Complexities of the Ancient Mortuary Rite of Cremation: An Osteoarchaeological Conundrum

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Introduction

Undoubtedly, there will have been geographic and temporal variations in practices and beliefs associated with the rite of cremation or parts thereof, but the central issues are the same across Europe and beyond—the deliberate use of fire as a medium of transformation, altering the corpse from one state to another, forming the primary part of a complex mortuary rite which involved various secondary procedures, predominantly that of burial of some or all of the cremated remains. Consequently, although the contents of this paper draw largely on the writer's observations and analyses of cremated remains and mortuary deposits from the British Isles [over 7000, encompassing a broad temporal range from Early Neolithic to Norse (fourth millennium BC to ninth century AD)], archaeologically the aims, interests, and challenges are shared irrespective of the origins of the material.

The analysis and interpretation of cremated remains covers a broad range of themes: those common to the study of all archaeological human bone, comprising the recovery of demographic data and evidence for pathological lesions/conditions, and those specific to cremation mortuary rites and pyre technology. Each area of study carries its own challenges and possibilities. It is beyond the scope of this chapter to cover all aspects associated with the study of such remains; so the intention is to focus on cremation itself and consider how the data recovered in analysis can be used to further our understanding of the overall mortuary rite including pyre technology.

There are two imperatives when working with cremated remains that were often overlooked in the past and occasionally still are now: an understanding of what happens when a body is cremated (i.e. burnt as part of the mortuary rite) or otherwise subject to the effects of fire is fundamental. A further essential ingredient

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of any analysis is the archaeological context in which the material was found. In this complex rite, the components within a deposit may be the same or similar, but the formation process(es) and location may differ and reflect different parts of the overall mortuary rite (e.g. the cleared or un-cleared (manipulated or intact) pyre site, the burial remains, or redeposited pyre debris; Fig. 1).

Other context details may reveal factors affecting the condition of the bone. These include the locality and the associated geology and soils. Although cremated bone often survives in soils where unburnt bone does not (the organic components of the bone being removed or at least substantially depleted during cremation), it

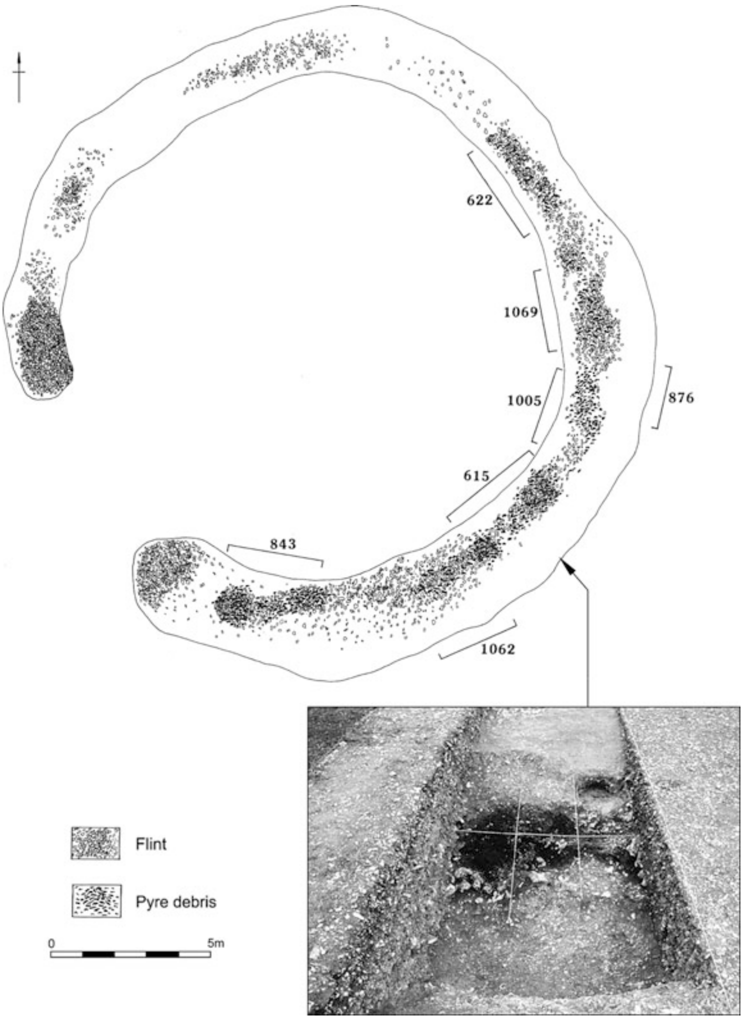


Fig. 1 Bronze age ring ditch, Twyford Down, Winchester, Hampshire, showing location of dumps of pyre debris within ditch fill and inset detail of deposit 615 (McKinley 2000c)

still suffers detrimental effects within some burial environments. Acid soils, such as free-draining sandy gravels and the alluvial silty clays commonly known as ‘brickearth’ in the British Isles, for example, frequently have damaging effects on cremated bone resulting in preferential destruction of the trabecular components. Cremated bone found in peaty soils is generally devoid of trabecular elements whilst the compact bone has a worn and ‘chalky’ appearance (Fig. 2a). Post-depositional disturbance of the remains (accidental/deliberate human activity or bioturbation) can affect the quantity of the bone recovered due to either removal of material and/or physical breakdown of the bone (which is very brittle and more susceptible to damage than unburnt bone). Some types of deposit afford greater protection than others, for example, an urned burial compared with an unurned one, the presence of an intact lid in association with the former and absence of soil around the bone being a major influence on preservation (Fig. 2b–c).

Finally, the excavation procedures and post-excavation processes employed can affect both the quantity and condition of the material available for analysis. Advised excavation procedures (McKinley 2000a, 2013a, forthcoming a) aim to ensure full recovery of all that survives and the maintenance, as far as possible, of the physical integrity of the material collected (which requires careful handling and storage due to its brittle nature).

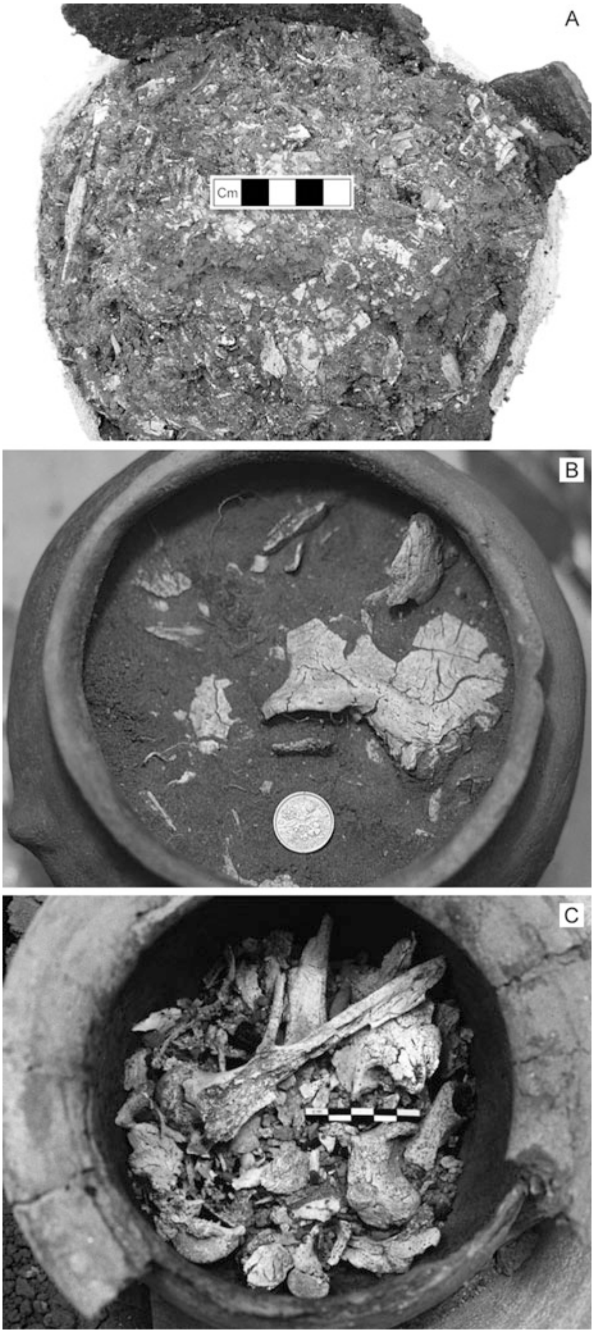
The Cremation Process

Modern Cremation

Various mechanisms have been used to enhance and expand our understanding of the cremation process, but modern crematoria offer the most useful starting place. Here the process is undertaken in a controlled environment, with a regulated heat source (gas in many countries, but electric in others (Davies 2005)) and air flows (to provide oxygen and heat circulation), within a heat-retentive structure, creating optimum conditions for what is deemed the most effective mode of cremation (ibid. 147–151; McKinley 1994a: 72–6, Figs. 16 and 17; Schultz et al. 2008).

Details of the chemical changes effected during cremation/heating bone have been covered by other contributors of this volume (see Tropper, van Strydonck, Schmahl) and researchers elsewhere (e.g. Herrmann 1977; Hiller et al. 2003; Holden et al. 1995a, b) and will not be repeated here. In summary, the cremation process is one of dehydration and oxidation of both the soft tissues and the bone itself (*c*. 30 % organic), affecting the bone chemistry and resulting in alterations in the crystal size/structure of the bone mineral (*c*. 70 % mineral component; calcium phosphate changed to tri-calcium phosphate; Lange et al. 1987: 17–19). These changes are affected by a combination of time, temperature, and oxygen supply; the first and last of these requisites are often overlooked in favour of the role of

Fig. 2 Urned burials showing different levels of bone preservation: (**a**) degraded bone in acidic soils; (**b**) soil infiltration of dehydration fissures; (**c**) lidded vessel with no soil infiltration



temperature, but, without sufficient oxygen, for example, reducing conditions will prevail.

The operating temperatures within modern crematoria generally fall in the 800–1100 °C range, with an ignition temperature of around 500 °C. Overall duration of the process is variable but averages about 1½ h. The temperature fluctuates throughout cremation following a similar pattern in each case: a rapid rise as the soft tissues ignite and create heat as they burn, with a gradual fall once most of the organic material has gone (Fig. 3). Cremators cool over the weekend/night when not in use and may be preheated for the first charge of the day; following one or two cremations in a day, the ignition temperature is sufficient without the need to apply the external heat source. There are variables associated with body mass; those with little soft tissues to enhance the temperature (children, the elderly, and emaciated individuals) require more external heat to aid cremation; those with heavy fat deposits may cremate more rapidly due to an early boost in temperature; those with heavy muscle deposits (dense tissue) tend to take longest to cremate. Unknown variables may also have an influence; e.g. Charges 5a and 5b in Fig. 3a, males of similar age and build, were placed in adjacent cremators registering the same temperature at the same time. Charge 5b followed the standard oxidising pattern; however, charge 5a showed a drop in temperature and over the same period only charring occurred. The cause of the latter was undetected (no known medical or different funerary treatment); full cremation was eventually effected by allowing more time.

The variable extent of soft tissue coverage affects at what stage different parts of the skeleton will cremate/oxidise, e.g. the bones of the hand/feet, cranium, leg, and forearm will burn before those of the upper arm and thigh. Some dense soft tissues might fall away from the skeleton and continue to burn after the bone itself is oxidised, e.g. the large muscle mass around the buttock area and the brain tissues—the cranium needs to be open to allow oxygen access (NB. These materials will remain in the cremator until they have oxidised: in the lower hearth with refreshed oxygen supply following collection of the bone if necessary; McKinley 1994a: Figs. 16 and 17). Once freed from the insulating effects of the overlying soft tissues (oxygen cut-off) the bone itself oxidises from the exposed surfaces (outside or medullary cavity) through towards the centre, potentially creating a 'sandwich' effect where oxidation is incomplete (McKinley 2008: Fig. 10.2). The degree of oxidation is evident in the colour of the bone, progressing from the black of charred bone through hues of blue and grey to the white of fully oxidised (Devlin and Herrmann 2008; Holden et al. 1995a; Shipman et al. 1984). Consequently, the heat-induced microscopic changes to the bone mineral seen in individual bones from a cremation will not necessarily all reflect the same temperature, or that of the cremator (or pyre) itself (ibid.; Rogers and Daniels 2002; Thompson et al. 2013). Potentially, different bones will reflect different temperatures dependent on the depth of the overlying soft tissue insulation, and the stage at which that is removed relative to the heat of the cremator.

Cremated bones maintain their original basic morphological appearance (Fig. 4a). The visual effects, other than colour, are largely related to dehydration.

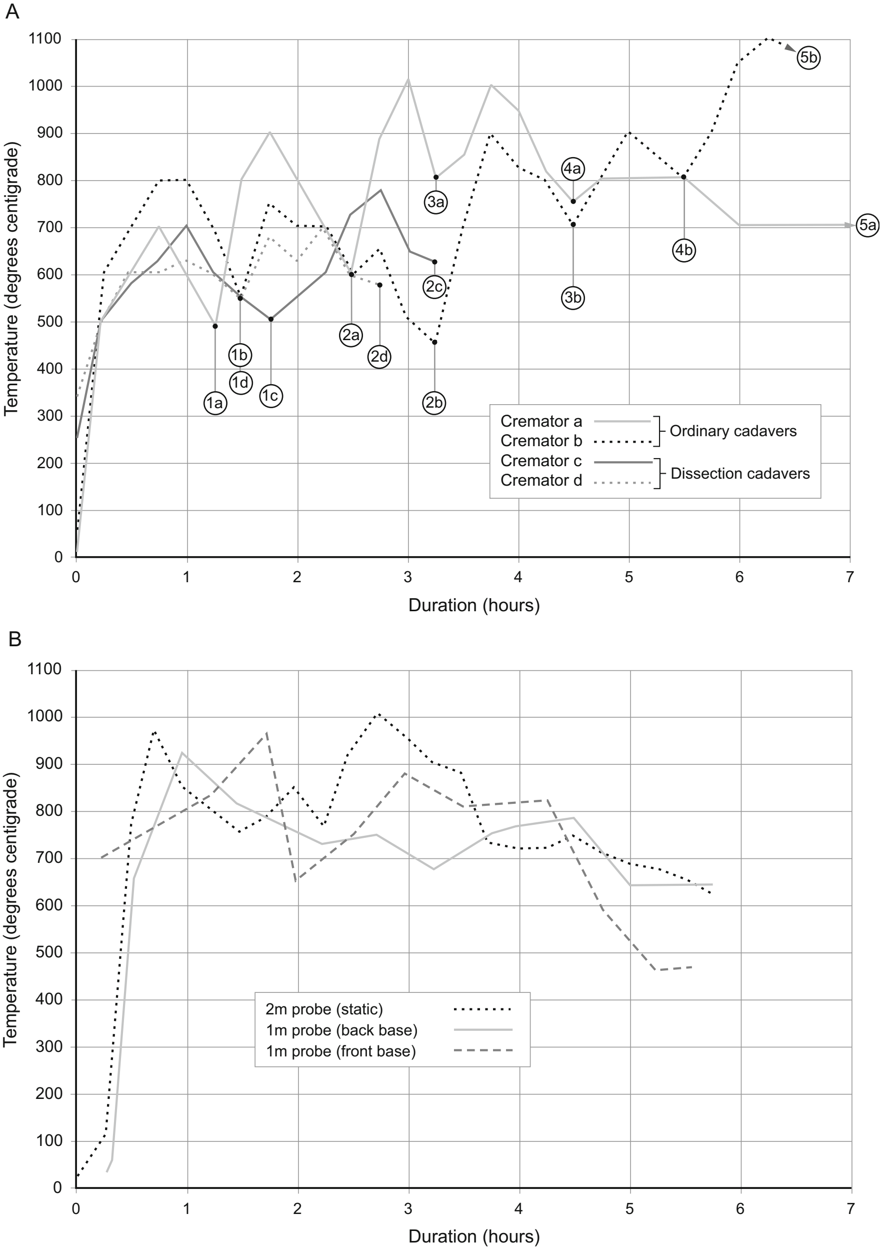


Fig. 3 Temperature readings: (**a**) from four modern cremators (**a**–**d**), showing between two and five separate charges for each cremator, (**b**) from three probes located in different parts of an experimental pyre cremation

Fig. 4 Modern cremated remains: (**a**) on main hearth towards end of cremation, (**b**) in collection box prior to cremulation

Variable levels of shrinkage may be evident (both amongst material from the same firing and between cremations), especially amongst the trabecular components; the smaller bones, such as carpals and tarsals, often survive complete (Fig. 4b). The bone fissures and fragments, sometimes with marked twisting. The points of breakage are commonly at junctions between different bone densities, e.g. that between the compact long bone shaft and the trabecular articular surface, and between the vertebral body and dorsal portion. Classic fragmentation patterns include 'U'-shaped fissuring along long bone shafts, concentric fissuring within humeral/femoral heads, and parting between the anterior and dorsal sides of the mandibular arch (Fig. 5; see Symes et al. 2008 for further details). Tooth enamel, having no organic components, does not have the flexibility of the rest of the skeleton and shatters into small fragments as it expands in the heat of cremation. Unerupted tooth crowns provide an exception; being insulated from the heat within the crown crypts, these elements commonly survive relatively unscathed.

The quantity of bone remaining at the end of cremation is largely dependent on the age and size/body mass of the living subject. There is inconsistency within the minimum, maximum, and mean values for adults recorded by different researchers, though there are understandable reasons for such variability. The writer's own observations (McKinley 1993), which gave a range of 1001.5–2422.5 g with a mean of 1625.9 g, were deliberately targeted at recovering data commensurate with that which might survive archaeologically. The bone from the collecting box was weighted pre-cremulation (i.e. before mechanical pulverisation) excluding the smallest 'dust' fraction (<2 mm) which would not be recovered in archaeological contexts (also serving to eliminate any coffin dust. NB. Including the dust fraction

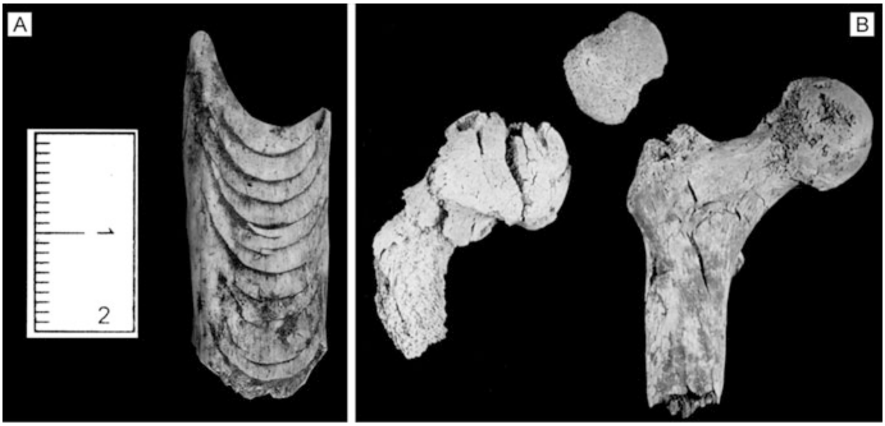


Fig. 5 Dehydration fissures: (**a**) ‘U’-shaped fissuring in long bone shafts, (**b**) progressive levels of fissuring in proximal femora

the weights were about 20 % higher with an average of 2016.4 g). It was also observed that many of the subjects were elderly individuals (>70 year) who (particularly the females) had clearly suffered from some degree of osteoporosis resulting in much of the trabecular bone (particularly the vertebral bodies) crumbling extensively during cremation and recovery; NB. other pathological conditions may have a similar affect. Weights recorded elsewhere (mean values 2348–2893 g, maximum 5379 g; Bass and Jantz 2004; Gonçalves et al. 2015; Holck 1989: Table 9) appear to be inclusive of the ‘dust’ fraction and younger individuals with a more robust bone structure and potentially larger body mass. It should also be remembered, when comparing some of these weights with archaeological material, that average height has increased within the last five to six decades, the larger body mass associated with enhanced dietary intake for many undoubtedly also affecting bone weights.

Observations of the cremation of dissection-room cadavers, representative of defleshed corpses, showed speedier and consistently full oxidation of the bone due to the absence of overlying soft tissues. There tended to be more pronounced warping of bone due to the enhanced speed and generally higher temperature affecting the bone (it being earlier in the process). However, in an anonymous situation, the visual effects could not confidently be distinguished from those seen in some fleshed cadavers.

Dry bone is already dehydrated so the classic fissuring observed in ‘green’ bone is absent. Similarly, since much/most of the organic component of the bone has already been lost, the colour changes indicative of oxidation are less consistent (Baby 1954; Binford 1963; Thurman and Wilmore 1981).

Pyre Cremation

Whilst modern crematoria present the optimum conditions, archaeologists need to be familiar with cremation on an open pyre, generally using wood as a fuel, this being the mechanism by which the rite would most commonly have been undertaken in the past, and the operational similarities and potential differences that would have entailed.

Images and texts, from Bronze Age Greece to present-day India (Fig. 6), demonstrate a similar pyre construction (e.g. Holck 1989: Figs. 2 and 4; Lange et al. 1987, cover plate; Toynbee 1996: Figs. 15 and 16); an open lattice-work, rectangular form (layers of logs/poles set at right angles) of variable size, providing sufficient fuel to 'complete' cremation and a stable platform on which to lay the corpse and pyre goods, whilst allowing oxygen access. There may have been a shallow under-pyre draught pit to assist drawing air in, and corner poles (or further marginal uprights) may have been employed to help stabilise the structure (e.g. Fitzpatrick 1997: Figs. 11–20, Plates 10–11).

Placing the corpse towards or at the top of the pyre ensures the benefit of optimum heat and oxygen availability (lower down, most oxygen would be consumed by the burning fuel), and as the pyre collapses the body maintains its position relative to the fuel source. Experimental pyres have recorded temperatures similar

Fig. 6 Pyre under construction on an Indian cremation ghat

Fig. 7 Effects of strong wind on an experimental pyre cremation, Shetland (NB. Pyre comprised supportive wooden structure around a peat stack hence relative paucity of wood)

to modern crematoria, but obviously the heat is lost to the atmosphere rather than being circulated, and there are sometimes marked spatial variations, e.g. cooler margins (Fig. 3b). The potential effects of the weather, particularly in an often wet and windy British Isles, might have influenced the length of time between death and cremation (also potentially affected by other ritual and practical considerations) and rendered the presence of someone to manage/attend the pyre and deal with unanticipated problems, desirable. Strong, veering winds could cause uneven burning and collapse of the pyre, for example, with unwanted slippage of the corpse (Fig. 7), or heavy, persistent rain could douse the whole process.

In experiments conducted by or in corroboration with the writer, the pyres burnt down to an ash base over 3–4 h, at which stage a considerable amount of charred soft tissues remained together with some oxidised bone (Fig. 8). However, the wood ash remained hot (around 500 °C) for 6–7 h or more (depending on the weather; wind strength), and in cases where peat was used as the primary fuel source the base was still too hot to handle 12 h later. Left overnight, most of the soft tissues from a pyre lit in the early afternoon had oxidised (McKinley 1997a, 2008; Becker et al. 2005: Plates 5–6). Obviously, the speed of the burn is influenced by a number of factors, including the quantity and type of fuel (see Holck (1989: 27–45) for calorific values of different wood species).

Fig. 8 Experimental pyre cremation showing cremated bone and charred soft tissues (sheep) on wood ash base 4 h after lighting pyre

Laboratory Experiments

With regular applied controls, laboratory experiments have given valuable insights into aspects of the cremation process, particularly into microscopic details and bone chemistry (see Lange et al. 1987; Schmidt and Symes 2008; Thompson 2015), not readily accessible by other means. Such analyses do have limitations, however. Principally, researchers tend to use body parts or individual skeletal elements, often defleshed, that do not mimic the cremation of intact fleshed bodies. Ideally, the approaches covered in this section—observations at modern crematoria, experimental pyre cremations, laboratory experiments, and observations from forensic settings—will complement one another and combine to assist our understanding of ancient cremations.

General Osteological Analysis

As with most archaeological analyses, that of cremated bone needs to be methodical and replicable to facilitate comparisons between datasets. This is particularly important when looking at aspects of pyre technology and cremation ritual. The level of detail and magnitude of recoverable data is dependent on the quantity and condition of the surviving bone, which for a variety of reasons (see above) can be highly variable. Figure 9, for example, shows a large collection of bone from the

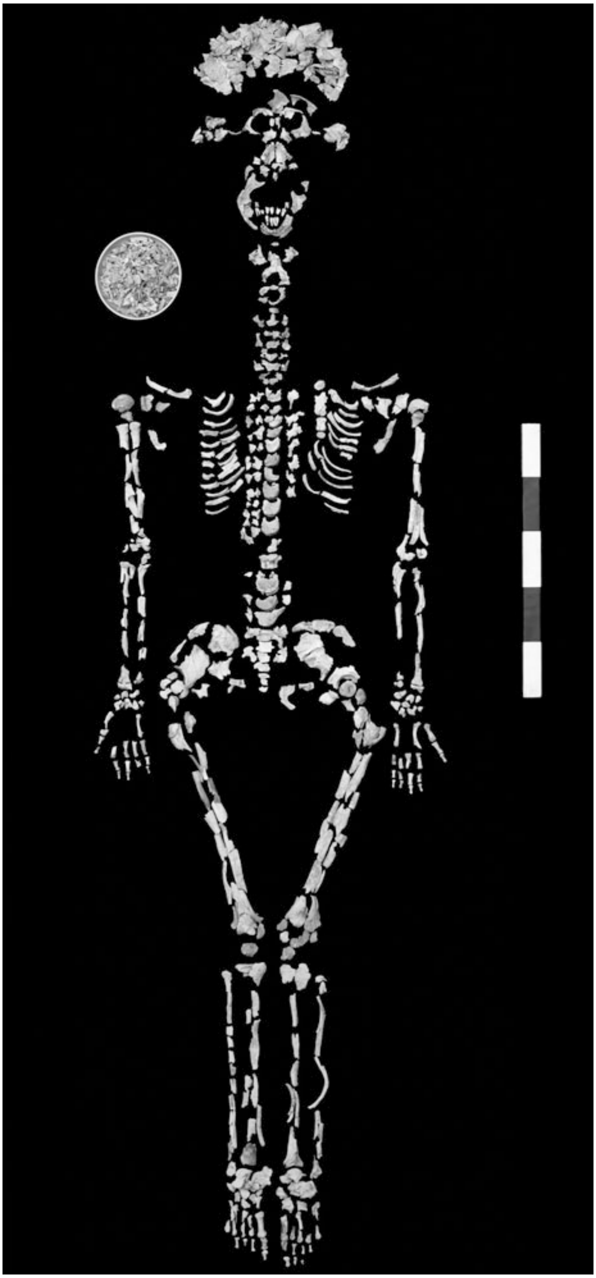


Fig. 9 Amesbury barrow 1/52; Early Bronze Age subadult female, remains laid in anatomical order

remains of an Early Bronze Age urned burial (1758.9 g; female, *c*. 15–17 years.) where an unusually high proportion of the bone (78 % by weight; laid out in anatomical order) could be identified to skeletal element; more commonly, substantially lower weights of bone are recovered, *c*. 500–800 g, and about 30–50 % is identifiable to element. Knowledge of the archaeological context is important for all areas of interpretation: the osteologist must distinguish levels of disturbance and the type of deposit, and consider locational and archaeological criteria; one cannot, for example, make direct comparisons between material from heavily disturbed unurned burials with that from intact, lidded urned burials; unsurprisingly, it will not look the same.

The recovery of demographic and pathological data is not within the primary remit of this paper, but both have their challenges and limitations. The most frequently encountered deposit types are burial remains, deriving from a secondary event within the overall mortuary rite (and one which may not always have occurred). The primary act of cremation represented the main focus of the mortuary rite, and the burial remains rarely comprise all that would have survived at the end of cremation. Inevitably, those collecting bone for burial did not always recover the fragments of most use to future osteoarchaeologist for ageing and sexing individuals, or those which would enable them to record and diagnose someone's pathological conditions. In brief, some of the challenges specific to cremated remains comprise:

> The *minimum number of individuals (MNI)*, primarily determined by duplication of specific skeletal elements (predominantly singular or paired cranial features such as the petrous temporals, malar bones or neural crests) or major age-related variations, is not always readily apparent. In addition to a deposit potentially including the remains of more than one individual (e.g. an Early Bronze Age cist grave at Trelowthas Barrow, Cornwall was found to contain the remains of a minimum of 19 individuals (bone weight 9584.8 g; McKinley 1996 unpublished) and a spread of redeposited pyre debris from the Romano-British cemeteries of East London (Plot 28) from which a MNI of 18 was recovered (McKinley 2000b: 64–66), the remains of one individual could be represented within more than one type of deposit within a cemetery/group of mortuary related features. Examples of the latter include single burial deposits made in more than one vessel or combined urned and unurned burial deposits such as those in the Early Anglo-Saxon cemetery (fourth-early fifth century AD) at Spong Hill, Norfolk (McKinley 1994a: 93–4, Fig. 28). Singular or small numbers of duplicate skeletal elements may be the product of contamination (disturbance/re-used pyre sites) or represent 'token'/memento mori deposits (see below).
>
> *Ageing and sexing* can be rendered difficult, with only partial recovery of remains for burial exacerbated by small fragment sizes and incomplete skeletal elements. Sternal rib ends have been found in less than 0.1 % of deposits examined by the writer, for example; it is generally not possible to discern the wear patterns in fragments of erupted tooth crowns, even in the exceptional cases where they are found; and some of the classic pelvic elements used in sexing are rarely recovered in useful numbers, with only about 4 % of the deposits examined by the writer containing fragments of the pubic symphysis with a decipherable sub-pubic angle. The common survival of unerupted tooth crowns is, however, useful for ageing infants and juveniles.
>
> *Pathological lesions* do survive, including some fairly unusual forms e.g. calcified lymph nodes indicative of tuberculosis (McKinley 1994a: Plate 33); benign osteoma in the mandibular fossa (McKinley 1994a: Plates 34–5); and diffuse idiopathic skeletal hyperostosis (DISH; McKinley 2013b: Plate 2), but incomplete skeletal recovery often limits diagnosis.

Cremation Ritual

The interpretation of pyre technology and cremation ritual considers features of the bone's appearance and the composition of individual and potentially related deposits.

Efficiency of Oxidation

The efficiency of oxidation is reflected in the colour of the bone (see above). Variations in colour, affecting specific areas of the skeleton or individual skeletal elements, may indicate shortfalls in the levels of oxidation.

General shortfalls may be related to insufficient time or temperature. A review of cremated remains from 1720 Romano-British burials collated from 60 sites in England indicated body mass was the main factor affecting level of oxidation, with the remains of adult males showing the most frequent and extensive lack of oxidation (McKinley 2008). The results suggest a lack of adjustment in pyre size to suit the size of the individual being cremated. Unlike in most other periods when the rite was practised, Roman cremation (certainly in towns) was probably undertaken by professionals (*ustores*) with clients paying for the quantity of wood used. This is also the only period in which the writer has observed evidence for incomplete cremation ('trunk' area of corpse unburnt, charring to mid-distal shafts of humerus and femur, the hands/feet, forearm, and leg bones, and parts of skull vault fully cremated; McKinley 1991 unpublished report on the Area 15 cemetery Baldock, Hertfordshire), a likely explanation being that heavy rain curtailed the process leaving most of the corpse only charred.

Incomplete oxidation of the hand/foot bones and the cranium might reflect the peripheral location of these elements on a slightly undersized pyre, with a related reduction in the temperature in these areas. Skeletal elements could also fall off the pyre once a breakdown of the integrity of the corpse had occurred. This was observed in several experimental pyres, involving limb extremities being thrown up to a metre out of the pyre during a shift of the structure as it collapsed down, and without an attendant to return the elements to the pyre the degree of oxidation could be affected.

More specific patterns of incomplete oxidation, such as that to only one upper limb or the cranium, might indicate the insulating effect of items under/around the corpse, e.g. a leather/fur hat/cape or a pillow under the head. This would cut off the oxygen supply and heat to this area delaying the onset of cremation (NB. newspapers placed on a fire will only burnt around the edges unless the individual sheets are separated to allow oxygen between them).

Whilst full oxidation of the all the organic components of the bone is a requisite of modern Western cremation, such is not necessarily the case globally or in the past. Where the ‘magic’ of a visual transformation from one state to another was what was required, the degree of oxidation attained by individual skeletal components may have been of little or no consequence.

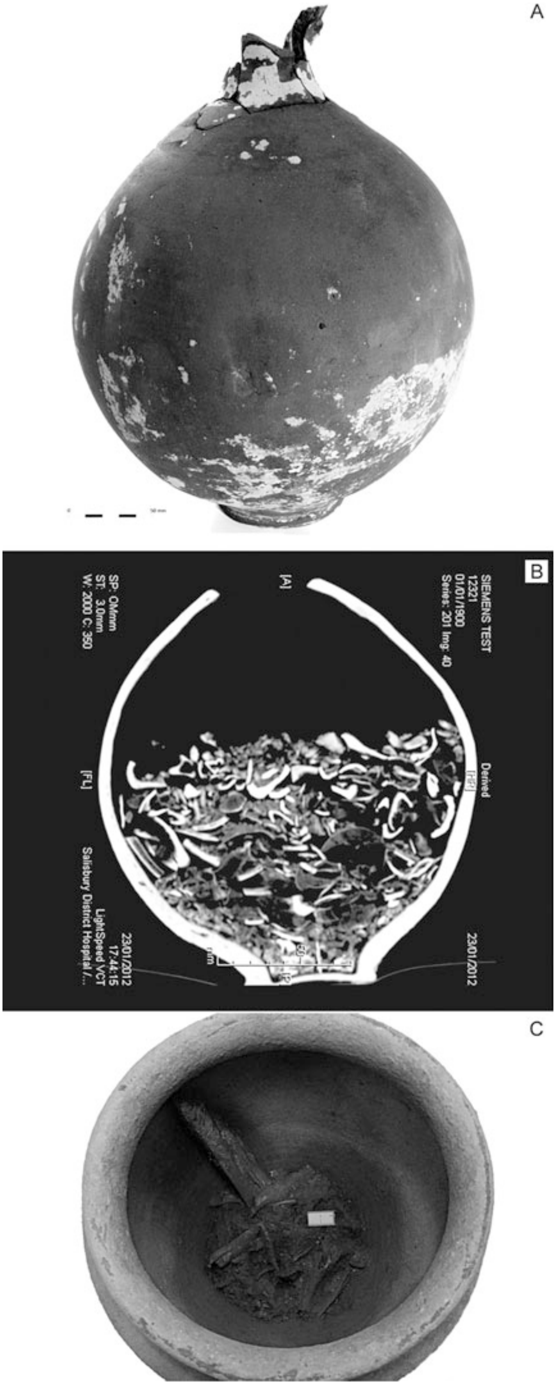
Fragmentation

Much of the fragmentation of the bone occurs during cremation (see above). Very brittle, especially when hot, further breakage would have ensued during management to re-oxygenate the pyre during cremation, and in the course of recovery for burial and other forms of deposition, which might have involved trampling across the pyre site rather than raking or hand collection of bone from the margins, and could have included recurrent transference of the remains from one receptacle to another. Deliberate cooling of the hot bone—using water, wine, or other liquids for practical and/or ritual purposes, for which there is written evidence (e.g. *Iliad* Book 23, Lines 239–240; Toynbee 1996: 50 and 63; Downes 1999: 23; Noy 2005)—would cause the bone to fragment further, generally along the lines of pre-existing dehydration fissures. Were the bone raked off the pyre *en masse* and winnowed (via deposition in water or using a basket and the wind) to remove the fuel ash (cremation burials, certainly in the UK, are generally devoid of this material even if the rest of the grave fill is not), this would also result in further fragmentation.

It is also clear that the bone breaks up further within the burial environment. Over time, soil infiltrates the cracks/fissures, breaking the bone down via wet/dry/freeze/thaw action and chemical degradation in adverse soil conditions (Fig. 2), particularly where the bone is afforded no barrier between it and the soil matrix, and disturbance has caused additional stress either directly (physical damage) or indirectly (by altering the burial environment).

None of these mechanisms represent deliberate fragmentation. Arguments have been made for intentional fragmentation in cases of the use of narrow-necked ceramic vessels as burial containers, the bone presumed to have been broken to fit. There is, however, clear evidence that either the vessels themselves were manipulated or that large bone fragments were ‘fed in’ at an appropriate angle. Figure 10a, b shows a Dressel 20 amphora which functioned as a burial urn. Recognising that the internal diameter of the neck (30 mm) was too narrow to allow the bone to be inserted, those undertaking the burial had knocked off the neck, creating a 61 × 49 mm opening through which the large bone fragments could be fed (maximum fragment 111 mm), replacing the broken neck before burial (McKinley 2015a). Another urned burial from the same site (Fig. 10c) represents one of numerous examples of bone fragments of substantial length (170 mm; commensurate in size with those from modern crematoria prior to cremulation) being added to the vessel length-ways and maintaining position in burial.

Fig. 10 (**a**) Dressel 20 vessel used as a cremation urn, showing in situ deliberately broken neck and (**b**) CT scan of vessel contents prior to removal; (**c**) In situ large bone fragments set upright within a vessel



An average maximum fragment size of 128 mm and an overall maximum of 195 mm were recorded from modern British crematoria where no deliberate fragmentation occurs prior to cremulation (Fig. 4); the majority of the bone (average 55 % by weight) being recovered from the 10 mm fraction (from a series of 10, 5, and 2 mm sieves; McKinley 1993). Similarly, the majority of the bone (>50 %) in archaeological burials from the UK is generally recovered from the larger sieve fraction with mean maximum fragment sizes of 40–70 mm, though up to 215 mm has been recorded (remains from unurned burials, disturbed deposits, those with overlying flint cairns (exerting pressure), and those of immature individuals tend to be more extensively fragmented; e.g. McKinley 1994b, 2004: Table 6.7, 2015b). Taking into consideration the potential contributory mechanisms on individual sites, in the majority of cases there is no convincing evidence for deliberate fragmentation of bone from burials from the British Isles, though incidental breakage due to differences in tending/collection procedures has been suggested (e.g. McKinley 2015a). There are, however, rare exceptions where the consistently small size of fragments (e.g. 78 % 5 mm or less; maximum 35 mm) within undisturbed adult burial deposits where the bone is well preserved suggest a more methodical attempt at fragmentation (e.g. the Mid-Late Bronze Age burial from Hartshill Copse, Berkshire; McKinley 2003 unpublished). NB. No evidence for percussive breaks has been observed to date.

Bone Weights

The weights of bone recovered from cremation burials are immensely variable. Most adult burials fall into the 500–800 g range, though in some periods and localities the averages can be lower (around 300–500 g), with a relatively small proportion (about 5–10 %) weighing over 1000 g (e.g. McKinley 1997a, 2004: Table 6.6). Of the three largest single adult burials examined by the writer (1900–2000 g), two were Bronze Age and one Romano-British; all were male and from different regions in England.

Although some bone loss occurs due to taphonomic factors, it is clear that it was rare for all the bone remaining at the end of cremation to be included in the burial (see above); though experiments have demonstrated that even very small bones would survive the process and, with sufficient expenditure of time, could all be collected (Fig. 11).

This poses the questions: Why there was this variation and what happened to the rest of the bone? The only consistent patterns the writer has detected to date are that the ‘primary’ Early and Middle Bronze Age barrow burials seem to consistently include high weights of bone (e.g. Fig. 9), and that in the Late, pre-Roman Iron Age there seems to be consistently lower weights of bone than in other periods in some areas (e.g. McKinley 1997b: 68–9, 2015a; Wahl 2008, a Danish colleague recently

Fig. 11 Survival of small bones: vertebrae (**a**) and distal bones of the front and rear limb (**b**) of a small elderly cat afforded pyre cremation

confirmed this was also the case there). The variation may have reflected the status of the individual (not necessarily related to power or wealth) reflected in the time/effort expended in the secondary rites, the personal preference of those undertaking the cremation, or in a requirement for deliberate separation of the remains.

Cremated bone is recovered from a variety of deposit types and it is likely that much of the bone remained amongst the pyre debris, which was then disposed of in a variety of ways (McKinley 1997a, forthcoming a; Polfer 1993, 2000), with only a random selection of elements from various parts of the skeleton required for the mortuary act of burial. Other uses or modes of disposal for this highly divisible and portable material are likely, some of which have been recognised archaeologically. Selected bones might have been distributed to relatives or friends (Hiatt 1969: 105; see memento mori), some might have been scattered on the land/water as in some contemporary cultures (Metcalf and Huntington 1991: 102; Downes 1999: 23), and in certain cases some or most might have been dispatched for burial elsewhere (Oestigaard 1999). There is evidence, for example, that members of the Roman military who died away from home were cremated where they died and their remains transported back for burial, as in the case of the Emperor Septimius Severus (died and cremated in York, cremated remains returned to Rome; Noy 2005; Toynbee 1996: 59). Some cremation-related features can have all the outward appearance of a cremation grave but include little or no bone; several examples of such cenotaph/memorial deposits have been found in a few of the Romano-British Northern Frontier Forts, some taking the form of *bustum*-style pyre sites (Cool 2004: 457–460; McKinley 2004: 306–7, forthcoming a; Toynbee 1996: 54; Wheeler 1985).

There is also growing evidence for the existence of memento mori/‘tokens’, small quantities or even single bones apparently dispensed to relatives/friends, at least some of which were later buried together with someone else. Striking examples of the latter were recovered from Early Anglo-Saxon (late fifth-early seventh century AD) inhumation graves in a cemetery in southern England. Here small packets of cremated bone (9 g and 48 g) were placed directly over the inhumed corpse in two graves (Fig. 12: McKinley forthcoming b). Elsewhere, smaller (single bones or <10 g) 'token' quantities of bone are believed to have been added to cremation graves, predominantly of prehistoric date, at or potentially shortly after burial (McKinley 2013a, 2006, 2015b).

Pyre goods and Grave Goods

The recovery of pyre goods demonstrates the significance of the primary part of the mortuary rite: the corpse laid out on the pyre, dressed and adorned, often with other items arrayed about them (e.g. Sjösvärd et al. 1983). Not all pyre goods were

Fig. 12 Anglo-Saxon inhumation grave showing location of memento mori deposit of cremated bone

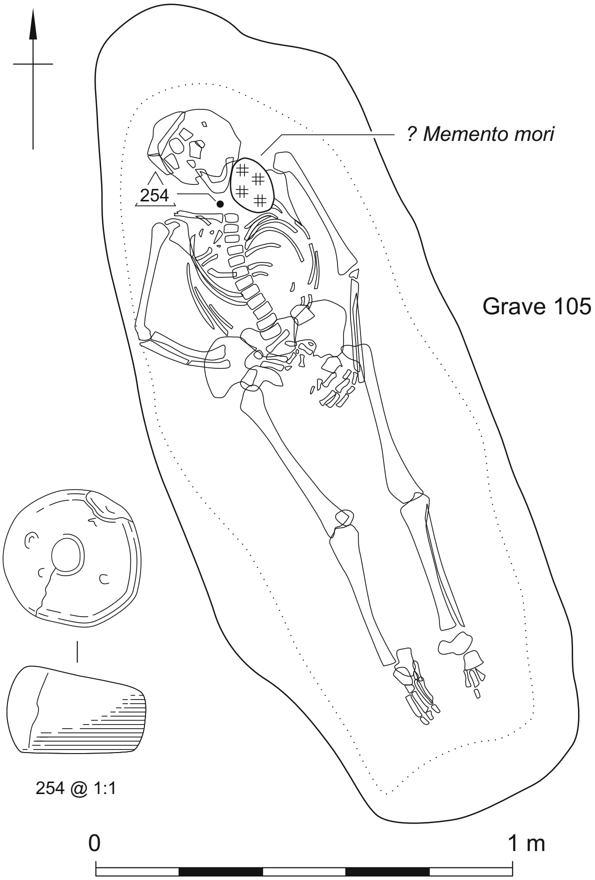


Table 1 Pyre goods; frequency and range of animal species commonly observed in British cremation burials (from a multi-period sample examined by the writer)

Period	Frequency (variations between cemeteries)	Quantities	Number of species	Common species
Mid-late Neolithic	c. 4 % burials	Few grams	Single	Sheep/sheep sized
Bronze Age	c. 16 % burials	Few grams	Single	Immature sheep/pig, bird
Late Iron Age (first century BC–early first century AD)	c. 22 % burials	Few grams	1–2	Piglet, chicken
Romano-British	10–80 % burials	Few grams (generally)	1–2	Immature pig/sheep, bird
Early Anglo-Saxon (earliest cemeteries only)	23–44 % burials	Often several 100 g	1–5	Horse, cattle, pig, dog

incorporated in the grave (Cool 2004; Polfer 1993, 2000), but the recovered materials indicate status, temperatures attained in parts of the pyre (melted glass and copper alloy), and where they may have laid in relation to the corpse (cooled material fusing to bones; e.g. McKinley 1994a: 86–92; Northover and Montague 1997). The inclusion of animal remains on the pyre was a common feature, quantities and species varying with time (Table 1); most seem to have represented food offerings, but status animals, pets, and those with ritual/amuletic qualities have also been found and studies have shown that specific species may be linked to the age and/or sex of the individual (McKinley 1994a: 92–100; Sigvallius 1994; Wahl 2008).

The presence of grave goods (unburnt items added only at the time of burial) in some periods raises interesting questions about why distinctions were made between these items and pyre goods, and what their purpose may have been. Such materials that survive are most common in the UK in the Romano-British period, and were generally ceramics (e.g. Cool 2004), perhaps connected with the grave-side commemorative feasting for which there is literary evidence (Hope 2007: 66, 115–6, 154–5; Toynbee 1996: 62, 95). In some recent excavations of both Romano-British and Anglo-Saxon burials, however, items more commonly used as pyre goods (personal adornment/equipment) have been recovered placed (unburnt) on top of the bone within the urns (Fig. 13). Were these items accidentally excluded from the pyre? did they represent mourner's gifts rather than personal items of the deceased's?, or are they linked with differing soul beliefs as discussed by Gräslund (1994).

Fig. 13 Romano-British urned cremation burial from Kent showing unburnt grave goods (copper alloy bracelets and a ring) placed on top of the cremated bone

Concluding Remarks

Fire is a powerful element combining opposites, being both destructive and life-giving. It has transformative powers, possessing the ability to render something that is potentially dangerous and frightening (i.e. the corpse) into something inert and ‘clean’. The end product of cremation is fragmentary and transportable, offering myriad possible uses. Most appears to have been subject to immediate burial, but not of all the remains; some or all was occasionally kept above ground; there is evidence for movement of remains with populations, perhaps helping to reinforce land claims in some cases (e.g. migrant Anglo-Saxons) or simply as tokens of personal affection, forming tangible and accessible memento mori of a loved one. The ‘living’ flame, with its varying colours, movement, and heat, is fascinating to watch (Fig. 14), the ever upward transmission potentially offering greater comfort and appeal than deposition in the cold, dark ground.

The Romans appear to have viewed cremation (at least theoretically) in a very modern light, as a neat hygienic way of disposing of the corpse, the end product forming a convenient ‘package’ for final disposal, whilst at the same time providing the opportunity for a ‘good show’ (Noy 2005). At other times cremation was viewed as a mechanism by which the spirit of the deceased was released (see *Beowulf* ‘. . .Heaven swallowed the smoke . . .’ (Line 3154); Brøndsted 1960: 304; Downes 1999: 28; Homer’s *Odyssey* Book XI, Lines 221–2) or prevented from returning (Barber 1990: 385–7). Unlocking these beliefs from the archaeological remains continues to present a fascinating archaeologically challenge.

Fig. 14 Living flame; pyre cremation (much loved pet cat)

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