these points, the frequency reported here should not be considered as other than indicative as it is likely that more would be visible using microscopy. There is a significant presence of canids which could have acted as scavengers amongst the faunal assemblage (Peto, *et al*., 2022 this volume).

Anthropogenic activity

The analysis of the femur described above indicates the possibility that towards the end of the Late Iron Age, at around the Iron Age / Roman transition, anthropogenic modification of the remains of the dead was undertaken in this area. It appears that in the individual concerned, some musculature (*M. pectineus*) had been deliberately removed from the bone using a sharp tool. Further, the shaft of the long bone had been split longitudinally. This type of breakage can only be achieved accidentally by severe compression forces that are unlikely to occur accidentally in the context of the period[4]. To deliberately affect that type of fracture on the long bone of any mammal necessitates the removal first of the epiphyseal ends and then splitting the bone from one end. This splitting reveals the marrow of the bone, and it is not impossible that this bone was split for that purpose. Similarly, filleting the muscle from the bone could also have been undertaken for nutritional reasons. If that is the case, then this might be suggestive of either nutritional or ritual human cannibalism. Such evidence is extremely rare

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[4] To effect a longitudinal fracture of the femur would take a force equivalent to jumping/falling from a high rise building and landing feet first.

for this period in Europe and no other examples are known for Britain. As such this fragment of bone has a level of importance that merits further consideration.

Criteria for establishing cannibalism

As with all osteological analysis, an accepted and repeatable approach is essential and since 2005 this has been much discussed in the literature (most recently see Bello *et al*., 2016; Knusel and Robb, 2016; Salidie and Rodrigues-Hidalgo, 2017). The lack of clarity of the context of the Alveston assemblage, and lack of understanding of the percentage of the whole that it represents does little to help clarify this, neither does the lack of detailed analysis of the faunal remains from the site. Bello and colleagues (2016) stress that to distinguish between evidence of cannibalism and secondary treatment of bodies as part of a funerary process relies upon the frequency, distribution and micro-morphometric characteristics of cut marks, and similarities to the corresponding faunal assemblage. Knusel and Robb's (2016) first three criteria for the same all rely upon comparisons with the faunal assemblage, and in this assemblage, there were very few marks observed on the faunal remains, even the butchery animals (Peto*, et al.,* 2022, this volume). Their fourth criteria (2016, 668) includes: *'...processing bones to retrieve marrow and brains for consumption'*. While the Alveston femur could indicate marrow retrieval, the logic behind the assertion about brain tissue is not clear as it is not particularly nutritious, though it's consumption could have ritual implications. The femur does however show evidence of filleting the muscle and that is highly nutritious as is marrow. Their last two criteria relate to the possibility of evidence of cooking (Burning/incinerating, roasting/baking and boiling (Roberts *et al*., 2002) [5]). That is not present here, but in any event we do not accept that as a necessary criteria for consumption as raw food would also be consumed, and of course 'food' removed from bone may be cooked afterwards. The presence of human teeth marks is also indicated as essential. There is no evidence of tooth marks here, but consumption of filleted muscle and marrow would not require the bone to be gnawed. All of that said, their conclusion (*ibid*, 668) that cannibalism is *'...a heterogenous and poorly bounded phenomenon and one very difficult to conclusively demonstrate'*, is undeniable.

Given the dearth of specific analysis addressing this aspect of human osteology in Britain from this period, we are not in a position to ascertain the uniqueness, or otherwise, of this case from the archaeological record at the present time.

While cannibalism (anthropophagia) may be ritual or may be utilitarian in intent, it is interesting to note that if it was widespread in Britain at this time, Roman writers are likely to have commented, just as they did in respect of human sacrifice and headhunting (Amit *et al*., 2011), and such cases as the *'Scythian cannibals who eat human bodies.'* (Pliny the Elder, Natural History VI. xx.53). However, no mention is made of cannibalism in the west or in Britain by Tacitus, Dio, Diodorus Siculus or Strabo (Guy de la Bedoyere, *pers. comm.* Feb 2001). That said, this geographical area is outside of the detectable historical record for this period. Historically it seems likely that prior to the Conquest in the mid-first century, and the development of nearby embryonic Gloucester and Cirencester by c.AD100, the area was chieftain based, with parallel rulers controlling small elastic areas.

Given the relatively recent date of the Alveston split femur, its possible importance in understanding human cannibalism through time is inestimable. While evidence from the

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[5] These can be indicated by changes to the surface topography of samples including to cover a range of samples that display the following characteristics: suspected to be boiled (white/ pearlescent), suspected burnt (dark black staining and cracking) and differential black staining, manganese mottling and/or speckling (Collett, 2018). Assessment of thermal modification is complicated by the direct link to time of exposure to the heat source as this affects the extent of any changes.

Americas, Europe and elsewhere does support its occurrence from the Upper Pleistocene to the Neolithic and beyond (Rosell *et al*. 1999; Defleur and White, 1999, Saladie and Rodrigues-Hidalgo, 2017), similar cases from Europe for this period remain extremely rare (*ibid*). The most recent cases discussed in Saladie and Rodriguez-Hidalgo (*ibid*) include nearby Gough's Cave (14,700 cal BP) which has been alternatively described as gastronomic (Andrews and Fernando-Jalvo, 2003) and ritual cannibalism (Bello *et al*., 2011, 2015). Other sites include Santa Maria (Spain, 9000-8000 BP, Aura Tortosa *et al*, 2010), Herxheim (Germany, 5000-4900 BP, Boulestin *et al*., 2009) and Fontbregoua (France, 4700-3100 BP, Villa *et al*., 1986).

During later prehistory, there is little conclusive evidence of cannibalism in Europe. While some Iron Age sites show evidence of cut marks and fresh breakages, and these have been interpreted as cannibalism (Aldhouse-Green 2001), they are not considered convincing (Saladie and Rodriguez-Hidalgo, 2017). As Saladie and Rodriguez-Hidalgo assert (*ibid*), where the numbers of bone are small and the context unclear, it is risky to draw firm conclusions. This of course applies to Alveston. Recent histological analysis does not offer unequivocal support to the possibility of cannibalism, but cannot, yet, rule it out (Bricking, 2022, this volume).

Late Iron Age/early Romano British funerary rites

It is presently impossible to know if the Alveston remains represent any particular funerary rite or are simply a series of related or unrelated events, some perhaps unintended. The British Iron Age is characterised by a diverse range of funerary rites that rather than being temporally discrete are parallel processes occurring simultaneously (King, 2014). This assemblage of bones from the very late Iron Age is extremely unusual in both context and character. Apart from the human remains recovered at the nearby Forty Acre Farm North swallet (Clarke and Levitan, 1987), nothing similar has been recorded. Hill (1995) suggests that the Middle Iron Age of southern England witnessed a peak of the deposition of partial corpses, and isolated body parts in pits for example that extended from the Neolithic. The presence of disarticulated and fragmentary human bone has been reported elsewhere. Broxmouth in south-east Scotland (Amit *et al*., 2013) is one example where fragmentary remains were found in association with contemporary inhumations and it has been suggested that these might represent the remains of outsiders, such as enemies killed in battle, or deviants of some kind whose bodies would be treated differently. This could range from being dismembered, exposed, curated and in some cases turned into objects (one example had been subject to deliberate modification). At Broxworth, such individuals, or components thereof, were buried apart from the community's dead. Fragmentary and disarticulated Iron Age remains from Kemerton Camp, Bredon Hill (Worcestershire) appear to reflect evidence of interpersonal violence (Western and Hunt, 2014), but there is no indication of anthropogenic alteration.

Amongst the human remains recovered from Antofts Windypit (Yorkshire) is a fragment of tibia which exhibits cut marks that some have attributed to cannibalism (Leach, 2015b) based on the cut marks alone. This remains uncertain and is much contested. King (2014) considers peri-mortem damage to remains from sites in East Yorkshire and Hampshire but suggests that this is all evidence of violence particularly on those who are for some reason marginalised; she found no evidence that is similar to that from Alveston.

Could the possible case of cannibalism suggested at Alveston represent deviance? We simply do not have the evidence at this stage to speculate. That said, parts of Scotland share the similarity with Alveston of being 'at the edge' of formal power structures, and Amit and colleagues have explored evidence for decapitation at Sculptures Cave, Covesea in north-eastern Scotland (Amit *et al*., 2011). As the authors suggest (Amit *et al*., 2013), funerary rites at this time were fluid and pluralistic (*ibid*, 97) and no doubt the same applied in the periphery of south-west England. Given the inter-regional and tribal differences of the Late Iron Age, and consequent differences in material culture, it is extremely unlikely that there would be homogeneity in the practices that may be inferred from the bioarchaeological record (Redfern, 2011).

There is little published in the archaeological literature on human exploitation of cave systems and particularly for this period. Schulting *et al* (2005) examined a Mesolithic assemblage from nearby Aveline's Hole in Burlington in Somerset, considered to be a cemetery. Of interest is the work of Leach (2015a) which focusses on twenty-one caves and rock shelters in Yorkshire, though most of the sites are from the late Neolithic / early Bronze Age. Though much neglected in the archaeological literature it seems more than likely that subterranean features of all types could have held special meaning to peoples from different regions and periods, possibly being seen as entrances to alternative realms (*ibid*, 2). Springs disappearing into swallet entrances would be no exception. They might have been perceived in many ways, from safe to dangerous, prosaic to spiritually important, normal or reserved for abnormal or special activities.

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK

Conclusions

This fragmentary assemblage resulting from two phases of archaeological and non-archaeological intervention of Fishmonger's Swallet, suggests the deliberate or accidental deposition of commingled disarticulated adult skeletal remains into the swallet system. Other remains may still be present in situ and these may include those of juveniles but none have been recovered to date. Given the volatile and turbatious nature of swallet systems it is not impossible that some of the incomplete and fragmentary remains may have been introduced to the swallet as intact bodies and have been subject to damage and destruction through turbation, and soil and water erosion. It is also possible that they may have been interred or disposed of close to the swallet and have been washed into the system during particularly wet periods, and as such may represent a discrete group or may indicate an aggregation of elements from more than one context. Equally, they may have been deposited deliberately into the swallet as disarticulated skeletons.

One skeletal element has been subject to deliberate post-mortem modification by humans and it is not impossible that more evidence of such modification may remain within the swallet, or be recognised by subjecting the presently excavated material to an appropriate programme of scientific approaches.

The skeletal remains discovered thus far are those of at least five adults, but possibly more, one of whom was probably a young female. She would appear to have suffered severe blows to her head (blunt and sharp force trauma) at around the time of her death. Both sexes are represented, and one individual was much older. Evidence for disease is limited to one cervical vertebra exhibiting indicators of degenerative joint disease (spondylosis deformans) and a possible, but by no means conclusive, case of Paget's disease. Those few teeth recovered were all healthy, but a partial mandible exhibits the destructive lesions associated with a dental abscess. The condition of the bone makes a confident diagnosis impossible.

Recommendations for further work

There are several areas of further work that are recommended:

- If it can be located, the possibly pagetic bone requires histological analysis to verify or otherwise the presence of this condition.
- All the Alveston human bone assemblage, and particularly those bone fragments macroscopically exhibiting indications of bone modification merit a programme of detailed macro- and micro-morphometric analysis (Bello *et al*., 2017). This can include such approaches as 3-dimensional microscopy, scanning electron microscopy and micro-computed tomography (Bello and Galway-Witham, 2019). Such approaches will improve diagnostic capability and confidence.
- The application of the Knusel and Outram's zonation method (2004, 85-97) to this assemblage is recommended (it has only been employed here in respect of the split femur). This method adopts the Dobney and Reilly (1988) method for faunal assemblages and would render the assemblage comparable with the animal bone assemblage. This would enable further exploration of the possibility of cannibalism in this assemblage (e.g., frequencies of zones present in the butchered animal bone component of the assemblage) which can then be directly compared with human bone zones present to see if they are similar. Zonation of this assemblage (Knusel and Outram, 2004, 2016) would also help gain more accurate minimum number of individual count (MNE count). Knusel and Outram's method (*ibid*) was specifically developed to deal with scattered, fragmented, human remains. When combined with MNE counts, breakage by element can be quantified more accurately, and when combined with analysis of fracture types, would allow extent, nature and sequence of breakage to be explored.
- To further understand the context and significance of these remains, isotope analysis and DNA analyses are recommended to explore the geographic and ethnic origins, and possible genetic relatedness of the individuals represented. To understand whether the individuals represented were native Britons or those from further afield would be extremely interesting and could influence any interpretation of the significance of this behaviour.
- More C14 dates should be established to help clarify if the bones within the swallet are contemporary depositions or represent an aggregation of deposits from different periods.
- Finally, a further programme of systematic scientific excavation of the swallet system by experienced cave archaeologists would be enormously helpful in determining if the human remains discussed here are typical of a larger assemblage or atypical of such a group. It might also enable an understanding of the character of the swallet as a deposition site to be established.

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Our thanks go to Andy Currant for being brave enough to suggest that we were seeing possible cannibalism in 2001, a time when to do so would lead to ridicule from peers; the Time Team archaeologists for their efforts; the late Juliet Rogers for x-raying the possible pagetic bone; Rick Schulting for much useful discussion and Nathan Cubitt for enhancing Figure 2.

APPENDIX 1
CRITERIA FOR IDENTIFYING ACTOR AND EFFECTOR

Based on Behrensmeyer et al., 1986, Binford, 1981, Blumenschine 1995, Blumenschine et al., 1996; Blumenschine and Slevaggio, 1988, Bunn 1981, Cook, 1986, Greenfield, 2000, Haglund et al., 1988, Hurlbut, 2000, Lyman, 1994, Milner and Smith, 1989; Morlan, 1984; Oliver 1989, Olsen and Shipman, 1988; O'Sullivan, 2001; Shipman, 1981, Potts and Shipman, 1981, Shipman and Rose, 1983; Walker and Long, 1977.

Actor	**Effector**	**Feature**	**Characteristic features**		**Context**
			Metal tool	Stone tool	
Human	Metal or stone tool	Cut/slice marks	Deep steep sided regular elongate groove; 'v'- or hard cornered 'u'-shaped cross-section; well defined apex; sometimes have internal longitudinal micro-striations of uniform depth and spacing; clean internal appearance[(1)].	Shallow wide irregular groove with uneven 'v'-shaped cross section; indistinct apex; walls tend to be concave rather than straight; one relatively steep, smooth wall and one gradual rough wall; internal parallel longitudinal micro-striations of uneven length and thickness which tend to occur on one wall more than the other ('shoulder effects'); micro-striations may give the impression of a series of shallow interconnected grooves; sometimes have small hooks ('barbs') at either end[(2)].	Anatomically meaningful locations (i.e. near articulations or in areas of muscle, tendon and ligament attachment)[(3)]; Have a function or purpose[(4)]; the distribution of cut/chop/scrape marks shows symmetry and repetitive patterning within the individual and the sample; absence of factors in the burial environment that could potentially mimic metal or flint marks (cut, scrape or chop)[(5)]; clustered rather than isolated; evidence of repeated interaction with the same sharp edge[(6)].
Human	Metal or stone tool	Cut/slice marks	Metal and stone tool		As above
		Cut/slice marks	Single elongate groove; no internal crushing; cut into surface of the bone; tend to be transverse to long axis; often occur in sub-parallel groups.		
		Chop marks	Usually transverse to long axis; elongate groove; contain internal crushing; lack		

Actor	Effector	Feature	Characteristic features		Context
			internal parallel striations; compared to cut and scrape marks, broader top in profile and shorter in plan[7].		
		Scrape marks	Multiple fine striations; occur in broad shallow fields; not confined to a single main groove; Shallow 'v'- shaped cross-section; often parallel to long axis[8].		
Human	Hammer-stone and anvil	Percus-sion marks	Occur in dense superficial patches; orien-tated transverse to the long axis of the bone; observe a strict uni-directionality; are straight and parallel; have shallow 'v'-shaped cross sections; less well defined than cut marks; often occur within or flank a percussion groove; often emanate from or are within percus-sion pits; grooves and pits lack crushing[9].		Associated flake scars; concentrated in areas of marrow exposure; within 5 mm of peri-mortem fracture margin[10]; usually confined to cortex; often at or opposite point of percussion impact[11]; common on large mid-shaft fragments and/or notched fragments and flakes[12].
Environ mental	Sediment	Scratch/s core	Multi-directional; often faint; shallow, 'v'- , 'u'- or 'w'-shaped cross-section; uneven thickness and depth; tend to cross, intersect, and curve; tend to lack fine parallel, internal microstriations; may be isolated or occur as a group[13].		Absence of obvious patterning and location; tends not to respect areas of muscle, tendon and ligament attachment; tends to occur on flat, rounded and/or convex areas of bone (e.g. limb shafts)[14]; factors present in the burial environment that could potentially mimic metal or flint marks; associated with other environ-mental damage (e.g. pressure features, plastic deformation)[15].
Faunal	Tooth	Scores/ furrows	Rodent score/furrow	Carnivore score/furrow	Concentrated in areas where there is the least soft tissue and the cancellous bone is less dense

Actor	Effector	Feature	Characteristic features		Context
					(e.g. epiphyseal ends of long bones)[20]; associated 'scooped' or 'hollowed' out cancellous bone and splintering[21]; nutritionally meaningful locations (i.e. in regions where the bone is richest in its marrow content); located on prominent areas of bone where it is easy to latch on; often on medullar and cortical surfaces and/or thickness[22].
			Rodent and carnivore score/furrow		
			Follow the contour of the bone; broad; frequently occur in parallel groups; generally perpendicular orientation.		
Faunal	Tooth	Pits	Bowl shaped interiors; 'u'-shaped cross-sections; evidence for internal crushing; rarely accompanied by microstriations but when present they are broad, disparate and deep[18].		
Faunal	Tooth	Punctures	Depressed fractures; roughly circular outline; sometimes stepped appearance; may contain fragments pushed inwards[19].		

(1).Greenfield, 2000:99-100; (2). Greenfield, 2000:99-100; Walker and Long, 1977:608-609; Shipman and Rose, 1983: 68-69; (3). Hurlbut, 2000:7; (4). Lyman, 1994: 298; (5). Oliver, 1989:93; (6). Behrensmeyer *et al*., 1986:770; (7). Potts and Shipman, 1981:577; Shipman, 1981; (8). Blumenschine and Slevaggio, 1988:764-765; Blumenschine *et al*., 1996:496; Potts and Shipman, 1981:577; (9). Blumenschine and Slevaggio, 1988:764-765; Blumenschine, 1995:29; (10). Blumenschine and Selvaggio, 1988:764; (11). Blumenschine *et al*., 1996:496; (12). Blumenschine and Selvaggio, 1991:23, 28; (13). Blumenschine and Selvaggio, 1988:765; Cook: 1986:282-283; Olsen and Shipman, 1988:543; Shipman and Rose, 1983; (14). Behrensmeyer *et al*., 1986: 770; Olsen and Shipman, 1988: 544; (15). Cook 1986:282; Oliver, 1989:93; (16). Bunn, 1981:575; (17). Bunn 1981:575; (18). Binford, 1981; Blumenschine, 1995:29; Blumenschine *et al*., 1996:496; Bunn, 1981; Morlan, 1984; (19). Blumenschine, 1995:29; Shipman. 1981:366; (20). Blumenschine, 1988; Haglund *et al*., 1988; Milner and Smith, 1989; (21). Binford, 1981; Haglund *et al*., 1988; (22). Blumenschine *et al*. 1996:496.

APPENDIX 2
CATALOGUE OF HUMAN REMAINS

This report was based on the assemblage of material recovered by Time Team during their August 2000 work and on that recovered prior to that time by the Hades Caving Club. Almost all of this material has now been relocated, has been kindly donated to the University of Bristol Spelaeological Society and is now curated in the Society's Museum under the catalogue number G10. Since that time, further material has been collected and lodged in the Museum. It is therefore more useful to inspect the spreadsheet catalogues online to understand the full extent of the assemblage as it continues to grow and be studied, than to simply list specimens here. The catalogue, along with the faunal catalogue can be found on the Society's website at https://ubss.org.uk/museum.php.

The material collected by the Time Team is catalogued with context numbers, but no record appears to have been made of what these relate to so they seem only to be useful in associating specimens together. The material collected by the HCC prior to 2000 was described as being collected from the mud/rock sediment at the base of the sink. Subsequent collections have been from the same area. See Hardwick, 2022 (this volume).

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