An osteological analysis and social investigation of the cremation rite at the cemeteries of Elsham and Cleatham, North Lincolnshire

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Abstract

This thesis provides a detailed osteological and social analysis of the cremated human remains from the early Anglo-Saxon cemeteries (5^{th}-6^{th} centuries AD) of Elsham and Cleatham, both located in North Lincolnshire. Primarily, the results of this assessment address demography, identity and pyre technology. The cremated remains of 566 burials from Elsham and 979 from Cleatham were subjected to osteological analyses. These results were then statistically interrogated in order to observe patterns between the demographic profile of the burial population, their differential grave assemblages, and their spatial distribution within each cemetery. This comprehensive contextual assessment highlights the fact that the Anglo-Saxon cremation rite was deeply symbolic, multi-layered, and communicated a multitude of messages concerning the deceased's identity. A number of significant correlations were found between grave provisions and the demographic profile of the deceased and these are suggested to have related to the construction of various identities through the mortuary ritual. Similarly, social significance was also observed in the cremation process itself. An analysis of pyre technology, which assessed the effects of burning on bone (using histomorphometry and FTIR analysis alongside an examination of the macroscopic appearance of cremated skeletal remains), examined the duration, temperature and oxidising conditions to which the body was exposed, and found duration to be an especially variable factor, and one that may have had social significance. These new results from Elsham and Cleatham significantly increases the number of Anglo-Saxon cremation cemeteries from which osteological data is currently available. Therefore this study makes an important contribution to our sum of knowledge as well as offering some original social interpretation and analysis.

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Chapter 1: Introduction

The early Anglo-Saxon period is well known for its rich material culture, considerable amounts of skeletal material and elaborate burial customs, which are most notable from inhumation cemeteries. However, contemporary cremation burials are often neglected based on the recurring view that '[c]remation sites … may yield some information about early Anglo-Saxon society, but their interpretation is much more difficult than inhumation sites' (Crawford 1999, 16). Consequently, inhumation burials are the primary source of archaeological evidence for social identity in the early Anglo-Saxon period. Therefore, the rationale for undertaking this research project is based upon the apparent deficiency of work carried out on skeletal material and associated artefacts from early Anglo-Saxon cremation cemeteries. The primary aim of this thesis is to expand the dataset of osteological remains from Anglo-Saxon cremation cemeteries in England which will, in turn, advance our understanding of this rite. Three major research themes will run throughout this thesis, which include the demography of cremation practicing communities, the symbolism of the cremation rite and pyre technology.

An osteological analysis of the skeletal material is critical in establishing the demographic profiles of the Elsham and Cleatham cemeteries. This assessment will also allow a comparison of population structure with contemporary inhumation sites, to explore whether there were differential burial rites for certain sectors of the population. Once the demographic structure of these sites has been established, an integrated analysis of these data will be undertaken together with the contextual information obtained from funerary deposits, which include pyre and grave goods, animal bone, cinerary urns and the spatial distribution of burials. This aims to gain an insight into the beliefs and burial customs afforded to different members of early Anglo-Saxon society. Specific questions relating to the symbolism of the cremation rite will be answered through osteological and statistical analyses. Some of the pressing questions that will be explored include the following. Were individuals belonging to certain social groups supplied with a greater or more elaborate burial assemblage than other individuals? Were specific artefacts, types of pot and animal offerings assigned to certain individuals? Was this due to the age, sex, gender or status of an individual? On the basis of the large quantity of animal bones recorded from early Anglo-Saxon cremation cemeteries, was there a strong relationship between animals and the Elsham and Cleatham communities, and if so why? Were certain groups segregated in defined areas of the cemetery based on their social position? These questions will also provide an understanding of artefact symbolism, for example whether specific objects in the cremation rite were selected based on the deceased's social standing. The examination of grave assemblages alongside the biological attributes of individuals will aid our understanding of the cremation rite during the early Anglo-Saxon period. This in turn will provide a clearer picture of the customs employed by cremation practicing groups and will allow a comparison with contemporary inhumation cemeteries to explore the reasons behind differential burials customs.

The third major research theme of this thesis is the exploration of pyre technology, effects of cremation on bone and the cultural implications of this process. The assessment of pyre debris and thermal alteration of cremated bone will be explored to gain an understanding of pyre conditions. Macroscopic changes to burned bone, which include the colour, warping, shrinkage and fracture patterns, will be examined from the Elsham and Cleatham skeletal assemblages. In addition, histomorphometry and Fourier Transform Infrared Spectroscopy (FTIR) will also be conducted on a sample of cremated bones from the Elsham cemetery. The application of these technical approaches to the study of archaeological cremated bone will provide further information regarding the structure and position of the deceased on the pyre, as well as temperature, duration and oxidising conditions of the pyre. The exploration of this information also aims to provide an insight into the economic investment and time offered to certain individuals with implications that the social status and position, wealth and popularity may have effected the decisions made regarding the cremation process. Subsequently, all of these data will be scrutinized and compared with contemporary sites from England and the Continent. Examples from literary sources and ethnographic case studies will also be drawn upon. However, caution must be exercised when comparing the Anglo-Saxon cremation rite with analogous practices witnessed from other periods of time and locations around the world as no two societies are the same. Nevertheless, the examination of comparable case studies is important in that it broadens our understanding of how different communities view death and conduct funerary practices, which lies outside of the expectations of a modern Western mindset (Humphreys 1981, 4).

The two principal case studies examined in this thesis are the cremation cemeteries of Elsham (grid reference TA 046 125) and Cleatham (grid reference SE 932 008), both situated in North Lincolnshire, which lay around 12 miles apart. Both sites were excavated in the 1970s and 1980s under rescue conditions. This region holds the most evidence for the practice of cremation funerary rites, whilst inhumation burials are broadly distributed across eastern and south-eastern England (Crabtree 1995, 20). However, in the majority of areas inhumation and cremation practice were carried out alongside each other, which is exemplified by the presence of mixed-rite cemeteries. Therefore, alongside the primary data collected from Elsham and Cleatham, nine contemporary cremation and mixed rite cemeteries will also be examined through the use of published and unpublished reports. These sites include: Sancton (East Riding of Yorkshire), South Elkington (Lincolnshire), Loveden Hill (Lincolnshire), Newark (Nottinghamshire), Spong Hill (Norfolk), Caistor by Norwich (Norfolk), Illington (Norfolk), Snape (Suffolk) and Mucking (Essex) (Fig 1.1). The data acquired from these sites will be employed as comparative examples and will aid in the identification of inter site trends.

The assessment of large assemblages of cremated bone from single sites using standardised methodologies is desirable if results are to be statistically meaningful and comparable with other cremation cemeteries. However, only a single large Anglo-Saxon cremation cemetery, namely Spong Hill, has been analysed in sufficient detail to allow objective comparison between osteologically-defined age and sex categories and patterns of associated material culture (McKinley 1994; Ravn 2003). A great deal of work has been carried out on the material from this site and this will be examined in subsequent chapters. The site at Sancton has also produced detailed osteological data but very little work has been conducted since the initial report nearly 20 years ago (McKinley 1993; Timby 1993). Despite the presence of small amounts of data from the various sites named above, Spong Hill is the most reliable for interpreting the demographic structure of early Anglo-Saxon communities that practiced cremation. There is an important unresolved question as to whether the patterns of age and sex found at Spong Hill, which include a high frequency of younger mature adults and females alongside an under-representation of infants, can be considered to be characteristic of groups that practiced the cremation rite during this period (McKinley 1994, 68). It should not be assumed that all cremation practicing communities possessed a similar population structure and carried out identical rites. The assessment of the Elsham and Cleatham assemblages will provide additional evidence to assess the validity of the notion that social organisation observed at Spong Hill was universal to all Anglo-Saxon cremation practicing communities.

Fig 1.1 Map of early Anglo-Saxon mixed rite and cremation cemeteries

This thesis begins with an examination of previous studies of Anglo-Saxon cremation cemeteries and how this field of research has developed over recent decades. There is an apparent shift in research interests from the first Antiquarian studies of Sir Thomas Browne (17^{th} century), Rev. James Douglas (18^{th} century) and John Mitchell Kemble (mid 19^{th} century), who were interested in migration, race and the origins of England, to modern day analyses of cremation cemeteries which focus upon the social structure of these communities. An in-depth examination will also look at the work carried out on material excavated from the most significant and best recorded early Anglo-Saxon cremation cemeteries in England. The contribution of biological anthropology is also playing a major role in the quest for more precise information about these communities. The development of osteological techniques and advances in more technical methodologies, such as the application of scanning electron microscopy (SEM) and small-angle X-ray scattering (SAXS), are becoming increasingly popular in cremation studies. These advances not only provide more information about the cremation process but highlight that many techniques applied to inhumed bones can also be employed in conjunction with cremated bone, given the correct circumstances.

Chapter three of this thesis will explore the symbolism of the cremation rite in the early Anglo-Saxon period. This will begin with an exploration of the differences between inhumation and cremation cemeteries and the social implications of the use of different burial rites. This will be followed by an examination of the lifecycle, gender and social status in the Anglo-Saxon period, based on the deposition of pyre and grave goods and cinerary urns in cremation cemeteries. A comparison of the grave assemblages frequently found in cremation and inhumation burials will be presented. The purpose of this examination is to establish whether communities that conducted different funerary rites employed unique artefact groupings to represent the same social groups, for example age and sex. Before going any further, it is necessary to point out the difference between pyre and grave goods. Pyre goods are classified as the artefacts that were placed on the pyre alongside the cadaver, while grave goods were placed within the urn or burial after the cremation process was complete (McKinley 1994(b), 133). The following discourse will examine ideas in relation to the transformation of the body through the cremation process. The notion of social memory will be examined in light of artefacts offered to the dead, the actual cremation process and the subsequent burial of the burned bones. This chapter will also examine the importance of animals in the Anglo-Saxon period, in particular, their exploitation in the cremation rite. Given the large quantities of faunal remains found in cremation burials, it is apparent that animals were highly revered among cremation practicing communities. Practical explanations and symbolic reasoning will attempt to determine why animals were such an integral part of early Anglo-Saxon society.

Chapter four of this thesis is concerned with pyre technology and the effects of burning on bone. Pyre construction and the fuel employed in the cremation process during the early Anglo-Saxon period will be explored through an analysis of surviving pyre sites and pyre debris. Discussion of the cremation process will explore the procedures that may have been carried out by past societies, based on an array of evidence including modern, ethnographic, archaeological and literary sources. This will involve a description of the difficulties that would have been encountered in the Anglo-Saxon period when conducting cremations since open air pyres are notoriously difficult to control unlike modern cremators. Pyre conditions that would have been achieved are examined through the available evidence in the form of cremated bone, pyre debris and remnants of pyre goods. This section is concluded by a discussion which explores the effects of thermal alteration on the macroscopic appearance and microscopic structure of bone as a result of the cremation process. The importance of examining cremated bone, on a macro- and microscopic level, will be addressed as such investigations can help to answer questions concerning the position of the cadaver on the pyre, temperature and oxidising conditions of the fire and the duration of this funerary rite.

The following methodology chapter will draw upon the osteological, statistical and technical methods that were employed during the skeletal assessment of the Elsham and Cleatham cemeteries. Where possible, osteological analyses followed the same methods employed by Jacqueline McKinley in her assessment of Sancton (McKinley 1993) and Spong Hill (McKinley 1994), given that these are the two most detailed studies carried out on Anglo-Saxon cremated material. This aims to produce comparable results to analyses of other cremation cemeteries and intends to highlight the importance of using standardised methods when assessing thermally altered bone.

The results from Elsham and Cleatham are split into two chapters. Chapter six contains the Elsham results while chapter seven covers the Cleatham results alongside comparative data analysis from other sites. The reason that the results chapter has been divided into two is due to the large quantity of data produced through osteological and statistical analyses. Each of these chapters follows the same structure. An assessment of unburnt bone and in the case of Elsham, inhumed individuals, will be initially examined. This will be followed by a macroscopic examination of the cremated bone consisting of sections relating to fragment size, weight, degree of warping, shrinkage and fissuring, and an assessment of the colour of burned bone. These aspects will be examined to provide evidence of pyre conditions. Subsequently, a detailed assessment of the demographic profile of these sites was undertaken, which will incorporate the minimum number of individuals (MNI), age, sex, population size and signs of disease and trauma. Animal bones and their relationship with associated burials will also be examined. Subsequently statistical tests demonstrating relationships between the demographic profile of the Elsham and Cleatham communities in comparison with cinerary urn, grave and pyre good provision and spatial distribution will be undertaken through means of statistical testing. These chapters will only contain the results of osteological analyses as a discussion and interpretation of these findings will be explored in detail in chapter eight (discussion chapter) of this thesis. The conclusion (chapter nine) will highlight the key results and findings of this research.

Future work will be suggested based on the conclusions made in this thesis. The raw data acquired from the osteological analyses of the Elsham and Cleatham assemblages can be found at the back of this thesis on the accompanying CD-ROM, while the descriptions of each thin-section sample from Elsham can be located in the *appendices* section of this thesis. Enlarged images of the Elsham micrographs that were employed for the purpose of histomorphological analysis can be found in appendix IV, which is also located on the accompanying CD-ROM at the back of this thesis.

Chapter 2: Previous studies of Anglo-Saxon cremation cemeteries and the potential of cremated remains in future analyses

In 1658 Sir Thomas Browne came across a burial and, while he might not have realised it at the time, this was one of the first encounters with an early Anglo-Saxon grave (Leeds 1913, 38). Ever since such early discoveries there has been a growing interest in Anglo-Saxon cemeteries. A greater focus has long been placed on the study of inhumation cemeteries rather than the contemporary cremation cemeteries, but with the development of new osteological techniques the examination of cremated human remains is becoming more common. In turn, this is allowing more thorough analyses of data. This chapter will assess previous studies that focus on Anglo-Saxon cremation studies from the 17th century to the present day, examining how research interests have shifted in this area of archaeology over time. Finally the potential of cremated human bone from such cemeteries will be explored, with the intention of highlighting the significant contribution these remains can make to our understanding of early Anglo-Saxon society.

2.1 Antiquarian studies

The discovery of numerous cinerary urns by various antiquarians, such as Sir Thomas Browne in the 17th century, frequently resulted in the conclusion that such artefacts belonged to the Roman period (Browne 1658; Williams 2008, 249). It was not until a century later that further analyses of these urns, which were carried out by Rev. James Douglas in 1793 after he excavated a number of burials on the site at Chatham Lines in Kent, established that they actually belonged to the Anglo-Saxon period based on the graves and artefacts within them, for example beads and tweezers (Leeds 1913, 40). Consequently the finds from these cremation cemeteries sparked great interest in the context of debate about migration and the origins of England. In the mid 19th century, as part of his discussion of race, John Mitchell Kemble examined cinerary urns excavated from Anglo-Saxon cremation cemeteries in England, which he compared with those from the continent, such as the burials from Perlberg at Stade (Williams 2005, 8). Similarities between English and continental urns that Kemble noted were primarily concerned with the fabric, form and style of funerary vessels. Kemble identified similar decorative features on urns from England and the continent, such as stamped decoration and bosses pressed out from the inside of the vessel rather than applied after the urn was complete (Williams 2005, 8). Kemble also observed similar grave and pyre goods from cremation urns in both England and Germany, which included bone combs, shears, beads and small knives (Williams 2005, 8). The apparent similarities between material culture from cremation cemeteries in England and on the continent allowed him to conclude that the origins of the English were Germanic, which he examined with the help not only of literary sources but also of archaeological material.

In an attempt to establish the origins of the English and their 'Teutonic' roots, distinct morphological features of skeletal remains that were recovered from the Anglo-Saxon burials were recorded during the 19th century. This is exemplified by William Wylie in the mid 1800s who stated that stature was an implicit indicator of the Teutonic affinities of the Fairford graves in Gloucestershire as the inhumed individuals appeared to have been relatively tall (Williams 2008(b), 70). Unfortunately, antiquarians did not examine the morphological features of cremated skeletal remains to determine the origins of the English and as a result cremated bones were frequently overlooked or discarded (McKinley 1994(b), 132). Distinguishable cremated bones were, however, recorded by antiquarians such as Sir Thomas Browne, who noted the presence of 'two pounds of bones, distinguishable in skulls, ribs, jaws, thigh-bones, and teeth, with fresh impressions of their combustion', within a number of urns excavated at Walsingham (Norfolk) (Lucy 2000, 5-6). Furthermore, inferences about sex, gender and English origins were also made by antiquarians, based on the observation of grave goods. For example, Akerman (1847, 121-122) inferred the sex of individuals from grave goods and the size of burial mounds, while Wylie recognised the Teutonic nature of various grave goods such as weapons (Williams 2008(b), 76). Again, these antiquarian authors solely focussed on inhumation burials and did not consider the artefacts found within cinerary urns. Nonetheless, from the evidence at hand it appears that the antiquarians felt that the cinerary urns, and, to a lesser extent, grave goods, from cremation cemeteries yielded the most information regarding the origins of the English.

2.2 Studies from the early 20th century to the present day

2.2.1 Early studies of cremation in Britain

A number of notable studies concerning cremated bones were carried out by British anthropologists in the 1950s. All of these works were inadequate because the biological anthropologists were misguided about the potential of cremated remains and failed to appreciate how cremation actually works, despite contemporary research published in Germany and in Scandinavia on the analysis of cremated bone. The work of Nils-Gustaf Gejvall, in the late 1940s and early 1950s, identified the potential of cremated remains. Gejvall demonstrated that if every possible fragment was collected and recorded it may be possible to deduce both the minimum number of individuals and other demographic information (Lisowski 1956, 83). An example of the neglect of cremations in Britain is exemplified in the report by Alexander Cave (1956, 55) who assessed the Viking-Age cremated bone from Heath Wood in Ingleby (Derbyshire). Cave (1956, 55) claimed that the intense burning and subsequent deliberate pounding of the bones was so thorough that the resultant fragments were generally impossible to identify. However, further excavations and re-examination of these early discoveries by Richards *et al.* (2004, 78) noted that the Heath Wood cremations contained bone fragments up to 49mm and are no more fragmented than is typical of early Anglo-Saxon cremation burials. Perhaps the earliest adequate study of skeletal remains from an Anglo-Saxon cremation cemetery was by Calvin Wells (1960) who examined the Illington (Norfolk) assemblage. Unfortunately, only an interim report on this site was ever published. In this article Wells (1960, 30) follows the pioneering work established by Gejvall in 1947 as he sets out the evidence for most of the main components of modern cremation analysis, which he applies to 140 cinerary urns containing cremated remains from Illington (Wells 1960, 29). These include the estimation of demographic attributes, minimum number of individuals, differential survival and transformation of different skeletal elements, pyre temperature and the presence of pyre goods. Since *Antiquity* was one of the foremost journals for British archaeology, there was little reason after 1960 for anthropologists to ignore the evidence provided by cremated bone. Wells' (1960) study should have been the starting point for more advanced analyses of cremated bone but it still took a number of years before satisfactory studies were undertaken.

2.2.2 South Elkington

The first published study devoted solely to an Anglo-Saxon cremation cemetery was produced in 1952 by Graham Webster and John Nowell Linton Myres who examined the site at South Elkington in Louth (Lincolnshire). The primary focus of their analysis was the cinerary urns, although the finds within these vessels were briefly listed. A site plan of the excavated area was also provided alongside many illustrations of the pottery. The cremated bones from these vessels were, however, only mentioned in passing when discussing contents of the urns. Webster (1952, 27-28) noted that all the urns contained, in addition to burnt bone, a number of flints, pebbles and pyre goods such as brooches and beads. Webster recorded that the cinerary urns were stored in Lincoln Museum though there is no mention of what had happened to the cremated bones. Myres had compiled an inventory of the pyre goods found within these urns for the London Institute of Archaeology in December 1947. This list was comprised of the pyre goods found at South Elkington and a note was made about the cremated bones. Myres (1947) reported that the objects had been placed in small envelopes in the top of each bone bag. However, Myres (1947, 2) was awaiting instructions from the Institute about the disposal of the bags and more crucially proclaimed that the bags containing objects should be sent back to Lincoln but believed there was not much point in keeping the rest. This is a major problem because over 200 burials were found at South Elkington but the lack of reporting of the cremated bones, and their subsequent disappearance, has left a void in our knowledge of the site that is irredeemable.

The research interests of Webster and Myres corresponded with those of their predecessors especially with regards to the determination of the origins of the South Elkington people. Based on the pottery decoration and form, Myres (1952, 61) suggested that the South Elkington inhabitants were of mixed origin, predominantly Anglian or Anglo-Frisian, but that they also had Saxon antecedents. Therefore, the styles of decoration and form of the urns from this site were primarily ascribed to Anglian, Anglo-Frisian and Saxon groupings. Myres (1952, 63) suggested that the latter type of pottery represented trade with southern England though the presence of local schemes of decoration was also noted. The same author also established that pottery production was on a small scale and that there was a paucity of artefacts deposited with the burnt bone in the urns compared to the objects recovered from the cremation burials from Caistor-by-Norwich (excavated in the 1930s but not published until 1973; see below) and Lackford (Suffolk) (Myres 1952, 64). Rather than considering factors such as the cremation process, collection and deposition of the objects and also preservation which may have resulted in the small number of pyre goods, Myres (1952, 64) suggested that 'the Elkington folk may have remained from first to last a poor, backward and rather unenterprising community'. The lack of thorough analyses and drawing of conclusions frequently based on mere assumptions need to be readdressed in an up to date analysis of the South Elkington artefact assemblage. Furthermore, an osteological examination of this collection, if the material had survived, would have contributed greatly to the growing corpus of Anglo-Saxon cremation cemeteries.[1]

[1] Lincoln Museum (Lincolnshire) holds the South Elkington cinerary urns but not the osteological remains.

2.2.3 Loveden Hill

In 1964 Kenneth Fennell wrote his doctoral thesis at the University of Nottingham on the Loveden Hill cemetery at Hough-on-the-Hill in Lincolnshire. The aim of this study was to examine the significance of the Loveden Hill cremation cemetery in relation to the Dark Age settlement of the East Midlands. Fennell (1964) discussed the geography of the site, the size of the associated settlement and the pottery found from the cemetery. Over half of this thesis was devoted to the ceramic urns excavated from the cemetery and at the time of this study over four hundred urns had been recovered. The primary areas of interest for this study were the cinerary vessels and burial practices. Unlike the authors of the South Elkington report, Fennell examined the chronological development of vessels from Loveden Hill, especially their form and decoration, in great detail. In contrast to the approach adopted in the South Elkington study, Fennell's analysis did not dwell on the idea that the decoration and form of the cinerary urns represented the origins of the inhabitants of the nearby settlement. However, it was noted that some of the stamps and decorative motifs on the cinerary urns were analogous to continental and insular examples recorded elsewhere (Fennell 1964, 370). It is interesting that Fennell appears to have been moving away from the traditional research focus of establishing the origins of the cemetery's inhabitants. Instead, the author showed an interest in the actual burial practices at Loveden Hill. The primary observations he made about the burial practices included the common practice of sealing cinerary urns with large flat stones, the practice of placing multiple vessels in one grave, and the haphazard collection and burial of cremated human remains (Fennell 1964, 96-100). Fennell (1964, 102) identified that the possible reasons for variation in burial practices must lie in strongly held and widely divergent religious beliefs and in the ritual practices stemming from those beliefs, as opposed to the variation being the result of race. Such innovative ideas for the time also led the author to explore the actual cremation process, including the temperatures reached on the pyre, which he deduced on the basis of the fusing point of glass beads, and the conclusion that people practicing this rite had a deep understanding of the cremation process (Fennell 1964, 103). Though the latter points were only briefly discussed, they are crucial to the development of Anglo-Saxon cremation cemetery studies. However, similar to previous studies, the cremated human remains were mentioned but were not elaborated upon in detail. There was no discussion of demography, accompanying small finds or spatial distribution despite the presence of a crude site plan of the cemetery that was included in this thesis. Conversely eight inhumations were analysed in greater amounts of detail with at least half a page devoted to each of these burials. The biological age, sex and stature were recorded, though the osteological methods employed were not outlined and the age groupings were vague. The position of the skeletal remains within the grave and accompanying grave goods were also noted. Fennell (1964, 91) concludes that inhumations three and eight were warriors based on the presence of military accoutrements, including a spear head in burial three and a small iron knife in grave eight. However, this point was founded on supposition due to the presence of grave goods that were commonly associated with males. In contrast to the inhumation burials from the Loveden Hill cemetery, the cremation burials (from the same site) were afforded limited analyses and interpretations.

In 1980, Leonard Wilkinson carried out a general survey of the cremated osteological remains from Loveden Hill. At the time of this publication approximately 1000 cremations had been excavated from this site (Wilkinson 1980, 221). The primary aim of this study was to address the problems of analysis and interpretation of skeletal remains, although this report also provides a useful insight into the social context of the Loveden Hill cemetery. The methods used to determine biological sex of the cremated remains were based on examination of morphologically distinct features where applicable, such as the supraorbital margins. However the determination of sex established on the basis of cranial vault and cortical bone (of long bones) thickness has since been shown to be unreliable (McKinley 1994, 20). Wilkinson's (1980, 227) approach also employed grave goods to determine the sex of individuals, alongside the osteological remains, for what he suggested was a more accurate result. Nonetheless, this method is not advisable as grave goods may have represented gender or other social attributes rather than biological sex during the early Anglo-Saxon period (Brush 1988, 84-85; Lucy 2000, 111). Basic techniques were employed to determine the biological age of individuals, such as ectocranial suture closure, although other methods, for example dental attrition, were not viable due to levels of preservation (Wilkinson 1980, 227). The latter continues to be a problem for the study of cremated remains, although the presence of teeth can provide some information on the age of an individual, such as dental eruption (Lucy 2000, 107). Double burials were also noted in Wilkinson's study, and this phenomenon was combined with the demographic data to determine social relationships between age groupings. The presence of animal remains and grave goods was also noted though not elaborated upon. The 20 inhumation burials from the cemetery were also examined, and brief notes were provided on the demography and evidence for disease or injury. While only three pages were devoted to the inhumation burials, more interpretation was lavished upon these findings in comparison with the discussion of the cremated remains. There are a number of major problems with this study. First, only a sample of the cremated remains was examined, and a complete assessment of the osteological remains from Loveden Hill would contribute significantly to our knowledge of Anglo-Saxon cremation practice. Second, the interpretation of these results is very limited. Thus, it would be useful to reanalyse the finds and examine possible social interpretations based on the skeletal material and accompanying grave assemblages.[2]

2.2.4 Caistor-by-Norwich

The excavation of the Caistor-by-Norwich cemetery was carried out by F. R. Mann between 1932 and 1937. However, the cemetery report was produced by J. N. L. Myres and Barbara Green in 1973, while the human remains, from both the cremation and inhumation burials, were assessed by Calvin Wells. Great emphasis in this report

[2] The Loveden Hill urns and osteological remains are currently held in Lincoln Museum (Lincolnshire).

is placed on the pottery and grave goods found within the cremation and inhumation graves. Similar to the South Elkington study, there still appears to be an interest in the origins of the English people and a number of the conclusions are based on the form and decoration of cinerary urns and the grave goods found within them (Myres and Green 1973, 43). The authors also use the pottery to produce a chronology of the site. For instance, the earliest pieces are defined as Germanic pottery which is then compared with analogous cinerary urns from Germany to provide additional evidence for the presence of Germanic burials at Caistor-by-Norwich (Myres and Green 1973, 44). A couple of paragraphs were also devoted to the cremations of children, which attempted to look for correlations between the age of these individuals and the cinerary urns in which they were interred. Myres and Green (1973, 71) noted that children were buried in smaller vessels (between 8.9-19.0mm) than the normal size of cinerary urns during the Anglo-Saxon period, though there is no reference to any comparative vessels from other contemporary sites. It was also observed that 16 of the decorated children's vessels contained twice the amount of grave goods compared with the average number of artefacts interred in adult urns elsewhere in the cemetery. Myres and Green (1973, 71) suggested that this may have indicated variations of wealth within the community. Such interpretations of cinerary urns, grave goods and osteological remains were pioneering and were an important milestone for the study of Anglo-Saxon cremation cemeteries. Furthermore, such an integrated analysis, albeit rather brief, was unlike Myres's usual research interests.

Only two pages of the report were devoted to the osteological analysis of the cremated remains, which were conducted by Calvin Wells. The methodology employed by Wells was not elucidated and there was a problem owing to the lack of adult cremated remains. It is notable that there was a preference towards the collection of the cremated remains, especially teeth, of children during the excavation of the Caistor-by-Norwich cemetery. The research interests of the excavator may therefore explain the dearth of adults from this site. Following his excavations of the site in the 1930s, Mann noted that in some instances very substantial amounts of bone were originally present in the urns (Wells 1973, 120), but there is no record of what happened to them subsequent to the excavation process. The results deduced from the small amount of cremated material, which amounted to 28 burials, were then compared with the findings from other cremation cemeteries, such as Loveden Hill and Spong Hill, although no interpretation of these results was attempted. Unlike the section devoted to inhumation burials in this study, there was no separate inventory of the demographic profiles of each cremation burial. An inventory was provided in this report that contained descriptions of the pottery and grave goods from the site and where cremated remains were found within cinerary urns the author recorded the presence of 'burnt bones' but rarely elaborated upon this point. Nonetheless, the Caistor-by-Norwich study was the first report that included data acquired from the pottery, grave goods and osteological remains alongside some interpretations of the significance of the results recorded. Numerous illustrations of the small finds, urns and site plans are also included in this report. This information could be used in the future though it would be more valuable if the adult burials from this cemetery were located as this may provide a more representative picture of the community that inhabited the area of Caistor-by-Norwich.[3]

2.2.5 Sancton

In 1973 J. N. L. Myres and W. H. Southern produced an intensive study of the pottery from the Sancton cremation cemetery in the East Riding of Yorkshire. The first half of this publication discusses the excavations of the Sancton cemetery, cemetery organisation and the Anglo-Saxon pottery. In Myres's introduction he focused on previous work on the cemetery, which was excavated in the 19th century and later in the mid 20th century by W. H. Southern. In this introduction there is also reference to written records, including letters, which provide information concerning the

[3] Norwich Castle Museum (Norfolk) holds the osteological material and pottery from the Caistor by Norwich cemetery.

whereabouts of the cinerary urns as early excavators presented pottery vessels from the site to relatives and friends (Myres and Southern 1973, 6-7). The main focus of this study was concerned with the continental origins of the inhabitants and when they settled in the Sancton region (Myres and Southern 1973, 12). Myres compared the pottery from Sancton with analogous material from continental cemeteries, principally Schleswig and Fünen, to establish the date of the cemetery and to highlight the close connections between these cemeteries (Myres and Southern 1973, 13). The section that discusses the cemetery arrangement is rather interesting in that Myres groups the urns around the cemetery based on their decorative features, and on what Myres believed to be their ethnic affiliations and influences (Myres and Southern 1973, 27). The conclusions that are drawn from the examination of the pottery are that the first users of the Sancton cemetery were individuals of Anglian and Saxon origin and the presence of continental parallels show the Sancton community had cultural links with groups inhabiting areas of Germany (Myres and Southern 1973, 29). The second half of this report is comprised of a descriptive inventory alongside illustrations of the pottery, which records the form, dimensions, decoration and fabric, and accompanying small finds. Based on the research interests of the authors it is hardly surprising that there is no mention of osteological analyses of the cremated remains in this study. For the time period, this was the norm as the cremated remains were rarely examined and material culture appears to have been regarded as a more important means of answering the research questions that were popular at the time.

It was not until 1993 that the Sancton cemetery was reassessed by Jane Timby and numerous other specialists. This in-depth study examined all aspects of the excavations and analysis of the finds. The results of the excavations were discussed before subsequent sections, which were devoted to the pottery, bone and antler, ivory, glass, metal, lead plugs, jewellery, stone and cremated human and animal bone. This site report was the first, comprehensive study of an Anglo-Saxon cremation cemetery, and, at last, a format similar to contemporary inhumation site reports had been adopted. A discussion on the pottery from Sancton was afforded 11 pages in this report, which is significantly fewer than in previous studies. Instead of looking for ethnic affiliations, David Williams (1993, 266-268) examined pottery fabric types from the Sancton cemetery based on petrological analyses which provided a clearer idea of the clay source exploited for the production of these vessels. Further work on the pottery was conducted by Francis Green (1993, 268-276) who analysed plant impressions in the vessel fabric. This investigation provided an insight into the environment where these urns were produced. The results from this analysis highlighted that cereals were quite abundant at the site. Green (1993, 275) also suggested that the recorded pottery stamps, which linked Sancton with a number of other cremation cemeteries in England, may have indicated individual potters. It is evident that the emphasis of research regarding cinerary urns had shifted from determining the origins of the people that used such vessels to learning about the environment and craftsmen that produced these objects. The numerous subsections, which discussed the various small finds, provided descriptions of the objects and in some cases stated whether they were interred with a male or female, an infant or adult. However such statements were rarely elaborated upon. The cremated bone section within this paper dominated all other sections and was spread over 19 pages. The osteological analyses were carried out by Jacqueline McKinley (1993, 287-316) who employed an extremely detailed and thorough data collection procedure on 330-335 burials from the site, which had not been previously employed in the analyses of cremated bone. The primary methods used in these analyses included recording the MNI (per burial), weighing and sieving the cremated bone through 2mm, 5mm and 10mm sieves, alongside a variety of techniques to determine the biological age and sex of individuals and any notable trauma. Cremation technology and ritual was also explored, which noted the efficiency of cremation by recording the colour of the cremated remains and maximum fragment size. The cremated animal remains were also analysed in detail by Julie Bond (1993, 300-308) who recorded species, age and signs of butchery. The importance of this section lies in the interpretations concerning the cremated remains and the exploration of observable relationships noted between various demographic attributes, urn dimensions and decorations, the presence of pyre goods and animal remains. This osteological assessment appears to have used the basic principles of Wilkinson's 1980 Loveden Hill study but is significantly more advanced and detailed. The 1993 Sancton study highlighted the shift of research interests within the field of Anglo-Saxon archaeology. As opposed to the Myres and Southern (1973) study, which focused on the origins of the Sancton community, the 1993 study attempted to understand the social structure, burial rites and the environment of the early Anglo-Saxon period.[4]

2.2.6 Elsham

The Elsham cemetery was excavated over the course of 1975 and 1976 and yielded at least 569 cremation burials. In 1977 the annual round-up of excavated sites of the previous year produced by Leslie Webster and John Cherry for the journal *Medieval Archaeology* included a short update on the excavations at Elsham in Lincolnshire. This brief report records the number of burials discovered at the cemetery and discusses the geology of the site. The research interests of the excavators, Freda Berisford and Chris Knowles, were also noted. The initial investigations of the site aspired to establish a relationship between the cemetery and nearby Roman road with two ditches which lay at right angles to Middlegate Lane (the modern successor of the ancient road). A further line of enquiry included the establishment of a chronological sequence for the development of the cemetery based on the pottery remains (Webster and Cherry 1977, 210). Unfortunately, there has been no subsequent published study solely devoted to the Elsham collection. Mary Harman (n.d.) produced an osteological report following the Elsham excavations, but the development of osteological methods and more standardised recording techniques renders a reassessment of the material a necessity. This is also the case for the osteological material from similar sites such as Caistor-by-Norwich and Loveden Hill. Aside from this osteological report, the available

[4] The Sancton cremation assemblage of pottery and cremated bone are held at the Hull and East Riding Museum (Yorkshire) and the Ashmolean Museum (Oxfordshire).

paper archive consists of a site plan, a draft publication of the site report and list of finds, but these will only be useful for future examination when the Elsham cremation cemetery is reassessed in detail.[5]

2.2.7 Richards' (1987) inter-site study

Julian Richards (1987) produced a comprehensive analysis of cremation urns from 18 Anglo-Saxon cremation cemeteries in England. This useful resource contained information pertaining to the relationships between cremated human and animal bone, pyre goods and the cinerary urns in which they were found. This publication, the result of Richards' doctoral thesis, also offered a detailed classification of the decoration of cinerary urns from the sites examined. One problem with this study, however, was the inclusion of mixed-rite cemeteries, some of which only produced a small number of urns, such as Longthorpe (Cambridgeshire) (Richards 1987, 59); in contrast, large cremation cemeteries, such as Spong Hill, yielded hundreds of vessels (Richards 1987, 61). The discrepancy between data-sets may have generated some biased results and should be considered when using this study. Another major drawback of Richards' (1987) study was that the researchers who analysed the human skeletal remains were not following the same standards, which may have caused inconsistencies in the data presented. Recent analyses of cremated bones will produce more accurate results due to the utilisation of standardised methods when determining demographic attributes of a cemetery population (McKinley 1993; McKinley 1994). Furthermore, since this study was published a number of the sites examined, such as Snape (Suffolk) and Spong Hill, have been excavated further and have consequently yielded additional burials, containing more cremated bone, pyre goods and decorated urns. This additional data may alter the results of Richards' (1987) publication if a reassessment was undertaken. Nonetheless, Richards' (1987) study examined a total of 2440 cremation urns, which was more than adequate for a statistically reliable sample. Due to the number of sites

[5] The cinerary urns and osteological material from Elsham are stored in North Lincolnshire Museum (Lincolnshire). A list of finds, the osteology report by Mary Harman (n.d.), draft publication and the site map were acquired from Freda Berisford, one of the site directors.

examined by Richards' (1987), in-depth analysis of each cremation cemetery was not viable though this would be a useful project in the future. On the whole this inter-site study provides a vast amount of information about the form and design of cinerary urns and the statements they apparently made about their occupant, for example the height of cremation vessels was closely correlated with the age of the deceased (Richards 1987, 195).

2.2.8 Newark

Excavations of the Newark cemetery took place over the course of 21 years from 1957 to 1978. However, it was not until 1989 that A. G. Kinsley published the Newark site report. This study is relatively short and mainly comprises of descriptions of the pottery, including form, decoration and deliberate damage to the vessels, and grave goods. Pottery fabric analysis was also carried out on 53 cinerary urns, which was used to determine where these vessels were produced in relation to the Newark cemetery. The conclusion of this assessment was brief. Based on an assessment of the urns, Kinsley (1989, 11) suggested that it is likely that pottery vessels were manufactured locally, although a production site with the remains of such material has not been found to date. Furthermore, the author also offers some parallels between the urn decoration at Newark and examples from Germany, although this was not dwelt upon in consideration of the origins of the Newark population (Kinsley 1989, 11). Grave goods recovered from the cinerary urns were also recorded, including a description of the artefacts and the date of production, while similar examples from contemporary cremation cemeteries were also drawn upon. Despite the relatively descriptive nature of the sections concerning pottery and grave goods from Newark there is no in-depth interpretation of the context in which the material culture was found, nor did the author attempt to consider the results from osteological analyses alongside these objects.

The osteological analysis of the cremated remains from Newark was carried out by Mary Harman (1989). Three pages in the report were devoted to the analysis of the cremated bone from the cemetery, beginning with a discussion of methodology. This section outlined the age categories employed in this study as well as detailing the osteological observations that were recorded which included the weight and maximum fragment size of each cremation burial alongside demographic attributes and pathological conditions (Harman 1989, 23). A total of 404 individual urns were excavated from the cemetery, although only 220 included cremated bones at the time of the study. The loss of cremated remains appears to have been a recurring problem for osteologists and was possibly due to excavation, curation methods and research interests. Double burials and the presence of animal remains within cinerary urns were also mentioned although little interpretation was attempted. Despite the lack of detailed analyses, the Newark osteological report includes a methodology section which highlights the general techniques and methods used in the study. The osteological methods employed in the skeletal assessments from this site are similar to those utilised in the present day, though the methods used in this study were less detailed and specific. Nonetheless, this report appears to have initiated a more systematic means of recording cremated human remains from Anglo-Saxon cremation cemeteries.[6]

2.2.9 Snape

In 1992 William Filmer-Sankey reported on the current results obtained from the Snape cemetery in Suffolk. This paper mainly discussed the excavations, dates of the site and the different burial rites, namely cremation and inhumation. The author also remarked, but did not expand on the point, that the cremation pyre at Snape was exclusively a Saxon, as opposed to Anglian, phenomenon, and he drew parallels with the pyre from Liebenau in Lower Saxony (Filmer-Sankey 1992, 49). The lack of such clarification may cause some confusion as the cremation rite was more prevalent in Anglian regions in England and the presence of a Saxon pyre did not correspond to the more prevalent

[6] The Newark cremation assemblage of pottery and cremated bone is now stored in the Newark Museum Services Resource Centre (Nottinghamshire).

funerary practice in Saxon areas, namely inhumation. These points were not explained in detail in this study, although fortunately they were examined further in a 1993 publication by Filmer-Sankey in conjunction with Shirley Carnegie. The paper by Filmer-Sankey (1992) provided an up to date recording of the finds from Snape and, therefore, there was little room for interpretations as further work was required.

Following Filmer-Sankey's 1992 report on the Snape cemetery, Carnegie and Filmer-Sankey (1993) elaborated on the cremation pyre and on finds from the area surrounding Snape following the 1985-1992 excavations. The presence of a cremation pyre was deduced from the occurrence of charcoal, pottery sherds and a spread of cremated bone within an area of 3.20 x 2.80m and a depth of around 0.1m (Carnegie and Filmer-Sankey 1993, 107). The presence of this pyre prompted the authors to speculate on the ethnic origins of the people using the Snape cemetery. They drew parallels with similar finds from the continent, namely the pyre site from Liebenau which Filmer-Sankey mentioned in the 1992 study. There were, of course, some minor differences between the Snape and Liebenau pyre, but the authors believed the pyre from Snape to have been of the 'Liebenau' type, which was Saxon in nature. Interestingly, remnants of funerary pyres are absent from Anglian cemeteries on the continent, for example at Bordesholm and Süderbrarup, while the 'cremation floor' from Sancton does not conform to the Liebenau type of pyre. Hence, the authors suggest that Anglian and Saxon communities conducted differential cremation rites (Carnegie and Filmer-Sankey 1993, 109). This paper cleared up the confusion of the 1992 publication by Filmer-Sankey and more interestingly the authors noted that rather than using grave goods to determine the ethnic origins, or regional preference, of communities the burial rite may be equally, if not more, diagnostic (Carnegie and Filmer-Sankey 1993, 110). The shift away from the detailed analysis of cinerary urns in the 1990s in order to draw conclusions about the ethnic origins of the burial populace is crucial, as archaeologists were starting to realise that other aspects of the archaeological record could provide a wealth of information regarding burial rites and the individuals who carried out these funerary practices.

The excavations and findings from the Snape cemetery were published in a single volume by William Filmer-Sankey and Tim Pestell in 2001. The report comprised of 7 chapters including an introduction to the site, excavations and surveys (between 1827-1984 and 1985-1992), a catalogue of the finds, detailed results of analyses on various artefacts and burials and finally a discussion of the finds. Unlike previous cremation cemetery studies, little attention was paid to the pottery from the site and, instead, a greater interest was shown in the cremated remains, organic remains and structural features from the site. This may, in part, have been the result of excellent organic preservation of wood, textiles and leather due to the charring of remains and also contact with metalwork (Cameron and Fell 2001, 204). However, this may also highlight the shift of archaeological interest over the latter part of the 20th century.

Owing to the acidic soils at Snape, the inhumed human remains were not preserved, which resulted, as observed at Sutton Hoo (Suffolk), in the survival of mere body stains in the soil. The site yielded 32 cremation burials, which were analysed by Steele and Mays (2001). Despite the relatively thorough analysis of the cremated remains, the standards used were slightly different from those employed by McKinley (1993; 1994) in the Sancton and Spong Hill studies. The disadvantage of this is that different age categories (which were not fully explained) were used. Similarly, rather than using the same sieve sizes employed in the Sancton and Spong Hill (McKinley 1993; 1994) reports, the osteologists used 2mm and 4mm meshes. The reason for the use of these different sized meshes is not explained in the cremated bone section of this report. Therefore, the use of a non-standardised methodology in the Snape osteological report will make a comparison with studies employing a homogeneous approach more difficult. A final problem with the osteological techniques employed in this report is that biological sex was determined based on overall skeletal size/robusticity if no morphological features were present in a sample (Steele and Mays 2001, 227). This approach is problematic as many variables could affect the robusticity of cremated bone, for example shrinkage as a result of the burning process as well as the actual build of an individual. The osteologists also investigate pyre temperature based on the colour of bone alone and they conclude that pyre temperatures were in excess of 940˚C (Steele and Mays 2001, 227). This conclusion was also based on the results from analogous studies, including Calvin Wells' (1960, 35) assessment of the Illington cremations. However colour is not the most reliable means of determining temperature as many variables will affect the colour of cremated bone, such as oxidation. Despite the criticisms of the osteological technique, some general conclusions can, nonetheless, be drawn regarding the demography of the cremated remains analysed. The in-depth study of the excavations and findings from Snape is extremely important, as grave goods, organic remains and structural features were examined in detail to explore the various funerary rites conducted at this site. In-depth interpretations of the small finds and organic remains by numerous specialists will be a valuable resource for prospective comparable studies. Future work that would be useful with regards to the osteological remains from Snape would be a bio-cultural analysis to determine relationships between the cremated human and animal remains, cinerary urns and pyre goods, alongside spatial organisation of the site, as detailed site plans are available in the report.[7]

2.2.10 Spong Hill

The first study that was solely devoted to the Spong Hill cremations was written by Glenys Putman (1980). This very short assessment of the cremated bone discussed the aims of the osteological analyses and made some generalized observations. A total of 59 cremation burials were analysed using statistical means and it was observed that there was an over-representation of females to males and a high infant and child mortality rate (Putman 1980, 217). The presence of cremated animal remains and

[7] The Snape cremation assemblage is stored in the Aldeburgh Museum (Suffolk).

multiple burials were also recorded but no interpretations were made based on the results from this study. However, the author noted that much work remained to be done as this study was carried out during the early stages of analysis (Putman 1980, 219). A complete excavation of the cemetery site was carried out between 1972 and 1981. The site subsequently required a more in-depth analysis once all of the cremations had been excavated.

In 1994 the two most detailed studies of the Spong Hill cremation cemetery were published. The first of these was a catalogue of the cremations, which examined the pottery, grave and pyre goods and a number of specialist reports that focused on various artefacts from this site (Hills, Penn and Rickett 1994). The recognition of stamp-linked groups on cinerary urns from Spong Hill was a major area of interest in this report (Hills, Penn and Rickett 1994, 1). Consequently, the 132 stamped groupings that were identified during analyses played a central role in this paper. Unfortunately, this paper presented a limited amount of interpretation and no firm conclusions were established based on the available information. This format was paralleled in the small finds and specialist report sections of the study. At the time of this publication all associated finds and pottery descriptions of the Spong Hill assemblage were recorded in a catalogue. Therefore, it would have been of interest to provide further analyses or interpretations based on the context of these artefacts alongside a comparison with other objects found within the same burial. Nonetheless, this publication provides up to date illustrations and findings from Spong Hill and is a useful resource for scholars interested in the artefacts that were recovered from this cemetery.

The second Spong Hill study published in 1994 was solely devoted to the cremated remains (McKinley 1994). This publication is the most detailed study of human bones from an Anglo-Saxon cremation cemetery to date and is a valuable resource. A total of 2,384 cremation burials were examined in this report, making Spong Hill the largest early Anglo-Saxon cremation cemetery excavated and assessed to date (McKinley

1994, 3). The osteological methods applied to the Spong Hill assemblage correspond with those used in the Sancton cremated bone report (McKinley 1993). In addition, the age groupings employed in the Sancton report were also utilised in the Spong Hill study, which will allow more accurate demographic inter-site comparisons. All of the results collected from analyses were printed in the publication which is generally rare and is advantageous for other scholars and archaeologists who often experience difficulties when trying to gain access to the raw data of a collection. The demography of the site, pathology and morphological traits were discussed and interpreted in great amounts of detail alongside an attempt to reconstruct the population size from the cremated remains (McKinley 1994, 69-71). An entire chapter was devoted to the cremation process, which draws upon modern, ethnographic and experimental studies to explain the nature of cremated bone, such as crystal structure and mineral changes, shrinkage, fissuring and colour. This section of the publication is extremely important since the cremation process had never been researched in relation to Anglo-Saxon cremated material before this report. The cremation ritual was also explored through an examination of the characteristics of cremated bone, such as fragmentation, which was suggested to have been the result of tending, raking and collecting the burned remains (McKinley 1994, 84-85). Relationships between the demographic attributes of individuals, pyre goods, cinerary urns and multiple burials were noted, where applicable, which mirrors the approach adopted in the study by Richards (1987), but on a site-specific scale. Some pyre good groupings were established based on biological sex: for instance males were often buried with tweezers, shears and blades (McKinley 1994, 89), which is significant as no previous study had recognised sexually diagnostic artefacts from cremation burials. Animal remains were also assessed in similar detail to the Sancton report (Bond 1994). In sum, this in-depth bio-cultural analysis of the Spong Hill cremated remains was thorough, detailed and illustrated with site plans and photographs of significant finds. The only missing feature from this report was an examination of spatial distribution according to age and sex as this may provide a greater insight into the social structure of the Spong Hill populace during the Anglo-Saxon period.[8]

More recently, a detailed social analysis of the Spong Hill cremation burials was undertaken by Mads Ravn (2003). The main focus of this study was the ornamentation of the urns and the provision of artefacts in relation to biological age and sex. Ravn (2003, 108) points out that the variables undertaken in this study are analogous to those used in Richards' (1987) inter-site analysis, especially with regards to the form and decoration of cinerary urns. The primary difference between these studies is that Ravn's research employs a much larger dataset for the Spong Hill site (Ravn 2003, 108). Consequently, Ravn (2003, 99) felt it was necessary to reassess the material in more detail using advanced statistical techniques. Two core analyses were carried out using the abundant data sources from the Spong Hill site reports to determine a relationship between demographic and artefact based variables. The first of these analyses was the examination of pottery stamps, gender and age while the second inspected artefacts, gender and age. Conventional (two-dimensional) analyses, such as the frequency of stamp types belonging to each age category, were carried out before the use of correspondence analysis to assess the significance of any patterns noted from the former type of analysis. This was important as no previous Anglo-Saxon cremation cemetery study had used correspondence analysis, or any other multivariate statistical techniques for that matter, to assess the relationship between variables. The only other author who did use statistical methods was Richards (1987, 72), who used principal components analysis to understand the variability among cinerary urns. A reassessment of the Spong Hill assemblages highlighted the presence of numerous sexually diagnostic artefacts: for instance, males were often associated with hone stones, glass vessels and playing pieces, while females were connected with spindle whorls, coins, pendants, glass beads and brooches (Ravn 2003, 114, 116-117). It is

[8] The Spong Hill cinerary urns, cremated bone and small finds are held in Norwich Castle Museum and Art Gallery (Norfolk).

interesting that statistically significant associations between grave goods and age were recorded among males, which the author suggested may have represented an internal social division among all males regardless of age (Ravn 2003, 117-118). This separation is supported by a number of stamp types associated with cinerary urns containing male cremated remains; while no connection between stamp types and female cremations was observed (Ravn 2003, 114). The spatial distribution of biological sex and age was also examined which pointed to an even distribution in both cases, suggesting that the Spong Hill community was buried in familial groups (Ravn 2003, 118). The main problem with this study was that the axes of the graphs were not labelled, which leads to some confusion regarding their meaning. Nonetheless this publication was an important step forward for Anglo-Saxon cremation studies as it examined the relationships between osteological remains, pottery stamps and pyre goods by statistical means. Despite the application of more sophisticated analyses, the results of Ravn's (2003) study were generally in agreement with the results presented in Richards (1987) inter-site assessment. Furthermore spatial distribution within an Anglo-Saxon cremation cemetery was considered for the first time. This is an important means of analysis, especially when assessing demographic data and artefact assemblages, as such an approach can deepen our understanding of social organisation during the early Anglo-Saxon period.

2.2.11 Mucking

The site at Mucking in Essex is best known for its settlement archaeology. However, this is the only site from the Anglo-Saxon period to be found in association with two cemeteries. Cemetery I is an inhumation cemetery, which only produced bone from four inhumation burials due to the acidic nature of the soil, while the second cemetery shows clear evidence of a mixed-rite site and yielded 403 cremation burials and 76 inhumations that contained skeletal remains (Mays 2009, 436). The cemeteries at Mucking were discovered and excavated between 1965 and 1978 by Margaret Jones and Tom Jones (Clark 1993, 1). The first volume of the Mucking excavation reports was published by Ann Clark in 1993 and focused upon the site discovery, excavation and post-excavation at Mucking. The only specialist reports included in this volume examined geology of the Mucking area, slag and metallurgical residue analyses. There was a limited amount of information concerning the cemeteries at this site, though this is understandable since the aim of this publication was to provide background information for the subsequent Mucking volumes (Clark 1993, 1). Also in 1993, Helena Hamerow published the second volume of the Mucking site. This publication comprised of a detailed report on the Anglo-Saxon settlement from Mucking but there was little detail concerning the cemeteries at this site. However, in 2009 Sue Hirst and Dido Clark published the third volume of the Mucking excavations which solely focused on the Anglo-Saxon cemeteries. This volume was published in two parts; the first produced an introduction, catalogue and specialist reports of the site which explored the analyses carried out on material culture, charcoal, human and animal remains, while volume two contained an analysis and discussion of the finds from the site.

Simon Mays (2009) produced the osteological report for the second cemetery site at Mucking, which produced 403 cremation and 146 inhumation burials. Despite the large quantity of cremated material from this site, a limited amount of analysis was carried out on the burned bone. This is evident as the bone report comprised of only five pages. The primary factors considered in Mays' (2009) report included: the recovery of the bones, bone preservation (weight and fragment size), age and sex profiles and pyre conditions. Nevertheless, this report is interesting in that Mays (2009) compares the preservation of bone and demographic profiles of the cremated remains with the inhumed material. This provides an excellent resource since an instant comparison between both types of burial can be obtained with ease. Another important feature of this report is the accompanying disc that can be found at the back of this volume, which contains the raw data obtained from the analyses conducted on the Mucking assemblage. This disc contains detailed tables of data concerned with the small finds and cinerary urns from Mucking as well as the information acquired through osteological analysis. Table nine contains information for each cremation burial, for example age and sex of the individual, colour of bone, mean fragment size and weight of cremated bone. These data is also available on the Archaeology Data Service (ADS) website (Hirst and Clark 2010). The availability of these data allows detailed comparative studies to be carried out with contemporary cremation sites.

In the second part of this volume a whole section is devoted to the cremation burials (Hirst and Clark 2009, 585-637). Initially this chapter explores pre-cremation rituals, pyre construction, cremation of the deceased with accompanying artefacts or offerings, collection of remains from the pyre site and subsequent interment of the cremated material, animal remains and associated features. A great deal of attention is also lavished upon the cinerary urns and artefacts interred within cremation burials. A social analysis is afforded seven pages of the report and explores cultural and ethnic groups based on cinerary urns and artefacts (Hirst and Clark 2009, 626-627). This section shows similarities with earlier works that were primarily interested in the origins of early Anglo-Saxon communities. Nevertheless, there is some discussion concerning the relationship between biological attributes, such as age and sex, and associated material culture. The main conclusion that was drawn from these analyses was that the quantity and type of artefacts increased with an individual's age, the height of cinerary urns increased with age and males were generally afforded larger vessels than their female counterparts (Hirst and Clark 2009, 630).

Spatial analysis was also conducted on the cremation burials from Mucking to explore the presence, or indeed absence, of spatial patterning based on the age or sex of individuals. The results obtained from these analyses were analogous to those identified in Ravn's (2003, 118) assessment of Spong Hill, given that there were no specific areas afforded to certain members of the community, which may suggest the use of familial plots (Hirst and Clark 2009, 633). The status and beliefs of these individuals were also explored based on associated material culture, which were then compared with Richards (1987) inter-site study and artefact assemblages from contemporary inhumation cemeteries. The primary problem with the ideas presented in this section is that they are relatively outdated and insufficient evidence was obtained from Mucking to support the proposed interpretations. It is unfortunate that, based on the large number of cremation burials excavated from this site, a more detailed osteological assessment and subsequent discussion were not afforded to the Mucking assemblage. However, this report is important since it does provide evidence of the demographic structure of this cemetery population. It also draws on relationships between age and sex profiles alongside associated artefacts and spatial distribution, which, on the whole, appear to correlate with finds from Sancton and Spong Hill. This contributes to our knowledge of early Anglo-Saxon cremation cemeteries, though does not take advantage of more modern methodologies and ideas that could have been applied to the material from this site[9].

2.2.12 Cleatham

In 1998 Kevin Leahy published a brief report on the excavation and finds from Cleatham in North Lincolnshire. This review provided background information on the site including its location, excavation methods and number of burials. Before this note in the journal *Medieval Archaeology,* the Cleatham cemetery had not been examined despite the discovery of the site in 1856 and complete excavation of the cemetery in 1985 as a result of changing agricultural practice (Leahy 2007, 3). It appears that this introduction to the site was to raise awareness of its existence. Nine years later Leahy (2007) published a detailed report on the pottery from Cleatham. A total of 1204 cinerary urns were initially identified, although only 979 deposits of cremated bone were recorded from the site and recent work by Gareth Perry (University of Sheffield) suggests that the total number of funerary vessels was slightly lower than originally recognised (Leahy 2007, 263; Perry, pers. comm.). The 2007 report was split into four

[9] The cremated bone, small finds and cinerary urns from Mucking cemetery II are now stored by the British Museum (London).

main sections focusing on cemetery organisation, analysis of the cinerary urns, dating, and comparisons of the urns and associated finds. The first section of this report focuses on cemetery organisation, which examines phasing of the site, distribution of grave goods and burial practices. An array of site and grave plans are illustrated throughout this section which is extremely useful for spatial distribution analysis. However, only three pages are devoted to the actual human remains because at the time of publication an assessment of the cremated bone had not been conducted. The 62 inhumation burials were analysed by Betina Jakob in 1999 for her MSc dissertation at the University of Sheffield. General conclusions established in this study were included in Leahy's (2007, 60-61) report where he also dedicated a couple of paragraphs to the relationship between grave goods and the age and sex of inhumed individuals. This discussion could have been elaborated upon since it produced some interesting results: for instance, adolescents were buried with artefacts more commonly found with adults (Leahy 2007, 61). Further analyses of these data, for example comparing body position, presence and types of grave goods and spatial distribution of the inhumation burials based on demographic data, would also have provided an interesting insight into the social structure of the Cleatham community. In addition, this information would have allowed comparisons with other contemporary inhumation cemeteries. It would also be of interest to compare the results acquired from the inhumation graves with the cremation burial data. This avenue of research may demonstrate whether groups that practiced different burial customs maintained a similar social structure and held comparable beliefs.

The remaining sections of the Cleatham report focused on the cinerary urns excavated from the cemetery while regional potters and associated finds were also illustrated and described in detail. The comprehensive analyses conducted on the urns and small finds in the Cleatham study is incomparable, which is extremely encouraging if future Anglo-Saxon cremation cemetery studies follow a similar format. The old tradition of determining the origins of the local populace based on pottery remains is absent from this report. However, the dates, and a typology, of the urns were established based on their decoration and form alongside comparisons with analogous urns from contemporary English cremation cemeteries. Another important resource associated with this report is the availability of the raw data obtained from the Cleatham material on the ADS website (Leahy 2007, 264; Leahy 2007(b)). The online database contains detailed information relating to the inhumation burials, cinerary urns and small finds from the Cleatham cemetery. The primary drawback of this report was the absence of an osteological assessment of the cremated material, although the inclusion of such data was impossible at the time of publication since the cremated remains had not been analysed.[10]

2.3 The potential of cremated human remains

Over the past couple of decades the interest in early Anglo-Saxon cremation practices has increased significantly. Researchers are now employing more sophisticated techniques of analysis to understand the individuals and communities who carried out cremation practices. This new found attention also appears to have been due to the development of more advanced methods in biological anthropology. Before outlining the more advanced methodologies employed in this study, the following section will explore new techniques that are currently being used in the fields of archaeology and forensics. These analyses may be applicable to Anglo-Saxon cremated material and may shed further light on demography, society and pyre technology during the period in question.

2.3.1 Biological sexing based on the petrous bone

Owing to the severe fragmentation of Anglo-Saxon cremated remains it is frequently difficult to establish the biological sex of individuals that were afforded the cremation rite. The petrous portion (or bone) of the temporal is one of the most dense and robust

[10] The cinerary urns and cremated bones from the Cleatham cremation cemetery are now stored in North Lincolnshire Museum (Lincolnshire).

structures in the human skeleton and is easily identifiable in cremated human remains, for example at Spong Hill (McKinley 1994, 20; Norén *et al.* 2005). The determination of sex based on the petrous bone is a method first devised by Joachim Wahl (1982, 95). This sparked an interest among other biological anthropologists who employed a variety of techniques to assess this bone. These methods were primarily based on metrics, for example measuring identifiable markers of the petrous bone (Wahl and Graw 2001), the lateral angle technique (Norén *et al.* 2005), an assessment of the angles and directional course of the internal acoustic meatus (Graw, Wahl and Ahlbrecht 2005) and an examination of the diameter of the internal acoustic meatus (Lynnerup *et al.* 2006). In all studies biological sex differences were recorded at a statistically significant level. However, research conducted by Schutkowski and Herrmann (1983, 226) highlighted that a number of the metric traits employed by Wahl (1982) were not reliable when attempting to establish biological sex based on the petrous bone. Lynnerup *et al.* (2006, 122) indicate that the diameter of the internal acoustic meatus may be suitable for sexing subadults, but further research is required. In addition, a recent study by Gonçalves, Campanacho and Cardoso (2011, 123) highlighted that the lateral angle of the internal auditory canal cannot be accurately used to establish the sex of subadults. Each of the research projects outlined above, aside from Wahl's 1982 study, use modern forensic samples with known sex. Successful results from a number of these studies strengthen the case for using these new methods, in conjunction with traditional osteological techniques, to determine the biological sex of individuals from Anglo-Saxon cremation burials. The primary advantage of these techniques is that, owing to the high survival rate and subsequent analysis of the petrous bone, a greater number of individuals from archaeological contexts will be assigned a biological sex. Furthermore, it may reinforce, or disprove, the previous conclusions drawn from Anglo-Saxon cremation cemeteries, that is, there is a clear bias towards female remains over males (McKinley 1993; McKinley 1994). The reason for this bias could be a result of underdeveloped or gracile features of younger males alongside the loss, in most instances, of sexually diagnostic elements of the cranium and os coxa (McKinley 1994, 68-69).

2.3.2 Thin-section analysis

Gilbert Forbes (1941) was the first to recognise the value of conducting thin-section (or histomorphological) analysis on human cremated bone. Forbes (1941, 60) carried out a number of experiments to determine the most efficient means of conducting thin-section (or histomorphological) analysis and established that cortical bone should be employed since trabecular bone is easily destroyed as a result of the cremation process. However, it wasn't until Bernd Herrmann (1977) conducted histomorphological analysis on archaeological material, which drew attention to a number of structural changes that occurred as a result of the burning process, that this technique received the recognition that it deserved. The cremated bone samples employed in this study were from Iron Age contexts and, thus, demonstrated that thin-section analysis can be applied to archaeological material. The main findings from this study emphasise that at the 'critical level' (700-800˚C) cremation is complete as the organic matter is completely incinerated and cause the crystals of bone mineral to fuse (Herrmann 1977, 101). The author also explores the underlying factors that cause the shrinkage of cremated bone. Thin-section analysis is extremely useful since the structural composition of burned bone can be assigned to a particular stage of the cremation process. Such detailed information can provide an insight into the temperatures that were reached on Anglo-Saxon funerary pyres, as opposed to a sole reliance usually placed on the colour of cremated bone. Histomorphometry can also shed some light on the duration of a cremation. For example, if a bone was placed on a pyre for a short period of time the outer cortical bone would show signs of complete cremation (e.g. the fusion of hydroxyapatite crystals) as the outer surface of bone would be directly exposed to high temperatures. In contrast, the inner cortical bone would show less intense incineration due to indirect contact with the fire (Holden, Phakey and Clement 1995, 27). This form of evidence holds significant implications regarding the social status of individuals belonging to communities that practised the cremation rite, for instance a greater investment was placed in the cremation rite of a prominent member of the community. Other studies that have employed histomorphometry also point out the potential of this technique when attempting to establish biological age (Hummel and Schutkowski 1993; Nor, Pastor and Schutkowski 2006). Nor, Pastor and Schutkowski (2006, 19) carried out thin-section analysis on a sample of unburned long bones from a Malaysian population and found that the number of osteons and size of Haversian canals increase with age while the size of osteons decrease with age. In addition, this method would be particularly useful when estimating the age of older individuals (i.e. those over 40 years) who were afforded the cremation rite, since the use of standard osteological methods is difficult owing to the cremation process and poor preservation.

A major problem with this technique is the fragile nature of cremated bone which often crumbles when attempting to cut thin-sections. This kind of drawback may deter osteologists and archaeologists from implementing histomorphometry in their research because of its time consuming nature. In the Spong Hill cremated bone report, McKinley (1994, 16-17) also commented on the problems that may be encountered in the production of thin-sections. Nonetheless, despite excluding this method from the Spong Hill study, she did state that it is possible to use this technique with archaeological material (McKinley 1994, 17). A solution to this problem is to use long bone fragments as these are robust and most suited for this type of analysis.

2.3.3 Scanning electron microscopy

Scanning electron microscopy (SEM) provides more precise detailed results than thin-section analysis. This technique is a reliable and reproducible method that can generate images of high resolution. Scanning electron microscopy is enhanced further when used in conjunction with energy dispersive x-ray spectroscopy (SEM/EDS), which produces an X-ray spectrum allowing examination of structural changes in bone (Bush *et al.* 2008, 419). A number of studies have been carried out using the SEM method on modern samples which record a variety of modifications to bone microstructure as a result of thermal alteration (Carr, Barsley and Davenport 1986; Holden, Phakey and Clement 1995; Holden, Phakey and Clement 1995(b); Quatrehomme *et al.* 1998; Schmidt 2008). These transformations transpire at various temperature thresholds and cause changes to combustion of the organic portion of bone tissue, recrystallisation (and an altered range of crystal morphologies) and fusion of crystals (Holden, Phakey and Clement 1995(b), 32-38). Furthermore, through the application of SEM, samples can also be ascribed to broad age categories, namely 1-22 years, 22-60 years and over 60 years of age, based on hydroxyapatite crystal morphology and size (Holden, Phakey and Clement 1995(b), 41). This method would be of particular use where there was little evidence for age, such as teeth and unfused/fused epiphyseal surfaces, as a result of the cremation process. Unlike thin-section analysis this method does not require the bone to be cut into thin-sections and will save time during analysis, though the sample still requires some degree of preparation before scanning. SEM is potentially a useful technique to apply to Anglo-Saxon cremated material as it produces relatively accurate temperature ranges. This method would also be useful when assessing the biological age of cremated remains from Anglo-Saxon cremation cemeteries because, similar to sexing methods, it is often rather difficult to establish the age at death of cremated individuals owing to the lack of diagnostic skeletal elements. However, a problem with this method is that continuous crystal growth over 600˚C hinders a detailed qualitative assessment of the mineralised collagen fibres (Holden, Phakey and Clement 1995(b), 41; Bradtmiller and Buikstra 1984, 535). Nonetheless, if employed, this method could contribute to our knowledge of pyre technology and the demographic profile of early Anglo-Saxon cremation cemeteries.

2.3.4 X-ray diffraction and small-angle X-ray scattering

Studies employing X-ray diffraction (XRD) frequently record that the increased heating of bone causes an enlargement in the crystal size of hydroxyapatite, which is the inorganic fraction of bone (Shipman, Foster and Schoeninger 1984; Enzo *et al.* 2007;

Piga *et al.* 2008). Hiller *et al.* (2003, 5091) also used XRD to detect a characteristic signature of crystal change at different stages of heating, with respect to increasing temperature. However, a more refined version of this technique, namely small-angle X-ray scattering (SAXS), examines crystallite nanostructure. Crystal shape, size and orientation can be specifically detected using this method regardless of crystal lattice perfection (Hiller *et al.* 2003, 5092). Based on the results published by Hiller *et al.* (2003, 5095), it is evident that SAXS can provide more detailed feedback, than scanning electron microscopy, regarding the mineral alteration of bone when heated at various temperatures over different periods of time. Nevertheless, the results achieved through the application of SAXS correspond positively with previous investigations using SEM, in that increased temperatures cause thickening and modification to crystal morphology (Hiller *et al.* 2003, 5095). The employment of SAXS would be beneficial to the analysis of Anglo-Saxon cremated remains because more detailed and accurate information regarding pyre temperature and duration of a cremation could be extracted from archaeological samples. This, in turn, may contribute to our understanding of the social status of individuals. For example, crystal morphology that shows signs of severe alterations would suggest high temperatures and/or longer periods of time exposed to intense heat, which may imply greater investment in the cremation process of a valuable member of society. However, SAXS appears to be a complementary method to other techniques such as SEM and XRD as it records fine-scale changes to crystallite size and shape which are not measured using the latter two techniques. Therefore, the main problem with this method would be that other techniques would also be required if SAXS was to be employed when analysing the cremated remains from an Anglo-Saxon cremation cemetery.

2.3.5 Fourier Transform Infrared Spectroscopy

Fourier Transform Infrared Spectroscopy (FTIR) is a relatively new method that can be used to analyse cremated bones (Thompson, Gauthier and Islam 2009, 910). This technique explores the effects of burning on bone microstructure to gain a greater understanding of the temperature and duration of the cremation process. The application of FTIR allows the osteologist to assess the Crystallinity Index (CI), carbonyl to carbonate ratio (C/C) and carbonate to phosphate ratio (C/P) of burned bone. The Crystallinity Index, or ‘splitting factor’, is one of the changes that can be observed using FTIR. The Crystallinity Index measures the crystal structure and order of bone, which is closely associated with the mean length of these crystals (Trueman, Privat and Field 2008, 161). When these crystals are heated they become more ordered and larger, which corresponds with the increased Crystallinity Index value (Stiner *et al.* 2001, 650). The carbonyl to carbonate ratio provides details concerning the structural organisation of cremated bone (Thompson, Gauthier and Islam 2009, 911). This value can also provide information regarding the ratio of organic to inorganic material in bone, since heating results in the loss of organic material while there is an increase in the inorganic fraction of bone (Herrmann 1977, 101). Similar to the effects of heating on the organic content of bone, the exposure to increasing temperatures cause a decrease in the carbonate to phosphate value of cremated remains (Thompson, Gauthier and Islam 2009, 911). Thompson, Gauthier and Islam (2009, 914) conducted a study on modern sheep long bones to accurately predict the temperature of burning and concluded that FTIR can differentiate non-burned bones from low and high intensity cremation based on the Crystallinity Index. Interestingly, Thompson, Gauthier and Islam (2009, 913-914) also observed that the loss of collagen occurs at 700°C and consequently the Crystallinity Index becomes stabilised at this temperature threshold. This is an important discovery as other authors, albeit employing different methods, have similarly noted that bone heated to 700°C causes major changes to its structural composition (Herrmann 1977; Newesely 1988; Nicholson 1993). The primary drawbacks of FTIR analysis are that this technique is extremely expensive to run, especially given the large sample sizes that are required to produce statistically significant results, and very few studies have been conducted on burned human bone. Nonetheless, FTIR has great potential for the future analyses of cremated human bone from archaeological contexts and will provide more accurate data with regards to the cremation process than the exclusive use of histomorphometry.

2.3.6 Trace element, isotope and DNA analysis

A study was carried out by Grupe and Hummel (1991) to assess the presence of trace elements in cremated bone that were excavated from archaeological contexts. Based on the results from this study, Grupe and Hummel (1991, 185-186) concluded that the presence of primary carbon residues in cremated bone would permit the estimation of phosphorus (P), calcium (Ca), strontium (Sr), barium (Ba) and lead (Pb) levels in life through the use of regression analysis. The use of trace elements to reconstruct palaeodietary habits is limited owing to the crystal modification of bone, which occurs at high temperatures, and alteration of the trace element content, as a result of diagenetic changes. Nonetheless, this study highlights that trace element analysis is successful, which is exemplified by the strontium (Sr) and calcium (Ca) ratios, providing that cremation temperature is known (Grupe and Hummel 1991, 186). In the case of Anglo-Saxon cremated bone, the use of histomorphometry, SEM or SAXS would be required prior to the application of trace element analysis since these methods can provide a relatively accurate estimate of incineration temperature. Nonetheless, the use of trace element analysis would provide a clearer understanding of early Anglo-Saxon dietary habits. Similarly, the application of stable isotope analysis to burned bone has been conducted with varying degrees of success (DeNiro, Schoeninger and Hastorf 1985; Privat, O'Connell and Richards 2002; Schurr, Hayes and Cook 2008). The effectiveness of this technique relies heavily upon collagen survival. However, the majority of these studies produced insufficient data required for dietary reconstruction given the poor survival of collagen in intensely cremated bone.

The extraction of preserved DNA from archaeological contexts is also rather difficult on account of taphonomic degradation. Nevertheless, the successful extraction of DNA from burned bones has been recorded in a number of studies (Brown, O'Donoghue and Brown 1995; Ye *et al.* 2004). This technique would be extremely useful for obtaining accurate information concerning the biological sex of an individual and establishing family ties between individuals within the same cemetery, or indeed, the same burial (Brown, O'Donoghue and Brown 1995, 186). The increasing popularity of the methods outlined in this section will hopefully provide a greater insight into the dietary patterns of early Anglo-Saxon people. Furthermore, the use of isotope and DNA analyses may also provide evidence of family ties, migration and ethnicity of the individuals buried in these cremation cemeteries, although further work is required.

2.3.7 The use of histological analysis to distinguish between human and animal cremated remains

It is possible to identify the difference between cremated human and animal remains, though the fragmentary nature of burned bones can make the process difficult. In a study conducted by Cattaneo *et al.* (1999), histological techniques were applied to modern samples of known human and non-human bone. Haversian canal parameters and osteons were measured to identify the differences between human and animal remains (Cattaneo *et al.* 1999, 181). This study demonstrated that the use of histological methods to differentiate between human and non-human cremated remains were more successful and reliable than biomolecular techniques such as ELISA or PCR (Cattaneo *et al.* 1999, 190). As previously mentioned, the disadvantage of a histomorphological assessment is the time consuming nature of cutting thin-section samples. Thus, it would be impossible to assess an entire assemblage in this way given the sheer quantity of material excavated from Anglo-Saxon cremation cemeteries.

2.4 Summary

The interest in Anglo-Saxon cremation cemeteries continues to grow, together with the development of more reliable osteological and scientific techniques. A greater variety of research interests among early Anglo-Saxon archaeologists emerged in the latter half of the 20th century. However, it was not until the 1980s that the research focus in this field moved away from searching for the origins of early Anglo-Saxon communities to assessing their social structure and funerary rites through the analysis of material culture and cremated bone. Many finds from antiquarian excavations have been lost or remain unrecorded, which has consequently left a void in our knowledge of the period. The antiquarians offered a limited amount of interpretation regarding their archaeological discoveries, though this could be explained through the narrow research scope at the time. The research interests of antiquarians are in stark contrast to archaeologists who carried out work in the latter half of the 20th century. It is apparent from the research conducted on the Spong Hill assemblage that it is possible to analyse contemporary cremation cemeteries in a great amount of detail providing the archaeological material survives. Despite the lack of interpretation and osteological analyses in early reports, the descriptions and illustrations of artefacts are good for their time and provide a record of objects which do not always survive to the present day. Consequently, there is an abundance of information with regards to material culture, for example cinerary urns and grave goods, compared to osteological data. The reason for this discrepancy may lie in the past belief that artefacts were easier to interpret, due, in part, to the lack of adequate osteological techniques that could be applied to these remains.

There is still a considerable amount of work that needs to be carried out on skeletal assemblages from Anglo-Saxon cremation cemeteries. Future analyses that are carried out on cremated bone should make the most of new scientific techniques which are more frequently employed in forensic and anthropological studies. The application of such methods would permit a greater insight into the social structure and funerary rites of early Anglo-Saxon England. The following chapter will explore the cultural implications and symbolism of the Anglo-Saxon cremation rite.

Chapter 3: Symbolism and the rites of cremation in the Anglo-Saxon period

It has already been noted that the interest in Anglo-Saxon funerary archaeology has increased over the past 30 years. The wealth of early Anglo-Saxon cemeteries have contributed to this popular research area, as these cemeteries not only produce rich artefacts, but have also yielded large amounts of skeletal material especially from inhumation sites (Boyle *et al.* 1998; Drinkall and Foreman 1998; Malim and Hines 1998). The finds from early Anglo-Saxon inhumation cemeteries have provided the basis for the principal research themes in this field. However, a number of authors note that similar approaches to those employed in exploring the symbolic nature of articulated inhumation burials can be applied to cremated material through the examination of cremated bone and associated material culture (Richards 1987; Ravn 2003; Williams 2005(b)). This will not only enhance our knowledge of groups that practiced the cremation rite but will also contribute to our understanding of social identity during the early Anglo-Saxon period. This chapter aims to explore the cultural aspects of the Anglo-Saxon cremation rite. Initially, the lifecycle, gender and social status will be explored through an examination of material culture and animal remains that were interred within cremation burials. The final section of this chapter will examine the transformation of the body during the cremation process which will deal with the symbolism of fire and the construction of social memory through artefacts, ceremonies and rituals.

This discussion begins by addressing the concept of symbolism. Richards (1992, 131) notes that ‘a symbol is an abbreviated form of communication’. Specific symbols hold particular meanings in different societies, for example the swastika is an auspicious symbol in India (Thapar 1981, 304) while in early Anglo-Saxon society this motif is thought to have held strong connotations with Thor (Reynolds 1980, 236). In contrast, the swastika holds negative connotations in modern-day Western society owing to its association with fascism. Similarly, artefacts interred with the deceased during the early Anglo-Saxon period may have held underlying connotations in relation to an individual's social position (Pader 1980, 144). Consequently, material culture from graves can provide the most information regarding the identities of individuals from the early Anglo-Saxon period; the primary problem is attempting to decipher the meanings behind these symbols and objects.

3.1 The lifecycle, gender and social status

The construction of social identities is currently attracting a significant amount of attention in Anglo-Saxon mortuary archaeology, in particular the expression of lifecycle and gender in the funerary context. Examination of the lifecycle has been primarily concerned with the differential burial treatment and provision of age-specific artefacts in the graves of children and adults. This approach principally aims to provide an insight into early Anglo-Saxon perceptions of children within society and how they were differentiated from adults (Crawford 1999; Lucy 2000; Stoodley 2000). The most common avenue of research into early Anglo-Saxon funerary practices over the past few years has been concerned with gender construction. Gender is generally thought to be a social construction based upon the biological sex of an individual. Typically this follows a standard arrangement of male and female sex which is aligned with a masculine or feminine gender identity, often marked by gender-specific grave goods. However, this is not always the case as occasionally sex and gender-specific grave assemblages do not always accord. Roberta Gilchrist (1997, 50-51, 55) points out that a great amount of attention is often placed upon such individuals by (medieval) archaeologists, for example a biological female buried with a male artefact assemblage. This approach to gender has led to the notion of multiple genders and the identification of the so-called *Berdache* in a number of past and contemporary societies especially when grave furnishings do not correspond with the biological sex of an individual (Oakley 1972; Lucy 1997; Hadley and Moore 1999; Knüsel and Ripley 2000; Weglian 2001).

A major difficulty encountered when examining the relationship between age and grave provision is the attribution of age thresholds. Human osteologists initially employ methods to determine the biological age of an individual based on skeletal indicators, such as tooth development and epiphyseal fusion of bones. Once a biological age has been established, chronological age is assigned to an individual, that is, age since birth which is usually calculated in years. Based on biological and chronological age, the social age of an individual is related to the cultural practices and beliefs of a society, for example menarche could be viewed as an important stage in a girl's life as this physical change to the body implies the transition from childhood to adulthood (Gowland 2006, 143-144). As outlined in chapter two, the absence of uniform chronological age categories employed in osteological reports make it difficult to compare age groups from different sites (Kamp 2001, 8). In the future, this problem can be rectified through the use of a standardised set of age categories that are universally employed during osteological analyses. However, this solution would not be applicable to older reports since age categories from such publications would have to be altered in order to facilitate comparisons between sites. On the other hand, the use of a definitive set of age categories may have detrimental effects on research since social age, which is a cultural construct, may differ significantly through time and within different societies (Halcrow and Tayles 2008, 203). This is highlighted in Anglo-Saxon and medieval law codes that address the age of adult responsibilities and criminal punishments. In the seventh century, individuals as young as 10 years old could be put on trial as an accessory to theft. This increased to 12 years of age in the 11th century under the reign of King Cnut and by the 12th century King Henry I increased the age to 15 years at which point a child could be prosecuted for criminal behaviour (Orme 2003, 322). This demonstrates a shift in the age of responsibility, which will consequently change social organisation, though this cultural information could not be obtained through the examination of osteological remains alone.

Gender may also change throughout the lifecycle. The most important interrelated aspect concerning age and gender, which connects biological and social age as well as sex and gender, is menarche and the menopause (Prout 2000, 10). Nick Stoodley (1999) identified key stages of the lifecycle based on biological age and gender-specific artefacts through the examination of grave assemblages from 46 early Anglo-Saxon inhumation cemeteries. Gender appears to have played an important role once females had reached the age of 10-12 years and continued until the 40 years mark, while gender became particularly noticeable among males during the late teens and became less significant after the age of 40 years (Stoodley 1999, 118). Sally Crawford (2000, 174) has recognised that the most frequently recorded grave goods from inhumation burials assigned to infants and children include: knives, beads, buckles, brooches, containers, pins and coins. Grave assemblages offered to younger members of the inhumation practicing communities contained a more limited range of objects than their adult counterparts. Artefacts commonly found within adolescent (those who had reached the adulthood threshold) and adult inhumation graves consisted of a more varied range of artefacts, which are frequently based upon clear gender divisions. Jewellery, including brooches and wrist clasps, and domestic related objects, for example spindle whorls, are predominantly found with females. In contrast, males are often associated with military accoutrements such as shields, spears and swords. The identification of polarised categories suggests that gender strongly relies on the biological sex of an individual (Stoodley 1999, 49). Stoodley (1999, 108, 118; 2000, 459) also points out that many of the young individuals (those less than 12 years) and some of the older members (those over 40 years) of the cemetery assemblage were provided with ‘gender neutral’ grave provisions, which include knives and pottery. Of course, there may be diverse reasons for the absence of gendered artefacts in the graves of the youngest and oldest members of society, for example gendered grave provision may signify an individual's economic and social role within the community. However, there is evidence that a number of individuals, either below or over this age threshold, were buried with gender specific items: for example a weapon burial was assigned to an individual under 12 years of age at West Heslerton (North Yorkshire) (Lucy 1998, 46), while at Berinsfield (Oxfordshire) a male over 45 years was interred with a weapon assemblage (Boyle *et al.* 1995, 54). In most cases when gender specific objects occur in the burials of infants and children they closely reflect the typical female assemblage outlined above. A similar pattern has also been identified among a number of sixth century inhumation graves at Dieue-sur-Meuse, France (Halsall 1996, 14). Halsall (1996, 14) has suggested that alternative to the notion that this represents the gender of these young individuals, infants and children may have been considered as extensions of their mothers, regardless of biological sex, and were consequently interred with feminine grave goods. Therefore, burials containing gender-specific artefacts must be approached with caution to avoid drawing immediate conclusions regarding the sex or gender of an individual (Lucy 1997, 150; Sofaer Derevenski 1997, 192; Crawford 1999, 18; Carver and Fern 2005, 288).

The social status of individuals who were afforded the inhumation rite has been established through a number of means based on grave good provision. Artefact type and the frequency of objects within burials are the most common factors used to determine the social status of individuals within a cemetery population (Arnold 1980, 108). Artefacts commonly associated with high-status individuals include: weapons, drinking vessels, playing pieces and elaborate jewellery (Härke 1990, 37-38; Stoodley 1999, 92-94). The production of these items would have required a significant amount of labour, time and economic investment. The late sixth and seventh century 'princely burials' highlight the association between high-status and elaborate grave goods for example polychrome jewellery, drinking horns, bronze vessels, helmets, weapons and horses are often found in these types of burial (Carver 1992, 362; Carver 1992(b), 177; Fern 2010, 134). However, these types of burials are relatively rare and the vast majority of inhumation burials contain more modest grave assemblages. The following sub-sections will explore the manifestation of the lifecycle, gender and social status within the cremation rite. These aspects of social identity will be compared with contemporary inhumation burials which intend to highlight the presence, or absence, of shared cultural attitudes towards age, sex and gender and social status.

3.1.1 The lifecycle

In contrast to the inhumation rite, artefacts associated with the lifecycle are less pronounced in cremation burials. However, it is notable that infants and children from both inhumation and cremation cemeteries are buried with fewer grave and pyre goods than adults (Härke 1989, 147; Crawford 1999, 169). Richards (1987, 130) inter-site study showed a strong relationship between infants interred with iron shears and iron blades while adults were strongly associated with iron tweezers, ivory, bone fittings, glass and playing pieces. Correspondence analysis conducted on the Spong Hill assemblage highlighted a positive correlation between infants buried with weapons, rings and razors while adults were strongly connected with brooches, toilet sets, playing pieces, spindle whorls, ivory and buckles (McKinley 1994, 90; Ravn 2003, 110). Richards (1987, 124) has proposed that infants and children were afforded a limited range of artefacts based on the belief that the youngest members of society were perceived and treated as ‘small adults’. Based on evidence from contemporary inhumation cemeteries it appears that progression through the lifecycle is linked to an increased range of grave furnishings, for example the deposition of shields at around 12 years old (Stoodley 1999, 108). However, the type of artefacts deposited with the dead also appears to have been dependent on other factors such as sex, gender, social status, ethnicity and ideology.

The most frequently occurring species from cremation burials is sheep or goat followed by horse, though the number of these animals varies from site to site (Bond 1996, 78). Faunal remains occur with all age groups, but are particularly dominant in the burials of adolescents and young adults (13-25 years) (Williams 2005(c), 32). This trend has been identified at the Sancton (East Riding of Yorkshire) (McKinley 1993, 311) and Spong Hill (Norfolk) (McKinley 1994, 99) cemeteries. Sheep or goat is the most common species buried with infants from Newark (Nottinghamshire) (Harman 1989, 24), Sancton (McKinley 1993, 310) and Spong Hill (McKinley 1994, 99), though the contrary was found at Mucking (Hirst and Clark 2009, 588), while other domesticates occur in much smaller numbers. Furthermore, infants and children are rarely afforded more than one species of animal in the cremation rite. At Sancton, one infant and one child contained more than one animal species (McKinley 1993, 311). Only one infant and three child burials produced two types of animal bone from the Spong Hill cemetery (McKinley 1994, 99). In contrast, adolescents and adults were interred with a greater frequency and range of animal bones than infants and children at Newark (Harman 1989, 24), Sancton (McKinley 1993, 310), Spong Hill (McKinley 1994, 99) and Mucking (Hirst and Clark 2009, 588). Cremated dog remains are, on the whole, evenly distributed throughout all age groups at Spong Hill, but occur in higher numbers with young adults (McKinley 1994, 99; Bond and Worley 2006, 94-95). The latter point is also exemplified at Sancton, since dog bones were only recovered from three deposits, all of which contained adults (McKinley 1993, 310). McKinley (1994, 99) has identified that horses are found in greater numbers in, and after, the adolescent age threshold at the Spong Hill cemetery. A similar pattern is notable at Newark (Harman 1989, 24) and Sancton (McKinley 1993, 310), while cattle remains from these sites are only associated with adolescents/young adults or adults. Practical and cultural explanations have been offered to account for the relationship between biological age and the provision of animal offerings from the above sites. Jacqueline McKinley (1993, 311; 1994, 99) has proposed that infants and children would have required a smaller pyre than adolescents and adults due to their small physique. Therefore, the placement of either large ungulates or numerous animal offerings would not have been viable owing to the additional labour and economic investment required to construct a larger pyre (McKinley 1993, 311; 1994, 99). Alternatively, animal offerings, similar to pyre and grave goods, may reflect aspects of the lifecycle, for example the adolescent age threshold is associated with an increased frequency of animal bone. This may indicate that tasks within the community, such as weaving and farming, were assigned to individuals as they commenced the transition to adulthood. Therefore, grave assemblages buried with these individuals may reflect their newfound social responsibilities.

The use of cinerary urns within the cremation rite offers an additional avenue of research that can contribute towards our understanding of social identity during the early Anglo-Saxon period. A trend observed in Richards' (1987, 137) inter-site study, as well as the intra-site assessments of the Sancton (McKinley 1993, 314) and Spong Hill (McKinley 1994, 102) assemblages, highlighted that older individuals were buried in taller urns. Adults may have been interred within taller vessels to denote their social standing within the community (Richards 1987, 136). For example, the presentation of taller urns may have been an important tradition which denoted that an individual had reached a significant age threshold, or indeed a milestone, of the lifecycle. On the other hand, taller vessels may have been selected for older individuals based on practical grounds. Adults produce more cremated bone than infants and children, therefore, taller receptacles would accommodate the large amount of cremated remains from these individuals. The regional study carried out by Richards' (1987, 139) and the intra-site research conducted on the Sancton (McKinley 1993, 314) assemblage showed that there was no relationship between biological age and cinerary urn rim size. Therefore, small vessels did not necessarily boast a diminutive rim, though Richards (1987, 139) observed receptacles possessing a small rim diameter were positively associated with infants and children. Rim size may not have been an important variable in the selection process of a cinerary urn compared to other attributes of the vessel, such as height, and may explain the insignificant relationship between age and rim diameter. The relationship between age and the decoration of cinerary urns is extremely complex, though past studies have highlighted some general observations.

Vessels containing infants and children are less inclined to exhibit plastic decoration, such as applied bosses, while incised slashes and hanging arches are just as likely to occur on the vessels of children and adults (Richards 1987, 167, 174, 184; Richards 1992, 143). The presence of recurring stamped motifs on cinerary urns is commonly associated with children, while designs consisting of an outline are affiliated with adolescents (Richards 1987, 184). In contrast, vessels that contain adults exhibit a much wider range of motifs. Plastic decoration and incised diagonal lines sloping to the right are strongly connected to adults, while young adults have been linked to cruciform stamp motifs (Richards 1987, 167, 184; Richards 1992, 143). Ravn (2003, 122) has suggested that a limited number of stamps were used to represent the age of an individual. However, there does appear to have been a stronger relationship between biological sex and pottery decoration. This point will be explored in more detail later in this chapter.

3.1.2 Sex and gender

Similar to the manifestation of the lifecycle within cremation burials, sex and gender specific divisions based on grave provision are extremely rare. Richards (1987, 126) inter-site study did not identify any sex-specific artefacts but observed that males were more frequently afforded miniature iron tweezers and miniature iron shears while females were often buried with ivory. An assessment of the Spong Hill assemblage highlighted that earscoops were the only sex-specific artefacts from the site and were associated with five male cremation burials (McKinley 1994, 89). However, the low frequency of earscoops does not provide secure evidence for their preferential use in male graves. The remaining artefacts from Spong Hill occur with both sexes, though some objects do appear in slightly higher numbers within either male or female burials. Tweezers, iron shears, iron razors, knives, miniatures and iron rivets/nails were prominent artefacts in male burials while brooches, spindle whorls, bronze and antler rings and crystal were associated with females (McKinley 1994, 89; Ravn 2003, 110). Bone/antler combs, playing pieces, glass fragments (possibly from vessels), metal fragments and, of course, cinerary urns occur in similar proportions in male and female burials (McKinley 1994, 89; Ravn 2003, 110). Overall, female associated artefacts from cremation deposits correspond well with objects interred with female inhumation burials. In addition, McKinley (1994, 90) has observed that the range of artefacts interred with infants at Spong Hill shows close parallels with objects afforded to female members of the community. The similar funerary treatment of infants, children and females from both inhumation and cremation cemeteries may reflect similar attitudes towards these members of society.

Artefacts that are associated with males from cremation burials are very different in nature to the type of objects that are often found in contemporary male inhumation graves. Males who were bestowed the cremation rite were frequently interred with objects associated with grooming and personal appearance, such as toilet sets, as opposed to the weaponry commonly deposited in inhumation burials. The presence of sword fittings was recorded in eight cremation deposits from Spong Hill. Two of these fittings were assigned to females and one was ascribed to a male burial, and subsequently such low frequencies cannot provide conclusive evidence about the deposition of weapons in male and female burials (McKinley 1994, 89). The number of weapons in cremation burials from Spong Hill is miniscule compared to the frequency found within inhumation graves. This discrepancy may be related to the differential role of weapons in the inhumation and cremation rite. It has been suggested that weapons were infrequently deposited in cremation burials as they acted as mnemonic agents which represented personhood in an idealised form and was more suited to the inhumation rite (Härke 1997, 120; Williams 2005(b), 269). Williams (2005(b), 269) points out that artefacts employed in the cremation rite produced select memories of the deceased ‘through the display and transformation, fragmentation and redistribution of bodies and artefacts’. Therefore, the presence of swords among the Spong Hill cremations may indicate a small number of individuals (both males and females) who belonged to a specific social group. These individuals may have used weaponry in the cremation rite to display social status, ethnicity, occupation or specific ideological beliefs. Brush (1988, 83) has proposed that biological sex or gender played a minor role in structuring the stipulation of pyre goods as the act of cremation may have been perceived as destroying gender. The lack of polarised gender groupings from early Anglo-Saxon cremation cemeteries suggests that other aspects of social identity, such as ideological beliefs, family affiliations and age, were deemed more important influences on the cremation ritual than gender.

A small number of significant relationships have been identified between biological sex and animal provision in Anglo-Saxon cremation burials. At Sancton (McKinley 1993, 311) and Spong Hill (McKinley 1994, 99), males were found with slightly more animal bone than their female counterparts. Sheep or goat is the most common species identified with both males and females from Spong Hill (McKinley 1994, 99). Interestingly, females from Sancton produced a much higher frequency of cattle and sheep or goat remains than males; the latter species was not identified among the male burials (McKinley 1993, 311). Males are found with a slightly higher number of horse remains than females from Sancton (McKinley 1993, 311) and Spong Hill (McKinley 1994, 99). However, the provision of horses within male and female burials is not that dissimilar in number and these observations are analogous to a number of contemporary cremation cemeteries found on the Continent (Fern 2007, 102). Similarly, there is an insignificant relationship between biological sex and the incidence of dog remains at the Spong Hill cemetery (McKinley 1994, 99; Bond and Worley 2006, 94-95), though at Sancton (McKinley 1993, 311), dogs are exclusively found within female burials. In contrast to the relationship between biological age and number of species within cremation burials, the deposition of more than one type of animal is not sex-related at Sancton (McKinley 1993, 311) and Spong Hill (McKinley 1994, 99). These examples provide further evidence that sex and gender were not necessarily primary factors in the selection of grave assemblages.

Studies exploring the relationship between biological sex and cinerary urn attributes have produced, on the whole, relatively unfruitful results compared to assessments that explore the association between vessel dimensions and age. The inter-site study conducted by Richards (1987, 137) highlighted that males produced a slightly larger mean urn height than females. Based on these results, it has been suggested that cinerary urn height may have denoted social position within a community. Therefore, this would suggest that females held a lower social standing than males (Richards 1987, 137). In contrast, analyses run on the Sancton assemblage produced statistically insignificant results between cinerary urn height and biological sex (McKinley 1993, 314). Furthermore, Richards (1987, 139) pointed out that males were not necessarily interred in vessels with a larger rim diameter. Similarly, an insignificant relationship between biological sex and vessel rim size was noted from Sancton (McKinley 1993, 314). These results add further support to the concept that age and other aspects of social identity were considered more important in the cremation rite than sex and gender. Nevertheless, there appears to be a number of correlations between cinerary urn decoration and biological sex. Males have been associated with vessels displaying incised, stamped and plastic decoration. Some of these associated motifs include cordons, vertical lines, bosses, diagonal lines sloping to the right and a variety of stamps (Richards 1984, 52; Richards 1992, 143; Ravn 1999, 46-47). In contrast, females were less likely to have been afforded urns that were decorated with plastic and incised curvilinear motifs (Richards 1984, 52-53). However, positive correlations between females and vessels that were adorned with diagonal lines and, similar to children, stamps made up of repeated motifs have been established (Richards 1984, 53; Richards 1987, 184). Ravn (1999, 51-52) has suggested that a group of males from the Spong Hill cemetery who were buried in highly decorated vessels highlights a social divide within household groups and among the wider community. Based on these observations it is notable that, aside from the age, sex and gender of an individual, cinerary urn decoration may represent many aspects of an individual's social identity including ideology, ethnicity, social status and family affiliations (Briscoe 1981, 28; Arnold 1983, 27; Richards 1988, 147).

3.1.3 Social status

Given the passing comments made about social status in the previous paragraphs, it is worth exploring this aspect of identity in more detail. Bone and antler combs and glass beads occur in almost all cremation burials and appear to have been an important object in this funerary rite regardless of social standing (Williams 2003, 101). However, the death of a prominent person may have held considerable repercussions on the immediate community. Therefore, as a means of recreating social relations within the group, additional resources, such as labour, and elaborate grave assemblages were invested into the cremation rite of important members of the community (Halsall 1996, 13). The grave furnishings offered to these individuals appear to have been selected based on their status, or role, within society. Artefacts associated with high-status in early Anglo-Saxon cremation burials include: playing pieces, glass and bronze vessels, cremated horse bone and stamped pottery (Ravn 2003, 127; Fern 2007, 99). The high-status objects found in cremation burials are similar to those found in contemporary inhumation graves, though the range of prestigious items is evidently more limited.

Individuals who were able to spare more time for leisure activities are likely to have belonged to high-status groups. Stoodley (1999, 93) has suggested that gaming pieces, frequently fashioned out of animal bone or antler, represent the amount of time an individual devoted to leisure activities. Distinctive animal bones, such as sheep astragali, are sometimes found in cremation burials and may have also been used for the same purpose (Wilkinson 1980, 228). The provision of gaming pieces may have also served as a means of evoking memories among mourners who participated in leisure activities with the deceased (Devlin 2007, 37).

A number of motifs identified on cinerary urns have been associated with high-status individuals, though the most widely discussed design is undoubtedly the swastika (Ellis Davidson 1964, 83; Reynolds 1980, 236; Wilson 1992, 142-146; Ravn 1999, 52). This representation has strong connotations with fire and Thor's hammer, which makes it of particular interest given that swastikas adorn vessels employed in the cremation rite (Wilson 1992, 146). There is still a great deal of mystery surrounding the swastika from these contexts, though various interpretations have been offered. It has been suggested that vessels ornamented with the swastika motif contained the remains of individuals who held specific ideological beliefs (Ravn 1999, 52). Interestingly, Reynolds (1980, 236) has pointed out that the swastika may have been a symbol of social standing rather than ideological beliefs based on the presence of this motif within the high-status burials at Sutton Hoo. However, Carver (1992, 350, 363) has pointed out that the symbolism employed in the Sutton Hoo cemetery was carefully selected based on aristocratic customs and ideological beliefs. Alternatively, the swastika may have been employed for the sole purpose of decoration (Wilson 1992, 143). The use of runes has also been identified on a small number of Anglo-Saxon cinerary urns, and, similar to the swastika, are elusive in their nature. A runic urn from Spong Hill contained cremated remains, though no osteological information was available, alongside a grave assemblage consisting of iron shears, bone playing pieces and glass beads (Hills 1974, 87). The runes on this urn may have represented a maker's or owner's mark. Alternatively, it has been proposed that these characters spelt out the name of the god *Tiw*, which may have been employed to protect the deceased on his, or her, journey from the realm of the living to the afterlife (Hills 1974, 91). Based on the examples outlined above, it appears that the decoration on cinerary urns provided an important medium for displaying ideological beliefs of the deceased.

The provision of horses and, to a lesser extent, dogs within the cremation rite suggests that a specific social group could afford to sacrifice commodities that other members of society would have seen as wasteful. The remains of these animals suggest that the whole body, as opposed to joints of meat, was placed upon the pyre. The burial of horses and dogs appear to convey a multitude of messages concerning the deceased's relationship with animals in life, leisure activities and social status (Fern 2007, 92). Crabtree (1995, 25) has suggested that these species were buried with the deceased as they were seen as companions to the living. At the Spong Hill cemetery, the size of dogs range from small terrier size to the physique of a wolf (Bond 1994, 132). Archaeologists have suggested that, based on funerary evidence, dogs performed a wide range of roles in early Medieval society, such as hunting, working, fighting and companionship (Gräslund 2004, 170; Bond and Worley 2006, 94). Hunting is frequently associated with the upper ranks of society (Härke 1997, 120). Evidence that dogs were used for hunting may explain the presence of deer, fox, beaver, hare, bear and raptor claws in cremation burials at Newark (Harman 1989, 24), Sancton (Bond 1993, 300) and Spong Hill (Bond 1994, 134). These species occur in small numbers and may indicate a small party of high-status individuals who took part in hunting as a means of showing their authority and social standing. Interestingly, dogs have also been found in a small number of contemporaneous inhumation burials, some of which have been recognised as belonging to high-status individuals, for example at Mitcham in Surrey (Wilson 1992, 101). Other cemeteries that have produced graves containing individuals accompanied by dogs include: Foulden (Norfolk) (Meaney 1964, 175); Minster Lovell (Oxfordshire) (Meaney 1964, 210-211); Loveden Hill (Wilkinson 1980, 229) and Great Chesterford (Essex) (Serjeantson 1994, 66). The dogs from these inhumation burials showed evidence that they were either very old or were no longer able to work due to physical impairment. In addition, the dogs from the Spong Hill cremation burials were all identified, with the exception of one, as adults (Bond 1994, 134). Wilson (1992, 100-101) has concluded that given the infirm nature of dogs interred within inhumation burials, it seems probable that these animals were placed in the grave alongside their owners as companions for the afterlife.

Horses would have been of particular value during the Anglo-Saxon period. The roles of these animals in life would have been entirely dependent on the owner. There is evidence to show that horses were exploited for working and transportation (Bond and Worley 2006, 94). The presence of pathological lesions, namely exostoses, on a number of horse metapodials from the Spong Hill cemetery suggests that these animals were used to pull heavy carriages or wagons (Bond and Worley 2006, 93-94). Despite the fact that these animals were used for working, horses are likely to have been a status symbol and an indication of an individual's wealth since the initial purchase and subsequent upkeep of these animals would have been expensive (Bond and Worley 2006, 94). Horse riding would have been an important means of transportation during the Anglo-Saxon period. The cremation and burial of whole horses may have also played an important part in the ideological beliefs of an individual. Williams (2005(c), 33) has suggested that the sacrifice, and subsequent burial, of horses was based on the belief that these animals would have served as a mode of transport into the afterlife. Interestingly, an ethnographic study of the Saami (who inhabit areas in northern Norway, Sweden and Finland) conducted in the 19th century recorded that once a recently deceased member of the community had been buried, a reindeer was sacrificed on their grave so the dead could ride into the next life (Van Gennep 1960, 154). The idea that horses would carry the dead into the afterlife may explain why the whole creature was cremated and interred during the Anglo-Saxon period, as butchering the animal into smaller portions would not permit the horse to fulfill its purpose in the next life.

As previously mentioned, owing to the large size of horses, a cremation pyre that was to accommodate both man and beast would have required additional economic investment, such as fuel and labour. In most instances, animal bone was placed within the deceased's cinerary urn. However, there are numerous examples of cremated animal bone that have been found in separate receptacles or in a unurned manner either within the same grave cut as the deceased or in a neighbouring pit (Fern 2010, 131). Urns that mainly contain animal bone are frequently referred to as ‘accessory vessels’. Examples of these vessels have been found at Newark (Harman 1989, 24); Sancton (McKinley 1993, 309-310) and Spong Hill (McKinley 1994, 93). Animal accessory urns are associated with individuals belonging to all age and sex groups, though there does appear to be a slight preference towards adults (McKinley 1993, 309-310; McKinley 1994, 93; Williams 2005(c), 33). Horses are the most common species interred within accessory vessels from early Anglo-Saxon cremation cemeteries, though cattle, sheep or goat, pig and dog have also been identified within individual urns (Fern 2007, 97). The tendency to bury horse bone within a separate vessel may have been a practical choice since these animals produce a large quantity of cremated material. Williams (2005(c), 33) has observed that the majority of accessory vessels from Spong Hill are plain in comparison to cinerary urns that contain human remains, although incised decoration is sometimes applied to these receptacles. Therefore, the mourners would have been able to distinguish between the cinerary urn and the accessory vessel based on the motifs adorning these containers. There is little doubt that the cremation and subsequent interment of a horse within an accessory vessel would have conveyed a strong message, regarding the social status of the deceased, to the living.

The cremated bones of wild animals have been recorded from a number of cremation cemeteries including Newark (Harman 1989, 24); Sancton (Bond 1993, 307-308) and Spong Hill (McKinley 1994, 92). The discovery of fox remains, in particular cranial bones, within cremation burials suggests that these wild animals were exploited for their skins (Pluskowski 2010, 114). Fox bones have been recorded from one burial at Sancton (McKinley 1993, 310) and two deposits from Spong Hill (McKinley 1994, 92). Bear remains have been identified in one burial from Sancton (McKinley 1993, 310) and on six separate occasions from Spong Hill (McKinley 1994, 92). At both sites, bear bone and teeth are associated with older adults and males, although one female burial contained bear claws at Spong Hill (McKinley 1994, 100). Likewise, the occurrence of bear remains, within contemporary cremation burials on the Continent, is more frequent among male burials, but there are exceptions to the rule (Holck 1986, 171-173; McKinley 1994, 100). Similarly, bear claws, phalanges and teeth are occasionally found in Anglo-Saxon cremation burials, which suggest that these animals were also killed for their furs. Based on archaeological evidence, bear claws, phalanges and teeth are relatively rare from cremation burials which may suggest that fur pelts were afforded to select members of the community. These individuals may have held ideological roles, such as priests, and employed pelts as part of a ritual or on ceremonial occasions involving animal disguise (Schönfelder 1994, 224; Pluskowski 2010, 114). Alternatively, animal skins may have been viewed as high-status objects since hunting would have been a dangerous endeavour (Pluskowski 2010, 117). It is also worth mentioning that bear skins would have been acquired through trade from the Continent since bears are thought to have become almost, if not entirely, extinct in Britain by the end of the Roman period (Dent 1974, 35-36; Pluskowski 2010, 114). The cremation and burial of wild animals is likely to have conveyed a variety of messages relating to the deceased's identity, ranging from ideological beliefs to social status.

The stylistic and abstract representation of animals on cinerary urns has also been associated with individuals belonging to a higher social standing. Fern (2010, 141) has suggested that 'U' shaped stamps found on a number cinerary urns, which are also seen in much smaller form on jewellery such as brooches and bracteates, resemble horse feet. Furthermore, the application of incised and moulded arches has been interpreted as an abstract representation of the horse shoe stamp (Fern 2010, 141). Chevron, grid and cross designs have also been connected to horses which are frequently associated with wyrm and swastika motifs (Williams 2005(c), 21; Fern 2010, 141). In 2005 Howard Williams produced a paper which, in part, explored the relationship between animal-linked ornamentation on cinerary urns and the animals interred within these vessels (Williams 2005(c), 21-22). He concluded that there is not an explicit relationship between the presence of animal bones and vessels that are adorned with zoomorphic motifs and stamps (Williams 2005(c), 22). These findings quash the notion that certain animals are associated with specific stamp types, for example horses buried within vessels with horseshoe decoration. The stylistic depiction of animals on cinerary urns − primarily through stamped motifs though there is also evidence of freehand incised drawing – provides explicit evidence for the important role they played in early Anglo-Saxon society (Hills 1983, 93). Species frequently represented on funerary vessels include: birds, deer, boar, wolves and dogs, though horses appear to be the most common (Eagles and Briscoe 1999). The irrefutable depiction of animals on cinerary urns is rare. However, some examples have been recorded from the Caistor-by-Norwich (Norfolk), Newark, Spong Hill and Lackford (Suffolk) cemeteries, while a small amount of comparable material has been identified on the Continent, for example at Süderbrarup, Angeln (Capelle 1987, 94; Hills 1983, 93). Archaeologists have suggested that individuals interred within urns decorated with animal motifs held a high social standing or ideological position within society (Ravn 1999, 51-52; Williams 2005(c), 21). Both explanations are plausible since the animals that are depicted on these vessels hold mythical connotations and are connected to high-status activities, such as hunting and horse riding. So far, this chapter has highlighted how grave assemblages were used to reflect the social identity of the deceased. The final section of this chapter will explore social memory and transformation of the dead through the cremation rite and accompanying grave assemblages.

3.2 Transformation and remembrance in the cremation rite

During the Anglo-Saxon period, it is likely that mourners would have witnessed the cremation process. The living would have observed the transformation of the human body from a recognisable individual to a mass of skeletal remains. In contrast, the inhumation rite hides this transformation from the living (McKinley 2006, 84). This suggests that the presentation and interment of the dead were more important in the inhumation rite while the transformation process of the deceased and associated rituals were deemed more significant in the cremation rite. This section will explore the transformation of the body as a result of the cremation process and how the cremation rite acted as a mnemonic agent. The final stage of the cremation rite that is archaeologically visible, which involves the burial of the cremated remains, will also be explored. A sub-section dedicated to ethnographic case-studies aims to offer an alternative perspective on the Anglo-Saxon cremation rite. To begin with, the symbolic role of artefacts and animals will be examined to gain an insight into the ideological beliefs of early Anglo-Saxon communities.

3.2.1 The symbolic role of artefacts and animals in the cremation rite

John King (2004, 225-226) has observed that mortuary costume articles, for instance brooches and buckles, frequently display some evidence of burning, in contrast, toilet implements, combs and coins, are more likely to have been ritually broken and are often found unburnt. McKinley (2006, 82) has described pyre and grave goods as ‘intrinsic’, items worn by the dead which are linked to mortuary attire and display such as buckles, and ‘extrinsic’, which have been interpreted as personal or practical objects and offerings, for example food and toilet sets. The placement of items on a funerary pyre may have permitted concurrent transformation with the deceased, allowing immediate use in the afterlife (McKinley 2006, 82). Conversely, this practice may have been a deliberate attempt to destroy these objects, for instance the conscious breakage of combs. Intentional damage inflicted on such artefacts may have been deemed necessary for a number of reasons. For example, personal objects were placed on the pyre, or broken after the cremation process, to prevent others from using them. Alternatively, objects belonging to the deceased may have been viewed as unclean and were placed on the pyre (this issue will be readdressed at a later stage in this chapter).

As previously mentioned, combs appear to have been a central element of the cremation rite; though they are much rarer in contemporary inhumation burials which may be a result of taphonomic factors (Williams 2003, 113). Combs are known to have been made from a variety of materials, including animal bone and antler. There is a possibility that wooden combs were also used in the cremation rite but these objects are archaeologically invisible since they would not have survived the cremation process if they were placed on the pyre (Hills 1981, 96). Williams (2003, 116-117; 2010, 74) has proposed that combs were important items in personal grooming, for instance in hair management, and rituals, for example comb fragments may have been shared between the living and dead to ensure an ongoing connection between both parties. The frequent deposition of combs and toilet sets, which include tweezers, earscoops, razors, shears and blades, both full-sized and miniature, may indicate the transformation of the deceased into a new form. Furthermore, Williams (2005(c), 29) has identified that combs are highly associated with sheep or goat and pig remains, while tweezers and shears are found with all animal types. The deposition of these artefacts alongside faunal remains may also hold some significance when considering the transformation of the deceased in the next life (Williams 2005(c), 29). Interestingly, Gräslund (1994, 20-21) has suggested that unburnt bronze objects, including razors and tweezers, found in Bronze Age cremation burials in Scandinavia, were not exposed to the cremation pyre as they were not intended for use in the afterlife. Instead, these items may have held an important role in a funerary ritual after the cremation process. Miniature versions of toilet sets and combs are clearly impractical which suggests that they were solely produced for funerary purposes. Williams (2010, 75) has noted that miniatures were placed in cremation burials based on the notion that these items held amuletic and regenerative properties. This idea suggests that miniature combs and toilet sets may have been afforded to ritual specialists or a particular status group within the cemetery (Williams 2010, 75). In sum, these objects appear to have been important in the transformation and remembrance of the deceased.

A variety of artefacts from cremation, and inhumation, burials have been identified as possible amulets, or as containing amuletic properties. These include: reused Roman objects, coins, a bag or collection of human teeth, animal teeth and bone, in particular, bear remains (Meaney 1981, 134; Crawford 1993, 85; Eckardt and Williams 2003, 157; Pluskowski 2010, 112, 114; Fern 2010, 143). The aforementioned objects are frequently found with females, infants and children, which may suggest that these items were seen as protective amulets (Meaney 1981, 138, 144). The reuse of Roman artefacts, such as brooches and coins, may have been a means of expressing Romano-British identity and would consequently induce images of the imperial past (Gowland 2006, 150). Eckardt and Williams (2003, 161) have observed that these items were frequently worn as funerary costume and each object would have held a unique history and biography. Therefore, these artefacts would have created social memories owing to their age and complex past (Eckardt and Williams 2003, 141). Conversely, these items may have served a practical function in the afterlife. Ethnographic studies in Greece, Eastern Europe and Japan, have also identified the deposition of coins within burials (Van Gennep 1960, 154). This practice has been recurrently linked to the belief that coins are used as payment for the journey into the afterlife (Van Gennep 1960, 154). If re-used Roman coins held a similar meaning and purpose to the ethnographic examples outlined above, these objects may have also offered protection to the deceased while travelling into the next world.

In the early Anglo-Saxon period, the deposition of human teeth (that did not necessarily belong to the occupant of the burial) is frequently associated with adult females. Teeth may have been offered as tokens from the living to the dead to express a biography between two individuals. Alternatively, deciduous teeth may have held ritual significance so were retained throughout life and were subsequently buried during the funerary rite of certain individuals (Crawford 2007, 87-88). Teeth that derived from horse and canines and the tusks of boars are the most frequently occurring animal teeth identified in Anglo-Saxon cremation burials (Pluskowski 2010, 114; Fern 2010, 143). These teeth were often worn as pendants or worked into gaming pieces (Fern 2010, 143). Pierced animal teeth also occur in contemporary inhumation cemeteries, for example a pierced pig or beaver tooth was discovered in the burial of an adult female at Castledyke South (North Lincolnshire) (Nicholson 1998, 239). Meaney (1981, 138) has noted that the deposition of horse teeth was of a sacral nature in early Anglo-Saxon ideology and beliefs, while boar and canid teeth may have served as protective amulets, against wild animals and ailments. It has also been suggested that pig's teeth were viewed as fertility amulets while beaver's teeth were seen to assist in the development of healthy teeth, which corresponds to the frequent deposition of animal teeth within female and infant burials (Meaney 1981, 138).

Sheep or goat, pig and cattle are among the most frequently occurring animals found in Anglo-Saxon cremation burials. Archaeological evidence suggests that these animals were often slaughtered, and subsequently cut into joints of meat, before placing them on the pyre. As opposed to the cremation and interment of whole animals, as a display of social identity, cuts of meat have been interpreted as either food offerings to nourish the deceased in the afterlife or the remnants of funerary feasts (Crabtree 1995, 22; Williams 2004, 277). In contrast to Anglo-Saxon cremation burials, contemporary inhumation graves produce a much smaller number of animal remains (Williams 2001, 197; Bond and Worley 2006, 90). This discrepancy may highlight that animals played a more important role in the life and death of individuals belonging to cremation practicing communities. Williams (2010, 72) argues that the act of slaughtering and cooking an animal was part of honouring the dead regardless of social position. Furthermore, the actual sacrificial process would have been an important symbolic and visual aspect of the cremation rite (Williams 2001, 201). Williams (2010, 72) has also suggested that the deposition of cooked meat within cremation burials represents the food shared between the living and dead during the funerary feast. Similar practices have been identified from a number of historical and modern contexts and highlight an ongoing connection between the living and the dead. There is archaeological evidence to show that funerary feasts, which involved sharing food and drink with the dead, also took place in Merovingian Gaul during the fifth century (Lee 2007, 89; Høilund Nielsen 2009, 99). The practice of providing food for the deceased has been recorded among the Mono-Alu people, who live on the Alu Island, which is located in the Solomon Islands. Denis Monnerie (1998, 102) has observed that taro (an edible root) and a domestic pig are placed on the funerary pyres of nobles, which serve as provisions for the journey to the afterlife. The *Śrāddha* is a Hindu tradition that is practiced in various parts of India which honours deceased relatives and ancestors on the anniversary of their death (Thapar 1981, 306). Participants of this rite believe that offering food, notably sheep, goats and fowl, will nourish the deceased and ancestors in heaven (Thapar 1981, 306). These case studies highlight that food plays an important part in funerary customs, in both the past and present, around the world. The provision of animals is believed to provide sustenance for the deceased and also offer an ongoing connection between the mourners and the dead. Therefore, there is no reason to doubt that similar beliefs were held by Anglo-Saxon cremation practicing communities.

A number of archaeologists have suggested that certain animals, based on their characteristics and virtues, were employed in early medieval funerary rites to connect the deceased with the afterlife and to facilitate their transformation into a new form (Gräslund 2004, 172; Fern 2010, 147; Pluskowski 2010, 116). Dogs and wolves are frequently linked with warrior ideology and Odin, the god of death and war (Gräslund 2006, 124). Gräslund (2004, 172) has proposed that dogs were included in funerary rites as they may have been accountable for transforming the deceased into the divine. Fern (2010, 147) has suggested that horses and birds served as communicating spirits between the living and the dead owing to their shape-shifting qualities. These characteristics are based on the depiction of Hos, an Anglo-Saxon mythological character who is half-human and half-animal (comprising of a horse's head, a boar's jaw, a serpent and the wings of a bird), on the Franks Casket which was produced in Northumbria during the early eighth century (Fern 2010, 147). Furthermore, the use of animal pelts may have been employed in special rites which involved shape-shifting and communicating with the ancestors. The exploitation of animals in the cremation rite provides further evidence for the importance of shamanistic beliefs in early Anglo-Saxon society. Similarly, the provision of material culture, such as jewellery, adorned with zoomorphic ornamentation and dualistic iconography of animals and humans may have served as visual representations of ideological and shamanistic beliefs (Haseloff 1974; Goldhahn and Oestigaard 2008, 230). Gansum (2004, 52) has proposed that the split-representation of animals and humans in Iron Age Scandinavian art may represent stories from the sagas that refer to the transformation of humans into animals and vice versa. Thus, the provision of animals in the cremation rite may have been a fundamental factor in the formation of ancestral identities (Williams 2001, 207).

3.2.2 The cremation process

A number of archaeologists are opposed to the idea that the identity of an individual can be directly read from a burial, arguing instead that funerary provision may, rather, reflect some important aspects of the deceased's identity that were deemed significant by the mourners (Lucy 2002, 76; Devlin 2007, 20). This highlights that mourners were active participants, since they selected the grave furnishings, in both the inhumation and cremation rite. Alternatively, the manner of burial and accompanying artefacts may have been used to create a new identity for the dead (Gilchrist 1997, 47; Williams and Sayer 2009, 3). More recently, Devlin (2009, 33) has suggested that the provision of grave assemblages were a means of 'finishing' memories with the deceased which would have caused a separation between the living and the dead. Covering the corpse or hiding certain objects within the grave may have constituted a part of the burial rite which dealt with the closure of an individual's life (Williams 2007, 115-116). The intricate link of memory and forgetting plays an important role in the mortuary dress of the Haya people, who inhabit the Kagera Region of Tanzania. When a death occurs among the Haya community, funerary shrouds are worn by both the living and the deceased at the time of the funeral which creates a link between the two worlds (Weiss

1997, 169). By wearing these shrouds, mourners are able to evoke memories of the deceased while simultaneously creating a distance from the dead which, in turn, destroys any intimate bond between the living and the deceased (Weiss 1997, 169). This ethnographic example adds further weight to the notion that funerary attire, worn by the dead in early Anglo-Saxon England, also functioned as a means of conveying complex social messages among the living. Therefore, it is necessary, when considering the construction of memory, not to focus exclusively on identity and the functionality of artefacts, but on how these items were used to create relationships between people. The following section of this chapter will explore the symbolism behind the cremation process, the transformation of the body and subsequent interment of the cremated remains.

The cremation process would have served as a multi-sensory experience owing to the changing form, colour, smoke, intensity, temperature, sound and smell of the funerary pyre (Williams 2004, 271; Sørensen and Bille 2008, 256). Sørensen (2009, 125) observes that a person can be thought of as constituted by a body and a mind, and suggests that the process of cremation (by the transformation of the body) acts to emphasise and yet undermine this division. The cremation process, by changing the materiality of an individual, is therefore a fundamentally transformative act: the person, by losing their body, is created as an idea (Sørensen 2009, 125). The transmogrifying properties of cremation were identified by Jonuks and Konsa (2007) who conducted the firing of three experimental cremation pyres (using whole animal cadavers) to gain a greater understanding, not only of prehistoric pyre technology, but, of the emotional response of mourners participating in this rite. The authors observed that prior to cremation, or burial, the deceased looked tranquil and neutral (Jonuks and Konsa 2007, 106). However, the following stage of decomposition or consumption by the flames is characterised and associated with danger and disgust (Jonuks and Konsa 2007, 106-107). After the complete decomposition of the body, the resultant cremated remains are, again, associated with a more innocuous dead person (Jonuks and Konsa

2007, 106-107). Nonetheless, we cannot be sure how participants of early Anglo-Saxon funerals interacted with cadavers and skeletal remains, although experiments, similar to the example outlined above, can provide a glimpse into personal reactions that are experienced during the cremation process. Through the use of ethnographic case-studies, the following sub-section aims to offer an alternative perspective on the cremation rite in early Anglo-Saxon England.

3.2.3 An alternative perspective on the Anglo-Saxon cremation rite

Fire has long been viewed as a purifier for immortality and since many cultures, in the past and present, see corpses as polluted and corrupt, cremation is often the preferred funerary rite (Burkert 1983, 280; Downes 1999, 28; Oestigaard 2000, 52; Prothero 2001, 88; Sørensen and Bille 2008, 262). Therefore, the primary aim of cremation is to release the soul and destroy the flesh (Oestigaard 2004, 25). A widely held view among these cultures is that, only when the flesh is destroyed and reincarnation is complete, can the spirit of an individual enter the afterlife and will no longer cause a threat of further death to the living; hence, this belief is supernatural rather than literal (Metcalf and Huntington 1991, 81-82). Thus, the living carry out a variety of rites to release the soul from the body so it can rest in peace and/or become an ancestor spirit, which are often referred to as the rites of separation (Van Gennep 1960, 164; Ametewee and Christensen 1977, 362; Oestigaard 2000, 26; Richards *et al.* 2004, 96). Furthermore, the cremation ground (or pyre site), objects associated with the dead and kin that had been in contact with the deceased were also viewed as unclean given their close association with the dead. If the cremation ground was seen as an area of corruption during the Anglo-Saxon period, this could explain the deficiency of pyre sites identified in the archaeological record, as these spaces would have been located away from the settlements and cemeteries. A number of ethnographic examples exhibit an array of rituals employed in the cremation rite to cleanse the living from the polluting nature of the dead.

The Brahmins are one of the caste groups in Indian society, consisting of priests and scholars, who employ the cremation rite. An important part of the Brahmin funeral concerns the four mourners who carry the deceased to the pyre site. Subsequent to the cremation process, these individuals bathe to cleanse and purify themselves of the pollution acquired from carrying the corpse (Dubois and Beauchamp 1906, 487). A similar practice is conducted by the Yąnomamö tribe, a group that inhabit the tropical forest bordering Brazil and Venezuela. This group believes that the burning cadaver is polluting and will contaminate the living and their possessions. Therefore, before a cremation is carried out, children and sick members of the community are sent away from the village, while bows and arrows are washed to cleanse these objects after the cremation process (Chagnon 1997, 115). It is also interesting to note that Zoroastrians, members of what is thought to be the oldest creedal religion in the world, believe that fire is the most potent symbol of purity and should not be employed for consuming polluting matter, which, in this case, is flesh (Boyce 1979, 1, 14). However, other Zoroastrians believe that electricity, rather than the sacred fire, creates the heat in modern electrical cremators which cremates the body without polluting the 'physical' fire (Schofield 2005, 429). These case-studies highlight that the primary aim of cremation, among these groups, is to safely release the soul for the journey into the next life. This idea offers an alternative explanation for the preference to cremate, as opposed to inhume, in areas of early Anglo-Saxon England.

3.2.4 Burial of the cremated remains

The burial of burned bone also appears to have played an integral role in the Anglo-Saxon cremation rite. These remains are most frequently found within pottery cinerary urns, which are likely to have functioned on a practical and an ideological level. To begin, funerary vessels may have been employed as a means of transporting cremated remains from the pyre site, or surrounding settlements, to the community cemetery, especially if the cremation process took place some distance away from the burial site (Hills 1999, 15; Oestigaard 1999, 351). However, examples of cremation burials without accompanying cinerary urns have been identified from a number of cemetery sites. These include: Brettenham (Norfolk) (Wilson and Hurst 1966, 172); Portway (Hampshire) (Cook and Dacre 1985, 57-59) and Snape (Filmer-Sankey and Pestell 2001, 250). There is a possibility that the cremated remains of these 'unurned' deposits were initially placed in organic containers, for example: wooden vessels or textile bags made of hides or fabric, but have not survived on account of taphonomic processes and poor preservation. This is not an implausible explanation as there is evidence, albeit in small numbers, from Loveden Hill (Fennell 1964, 93) and Snape (Filmer-Sankey and Pestell 2001, 250), that bronze bowls and stone cists were used to hold cremated bone. Thus, there is a great likelihood that material was considered an important factor during the selection process of a cinerary vessel. The choice of material may have communicated messages about the social status of an individual, for example bronze bowls are frequently associated with high-status grave assemblages. There is also a likelihood that 'unurned' deposits actually derive from displaced burials. McKinley (1994, 103) observed that the Spong Hill cemetery produced no deliberate 'unurned' cremations but, rather, any apparently unurned cremated remains were either from a disturbed urn or redeposited burials as a result of grave-robbing. Thus, the classification of 'unurned' cremation deposits must be applied with caution as these may in fact represent disturbed burials and/or pits that once held organic containers filled with cremated bone.

The use of cinerary urns may have also served as a means of conveying messages about the deceased and the afterlife. Williams (2006, 94; 2010, 74) has suggested that these receptacles represent the deceased's new 'body', while the decoration (on the vessel) and accompanying grave assemblage expresses the 'skin' and identity of the individual in the next life. The adornment on an urn may have functioned as a form of language that conveyed messages about the deceased and could be read by the mourners (Richards 1992, 141). The ornamentation on these vessels would also have provided the living with a final memory of the deceased before the burial of the burned bone and associated grave provisions (Williams 2005(c), 26). Furthermore, the placement of cremated remains within domestic vessels, which may have been used for food preparation and consumption, has been recorded from Cleatham (Leahy 2007, 86) and Mucking (Hirst and Clark 2009, 603). Economic or personal reasons, either of the mourners or deceased's final wishes, may account for the selection of domestic receptacles within a funerary context. However, the use of these vessels may reflect the analogous nature of cremation, which transforms the body into burned skeletal remains, and the irreversible process of cooking, which converts raw ingredients into cooked food. Despite the fact that cooked food can never revert back to its unprocessed form, it nourishes and generates life (Oestigaard 1999, 359). The presence of animal bones in the Anglo-Saxon cremation rite, as a food offering, provides additional support for this idea. Based on this notion, Oestigaard (1999, 359) has proposed that once the deceased enters the afterlife they will not return to the living world since they establish a new existence in the form of an ancestor. A similar belief is held among the Mono-Alu people. This group believe that burying the cremated bone and ashes of an individual allows the deceased to pursue a downward journey into the realm of the ancestors and, once they have crossed into the afterlife, they rejoin the original *nitu* (ancestor) (Monnerie 1998, 104). Each stage of the Anglo-Saxon cremation rite appears to hold a variety of messages concerning the deceased and their journey into the afterlife. The careful selection of cinerary urns would have provided the mourners with a final memory of the deceased, while the actual burial contains underlying connotations relating to the closure of an individual's life and rebirth in the next world.

3.3 Summary

A review of the archaeological material highlights the complexity of the cremation rite in early Anglo-Saxon England. This chapter highlights that an assessment of grave provision and the cremation process can undoubtedly increase our understanding of the social organisation and ideological beliefs of cremation practicing communities.

This, in turn, has been compared with contemporary inhumation burials to illustrate underlying similarities and differences between the two forms of burial in the early Anglo-Saxon period. The most striking difference between groups that practiced inhumation and cremation was their ideological beliefs. The cremation rite appears to express a complex belief system that involves transforming the physical body into a new state in order to adopt a new ancestral identity. The use of objects in the cremation rite, such as combs and toilet implements, seem to have played an important role in the reconstitution of the deceased's form in the afterlife. On the other hand, it appears that inhumation practicing groups did not consider the transformation of the body (into a new form) necessary for the deceased to enter the afterlife. The human form and rich grave assemblages, such as elaborate jewellery and weaponry, may have been deemed more suitable in the inhumation rite as the deceased would have been dressed for the funeral in an idealised form (Williams (2005(b), 269). Hence, accoutrements related to the formation of a new body, or identity, were not employed in the inhumation rite. This may also explain why cremation burials do not explicitly convey the personal attributes of the deceased, in particular sex and gender. Instead, more subtle patterns are notable which may, indeed, relate to the perception of social identity within cremation practicing communities, for example: age, gender, ideological beliefs and social standing may have played an equally important part in the construction of a person's identity. The following chapter will explore pyre technology and the expertise required to carry out this funerary practice in early Anglo-Saxon England.

Chapter 4: Pyre technology in the early Anglo-Saxon period

A common misconception concerning Anglo-Saxon cremation burials is that this form of funerary treatment is the ‘poor relation’ of the inhumation rite, since lavish grave assemblages, such as military accoutrements, are rarely associated with cremation burials (McKinley 2006, 81). However, an examination of the technological aspects of the inhumation and cremation ceremony produces a different picture with regards to the amount of commodities bestowed in each funerary rite. Of course, a great deal of investment would have been placed in inhumation burials, for example dressing the corpse, digging the grave and the interment of the deceased, though the cremation rite would have been more labour intensive. The cremation ritual would have involved: preparing the corpse, gathering pyre wood, constructing the pyre, overseeing the actual cremation process, and the subsequent collection and burial of the cremated remains. An assessment of burned bone and pyre debris is the sole means of extracting information about the technical aspects of cremation given the absence of documentary evidence from early Anglo-Saxon England. The primary aim of this chapter is to highlight the importance of cremated bone since these remains can provide a wealth of information regarding pyre conditions, in particular temperature, duration and oxidation. This in turn, may indicate social structure based on the degree of cremation afforded to various members of society.

Primarily, this chapter will explore the structure of Anglo-Saxon cremation pyres, the evidence of surviving pyre sites and types of fuel used in the cremation rite. Subsequently, a discussion of the cremation process will deal with the nature of fire alongside an examination of the temperature, duration and oxidation of Anglo-Saxon funerary pyres. Factors which may have affected the cremation process, such as the weather, manipulation of the pyre and consequent collection and processing of the cremated remains will also be considered. Finally, the effects of burning on the body and bone will be discussed in detail. This section will explore the thermal alteration of human remains, on a macroscopic and microscopic level, which occur as a result of the cremation process. Overall, this in-depth review aims to provide a valuable insight into pyre technology during the early Anglo-Saxon period.

4.1 Pyre construction

A variety of pyre structures are thought to have been employed in the archaeological past. For example the use of elevated biers in prehistoric Orkney (Photos-Jones *et al.* 2007, 19) and the *busta* cremations of the Roman period (McKinley 2000, 39). The latter type of cremation involved the construction of a pyre above a deep pit. The cavity beneath the pyre would have served two purposes, that is, to aid oxidising conditions and to function as a grave, since the cremated remains would collapse directly into the hole after the cremation process (McKinley 2000, 39). Furthermore, Ibn Fadlan, an Arab missionary working in the early 10th century, reported that the cremation of a Rus chief was conducted on a ship (Frye 2005, 70). However, the two forms of funerary pyre that are thought to have been used in early Anglo-Saxon England include a bonfire, or pyramid, type construction (Wells 1960, 34-35; Welch 1992, 64-65) and/or a criss-cross framed structure (McKinley 1994, 80). The bonfire pyre form would have been assembled by piling wood over the body, which was laid in a supine position on the ground (Welch 1992, 64). Wells (1960, 34) believed that this type of pyre was employed by the Illington (Norfolk) community. This conclusion was established after an examination of the cremated bones showed signs of deoxidising conditions that consequently led to inefficient combustion of the cadaver, especially on the dorsal surface of the body (Wells 1960, 34). The following ethnographic studies highlight that the use of ineffective pyre structures frequently causes incomplete cremation of the body owing to deoxidising conditions. Between 1829 and 1834, George Augustus Robinson observed an incomplete cremation that was conducted by the Australian Aborigines (Hiatt 1969, 104-105). The failure of this cremation appears to have been the result of assembling a mass of dry wood over the deceased. The failure of the initial cremation led to a second firing of the remains that were unconsumed by the flames (Hiatt 1969, 105). In 1801 the King of Thanjavur, who ruled the province of Thanjavur in India, died and was afforded the cremation rite. A pyramid shaped pyre was erected on wooden scaffolding within a large rectangular pit, similar to the Roman *busta* cremations, and the deceased was placed upon the structure (Dubois and Beauchamp 1906, 364). Once the pyre was ablaze, the posts that supported the construction were removed and the structure collapsed on top of the deceased, thus causing incomplete cremation owing to a restricted flow of oxygen (Dubois and Beauchamp 1906, 366; McKinley 1994, 80). Based on these examples, it is apparent that pyre construction plays a crucial role in the success of a cremation as a poorly designed structure will lead to incomplete incineration of the cadaver.

In contrast, the criss-cross pyre structure appears to have been a more successful construction for cremating the dead. Jacqueline McKinley (2000(b), 407) has suggested that this type of pyre was rectangular in form and consisted of separated timbers that were placed at right angles. The construction would have been filled with brushwood, or other organic matter, which acted as fuel and further support to the structure (McKinley 2000(b), 407). Finally, the deceased would have been placed on top of the pyre in a supine position accompanied by pyre goods and animal offerings. Literary, archaeological and ethnographic sources suggest that this type of pyre construction, or a similar structure with minor modifications, has been employed by many cremation practicing societies (Homer, *The Iliad*, Book 24, Lines 785-788; Rivers 1906, 362; Toulouse 1944, 68; Oestigaard 2004, 28; Photos-Jones *et al.* 2007, 19-20). An advantage of the criss-cross pyre formation, over the previously discussed bonfire variety, is that oxygen is able to circulate with greater ease. In particularly, the preparation of scoops or pits underneath these funerary pyres would have facilitated the flow of air (McKinley 1994, 80). However, experimental archaeology has highlighted that under-pyre features quickly fill up with wood-ash, which need to be cleared in order for a successful cremation to ensue (McKinley 2008, 167-168).

Pyre sites can provide valuable information about pyre construction, fuels that were used in the cremation process, position of the deceased and objects that were placed on the pyre (pyre goods) (Downes 1999, 27). Unfortunately, the survival of pyre sites from archaeological contexts in England is relatively rare (McKinley 1997, 132; Pearce 1998, 100-101; McKinley 2000, 38; Richards *et al.* 2004). This is especially true of Anglo-Saxon pyres, since only three have been identified with varying degrees of certainty at Sancton (East Riding of Yorkshire) (Myres and Southern 1973, 10; McKinley 1993, 295-296), Snape (Suffolk) (Filmer-Sankey 1992, 48-49; Carnegie and Filmer-Sankey 1993; Filmer-Sankey, Carnegie and Pestell 2001, 252) and Asthall Barrow (Oxfordshire) (Dickinson and Speake 1992, 116-119). Myres and Southern (1973, 10) believed that excavations had possibly uncovered a cremation floor at Sancton, which was represented by an area of burnt clay (measuring two by one foot), charcoal and bone. Further details of this surface have either been lost or were not recorded and consequently there is insufficient evidence to prove that this was once the site of a pyre (McKinley 1993, 295-296). The Snape pyre site was identified by a layer of grey sandy soil that contained areas of charcoal and a spread of material, which consisted of pottery sherds, cremated bone, burnt flint and a number of burnt copper-alloy fragments and objects (Carnegie and Filmer-Sankey 1993, 107).

Evidence of pyre sites has also been recorded on the Continent. At the sixth- and seventh-century AD cemetery at Lindholm Høje (Denmark) charcoal, sod, burned bone and pyre goods were found in cremation patches which pointed to the possibility of *in-situ* pyres within graves (Høilund Nielsen 2009, 84-88). Høilund Nielsen (2009, 85) has suggested that the pyres were constructed on turf owing to the general absence of burnt clay (reddened areas) from these cremation patches. The remains of several pyres have also been identified at the Liebenau mixed-rite cemetery in Germany, which dates from the fourth to ninth century AD (Genrich 1981, 60). Evidence that this was the site of the cremation rite was recognised on the basis of extensive patches of earth that had been blackened by charcoal, along with cremated bone, pyre goods and sherds of pottery (Genrich 1981, 59). Further support for the presence of cremation pyres at Liebenau came in the form of post-holes that appeared within the pyre areas. A number of these post-holes may have held the stakes that aided the assembly of the structures, though some of these features may have been used for the construction of grave monuments or funerary buildings (Genrich 1981, 60). As previously mentioned in chapter two, there were some minor differences between the pyre sites from Snape and Liebenau. At Snape there was an absence of secondary burning on pottery sherds, while the lack of an associated urn (with the cremation pyre) may indicate that either funerary vessels were not placed upon the pyre or, alternatively, have been lost due to ploughing or burial outside of the excavation area (Carnegie and Filmer-Sankey 1993, 108). Furthermore, the problematic nature of detecting pyre features, such as post-holes, in the topsoil at Snape has been put down to the dark colour of the soil (Carnegie and Filmer-Sankey 1993, 108). In sum, Carnegie and Filmer-Sankey (1993, 108) have suggested that the differences between the Snape and Liebenau pyre sites are the result of preservation bias as opposed to differing cultural practices.

In 1924 Edward Thurlow Leeds published the findings of an excavation conducted on a cremation burial and a possible *in-situ* pyre site from Asthall Barrow, which dated to the seventh century (Leeds 1924, 116). However, a more up to date reassessment of the site was carried out by Tania Dickinson and George Speake in 1992 (Dickinson and Speake 1992). The possibility that an *in-situ* funerary pyre was located at Asthall Barrow was primarily suggested based on the presence of cremated bone that was found on a yellowish clay layer (Dickinson and Speake 1992, 116). Associated finds in this stratum of clay included cremated bone, charcoal, charred timber and pottery sherds (Dickinson and Speake 1992, 100). Similar to the pyre site from Liebenau, post-holes were recorded from Asthall Barrow. However, Dickinson and Speake (1992, 118) have suggested that these post-holes may represent the construction of a mortuary structure rather than the structural remnants of a cremation pyre, perhaps similar to the ‘houses of the dead’ excavated at Apple Down (West Sussex) (Welch 1992, 66). Welch (1992, 66) has proposed that these small buildings were erected over cremation burials to commemorate the dead. Despite the dearth of surviving pyre sites, the vestiges of material culture and archaeological features from Snape, Asthall Barrow, and possibly Sancton, can provide a glimpse into the cremation process carried out by the Anglo-Saxons.

The discovery of charcoal from possible surviving pyre sites and within cinerary urns suggests that wood was the primary form of fuel employed in the cremation process during the early Anglo-Saxon period (Dickinson and Speake 1992, 100; Carnegie and Filmer-Sankey 1993, 107; McKinley 1994, 82; Filmer-Sankey and Pestell 2001, 251-252; Hather 2009, 427-428). However, some of this charcoal may have derived from wooden objects that were placed on the pyre with the deceased as opposed to being remnants of the pyre structure. The charcoal discovered from the supposed pyre site at Snape was mainly attributed to pine, along with hazel and oak (Filmer-Sankey and Pestell 2001, 176). Charcoal remnants of oak, gorse/broom, heather, alder, pine and the *prunus* species were found in cinerary urns from Snape but unfortunately no information was provided with regards to the quantities of each charcoal type in the site report (Filmer-Sankey and Pestell 2001, 251). Species of wood identified among charcoal inclusions from the Spong Hill cinerary urns mainly derived from oak, while smaller amounts of hazel or alder, pine, ash, lime and wood of the hawthorn variety were also identified (McKinley 1994, 82). McKinley (1994, 82) also notes that brushwood from hazel or alder, oak, ash and the *prunus* variety were employed to fill the cremation pyre. At Mucking, the primary types of wood recorded from funerary vessels included oak, beech and ash, while field maple, silver birch, hazel, elm and the maloideae, prunus, salicaceae and taxus baccata species of wood were found in smaller quantities (Hather 2009, 427). From a practical perspective, based on a sample of Norwegian species of wood; beech produced the greatest heat per kcal/kg followed by ash, pine, oak, lime, spruce and birch (Holck 1986, 43). Oak appears to have been the dominant type of wood at both Mucking and Spong Hill which was probably a result of availability and the recognition that this species was the most suitable type of wood for the cremation process (Hather 2009, 428). The presence of less dominant types of wood can be interpreted in a number of ways. The most obvious explanation is that they were collected by accident alongside the favoured species (Hather 2009, 428). Alternatively, woods may have been selected for a ritual purpose (Hather 2009, 428). Interestingly, *Tacitus* (*Germany* 27) recorded that 'the bodies of famous men are cremated with particular kinds of wood'. The selection of certain types of wood may have been ascribed to these individuals based on their occupation and social standing, or alternatively, ideological beliefs. This is of particular relevance since oak trees were closely connected with the Norse and Germanic gods, Thor and Donar (Hooke 2010, 193). It was believed that oaks were the greatest kind of tree in the grove as they were thought to have contained the strength, power and energy of the gods (Hooke 2010, 193). The use of oak in pyre construction is also noted in *Guthrunarhvot* (st 21), a poem in the Poetic Edda, which describes the construction of a large oak pyre for a fallen hero. Pine trees have been associated with immortality and protection of the body (Filmer-Sankey and Pestell 2001, 252). This affiliation may have warranted the use of pine trees in the cremation rite. Ash trees are also thought to have an ideological significance and are closely linked with Odin, the sea and water (Hooke 2010, 201). In addition, particular wood species may have been sought after for the funerary pyre to disguise the smell of the cadaver. Numerous ethnographic studies record the use of certain woods in the cremation process because of the distinctive odours they release when burnt, for example sandalwood, conifer, cedar, pine, mango and wood-apple (Dubois and Beauchamp 1906, 364; Levin 1930, 31; Wales 1931, 152; Parry 1994, 176-177). These case-studies also highlight that particular woods are selected on the belief that they hold sacred qualities (Parry 1994, 176-177). Consequently, these resources are extremely expensive and their use in the cremation rite depends on the social status of the deceased and their kin.

The amount of wood used to build a funerary pyre, and the subsequent size of the structure, would also have been dependent on the social status and perceived importance of the deceased. Numerous ethnographic examples highlight that persons of a lower social standing are afforded a smaller pyre, which regularly leads to incomplete cremation, owing to the economic investment required to build a funerary pyre or, alternatively, these individuals are afforded the inhumation rite (Rau 1986, 245; Monnerie 1998, 97; Barber 1990, 381; Metcalfe and Huntington 1991, 141-142; Mills 2005, 398). Holck (1986, 43) has estimated that under ideal conditions, the quantity of wood required to cremate a human body lies in the region of 146kg, based on the use of pinewood. However, McKinley (1994, 79) notes that two to three times this amount of wood is required to completely cremate a cadaver, which is a deduction based on modern crematoria, which use on average 210 units of gas to achieve a successful cremation. It is possible that during the early Anglo-Saxon period other accelerants, such as animal fat and clarified butter, were used to reach high temperatures. In the Roman period, perfumes and oils were poured on the funerary pyre, which would have assisted the cremation process (Williams 2004, 276). Similar practices are observed in modern India where ghee and scented oils are applied to the pyre (Dubois and Beauchamp 1906, 364; Parry 1994, 177). Other accelerants employed on modern open air cremation pyres include kerosene, petrol and coal tar while the use of gas jets has also been recorded (Ametewee and Christensen 1977, 363; Downes 1999, 23).

It is critical for cremation pyres to reach high temperatures to ensure complete combustion of the body. It has been noted that temperatures between 500 and 1000˚C are required in modern crematoria to thoroughly cremate a body, though this is variable based on the physique, age and sex of the deceased and amount of body fat available (McKinley 1989, 65). Wells (1960, 35) has suggested that bodies achieve complete cremation at temperatures between 820 and 900˚C. The kindling point (or auto ignition point) of subcutaneous fat is around 250-350˚C and is undoubtedly the best fuel source in the human body (Christensen 2002, 466; DeHaan 2008, 9). It has been observed that individuals with a greater amount of fat will cremate more easily than those with smaller fat deposits (Wells 1960, 35). Furthermore, females cremate more efficiently than males since they have larger stores of subcutaneous fat, especially in the thighs, buttocks and hips (McKinley 1994, 72; Power and Schulkin 2008, 932). However, there will always be exceptions to this rule. Subcutaneous fat will burn as a flame, as opposed to smouldering, and requires a porous wick, such as charred wood or clothing, as the fat will absorb into the wick and accordingly maintain a flame (DeHaan 2008, 9). Flames that are produced by fat cannot sustain a flame without the presence of a wick (DeHaan and Nurbakhsh 2001, 1078). In modern crematoria, a minimum temperature of 400˚C is required to ignite the coffin, which acts as a wick, and initiates the cremation process (McKinley 1994, 72). In the early Anglo-Saxon cremation rite, the use of wood, and garments worn by the deceased, would have acted as a suitable wick. Various studies have been conducted on the ignition temperatures of wood and it is generally agreed that the point of combustion occurs between 250-500˚C (Kirk 1969, 51; Babrauskas 2002, 184). The ignition point of leather is around 212˚C, hair and fur start to char at around 260˚C, while wool has a relatively high ignition temperature of 570-600˚C (Cafe 1992; Tian *et al.* 2003, 156; DeHaan 2007, 573). Once the fire has taken hold of the deceased, under ideal conditions, combustion will continue until no fuel remains (DeHaan and Nurbakhsh 2001, 1081). The following section of this chapter will explore each stage of the cremation process to gain a greater understanding of the technical aspects of this funerary rite during the Anglo-Saxon period.

4.2 The cremation process

As a result of modern practices, there has long been a false impression that the resultant material from the cremation process is fine ash (Murad 1998, 94). Before the bones are removed from modern cremation hearths (also known as cremators), the skeletal remains are still identifiable in their anatomical position, which are subsequently pulverised until the cremated material is no longer recognisable

(McKinley 1994, 75; Murad 1998, 94-95; Warren *et al.* 2002, 38; Warren and Schultz 2002, 657). The three key elements required for a successful cremation are temperature, duration and a sufficient supply of oxygen (McKinley 2006, 84). If one of these factors is lacking or significantly diminished, incomplete combustion of the body will ensue. The examination of evidence from modern crematoria is useful when studying ancient cremation practices, as similarities and differences can be observed, alongside the effects of fire on the human body. However, when comparing past and present cremation technologies it must be borne in mind that modern crematoria do not face the same issues that are encountered when cremating on a funerary pyre. For example, in modern crematoria a forced draft is used, which is powered by electric fans and circulates oxygen and hot gases around the cremator hearths (McKinley 1994, 72). This airflow ensures that complete cremation will be achieved within a one to two hour period (though this is variable), while the temperature in the cremator can be controlled through gas jets that are positioned above the main hearth (Wells 1960, 35; McKinley 1994, 72; McKinley 2000(b), 404). These factors are much harder to control on an open pyre and there are also environmental conditions to consider. Holck (1986, 41) pointed out that an open air cremation will never reach the optimum conditions as seen in modern crematoria for these reasons. Similarly, experiments that investigate the effects of burning on bone are normally conducted in controlled laboratory conditions which do not reflect the cremation environment of an open air pyre. Thus, caution must be exercised when attempting to apply the results of studies conducted in laboratories or modern crematoria to archaeological cremations. This section will explore the temperature, duration and oxidation attained in Anglo-Saxon pyres. Based on the examination of burned osteological remains and pyre debris it is possible to determine the conditions achieved on an open air funerary pyre. This section will conclude with a discussion on the subsequent collection and processing of the cremated remains from the pyre site.

Before commencing an examination of the cremation process, it is worth briefly exploring the nature of fire. Oxygen, fuel, heat and a chemical reaction are all required for the production of a successful fire (DeHaan 2008, 1). Different types of fuel and varying amounts of oxygen will generate either a flame or smouldering fire. A flaming fire occurs when oxygen reacts with the fuel, which must be in a gaseous form, and has a high heat release rate (Kirk 1969, 14; DeHaan 2008, 2). On the other hand, a smouldering, or glowing, fire is produced through the reaction of oxygen and the surface of a solid fuel, such as charcoal (Fairgrieve 2008, 25). In the case of wood being used as the main source of fuel, flames are produced through thermal decomposition (pyrolysis). This process involves the break down of wood into extremely small particles and, as a result, these molecules of solid fuel react with oxygen (DeHaan 2008, 3). Charcoal is a product of burning wood and will sustain combustion as a smouldering fire (Kirk 1969, 16). When no more fuel, oxygen or heat is available the fire will self-extinguish. This highlights that without one element of the fire making process, the end product will be a failure. The three main components of a funerary pyre will now be examined in turn to explore the nature of Anglo-Saxon pyre technology.

There is a wealth of evidence that can be examined to determine the temperatures achieved on Anglo-Saxon funerary pyres, including pyre debris and the damage sustained to pyre goods. For example, globules of melted glass and copper-alloy have frequently been found within cinerary urns from the Anglo-Saxon period. These remnants are likely to have derived from artefacts that were placed on the funerary pyre, which, as a result of high temperatures, melted into a liquid form. Glass attains a molten state at temperatures around 800-900˚C while copper-alloy has a melting point of 1084˚C (Holck 1986, 42; Mays 2009, 439). The presence of fuel ash slag can also help to establish the temperatures achieved on cremation pyres. Slag is formed through the fusion of silica and an alkali/calcium as a result of high temperatures (Henderson, Janaway and Richards 1987, 93). Henderson, Janaway and Richards

(1987, 97) examined cremation slag from a number of cinerary urns from Elsham and Illington and concluded that this by-product was created through the fusion of silica-bearing sandy soils with materials from the pyre heated at temperatures in excess of 900˚C. The remains of molten pyre goods and debris provide a broad temperature range attained on Anglo-Saxon funerary pyres. However, an analysis of the osteological remains will provide more detailed information concerning temperatures achieved on cremation pyres and will be assessed in detail at a later stage in this chapter.

It is difficult to estimate exactly how long cremations lasted during the Anglo-Saxon period. However, through the examination of experimental and ethnographic cases we can gain a greater understanding of the length of time required to cremate a body on an open air funerary pyre. The duration of an open air cremation is dependent on both practical and cultural considerations. The first factor to bear in mind is environmental issues, such as weather conditions. Heavy rain or snow would have significantly delayed cremation (Gejvall 1969, 470). A moderate downpour would have reduced the temperature of the pyre, if it did not completely extinguish the fire (McKinley 2008, 168). McKinley (2008, 168) points out that strong winds would have speeded up the burning time of the pyre but this does not mean that such conditions were favoured or effective as the pyre would have rapidly subsided and resulted in uneven burning of the cadaver. Jonuks and Konsa (2007, 104-105) carried out an experimental cremation on an adult pig and similarly observed that strong winds actually drew the flames and heat away from the cadaver and as a result it took six hours to cremate the body. Dry weather and a light wind would have been the optimum condition for a cremation as dry wood would have burnt more successfully and a gentle breeze would have provided suitable oxidising conditions.

Under favourable weather conditions, ethnographic and experimental studies have demonstrated that open air cremation can last between one hour and a whole day. In

India, cremation has been observed to last between one to two hours. Some locals report that it takes over six hours to cremate an individual who has committed sin, though this is likely to be the result of practical failures of the cremation process (Oestigaard 2000, 30; Oestigaard 2004, 27). Interestingly, gas jets are now used to aid the cremation process of open air pyres in Bali as they speed up the procedure from a whole day to only two and a half hours (Downes 1999, 23). Based on historical texts and literary sources, it has been suggested that early medieval cremations would have lasted for seven to ten hours (Høilund Nielsen 2009, 101). The latter estimate implies that the collection of burned bone took place in the days following the cremation process. This would have allowed the cremated material, in particular the charcoal which retains heat longer than burned bone, to cool down sufficiently so relatives, friends, or workers, could then collect the skeletal remains from the pyre site (McKinley 1997(b), 68). Ethnographic studies highlight that a similar practice was conducted in late 19th century Australia and early 20th century India (Dubois and Beauchamp 1906, 366; Hiatt 1969, 108). Unlike modern cremation, which normally allows a cooling period of an hour before further processing of the remains can take place, it appears that skeletal material was left at the pyre site for a significant period of time, possibly overnight, before it was collected and subsequently buried (Bohnert, Rost and Pollak 1998, 13). At Spong Hill, the adhesion of melted copper-alloy and glass to cremated bone may support this notion (McKinley 1994, 84). Nevertheless, it is also possible that these remains were artificially cooled, for example by quenching the bones or pyre (McKinley 1994, 84). In the Roman period, wine was used to douse cremated bones once the flames of the pyre had died down (Toynbee 1971, 50). Similarly, in Homer's *The Iliad* (Book 23, Lines 249-257), mourners poured sparkling wine over Patroclus' pyre, at the end of the cremation, to extinguish any materials that continued to burn. Pouring cold liquid over hot cremated bone will cause cracking along heat induced fractures and, in most cases, such an intervention is difficult to detect from archaeological material (McKinley 1994, 85). However, this rite cannot be ruled out as a method of extinguishing the pyre or washing the cremated bone; the latter practice would have been a cultural tradition as opposed to a practicality (McKinley 2000(b), 415). The examination of these studies provides us with a general idea of the duration of an open air cremation.

The oxidation of a cremation pyre would have been naturally achieved from the surrounding air and wind. It appears that individuals in the past did understand the importance of airflow in assisting the cremation process. This is highlighted in Homer's *The Iliad* (Book 23, Lines 190-200) when describing the initial combustion of Patroclus' funerary pyre. This passage indicates that Patroclus' pyre would not set alight, so the north and east winds were summoned, and, thereafter, the wood started to burn and the cremation quickly ensued (Homer, *The Iliad*, Book 23, Lines 190-200). As previously discussed, pyre construction also played a major part in creating an oxidising environment, and pyres may have been constructed in a manner to provide the optimum oxidising conditions. It is also possible that artificial means were used to create oxidising conditions, for example bellows. Høilund Nielsen (2009, 97) has pointed out that if such equipment was employed in the archaeological past, specialists would have been required to carry out the cremation process. In the Roman period, *ustores* were professional undertakers that specialised in the cremation rite. Little is known about the roles of these individuals but it is thought that they constructed the pyre and watched over the cremation process (Toynbee 1971, 45; Noy 2000, 187). Unfortunately, there is no supporting archaeological or literary evidence that bellows were used during the cremation process in the Roman or Anglo-Saxon period. Similarly, there is little proof for the practice of tending the cremation pyre. Tending, or stoking, of the pyre would have involved stirring the construction with sticks or similar devices to create movement and a sufficient flow of air that would have ensured efficient incineration (Gejvall 1969, 470). Stoking the pyre would have resulted in further fragmentation of the burnt bone although this is difficult to identify in the archaeological record (McKinley 1989, 72). More recent examples of this procedure have been identified from 19th century Tasmania and modern day Nepal and India

(Hiatt 1969, 105; Oestigaard 2000, 29; Oestigaard 2004, 27). These case-studies have highlighted that tending is often carried out to re-establish the funerary pyre to ensure complete cremation of the cadaver. However, stoking does not appear to have been a common practice in Anglo-Saxon England. At Sancton (McKinley 1993, 296) and Spong Hill (McKinley 1994, 84), the poor oxidation of some bones suggests that tending or the use if bellows, to create an oxidising environment, were not employed in the cremation process.

The effects of oxidation on skeletal remains are manifested through the colour change of bone. Walker and Miller (2005) have observed that under deoxidising conditions the colour of bone will change slower than skeletal remains exposed to an oxidising environment. Thus, bones fired on a pyre with limited access to oxygen will be black in appearance as a result of charring, while a greater availability of oxygen will produce hues of blue and grey and fully oxidised bone is manifested through its white appearance (McKinley 2008, 168). It is possible that the same bone can be exposed to varying amounts of oxygen based on its position on the pyre and also how much muscle protects the bone. If the bone has not been fragmented as a result of the collapsing pyre, oxidation will be initially observed on the periosteal surface and will be white in colour. Smaller fragments of bone have a greater surface area and are more likely to be exposed to oxidising conditions which will produce hues of light grey to white (Holden, Phakey and Clement 1995, 18-19). The mid-cortical section of bone will then develop into varying shades of grey, while the endosteal region will be black in colour as a result of deoxidising conditions (Holden, Phakey and Clement 1995, 19). Furthermore, trabecular bone (also known as cancellous or spongy bone) contains a greater amount of organic components in comparison to cortical bone and, consequently, will take longer to oxidise (McKinley 2008, 165). The development of macroscopic examination, in particular the analysis of colour, to gain an understanding of pyre conditions will be considered further in the next section of this chapter.

The collection of cremated remains from Anglo-Saxon pyre sites appears to have undergone a certain degree of processing based on the lack of pyre debris found within cinerary urns (McKinley 1994, 85). It is possible that the positioning of the deceased and accompanying furnishings on the funerary pyre were planned to facilitate efficient collection of the cremated bone. Wells (1960, 35) has suggested that placing the cadaver on top of the pyre would have been ineffective since the collapsing structure would have spread out the cremated bone. Therefore, laying the deceased underneath the pyramid style of funerary pyre would have aided the collection process as falling debris from the construction would have caused minimal disturbance to the burned remains (Wells 1960, 35). However, a problem with this idea is that it does not account for animals that may have been placed on the cremation pyre alongside the deceased. It has been suggested, based on the criss-cross pyre form, that a larger pyre would have been required to accommodate animal carcasses, which were likely to have been placed on the peripheries of the structure (McKinley 1994, 98; Bond 1996, 80). Therefore, we might expect to see systematic differences in the degree of burning experienced by human and animal bone. This arrangement, of the deceased surrounded by animal offerings, may have also paralleled the layout of inhumation burials (Williams 2004, 270). Furthermore, the methodological organisation of a funerary pyre would have aided the identification and collection of both human and animal bone (Williams 2005(c), 33).

The collection of cremated remains from the pyre site was probably carried out by relatives or friends of the deceased. There does not appear to have been preferential collection of certain skeletal elements which is highlighted at the Sancton (McKinley 1993, 298) and Spong Hill (McKinley 1994, 85) cemeteries. McKinley (1994, 85) observed that the majority of cremation burials from Spong Hill contained bones from the crania, axial, upper and lower limbs. At Sancton there does not appear to have been such an even representation of all body segments, which has been attributed to poor rates of survival of trabecular bone, though most cremation burials from this site contained all four skeletal groups in varying quantities (McKinley 1993, 297). Nevertheless, skeletal representation at these sites seems to suggest that the most important aspect of the recovery process was to deposit a representative amount of bone within the urn. McKinley (1993, 298) has proposed that cremated material from Anglo-Saxon pyre sites was gathered all together as opposed to the collection of individual bones. It is likely that these remains were mainly collected by hand but implements such as rakes, tongs and shovels may also have been employed to assist in the collection process, although the use of such objects would have resulted in further fragmentation of the skeletal remains (McKinley 2006, 85). The recovery of individual bones is a practice carried out by a number of east Asian Buddhist communities. This rite involves family members of the deceased using chopsticks to pick out specific bone fragments, which are then placed in special cinerary vessels and are later used in commemorative ceremonies (Davies 2005, 58). Based on ethnographic evidence and experimental cremations, McKinley (1997(b), 68) has estimated that the collection process would take at least three hours if one individual gathered all of the burned bone, from a pyre site, by hand. However, depending on the social status of the deceased, the time invested in the collection process would have varied between individuals (McKinley 2006, 85). For example, in the case of a high-status member of the community, a great amount of time and labour may have been involved at this stage of the funerary rite, thus a greater quantity of material would have been retrieved and subsequently interred within a cinerary urn.

The weight of cremated remains from the Anglo-Saxon period varied considerably from burial to burial. The smallest deposit from an undisturbed burial weighed 117.2g from Spong Hill (McKinley 1994, 85) and the largest weighed 3800.3g from Sancton (McKinley 1993, 296). Many factors will affect the amount of burned bone excavated from a cremation burial. These include: minimum number of individuals, age, sex and physique of the deceased, presence of animal remains, and as outlined above, the amount of bone collected at the pyre site. Based on modern crematoria, a complete adult cremation can generate between 1000-3600g of cremated bone (McKinley 2000(b), 404). Unfortunately, little work has been carried out on the weight of cremated remains that derive from infants and children but it is palpable that these age groups weigh less than a fully developed adult. It has been estimated that the percentage of burned bone weight to pre-cremation body weight of adults, children and infants is 3.5%, 2.5% and 1%, respectively (Ubelaker 2009, 4). However, the application of this calculation to juvenile cremated remains is seriously lacking in the literature. A more common research interest is concerned with the differences in post-cremation weight between males and females. McKinley (1993(b), 285) has recorded that the range of post-cremation weights for females, based on the results acquired from two modern crematoria, varied from 1001.5g to 1757.5g, producing an average weight of 1271.9g, while males generated a weight range of 1384.6g to 2422.5g with a subsequent mean weight of 1861.9g. It is apparent that the male average post-cremation weight is 590g heavier than the female weight. However, the large degree of overlap between male and female weights highlight that this measurable attribute is not a suitable means of establishing biological sex (McKinley 1993(b), 285-286).

Based on the information obtained from modern crematoria, it is evident that the majority of Anglo-Saxon cremation burials do not contain the complete quantity of bone that would have been produced on the funerary pyre. In many cases only a small amount of bone is present in a burial. These interments are frequently referred to as ‘token’ deposits (McKinley 2006, 42). This may have been the result of incomplete collection of material from the pyre site based on the labour invested in a cremation, or because adverse weather conditions prevented the complete collection of burned remains (McKinley 1994, 85). Alternatively, it is possible that some of the cremated bone was distributed among mourners or may have been buried with relatives at a later date (Williams 2004, 282). In other cases, the presence of extremely large quantities of cremated material suggests that numerous individuals were interred within a single deposit. Under such circumstances, the examination of osteological material usually shows that either multiple individuals or cremated animal remains were deposited within the same cinerary urn. This is clearly exemplified at Sancton, as the largest cremation from the site weighed 3800.3g and contained the cremated bones of two adults alongside a large amount of animal remains, which primarily derived from a horse (McKinley 1993, 296, microfiche 2/19). Therefore, it is imperative that osteological analysis is carried out on cremated material to gain an indication of the number of individuals interred within an urn as opposed to estimating this figure based solely on the weight of a deposit.

It has already been mentioned that the fragmentation of cremated remains would have occurred on the funerary pyre and during the collection process. Further fragmentation may have transpired through the interment of burned bone within cinerary urns (Merbs 1967, 504). In some cases deliberate breakage of large fragments of burned bone may have taken place to facilitate their inclusion within a funerary vessel. However, McKinley (1994(c), 342) has observed that fragment size of archaeological cremated bone is comparable to the measurements of burned skeletal remains that derive from modern crematoria. These results demonstrate that deliberate pre-depositional fragmentation was not frequently practiced in Anglo-Saxon England and any degeneration that did occur was likely to have been post-interment (McKinley 1994(c), 342). Nonetheless, the placement of cremated bone within cinerary urns would have protected these remains from further taphonomic disturbance (McKinley 1994(c), 341). Deep ploughing, excavation and post-excavation handling of burned bone, such as storage and osteological assessment, are additional factors that contribute to the increased fragmentation of urned and unurned cremated material (McKinley 1994(c), 341). The following section will explore the effects of burning on the human body and bone. This intends to highlight the variety of information that can be extracted from cremated bone which will further our understanding of the cremation process and funerary rites in the early Anglo-Saxon period.

4.3 *Effects of burning on the body and bone*

It is difficult to know for certain what form of cremation pyre was used by early Anglo-Saxon groups given the scarcity of surviving pyre sites, though the examination of cremated remains may provide a greater insight into this technology. As previously mentioned, temperature, duration and the presence of an oxidising environment are the main factors that ensure a successful cremation. Even when these three factors are present, the cremation process varies from case to case. Infants, the elderly and individuals affected by tissue wasting diseases, such as tuberculosis and carcinoma, generally take a longer amount of time to cremate due to the deficiency of fat stores (Wells 1960, 35; McKinley 2000(b), 404). Furthermore, individuals that suffer from metabolic conditions in life, such as osteoporosis, are prone to rapid destruction during the cremation process owing to the loss of trabecular bone (McKinley 1994, 106; Christensen 2002, 469; Roberts and Manchester 2005, 242). Nevertheless, bodies that are subjected to thermal alteration all produce a similar pattern of burning. The final section of this chapter will explore the effects of burning on the body and subsequently on human bone at a macroscopic and microscopic level. The following description explores the effects of the cremation process on the human body based on ideal conditions in modern crematoria. Of course, each cremation is different so a number of examples will be considered to gain a general idea of the various stages that are entailed in the cremation process.

Depending on the time of day, the duration of a modern cremation will vary: for instance, the hearth will be cooler in the morning than the afternoon and this will subsequently affect the cremation process (McKinley 1994, 72). However, the cremator must be hot enough to initiate the most important stage of the cremation process, that is, the initial incineration of the cadaver. Thermal alteration of the body commences once combustion has taken hold of the coffin, which is normally made out of cardboard, chipboard and wood (Jones and Williamson 1975, 80). Gas jets are usually turned off when temperatures reach around 800˚C as soft tissues combust at about 700˚C and the fat within the body will then act as the main fuel source (McKinley 1994, 72; Bohnert, Rost and Pollak 1998, 13; Goldhahn and Oestigaard 2008, 219). Modern protocol requires that cadavers are always placed within a coffin in a supine, extended position which has implications for the burning patterns of the body. The primary changes that can be identified to the corpse after ten minutes in the cremation hearth include the so-called 'pugilistic pose', dehydration of soft tissue and charring and splitting of the skin (Bohnert, Rost and Pollak 1998, 13; DeHaan and Nurbakhsh 2001, 1077). The pugilistic pose (also referred to as the pugilistic posture or attitude) is induced through high temperatures which causes muscle shrinkage, owing to protein denaturation and dehydration, and contraction which consequently protects some tissues (such as bone) though exposes others based on their depth and posture as a result of tissue shielding (Saukko and Knight 2004, 316; Symes *et al.* 2008, 30; Ubelaker 2009, 2). In comparison to the extensors, the flexor group of muscles are particularly affected by the heating process due to their large size (Saukko and Knight 2004, 316). Thermal alteration of the flexor muscles cause the body to contract, especially at the elbows, wrists and knees (Saukko and Knight 2004, 317). However, extension of the head also occurs as a result of the many superficial and deep muscles of the neck (Fairgrieve 2008, 45). Therefore, these areas of the skeleton are most vulnerable to heat modification. Consequently, the distal epiphyses of the radii and ulnae, dorsal surface of the carpals, and a small area of the anterior distal femora, patellae and proximal epiphyses of the tibiae and fibulae are the primary bones affected by the fire (Symes *et al.* 2008, 31-33).

The visible exposure of many bones and the oxidation of soft tissue, apart from the thickest layers of muscle and fat, occur within the first 45 minutes of the cremation process (McKinley 1994, 74; Bohnert, Rost and Pollak 1998, 13-14). During this period, internal organs show increased shrinkage and charring (Bohnert, Rost and Pollak 1998, 14). Areas of the skeleton that are frequently revealed within this time frame include sections of the cranial vault (in particular the frontal bone), facial bones, hand phalanges and elements in the thorax and abdomen region (Bohnert, Rost and Pollak 1998, 13-14; Symes *et al.* 2008, 31-33). Furthermore, the anterior femora, patellae, tibiae and fibulae show increased signs of thermal alteration (Bohnert, Rost and Pollak 1998, 13-4; Symes *et al.* 2008, 31-33).

The remaining skeletal elements to be affected by heat modification occur within the last half an hour of the cremation process (Jones and Williamson 1975, 83). The reason behind the late incineration of these bones is that they are either protected by large amounts of soft tissue and/or these elements are surrounded by a limited amount of fatty deposits. Thick layers of soft tissue will inhibit high temperatures and oxygen flow from reaching certain bones and will lead to incomplete cremation (McKinley 1994, 75). Skeletal elements that frequently experience imperfect combustion include: the base of the occipital, bones within the cranial vault such as the petrous bones, the posterior surface of the proximal femora, tibiae and fibulae, the anterior sacrum and os coxa, posterior scapulae, anterior surface of the vertebrae, posterior distal humeri, distal hand phalanges and the palmar surface of the hands (Bohnert, Rost and Pollak 1998, 16; Symes *et al.* 2008, 32-33). In addition, articular surfaces also take a longer amount of time to cremate since these elements contain a greater proportion of organic matter (McKinley 1994, 75). As previously mentioned in this chapter, under ideal conditions of a modern crematorium, it takes between one to two hours at temperatures exceeding 700˚C to achieve complete combustion of a cadaver. The following section of this chapter aims to address the validity of using burning patterns, which have been identified on skeletal remains from modern crematoria, to gain an understanding of pyre technology in the Anglo-Saxon period.

It has already been established that open air pyres are not entirely analogous to modern, enclosed crematoria, due to external environmental conditions that will affect the cremation process. However, osteological assessments of Anglo-Saxon cremated bone have identified that, in most cases, the degree of incineration is surprisingly thorough given the obstacles that would have been posed upon communities employing funerary pyres (McKinley 1993, 296; McKinley 1994, 83; Mays 2009, 439-440). It has been suggested that surviving cremated remains from Illington and Spong Hill is the result of either deoxidising conditions, the accidental or intentional placement of appendages on the peripheries of the pyre or bones that were insulated by thick layers of soft tissue (Wells 1960, 34; McKinley 1994, 83). Skeletal elements that are frequently found in an incomplete state of combustion from Anglo-Saxon cremation burials include petrous bones, dorsal vertebrae, fibulae and tibiae, tarsals, hand and foot phalanges and occasionally fragmented sections of os coxae, sacra and proximal femora (Wells 1960, 33-34; McKinley 1994, 83). In contrast, elements that rarely survive from the Anglo-Saxon cremation rite include facial bones, teeth, ribs, clavicles, sterna, scapulae and carpals (Wells 1960, 33-34; McKinley 1994, 83). The survival of these bones varies between each cremation burial. Furthermore, these skeletal elements may have been left at the pyre site or, alternatively, these remains were collected but for whatever reason did not make it into the grave. Wells (1960, 33) has observed that complete permanent teeth rarely survive the cremation process, although their roots are often represented in the archaeological record. In contrast, unerupted deciduous and permanent teeth, which are protected by the bone of the mandible or maxilla, survive to a greater degree. Beach, Passalacqua and Chapman (2008, 142-143) have identified that separation of the tooth crown at the cementoenamel junction occurs at temperatures over 400˚C. In addition, these authors have also recognised that tooth enamel disintegrates when exposed to direct heat over 500˚C (Beach, Passalacqua and Chapman 2008, 142-143). These results highlight that the crowns of erupted teeth would have been destroyed at an early stage of the cremation process. Despite the lack of detailed work carried out in this research area, it is apparent that combustion patterns identified on skeletal remains from modern crematoria are similar to those seen on cremated bone from the Anglo-Saxon period.

The distinctive patterns of thermal alteration that have been observed on burned bone holds a number of inferences regarding the placement of cadavers on open air funerary pyres. Based on the comparable burning patterns and fragment sizes of archaeological and modern cremated bone, it appears that intensive tending or interference with the pyre did not take place during the Anglo-Saxon cremation rite, as witnessed at Sancton (McKinley 1993, 297) and Spong Hill (McKinley 1994, 84), though some degree of movement would have occurred naturally. The adherence of molten glass and copper-alloy to burned bone may also indicate the position of the body and accompanying objects on the cremation pyre (McKinley 1994, 83). For example, a body that was placed in a supine position, which endured minimal disturbance, would have allowed sufficient time for fusion between artefact debris and skeletal remains. In contrast, the placement of a cadaver in a prone position would have caused artefacts, which were either placed upon and/or attached to the clothing of the deceased, to fall away from the body at an earlier stage of the cremation process and, as a result, would have prevented molten glass or copper-alloy from adhering to the burned bone. In addition, the ventral surface of the cadaver would show signs of deoxidisation if placed on the pyre in a prone arrangement. The thermal alteration of Anglo-Saxon cremated bone suggests that the dorsal surface of cadavers was exposed to deoxidising conditions, thus it appears that individuals were placed on the pyre in an extended supine position. The similar patterns of burning that have been identified at Illington and Spong Hill may, in fact, indicate that the dead were arranged on the pyre in the same manner at both sites. Burned bone from these cemeteries exhibit analogous patterns of oxidisation that could only have been achieved if the cadaver was placed on top of the funerary pyre (Wells 1960, 33-34; McKinley 1994, 83). Furthermore, the remains of cremated bear phalanges and claws, which have been found in Anglo-Saxon cremation burials, suggest that pelts were placed upon the pyre. It has been identified that wrapping a pelt around the body, like a shroud, would prevent successful cremation since high temperatures and a flow of oxygen would have to permeate these skins before reaching the cadaver (Holck 1986, 173; McKinley 2008, 178). Alternatively, pelts may have functioned as a rug or throw which was placed over the wooden structure and would have created an insulating layer between the pyre and the deceased (McKinley 1994, 94). The use of pelts in this manner would have created a deoxidising environment around the dorsal surface of the body. Nonetheless, laying out animal skins on top of the pyre would have been more efficient, in terms of the cremation process, than wrapping these articles around the cadaver.

The hottest part of the funerary pyre would have been in the centre, while the peripheries would have attained cooler temperatures (McKinley 1994, 83). This point is reinforced by the survival of complete hand and foot phalanges from Anglo-Saxon cremation deposits. It is likely that the arms were placed either at the side or on the torso of the body. Hence, these appendages would have been exposed to lower temperatures and less favourable oxidising conditions (Holck 1986, 160). As a result of the cremation process, the loosening of ligaments would have caused the hands and feet to fall away from the body and towards the edge of the pyre, or away from the pyre completely, which would have led to curtailed combustion (McKinley 1989, 72; McKinley 2008, 176). It is also possible that funerary pyres were not always large enough to accommodate a fully extended cadaver and resulted in incomplete burning of the hands, feet and head. Other aspects of macroscopic analysis can also shed some light on to incineration patterns that are identifiable on cremated remains. The following section will examine the shrinkage of burned bone and heat-induced fractures (or fissuring), which aims to provide further insight into the Anglo-Saxon cremation process.

Shrinkage of cremated remains is partially the result of dehydration since the heating process causes a loss of moisture (Murad 1998, 92). It has been identified that bone starts to lose weight when heated to 100˚C as a result of the quantitative removal of organic matter (Thompson 2004, 204). However, skeletal remains that are exposed to temperatures of less than 800˚C for a short period of time display minimal amounts of shrinkage (Holland 1989, 460). Kenneth Kennedy (1996, 690) has noted that bone is completely dehydrated at 1100˚C and, subsequently, shrinkage ceases at this point of the cremation process. Nonetheless, further shrinkage can occur through combustion of the organic fraction of bone (also see the point below concerning the shrinkage of trabecular versus cortical bone) (Kennedy 1996, 690). Based on a number of studies, it is generally agreed that increased temperatures and duration of burning will lead to greater degrees of shrinkage (Shipman *et al.* 1984, 320; Correia 2006, 277; Thompson 2005, 1013). Research has shown that the amount of shrinkage that occurs to bone as a result of the cremation process varies between 1-2% and 20-25% (Herrmann 1977, 102; Wahl 1982, 10-11; Bush *et al.* 2007, 158). Shipman *et al.* (1984, 322) have also conducted experiments on bone shrinkage which has highlighted that the maximum mean percentage of shrinkage is around 15%. It is notable that significant variability does occur between experiments. The type of bone, as in cortical and trabecular bone, and its anatomical position may influence the degree of shrinkage and could explain the inconsistency between studies (McKinley 1994, 77). Recent research into this area has shown that trabecular bone shrinks to a greater degree, as it contains a higher proportion of organic material, than cortical bone (McKinley 1994, 77; Thompson 2005, 1011). It is also possible that the experiments outlined above were not conducted under the same conditions and/or did not follow a uniform methodology (Bradtmiller and Buikstra 1984, 536). Therefore, it is necessary to employ standardised procedures when carrying out experiments as this will permit an accurate comparison between results that have been obtained from a number of studies.

The cremation process also causes bone to fracture (or fissure) and warp. Heat-induced fractures can provide information regarding the state of preservation of the body at the time of cremation, for example whether bones were protected by soft tissue and fat (wet or green bone) or skeletal elements were placed on the pyre in a defleshed state (dry bone) (Baker Bontrager and Nawrocki 2008, 217). Seven types of heat-induced fractures have been identified on archaeological and modern bone.

These include longitudinal, curved and straight transverse, burn line, delamination, step and patina fractures (Herrmann and Bennett 1999, 461; Symes *et al.* 2008, 42-43). Wet bones usually produce transverse and curvilinear transverse fracturing while dry bones commonly exhibit longitudinal, delamination and patina fractures as a result of the cremation process (Binford 1972, 376; McKinley 1994, 78; Fairgrieve 2008, 52; Ubelaker 2009, 3). McKinley (1994, 78) has also observed that dry bones cremate at a faster rate than fleshed remains and has suggested that this is because defleshed bones are directly exposed to oxidising conditions. The rapid oxidisation that these conditions enable creates increased patina fracturing (McKinley 1994, 78). Cortical bone displays noticeably more warping and fracturing than trabecular bone; the latter type is primarily affected by delamination fractures (McKinley 1994, 77). Patina, longitudinal, delamination and curvilinear transverse fractures are frequently identified on cranial bones (Pope and Smith 2004, 434-436; Symes *et al.* 2008, 43). Scott Fairgrieve (2008, 53-54) has pointed out that cranial bones face the added pressure of intracranial strain, due to the high temperatures of cremation, which contributes to further fracture patterns. Fissuring is particularly distinctive on the diaphyses and epiphyseal surfaces of long bones. Diaphyseal cortical bone is frequently characterised by longitudinal, step, transverse, curved transverse and delamination fractures while epiphyses commonly display curved transverse and patina fissure patterns (Symes *et al.* 2008, 42-43). However, the observations outlined above should not be used as a standardised method of recording heat-induced fracture patterns as variability does occur between cases. It is also interesting to note that heat-induced fractures are commonly associated with the warping of burned bone (Ubelaker 2009, 3). Warping is easier to identify on larger fragments of cremated material. Unfortunately, there is currently no standard method of recording this heat-induced trait, aside from noting the presence or absence on burned bone (Baker Bontrager and Nawrocki 2008, 217). It has been observed that dry bones display less warping, as they are more prone to dehydration and consequently contain a smaller amount of organic material, than fleshed bone (Binford 1972, 375; McKinley 1994, 78; Kennedy 1996, 690). The following section will highlight that organic content also affects the colour and microstructure of cremated bone.

As previously discussed in this chapter, the colour of burned bone can provide information about the oxidising conditions of a cremation, but can the appearance of cremated remains contribute any additional details to our understanding of the Anglo-Saxon cremation process? The colour of burned bone was once thought to indicate the presence of multiple individuals (Gejvall 1969, 473). However, this is now known to be an inaccurate method of determining the minimum number of individuals and should not be employed in the analysis of cremated bone. Nonetheless, the colour of burned bone can be used to detect temperatures achieved during the cremation process. Shahack-Gross, Bar-Yosef and Weiner (1997, 439) have commented that initial decomposition and carbonisation of the organic component of bone causes skeletal elements to turn black in colour. At the other end of the spectrum, bone that is in a complete state of calcination is recognised by its white outward appearance (Shahack-Gross, Bar-Yosef and Weiner 1997, 439). It is important to highlight that these observations do not account for other factors, or indeed different stages of the burning process, that affect the colour of cremated bone. Shipman, Foster and Schoeninger (1984) have produced one of the most important research projects to date that deals with the colour of burned skeletal remains. These authors devised five stages of heating based on the resultant colour of thermally altered bones. It was identified that skeletal remains experience a variety of colour changes during the cremation process owing, in part, to increasing temperatures. The colour of burned bone ranges from pale yellow through brown, black, bluish grey, light grey and, finally, white (Shipman, Foster and Schoeninger 1984, 312-313). Similarly, Holden, Phakey and Clement (1995, 25; 1995(b), 32) have revealed that at 200˚C bone turns orange in colour, which subsequently darkens and develops into black as the temperature increases to 300˚C. When temperatures reach around 600˚C the colour of bone lightens to grey, which then turns white when exposed to heat in excess of 800˚C (Holden, Phakey and Clement

1995, 25; 1995(b), 32). However, temperatures attained on a cremation pyre would have varied throughout the structure and, consequently, each skeletal element would have produced unique patterns of burning depending on their position on the funerary pyre. Therefore, recording the colour of each skeletal area from cremation burials will also allow archaeologists to build up a more detailed picture of the temperatures that were attained in the cremation process during the Anglo-Saxon period.

The colour of bone before the cremation process and post-depositional taphonomy may have also influenced the outward appearance of burned skeletal remains (Gejvall 1969, 470; McCutcheon 1992, 366-367; Taylor, Hare and White 1995, 116; Shahack-Gross, Bar-Yosef and Weiner 1997, 445). Franchet (1933) (as cited by Nicholson 1993, 423) has observed that acidic soil can cause cremated bone to turn brown, blue grey or dark blue, whilst compounds such as manganese dioxide, iron oxides and iron phosphates can cause blackening, orange and yellow colouring, and light green and blue tones, respectively. This highlights that taphonomic processes can influence the colour of burned bone and must be considered when carrying out a macroscopic examination of cremated remains. More recently, an advanced method of assessing the outward appearance of burned bone has been developed which aims to provide a better insight into the underlying factors that affect the colour of burned bone. Walker, Miller and Richman (2008) have improved our understanding of the relationship between the colour of cremated bone and temperature, duration of burning, availability of oxygen and organic compounds through evaluating RGB values of postcremation digital images. The use of colour coordinate systems have also been employed which allows the measurement and comparison of general colour differences between skeletal elements (Devlin and Herrmann 2008). In turn, this technique can provide a more comprehensive understanding of the temperature attained throughout a funerary pyre and duration of the cremation process (Devlin and Herrmann 2008, 125-126). Despite recent advances that have been made in this field of research, it is widely recognised that macroscopic analysis needs to be employed in conjunction with microscopic techniques to gain a more in-depth insight into the cremation process and effects of burning on bone.

Thompson (2004, 204) has identified that primary level changes, at the microscopic level, are closely linked to secondary level alterations which are manifested at the macroscopic level. Studies combining these avenues of research have increased significantly in recent years and were outlined in detail in chapter two of this thesis. The final section of this chapter will explore how thermal alteration affects bone microstructure. This form of assessment can provide information regarding the organic degradation and structural changes of burned remains. Skeletal material that is exposed to temperatures below 200˚C normally experience some degree of weight loss, due to the evaporation of water and liquids, although this process has little effect on bone microstructure (Olsen *et al.* 2008, 792). When temperatures are increased to 200-300˚C, charring can be seen on the bone's periosteal surface (Lanting, Aerts-Bijma and Van der Plicht 2001, 250). In spite of the macroscopic changes that take place within this temperature threshold, organic components, such as proteins (including collagen) and fats, survive within the bone matrix (Cattaneo *et al.* 1994, 568, 570; Lanting, Aerts-Bijma and Van der Plicht 2001, 250). The application of X-ray diffraction (XRD) has shown that temperatures over 500˚C cause structural changes to the inorganic component of bone (Shipman, Foster and Schoeninger 1984, 320; Rogers and Daniels 2002, 2584). Shipman, Foster and Schoeninger (1984, 320) have observed that there is a gradual increase in hydroxyapatite crystal size between 20-525˚C. This (inorganic) faction of bone experiences augmented growth when exposed to temperatures between 525-645˚C, though skeletal remains that are heated in excess of 645˚C show a less pronounced change to the dimensions of hydroxyapatite crystals (Shipman, Foster and Schoeninger 1984, 320). Furthermore, Holden, Phakey and Clement (1995(b), 33) have identified that at 600˚C some degree of recrystallisation has already taken place which is manifested in the form of spherical crystals.

As previously mentioned in chapter two, Herrmann (1977, 101) has identified that the 'critical point' of the cremation process occurs between 700-800˚C. At this stage, the organic component of bone is completely oxidised and the inorganic fraction commences fusion (Herrmann 1977, 101). These changes are caused by the combustion of residual carbon (from the organic section of bone) which is subsequently converted to carbon dioxide and, as a result, only the inorganic component of bone is left behind (Grupe and Hummel 1991, 177-178). Holden, Phakey and Clement (1995(b), 35) have observed that hexagonal shaped crystals start to appear in the bone matrix between 800-1000˚C. However, the assessment of bones burned at higher temperatures can be problematic owing to the fusion of bone and increased crystal size (Hiller *et al.* 2003, 5095-5096). At temperatures between 1000-1400˚C, rhomboid, rosette, platelet and irregular shaped crystals start to materialise while hydroxyapatite crystals that possess a hexagonal morphology begin to fuse (Holden, Phakey and Clement 1995(b), 36-38). The melting point of bone occurs at around 1600˚C and, subsequently, this is the final stage of thermal alteration. The effects of such high temperatures on bone microstructure causes the obliteration of all structural features, including inorganic hydroxyapatite crystals, as the bone melts and, consequently, recrystallises during the cooling process (Holden, Phakey and Clement 1995(b), 38). Despite the application of different methodologies, in each of the case-studies outlined above, all authors came to the same conclusion that temperature has a significant impact on bone microstructure. In addition, the research that has been examined throughout this section demonstrates that relatively defined temperature ranges can be detected through the microscopic analysis of burned bone.

4.4 Summary

This chapter has highlighted that the assessment of burned bone, both on a macroscopic and microscopic level, and pyre debris can provide copious amounts of information about the Anglo-Saxon cremation rite and pyre technology. An assessment of osteological techniques, both old and new, alongside an examination of documentary sources, ethnographic examples and modern cremation practices can contribute to a more in-depth understanding of the funerary technologies that were employed in Anglo-Saxon England. Based on the evidence at hand, it appears that the dead were placed in a supine, extended position on top of the criss-cross style of cremation pyre given the burning patterns that have been identified on cremated bone. Charcoal analysis has highlighted that funerary pyres were primarily constructed out of oak or, to a lesser extent, other species of wood such as beech, ash, pine and hazel. Particular species of wood may have been selected due to practical considerations, ideological beliefs or the social standing of an individual. Furthermore, the amount of fuel and time that was invested in a cremation may also contribute to our understanding of the people, both the living and deceased, who were involved in this funerary rite. For example, the cremation of a high-status individual may have attracted a higher frequency of mourners and greater economic investment, such as the construction of a larger pyre, than their less fortunate counterparts.

The osteological analysis of burned skeletal remains can be used to identify variability between cremations, which, in turn, holds significant implications regarding the social identity of individuals that were afforded the cremation rite. Macroscopic and microscopic assessment of cremated bone can provide evidence for the duration of the cremation process as well as the temperatures and oxidising conditions that were achieved in open air pyres during the Anglo-Saxon period. Based on this osteological evidence, funerary pyres seem to have frequently attained temperatures of 500˚C to over 1000˚C under relatively successful oxidising conditions, though there appears to have been significant variability between the duration of cremations. Interestingly, there is no archaeological or documentary evidence for failed cremations from Anglo-Saxon England. This suggests that communities employed a variety of methods to identify when a cremation was ‘complete’, for example when the bones had turned white in colour or when there was no longer flesh adhered to the skeletal remains. For the most part, these conditions seem to have been frequently achieved which demonstrates that

Anglo-Saxon communities had a good understanding of the factors required to ensure a successful cremation. In addition, the fusion of artefact debris to burned bone indicates that cremated remains were left at the pyre site for a length of time, maybe overnight, to ensure that they were cool enough to handle during the collection process. The macroscopic and microscopic assessment of burned bone is extremely important as these methods can be employed to enhance our understanding of the cremation process and the social identities of individuals who were afforded this funerary rite in Anglo-Saxon England. The following chapter will outline the methodology that was utilised during the data collection phase of this thesis.

Chapter 5: Methodology

As outlined in the introduction of this thesis, the primary aim of this research is to expand the dataset of cremated remains from Anglo-Saxon England through a detailed assessment of the burned bone from the Elsham and Cleatham cemeteries. This chapter will outline the methods that have been employed throughout the data collection process and in the statistical analyses that followed. To begin, each stage of the osteological analysis will be discussed in detail. This will lead on to an exploration of the osteological procedures that have been employed to assess the demographic attributes of unburned and cremated bone. The following two sections will address the various means that have been used to gather information about pyre and grave goods and cinerary urns. Subsequently, the statistical methods that have been utilised to assess osteological data, artefact type and material, animal bone, pottery dimensions and cemetery organisation will be addressed. Finally, this chapter will conclude with a discussion concerning new, or relatively unused, techniques that have been applied to the analysis of cremated bone from the Elsham and Cleatham assemblages.

5.1 Osteological analyses

The contents of eight inhumation and 566 cremation burials from the Elsham cemetery were subjected to an osteological assessment from the 27th May 2009 to the 30th September 2009. Unfortunately, the cremated bone from three urns, EL75LN (no urn number), EL75LR/LV (urn 210/214 – possibly the same urn), and EL76IN (no urn number), were missing at the time of analysis. Osteological analyses were conducted on the contents of 979 cremation burials, apart from two missing deposits (1101 and 1102), and 28 deposits of associated unburnt bone from the Cleatham cemetery. The analysis of this bone assemblage was carried out from the 1st February 2010 to the 21st September 2010. All osteological assessments were performed in the osteology laboratory at the University of Sheffield where both collections were stored while on loan from North Lincolnshire Museum. The principal ethical issue of this research was embedded in the osteological analysis of the cremated remains. Therefore, guidelines and conduct concerning the handling of human skeletal material were followed in compliance with the BABAO Code of Ethics for archaeological human remains (Mays 2008).

5.1.1 Osteological assessment of unburned bone

Before discussing the osteological procedures that were employed during the assessment of cremated bone, it is necessary to summarise the methods that were utilised during the analysis of inhumation burials from Elsham and fragments of unburned bone from both sites. To begin with, unburned bone was laid out and the completeness of each deposit were recorded in compliance with the standards outlined by Buikstra and Ubelaker (1994, 7). The varying degrees of skeletal completeness can shed light on the disturbance endured to burials or, alternatively, the selective interment of specific bones. Next, preservation of the cortical surface was categorised based on the standards presented by McKinley (2004, 15-17). This system of recording highlights the degree of taphonomic degradation endured to skeletal remains as a result of their burial environment. Munsell soil colour charts (2000) were employed to record the general colour and discolouration, such as bleaching or staining, of unburned bone. The colour of these skeletal remains can provide information about burial conditions, associated artefacts and the position of these objects within the grave. Subsequently, any demographic information that could be gleaned from these remains was recorded. Osteological procedures that were utilised during the biological assessment of unburned bones were the same as those employed during the analysis of cremated remains. However, tooth wear, which is used to determine age, and stature estimation of unburned material was also considered owing to the better preservation of these remains. Each of these methods will be outlined later in this chapter.

5.1.2 Osteological assessment of cremated bone

The first stage of analysis involved weighing each cremation deposit using a Mettler PM2000 electronic scale, which recorded weight in grammes and to two decimal places. The total weight of each burial will reflect whether all of the skeletal remains were collected and buried after the cremation process. Next, the burned bone was sieved and the contents of each sieve compartment were weighed. These procedures aimed to assess the degree of fragmentation in each burial and to identify whether there was a preference to collect and, subsequently, deposit certain fragment sizes. The mesh sizes that were employed in this study measured 10mm, 5mm and 2mm, and are analogous to those employed in the Sancton (East Riding of Yorkshire) (McKinley 1993, 288) and Spong Hill (Norfolk) (McKinley 1994, 5) osteological analyses. The use of standard mesh sizes will, in turn, permit an accurate comparison of fragmentation between sites. Subsequently, maximum fragment size was recorded for each sieve compartment. These measurements will serve as an indication regarding the extent of fragmentation within each cremation burial (for further discussion on the problems of fragmentation see sections 4.2 and 8.3). Identifiable bone was then separated into four categories, which included cranial, axial, limb bones (including upper and lower limbs) and unidentifiable groups, although this method was only undertaken on a 20% sample of the Elsham bone assemblage due to time constraints. These remains were then sieved and weighed to determine whether there was a preference to the collection and interment of specific bones in the Anglo-Saxon cremation rite. Deposits that were not afforded this in-depth assessment were still separated into cranial, axial, limb bone and unidentifiable groups but were not weighed or sieved. The separation of elements in this manner allowed a more effective means of recording identifiable bones, some of which were used in a demographic assessment.

Munsell soil colour charts (2000) were used to document the colour of cremated bone from each sieve compartment. Warping, fissuring (or fracturing) and shrinkage of cremated remains were also noted. However, since there is no standardised procedure for recording these characteristics, based on the author's macroscopic observations, a three point scale was adopted for the purpose of this task, which assessed the degree of warping, fissuring and shrinkage in turn. This method recorded whether a cremation burial exhibited either no modification (none), a small amount of modification (moderate) or significant amounts of modification (severe) as a result of thermal alteration. Brief descriptions were also provided to justify the scores ascribed to each heat induced characteristic. The outward appearance of cremated bone was documented in detail to build up a picture of pyre conditions that were achieved in Anglo-Saxon North Lincolnshire.

5.1.3 Criteria for assessing the minimum number of individuals (MNI)

The minimum numbers of individuals were identified in accordance with the methods employed in the Sancton (McKinley 1993, 288) and Spong Hill (McKinley 1994, 6) reports. Clear examples of duplicate elements were the primary means of detecting multiple individuals within a burial. The size of bones were only used to determine MNI where differences were immediately apparent, for example it is easier to detect the burial of an infant and adult within the same cinerary urn as opposed to the identification of two adults within the same burial (McKinley 1994, 6). Weight was not employed as a method of determining MNI because, as outlined in chapter four, the amount of skeletal remains recovered from an adult cremation can vary significantly from about 1000 to 3600g (McKinley 2000(b), 404). Similarly, the colour of cremated bone was not used to identify the MNI within a burial since burning patterns are variable throughout the skeleton. There was some indication which suggested that a second individual was interred within a cinerary urn from the Elsham and Cleatham cemeteries. However, a number of these 'additional' persons were recorded as 'probable' owing to the low frequency of duplicate elements that were associated with these individuals.

5.1.4 Criteria for determining biological age

The biological age of each cremation burial was established, where sufficient evidence survived, using a variety of standard techniques which are commonly employed when assessing inhumed skeletal remains. These methods were also applied to the inhumation burials from Elsham and disturbed deposits of unburned bone from both sites. The main problems encountered during this stage of analysis was the degree of fragmentation, absence of elements and damage caused to skeletal remains, especially to teeth, as a result of the cremation process. Furthermore, it should be noted that establishing the age of older individuals, over 25-30 years, is extremely problematic since indicators that are used to assess the age of persons afforded the inhumation rite are often destroyed due to cremation, for example tooth, or occlusal, wear (McKinley 1994, 11).

Ectocranial suture closure (Meindl and Lovejoy 1985) was employed as a very general guide of establishing the age of an individual. As a result of fragmentation, specific sutures could not be identified, therefore, both the lateral-anterior and ectocranial sutures scoring systems were utilised during analysis. This use of this method produced broad age categories which were only applicable to individuals over the age of 30 years, since the closure of sutures is most common after this age threshold. Tooth eruption and development was one of the primary means of establishing biological age (Moorrees, Fanning and Hunt 1963; Schwartz 2007, 222-223). This method can produce particularly narrow age estimates for infants and children. The reason for this is that unerupted tooth crowns frequently survive the cremation process because they are protected by the mandible or maxilla (Fig 5.1). Conversely, only the roots of fully developed teeth

Fig 5.1 Unerupted tooth crowns from burial MT84FX (urn 230) (Cleatham)

survive cremation since the enamel crowns shatter as they are directly exposed to the intense heat of the pyre. There are some rare instances where enamel has survived the cremation process, though these examples are often very damaged which prevents an assessment of tooth wear. However, occlusal wear was used to determine the age of unburned remains since tooth enamel from these deposits was not affected by thermal alteration. The occlusal wear of teeth was recorded in compliance with the standards outlined by Miles (1962).

The survival of unfused, and fused, diaphyses and epiphyses is extremely useful as these elements permit age estimation of individuals up to the age of 29 years, which is the point when the medial aspect of the clavicle has completely fused (Scheuer and Black 2004, 252). The standards employed to assess the varying degrees of epiphyseal fusion were based on those presented by Scheuer and Black (2000; 2004) (Fig 5.2). Unfortunately, the pubic symphysis, of the pubis bone, and auricular surface, of the ilium, rarely survive the cremation process. On the rare occasion that these bones are found in cremation burials, these elements are particularly useful in establishing the age of older individuals, especially persons over 20 years old. The standards utilised to evaluate age related features of the pubic symphysis were based on those established by Brooks and Suchey (1990). Two methods were employed to assess age related changes to the auricular surface based on the methods and criteria presented by Lovejoy *et al.* (1985) and Buckberry and Chamberlain (2002). The application of two methodologies aimed to produce a relatively accurate age range for individuals who were interred within a deposit that contained a surviving auricular surface(s).

Fig 5.2 Unfused proximal femoral diaphysis from burial MT84DM (urn 260) (Cleatham)

After establishing biological age, an age category was allocated to each individual. These age groupings are the same as those employed in the Sancton (McKinley 1993, 289) and Spong Hill (McKinley 1994, 19) reports (Table 5.1). This classification system was employed to facilitate successful intra- and inter-site comparisons (see sections 6.4.6 and 7.2.6). Broader age categories, for example young adult/younger mature adult, were also employed in this thesis as some individuals could not be ascribed to one of the more defined groupings. However, where further statistical tests were carried out, individuals that were assigned a broad age category were proportionally distributed among the flanking age groupings (Chamberlain 1994, 20). Demographic data from other sites, including Illington (Norfolk) (Wells 1960, 31), Loveden Hill (Lincolnshire) (Fennell 1964; Wells n.d.)[11], Newark (Nottinghamshire) (Harman 1989, 23) and Snape (Suffolk) (Steele and Mays 2001, 227), were also examined. However,

Age category	Age range
Foetus	8 weeks-39 weeks *in utero*
Infant	0-4 years
Child	5-12 years
Adolescent	13-18 years
Young adult	19-25 years
Younger mature adult	26-30 years
Older mature adult	31-40 years
Older adult	41+ years
Infant/child	0-12 years
Child/adolescent	5-18 years
Adolescent/young adult	13-25 years
Young adult/younger mature adult	19-30 years
Younger mature adult/older mature adult	26-40 years
Older mature adult/older adult	31+ years
Subadult	0-18 years
Adult	19+ years

Table 5.1 Age categories based on McKinley (1994, 19)

[11] Unpublished notes by Calvin Wells (acquired from Biological Anthropology Research Centre at the University of Bradford library) outline the results from osteological analysis conducted on the Loveden Hill cremation burials. This piece of work is not dated, though based on correspondence information between Wells and Fennell it appears that osteological analyses were carried out at some point between 1962 and 1966.

each of these four studies has used different age categories which make inter-site comparisons extremely problematic. Therefore, the biological data from these sites will be excluded from more advanced analyses and statistical testing.

5.1.5 Criteria for ascertaining biological sex

The biological sex of individuals who were afforded the cremation rite was established using a range of techniques which are frequently utilised when analysing inhumed skeletal remains. These methods were also used to assess the biological sex of inhumed individuals from the Elsham cemetery. Skeletal remains that display sexually dimorphic traits are often destroyed during the cremation process, although a number of bones, such as the mastoid process and zygomatic, survive quite well. The identification of numerous sexually diagnostic elements was necessary to ascertain the biological sex of an individual. The sex categories employed in this thesis reflect the groupings employed in the Sancton (McKinley 1993, 289-291) and Spong Hill (McKinley 1994, 19-20) reports, which was to ensure a uniform method of recording.

Fig 5.3 Left supraorbital margin from burial MT88ASR (urn 738) (Cleatham)

This classification system consists of: confidently assigned (or unquestionable) male or female, probable male or female, possible male or female, indeterminate and unsexed (McKinley 1994, 20). Only individuals that had been assigned to the 'unquestionable' or 'probable' groups were included in statistical analyses. The fragment size of cremated bone is dependent on a number of variables, for example physique of the deceased and the shrinkage of bone which is caused by the cremation process, and was therefore not assessed when

Fig 5.4 Supraorbital ridge from burial MT85HX (urn 389) (Cleatham)

ascertaining the biological sex of individuals from the Elsham and Cleatham cemeteries. The nuchal crest, mastoid process, supraorbital margin, supraorbital ridge and mental eminence of the skull and greater sciatic notch of the os coxa were among the primary skeletal features that were employed to determine the biological sex of individuals (Figs 5.3 and 5.4). These features were scored on a five point scale based on the scoring system presented by Buikstra and Ubelaker (1994, 21) which ranged from a score of one, which denoted females, to five, which represented males (Table 5.2). Other sexually diagnostic features of the skull, such as the zygomatic, and os coxa, for example the ischial spine and postauricular sulcus, were also recorded based on descriptions produced by Bass (1995) and Schwartz (2007).

Similar to the Sancton (McKinley 1993, 294) and Spong Hill (McKinley 1994, 19) reports, biological sex was only established for adults and, in some cases, older adolescents, who were over 16 years of age and provided sufficient amounts of evidence to substantiate any conclusions made about the sex of an individual. The primary reason for excluding infants, children and younger adolescents from this form of analysis is because sexual dimorphism does not commence until adolescence in males and females (Scheuer and Black 2004, 14). Therefore, the criteria used to determine the biological sex of adult skeletal remains cannot be employed in conjunction with immature skeletons as this type of assessment will produce unreliable results. Biological sex was determined based on the analysis of skeletal remains alone. Pyre and grave goods were only assessed after osteological analyses had been conducted which was to ensure that the author's interpretation of the cremated material was not influenced by any sex or gender orientated artefact groupings.

Score	Sex
1	Female
2	Probable female
3	Indeterminate
4	Probable male
5	Male

Table 5.2 Scoring system employed to assess sexually dimorphic features (*Source:* Buikstra and Ubelaker 1994, 21)

5.1.6 Population size

Once the minimum number of individuals had been established from both the Elsham and Cleatham cemeteries, it was then possible to calculate the number of deaths per year, size of the living population and area served by each site. The number of deaths that occurred each year can provide a basic idea of the mortality rates that were experienced in a cemetery population. Leahy (2007, 263) has pointed out that at the Cleatham cemetery, cremation and inhumation were practiced alongside each other from the fifth to sixth centuries, though only the inhumation rite was employed into the seventh century. The length of time that the Elsham cemetery was utilised is currently unknown, but it is likely to parallel the longevity of the Cleatham site. Consequently, population size for 150 and 200 year periods was examined in turn (Leahy 2007, 32). The calculation that was used to determine number of deaths per year can be seen below:

$$\text{Number of deaths per year} = \frac{\text{minimum number of individuals}}{\text{duration of cemetery use}}$$

Size of the living population was determined by applying the calculation employed by Christopher Arnold (1984, 125), in order to establish the population size of several early Anglo-Saxon inhumation cemeteries, to the MNI from Elsham and Cleatham. This formula can be seen below:

$$\text{Living population} = \frac{\text{minimum number of individuals x average life expectancy}}{\text{duration of cemetery use}}$$

David Hill (1981, 19) has estimated that typical Anglo-Saxon rural population density in North Lincolnshire consisted of five persons per square mile. Based on Hill's (1981, 19) study of Anglo-Saxon population and the use of a simple calculation (see below) it was possible to estimate the size of each site's catchment area:

$$\text{Area served per square mile} = \frac{\text{living population}}{\text{number of persons per square mile}}$$

5.1.7 Health and disease

It should be noted that health and disease is not a primary research focus within this thesis. However, the identification of any skeletal or oral abnormalities, including non-metric traits, were photographed and noted accordingly using two primary sources (Aufderheide and Rodríguez-Martín 1998; Roberts and Manchester 2005). Furthermore, the true prevalence rate (TPR) and crude prevalence rate (CPR) of all palaeopathological and morphological indicators were recorded. The TPR provided information regarding the frequency of palaeopathological indicators on a specific bone(s) (Roberts and Cox 2003, 20). In contrast, CPR was used to highlight the frequency of individuals that possessed evidence of a specific health-related condition, regardless of the skeletal element (Roberts and Cox 2003, 20). It should be noted that the presence or absence of each skeletal element was recorded during the osteological analysis of each burial. Hence, given the fragmentary nature and irregular recovery of cremated bone, the TPR and CPR values provided in this thesis are estimates and these values should only be used as a general guide when examining prevalence rates of oral and skeletal anomalies from Elsham and Cleatham.

5.1.8 Stature

A small amount of work has been conducted on stature estimation of cremated remains (McKinley 1994, 21). However, the author felt that the methods available were not suitable for ascertaining the stature of individuals, who were afforded the cremation rite, from the Elsham and Cleatham cemeteries. Therefore, in this thesis, stature estimations were only made for inhumed individuals from the Elsham cemetery and were established in compliance with the standards produced by Mildred Trotter (1970).

5.1.9 *Distinction between human and animal remains*

Human and faunal cremated remains that had been excavated from the same burial, at both Elsham and Cleatham, were stored together and had not been divided into 'human' and 'non-human' bags prior to the present osteological analyses. Cremated animal remains were identified based on: the survival of distinctive epiphyses, the size and weight of fragments (which primarily applied to large ungulates), reticular cracks and/or dendritic fissures of the trabecular bone and diaphysis fragments that exhibited transverse cracks and longitudinal splits (Whyte 2001, 447). Where possible faunal remains were designated to a specific species, but if one could not be identified the size of the animal was recorded, for example 'sheep/pig sized mammal'. There were also cases where the only factor that could be documented was that 'non-human' skeletal material had been identified from a burial.

5.2 Pyre and grave goods

As previously mentioned, an assessment of grave and pyre goods from the Elsham and Cleatham cemeteries was carried out subsequent to the completion of osteological analyses. Information concerning grave and pyre goods from the Elsham cemetery was acquired from an unpublished catalogue (Berisford 2008). Unfortunately, this secondary source is, essentially, a list of objects that have been identified from each cremation deposit. Furthermore, this catalogue provides limited amounts of detail regarding each burial assemblage, for example, in most instances, there is no distinction between pyre (objects placed on the pyre) and grave (artefacts deposited directly into the burial) goods. To date, no photographs of these artefacts have been found and the location of these finds is unknown, despite the author (of this thesis) contacting the site directors and a number of local museums. Conversely, detailed information about the Cleatham grave and pyre goods were obtained with greater ease. The Cleatham ADS resource (Leahy 2007(b)) was primarily employed for this task. This online database provided comprehensive records of each cremation burial, which also documented every artefact from the site. Additional details, such as the physical properties (material and dimensions) of each object, were also offered on the ADS website. This information was gathered to establish whether certain artefacts were afforded to individuals on the basis of their age, sex and gender. In addition, these data were examined to identify and explain the reasons behind recurring artefact combinations at the Elsham and Cleatham cemeteries.

5.3 Pottery analyses

The dimensions of 300 cinerary urns from the Elsham assemblage were examined and recorded for the author's Master's dissertation in August 2008. Gareth Perry, who is currently conducting a doctoral thesis at the University of Sheffield, recorded the measurements for the remaining vessels. Cinerary urns, which were either complete or reconstructed, and pottery sherds were measured using rulers, sliding callipers and a rim chart. The complete height, maximum diameter, height of maximum diameter, rim diameter and base diameter of the Elsham funerary vessels were measured. Where possible, all measurements were recorded to the nearest millimetre. These dimensions were recorded in compliance with the measurements used in Richards' (1987, 69) study on the form and decoration of Anglo-Saxon cremation urns. Therefore, the Elsham pottery assemblage can be compared accurately with cinerary urn data from other sites since uniform methods of recording have been employed in this thesis. Dimensions of the Cleatham funerary vessels were acquired from the ADS online resource (Leahy 2007(b)). Decoration was not recorded due to its complex nature and this area of research stands outside the bounds of this thesis. However, it should be noted that Gareth Perry is undertaking work on the decoration of the Elsham and Cleatham pottery as part of his doctoral research.

5.4 Statistics

Statistical analyses of the Elsham and Cleatham data were carried out using Microsoft Excel, SPSS 15.0 and ArcGIS 9.3 for Windows. The primary statistical methods employed throughout the analysis stage of this research are described below.

5.4.1 Relationship between age and sex, animal bone and artefacts

Biological age and sex, animal bone, artefact type and material (used to produce grave and pyre goods) are categorical variables. Therefore, cluster and correspondence analyses were carried out to test whether specific grave assemblages, or individual artefacts, were afforded to individuals on the basis of their biological attributes. For the purpose of these statistical tests, age groupings were simplified into either adult or subadult groups since the use of numerous (though better defined) age categories would not show any significant patterns within the data. In addition, each test that dealt with biological age was conducted twice; the first combined the adolescent (13-18 years) group with infants and children in the 'subadult' category while the second assessment incorporated adolescents in the 'adult' classification. The reason for this was to determine whether 13-18 year olds were treated in the same way as adults in the cremation rite. This is important because in contemporary inhumation burials the grave goods found with this age group have more in common with the artefact repertoire afforded to adults than infants and children.

The aim of utilising statistical methods was to highlight any discrete groupings which may have occurred throughout these datasets. Correspondence analysis is a valuable means of assessing large sets of data as this statistical test organises the cases in a linear order that frequently reflects an important single underlying variable, for example biological age. In this thesis, correspondence analysis was performed in SPSS 15.0 which generated a number of tables and graphs. However, quantification plots and object scores plots were two of the most useful charts produced in these analyses. Quantification plots display variables that are closely associated while the object score plots depict patterns among individual cases. Cluster analysis was employed to determine whether biological groups could be classified into distinctive categories based on artefact type and material through the use of similarity and distance measures. These coefficients were based on qualitative presence/absence (also known as 'binary') data, such as the presence or absence of combs (Shennan 1997, 223). The application of cluster analysis to these data calculates a multivariate distance between each pair of cases, for example on the basis of biological age. Consequently, similar cases are positioned together on the dendrogram, for instance a group of males containing similar artefact combinations. On the other hand, the distance between disparate cases on a dendrogram are dependent on the varying degrees of difference concerning the biological attributes of cremated remains and grave assemblages from each burial. For example, females that were buried with spindle whorls will be allocated to a different cluster than males who were only associated with toilet implements.

5.4.2 Pottery analyses

One-way Analysis of Variance (ANOVA) and homogeneity of variance tests were employed to analyse the cinerary urns from the Elsham and Cleatham cemeteries. Due to time constraints, only the complete height and rim diameter of funerary vessels were analysed in conjunction with demographic data as these variables appear to have produced the most interesting results from previous studies (Richards 1987, 136-139; McKinley 1993, 314; McKinley 1994, 102). Cinerary urn measurements were classified as 'continuous' data while demographic attributes were recorded as 'categorical' variables. Homogeneity of variance tests were carried out to determine whether the variability of scores was equal for each categorical variable. One-way ANOVA tests were also employed to establish whether there were any significant differences between the mean scores of at least two or more categorical variables (Rowntree 1981, 143; Pallant 2007, 103-104). Box plots have been used to display these data since they are the most effective means of illustrating the distribution of pottery measurements between each categorical group.

5.4.3 Cemetery organisation

The spatial distribution of individuals that had been assigned biological age and sex along with multiple burials from the Elsham and Cleatham cemeteries was analysed using ArcGIS 9.3 software. Unfortunately, there was no record, or list, of site co-ordinates from the Elsham cemetery. Therefore, a scaled down image of the archaeological plan was scanned into the author's computer and, through the use of ArcGIS 9.3, the location of each cremation burial was measured and, subsequently, plotted on to a digitalised version of the site plan. A number of burials were not recorded on the Elsham site plan and, consequently, these deposits were excluded from spatial analyses. Co-ordinates for the Cleatham cemetery were obtained from the online archive on the ADS (Leahy 2007(b)). However, the co-ordinates for three deposits, which include MT85MD (ditch fill), MT85MI (ditch fill) and MT86TL (no urn number assigned to this burial), were not recorded on the ADS database (Leahy 2007(b)). The co-ordinates and relevant demographic data from both sites were inputted into Microsoft Excel databases. ArcCatalog was then used to convert these Excel files into a new database format which facilitated the production of maps in ArcMap[12]. Once a map had been produced the relevant site plan was opened as a layer in ArcMap which provided an outline of the excavation boundaries. In accordance with the scale used on both the Elsham and Cleatham site plans, all measurements were recorded in metres. Cluster and outlier analysis was also carried out in ArcMap to identify the presence of any significant burial clusters based on demographic attributes from the Elsham and Cleatham cemeteries. These analyses generated 'Z scores' that were plotted on each map and showed the statistical significance between burials. A high positive Z score denoted a burial that was surrounded by other deposits of a similar value. Thus, these burials were statistically significant and were represented by red circles on the digitalised site plans. On the other hand, a low negative Z score would have indicated that a grave was surrounded by interments of dissimilar values. These statistically insignificant burials were symbolised by dark blue circles on the digitalised site maps. Based on the copious amounts of data that can be displayed on maps, this form of visual representation has been selected to illustrate the spatial

[12] ArcCatalog and ArcMap are both components of the ArcGIS programme.

distribution of burials from the Elsham and Cleatham cemeteries in the following results' chapters.

5.5 The application of advanced methods of analysis

Chapter two of this thesis has already highlighted the array of technical methods that can be used to extract important information from cremated bone. Based on this research, the author decided to employ thin-section (or histomorphological) analysis and Fourier Transform Infrared Spectroscopy (FTIR) in this thesis to gain a greater understanding of pyre technology and the cremation rite in Anglo-Saxon England. As a result of time constraints and the availability of cremated bone at the time of assessment, FTIR and histomorphological analysis could only be afforded to specimens that were obtained from the Elsham skeletal assemblage. However, this section will initially outline the additional means of assessment that were used to determine the biological sex of individuals from the Elsham and Cleatham cemeteries.

5.5.1 The determination of biological sex based on the petrous bone

The petrous bone was examined as a supplementary technique of establishing the biological sex of individuals from the Elsham and Cleatham cemeteries owing to its robusticity and high survival rate in cremation deposits. These methods were employed based on the successful results that were acquired in a pilot study, which assessed the viability of using the petrous bone as a means of determining the biological sex of inhumed individuals from the Barbican site (York), conducted by the author in February 2009. Only individuals that had been confidently assigned biological sex (through the use of traditional osteological methods) were used in this pilot study. Due to time constraints, it was impractical to use the lateral angle method on the cremated material from Elsham and Cleatham, since casts of the internal acoustic meatus must be produced in order to accurately record the lateral angle measurement (Norén *et al.* 2005, 319). However, the diameter of the internal acoustic meatus (or internal auditory canal) was assessed since this measurement could be recorded using the blunt end of ordinary metal drills (Lynnerup *et al.* 2006). Drill bits were employed in this analysis because they provided a quick and effective means of measuring the diameter of the internal acoustic meatus. These drills also possessed diameters ranging from 1.0-10.0mm, which increased in size by 0.5mm increments, making them particularly suitable for measuring this feature of the petrous bone. The primary criterion of this osteological technique was that before a measurement could be taken the drill bit had to fit comfortably into the opening of the internal acoustic meatus. The second method that was employed as a supplementary means of establishing biological sex involved measuring fifteen different landmarks on the petrous bone (Wahl and Graw 2001, 217-218). Only 10 out of the 15 markers used by Wahl and Graw (2001) were used in this analysis as these were found to be the most useful based on the author's pilot study. Electronic digital calibrated callipers, with a measuring accuracy of 0.1mm, were employed to take these measurements. In both of the methods discussed, all measurements were taken three times for accuracy. Furthermore, these osteological techniques were only used when other sexually diagnostic elements survived, since these methods alone are not accurate enough to produce confident estimates of biological sex.

5.5.2 Thin-section analysis

Thin-section (or histomorphological) analysis was employed in this study to assess the effect of burning on bone microstructure. Sixteen samples from the Elsham skeletal assemblage were chosen at random, all of which derived from single burials. The only condition of this sampling strategy was that the remains were taken from long bones as these are the most suited to thin sectioning. Initially, each sample was cleaned of any dirt that may have remained on the bone's surface. A macroscopic examination of these samples was also undertaken, which involved recording the colour range, shrinkage, fissuring and warping of burned bone. These specimens were then placed into individual sectors of an ice cube container. The next stage of preparation involved embedding the selected fragments of cremated bone. L R white resin and an accelerator (to make the resin set) were poured into each individual section of the ice cube tray, ensuring that all samples were completely covered. Consequently, an exothermic reaction took place during polymerisation and, as a result, the mould containing the bone fragments were cooled in a sink of cold water. Once these bones were completely set in the resin, each specimen was cut by a Leica SP 1600 saw microtome at a speed of 600RPM, which ensured that the cremated samples did not crumble. Sections were cut to either sixty, seventy five or one hundred microns due to the fragile nature of the bone. Cremated samples that were particularly brittle were cut to one hundred microns as this prevented the bone from disintegrating and produced the thickest sections. The embedded thin-sections were then mounted between two glass slides and, subsequently, micrographs were taken of each specimen.

A Leitz LaborLux 12 Pols microscope was employed in this analysis so that samples could be assessed under plane polarized and cross polarised light. Plane polarised light (PPL) involves the transmission of light through one polar, below the specimen, which causes the refraction of all light rays on a single plane. The use of PPL in conjunction with burned bone causes different coloured light, or, indeed, the total absence of light depending on the sample's microstructure (Andrews and Doonan 2003, plate 2). In contrast, cross-polarised light (XPL) allows light to pass through an upper and lower polar. The use of two polars causes the light to split into two rays which results in birefringence (double refraction). Collagen and the mineral phase of bone are birefringent materials. Consequently, under XPL, the inorganic component of bone appears darker than areas containing organic matter. Magnification remained at x25 throughout the process. A Canon EOS300D camera was utilised to capture images of the bone microstructure. Each micrograph was imported on to remote capture software and measured twenty eight microns in width. However, several adjacent images of each sample were taken since the cross section of these bones was so large that they did not fit on to a single image. Subsequently, these micrographs were fitted together using Photoshop CS software.

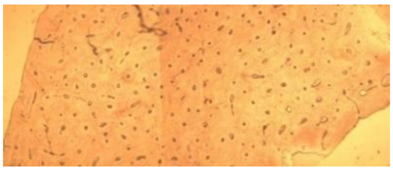
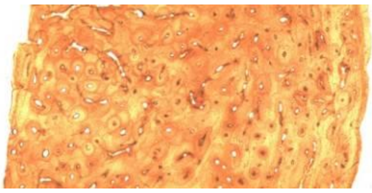
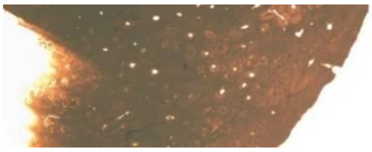
Category	Degree of microstructure destroyed (%)	Temp (°C)	Micrograph of comparative thin sections	Description
Less intensely cremated	<50%	300-600°C		• Many Haversian systems • Small number of Volkmann's Canals • Organic material and canaliculi clearly preserved • Some fusion of hydroxyapatite crystals • Very dark grey in colour throughout the section of bone
Intensely cremated	>50%	600-900°C		• Outline of Haversian systems are more defined and brown in colour under PPL • Very few, if any, Volkmann's Canals and <50% organic material preserved • Canaliculi are still evident • Many hydroxyapatite crystals have fused causing a disorganised arrangement • Light grey to white in colour throughout the section of bone • Glass and copper alloy melt → 700 - 1000°C
Completely cremated	100%	≥900°C		• No Haversian systems, Volkmann's Canals, organic material or canaliculi preserved • Hydroxyapatite crystals have completely fused • White in colour throughout the section of bone • Slag debris → 1000 - 1200°C

Table 5.3 Categories used to classify cremated bone

Three comparative burned bone thin-sections have been employed as an aid to establish the effects of cremation on bone when pyre conditions are unknown. The comparative thin-sections were prepared by Lisa Bhayro (2003), as part of her MSc dissertation at the University of Sheffield, and micrographs of these slides were taken by the author of this thesis. These samples were obtained from a defleshed adult human femur that derived from a modern anatomical specimen, though its origin is unknown. Each sample was heated in a Lenton Eurotherm 902P furnace for 15 minutes at 300°C, 600°C and 900°C, respectively (Bhayro 2003, 25). The microstructure of these bones was compared with the Elsham thin-sections where temperature was unknown. Based on these observations, the author devised three standardised categories that can be used to classify varying degrees of heat-induced change to bone microstructure (Table 5.3). Surviving pyre and artefact debris was also recorded as further evidence of temperature. The comparative samples that were used in this research are stored in the slide collection in the Department of Archaeology at the University of Sheffield.

5.5.3 Fourier Transform Infrared Spectroscopy

Fourier Transform Infrared Spectroscopy (FTIR) was employed in this thesis to determine whether this technique could be used to identify varying degrees of burning intensity in archaeological bone. Samples were taken from two inhumed individuals (EL76AK; EL76JO), three less intensely cremated (EL75BB; EL75ES; EL76DH), one intensely cremated (EL76PB) and two completely cremated (EL75MQ; EL76NN) samples from the Elsham assemblage. Due to time constraints, thin-sections were not produced and, as a result, the intensity of burning was based solely on the colour of bone (Table 5.4). Each sample was taken using a scalpel from the periosteal surface of the anterior distal third of a femoral diaphysis and was stored in a sealed test tube. Collecting samples in this manner produced fine grains of cremated bone and tiny flakes of bone from the inhumed samples. Unburned bones (inhumed samples) were used as a control for the study. The author wore gloves throughout the procedure to avoid contamination. FTIR was conducted by the author in the School of Science and Technology at Teesside University.

The FTIR-ATR method was used in this research as it is a more effective approach than the traditional FTIR-KBr procedure (Thompson, Gauthier and Islam 2009, 911). Thompson, Gauthier and Islam (2009, 911) have explained that the FTIR-ATR method employs an attenuated total reflection (ATR) accessory which measures changes that take place within a reflected infrared ray (or beam) once this beam makes contact with the bone sample. A Nicolet 5700 FT-IR Spectrometer controlled by OMNIC 7.3 software was used in this study. Each specimen was scanned three times for accuracy.

Before and after the analysis of each sample, the diamond stage of the spectrometer was cleaned with propanol to avoid contamination. As soon as a background spectrum had been collected, each specimen was, in turn, placed on to the diamond stage. Once a sample was in place, the control knob was used to lower the probe and was then tightened accordingly. Subsequently, spectra were produced automatically using the OMNIC software.

Sample number	Burning intensity	Munsell value
EL76AK (FN 321)	Unburnt	10YR 6/6 (brownish yellow)
EL76JO (FN 483(a))	Unburnt	10YR 6/6 (brownish yellow)
EL75BB (FN 13)	Less intensely cremated	GLEY 2 5B 3/1 (very dark bluish grey)
EL75ES (FN 82/83/86)	Less intensely cremated	GLEY 2 5B 2.5/1 (bluish black)
EL76DH (FN 380)	Less intensely cremated	GLEY 2 5B 3/1 (very dark bluish grey)
EL76PB (FN 576)	Intensely cremated	GLEY 2 5PB 4/1 (dark bluish grey)
EL75MQ (FN 225)	Completely cremated	5Y 8/1 (white)
EL76NN (FN 549)	Completely cremated	GLEY 2 10B 7/1 (light bluish grey)

Table 5.4 Unburnt and cremated bone samples selected for FTIR spectroscopy

5.6 Summary

The cremated remains from Elsham and Cleatham were analysed using a variety of methods to gain a greater understanding of the social structure, funerary rites and cremation techniques during the early Anglo-Saxon period. Standardised methods of data collection and recording were used throughout this research to ensure that the Elsham and Cleatham demographic data can be used in future inter-site comparisons. The following chapter will explore the results that were obtained from analyses conducted on the Elsham bone assemblage.

Chapter 6: Elsham results

The first skeletal assemblage that was assessed in this thesis derived from the Elsham cremation cemetery. As mentioned in the preceding methodology chapter, a total of 566 cremation deposits and eight inhumation burials were analysed from this site. This chapter will present the results that were obtained from osteological analyses carried out on the inhumation and cremation burials from the Elsham cemetery. In addition, analyses were run to determine whether cemetery organisation and grave assemblages afforded to the deceased, for example cinerary urns, animal offerings and grave and pyre goods, were influenced by demographic attributes of the burial population. Pyre technology will also be investigated through an assessment of the macroscopic and microscopic characteristics of cremated bone.

6.1 Osteological analysis: inhumation burials

Inhumation burials were identified on eight separate occasions at the Elsham cemetery. The site directors observed that inhumations EL75RX (FN 318) and EL75RY (FN 319) dated to the Bronze Age. Burial EL75RX (FN 318) was confidently assigned to this period based on the identification of a beaker vessel that was interred within this grave. A prehistoric ditch in the south-western corner of the cemetery also provides additional support for the date of these early burials (Berisford and Knowles n.d., 8). A complete osteological assessment was carried out on both the Bronze Age and Anglo-Saxon inhumed skeletal material. The results from these analyses will be examined in the following section of this chapter.

6.1.1 Quantifying the material

A total of seven individuals were identified from six Anglo-Saxon inhumation burials, since EL76JO (FN 483) was classified as a double burial, although there is insufficient evidence to say if these individuals were interred at the same time or consecutively.

The overall completeness of the skeletal remains was, on the whole, relatively poor with the absence of any complete individuals. The completeness of six individuals was categorised as <25% complete while the remaining three inhumations were assigned to the 25-75% group. In most cases, the crania, axial, upper limb and lower limb bones were evenly represented, which demonstrates that the selective interment of specific skeletal elements was not taking place among the inhumation practicing sector of this site (Table 6.1).

Inhumation number	Crania	Axial	Upper limb	Lower limb
EL75EN (FN 71)	Miscellaneous cranial fragments, teeth	Scapula, vertebrae, pelvis	Humerus, metacarpals	Femur
EL75RR (FN 316)	Right parietal			
EL75RX (FN 318)		Ribs		
EL75RY (FN 319)	Temporal, maxilla, mandible, frontal, zygomatic, teeth	Scapula, vertebrae, ribs, clavicle, manubrium	Radius, metacarpals	Metatarsals
EL76AK (FN 321)				Left femur, left and right tibia, left and right fibula, right patella, tarsals, metatarsals
EL76AL (FN 321)	Miscellaneous cranial fragments, mandible including all teeth except right M1, M2 and M3	Pelvis (ilium), ribs	Phalanges	Tibia
EL76GU (FN 441)	Miscellaneous cranial fragments	Scapula, vertebrae, ribs		
EL76JO(a) (FN 483(a))	Miscellaneous cranial fragments	Vertebrae, pelvis, ribs	Humerus	Femur, tibia
EL76JO(b) (FN 483(b))		Ribs	Ulna	Femur

Table 6.1 Skeletal segments identified from the Elsham inhumation burials

6.1.2 State of preservation

Fragmentation was extensive in all specimens. The general preservation of the assemblage was very poor, and the majority of individuals were ascribed a score of either four or five (Table 6.2; Fig 6.1). The Bronze Age skeletons were assigned preservation scores of grade five (EL75RX [FN 318]) and grade four (EL75RY [FN 319]). The primary reason for such poor preservation is that the soil at Elsham is naturally wet, very acidic, sandy and loamy (National Soil Resources Institute Soilscapes Viewer 2006). Consequently, osteological indicators that may have once been present on the cortical surface of these inhumed bones, for example metric traits or pathological markers, have been lost due to taphonomic conditions. Based on the use of Munsell soil colour charts (Munsell 2000), the general colour of the skeletal assemblage was brownish yellow (10YR 6/6) (Table 6.2). Dark mottling was also observed on three individuals, two of which occurred on the cranium and the third incidence was identified on a femur. The comparable colouration of these bones indicated that they were interred in a similar burial environment and soil type. The bleaching of bone was notable on the remains of five individuals from the Elsham cemetery (Fig 6.1). Other discolouration identified on the inhumed material included red staining, which was probably caused by associated grave assemblages, particularly iron objects. Discolouration appears to have been the result of taphonomic conditions and the position of skeletal remains in the burial context.

Fig 6.1 Grade 5+ preservation and bleaching on an unburnt tibia from Elsham inhumation EL76AL (FN 321)

6.1.3 Demographic attributes

Aging techniques that were employed in this analysis was dependent on the state of preservation and completeness of the skeletal remains. The Bronze-Age skeletons from Elsham were both extremely young individuals. A probable neonate was identified from burial EL75RX (FN 318) while burial EL75RY (FN 319) contained an individual that was assigned to the older infant age category. A total of five adults, two of which belonged to the older mature adult category, and two subadults were identified from the Anglo-Saxon inhumation burials (Table 6.3; Fig 6.2).

Inhumation number	General colour	Bleaching	Other	Preservation grade
EL75EN (FN 71)	10YR 5/6 (yellowish brown)	2.5Y 8/3 (pale yellow)	5YR 4/4 (reddish brown) 2.5Y 2.5/1 (black)	5
EL75RR (FN 316)	7.5YR 7/6 (reddish yellow)			1
EL75RX (FN 318)	7.5YR 6/6 (reddish yellow)			5
EL75RY (FN 319)	10YR 7/6 (yellow)			4
EL76AK (FN 321)	10YR 6/6 (brownish yellow)	10YR 8/2 (very pale brown)	5YR 5/8 (yellowish red)	2
EL76AL (FN 321)	7.5YR 6/8 (reddish yellow)	2.5Y 8/2 (pale yellow)	5YR 3/4(dark reddish brown) 7.5YR 2.5/1 (black)	5+
EL76GU (FN 441)	10YR 6/6 (brownish yellow)			5
EL76JO(a) (FN 483(a))	10YR 6/6 (brownish yellow)	2.5Y 8/1 (white)	2.5Y 5/1 (grey)	4
EL76JO(b) (FN 483(b))	10YR 4/6 (yellowish brown)	2.5Y 8/3 (pale yellow)		3

Table 6.2 Coloration, discolouration and preservation grades of the Elsham inhumed skeletal remains

Inhumation number	Age category	Sex	Stature (cm)	Grave goods
EL75EN (FN 71)	Young adult	Female	?	Two iron knives, iron buckle, copper-alloy needle
EL75RR (FN 316)	?Young adult/?Younger mature adult	?	?	None
EL76AK (FN 321)	Adult	?	175-176	None
EL76AL (FN 321)	Older mature adult	Male	?	None
EL76GU (FN 441)	Subadult	?	?	Two copper-alloy sheet lozenges, glass bead, iron knife, bone comb fragments
EL76JO(a) (FN 483(a))	Older mature adult	Female	?	Iron buckle
EL76JO(b) (FN 483(b))	Infant	?	?	None

Table 6.3 Demographic attributes and associated grave goods from the Elsham Anglo-Saxon inhumation burials

The determination of biological sex was problematic owing to the lack of sexually diagnostic attributes and fragmentary nature of the skeletal assemblage. Thus, the sex of only three individuals was established, which include one male and two females. Based on the evidence at hand, the only conclusive statement that can be offered regarding the demographic profile of these burials is that all ages and both males and females were afforded the inhumation rite. Stature could only be established for one (Anglo-Saxon) inhumed individual (EL76AK [FN 321]) owing to the survival of a complete right tibia and a left fibula. The application of Trotter's (1970) stature estimation method suggested that the individual from burial EL76AK (FN 321) measured 175-176cm.

Fig 6.2 Tooth wear was one of the methods used to establish the age of the individual from inhumation burial EL76AL (FN 321) (Elsham)

6.1.4 Health and disease

A variety of skeletal and oral conditions were identified on four inhumed individuals from the Elsham inhumation burials (Fig 6.3). The young adult female from burial EL75EN (FN 71) exhibited the greatest number of pathological indicators, which included Schmorl's nodes, osteophytic growth on vertebral borders, periostitis of the lower limb and two dental caries. The skeletal remains from burial EL76AK (FN 321) provided evidence of osteochondritis dissecans on the left and right talus, which was located on the proximal surface of the trochlea in the same medial location. Dental calculus was apparent (on the buccal

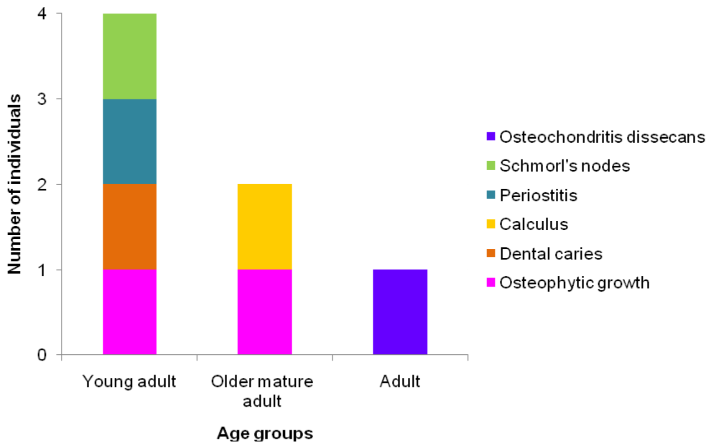


Fig 6.3 Palaeopathological indicators identified in each age category of the Elsham inhumation burials

surface) on the surviving teeth from burial EL76AL (FN 321). Finally, spinal osteophytosis and increased porosity of thoracic vertebrae alongside osteophytic growth on left and right patella and hand phalanges were recorded after assessing the osteological remains from burial EL76JO(a) (FN 483). Interestingly, only adults exhibited palaeopathological indicators from this inhumation assemblage. These adults exhibited detrimental conditions, such as spinal defects and osteophytic growth, which was likely to have damaged the individual's overall health and would have affected their participation in everyday activities.

6.2 Grave goods

Only three inhumation burials contained evidence of associated grave assemblages (Table 7). Material culture that was discovered from burials EL75EN (FN 71), EL76GU (FN 441) and EL76JO(a) (FN 483(a)) included iron knives, iron buckles, a copper-alloy needle, copper-alloy lozenges, a glass bead and bone comb fragments. Statistical testing was not carried out owing to the small number of burials that contained grave goods, as the results of such analyses would have been meaningless. It is noteworthy that both females and two subadults, one of which belonged to a multiple burial (EL76JO [FN 483]), were interred with some form of material culture.

6.3 Cemetery organisation

Unfortunately, the Anglo-Saxon inhumation burials were not recorded on the Elsham site plan and, as a result, the spatial distribution of these graves cannot be assessed. However, one of the Bronze-Age inhumations (EL75RX [FN 318]) was illustrated on the cemetery plan and was located south of the prehistoric ditch. This burial was the only deposit in the south-west corner of the cemetery interred beyond the ditch.

6.4 Osteological analysis: cremation burials

Despite the discovery of Anglo-Saxon inhumation burials from the Elsham cemetery, cremation was the most prevalent funerary rite at this site. The next section of this chapter will focus upon the osteological analyses that were performed on the cremated remains from the Elsham cemetery.

6.4.1 Total weight

Human and animal bone was weighed to gain a greater understanding of the collection and interment stages of the Anglo-Saxon cremation rite. Burial EL75PH (FN 270), which contained three individuals and sheep bone, weighed 5406g and produced the greatest amount of human cremated material from a single urn. In contrast, burial EL76BJ (FN 299) only weighed 0.3g and yielded the smallest quantity of burned bone from this skeletal assemblage. The average weight of the Elsham cremation burials was calculated, which generated a mean value of 523g. However, the weight of burials from this site produced a skewed distribution, as illustrated in Fig 6.4. Therefore, the median weight of the Elsham assemblage was established which produced a value of 382g. Based on the 566 burials that were assessed in this analysis, 331 deposits weighed between 0-500g and only nine graves contained over 2000g of cremated bone (Fig 6.4). Furthermore, all of the burials that weighed over 2500g contained varying quantities of animal bone. These results illustrate that it was uncommon to collect and inter the majority, if not all, of the skeletal remains that would have derived from a fully articulated (adult) cadaver.

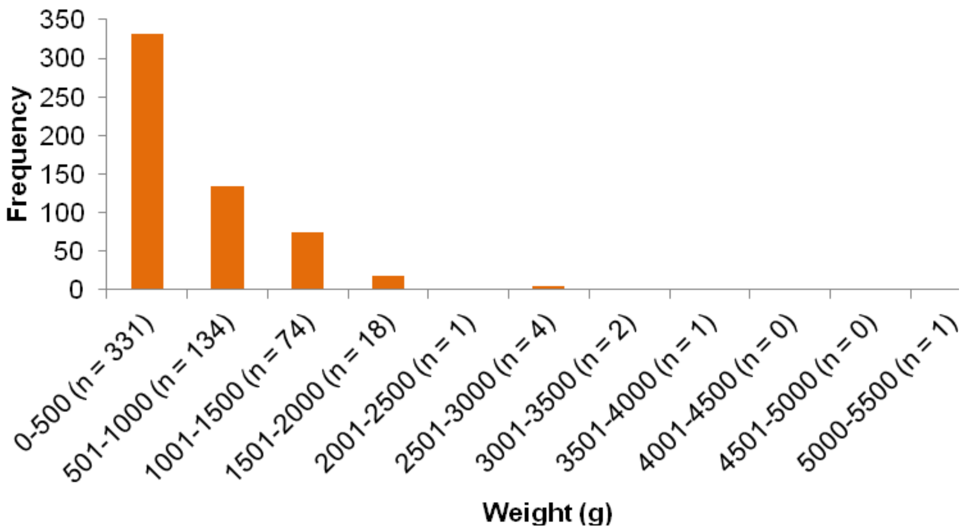


Fig 6.4 Histogram illustrating weight distribution of cremated bone from Elsham

A total of 114 cremation burials (20% of the assemblage) from the Elsham cemetery were assessed to establish whether there was any preference with regards to the collection and interment of bones from the crania, axial and limb bone regions. The results from this analysis highlighted that cranial and axial fragments occurred in similar proportions while limb bones were the most prevalent remains from the Elsham cremation burials (Table 6.4). These results are in accordance with the expected weights of each skeletal area from an inhumation burial. These weights were calculated for the cranial, axial and limb bones and produced expected values of 20%, 25% and 55%, respectively (Silva, Crubézy and Cunha 2009, 638). Limb bones comprise the greatest proportion of weight of an intact skeleton than the crania and axial regions which explains the high percentage of limb bones from both inhumation and cremation burials. The results from the Elsham sample indicate that no preferential selection and deposition of skeletal elements took place at this site. Similarly, crania, axial and limb bones were collected and interred with no partiality towards certain skeletal segments at Sancton (East Riding of Yorkshire) (McKinley 1993, 297) and Spong Hill (Norfolk) (McKinley 1994, 85). The idea of preferential collection and interment of certain bones will be explored in further detail in the discussion chapter of this thesis.

Skeletal segments	5mm weight (g)	10mm weight (g)	Total average weight (g)
Crania	12	22	34 (18%)
Axial	16	17	33 (18%)
Limb bones	56	65	120 (64%)

Table 6.4 Average weights of crania, axial and limb bones from a 20% sample of the Elsham skeletal assemblage

6.4.2 Maximum fragment size

The fragment size of cremated bone was examined in this thesis as it can provide useful information concerning the degree of pre- and/ or post-depositional disturbance. In sum, 47% of bone from the Elsham cremation burials accumulated in the 10mm sieve and 81% of bone was collectively gathered in the 5mm and 10mm sieve compartments. The maximum fragment size obtained from the Elsham cemetery was recorded from burial EL76DH (FN 380) (Fig 6.5). This fragment belonged to a right femur and measured 89mm in length, though, in contrast, the average maximum fragment size of cremated bone from Elsham was only 43mm in length.

Fig 6.5 Maximum fragment size from Elsham (EL76DH [FN 380])

The examination of cranial, axial and limb bone fragmentation was also assessed to contribute to our understanding of fragmentation and how this may have effected the collection and deposition of cremated remains. As mentioned in the previous section of this chapter, a total of 114 burials from the Elsham cemetery (or 20% of the assemblage assessed) were incorporated in this analysis. It is notable that the crania, on average, produced smaller fragment sizes than axial and limb bones (Table 6.5). The largest average fragment size, from each burial examined, was obtained from a limb bone. One possible explanation for these recurring results is that the limb bones are larger and, in most cases, more robust than the crania and axial bones. Thus, limb bones would have been more difficult to fragment than the crania and axial portions of the skeleton. Furthermore, these results concur with the average weights of cremated cranial, axial and limb bone obtained from the Elsham cremation burials. In addition, thermal alteration would have also affected the fragment size of skeletal elements that contained a significant amount of trabecular bone; the reasons for this are outlined in chapter four of this thesis. Fragmentation will be explored further in the Cleatham results and discussion chapters of this thesis.

Skeletal segments	5mm sieve compartment (mm)	10mm sieve compartment (mm)	Total average fragment size (mm)
Crania	17	19	36
Axial	24	25	49
Limb bones	26	34	60

Table 6.5 Average fragment size of crania, axial and limb bones from a 20% sample of the Elsham skeletal assemblage

6.4.3 Shrinkage, fissuring and warping

The criterion that was employed to determine shrinkage, fissuring and warping of cremated bone was outlined in the methodology chapter (chapter five) of this thesis. It should be noted that animal bones were also included in the following analyses. Shrinkage was moderate in most cases while only four burials displayed no evidence of shrinkage (Table 6.6; Fig 6.6). Fissuring of bone primarily fell into the 'moderate' category followed by the 'moderate-none' grouping (Table 6.7; Fig 6.7). However, fissuring varied significantly within burials. For instance, fissuring on bones such as the phalanges frequently displayed no fracture patterns while long bones displayed more intense fissuring. In the vast majority of cases warping was moderate; only a very small proportion of cremated bone from the Elsham burials showed signs of severe warping (Table 6.8; Fig 6.8).

Degree of shrinkage	Number of burials
Severe	42 (7.4%)
Severe-moderate	70 (12.4%)
Moderate	359 (63.4%)
Moderate-none	91 (16.1%)
None	4 (0.7%)

Table 6.6 The degree of shrinkage of cremated bone from the Elsham burials

Fig 6.6 A vertebral fragment from burial EL76IL (FN 367) showing moderate to no evidence of shrinkage

Degree of fissuring	Number of burials
Severe	12 (2.1%)
Severe-moderate	45 (8.0%)
Moderate	288 (50.9%)
Moderate-none	190 (33.6%)
None	31 (5.5%)

Table 6.7 The degree of fissuring identified on cremated bone from Elsham

Fig 6.7 Radius fragment from burial EL76PB (FN 576) showing evidence of severe to moderate patina fracturing

Degree of warping	Number of burials
Severe	12 (2.1%)
Severe-moderate	21 (3.7%)
Moderate	225 (39.8%)
Moderate-none	241 (42.6%)
None	67 (11.8%)

Table 6.8 The degree of warping of cremated bone from the Elsham burials

Fig 6.8 Bones from burial EL75MQ (FN 225) show evidence for a moderate degree of warping

6.4.4 Colour of cremated remains

The colour of cremated remains often varied within the same burial, ranging from white (5Y 8/1) to bluish black (GLEY 2 5PB 2.5/1) in colour (Fig 6.9). Other frequently recorded colours included yellow (10YR 7/6) and brownish yellow (10YR 6/6), in cases where remains were poorly cremated. Some bones also exhibited discolouration, for example red (2.5YR 5/8), reddish yellow (7.5YR 6/6) and pale green (GLEY 1 5G 7/2), which may have been the result of contact with iron and copper-alloy artefacts.

Fig 6.9 Colour variation among the cremated remains from burial EL76PB (FN 576). This is represented by the mandibular condyle (left) and a tibia fragment (right) from this burial

6.4.5 *Minimum number of individuals (MNI)*

Only 552 of the 566 burials that were examined from the Elsham cemetery contained human cremated remains, though, the minimum number of individuals from the site increased to 564 owing to the identification of multiple burials. However, three of these double burials are only probable, that is, there is evidence of a second individual but not enough proof to confirm that these burned bones were deliberate inclusions or that these remains once represented the deposition of a complete individual. A total of seven double burials, three probable double burials and one triple burial were identified from the Elsham assemblage (Table 6.9). These multiple deposits consisted of one

Burial number (urn number)	Burial type	MNI	Age	Sex	Pyre goods
EL75CW (FN 51)	Urned	2	1=Young adult/ **younger mature adult** 2=Young child	1=?Male 2=?	Glass beads, glass melt, crystal fragments, copper-alloy wire, copper-alloy fragments, iron purse mount, iron knife, parts of comb, stone whorl, ivory, cowrie
EL75DJ (FN 54)	Urned	2	1=Young adult 2=Infant	1=??Female 2=?	Glass beads, copper-alloy melt, sheep
EL75EU (FN 82)	Urned	2	1=Young adult/ **younger mature adult** 2=Adult	1=??Male 2=?	Copper-alloy sleeve clasp, copper-alloy sheet fragments, comb fragment, ivory, horse
EL75HP (FN 131)	Urned	2	1=Younger mature adult 2=Child	1=Male 2=?	Copper-alloy sheet fragments
EL75PG (FN 269)	Urned	2	1=Subadult/**adult** 2=Child	1=? 2=?	Crystal bead, sheep
EL75PH (FN 270)	Urned	3	1=Adult 2=Adult 3=Infant	1=Male 2=Female 3=?	Iron object, comb fragments, copper-alloy melt, sheep
EL75QG (FN 287)	Urned	2	1=Older mature adult 2=Young child	1=Male 2=?	Copper-alloy sheet fragment, piece of comb, horse and sheep
EL76NW (FN 558)	Urned	2	1=Adult 2=Young child	1=? 2=?	None
EL75GC (FN 102)	Urned	1/?2	1=Adolescent/ **young adult** 2=Infant	1=? 2=?	Glass melt, piece of comb
EL75PB(a) (FN 264)	Urned	1/?2	1=**Subadult**/adult 2=Child	1=? 2=?	Piece of comb, sheep
EL76MY (FN 534)	Urned	1/?2	1=Adult 2=**Infant**/young child	1=Female 2=?	None

Table 6.9 Multiple deposits and associated grave assemblage from Elsham

(9.1%) burial that contained two subadults (a child and older subadult), one (9.1%) deposit that included two adults while nine (81.8%) multiple interments comprised of at least one adult and a subadult. Biological sex does not appear to have played an important role in the multiple burial rite at the Elsham cemetery. One female, one possible female, two males, one probable male and one possible male were recorded from the interments that contained an adult and a subadult. The triple burial, EL75PH (FN 270), contained two adults (a male and a female) and an infant. The remaining adults from the multiple burials could not be assigned to a biological sex category owing to the lack of sexually diagnostic elements. A total of 14 burials mainly contained cremated animal bone with little, if any, trace of burned human bone. These deposits appear to have been animal accessory vessels and will be examined further in the animal bone section of this chapter.

6.4.6 Age

Age was successfully assigned to 491 individuals within the age limits outlined in the methodology chapter (chapter five) of this thesis (Table 6.10). Thus, age could not be assigned to 73 individuals. The highest frequency of individuals allocated to a single age category contained 54 persons and belonged to the ‘younger mature adult’ (26-30 years) group. The greatest number of immature deaths occurred in the ‘child’ age (5-12 years) category, though a similar frequency of ‘infant’ (0-4 years) deaths was also recorded. It is notable that there is an underrepresentation of infants and children from the Elsham cemetery. Infants made up 8% of the cemetery population while children comprised 9% of the osteological assemblage from this site. Such an underrepresentation of infants and children from Elsham holds significant social implications which will be explored in further detail in subsequent chapters. The highest frequency of individuals that belonged to a broad age category, that is, a grouping that contained individuals who could not be assigned to a narrow age category, belonged to the ‘young adult/younger mature adult’ (19-30 years) group and comprised of 104 persons. However, the high frequency of individuals that were ascribed to broad age categories was problematic with regards to statistical analyses. Therefore, for demographic purposes, persons that had been assigned a broad age category were reassigned to an adjacent age grouping in proportion to the number of individuals already in those narrow categories (Table 6.11). For more technical analyses, such as correspondence and cluster analyses, it was necessary to employ larger age categories. Thus, infants, children, adolescents and the subadult group were grouped together as subadults (170 individuals) while young adults, younger mature adults, older mature adults, older adults and the adult category were classified as adults (321 individuals).

Age category	Number of individuals
Infant	35
Infant/child	10
Child	39
Child/adolescent	0
Adolescent	32
Subadult	18
Adolescent/young adult	6
Subadult/adult	66
Young adult	9
Young adult/younger mature adult	104
Younger mature adult	54
Younger mature adult/older mature adult	7
Older mature adult	24
Older mature adult/old adult	1
Older adult	2
Adult	84
Age could not be assigned to individual	73
Total	**564**

Table 6.10 Number of individuals in each age category from Elsham

Age category	Number of individuals
Infant	40
Child	44
Adolescent	35
Young adult	64
Younger mature adult	109
Older mature adult	28
Older adult	3
Subadult	51
Adult	117
Total	**491**

Table 6.11 Number of reassigned individuals identified in each narrow age category from Elsham

A statistical analysis was carried out to determine whether there was a relationship between (reassigned) biological age and the weight of cremated bone. In total, 307 individuals were included in this analysis which consisted of 36 infants, 38 children, 35 adolescents, 62 young adults, 106 younger mature adults, 27 older mature adults and three older adults (Fig 6.10). ‘Subadult’ and ‘adult’ age groupings were excluded from this statistical analysis as the primary interest of this assessment was a detailed breakdown of cremation weight versus biological age. Multiple burials were also excluded from this analysis since it was not possible to identify and assign every bone to the numerous individuals that were interred within a single deposit. Levene's test for homogeneity of variances produced a significant result at the 0.01 level (W = 7.521; p = <0.01).

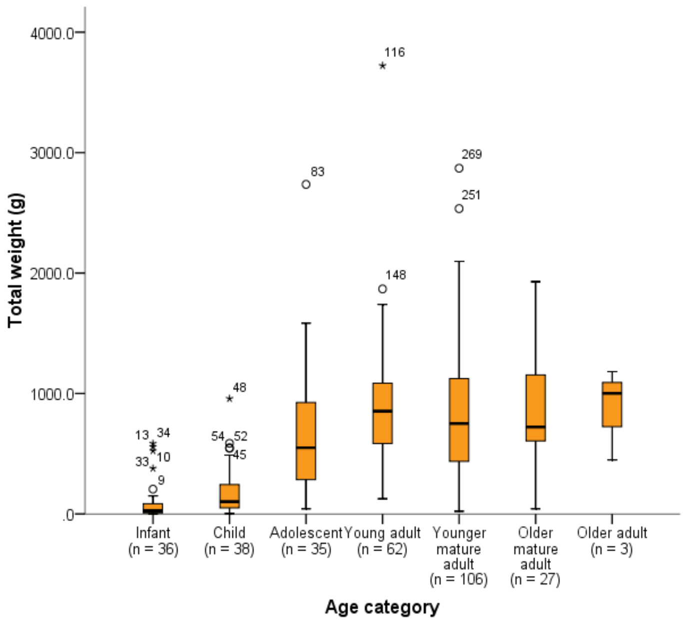


Fig 6.10 Box plot illustrating the relationship between cremation weight and biological age from the Elsham cemetery

This highlights that the weight variation of these age categories are unequal and could be the result of differential sample (age group) sizes. The ANOVA test applied in this analysis also produced a significant value at the 0.01 level (F = 22.046; p = <0.01). Corresponding post-hoc tests were carried out and showed significant associations between weight and a number of individual age thresholds. These include: infants and adolescents (p = 0.000; statistically significant), infants and young adults (p = 0.000; statistically significant), infants and younger mature adults (p = 0.000; statistically significant), infants and older mature adults (p = 0.000; statistically significant), children and adolescents (p = 0.000; statistically significant), children and young adults (p = 0.000; statistically significant), children and younger mature adults (p = 0.000; statistically significant) and children and older mature adults (p = 0.000; statistically significant). This highlights that there is a significant difference between the weights of infant and child cremation deposits compared to adolescent and adult interments. This analysis also illustrates that in the majority of instances all of the bones that would have derived from a complete skeleton was not collected and/or buried after the cremation process.

6.4.7 Sex

Based on the total number of adults[13], biological sex was successfully assigned to 58 adults (18%) from the Elsham cemetery. This value increased to 63 individuals (19%) subsequent to the analysis of five older adolescent (16-18 years) burials that contained sufficient evidence to establish the biological sex of these persons (Fig 6.11). A further 26 individuals, including two older adolescents (one male and one female), were assigned to the probable male and female categories. Therefore, a total of 89 individuals (27%) were ascribed to either the confidently assigned or probable biological sex categories. In addition, 29 individuals were assigned to the 'indeterminate' category due to the presence of both male and female diagnostic bones (Fig 6.12). A further 64 adult cremation burials produced sexually diagnostic elements, but have been discounted from this study as these deposits contained an insufficient number of diagnostic bones to permit accurate analyses. An assessment of these data have highlighted that there were almost twice as many females

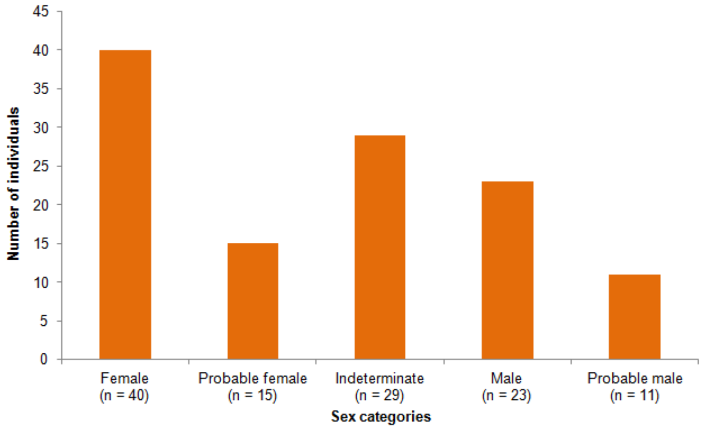


Fig 6.11 Histogram illustrating the number of individuals in each biological sex category from Elsham

Fig 6.12 Nuchal crest from EL76PB (FN 264). This fragment was assigned a score of four (probable male) though due to the presence of female and male traits this individual was assigned to the 'indeterminate' category

[13] The total number of adults (321 individuals) was employed in these calculations since biological sex could only be established for a very small proportion of (older) subadults. Therefore, the inclusion of the total number of subadults was deemed inappropriate in these analyses. In cases where older subadults were ascribed to a biological sex category, these individuals were added on to the total number of adults.

to males at the Elsham cemetery. Based on the use of a Chi-square test, a significant value at the 0.05 level ($X^2 = 0.03$; p = <0.05) illustrated that there were significantly more females than males in this skeletal assemblage. The inclusion of probable females and males into this Chi-square test continued to demonstrate a significant relationship between the frequency of males and females at the Elsham cemetery ($X^2 = 0.03$; p = <0.05). The highest frequency of female deaths occurred in the younger mature adult group followed, in relatively even proportions, by the remaining adult groups (Fig 6.13). Male mortality rates within each age category appear to have followed a similar demographic model to the female mortality profile. However, a Kolmogorov-Smirnov test was employed to demonstrate whether age distribution was the same in each biological sex group. This test highlighted that age did not show a normal distribution in each sex category at the 0.01 level (p = 0.27; non significant). Section 8.1.2 of this thesis will explore the possible reasons behind the differential mortality rates of males and females at Elsham.

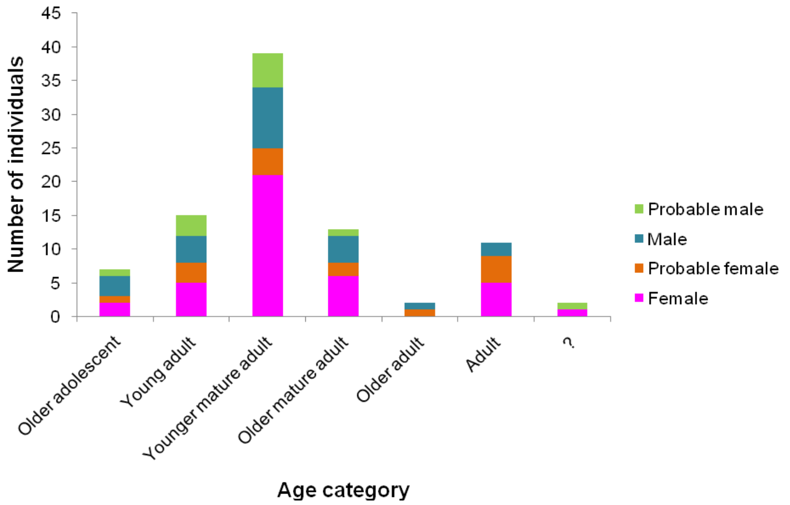


Fig 6.13 Sex distribution among age categories at the Elsham cemetery

Statistical analyses were carried out to determine whether there was a relationship between biological sex and weight of cremated remains. A total of 58 individuals were included in this analysis which comprised of 38 females and 20 males (Fig 6.14). Again, multiple deposits were excluded form this statistical analysis as a detailed breakdown of cremation weight versus biological sex was the primary interest of this test. The mean weight of female and male burials from Elsham totalled 964g and 876g, respectively. Levene's test for homogeneity of variances produced an insignificant result at the 0.05 level (W = 1.327; p = >0.05). This highlights that weight variation is relatively equal within the female and male groups. The ANOVA test was also conducted and produced an insignificant value at the 0.05 level (F = 0.492; p = >0.05). This statistical test shows that similar quantities of bone were found in male and female burials. Subsequently probable females (15) and probable males (10) were included in this analysis to establish whether the 'probable' groups would strengthen or alter the results that were generated from the previous analysis, which only dealt with confidently assigned males and females. A reassessment of female and male mean weight, which included probable females and probable males, generated new average weights of 952g and 941g, respectively. Levene's test for homogeneity of variances produced an insignificant result at the 0.05 level (W = 0.417; p = >0.05). Likewise, the ANOVA statistical test generated an insignificant result at the 0.05 level (F = 0.009; p = >0.05). Post-hoc tests could not be carried out on this dataset since only two categories (male and female) were employed in this assessment. Nonetheless, these statistical analyses highlight that biological sex was not an important factor in the collection and deposition of cremated remains from the Elsham cemetery.

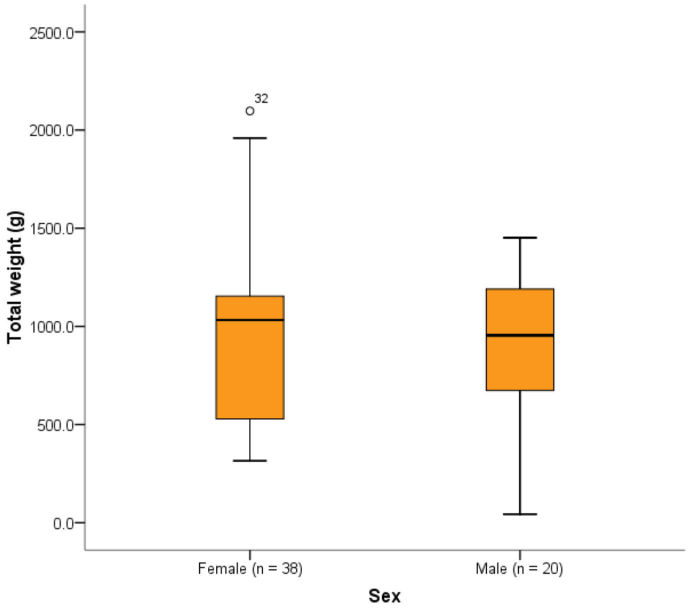


Fig 6.14 Box plot showing the relationship between cremation weight and biological sex from the Elsham cemetery

6.4.8 Population size

As outlined in the methodology chapter (chapter five) of this thesis, population size was estimated based on the premise that the Elsham cemetery was employed for 150 and

200 years. Owing to the under-representation of infants from Elsham, a model life table could not be established for this site. Therefore, a life expectancy value was taken from a pre-existing model life table. In this case, a value was obtained from the female west level three model life table that was designed for populations practicing subsistence agriculture (Coale and Demeny 1983, 82; Chamberlain 2006, 65-66). Average life expectancy for these populations lie in the region of 25-30 years, though the lowest value (25 years) will be employed in the following calculations. Based on the minimum number of individuals (564 persons) and longevity of the Elsham cemetery (150 years) an average of three to four burials would have occurred per year. This number of burials would have been supplied by a living population of around 94 persons, assuming that average life expectancy at birth was 25 years. If the site was employed for 200 years, an average of two to three interments would have taken place each year and would have been used by a living population of around 71 individuals. Based on this information, alongside Hill's (1981, 19) Anglo-Saxon rural population estimate (five individuals per square mile), the Elsham site would have served an area of around 19 square miles for a 150 year period of use and an area of 14 square miles for a 200 year period.

6.4.9 Health and disease

A total of 90 individuals (16%) from the Elsham cemetery displayed palaeopathological indicators and/or non-metric traits (Table 6.12). It is possible that there was a higher frequency of such markers but this information has been lost owing to the differential survival of skeletal elements as a result of the cremation process. Furthermore, an in-depth assessment of health and disease of the Elsham cemetery population was restricted due to time constraints placed on the author. A detailed breakdown of individual bones that were affected by disease, or displayed a non-metric trait, can be found in appendix I (on the accompanying disc).

Pathology	Number of individuals	Percentage (CPR)	Percentage (TPR)
Dental caries	28	4.96	7.33
Schmorl's nodes	12	2.13	6.38
Periostitis	12	2.13	3.21
Pronounced musculoskeletal markers (MSM's)	9	1.60	2.78
Non-metric trait	9	1.60	1.16
Osteoarthritis	7	1.24	0.74
Osteophytic growth	6	1.06	4.79
Cribra orbitalia	5	0.89	0.97
Antemortem tooth loss	5	0.89	0.97
Osteoporosis	2	0.35	2.22
Cyst	1	0.18	0.40
Os acromiale	1	0.18	0.39
Dental abscess	1	0.18	0.19
Fracture	1	0.18	0.19
Spondylosis	1	0.18	0.53

Table 6.12 Actual number, crude prevalence rate (CPR) and true prevalence rate (TPR) of palaeopathological indicators identified on cremated bone from Elsham

An array of dental conditions was recorded from the Elsham skeletal assemblage, for example dental caries, antemortem tooth loss and dental abscesses (Fig 6.15). Dental caries were identified in 28 individuals and were most commonly found on premolars and molars. Instances of antemortem tooth loss were noted in five individuals, four of which were observed on the maxilla while one was detected on a mandible (Fig 6.16). In total six individuals showed signs of osteophytic growth; the main site of this growth was the borders of vertebral bodies. Similarly, Schmorl's nodes affect the vertebrae and were identified on 12 separate occasions. Periostitis affected 12 recorded individuals and was most commonly observed on the tibiae and fibulae of an individual. Non-metric traits, including wormian bones, metopic sutures and a variety of cranial foramina, were observed in nine burials from Elsham. A cyst, located on the head of a rib (EL75PB(a) [FN 264]), os acromiale (EL75AP [FN 8]), a dental abscess (EL76JP

[FN 484]), the early stages of spondylosis (EL76GF [FN 430]) and compression fractures to the cranium (EL76IL [FN 367]) were observed on one occasion on different individuals of the Elsham population. The following section of this chapter will deal with the animal bones that were found in the Elsham cremation burials.

Fig 6.15 Maxillary dental abscess identified from burial EL76JP (FN 484)

Fig 6.16 Maxillary resorption from burial EL76PU (FN 586) indicative of antemortem tooth loss

6.5 Animal bone

Animal bone was found in 227 burials (40%) from the Elsham cemetery. Based on the fact that some deposits contained at least two species, 173 instances of faunal remains could be assigned to specific species, while 73 occurrences of burned animal bone could not be designated to a specific species (Table 6.13). A more detailed assessment of these animal bones will provide a more thorough understanding of the species that were interred within the Elsham cremation burials. Unburnt animal bone was found in eight deposits, two of which also contained cremated bone. Small mammals that were found within cremation burials may have burrowed and subsequently died in these deposits, though this cannot be proved due to the lack of contextual information. Long bones were the most frequently occurring unburnt element and were recorded from six deposits; of those identified, four derived from sheep and two originated from small mammal(s)/bird(s). The presence of subadult animals was also recorded. Based on the presence of unerupted teeth and unfused bones, five juvenile animals were identified from Elsham, four of which were identified as pigs.

Animal species	Number of occurrences
Sheep	51
Horse	47
Horse/cattle	21
Pig	17
Cattle	12
Bear	6
Small mammal/bird	6
Dog	4
Bird	4
Sheep/pig	2
Crustacean	2
Fish	1
Unidentifiable	73
Total	**246**

Table 6.13 Animal remains identified from the Elsham cemetery

In sum, at least one species of animal was recorded from 154 cremation burials. Snail shells of varying sizes were identified in 111 deposits but were excluded from further analyses since these remains may have been the result of post-depositional interment. The most frequently occurring species at Elsham was sheep followed by horse. Birds, small mammals, fish and dog occurred in much smaller numbers. A total of 16 deposits contained two species of animal and one burial (EL75QQ [FN 296]) held the cremated remains of three species (Table 6.14). The most common combination of species that were recorded from these burials comprised of horse and sheep. The three species that were detected from burial EL75QQ (FN 296) were identified as horse, cattle and sheep. A total of 14 deposits, eight of which were found in a vessel or were associated with an urn or pottery sherds, contained animal bones with little or no evidence of human remains. As previously mentioned in the symbolism chapter (chapter three) of this thesis, these interments are often referred to as ‘accessory vessels’. Eight of these deposits contained horse (two of which also contained sheep bone), the cremated remains of two large ungulates (either horse or cattle) were found in two separate burials, dog and cattle each occurred on one occasion and the burned bone from two animal deposits could not be assigned to a particular species. The use of these so-called 'accessory vessels' in the Anglo-Saxon cremation rite will be explored in subsequent chapters of this thesis. Next, the provision of animal remains will be examined alongside age and sex in an attempt to establish whether these biological attributes influenced the species and number of faunal offerings made to the Elsham burial population.

Cremation number	**Species**		
EL75CN	Cattle	Sheep	
EL75FF	Cattle/horse	Horse	
EL75GD	Cattle	Dog	
EL75GX	Pig	Horse	
EL75HM	Horse	Sheep	
EL75IC	Pig	Bear	
EL75JI	Horse	Sheep	
EL75KS	Cattle/horse	Small mammal/bird	
EL75KT	Horse	Bear	
EL75LT	Horse	Sheep	
EL75MR	Horse	Sheep	
EL75NL	Horse	Sheep	
EL75QG	Horse	Sheep	
EL75QQ	Horse	Cattle	Sheep
EL76PQ	Horse	Cattle	
EL76PR	Horse	Sheep	

Table 6.14 Burials containing at least two species of animal from Elsham

6.5.1 Biological age vs. animal bone

In total 48 subadult and 138 adult burials contained animal bone from the Elsham cremation burials. Of these deposits, 36 subadults and 93 adults contained animal bones that could be identified in varying degrees of detail, ranging from the general size of an animal to specific species (Fig 6.17). Sheep were the most identified species from this assemblage, which occurred among all age groupings except the older adult category. Bear phalanges were confined to the adult age groups while dog bones, interestingly, were only found with subadults under the age of 18 years. However, animal species that were solely associated with either adults or subadults occurred in small numbers and, as a result, may not be statistically significant.

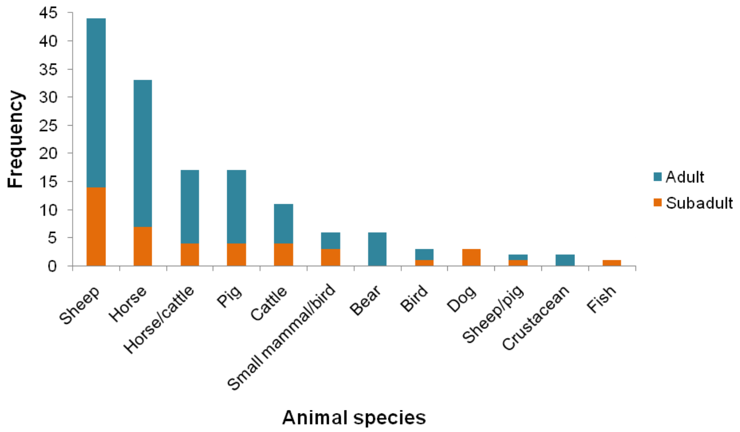


Fig 6.17 Stacked graph illustrating the frequency of animal species found in biologically aged burials from Elsham

A Pearson Chi-square test was employed to determine whether there was a relationship between biological age and the presence of animal bone. This statistical analysis produced a significant Chi-Square value at the 0.05 level (X^2 = 8.733; p = <0.05). It was also of interest to establish whether adolescents were culturally identified as adults. Therefore, adolescents were included in the 'adult' age category and a second Pearson Chi-Square analysis was carried out to establish whether this altered the previous Chi-Square results. This analysis generated statistically significant results at the 0.01 level (X^2 = 24.814; p = <0.01). It is apparent that, by including the adolescents in the adult group, the relationship between the provision of animal bone and adults is strengthened further. However, the significant association between adults and faunal remains was extremely high in the first instance, and, by increasing the dataset size (with adolescents) this added further strength to the significance value. Nonetheless, based on these statistical tests it is clear that adults were more likely to have been afforded animal offerings than subadults.

6.5.2 Biological sex vs. animal bone

Animal bones were identified in 23 female and nine male burials from the Elsham cemetery. A total of 18 females and eight males were associated with faunal remains that could be identified with varying degrees of certainty, ranging from the general size of an animal to specific species (Fig 6.18). Sheep were the most commonly occurring species in this sample and were found in the burials of four males and four females. Male and female burials also contained horse, pig, horse/cattle, bear and small mammal/bird. Bird, cattle and pig/sheep sized bone were only found with females; though these occur in such a low frequency that this is unlikely to have been statistically significant. A Pearson Chi-square test was carried out to determine whether there was a relationship between the provision of animal remains and biological sex. This test produced an insignificant Chi-Square value at the 0.05 level (X^2 = 1.277; p = >0.05). Based on the small number of males and females employed in the initial analysis, a second Chi-square test was conducted, which included three probable males and seven probable females (who were also found with animal bone). Despite the use of a larger sample size, this analysis also generated an insignificant value at the 0.05 level (X^2 = 2.113; p = >0.05). These results demonstrated that was no relationship between biological sex and the deposition of animal bone at the Elsham cremation cemetery. However, as a result of

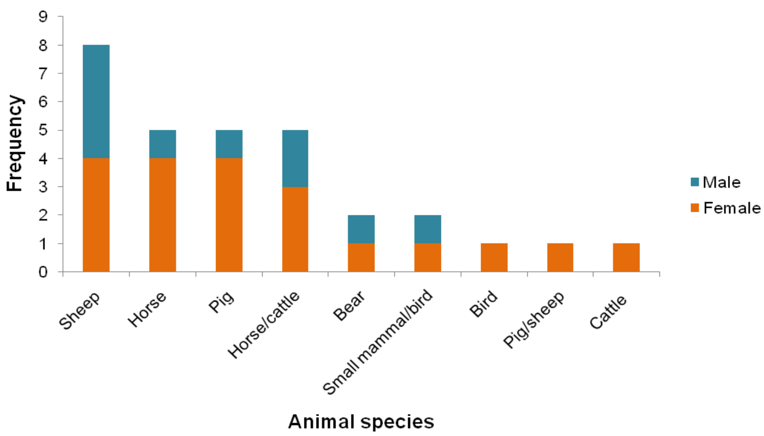


Fig 6.18 Stacked graph displaying animal species found in male and female burials from Elsham

small sample size, these tests may not provide a true representation of animal bone provision in male and female cremation burials. Therefore, caution must be exercised when interpreting these results. A discussion concerning the significance and meaning of age- and sex-specific animal remains can be found in section 8.2.1 of this thesis. The next section of this chapter will provide an in-depth assessment of cinerary urn attributes in conjunction with the demographic profile of the Elsham cemetery.

6.6 Cinerary urns

Cremation burials from Elsham were either deposited in a cinerary urn, which varied in size, form and decoration, or in a unurned state. Lead plugs were identified in seven cinerary urns from the Elsham cemetery (Table 6.15). These vessels were not afforded to a specific age group and only one individual that was buried in this type of modified receptacle were assigned biological sex (EL75KV(b) [FN 198(b)]). Consequently, no clear-cut relationships between lead plugged cinerary urns and the biological attributes of associated individuals could be identified from the Elsham assemblage.

Cremation number	MNI	Age	Sex	Number of lead plugs
EL75BQ (FN 21)	1	Adolescent	?	1
EL75EO (FN 80)	1	Subadult	?	1
EL75KV(b) (FN 198(b))	1	Older mature adult	Male	1
EL75MZ (FN 229)	1	?	?	1
EL75QC (FN 283)	1	Subadult	?	1
EL76HQ (FN 450)	1	Younger mature adult	?	1
EL76NJ (FN 546)	1	Subadult	?	1

Table 6.15 Holed urns that contain human remains and evidence of lead plugs from Elsham

A total number of 29 deposits were found in a ‘unurned’ state from the Elsham cemetery (this figure excludes the animal deposits discussed in the previous section of this chapter) (Table 6.16). Five of these ‘unurned’ deposits were discovered underneath associated cinerary vessels, while burial EL76KL(b) (FN 496(b)) was found lying beside urn EL76KL(a) (FN 496(a)). In addition, 23 of these deposits were

Cremation number	Total weight (g)	Max fragment size (mm)	Disturbed	Other notes
EL75AA	15.00	29.05	Yes	No urn
EL75AV	7.30	35.65	Yes	No urn
EL75BK	51.03	33.02	Yes	No urn
EL75EF	2.80	24.84	Yes	No urn
EL75EX	5.50	43.98	Unknown	No urn
EL75EZ	12.90	30.80	Unknown	No urn
EL75FE	123.40	45.30	Unknown	Bones below urn EL75ET (FN 83)
EL75GQ	3.10	22.21	No	No urn
EL75HX	185.06	36.56	Yes	No urn
EL75IN	63.27	28.34	Yes	No urn
EL75IR	20.66	35.16	Unknown	No urn
EL75IT	5.84	19.65	Yes	Bones below urn EL75IC (FN 141)
EL75JA	53.00	33.43	Yes	No urn
EL75KC	3.03	21.18	Yes	No urn
EL75RI	125.40	39.22	Yes	No urn
EL75RQ(b)	1094.20	72.90	Unknown	Bones below urn EL75RQ(a) (FN 315)
EL76AF	1329.24	68.28	No	No urn
EL76CD	87.15	29.74	Unknown	Bones below urn EL76CC (FN 354)
EL76CM	379.90	50.85	Yes	No urn
EL76CN	88.00	30.17	Yes	No urn
EL76EO	563.22	49.71	Unknown	Bones below urn EL76EP (FN 403)
EL76HT	58.20	27.91	Yes	No urn
EL76KL(b)	1762.40	42.89	Yes	Cremated bones lying beside EL76KL(a) (FN 496(a))
EL76LF	41.55	25.14	Yes	No urn
EL76LG	29.09	46.63	Yes	No urn
EL76OQ	650.90	41.15	Yes	No urn
EL76PC	52.77	32.00	Yes	No urn
EL76PE	1022.20	68.99	No	V-shaped pit filled with cremated bone - no urn
EL76PX	333.50	61.90	Yes	No urn

Table 6.16 Unurned cremation deposits from Elsham

recorded as 'unurned' with no associated contemporary vessels or pottery sherds, seven of which were from unstratified contexts. There is a possibility that these unurned interments were redeposited burials. Another explanation is that unurned deposits, which contained large quantities of cremated bone, may have once been held in organic containers or bags but due to taphonomic processes these receptacles have not survived in the archaeological record. Alternatively, post-depositional damage, such as ploughing, may account for burned bone that was identified in a 'unurned' state. In comparison to urned burials, unurned deposits possess a much lower average and median weight. Urned burials produced an average weight of 535g and a median weight of 418g, while unurned deposits generated a mean weight of 282g and a median weight of 58g. There is a common assumption that the use of cinerary urns would have provided greater protection for cremated material; hence these bones would have experienced a minimised degree of fragmentation (McKinley 1994(c), 341). It is possible that unurned deposits produced smaller amounts of cremated bone than urned burials because they were more susceptible to post-depositional disturbance and taphonomic processes. However, based on comparable average maximum fragment size of unurned (39mm) and urned (45mm) interments it appears that both types of deposit suffered from similar pre- and/or post-depositional disturbance.

The next section of this chapter will explore the relationship between cinerary urns and the demographic attributes of individuals buried within these vessels. A major problem that was encountered throughout these analyses was the disturbed nature of funerary vessels from the Elsham cemetery. Consequently, many measurements, especially total height, could not be obtained because of the small number of complete vessels. Therefore, only individuals that were associated with urns that possessed complete measurements were considered in these analyses. Vessels that contained more than one individual were excluded from the below analyses as these interments would have skewed the results; for example, two different age groups cannot provide useful information concerning the vessel dimensions of one urn.

6.6.1 Biological age vs. cinerary urn height

To begin, the relationship between biological age and cinerary urn height will be examined. A total of 43 individuals were included in this analysis which comprised of eight infants, eight children, two adolescents, eight young adults, 14 younger mature adults and three older mature adults (Fig 6.19). The main drawback of this dataset is the small sample size, owing to the lack of complete cinerary urns. A test of homogeneity of variances produced an insignificant value at the 0.05 level ($W = 1.358$; $p = >0.05$) which demonstrated that the variance in cinerary urn height was relatively similar in each age category. However, when considering the relationship of age and cinerary urn height between groups, using the ANOVA test, a significant value was generated at the 0.01 level (F = 5.509; p = <0.01). Post-hoc tests highlighted that there were significant differences between the vessel heights of infants and young adults (p = 0.015; statistically significant), infants and younger mature adults (p = 0.002; statistically significant) and children and younger mature adults (p = 0.018; statistically significant) at the 0.05 level. This illustrates that older individuals were afforded taller urns at the Elsham cemetery.

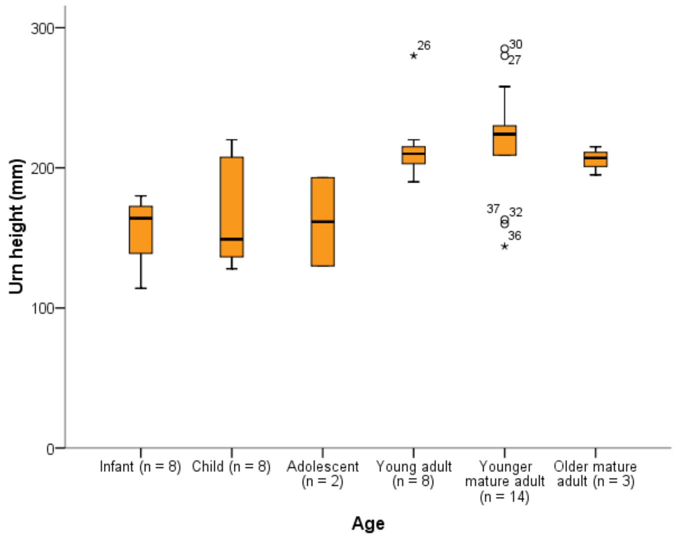


Fig 6.19 Box plot illustrating the relationship between cinerary urn height and biological age categories from the Elsham cemetery

6.6.2 Biological age vs. cinerary urn rim diameter

The following analysis aimed to establish whether there was a relationship between biological age and cinerary urn rim diameter. The associated pottery of 124 individuals, which included 18 infants, 17 children, 14 adolescents, 24 young adults, 39 younger mature adults, 11 older mature adults and one older adult, were available for statistical testing (Fig 6.20). Again, a limitation of this dataset is the small sample sizes owing to the high prevalence of damaged cinerary urns from the Elsham cemetery. A test of homogeneity of variances produced an

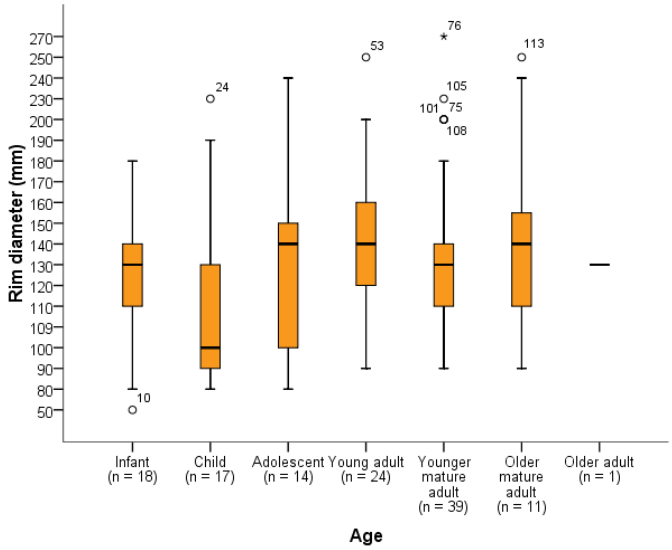


Fig 6.20 Box plot highlighting the relationship between cinerary urn rim diameter and biological age categories from the Elsham cemetery

insignificant value at the 0.05 level (W = 0.415; p = >0.05). This illustrated that the variance in scores (rim diameter) was similar for each age category. The ANOVA test was also conducted on this dataset and generated an insignificant value at the 0.05 level (F = 1.056; >0.05). Post-hoc tests were carried out on these data but did not highlight any significant differences between age categories at the 0.05 level. Therefore, based on statistical analyses, the null hypothesis that older individuals were interred within cinerary urns that possessed a larger rim diameter was disproved.

6.6.3 Biological sex vs. cinerary urn height

Statistical analyses were carried out to determine whether there was a relationship between biological sex and cinerary urn height. An initial analysis excluded the only older adolescent (16-18 years), for whom it was possible to assign biological sex (EL75ON [FN 252]), in this sample to determine whether the inclusion of older adolescents had an impact on this statistical test. The exclusion of this sample brought the total number of individuals down to three males and seven females. A test of homogeneity of variances produced an insignificant value at the 0.05 level (W = 0.715; p = >0.05). Similarly, an ANOVA test employed in this analysis generated an insignificant value at the 0.05 level (F = 2.653; p = >0.05). Since the exclusion of the older adolescent (EL75ON [FN 252]) produced statistically insignificant results in this initial analysis, this individual was subsequently included in a secondary analysis to establish whether biological age had an effect on the overall relationship between urn height and biological sex. Therefore, a

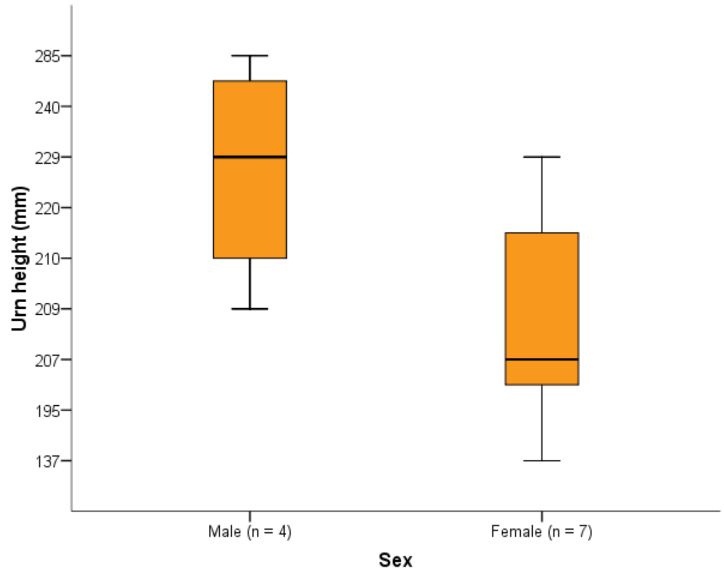


Fig 6.21 Box plot illustrating the relationship between cinerary urn height and biological sex categories from the Elsham cemetery

total of 16 individuals, which consisted of four males and seven females, were included in this analysis (Fig 6.21). It should be noted that only confidently assigned males and females were employed in this statistical analysis. A test of homogeneity of variances produced an insignificant value at the 0.05 level (W = 0.106; p = >0.05). Similarly, the ANOVA test employed in this analysis generated an insignificant value at the 0.05 level (F = 3.714; p = >0.05). Subsequently, probable males (three) and probable females (four) were included in this analysis to increase the otherwise small size of this sample. Again, Levene's test for homogeneity of variances produced an insignificant value at the 0.05 value (W = 0.780; p = >0.05). However, the corresponding ANOVA analysis produced a significant value at the 0.05 level (F = 5.503; p = <0.05). This may have been the result of a slightly larger sample size than the initial analysis which has consequently strengthened the association between biological sex and cinerary urn height. Post-hoc tests could not be carried out because only two sex categories, that is, males and females, were employed in this analysis. Initial analyses disproved the null hypothesis that males were afforded taller urns than females, yet the inclusion of probable males and females in this dataset supported the null hypothesis that males were buried within taller vessels than their female counterparts. However, caution must be exercised in the interpretation of these results due to the small sample sizes that were used in these analyses.

6.6.4 Biological sex vs. cinerary urn rim diameter

The aim of the following analyses was to determine whether there was a relationship between biological sex and cinerary urn rim diameter. An initial analysis excluded three older adolescents, for whom it was possible to assign biological sex (EL75BX [FN 33], EL75GI [FN 105] and EL75ON [FN 252]), to establish whether the inclusion, and exclusion, of (older) adolescents had an impact on this test. Thus, a total number of 19 individuals, which included three males and 16 females, were employed in this initial analysis. A test of homogeneity of variances produced an insignificant at the 0.05 level (W = 0.147; p = >0.05). Similarly, the ANOVA test generated an insignificant value at the 0.05 level (F = 0.140; p = >0.05). Subsequently, the three older adolescents were included in a second analysis. Thus, a total of 22 individuals, which consisted of six males and 16 females, were incorporated into these statistical tests (Fig 6.22). A test of homogeneity of variances produced an insignificant value at the 0.05 level (W = 0.956; p = >0.05). Similarly, the ANOVA test generated an insignificant value at the 0.05 level (F = 0.004; p = >0.05). The results from these statistical analyses disproved the null hypothesis that males were buried in funerary vessels with larger rim diameters than females. Furthermore, the inclusion of the older adolescents mentioned above did not have a significant effect on these results. Finally, nine probable males and 14 probable females were incorporated in this analysis. Again, Levene's test for homogeneity of variances produced an insignificant value at the 0.05 level (W = 2.809; p = >0.05). Similarly, the ANOVA test generated an insignificant value at the 0.05 level (F = 0.066; p = >0.05). Post-hoc tests could not be conducted due to the lack of biological sex categories utilised in these analyses. If a greater number of surviving urns were available for analysis; these tests would have produced more representative statistically significant results. Despite the small sample sizes that were available for analysis, the results that were generated by these statistical tests may, in fact, highlight that there was no relationship between biological sex and cinerary urn rim diameter. A discussion regarding cinerary urn dimensions and biological sex can be found in section 8.2.2 of this thesis. The following section of this chapter will examine the grave and pyre goods that were found in the Elsham cremation burials.

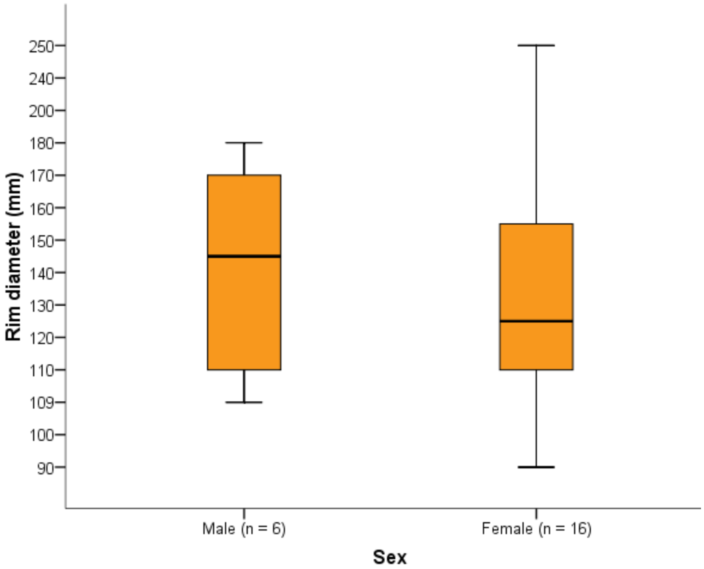


Fig 6.22 Box plot highlighting the relationship between cinerary urn rim diameter and biological sex categories from the Elsham cemetery

6.7 Pyre and grave goods

As outlined in the methodology chapter of this thesis, an unpublished catalogue was used to obtain information about the artefacts from the Elsham cremation burials (Berisford 2008). Unfortunately, this document contained limited information about these grave assemblages, for example there is rarely a distinction between pyre and grave goods. Thus, both burnt and unburnt artefacts were grouped together in the following analyses. Furthermore, due to the sheer quantity of pyre and grave good types, many objects have been grouped together based on artefact type (Table 6.17).

Artefact categories	Objects within artefact categories
Beads	Glass, crystal, coral, bone
Brooches	Cruciform, penannular, bow, annular, small-long, disc, brooch pins
Coin	Copper-alloy
Comb	Worked bone/antler
Counters/discs	Bone, copper-alloy
Decorated strips	Bone, copper-alloy
Handles	Bone
Miniatures	Toilet sets, combs
Needles	Awls, points, pins
Purse mounts	Iron
Rings	Antler, iron, copper-alloy
Rivets and nails	Copper-alloy, iron
Roman pottery	Vessel sherds, tile
Sleeve clasps	Copper-alloy
Spindle whorls	Antler, stone, lead, clay
Toilet implements	Tweezers, shears, spoons/earscoops, razors
Vessels	Glass vessels, iron rim bindings, copper-alloy rim bindings
Weaponry	Knives, blades, arrowheads
Whetstone	
Miscellaneous	Unidentifiable objects, metal wire, metal hooks, metal staples, tin

Table 6.17 Pyre and grave goods identified from the Elsham cremation burials

A total of 236 cremation burials contained identifiable artefacts from the Elsham cemetery. Combs were the most common type of artefact identified and were found in 107 cremation burials (Fig 6.23). Beads, spindle whorls and toilet implements also occurred in relatively high numbers. In contrast, objects such as purse mounts, coins, and whetstones were rare.

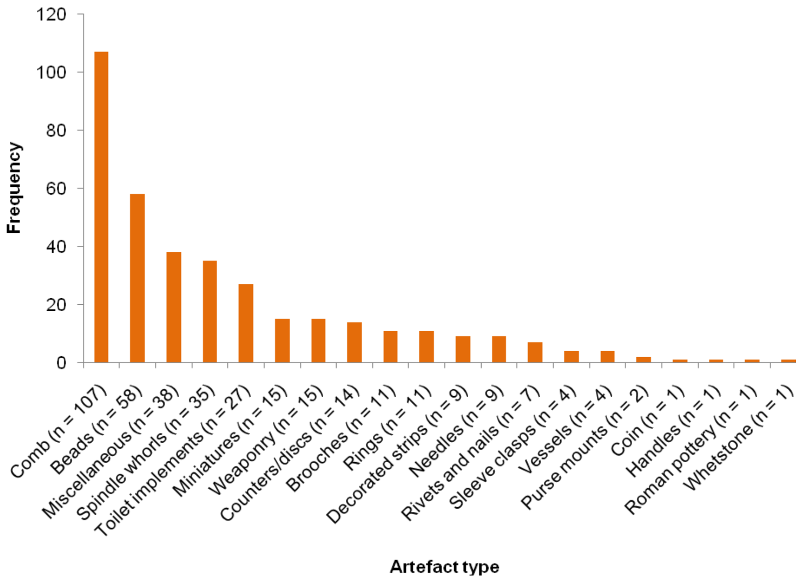


Fig 6.23 Histogram showing the frequency of pyre and grave goods identified from the Elsham cremation burials

Material that was used to produce artefacts, whether in a molten, burnt but identifiable or unburnt state, was recognised from 341 burials. Material types that were documented from these burials included: iron, copper-alloy, lead, glass, crystal, worked bone/antler, ivory, coral, cowrie, clay, stone and (worked) flint. Glass, closely followed by worked bone/antler, was the most common material type found in the Elsham cremation burials (Fig 6.24). Copper-alloy, ivory and iron also occurred in relatively high frequencies. Additionally, pyre and grave goods were also likely to have been manufactured out of organic materials, such as wood. However, the placement of such objects on a funerary pyre or burial (in an unburnt state) in an unfavourable taphonomic environment would leave little, if any trace, of these artefacts in the archaeological record. The subsequent sub-sections will present the results from analyses that were conducted on pyre and grave goods, in conjunction with the demographic attributes of the Elsham burial population, to establish whether there were any underlying artefact groupings based on biological and social identity. Furthermore, multiple burials were discounted from all of the following analyses, similar to the strategy employed in the Spong Hill assessment, since the presence of a subadult and adult, or a male and a female, within a single burial would have obscured any statistically significant results concerning artefact groupings and specific biological attributes (McKinley 1994, 88).

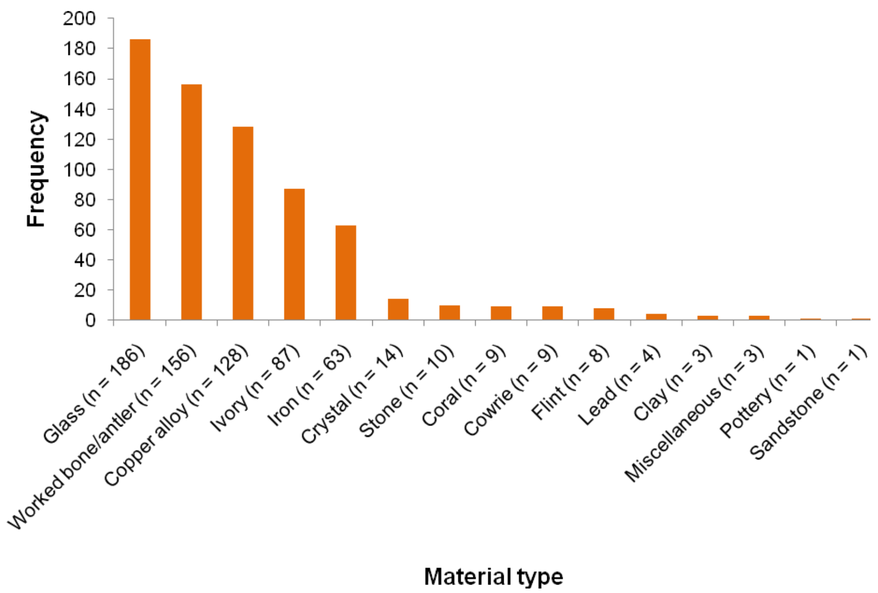


Fig 6.24 Histogram illustrating the frequency of pyre and grave goods categorised by material type from the Elsham cremation burials

6.7.1 Biological age vs. pyre and grave good type

At the Elsham cemetery, artefacts were buried with 211 biologically aged individuals, which comprised of 63 subadults and 148 adults (Fig 6.25). Combs occurred in the highest frequency in both subadult and adult burials. Handles and whetstones were confined to adult burials while purse mounts were solely assigned to subadults. However, it was difficult to establish whether these were, indeed, age-specific artefacts owing to the low frequencies that were recovered from the Elsham burials. A Pearson Chi-square test was conducted to establish whether there was an association between age and the deposition of pyre and grave goods. This statistical analysis produced an insignificant value at the 0.05 level (X^2 = 0.80; p = >0.05). It was also of interest to determine whether adolescents were culturally identified as adults. Therefore, a second Pearson Chi-Square test was carried out which incorporated adolescents into the adult age category. However, this analysis also generated a statistically insignificant result at the 0.05 level (X^2 = 0.47; p = >0.05). These analyses highlighted that the deposition of pyre and grave goods was not influenced by the age of an individual. The inclusion of adolescents in the 'adult' age category slightly strengthened the association between age and grave provision, which was possibly due to an increased sample size, though the significance value remained statistically insignificant.

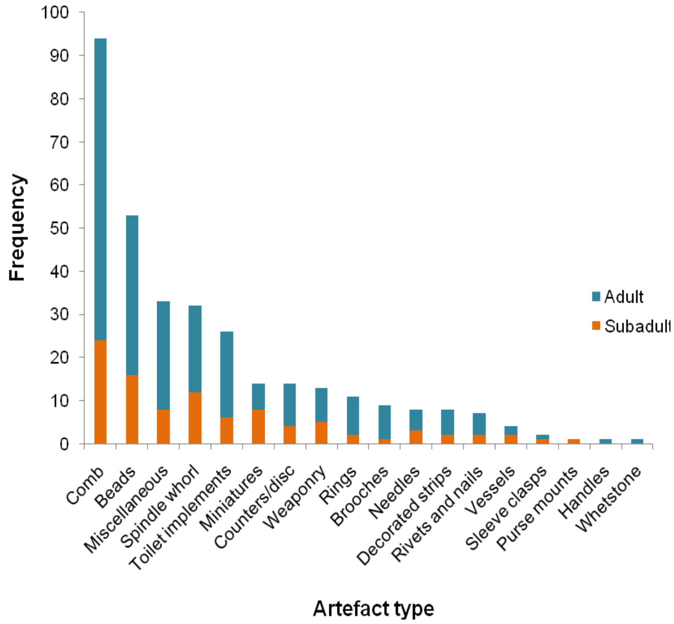


Fig 6.25 Stacked graph showing the frequency of pyre and grave goods buried with biologically aged cremation burials from Elsham

Correspondence and cluster analyses were applied to this dataset to highlight any discrete associations between artefact types, animal bone and biological age. A total of 298 individuals, which consisted of 86 subadults and 212 adults, were incorporated in the following analyses. The quantification plot that was produced by correspondence analysis illustrated two distinctive artefact groupings (Fig 6.26). The first grouping, group one, contains toilet implements, miniatures and weaponry and is located along dimension one, while group two is comprised of rings, brooches and sleeve clasps and is positioned along dimension two. Group one contained three subadults and three adults. Each of these individuals was associated with at least two of the artefacts identified in this group. Group two comprised of a slightly lower frequency of individuals, which included one subadult and four adults. The object score plot that was generated through correspondence analysis produced a large cluster of points that indicate the absence of a strong association between age, artefact types and animal bone. However, a number of outliers were also plotted. The outliers that are positioned near dimension one represent group two and can be explained by the rare occurrence of these age associated objects in this analysis (Fig 6.27). The cases in group one are loosely positioned around the top and right hand side of the central cluster of points. In comparison to group two, group one is located closer to the central cluster of cases because individuals belonging to this grouping are associated with a higher frequency of similar artefacts and, consequently, have less unique age and artefact associations. Similarly, cluster analysis also illustrated the strong association between the artefact groupings that were identified in correspondence analysis, though the relevant dendrogram sections (from cluster analysis) are too large to include here. Furthermore, cluster analysis also highlighted that combs and beads made up the most common artefact combination from the Elsham cemetery and were found in five subadult and 10 adult burials. Subsequently, correspondence and cluster analyses were conducted for a second time, though adolescents were reclassified from the 'subadult' group to the

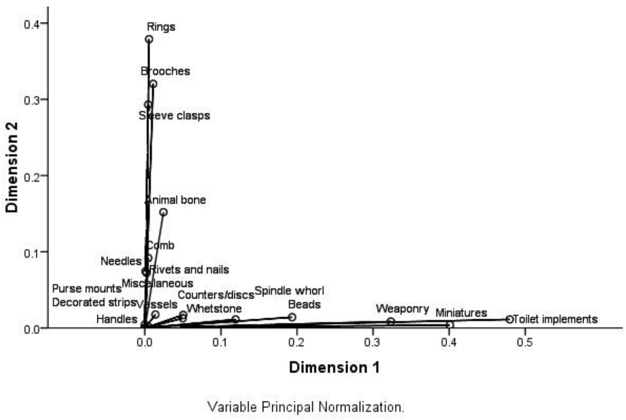


Fig 6.26 Quantification plot displaying discrimination measures based on artefact type and biological age from the Elsham cremation burials

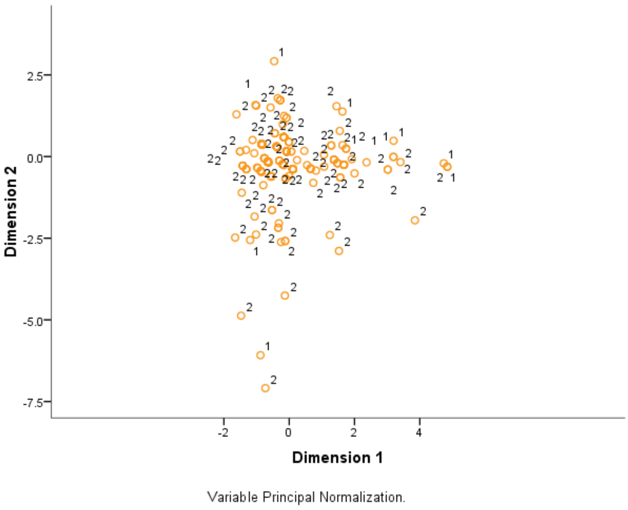


Fig 6.27 Object score plot highlighting object points based on artefact type labelled by age (1 = subadult; 2 = adult) from the Elsham cremation burials

'adult' age category. The results from both statistical methods showed that the inclusion of adolescents in the adult age grouping did not alter the artefact groupings that were identified in the initial analyses. In sum, there were no clear differences regarding the artefact types afforded to subadults and those offered to adults at the Elsham cemetery.

6.7.2 Biological age vs. material type

The following sub-section will explore whether there were any associations between biological age and the material that was used to produce grave and pyre goods. A total of 308 biologically aged individuals, comprising of 98 subadults and 210 adults, were buried with artefacts where the material of these objects could be identified (Fig 6.28). Glass, followed by worked bone/antler, copper-alloy, ivory and iron, was the most prevalent material found with both subadult and adult age categories. Age-specific materials were only identified in adult burials, these included crystal, coral, lead and sandstone. However, these materials occurred in very small numbers and do not necessarily represent an accurate picture of age-specific materials that were used in the cremation rite at Elsham. Furthermore, the notion that adults were solely buried with exotic objects can be discounted based on the presence of ivory in both adult and subadult groups.

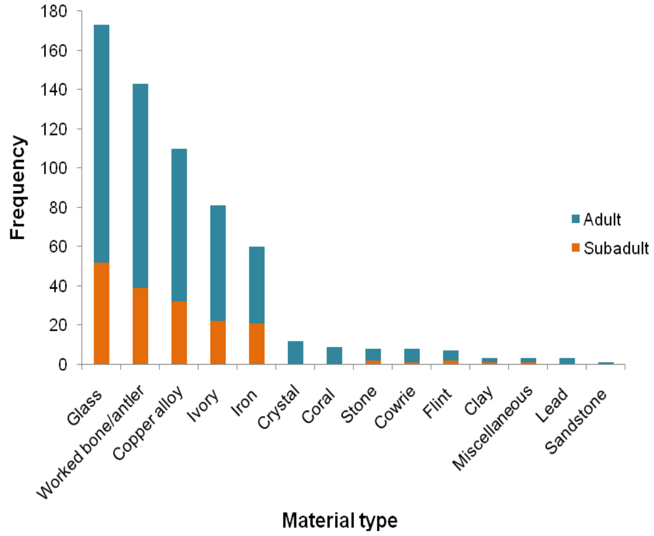


Fig 6.28 Stacked graph illustrating the frequency of pyre and grave goods categorised by material type in subadult and adult graves from Elsham

Correspondence and cluster analyses were carried out on the identifiable material of grave and pyre goods that were found with 110 subadults and 247 adults to establish whether age influenced the choice of artefact material types that were afforded to different funerary assemblages. The quantification plot, which was generated through correspondence analysis, illustrated two notable associations. Group one contains individuals with a strong association with ivory and glass, which is positioned along dimension one, while group two is comprised of persons associated with worked bone/antler and iron, which is located adjacent to dimension two (Fig 6.29). This plot depicted a relatively even distribution of artefact materials in subadult and adult burials. In addition, the object score plot depicted a random dispersion of subadult and adult cases which added further support to the notion that age did not influence the deposition of specific material types (Fig 6.30). Cluster analysis highlighted that ivory and glass (group one) were found together on 60 separate occasions, which were identified in 16 subadult and 44 adult burials, while a combination of worked bone/antler and iron (group two) was recorded on 28 different instances, which included six subadult and 22 adult burials. Consequently, correspondence and cluster analyses were performed again to explore whether the inclusion of adolescents in the 'adult' age category – since they may have been viewed culturally as adults – affected the deposition pattern of artefact material types. The output from these tests showed no significant differences to the results that

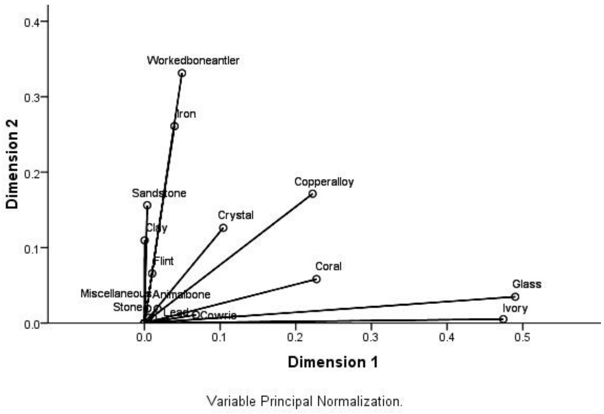


Fig 6.29 Quantification plot displaying discrimination measures based on artefact material and biological age from the Elsham cremation burials

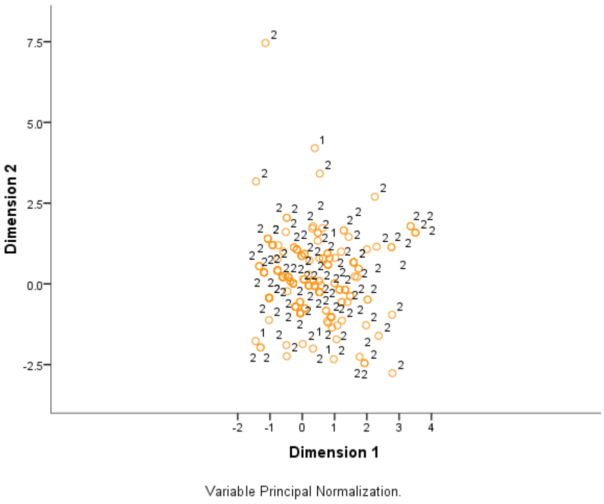


Fig 6.30 Object score plot highlighting object points based on artefact material labelled by age (1 = subadult; 2 = adult) from the Elsham cremation burials

were generated in the initial analyses. Therefore, the null hypothesis that the deposition of specific material types was dependent on the age of the deceased can be dismissed.

6.7.3 Biological sex vs. pyre and grave good type

A total of 46 biologically sexed individuals, which included 24 females, eight males, 10 probable females and four probable males, were assessed to determine whether there was a relationship between biological sex and artefact type (Fig 6.31). Probable females and probable males were included in these analyses as they reinforced conclusions that were produced in initial analyses which solely employed confidently assigned males and females. Combs were the most frequently occurring artefact in male and female burials. Both male and female burials also contained toilet implements, needles, weaponry, miniatures and rings. Needles and weaponry occurred more frequently with males than females, while handles, which may have derived from a knife or a tool, were only found in male burials. However, the low frequencies of male-orientated artefacts do not permit any significance to be attached to these associations. Objects that could possibly be categorised as female-specific artefacts include: spindle whorls, beads, counters/discs, brooches, decorated strips and rivets or nails. Yet again, some of these artefacts occurred in such low frequencies that the pattern of association with female burials may not be statistically significant. A Pearson Chi-square test was carried out to determine whether there was a relationship between biological sex and the interment of associated grave furnishings. Statistical testing produced an insignificant Chi-Square value at the 0.05 level (X^2 = 2.234; p = >0.05),

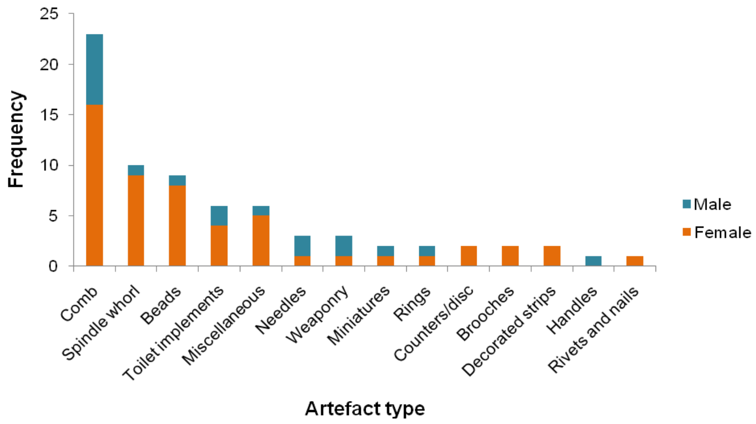


Fig 6.31 Stacked graph showing the frequency of pyre and grave goods in male and female cremation burials from Elsham

which highlighted that there was no relationship between biological sex and the deposition of artefacts at the Elsham cremation cemetery.

Correspondence and cluster analyses were conducted on 61 individuals, which included 31 females, 14 males, 11 probable females and five probable males, and their associated grave assemblages. The application of correspondence analysis to this dataset produced three discrete groupings. Group one contains miniatures and toilet implements, which are located along dimension one of the quantification plot, while group two is comprised of animal bone and rings, which are positioned along dimension two of the same graph (Fig 6.32). In addition, a third group was identified, which contained weaponry and counters/discs, and is positioned at 45˚ between dimensions one and two. Cluster analysis highlighted that group one contained one male and one female that were buried with both miniatures and toilet implements. In contrast, animal bone and rings, both assigned to group two, were not found together on any one occasion. Group three contains objects found in groups one and two which explains its central position on the quantification plot. The object score plot depicts patterns among male and female

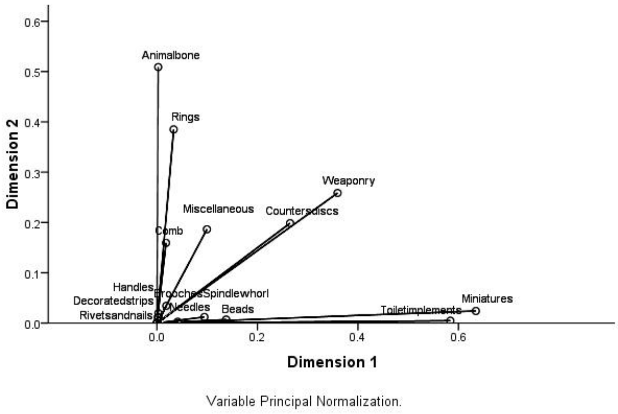


Fig 6.32 Quantification plot highlighting discrimination measures based on artefact type and biological sex from the Elsham cremation burials

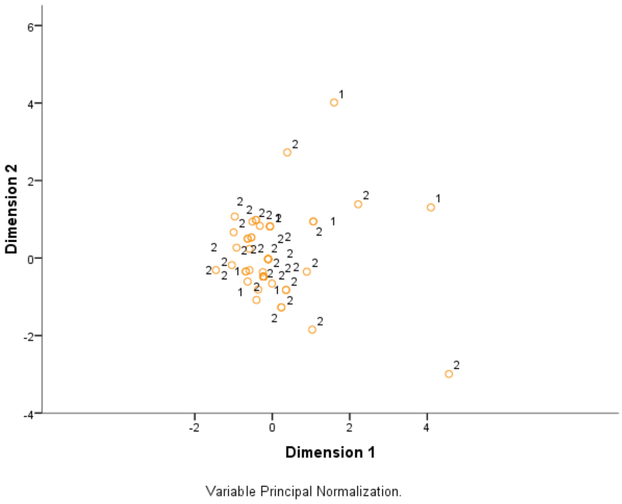


Fig 6.33 Object score plot displaying object points based on artefact type labelled by sex (1 = male; 2 = female) from the Elsham cremation burials

burials. The central cluster of points indicates no strong association between artefact type and sex, though three female and two male cases were identified as outliers on the plot (Fig 6.33). The female (EL75HK [FN 129]) outlier, which can be found along dimension one of the object score plot and belongs to group one, was caused by a unique grave assemblage, consisting of miniature iron shears, a copper-alloy toilet implement (tweezers), counter/disc and miscellaneous (iron wire and copper-alloy sheet). It is extremely likely that these analyses would have provided clearer associations between biological sex and specific artefacts if a greater proportion of individuals (that contained associated grave assemblages) were assigned to a biological sex category.

6.7.4 Biological sex vs. material type

The primary focus of the subsequent analyses was to establish whether biological sex was associated with the material of pyre and grave goods. A total of 65 biologically sexed individuals, which included 36 females, 12 males, 12 probable females and five probable males, were included in the following assessment (Fig 6.34). Glass was the most frequently documented material type from female burials, while worked bone/antler was most commonly afforded to their male counterparts. All material types were buried with both males and females, though there were some exceptions. Crystal, clay, coral, cowrie and stone were exclusively found with females while the sole occurrence of lead was recorded from a male burial. However, these 'sex-specific' types of material were identified in small numbers and, consequently, may not have represented any

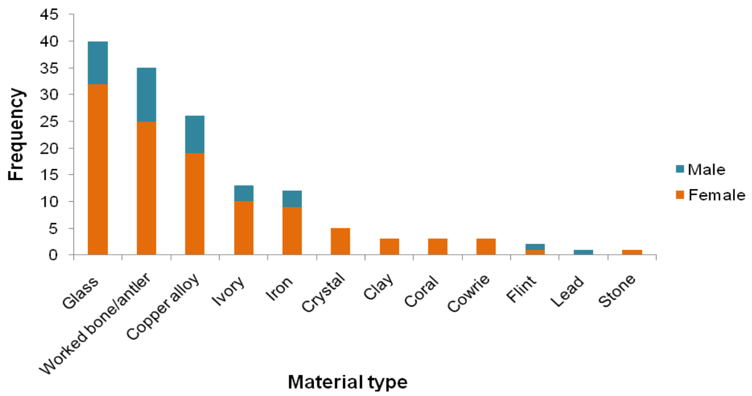


Fig 6.34 Stacked graph showing the frequency of pyre/grave goods categorised by material type in male and female graves from Elsham

significant relationships between biological sex and the material of artefacts that were interred in the Elsham cremation burials.

A total of 71 sexed individuals, which included 37 females, 15 males, 13 probable females and six probable males, were included in the following correspondence and cluster analyses. The quantification plot, which was generated through correspondence analysis, depicted a relatively equal distribution of material types among male and female burials, though some discrete groups were identified (Fig 6.35). Group one contains stone and crystal, which is located along dimension one of the quantification plot, though cluster analysis highlighted that this combination of material types only occurred in one female burial. Group two is comprised of cowrie and copper-alloy, which is positioned along dimension two of the same plot, and represent two female burials. The object score plot illustrated a relatively weak cluster of points and a number of outliers that are mainly comprised of female cases (Fig 6.36). The overall weak associations identified in the object score plot is the result of a high frequency of females in this sample and the similar material types buried with these individuals. On the whole, it appears that biological sex did not play a significant role in the selection

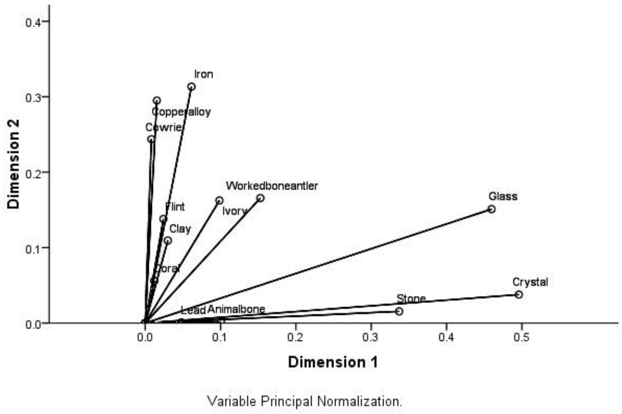


Fig 6.35 Quantification plot displaying discrimination measures based on artefact material

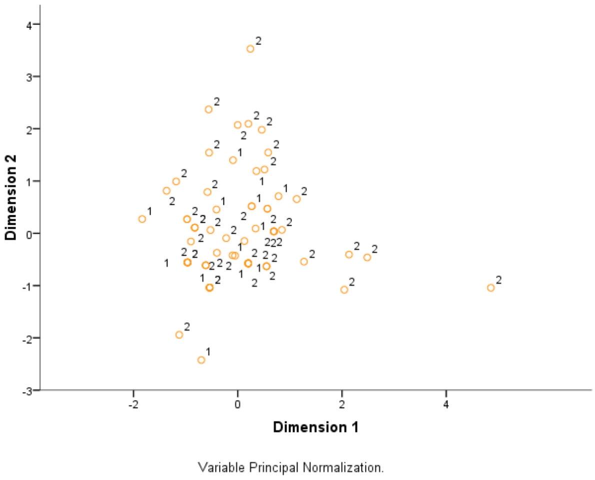


Fig 6.36 Object score plot highlighting object points based on artefact material labelled by sex (1 = male; 2 = female) from the Elsham cremation burials

and burial of artefacts that were manufactured out of specific materials. It is important not to forget that the relationships that have been identified in these analyses occurred in extremely low frequencies and may not represent a true picture of sex-specific material types that were employed in the early Anglo-Saxon cremation rite. The next section of this chapter will explore the spatial distribution of burials at the Elsham cremation cemetery.

6.8 Cemetery organisation

Cemetery organisation was examined in order to determine whether there were any distinctive burial clusters, based on multiple deposits, age and sex, at the Elsham cemetery. The co-ordinates of 535 cremation burials were available for the subsequent analyses. An examination of the Elsham site plan provided evidence for a separation between the eastern and western halves of the Elsham cemetery. Consequently, this division was assessed to establish whether there were any underlying reasons for this split pattern of disposal. A total of 260 cremation deposits were interred in the eastern half of the site while 275 burials lay to the west of the cemetery. The number of cremation burials is relatively even in the eastern and western halves of the site. To begin with, the distribution of multiple deposits at the Elsham cemetery was examined.

6.8.1 Multiple deposits

A total of eight confirmed and three probable multiple deposits were available for spatial analysis. The distribution map illustrated that the majority of multiple deposits lay in the western half of the cemetery (Fig 6.37). Three multiple burials were located on the eastern half of the site while the remaining eight deposits were situated in the western half of the cemetery. A Pearson Chi-square test was carried out to determine whether there was a significant relationship between multiple burials and the location of their interment (when considering burial in the eastern and western halves of the site). This statistical test produced an insignificant value at the 0.05 level ($X^2 = 2.045$; $p = >0.05$) which demonstrated that there was no relationship between multiple burials and the site of their deposition at the Elsham cemetery. Another consideration is that the sample size employed in this analysis is extremely small and may have caused an insignificant value. Unfortunately, due to the low frequency of multiple deposits from the Elsham cremation cemetery, spatial cluster analysis could not be carried out on these burials.

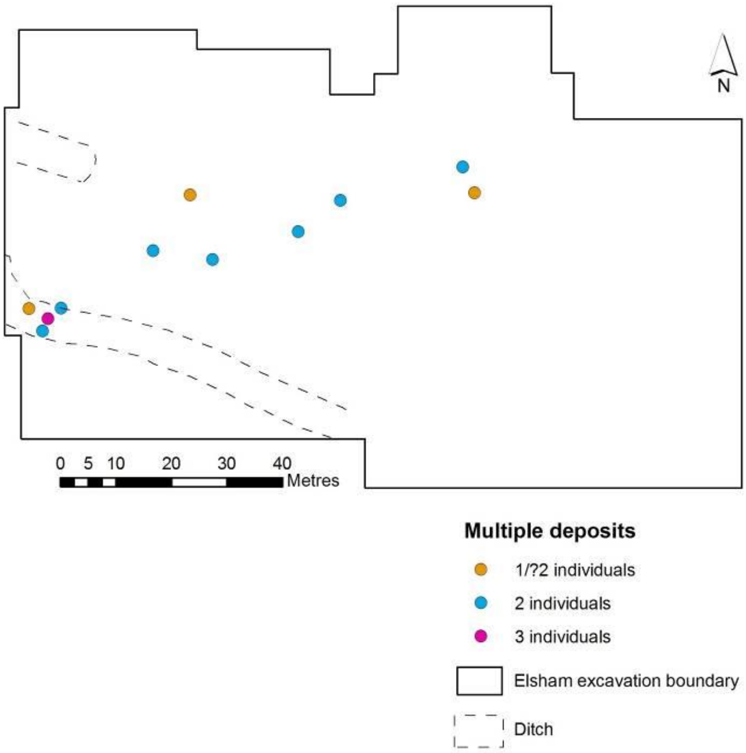


Fig 6.37 Spatial distribution of multiple deposits at Elsham

6.8.2 Age

The co-ordinates for 477 biologically aged individuals were available for this analysis. Initially analyses were conducted on 38 infants, 43 children, 34 adolescents, 64 young adults, 106 younger mature adults, 27 older mature adults, three older adults, 51 subadults and 111 adults. However, owing to the presence of numerous age categories, it was difficult to identify any clear spatial patterning, therefore, this analysis was disregarded. Consequently, broader age categories (subadults and adults) were employed in this study which aimed to provide an unambiguous depiction of the spatial deposition of aged individuals at the Elsham cemetery. Thus, infants, children and adolescents formed the subadult group, which contained 165 individuals, while young adults, younger mature adults, older mature adults and older adults were placed in the adult category which consisted of 312 individuals. A total of 78 subadults and 145 adults were interred in the eastern half of the cemetery while 87 subadults and 167 adults were buried in the western half of the site (Fig 6.38). A Pearson Chi-square test carried out on these data to establish whether there was an association between biological age and the location of interment. The results from this statistical test generated an insignificant value at the 0.05 level ($X^2 = 0.028$; $p = >0.05$). These data showed that burial in the eastern or western half of the cemetery was not dependent on the biological age of an individual at the Elsham cemetery.

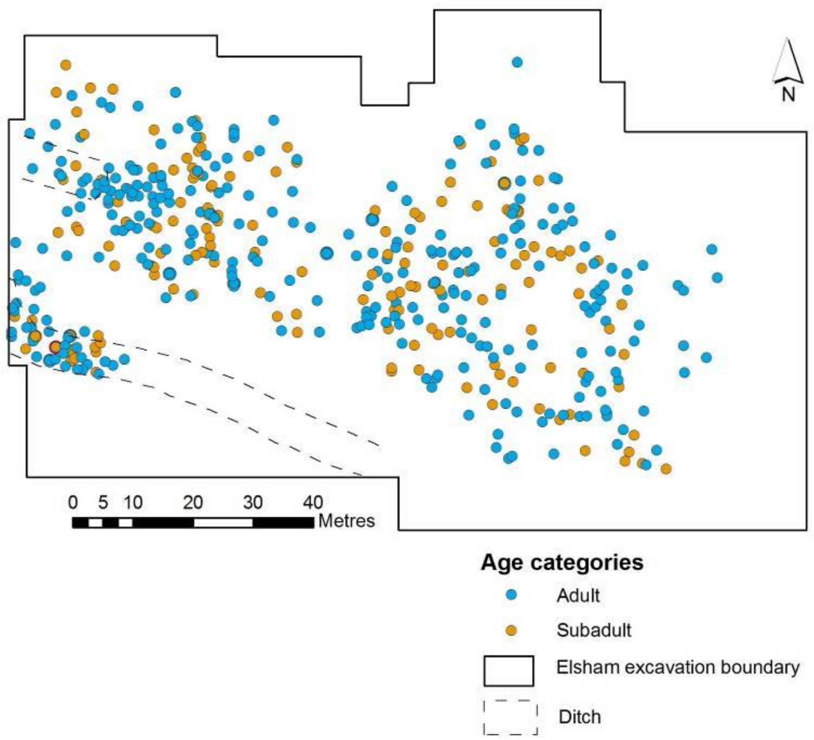


Fig 6.38 Spatial distribution of subadult and adult burials at Elsham

Spatial cluster analysis was utilised in conjunction with these data to produce a clearer depiction of the significant and insignificant associated subadult and adult burials (Fig 6.39). The clusters of biologically aged burials located in the eastern half of the cemetery are small in number but are worth briefly mentioning. The first group of burials were all ascribed to the adult age category and were located at the far eastern point of the site. A total of three strongly associated points were surrounded by 18 burials ascribed significance Z scores of 0.3-0.9 (see section 5.4.3 of this thesis for further details regarding Z scores). This grouping also contained a small number of adult burials that possessed weak associations with this burial cluster, which was manifested by scores of -0.2-0.3. The dark blue points each represented subadult deposits that were interred among this group of adult graves. Moving towards the central area of the site plan, 17 dark blue points, which represented very low negative Z scores, symbolised adult burials among a cluster of associated subadult deposits. Two of these subadult burials were strongly associated since they were interred next to each other while the remaining 15 subadult deposits were ascribed positive significance Z values of 0.3-0.9. A greater frequency of statistically significant and, in some cases, insignificant clusters of adult and subadult burials were observed in the western sector of the cemetery. This area was separated from the eastern half of the site by numerous low negative Z score markers, which represented a mixture of

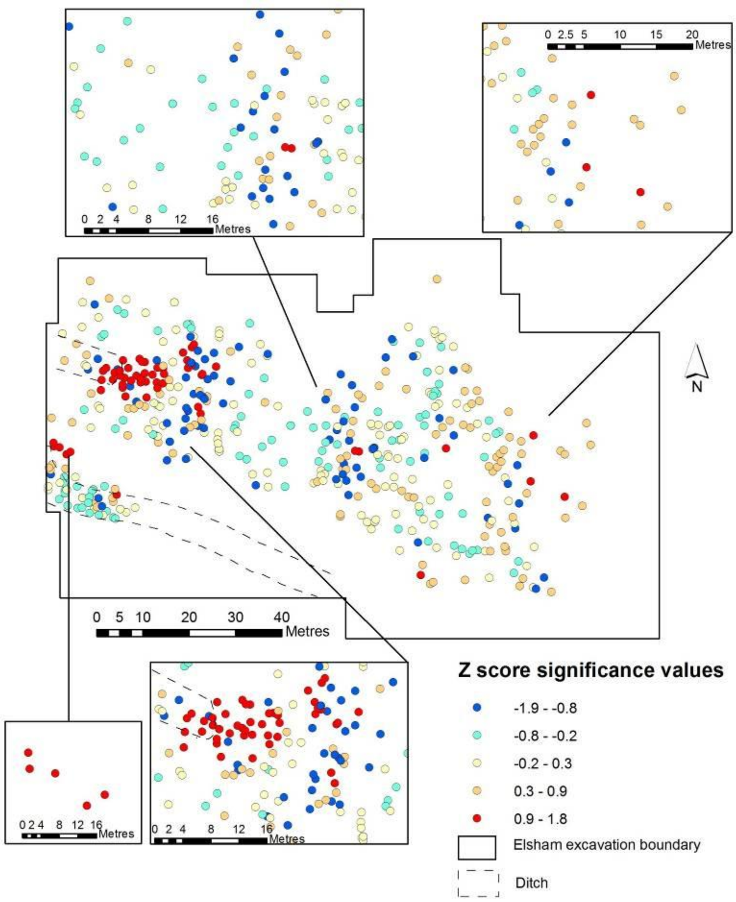


Fig 6.39 Spatial cluster analysis of subadult and adult burials at Elsham

subadult and adult burials, and illustrated that these burials were disassociated from each other.

A number of high positive Z score points were identified amid a sea of burials that were assigned extremely low negative Z values, which were located to the west of the central cluster of disassociated burials. Each of the deposits that were assigned very high Z scores represented 11 strongly associated subadult burials while the 21 strongly disassociated burials were all adult deposits. In contrast, six strongly disassociated subadult burials lay among 33 strongly associated adult burials, all of which possessed Z scores of 0.9-1.8, to the west of the aforementioned grouping. The ditch located in the south-western corner of the Elsham cemetery produced one strongly significant Z score, which was identified as a subadult burial. This deposit was surrounded by three associated subadults, two of which were situated to the south and one was located just north of the ditch. The vast majority of burials in the ditch produced a low negative Z score, two of which were strongly disassociated, and highlighted that the burial of both subadults and adults took place in this area. Five strongly associated adult burials were detected immediately north of the ditch at the most western point of the cemetery. This cluster of burials stood alone, though the closest deposits to this grouping were all identified as adult burials, which possessed significance Z values of 0.3-0.9. An initial assessment of these data highlighted that subadult and adult burials were dispersed throughout the Elsham cemetery. However spatial cluster analysis illustrated that there was a number of discrete statistically significant burial clusters based on biological age of the burial population.

The following analyses were conducted to examine whether adolescents were culturally viewed as adults, as opposed to subadults, and if this had an influence on the spatial distribution of burials at the Elsham cemetery. Therefore only infants and children were allocated to the ‘subadult’ group, which contained 132 individuals, while adolescents, young adults, older mature adults and older adults were assigned to the 'adult' category, which consisted of 345 individuals. A total of 65 subadults and 159 adults were interred in the eastern half of the cemetery while 67 subadults and 186 adults were interred in the western half of the site (Fig 6.40). A Pearson Chi-square test was carried out on these data and produced an insignificant value at the 0.05 level ($X^2 = 0.221$; $p = >0.05$). Again, these data demonstrated that burial in the eastern or western half of the cemetery was not dependent on the age of an individual, even when adolescents were classified as adults, at the Elsham cemetery.

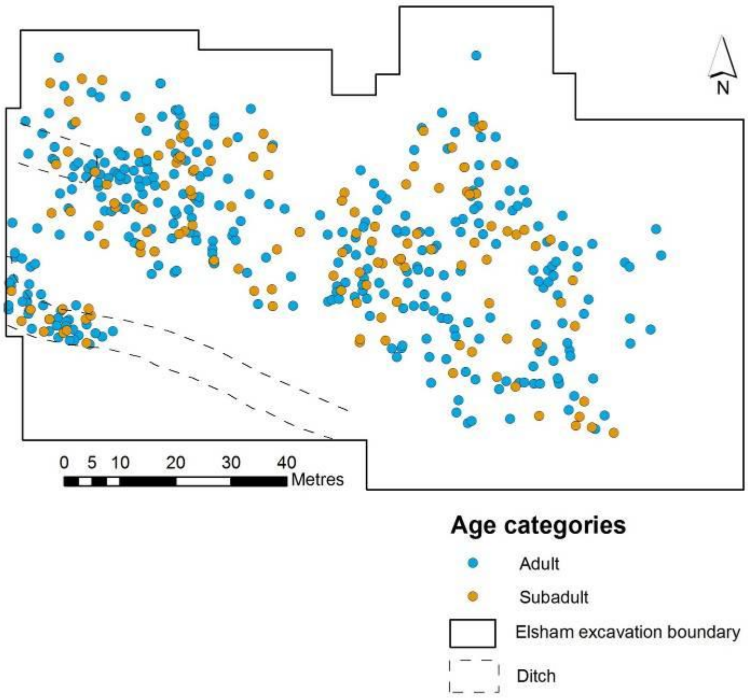


Fig 6.40 Spatial distribution of subadults and adults at the Elsham cremation cemetery when adolescents are classified as adults

Spatial cluster analysis was applied to these data to illustrate the presence of any significant and insignificant groupings based on the age of the Elsham burial population (Fig 6.41). The inclusion of adolescents in the adult age category has strengthened many associations between the adult deposits; the most significant clusters will be examined in this section. To begin, a cluster of seven positively associated adult burials emerged in the southern central region of the site; these were surrounded by 10 adult deposits with Z score values of 0.1-0.7. Interestingly, the strongly associated cluster of subadult burials in the west of the cemetery, which was observed in the previous cluster analysis, has been strengthened further owing to the presence of 14 subadults that were ascribed high positive Z scores. The number of disassociated adult burials has decreased to a total of 11 deposits, which possessed Z values of -1.9 to -1.0. The strongly associated adult burials that lay west of this subadult grouping are still noticeable. Seven strongly disassociated subadult deposits were interred within a cluster of 29 adult burials, which were ascribed high positive Z scores of 0.7-1.5. Finally, the cluster of strongly associated adult burials (observed in the previous cluster analysis) that lay north of the ditch at the far west of the site, was also recorded. Furthermore, this association was strengthened through the inclusion of adolescents in the adult age grouping. Seven individuals were ascribed positive Z scores of 0.9-1.8, one of which lay in the far north section of the ditch and was, again, surrounded by associated adult burials with similar Z values. In sum, the inclusion of adolescents in the adult age category has, in some cases, strengthened positive subadult and adult associated burials. However, these new associations were most likely to have been the result of increased adult and decreased subadult sample sizes.

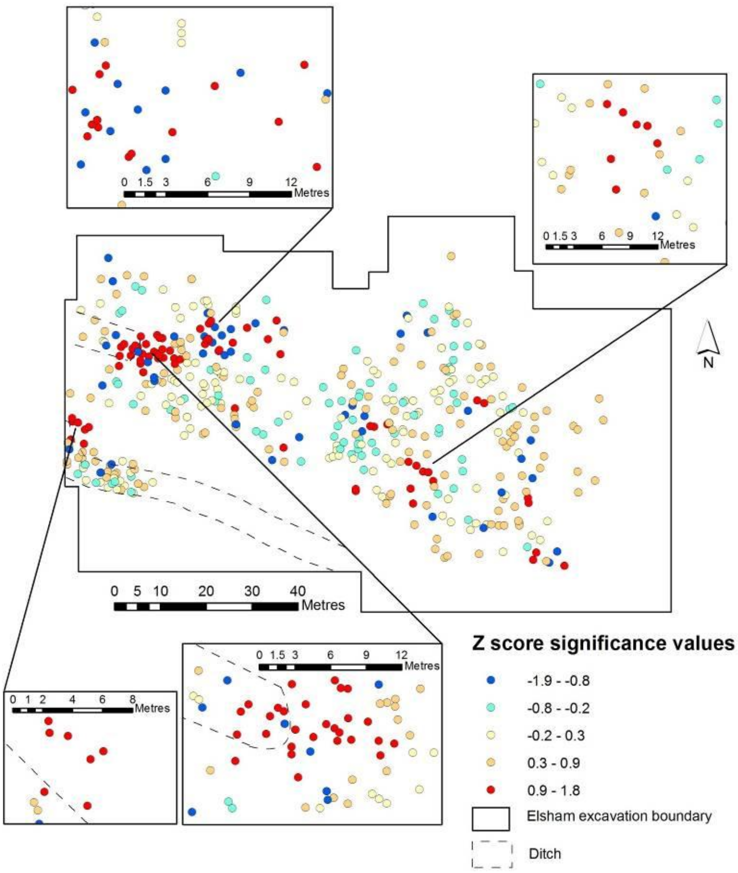


Fig 6.41 Spatial cluster analysis of subadult and adult burials at Elsham when adolescents are classified as adults

6.8.3 Sex

The final spatial analysis that was conducted on the Elsham assemblage assessed the distribution of cremation burials based on biological sex. Co-ordinates were available for 38 females, 15 probable females, 29 indeterminates, 22 males and eight probable males; which generated a total of 112 individuals. These burials were plotted on to a distribution map which illustrated that males and females were, on the whole, randomly dispersed throughout the cemetery (Fig 6.42). 'Confidently assigned' and 'probable' males and females were incorporated into the same group for the purpose of statistical testing. The eastern half of the cemetery contained 22 females and 10 males, while a total of 31 females and 20 males were identified in the western half of the site. A Pearson Chi-square test was performed to determine whether individuals were interred in the eastern or the western half of the cemetery on the basis of their biological sex. The results from this statistical test produced an insignificant value at the 0.05 level (X^2 = 0.541; p = >0.05). This analysis highlighted that burial in the eastern or the western half of the cemetery was not dependent on the biological sex of an individual.

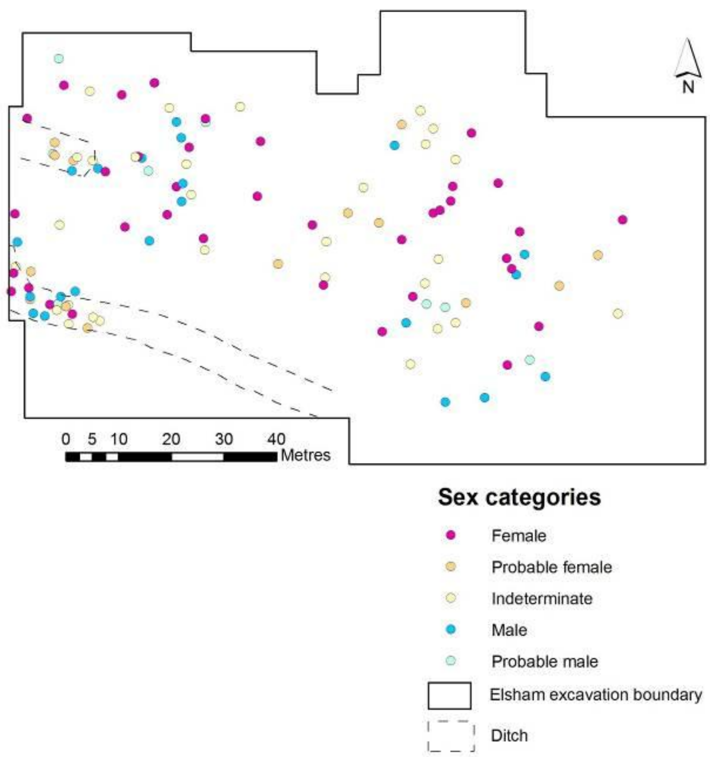


Fig 6.42 Spatial distribution of male and female burials at Elsham

Interestingly, cluster analysis highlighted that the burials which possessed the strongest associations and highest Z scores were all identified as female (Fig 6.43). The largest cluster of positively associated female burials consisted of six deposits and was located in the eastern half of the cemetery. Four strongly disassociated female burials were identified south of the aforementioned group. These female deposits were assigned dissimilar values because they were surrounded by males, probable males and indeterminately sexed individuals. In the western half of the site a total of six strongly disassociated female burials were allocated very low negative Z scores between -2.4 and -1.4. Again, such a strong disassociation between these burials is the result of their physical distance from one another and the fact that they are surrounded by individuals identified as male, probable male or indeterminate. For the most part, there were few strong associations between burials which indicated that males and females were, on the whole, evenly distributed throughout the cemetery. These results

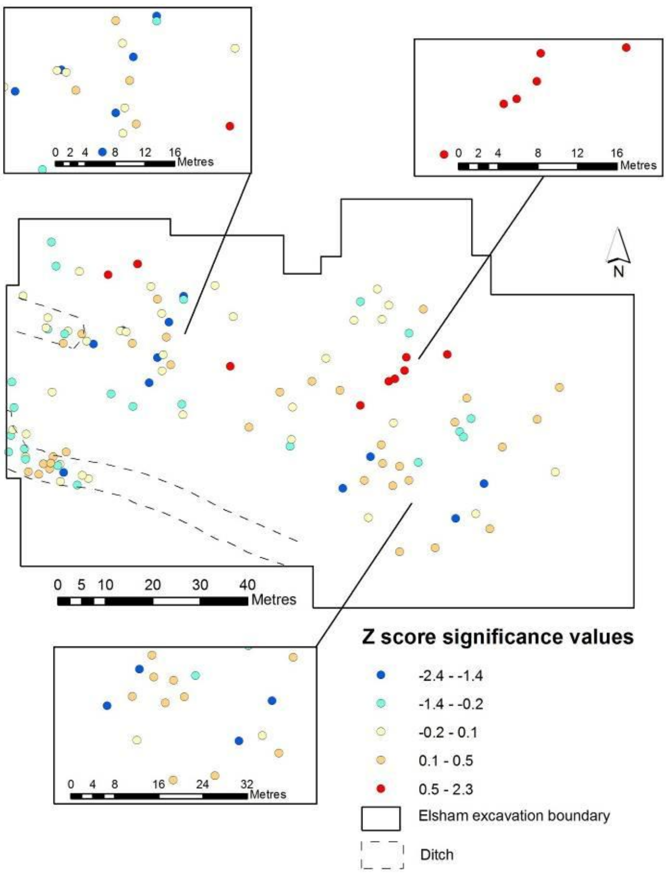


Fig 6.43 Spatial cluster analysis of male and female burials at Elsham

suggested that biological sex was not an influential factor in the burial location of individuals at the Elsham cremation cemetery.

6.9 Microscopic analyses

The final section of this chapter will outline the results that were obtained through the application of thin-section analysis, or histomorphometry, and Fourier Transform Infrared Spectroscopy (FTIR) to a sample of cremated bone from the Elsham cemetery. These forms of assessment aimed to provide not only a greater understanding of pyre conditions and the effects of burning on bone microstructure, but also to establish whether the microstructural composition of cremated bone positively corresponded with its outward appearance. Sections 5.1.2, 5.5.2 and 5.5.3 of this thesis details the methods used in this study. A more detailed description of the macro- and microscopic characteristics of each thin-section sample can be found in appendix III of this thesis. The results and a discussion of these analyses can also be found in Squires *et al.* (2011).

6.9.1 Thin-section analysis

The microscopic appearance of 16 burned bones from the Elsham cemetery was examined for the purpose of this thesis (Table 6.18). Enlarged images of these micrographs can be found in appendix IV of this thesis, which is located on the accompanying CD. An examination of bone microstructure highlighted that eight of the Elsham samples were burnt at temperatures over 900°C and were thus assigned to the completely cremated category. The exposure of skeletal elements to high intensity cremation conditions was exhibited through the destruction of organic material and incineration of bone microstructure alongside the fusion of hydroxyapatite crystals. Identifiable changes to the inorganic fraction of bone included the disappearance of osteocyte lacunae, the decreased size of osteon diameters and the increased diameter size of Haversian canals (Mayne Correia 2006, 279; Fairgrieve 2008, 136). Only two samples, EL75BK (FN 22) and EL76CA(a) (FN 355(a)), exhibited the complete loss of microstructure, which occurs at over 900°C. The remaining six samples displayed a very small number of osteons, suggesting that these bones were exposed to temperatures of around 900°C. These observations highlight that 'completely cremated' bones were heated to temperatures of at least 900°C.

The remaining eight samples showed evidence of burning at lower temperatures and were assigned to the intensely cremated group. These thin-sections showed evidence of surviving osteons in at least one area of the micrograph which suggests that these bones were exposed to temperatures less than 900°C. A comparison was made between the intensely cremated bones from Elsham and the experimental thin-sections that were prepared by Lisa Bhayro (2003). An assessment of both archaeological and modern material highlighted that the Elsham samples were exposed to temperatures between 600°C and 900°C. This evidence also suggested that the outer cortical bone attained higher temperatures than the mid- and inner-cortical sections owing to differential duration of the burning process (Holden, Phakey and Clement 1995, 27). Cremation that took place over an extended period of time facilitated complete incineration as a relatively constant temperature permeated throughout the bone. In contrast, bone that was exposed to similar temperatures, but for a shorter period of time, displayed incomplete combustion of the inner section of cortical bone. Simultaneously, direct exposure to a heat source caused extensive incineration of the outer cortical bone. However, three intensely cremated bones, EL75GA (FN 101); EL75PM(b) (FN 273(b)) and EL76NN (FN 549), were of particular interest since burning intensity varied throughout each of these samples. The fragmentation of bone, owing to intentional and/or accidental disturbance to the funerary pyre, may explain the uneven burning patterns that were identified in these samples. For example, bone that was normally shielded from intense burning conditions would have been directly exposed to this kind of environment. Thus, modification to skeletal remains caused anomalies to the appearance of bone on a microscopic level.

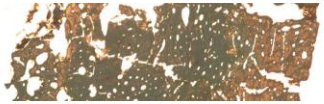
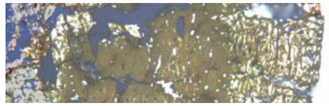
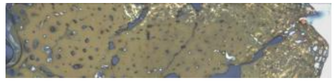
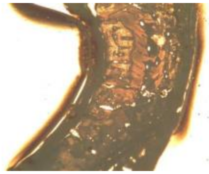
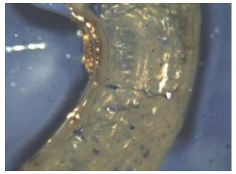
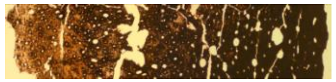
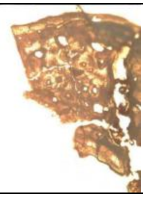
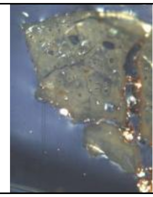
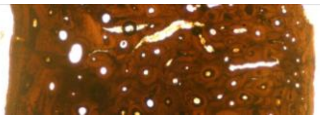
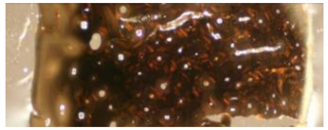
Burial number	Bone	Section thickness (microns)	Burning intensity	Colour of bone sample	Shrinkage	Fissuring	Warping	Micrograph under plane polarized light	Micrograph under cross polarized light
EL75AM (FN 5)	Femur	100	Completely cremated	5Y 8/1 (white); GLEY 2 5PB 3/1 (very dark bluish grey)	Severe-moderate	Moderate	Severe		
EL75AO (FN 7)	Tibia	75	Completely cremated	5Y 8/1 (white)	Moderate	Severe-moderate	None		
EL75BK (FN 22)	Humerus	60	Completely cremated	5Y 8/1 (white); GLEY 2 10B 4/1 (dark bluish grey)	Moderate-none	None	Moderate-none		
EL75BQ (FN21)	Tibia	60	Completely cremated	5Y 8/1 (white)	Moderate	Moderate	Moderate		
EL75BY (FN 32)	Humerus	100	Intensely cremated	5Y 8/1 (white); GLEY 2 10B 6/1 (bluish grey)	Moderate	Moderate-none	Moderate		
EL75CR (FN 43)	Radius	60	Intensely cremated	5Y 8/1 (white); GLEY 1 N 2.5/ (black)	Moderate	Moderate	Moderate-none		

Table 6.18 Macroscopic and microscopic observations of the Elsham thin-section samples

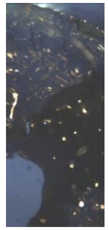
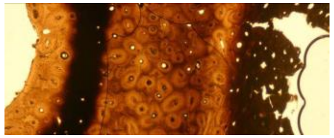
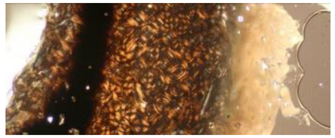
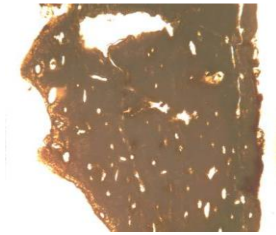
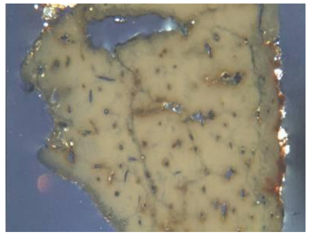
Burial number	Bone	Section thickness (microns)	Burning intensity	Colour of bone sample	Shrinkage	Fissuring	Warping	Micrograph under plane polarized light	Micrograph under cross polarized light
EL75GA (FN 101)	Radius	60	Intensely cremated	5Y 8/1 (white); GLEY 1 N 2.5/ (black)	Moderate	Moderate	Moderate-none		Not available
EL75HL (FN 130)	Radius	75	Intensely cremated	5Y 8/1 (white); GLEY 1 N 2.5/ (black)	Moderate	Severe-moderate	Moderate-none		
EL75PF (FN 268)	Tibia	100	Intensely cremated	GLEY 2 10B 4/1 (dark bluish grey); GLEY 1 N 2.5/ (black)	Moderate-none	None	Severe		
EL75PM(b) (FN 273(b))	Humerus	60	Intensely cremated	5Y 8/1 (white); GLEY 2 10B 7/1 (light bluish grey); GLEY 2 5PB 4/1 (dark bluish grey); GLEY 1 N 2.5/ (black)	Moderate-none	Moderate	Severe		
EL76CA(a) (FN 355(a))	Femur	75	Completely cremated	5Y 8/1 (white)	Moderate	Moderate-none	Moderate-none		

Table 6.18 Continued

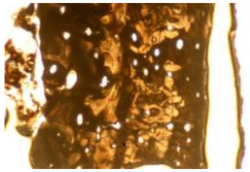
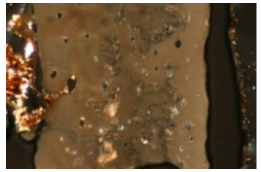
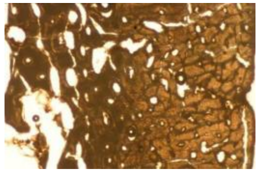
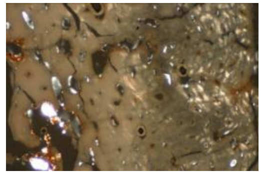
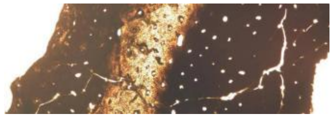
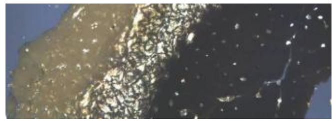
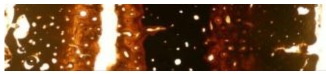
Burial number	Bone	Section thickness (microns)	Burning intensity	Colour of bone sample	Shrinkage	Fissuring	Warping	Micrograph under plane polarized light	Micrograph under cross polarized light
EL76EI (FN 406)	Femur	100	Completely cremated	GLEY 2 10B 6/1 (bluish grey); GLEY 1 N 2.5/ (black)	Moderate-none	Moderate	Moderate-none		
EL76EQ (FN 414)	Femur	60	Completely cremated	5Y 8/1 (white); GLEY 1 N 7/ (light grey)	Moderate	Moderate	Moderate		
EL76MQ (FN 526)	Tibia	100	Completely cremated	5Y 8/1 (white)	Severe-moderate	Moderate	Moderate		
EL76NA (FN 536)	Ulna	100	Intensely cremated	5Y 8/1 (white); GLEY 2 5PB 7/1 (light bluish grey); GLEY 2 5B 3/1 (very dark bluish grey)	Moderate	Moderate	Moderate-none		
EL76NN (FN 549)	Femur	100	Intensely cremated	5Y 8/1 (white); GLEY 2 10B 7/1 (light bluish grey); GLEY 1 N 2.5/ (black)	Moderate-none	Moderate	Severe-moderate		

Table 6.18 Continued

6.9.2 *Presence of pyre goods vs. cremation intensity*

Results that were obtained from thin-section analysis were examined in conjunction with grave assemblages that were found in the same burial. This assessment aimed to establish whether cremation intensity was correlated with the interment of associated pyre and grave goods. In sum, 56% of intensely cremated bone and 71% of the completely cremated bone sample were recorded alongside an accompanying artefact(s) (Fig 6.44) (Squires *et al.* 2011, 2407). A Pearson Chi-square test was conducted on these data and produced a statistically insignificant value at the 0.05 level (X^2 = 0.423; p = >0.05). Similarly, statistically insignificant relationships between cremation intensity and age, sex and the frequency of pyre and grave goods were also identified in these analyses. Indeed, insignificant results may have been generated due to the use of a small sample size. On the other hand, it is possible that cremation intensity was not related to the deposition of grave and pyre goods or the age and sex of an individual.

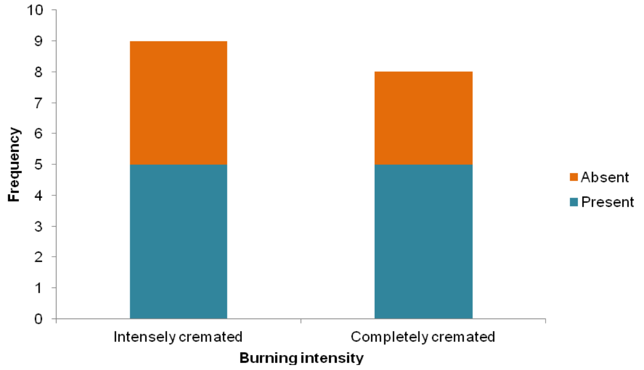


Fig 6.44 Histogram displaying the presence of pyre goods in relation to burning intensity

6.9.3 *Differential cremation of the upper and lower limb*

The microscopic examination of cremation intensity of the upper and lower limbs aimed to provide an insight into the position in which individuals were placed on the pyre. Interestingly, all of the completely cremated bones belonged to the lower limb, with the exception of one humerus sample (Table 6.19). The differential cremation between upper and lower limbs was statistically significant at the 0.05 level (X^2 = 4.06; p = 0.041) but, again, the interpretation of these results must be approached with some degree of caution owing to the small sample size that was used in this study (Squires *et al.* 2011, 2407). The differential cremation of upper and lower limb bones is most likely to reflect the cadaver's position on the funerary pyre. This notion will be explored further in the discussion chapter (chapter eight) of this thesis.

Bone	Intensely cremated	Completely cremated
Humerus	2	1
Radius	3	0
Ulna	1	0
Femur	1	4
Tibia	1	3

Table 6.19 Differential cremation of the upper and lower limbs

6.9.4 Fourier Transform Infrared Spectroscopy

Fourier Transform Infrared Spectroscopy (FTIR) was conducted on eight femora samples from the Elsham skeletal assemblage (Table 6.20). This form of analysis illustrated that a rise in cremation intensity caused increased Crystallinity Index (CI) values while carbonate to phosphate (C/P) ratios decreased in value. These trends were consistent with results from previously published work (Thompson, Gauthier and Islam 2009; Thompson *et al.* 2011). As a result of sample size, this analysis generated relatively large standard deviations. However, through the application of FTIR to archaeological skeletal material, it is possible to distinguish unburned bone from burned bone. An assessment of bone colour alongside CI and C/P values facilitates the identification of subtle differences from unburned bone and bone that has been burned at low, medium and high intensities (Squires *et al.* 2011). The conclusions obtained through histomorphometry and FTIR are generally in agreement and, despite scepticism already raised in this thesis, macroscopic examination of cremated bone can be used as a broad indicator of burning intensity.

Sample number	Burning intensity	Munsell code	Mean CI	SD CI	Mean C/P	SD C/P
EL76AK	Unburnt	10YR 6/6 (brownish yellow)	3.31	0.19	0.39	0.06
EL76JO	Unburnt	10YR 6/6 (brownish yellow)	3.59	0.18	0.27	0.03
EL75BB	Less intensely cremated	GLEY 2 5B 3/1 (very dark bluish grey)	5.13	0.28	0.11	0.01
EL75ES	Less intensely cremated	GLEY 2 5B 2.5/1 (bluish black)	3.78	0.39	0.21	0.02
EL76DH	Less intensely cremated	GLEY 2 5B 3/1 (very dark bluish grey)	4.79	0.15	0.11	0.01
EL76PB	Intensely cremated	GLEY 2 5PB 4/1 (dark bluish grey)	4.91	0.26	0.11	0.01
EL75MQ	Completely cremated	5Y 8/1 (white)	4.84	0.17	0.07	0.01
EL76NN	Completely cremated	GLEY 2 10B 7/1 (light bluish grey)	6.07	1.10	0.05	0.01

Table 6.20: burning intensity, macroscopic colour and FTIR data from a sample of cremated and unburnt bone from the Elsham cemetery

6.10 Summary

A full osteological assessment of the Elsham inhumations highlighted that preservation at the site was extremely poor owing to the burial environment. All age groups and both males and females were afforded the inhumation rite, though, due to the small sample size, statistical analyses were not conducted on these data. In contrast, the cremation burials produced a total of 564 individuals from the Elsham cemetery which facilitated the application of a variety of analyses to these data. The cremated bone from this site was extremely fragmentary and only a handful of burials reflected the collection and interment of all cremated remains that would have been derived from a fully articulated body. Furthermore there was no clear evidence for the preferential selection and deposition of particular skeletal elements in the Elsham cremation burials. Based on the MNI it was estimated that if the site was used for a 150 year period it would have catered for a living population of 94 individuals who would have seen three to four interments every year. However, if this cemetery was in use for a slightly longer 200 year period the number of burials per annum would decrease to two to three and the living population would have numbered around 71 individuals. Due to poor preservation and the deficiency of diagnostic bones, the identification of biological sex and palaeopathological indicators was limited. In addition, stringent criteria were employed during osteological assessment to reduce the possibility of misidentifying individuals and may have contributed to the low frequency of biologically sexed individuals from Elsham. A demographic assessment of the Elsham assemblage highlighted that the highest frequency of deaths occurred in the younger mature adult category while infants were clearly underrepresented. Furthermore, there were notably more females than males. The demographic profile of this site closely reflects the social structure that has been identified from other contemporary cremation cemeteries, such as Sancton (McKinley 1993) and Spong Hill (McKinley 1994), and will be explored in further detail in subsequent chapters of this thesis.

A recurrent problem that was encountered during the analysis of the Elsham cremation assemblage was the fact that, in most instances, only small sample sizes could be included in statistical testing owing to the dearth of osteological and/or artefact data. Nonetheless, some interesting results were generated in these analyses, for instance cinerary urn height produced stronger correlations with biological attributes, particularly age, than the rim diameter of vessels. The reclassification of adolescents from the ‘subadult’ grouping to the ‘adult’ age category for the purpose of statistical testing illustrated that adolescents were not culturally identified as adults based on pyre and grave goods, animal bone and spatial analysis. However the inclusion of adolescents in the ‘adult’ age grouping did strengthen a small number of statistical relationships, for example the association between adults and the deposition of animal bone, though this appears to have been the result of increased adult and decreased subadult sample sizes. In contrast to contemporary inhumation cemeteries there were no clear cut relationships between the types of grave and pyre goods and biological attributes of the burial population. These analyses also highlighted that multiple deposits, age and sex were not influential factors in the burial location of individuals at the Elsham cremation cemetery. Finally, this chapter has also demonstrated that histomorphometry and FTIR can be successfully used in conjunction with macroscopic assessment to identify burning intensity of archaeological bone. The following chapter of this thesis will present the results that were obtained through detailed analyses of the Cleatham bone assemblage.

Chapter 7: Cleatham results

The second bone assemblage that was analysed for the purpose of this thesis derived from the Cleatham cemetery. As previously mentioned in the methodology chapter (chapter five) of this thesis, a total of 979 interments were examined in this study. However one of these deposits solely comprised of unburnt human bone (no number was ascribed to this deposit) while a second group of unburnt bone and teeth were identified as cattle remains (MT85NI). This chapter will present the results that were obtained from osteological analyses carried out on the unburnt bone deposits and cremation burials from the Cleatham cemetery. Subsequently, statistical means were employed to establish whether grave furnishings and cemetery organisation were influenced by demographic attributes of the Cleatham burial population. The results from these analyses will be discussed in the latter half of this chapter.

7.1 Osteological analysis: unburnt bone deposits

None of the unburnt bone deposits that were examined in this study could be classified as complete inhumation burials. These bones appear to have derived from disturbed interments and, on a number of occasions, unburnt skeletal material was also found inside cinerary urns. These remains will be examined in the subsequent section of this chapter. A detailed breakdown of each burial containing unburnt bone can be found in appendix II (on the accompanying disc) of this thesis.

7.1.1 Quantifying the material

Unburnt bone was recorded from 28 deposits. The overall completeness of the skeletal remains was extremely poor and all deposits were categorised as <25% complete. Limb bones were the most frequently occurring unburnt bone closely followed by cranial fragments (see appendix II for all skeletal elements that were identified from these deposits).

Burial number (urn number)	General colour	Preservation grade	Age
MT84CW (1116)	10YR 7/6 (yellow)	5	?
MT84HN (73)	10YR 7/6 (yellow)	5	?
MT84IX (88)	10YR 8/6 (yellow)	3	?
MT84JB (76)	10YR 7/6 (yellow)	5+	?
MT84JS (103(a))	7.5YR 7/8 (reddish yellow)	3	?
MT84JZ (124)	10YR 7/6 (yellow)	4	?
MT84KO (210)	10YR 6/6 (brownish yellow)	5+	?
MT84MA (90)	Not recorded	Not recorded	?
MT84MN (233)	10YR 7/6 (yellow)	5	?
MT85AU/AV (275/286)	7.5YR 6/6 (reddish yellow)	4	?
MT85FA (394)	10YR 8/6 (yellow)	5	?
MT85GF (336)	10YR 7/6 (yellow)	4	?
MT85GQ (325)	10YR 8/6 (yellow)	5+	?
MT85KT (368)	10YR 8/6 (yellow)	4	?
MT86OU (586)	10YR 7/8 (yellow)	5+	?
MT86RU (524)	10YR 6/8 (brownish yellow)	5	?
MT88AAC (690)	10YR 8/6 (yellow)	2	<30 years
MT88AAY (794)	10YR 7/6 (yellow)	5	?
MT88ADA (702)	10YR 6/8 (brownish yellow)	0	?
MT88ADN (663)	Not recorded	0	>12 years
MT88AFZ (676)	10YR 7/6 (yellow)	5	?
MT88ALM (789)	10YR 8/6 (yellow)	5	?
MT89BAR (861)	10YR 7/8 (yellow)	5	?
MT89BBZ (895)	10YR 7/6 (yellow)	0	>9 years
MT89BEA (903)	10YR 7/6 (yellow)	5	?
MT89BGD (852)	10YR 7/6 (yellow)	0	?
MT89BGK (864)	7.5YR 7/8 (reddish yellow)	3	?
No number provided	10YR 7/8 (yellow)	5	1 = subadult ?2 = adult

Table 7.1 Unburnt bone deposits from the Cleatham cemetery

7.1.2 State of preservation

A recurring trait that was identified in each of the unburnt bone deposits was the extensive fragmentation of skeletal remains. The preservation grade of one deposit (MT84MA [urn 90]) was not recorded because only cancellous bone survived. Nonetheless, the majority of deposits were assigned a preservation score of grade four or above (Table 7.1). These high preservation scores highlighted that the degree of preservation at the site was poor which appears to have been the result of burying unburnt skeletal remains in soil that was characteristically naturally wet, very acidic, sandy and loamy (National Soil Resources Institute Soilscapes Viewer 2006).

Consequently, many bones could not be identified with confidence and osteological markers that may have once been present on the cortical surface of these unburnt bones, for example metric traits or pathological indicators, have been lost as a result of poor taphonomic conditions. Based on the standards employed in this thesis (Munsell 2000), the general colour of the unburnt bone assemblage was yellow (10YR 7/6) (Table 7.1). No abnormal discolouration, such as bleaching or metal staining, was identified on these bones.

7.1.3 Demographic attributes

The apparent lack of diagnostic skeletal elements meant that biological sex was not ascribed to any of the unburnt bone deposits, while biological age could only be (broadly) established for five individuals (see Table 7.1). One of these interments (no accession number provided) appears to have contained the skeletal remains of two individuals. However this figure was established on the basis of bone size and robusticity and, since no osteological markers had survived to facilitate the ageing process, it is not possible to confidently verify that there were two individuals in this deposit. In addition, no palaeopathological indicators were identified on these remains because the outer cortical surface of the bones from this deposit had sustained severe taphonomic damage. Burial MT88AAC (urn 690) produced unburnt robust frontal bone fragments that exhibited unfused cranial sutures, which, based on such scanty evidence, may suggest that this individual was under the age of 30 years (Meindl and Lovejoy 1985, 63). Unburnt fully developed permanent teeth, which displayed no signs of dental wear, were detected among cremated material from burial MT88ADN (urn 663) and MT89BBZ (urn 895). Unfortunately, due to the absence of additional unburnt osteological remains from these burials, the author was unable to assign specific age categories to the owners of these unburnt teeth. The intentional deposition of unburnt teeth within cinerary urns may have held a votive purpose. The occurrence of unassociated human teeth has also been noted from a small number of early Anglo-

Saxon inhumation cemeteries (Lucy 2000, 94). This notion will be explored in further detail in the subsequent discussion chapter.

7.2 Osteological analysis: cremation burials

The vast majority of individuals buried in the Cleatham cemetery were afforded the cremation rite. The following section of this chapter will deal with the osteological analysis of the cremated remains that were excavated from this site.

7.2.1 Total weight

All cremated bone from the Cleatham cemetery was weighed to establish whether the amount of bone that was collected and, subsequently, buried at this site was similar to patterns of deposition that have been previously identified from other contemporary cremation cemeteries. The greatest quantity of cremated bone that derived from a single urn from the Cleatham cemetery was acquired from burial MT84GB(b) (urn 242) and weighed 4470g. However, this deposit primarily consisted of horse bone and only one cremated human bone, the right temporal, derived from this interment. This (human) cranial fragment appears to have originated from the associated burial (MT84GA [urn 71]) that was located above this urn. Burial MT89BEC (urn 876) held the greatest amount of human cremated bone from the Cleatham cemetery, though this deposit also contained a small amount of animal bone, and weighed 3973g. In contrast, burial MT84MA (urn 90) produced the smallest human bone deposit and weighed a mere 0.5g. The cremated bone from the Cleatham burials generated an overall average and median weight of 525g and 401g, respectively. Similar average weights have been identified from the Elsham, Sancton (East Riding of Yorkshire) (McKinley 1993, 296) and Spong Hill (Norfolk) (McKinley 1994) cremation burials, which produced mean weights of 523g, 566g and 514g, respectively. However, Mucking (Essex) yielded the smallest average weight of 147.4g (Mays 2009, 436). In addition, based on the 977 cremation burials that were assessed from the Cleatham cemetery, 559 deposits weighed between 0-500g and only 12 graves contained over 2001g of cremated bone, two of which (MT84GB(b) [urn 242] and MT88AEJ [urn 639]) contained a significant proportion of animal bone (Fig 7.1). As previously mentioned in chapter four of this thesis, a complete adult skeleton produces between 1600-3600g of cremated material, with an average of 2500-3000g (McKinley 1994, 75). The weights of burned bone from Anglo-Saxon cremation burials, including those documented from the Cleatham cemetery, have highlighted that it was extremely rare to collect and bury the majority, if not all, of the skeletal remains that would have derived from a fully articulated cadaver after the cremation process.

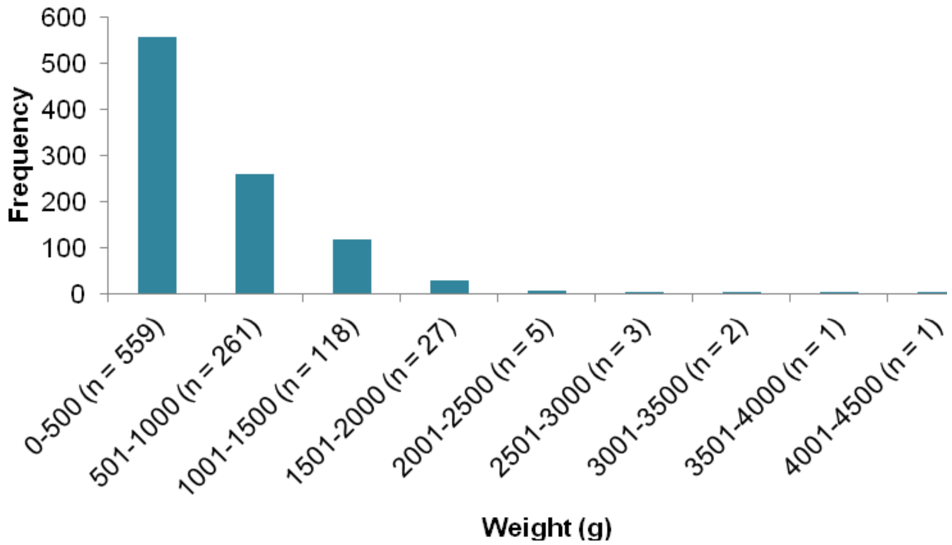


Fig 7.1 Histogram showing weight distribution of cremated bone from Cleatham

7.2.2 Maximum fragment size

Sliding callipers and sieve compartments with 2mm, 5mm and 10mm mesh sizes were employed to assess fragment size of the Cleatham bone assemblage. In total, 48% of bone from the Cleatham cremation burials accumulated in the 10mm sieve while 81% of burned remains were collectively gathered in the 5mm and 10mm sieve compartments. Interestingly, these percentages are almost identical to those recorded from the Elsham cremation burials. The maximum fragment size of human cremated bone observed at Cleatham was obtained from burial MT89BJX (urn 962). This fragment was identified as a proximal fibula diaphysis and measured 106mm in length, while the average maximum fragment size of cremated bone from Cleatham was only

48mm (Fig 7.2). The largest fragment of burned bone that was identified from the Cleatham assemblage fell into the range of maximum fragment sizes that were recorded from Mucking (which appears to be an anomaly) (Mays 2009, 437), Elsham, Sancton (McKinley 1993, 297) and Spong Hill (McKinley 1994, 84), which produced maximum fragment sizes of 23mm, 89mm, 100mm and 120mm, respectively. McKinley (1994, 84) has documented that the maximum fragment size of burned bone retrieved from modern crematoria (before raking) lays around 250mm. Based on the maximum fragment sizes of cremated bone from Elsham and Cleatham, it is notable that some form of disturbance, whether on the pyre, during collection and burial of the remains or as a result of post-depositional disturbance, caused varying degrees of fragmentation of these archaeological skeletal remains.

Fig 7.2 A large fragment of cremated human tibia measured 98.58mm from burial MT85EM (urn 310)

7.2.3 Shrinkage, fissuring and warping

The criteria that were used to assess shrinkage, fissuring and warping of cremated bone can be found in the methodology chapter (chapter five) of this thesis. It is worth pointing out that animal bones were also included in these analyses. Shrinkage was moderate in most instances while only nine burials manifested no shrinkage at all (Table 7.2; Fig 7.3). Fissuring of bone principally fell into the 'moderate' category followed by the 'moderate-none' grouping, though there were exceptions (Table 7.3; Figs 7.4 and 7.5). Similar to the Elsham (cremation) burials, fissuring varied significantly within each cremation deposit from the Cleatham cemetery and was exemplified through an examination of individual skeletal remains. The warping of cremated bone from the Cleatham assemblage was predominantly recorded as 'moderate-none' and warping was only identified to be 'severe' on three occasions (Table 7.4; Fig 7.5).

Degree of shrinkage	Number of burials
Severe	67 (6.9%)
Severe-moderate	181 (18.5%)
Moderate	603 (61.7%)
Moderate-none	117 (12.0%)
None	9 (0.9%)

Table 7.2 The degree of shrinkage of cremated bone from the Cleatham burials

Fig 7.3 Complete right zygomatic from burial MT84HR (urn 59) showing a moderate degree of shrinkage

Degree of fissuring	Number of burials
Severe	69 (7.1%)
Severe-moderate	130 (13.3%)
Moderate	437 (44.7%)
Moderate-none	306 (31.3%)
None	35 (3.6%)

Table 7.3 The degree of fissuring identified on cremated bone from Cleatham

Fig 7.4 Left femur fragment from burial MT89BBA (urn 934) showing evidence of severe patina fracturing

Degree of warping	Number of burials
Severe	3 (0.3%)
Severe-moderate	11 (1.1%)
Moderate	218 (22.3%)
Moderate-none	518 (53.0%)
None	227 (23.2%)

Table 7.4 The degree of warping of cremated bone from the Cleatham burials

Fig 7.5 An intermediate hand phalanx from burial MT84IC (urn 171) showing no evidence of warping. Also note the absence of fissuring.

7.2.4 Colour of cremated remains

Burned bones from the Cleatham cemetery ranged in colour, between deposits and within the same burial, from white (5Y 8/1) to black (GLEY 1 N 2.5/) (Fig 7.6). Interestingly, the cremated remains of infants and children were often more uniform and lighter in colour, which produced higher Munsell (2000) value (lightness) scores, than adult skeletal remains. In cases where skeletal remains were poorly cremated, some of the frequently recorded colours included: yellow (10YR 8/6), brownish yellow (10YR 6/6) and very pale brown (10YR 8/4). Dark red (2.5YR 3/6), yellowish red (5YR 4/6) and pale green (GLEY 1 5G 8/2) staining, which appears to have been the result of contact with iron and copper-alloy artefacts, was also identified on a number of bones (Figs 7.7 and 7.8).

Fig 7.6 Colour variation of cremated remains from burial MT88ARJ (urn 803). This is represented by a fibula diaphysis fragment (left) and femur fragment (right) from the same burial.

Fig 7.7 Iron staining identified on cranial fragments from burial MT86XY (urn 557)

Fig 7.8 Copper-alloy staining detected on a metacarpal fragment from burial MT88ACN (urn 731)

7.2.5 Minimum number of individuals (MNI)

A total of 969 burials analysed in this thesis contained human cremated remains. Based on the presence of dual cremation burials, the MNI has been estimated to equal 1009 individuals, though 20 of these multiple deposits are probable. Thus, 20 double burials were confidently identified and 20 probable double burials were also recorded (Table 7.5; Fig 7.9). The predominant dual burial at Cleatham contained an adult (over 19 years), regardless of biological sex, and a subadult (0-18 years). Of the 40 multiple deposits, five (12.5%) comprised of two subadults, 27 (67.5%) contained an adult and a subadult, three (7.5%) consisted of two adults, three (7.5%) included a subadult and an unknown and two burials (5%) contained an adult and an unknown. The deposition of two subadults on five separate occasions within the same deposit was of particular interest and comprised of a foetus-neonate interred with an infant, a foetus-neonate buried with a child, an infant associated with a subadult and two deposits contained an infant and an adolescent (one of which was a female). In total, 28 out of the 80 individuals who were afforded the multiple burial rite were assigned to a biological sex category. These included: seven females, six probable females, two possible females, six indeterminates, four males and three probable males. A slightly higher frequency of females than males were identified from these multiple deposits. However this was a recurring trend seen throughout the Cleatham cemetery, regardless of burial type, and will be discussed at a later stage in this chapter. A total of nine interments, which included eight burials and one ditch deposit (MT85NI), were largely comprised of cremated animal bone with little, if any, trace of burned human bone. These deposits will be examined further in the animal bone section of this chapter.

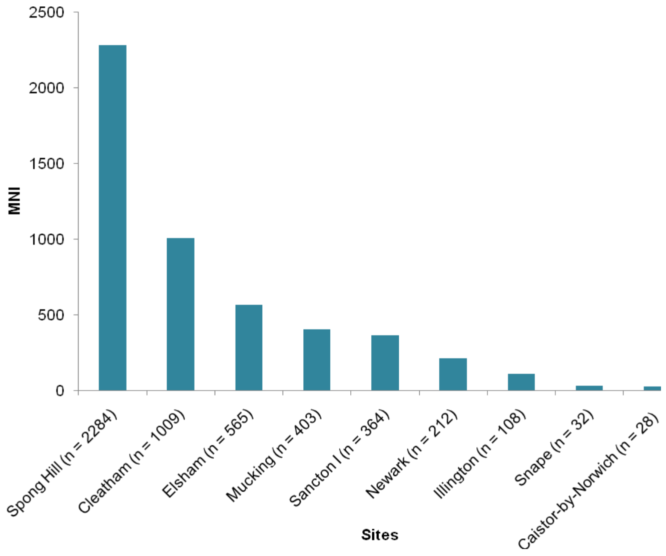


Fig 7.9 MNI from early Anglo-Saxon cremation cemeteries

Cremation number (urn number)	MNI	Age category	Sex	Pyre and grave goods
MT84GN (137)	2	1 = **Young adult**/younger mature adult 2 = **Young adult**/younger mature adult	1 = Indeterminate 2 = ??Female	Struck flint flake, bone comb, glass melt, animal bone
MT84HG (64)	2	1 = Young adult/**younger mature adult** 2 = Subadult	1 = Female 2 = ?	Ivory ring, bone comb, one glass bead, animal bone
MT84HP (89)	2	1 = Foetus 2 = **Young adult**/younger mature adult	1 = ? 2 = Female	Roman pottery, bone comb, perforated copper-alloy plate, six glass beads, animal bone
MT84HT (172)	2	1 = **Young adult**/younger mature adult 2 = Child	1 = ? 2 = ?	Ivory ring, bone comb, block of unfired clay, four glass beads, animal bone
MT84IY (215)	2	1 = Foetus/neonate 2 = Infant	1 = ? 2 = ?	One glass bead, bone comb
MT84JA (229)	2	1 = Foetus/neonate 2 = Child	1 = ? 2 = ?	Bone comb, Roman pottery, animal bone
MT84JE (239)	2	1 = Young adult 2 = Infant	1 = ? 2 = ?	Bone comb, ivory ring fragment, silica frit
MT84MX (85)	2	1 = Infant 2 = **Young adult**/younger mature adult.	1 = ? 2 = ?	Bone comb, animal bone
MT85EJ (288)	2	1 = Young adult/**younger mature adult** 2 = Infant/**child**	1 = Female 2 = ?	Antler spindle whorl, antler ring, ivory ring, bone comb, cowrie shell, copper-alloy melt, two glass beads
MT85EX (367)	2	1 = Infant 2 = Adolescent	1 = ? 2 = ?	Chalk spindle whorl, three glass beads
MT85FE (361)	2	1 = **Young adult**/younger mature adult 2 = **Young adult**/younger mature adult	1 = ?Male 2 = Indeterminate	None
MT85JC (384)	2	1 = **Young adult**/younger mature adult 2 = **Young adult**/younger mature adult	1 = Male 2 = ?Male	Copper-alloy sleeve clasp, silica frit, animal bone
MT85KQ (373)	2	1 = **Young adult**/younger mature adult 2 = Subadult	1 = Indeterminate 2 = ?	Copper-alloy sleeve clasp, ivory ring, animal bone
MT85LL (421)	2	1 = **Infant**/child 2 = **Young adult**/younger mature adult	1 = ? 2 = ?Female	Bone comb, animal bone

Table 7.5 Multiple deposits and associated grave assemblages from Cleatham

Cremation number (urn number)	MNI	Age category	Sex	Pyre and grave goods
MT88AFZ (676)	2	1 = (Older) adolescent 2 = **Infant**/child	1 = Female 2 = ?	Bone comb, shell/crustacean fragments
MT88AGY (636)	2	1 = Young adult/**younger mature adult** 2 = **Child**/adolescent	1 = ?Female 2 = ?	Chalk spindle whorl, copper-alloy ring, seven glass beads, one coral bead, copper-alloy cruciform brooch, bone comb, ivory ring, copper-alloy melt, two copper-alloy wire 'hooks', animal bone
MT88AHX (831)	2	1 = Younger mature adult 2 = Infant	1 = Indeterminate 2 = ?	Bone comb, five glass beads
MT88ALD (780)	2	1 = Young adult 2 = Infant	1 = Indeterminate 2 = ?	None
MT89BHT (933)	2	1 = Infant 2 = Young adult	1 = ? 2 = ?	Iron rivet, one glass bead, two bone combs, ivory ring, copper-alloy melt, animal bone
MT89BLE (886)	2	1 = Subadult/**adult** 2 = Subadult	1 = ?Male 2 = ?	Copper-alloy sheet, bone comb, iron fragments, animal bone
MT84KM (212)	1/?2	1 = Young adult/**younger mature adult** ?2 = Subadult	1 = Male ?2 = ?	Fragment of worked bone/antler, copper-alloy sheet object, animal bone
MT85AU/AV (275/286)	1/?2	1 = **Young adult/**younger mature adult ?2 = ?	1 = ? ?2 = ?	Two glass beads, bone pin, ivory ring, bone comb, animal bone
MT85DQ (294)	1/?2	1 = Subadult/**adult** ?2 = Subadult	1 = ?Female ?2 = ?	Pair of iron miniature shears, bone comb, bone pin
MT85EK (292)	1/?2	1 = **Infant/**child ?2 = **Subadult/**adult	1 = ? ?2 = ?	Iron knife, six glass beads, copper-alloy melt
MT85KH (410)	1/?2	1 = Younger mature adult ?2 = Infant	1 = Male ?2 = ?	None
MT85KL (372)	1/?2	1 = **Infant/**child ?2 = ?	1 = ? ?2 = ?	None
MT85KM (364)	1/?2	1 = Young adult/**younger mature adult** ?2 = ?	1 = Female ?2 = ??Female	Burnt fossil, bone comb, antler spindle whorl, eight glass beads, copper-alloy melt

Table 7.5 Continued

Cremation number (urn number)	**MNI**	**Age category**	**Sex**	**Pyre and grave goods**
MT85KZ (399)	1/?2	1 = Subadult/**adult** ?2 = Subadult	1 = ? ?2 = ?	Animal bone
MT85LO (428/1053/1054)	1/?2	1 = Young adult/**younger mature adult** ?2 = Subadult	1 = ?Female ?2 = ?	Bone comb, iron pin, one glass bead, ivory ring, animal bone
MT86OC (446)	1/?2	1 = Infant/**child** ?2 = ?	1 = ? ?2 = ?	None
MT86OJ (445)	1/?2	1 = Young adult/**younger mature adult** ?2 = Infant	1 = ? ?2 = ?	Unburnt struck flint flake, no animal bone
MT86OV (588)	1/?2	1 = Infant ?2 = Subadult/**adult**	1 = ? ?2 = ?	One glass bead, iron knife, bone comb, animal bone
MT86UQ (464)	1/?2	1 = Young adult/**younger mature adult** ?2 = Subadult	1 = ?Female ?2 = ?	Struck flint flake, animal bone
MT86UR (465)	1/?2	1 = Child ?2 = ?	1 = ? ?2 = ?	Bone/antler disc pendant, bone comb, five glass beads
MT88AAH (768)	1/?2	1 = **Young adult**/younger mature adult ?2 = Subadult	1 = ?Female ?2 = ?	Bone comb, ivory ring, animal bone
MT88AAJ (773)	1/?2	1 = Older mature adult ?2 = Subadult	1 = Female ?2 = ?	Bone comb, animal bone
MT88AAW (729)	1/?2	1 = Older mature adult ?2 = Subadult	1 = Indeterminate ?2 = ?	Iron nail, ivory ring, bone comb, one crystal bead, copper-alloy melt
MT88ACB (744)	1/?2	1 = Young adult/**younger mature adult** ?2 = Subadult	1 = ? ?2 = ?	Copper-alloy melt, 15 glass beads, fragments of copper-alloy sheet
MT88AKU (797)	1/?2	1 = Young adult/**younger mature adult** ?2 = Subadult	1 = Female ?2 = ?	None
MT89BLO (976)	1/?2	1 = Younger mature adult ?2 = Subadult	1 = Male ?2 = ?	Copper-alloy sleeve clasp, copper-alloy annular brooch, animal bone

Table 7.5 Continued

7.2.6 Age

Biological age was successfully assigned to 856 individuals within the age limits outlined in the methodology chapter (chapter five) of this thesis (Table 7.6). Therefore, age could not be assigned to 153 individuals. The highest frequency of individuals that were allocated to a single adult age category belonged to the 'younger mature adult' (26-30 years) grouping which contained 61 individuals. The greatest number of immature deaths occurred in the 'infant' (0-4 years) age grouping. Analogous to the

Age category	Number of individuals
Foetus/neonate	3
Infant	87
Infant/child	23
Child	56
Child/adolescent	7
Adolescent	48
Subadult	54
Adolescent/young adult	5
Subadult/adult	158
Young adult	39
Young adult/younger mature adult	246
Younger mature adult	61
Younger mature adult/older mature adult	3
Older mature adult	21
Older mature adult/old adult	1
Older adult	2
Adult	42
Age could not be assigned to individual	153
Total	**1009**

Table 7.6 Number of individuals identified in each age category from Cleatham

Age category	Number of individuals
Foetus/neonate	3
Infant	99
Child	71
Adolescent	54
Young adult	164
Younger mature adult	185
Older mature adult	23
Older adult	3
Subadult	131
Adult	123
Total	**856**

Table 7.7 Number of reassigned individuals identified in each narrow age category from Cleatham

Elsham cemetery, an underrepresentation of infants and children was apparent at Cleatham. Infants made up 12% of the Cleatham cemetery population while only 8% of the assemblage was assigned to the 'child' (5-12 years) age category. This issue will be explored in the next section of this chapter. The 'young adult/younger mature adult' (19-30 years) grouping contained the largest proportion of individuals that were allocated a broad age category and comprised of 246 individuals. For demographic purposes, individuals who were allocated a broad age category were reassigned to an adjacent age grouping in proportion to the number of individuals already in those narrow categories (Table 7.7). However, for more advanced statistical analyses it was necessary to regroup individuals into larger age categories. Thus, foetuses, infants, children, adolescents and the subadult group were categorised as 'subadults' (359 individuals) while young adults, younger mature adults, older mature adults, older adults and adult category were grouped together as 'adults' (497 individuals).

An examination of the demographic profile of numerous cremation and mixed-rite cemeteries was conducted to establish whether cremation was the alternative mortuary rite for individuals under the age of 12 years given the low numbers, particularly of infants, identified from contemporary inhumation cemeteries (Crawford 1999, 76; Leahy 2007, 60). Only individuals that were assigned biological age were included in the following analyses. With the exception of Caistor-by-Norwich, where there were an unusually high number of children, the frequency of infants and children was similar among all cremation cemeteries (Fig 7.10). In total 10% of individuals from cremation burials and 9% of persons from inhumation cemeteries were ascribed to the infant age grouping (Fig 7.11). A slightly higher proportion of children were identified from both cremation (16%) and inhumation (13%) cemeteries. However, based on model life tables infant mortality (from modern pre-industrial societies) has been estimated to lie between 40 and 50 percent (Coale and Demeny 1983). Therefore, it is apparent that there is a clear underrepresentation of infants (and children) from both inhumation and cremation cemeteries. These analyses have demonstrated that infants and children were treated in a similar manner among communities that practiced both inhumation and cremation. This seems a significant finding especially in the light of recent work highlighting the fundamental differences between inhumation and cremation as rites of transition; despite their dissimilarities, infants were treated in the same way. A more in-depth examination of these results and a subsequent discussion of these analyses can be found in Squires (forthcoming).

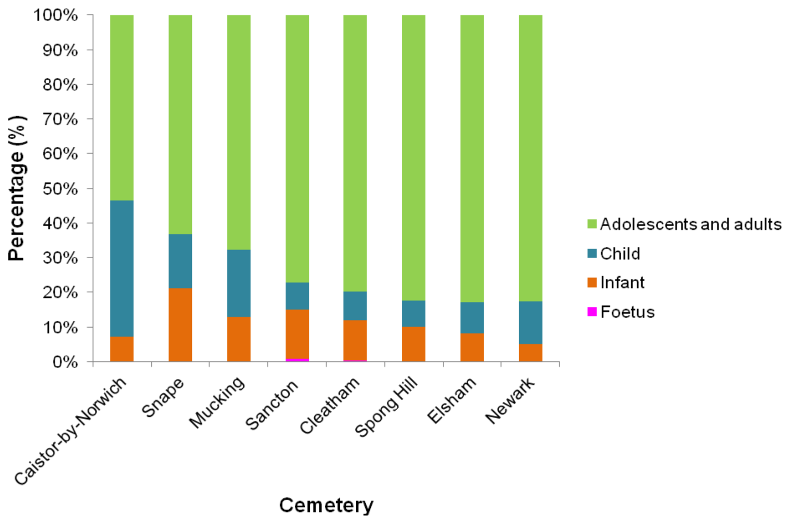


Fig 7.10 Percentage of foetuses, infants and children from the total number of burials from cremation cemeteries

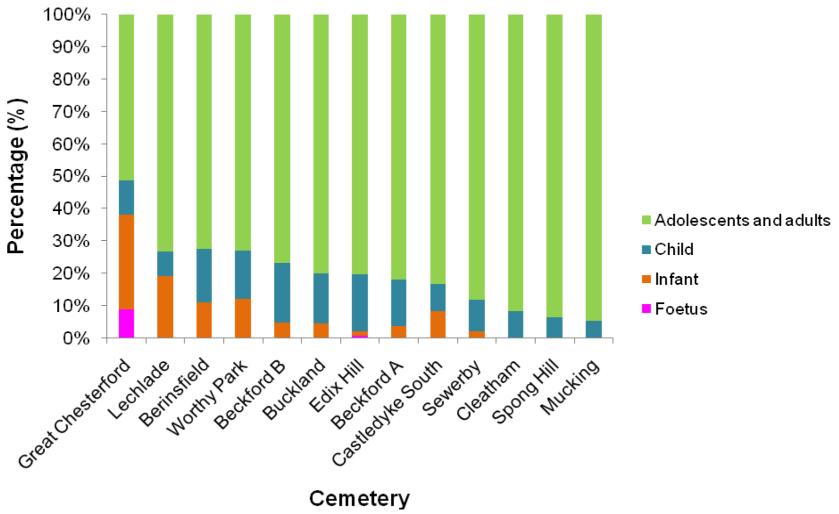


Fig 7.11 Percentage of foetuses, infants and children from the total number of burials from inhumation cemeteries

Statistical analyses were carried out to establish whether there was a relationship between (reassigned) biological age and the weight of cremated remains. A total of 546 individuals were included in this analysis which comprised of 85 infants, 65 children, 52 adolescents, 148 young adults, 172 younger mature adults, 21 older mature adults and three older adults (Fig 7.12). Multiple deposits and the ‘subadult’ and ‘adult’ age categories were excluded from this assessment because it was of interest to record the quantity of bone that derived from individual burials where a defined age category could be ascribed to the occupant of the grave. Levene’s test for homogeneity of variances was conducted and produced a significant result at the 0.01 level (W =

14.430; p = <0.01). Thus, weight variation of these age categories were unequal which could have been the result of using uneven (age group) sample sizes in this analysis. Nonetheless, the ANOVA test that was employed in conjunction with these data also generated a significant value at the 0.01 level (F = 57.630; p = <0.01). Post-hoc tests were employed to examine the significance of relationships between weight and each age threshold. The results from these analyses identified particularly strong associations between: infants and adolescents (p = 0.000; statistically significant), infants and young adults (p = 0.000; statistically significant), infants and younger mature adults (p = 0.000; statistically significant), infants and older mature adults (p = 0.000; statistically significant), infants and older adults (p = 0.003; statistically significant), children and adolescents (p = 0.002; statistically significant), children and young adults (p = 0.000; statistically significant), children and younger mature adults (p = 0.000; statistically significant), children and older mature adults (p = 0.000; statistically significant) and children and older adults (p = 0.032; statistically significant). These significant relationships will be explored in further detail in the discussion chapter (chapter eight) of this thesis.

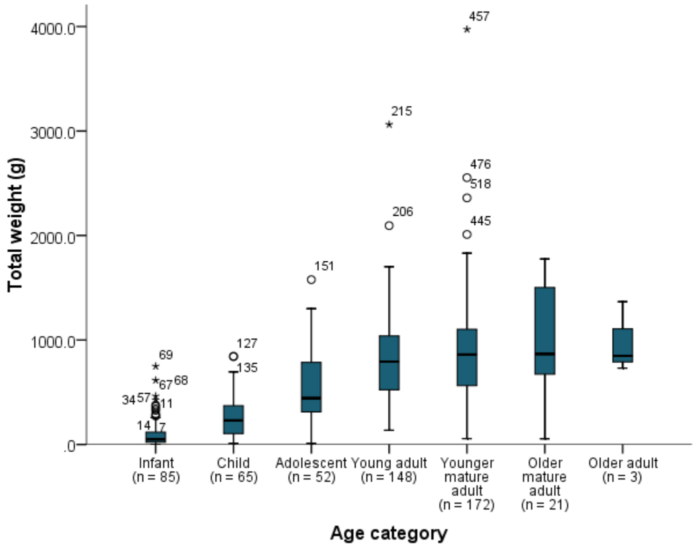


Fig 7.12 Box plot showing the relationship between cremation weight and biological age from the Cleatham cemetery

7.2.7 Sex

There was a dearth of sexually dimorphic bones among the Cleatham cremated remains. Biological sex was confidently assigned to 90 individuals (18%), which included an older adolescent (16-18 years) owing to the survival of sufficient osteological evidence, of the Cleatham burial population (Fig 7.13). In addition, a further 57 individuals were identified as either ‘probable males’ or ‘probable females’, which increased the total of biologically sexed individuals to 147 (30%). These calculations were based on the total number of adults (497 individuals) from the Cleatham assemblage. Any older subadults that were assigned biological sex were also added on to this total; the inclusion of all subadults was discounted in these calculations since biological sex cannot be assigned to youngest members of the burial population. Another 67 individuals were assigned to the ‘indeterminate’ category owing to the presence of both male and female diagnostic bones within a single deposit. Similar to the Elsham assemblage, almost twice as many females to males were identified from the Cleatham cemetery. This pattern proved to be statistically significant at the 0.05 level ($X^2 = 0.006$; $p = <0.05$). This significant relationship was strengthened further when probable females and probable males were included in this statistical test ($X^2 = 0.00$; $p = <0.01$). Interestingly, the ratio of males to females at the Cleatham cemetery is closely reflected by the demographic profile of other contemporary early Anglo-Saxon cremation cemeteries (Fig 7.14).

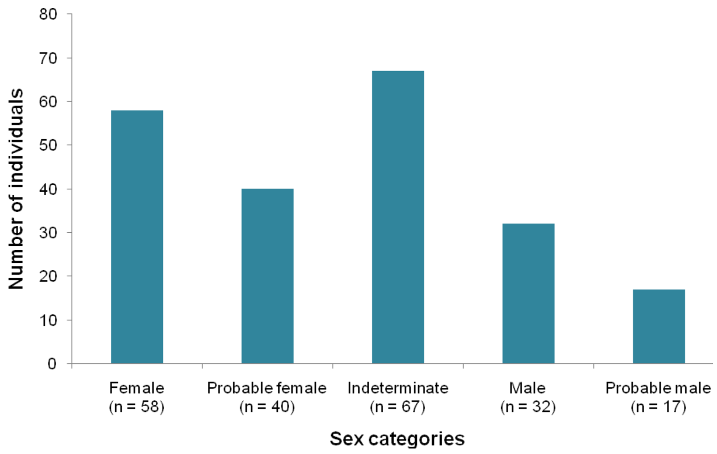


Fig 7.13 Histogram illustrating the number of individuals in each biological sex category from Cleatham

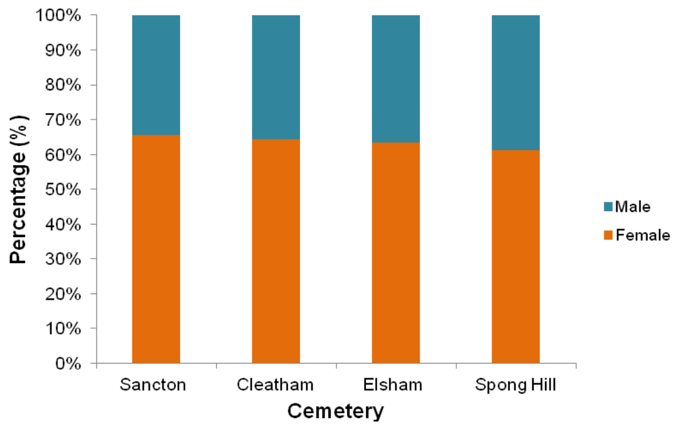


Fig 7.14 Percentage of confidently identified males and females from four Anglo-Saxon cremation cemeteries

At the Cleatham cemetery, the highest frequency of female deaths occurred in the younger mature adult category closely followed by the young adult grouping (Fig 7.15). A Kolmogorov-Smirnov test was applied to these data to determine whether age distribution was uniform among male and female categories. The results from this analysis showed that the distribution of age among each sex grouping was unequal at the 0.01 level (p = 0.30; non significant). The discussion chapter (chapter eight) of this thesis will explore the possible reasons behind the differential mortality rates of males and females from this site.

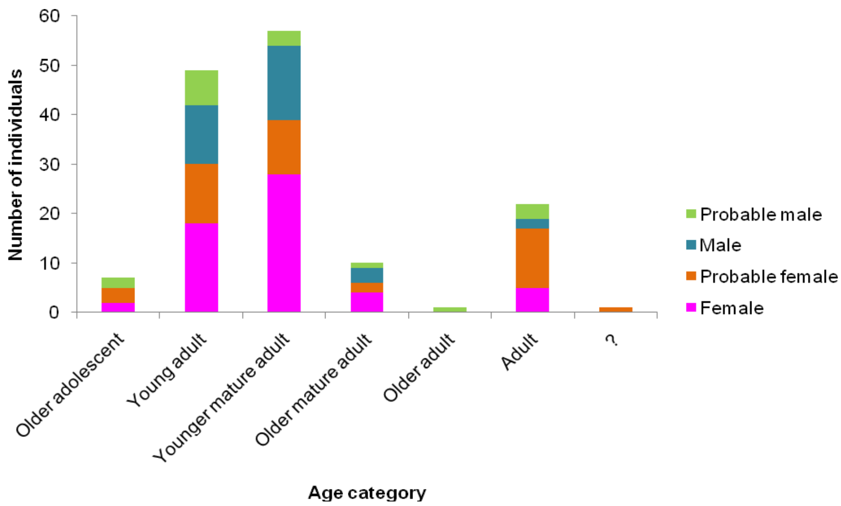


Fig 7.15 Sex distribution among age categories at the Cleatham cemetery

Statistical analyses were carried out to determine whether there was a relationship between the weight of cremated remains and biological sex. A total of 79 individuals who had been confidently assigned biological sex, which comprised of 51 females and 28 males, were included in this analysis (Fig 7.16). Again, multiple deposits were excluded from the following statistical analyses. The mean weight of female and male cremation burials from Cleatham totalled 997g and 1091g, respectively. Levene's test for homogeneity of variances generated a statistically insignificant result at the 0.05 level (W = 1.339; p = >0.05). This result highlighted that the weight variation within the female and male groups are relatively equal. The ANOVA test demonstrated an insignificant value at the 0.05 level (F = 0.953; p = >0.05). This illustrated that there was little difference, if any, between the weights of male and female cremation burials. Consequently probable females (34) and probable males (14) were included in this analysis and, as a result, the mean weight of cremated remains that derived from females and males decreased to 898g and 1042g, respectively. Levene's test for homogeneity of variances produced an insignificant value at the 0.05 level (W = 0.069; p = >0.05). Similarly, the ANOVA statistical test generated an insignificant result at the 0.05 level (F = 3.204; p = >0.05). Post-hoc tests could not be conducted on these data because only two categories (male and female) were employed in this assessment. Despite the inclusion of probable females and probable males in these statistical analyses, it appears that biological sex did not have a major effect on the amount of cremated bone that was collected and deposited by mourners.

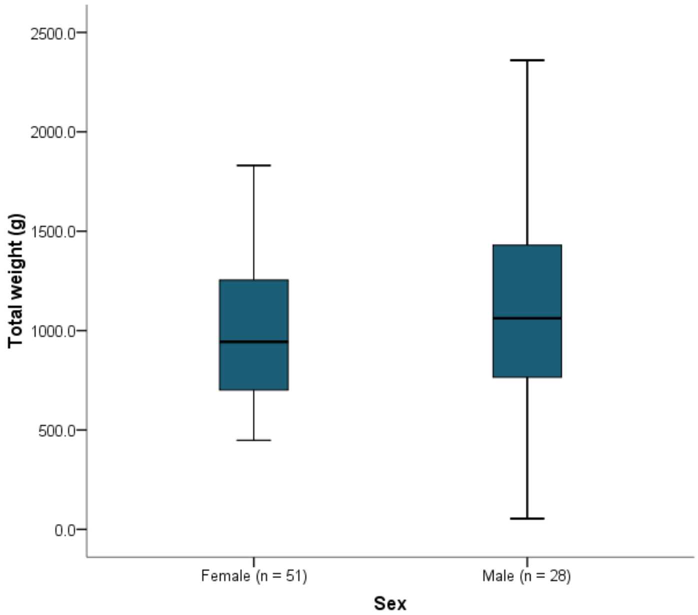


Fig 7.16 Box plot illustrating the relationship between cremation weight and biological sex from the Cleatham cemetery

7.2.8 Population size

Similar to the Elsham assemblage, an under-representation of infants from the Cleatham cemetery resulted in the inability to produce a model life table for this site. Thus, based on the demographic profile of the Cleatham cemetery, the female west level three model life table was employed in this analysis (Coale and Demeny 1983, 82). This model life table generated a mean female life expectancy of 25 years (Coale and Demeny 1983, 82; Chamberlain 2006, 65-66). If the Cleatham cemetery was utilised as a primary burial site for 150 years, which catered for 1009 individuals throughout its period of use, an average of six to seven burials would have taken place every year and would have been supplied by a living population of around 168 persons. However, if the site was employed for 200 years, an average of five interments would have taken place per annum and would have been used by a living population of around 126 individuals. Anglo-Saxon rural population density has been estimated to lay around five individuals per square mile (Hill 1981, 19). Therefore, the Cleatham cemetery would have served an area of 34 square miles for a 150 year period of use and an area of 25 square miles for a 200 period of use.

7.2.9 Health and disease

In total 155 individuals (15%) of the Cleatham burial population manifested at least one palaeopathological marker or non-metric trait (Table 7.8). It is likely that a higher frequency of individuals suffered from conditions that left palaeopathological indicators on bones. However these skeletal markers have been lost due to the differential survival of skeletal elements. In addition, an in-depth assessment of health and disease of the Cleatham burial population was restricted due to time constraints placed on the author. For more detailed information concerning individual elements that were affected by pathological conditions, or exhibited non-metric traits, please refer to appendix II (on the accompanying disc) of this thesis.

Dental conditions that were identified from the Cleatham bone assemblage included caries, antemortem tooth loss, dental abscesses, periodontal disease and, surprisingly, tooth wear (or dental attrition) (Table 7.8; Figs 7.17 and 7.18). Premolars and molars were most frequently affected by dental caries and were recorded on 15 different individuals. Interestingly, one individual (MT89BLG [urn 983]) showed signs of severe tooth wear (Fig 7.17). A mandibular second premolar, which was found in this interment, was worn down to such an extent that the dental pulp would have been exposed.

Pathology	Number of individuals	Percentage (CPR)	Percentage (TPR)
Periostitis	37	3.67	7.96
Exostosis	28	2.78	23.53
Pronounced musculoskeletal markers (MSMs)	28	2.78	2.73
Non-metric trait	18	1.78	1.06
Osteoarthritis	17	1.68	1.23
Osteophytic growth	17	1.68	1.54
Dental caries	15	1.49	2.06
Non-specific infection	11	1.09	1.01
Schmorl's nodes	8	0.79	1.82
Cribra orbitalia	5	0.50	0.58
Depressions to the skull	5	0.50	0.58
Porotic hyperostosis	5	0.50	0.58
Antemortem tooth loss	4	0.40	4.76
Degenerative disc disease	4	0.40	0.91
Degenerative joint disease	4	0.40	0.76
Cyst	3	0.30	0.35
Dental abscess	3	0.30	0.32
Periodontal disease	2	0.20	2.38
Fracture	1	0.10	0.27
Tooth wear	1	0.10	0.14
?Tuberculosis	1	0.10	0.23
Thickening of the cranial vault (?Paget’s disease)	1	0.10	0.12

Table 7.8 Actual number, crude prevalence rate (CPR) and true prevalence rate (TPR) of palaeopathological markers identified on cremated bone from Cleatham

Periostitis was recorded on more occasions than any other palaeopathological condition from the Cleatham cemetery. In sum 37 individuals showed evidence of periostitis, particularly of the tibiae and fibulae. Non-specific infection was identified in 11 individuals and mainly affected the long bones (Fig 7.19). Skeletal evidence from 28 individuals showed signs of exostosis, which, in most cases, was located on the patellae and calcanei. Osteophytic growth was identified in 17 individuals and most commonly affected the vertebrae. This is particularly well illustrated by vertebrae from burial MT88AKW (urn 791) which not only displayed signs of osteophytic growth but also presented evidence of Schmorl's nodes and degenerative joint disease (Fig 7.20). Destructive and infective lesions were identified on a vertebral body from burial MT89BBX (urn 907). This kind of evidence is usually suggestive of a tuberculosis infection but no other evidence was present to support this diagnosis. Many cranial fragments from burial MT88AHY (urn 627) displayed abnormal thickening, which can be indicative of Paget's disease. Once again, however, the lack of diagnostic evidence means that this conclusion can only be tentative. Non-metric traits were noted on 18 individuals. These included wormian bones, metopic sutures, enamel extension of a second maxillary permanent molar, acetabular crease of an os coxa fragment and posterior condylar canal patent of an occipital bone. The following section of this chapter will deal with the animal bones that were found in the Cleatham cremation burials.

Fig 7.17 Evidence of tooth wear was identified from burial MT89BLG (urn 983)

Fig 7.18 Antemortem tooth loss and periodontal disease was recorded from burial MT84GJ (urn 84)

Fig 7.19 Non-specific infection of a femur fragment from burial MT84AI (urn 168)

Fig 7.20 Vertebrae from burial MT88AKW (urn 791) showing signs of osteophytic growth, Schmorl's nodes and degenerative joint disease

7.3 Animal bone

In total, 370 occurrences of animal bone were identified from the Cleatham bone assemblage. A further 32 deposits contained snail shells with no other evidence of animal remains. From this point snail shell and unidentifiable shell fragments will be excluded from further analyses. Only a small number of animals could be identified to a specific species (Table 7.9). A more detailed analysis of these animal bones will provide a more thorough understanding of the species that were frequently used in the cremation rite at the Cleatham cemetery. Unburnt animal bone was recorded from 22 deposits, 10 of which contained both cremated and unburnt bone. The identification of unburnt small mammal bones from a number of cremation burials seems to suggest that these animals burrowed and, subsequently, died in these deposits, though this cannot be proved owing to the lack of contextual information available for each deposit. Teeth were the most commonly occurring unburnt element and were recorded from nine deposits. A total of 44 'subadult' animals were also documented on the basis of unerupted teeth and unfused bones (Fig 7.21).

Fig 7.21 Unfused sheep/goat distal ulna diaphysis from burial MT84FT (urn 60)

In total 16 deposits included more than one species of animal, although this figure may increase after zooarchaeological assessment of the assemblage (Table 7.10). Burial MT89BEC (urn 876) contained three species which were identified as horse, dog and bear. A total of nine deposits from Cleatham contained animal bones with little or no evidence of human remains. Eight of these deposits were found in or associated with an urn or sherds, while an unburnt cattle bone was found in a ditch fill (MT85NI). However, MT84GB(b) (urn 242) and MT88AEK (associated with urn 639) contained disturbed human bone and teeth from associated deposits, MT84GA (urn 71) and

MT88AEJ (urn 639), respectively. The animal bone from burials MT84LS (urn 158) and MT88AEK (urn 639) were found next to and underneath associated cinerary urns. Three of the interments that chiefly contained animal remains were identified as horse, one deposit mainly comprised of pig bone, three belonged to medium or large mammals and the final deposit was an unburnt tooth which could not be assigned to a specific species. As outlined in the previous results chapter (chapter six), these interments are thought to have represented so-called 'accessory deposits' and have been documented from Elsham, Sancton (McKinley 1993, 310), Spong Hill (McKinley 1994, 93) and contemporary cemeteries on the Continent (Fern 2007, 98-99; Fern 2010, 134).

Animal species	**Number of occurrences**
Bear	10
Dog	11
Hare	1
Pig	3
Sheep/goat	7
Cattle	1
Horse	5
Small mammal/bird	16
Bird	1
Oyster	1
Shell	17
Snail	53
Horse/cattle	6
Small mammal	1
Medium mammal	6
Large mammal	11
Small/medium	2
Medium/large	11
Unidentifiable	286
Total	**449**

Table 7.9 Animal remains identified from the Cleatham cemetery

Cremation number (urn number)	Species		
MTDA/MTDE (5)	Medium mammal	Bear	
MT84EB (43)	Large mammal	Small mammal/bird	
MT84FS (186)	Large mammal	Small mammal/bird	
MT84FT (60)	Sheep/goat	Small mammal/bird	
MT84GN (137)	Large mammal	Small mammal	
MT84KJ (192)	Medium/large mammal	Small/medium mammal	
MT84KT (117)	Bear	Unidentifiable	
MT85DP (283)	Large mammal	Small mammal/bird	
MT85GP (346)	Sheep	Unidentifiable	
MT86SB (458)	Unidentifiable (?medium/?large mammal)	Unidentifiable (?small mammal/?bird)	
MT86VB (577)	Bear	Unidentifiable	
MT88AAH (768)	Cattle/horse	Bird	
MT88ABG (719)	Bear	?Sheep	
MT88ASV (735)	Bear	?Dog	
MT89BEC (876)	Horse	Dog	Bear
MT89BLE (886)	Medium/large mammal	Small/medium mammal	

Table 7.10 Burials containing at least two species of animal from Cleatham

An inter-site comparison that examined the frequency of faunal remains in cremation burials generated some interesting results (Fig 7.22). Animal bone was recorded in 38% of burials from Cleatham and 40% of interments from the Elsham cemetery. Similar amounts of animal bone were recorded from Sancton (McKinley and Bond 1993, 308) and Spong Hill (Bond 1994, 121), 40% and 46%, respectively. In contrast only 29% of burials from Newark (Harman

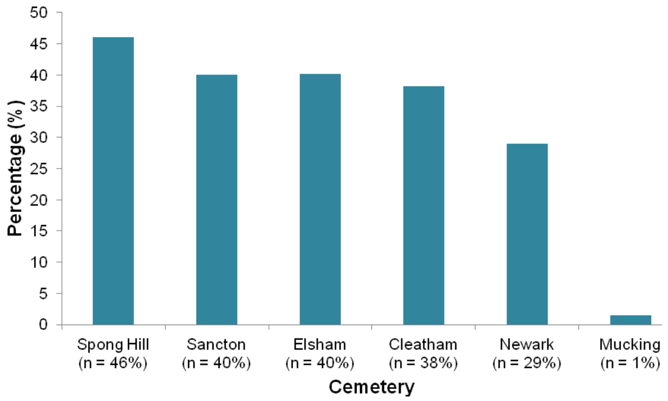


Fig 7.22 Histogram illustrating the percentage of burials containing animal bone from six Anglo-Saxon cremation cemeteries

1989, 24) and 1% of interments from Mucking (Mays 2009, 440) contained animal bone. Nonetheless, based on the high frequency of faunal remains that were identified from the majority of Anglo-Saxon cremation cemeteries, animals clearly played an integral role in this funerary rite.

7.3.1 Biological age vs. animal bone

Faunal remains were found in 98 subadult and 211 adult cremation burials from the Cleatham cemetery, though species could only be ascribed to a small number of these animals (Fig 7.23). The most interesting find from these data related to the identification of bear bone. Bear phalanges were recorded from 10 burials and were found with all age groups, aside from 'foetuses' and 'infants' (Fig 7.24). Most of these burials contained either one or two cremated bear phalanges. However one older mature adult (MT86UB [urn 478]) was associated with eight bear phalanges and one older adult (MT89BLG [urn 983]) was found with 10 bear phalanges. Unfortunately there is insufficient evidence to confidently conclude that there was a significant relationship between age and number of bear phalanges from the Cleatham cremation burials. Similarly animal species that were solely associated with either adults or subadults occurred in such low frequencies that it was not possible to establish whether there was an explicit relationship between age and species of animal.

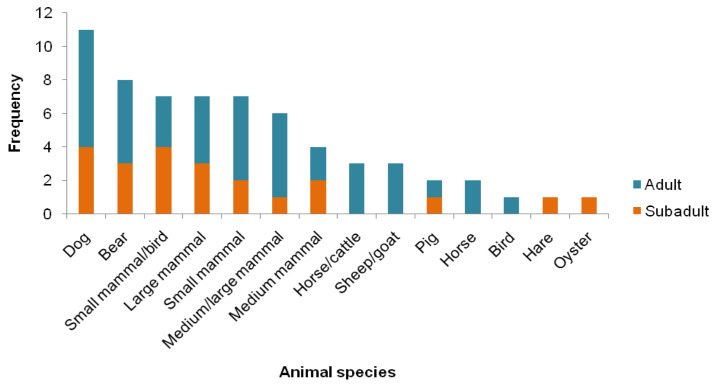


Fig 7.23 Stacked graph illustrating the frequency of animal species found in biologically aged burials from Cleatham

Fig 7.24 Bear phalanges identified from burial MT89BLG (urn 983)

A Pearson Chi-square test was conducted to determine whether there was an association between biological age and the deposition of animal bone. This statistical analysis generated a statistically significant value at the 0.01 level ($X^2 = 17.639$; $p = <0.01$). It was also of interest to determine whether adolescents were culturally identified as adults at the Cleatham cemetery. Therefore, adolescents were included in the 'adult' age category and a second analysis was carried out to establish whether the reclassification of 13-18 year olds altered the results that were obtained from the previous statistical test. The results from this Chi-Square analysis also produced a statistically significant value at the 0.01 level ($X^2 = 30.227$; $p = <0.01$). However, by including the adolescent grouping in the adult age category, the relationship between the deposition of animal bone and age is strengthened further. Nonetheless, statistical significance was extremely high in the first instance, and, it appears that by increasing the 'adult' dataset size (with adolescents) this added further strength to the significance value. Based on these statistical tests it is apparent that adults were more likely to have been afforded animal offerings than subadults in the cremation rite at Cleatham. Comparable observations have been made from the Elsham, Sancton (McKinley 1993, 311) and Spong Hill (McKinley 1994, 99) cemeteries which may have been the result of practical and economic factors.

7.3.2 Biological sex vs. animal bone

Animal bones were documented from 28 female, 16 probable female, 14 male and five probable male burials. Unfortunately a limited amount of information was obtained from these faunal remains. The only animal groupings that could be identified from this sample included horse/cattle, medium/large mammal and bird/small mammal, and were all found in female burials. Consequently there was insufficient data, owing to the high frequency of unidentified faunal remains, to produce a graph which presented the number of animal species from male and female cremation burials. However a Pearson Chi-square analysis was employed to examine the deposition of animal bone in male and female burials. This statistical test generated an insignificant Chi-Square value at the 0.05 level (X^2 = 0.174; p = >0.05). Based on the small number of males and females employed in the initial analysis, a second Pearson Chi-square test was conducted which included 16 probable females and five probable males (who were also interred with animal bone). This statistical analysis also produced an insignificant Chi-Square value at the 0.05 level (X^2 = 0.396; p = >0.05). Thus, these results disproved the null hypothesis that males were more likely to have been afforded animal offerings than females in the cremation rite at the Cleatham cemetery.

7.4 Cinerary urns

Cremated remains were most frequently placed in a cinerary urn prior to interment at the Cleatham cemetery. Lead plugs are occasionally found with Anglo-Saxon funerary vessels. These metal fittings were used to fill perforations in the wall and/or base of a cinerary urn. Ten individuals from the Cleatham cemetery were buried in receptacles that showed clear evidence for the use of lead plugs; on four occasions these articles were found in-situ in the wall or base of a vessel (Table 7.11). These modified urns were afforded to individuals regardless of age. However, biological sex was confidently established for three of these individuals and, interestingly, each were classified as 'female' (MT86OR [urn 566], MT86SB [urn 458] and MT88AKX [urn 649]). In addition,

Cremation number (urn number)	MNI	Age	Sex	Number of lead plugs
MT85BK (1036)	1	Subadult	?	1
MT85JZ (416)	1	Infant	?	1
MT86OF (448)	1	Subadult	?	4
MT86OR (566)	1	Younger mature adult	Female	1
MT86SB (458)	1	Younger mature adult	Female	1
MT88AAU (793)	1	Younger mature adult	Indeterminate	2
MT88AFQ (683)	1	Infant	?	1
MT88AKX (649)	1	Younger mature adult	Female	1
MT88AQD (824)	1	Adult	?	3
MT89BLA (925)	1	Subadult	?	3

Table 7.11 Holed urns that contain human remains and evidence of lead plugs from Cleatham

the number of lead plugs that were identified with a vessel did not show any clear association with the biological attributes of the urn's occupant. These observations illustrated that there was no clear relationship between lead plugged cinerary urns and the biological attributes of associated individuals from the Cleatham assemblage.

A total of 13 deposits were classified as unurned, two of which were found in a ditch fill. The remaining 11 unurned deposits were not found with any pottery sherds and may have been deliberate burials without an urn or redeposited burials (Table 7.12). Alternatively these deposits may have been placed in organic receptacles, for example wooden vessels or cloth bags, but due to poor preservation these containers have not survived in the archaeological record. Urned burials produced an average and median weight of 527g and 404g, respectively. In contrast unurned interments generated both a lower mean weight, of 347g, and median weight, of 385g, than urned burials from Cleatham. At first it was assumed that unurned deposits were particularly susceptible to taphonomic disturbance (McKinley 1994(c), 341). However, an examination of average maximum fragment size from unurned interments (47mm) and urned burials (48mm) highlighted that both types of deposit suffered from similar pre- and/or post-depositional disruption.

Cremation number (burial number)	**Total weight (g)**	**Max fragment size (mm)**	**Disturbed**	**Other notes**
MT84MY (46)	714.90	50.45	No	No urn
MT84MZ (61)	94.70	64.92	Yes	Scatter of burnt bones
MT84NA (74)	790.80	60.67	No	No urn
MT85BG (249)	454.70	50.13	No	No urn
MT85CX (248)	508.60	52.38	No	No urn
MT85DJ (266)	20.70	24.19	Yes	No urn
MT85JS (392)	168.90	53.03	No	No urn
MT85MD (ditch fill)	2.20	16.93	Yes	No urn
MT85MI (ditch fill)	1.80	15.11	Yes	No urn
MT86XC (530)	674.50	58.35	No	No urn
MT88ACH (761)	384.60	46.04	No	No urn
MT88AGR (688)	291.60	62.30	No	No urn
MT89BQZ (840)	403.40	62.79	No	No urn

Table 7.12 Unurned cremation deposits from Cleatham

The following section of this chapter will explore the relationship between the Cleatham cinerary urns and the demographic attributes of individuals buried in these vessels. Only individuals that were associated with urns that produced complete measurements were considered in these analyses. In addition, it should be noted that vessels that held the cremated remains of more than one individual were excluded from statistical testing.

7.4.1 Biological age vs. cinerary urn height

The relationship between biological age and cinerary urn height was initially examined. A total of 337 individuals, which comprised of 50 infants, 46 children, 31 adolescents, 97 young adults, 99 younger mature adults, 13 older mature adults and one older adult, were included in this analysis (Fig 7.25). Levene's test for homogeneity of variances was carried out on these data and produced an insignificant value at the 0.05 level (W = 0.179; p = >0.05). These results illustrated that variance in cinerary urn height was similar in each age category. The ANOVA statistical test generated a significant value at the 0.01 level (F = 28.905; p = <0.01) which highlighted that there was a strong association between age and urn height. Post-hoc analyses were also run on these data. Due to the small sample size of the 'older adult' age category it was not feasible to include this group in the following analyses. There was a statistically significant relationship at the 0.05 level between: infants and children (p = 0.001; statistically significant), infants and adolescents (p = 0.000; statistically significant), infants and young adults (p = 0.000; statistically significant), infants and younger mature adults (p =

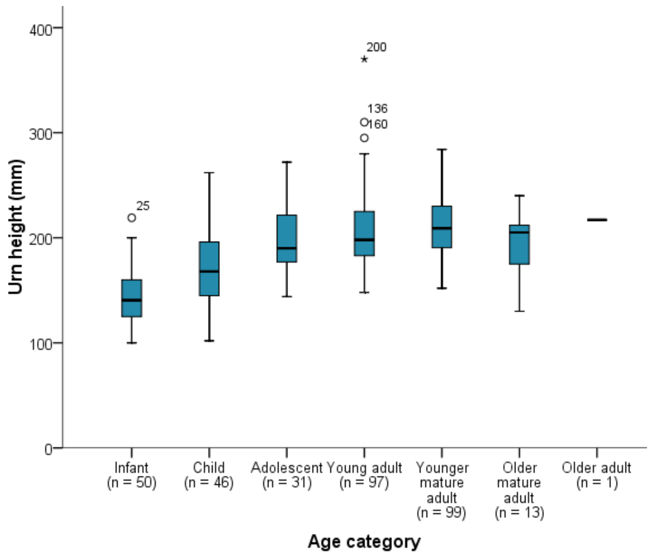


Fig 7.25 Box plot showing the relationship between cinerary urn height and biological age from the Cleatham cemetery

0.000; statistically significant), infants and older mature adults (p = 0.000; statistically significant), children and adolescents (p = 0.012; statistically significant); children and young adults (p = 0.000; statistically significant) and children and younger mature adults (p = 0.000; statistically significant). These statistical analyses proved the null hypothesis that older individuals were buried in taller cinerary urns at the Cleatham cemetery.

7.4.2 Biological age vs. cinerary urn rim diameter

In total 342 individuals, which consisted of 52 infants, 49 children, 31 adolescents, 93 young adults, 103 younger mature adults, 13 older mature adults and one older adult, were employed in statistical analyses to establish whether there was a relationship between biological age and cinerary urn rim diameter (Fig 7.26). Levene's test for homogeneity of variances generated an insignificant value at the 0.05 level (W = 2.662; p = >0.05). This result showed that the variation of rim diameter sizes was comparable for each age category. The ANOVA test produced a significant score at the 0.01 level (F = 10.024; p = <0.01) which illustrated that older individuals were buried in vessels that boasted larger rim diameters. Post-hoc analyses were also run on these data which highlighted a number of statistically significant differences between urn rim diameter and individual age groupings. Again, the 'older adult' grouping was excluded from these tests due to the small sample size of this age category. There was a statistically significant relationship at the 0.05 level between: infants and adolescents (p = 0.003; statistically significant), infants and young adults (p = 0.000; statistically significant), infants and younger mature adults (p = 0.000; statistically significant), infants and older

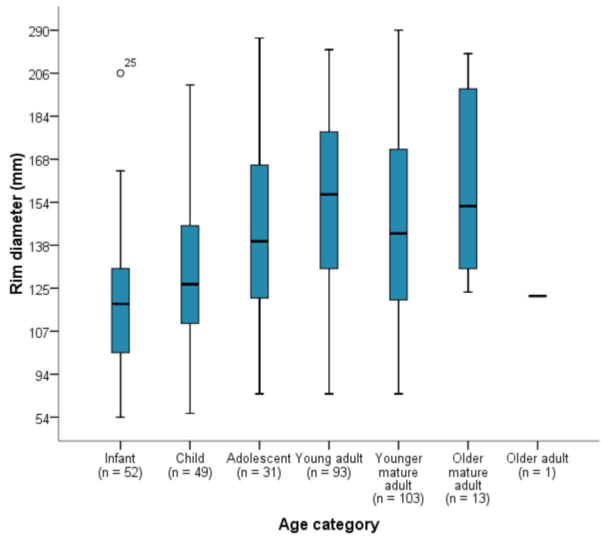


Fig 7.26 Box plot highlighting the relationship between cinerary urn rim diameter and biological age from the Cleatham cemetery

mature adults (p = 0.000; statistically significant), children and young adults (p = 0.000; statistically significant), children and younger mature adults (p = 0.004; statistically significant) and children and older mature adults (p = 0.005; statistically significant). Thus, based on these statistical analyses, the null hypothesis that older individuals were buried in cinerary urns that possessed a larger rim diameter was proved.

7.4.3 Biological sex vs. cinerary urn height

Statistical analyses were carried out to determine whether there was a relationship between biological sex and cinerary urn height. An initial analysis excluded three (older) adolescents (16-18 years) for whom it was possible to assign biological sex (MT84GG [urn 207], MT86WY [urn 532] and MT88AAK [urn 795]). The purpose of excluding these individuals was to test whether the inclusion, and exclusion, of (older) adolescents had an impact on this statistical test. Therefore a total of 22 males and 34 females were included in the following analysis. A test of homogeneity of variances produced an insignificant value at the 0.05 level (W = 0.051; p = >0.05). Similarly, an ANOVA test generated an insignificant score at the 0.05 level (F = 0.958; p = >0.05) which illustrated that there was no association between biological sex and urn height. Since the exclusion of (older) adolescents produced statistically insignificant results in this initial analysis, they were subsequently included in a secondary analysis to establish whether biological age had an effect on the overall relationship between urn height and biological sex. The inclusion of these adolescents increased the total number of individuals to 59, which consisted of 23 males and 36 females (Fig 7.27). It should be noted that only

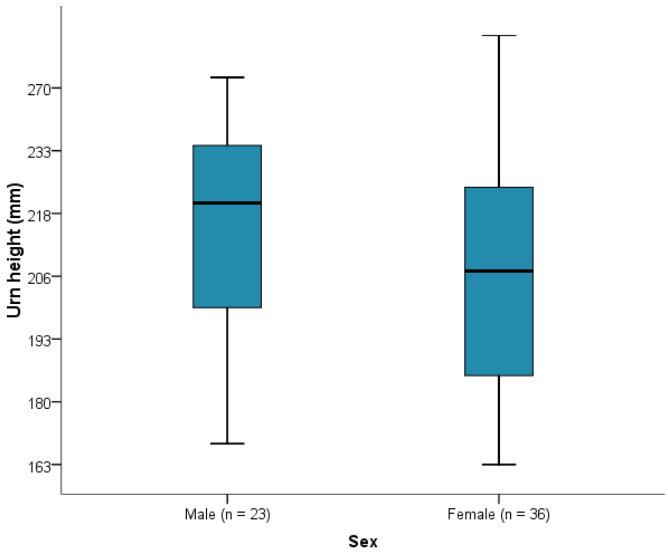


Fig 7.27 Box plot illustrating the relationship between cinerary urn height and biological sex from the Cleatham cemetery

individuals who were confidently assigned to either the 'male' or 'female' category were employed in this analysis. Levene's test for homogeneity of variances produced an insignificant value at the 0.05 level (W = 0.081; p = >0.05). This highlighted that the variance in cinerary urn height was similar for the male and female groups. The ANOVA test employed in this analysis generated an insignificant value at the 0.05 level (F = 1.058; p = >0.05) which illustrated that there was no significant difference between the mean cinerary urn heights for males and females. Moreover, the inclusion of the older adolescents mentioned above did not have a significant effect on these results. Subsequently probable males (nine) and probable females (24) were included in this analysis to increase the otherwise small size of this sample. Again, Levene's test for homogeneity of variances produced an insignificant result at the 0.05 value (W = 0.313; p = >0.05). Similarly, the ANOVA test generated an insignificant value at the 0.05 level (F = 1.885; p= >0.05). Even though males can be seen to have a greater mean urn height (Fig 7.27) these statistical tests have shown that this is statistically insignificant. Therefore, the null hypothesis that males were buried in taller urns can be dismissed.

7.4.4 Biological sex vs. cinerary urn rim diameter

The aim of the following analyses was to determine whether there was a relationship between biological sex and cinerary urn rim diameter. An initial analysis excluded three older adolescents for whom it was possible to assign biological sex (MT84GG [urn 207], MT86WY [urn 532] and MT88AAK [urn 795]). As outlined in the previous section of this chapter, the reason for excluding these individuals was to establish whether the inclusion, and exclusion, of (older) adolescents had an impact on this statistical test. Thus a total of 54 individuals, which included 19 males and 35 females, were included in the following analysis. A test of homogeneity of variances produced a significant value at the 0.05 level (W = 0.022; p = <0.05) which demonstrated that the variance in urn rim diameter was similar for the male and female groups. The corresponding ANOVA test generated an insignificant value at the 0.05 level (F = 0.322; p = >0.05) which illustrated that there was no significant difference between the mean cinerary urn rim diameter for males and females. The exclusion of (older) adolescents from the above statistical analysis produced statistically insignificant results. Therefore these individuals were included in a secondary analysis to establish whether the inclusion of subadults had an effect on the overall relationship between urn rim diameter and biological sex. The inclusion of subadults increased the sample size to 57 individuals, which consisted of 20 males and 37 females (Fig 7.28). It should be noted that only confidently assigned males and females were employed in this statistical analysis. A Levene's test for homogeneity of variances produced an insignificant value at the 0.05 level (W = 6.471; p = >0.05). The ANOVA test that was conducted on this sample generated a statistically insignificant score at the 0.05 level (F = 0.136; p = >0.05). These results illustrated that there was no significant difference between mean cinerary urn rim diameter for males and females. In addition the inclusion of the older adolescents mentioned above did not have a significant effect on these results. Subsequently probable males (nine) and probable females (25) were included into this dataset to increase the otherwise small size of this sample. Again, Levene's test for homogeneity of variances produced an insignificant value at the 0.05 value (W = 6.935; p = >0.05). The corresponding ANOVA test also generated an insignificant score at the 0.05 level (F = 0.948; p= >0.05). Despite the fact that females appear to have been buried in urns that possessed a larger mean rim diameter than males (Fig 7.28) the results from these analyses have shown that this association was statistically insignificant. Thus, the null hypothesis that males were interred in urns with a larger rim diameter was disproved.

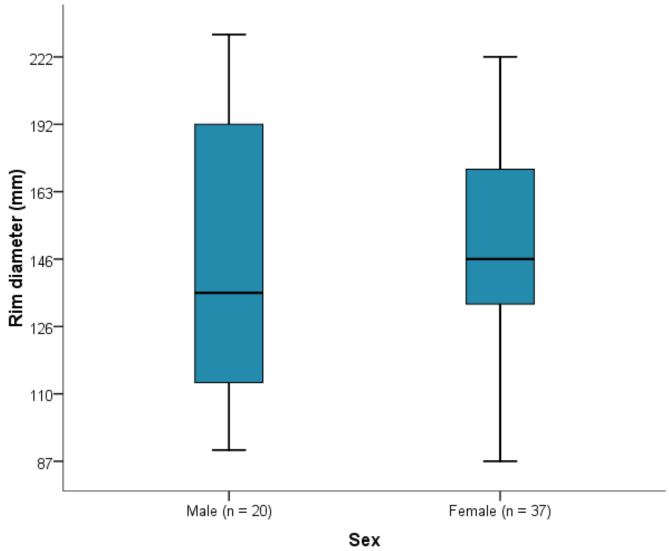


Fig 7.28 Box plot showing the relationship between cinerary urn rim diameter and biological sex from the Cleatham cemetery

7.5 Pyre and grave goods

As outlined in the methodology chapter of this thesis, the Cleatham site report (Leahy 2007) and individual records on the ADS (Leahy 2007(b)) were employed to acquire detailed information concerning pyre and grave good attributes. During osteological analyses, a number of fragmented artefacts and pyre debris was found among the cremated material. These artefact remnants were only included in analyses that dealt with artefact material type since the original form of these objects could not be identified. Due to the sheer quantity of pyre and grave good types from the Cleatham cemetery many objects were grouped together based on artefact type (Table 7.13). A total of 580 cremation burials contained identifiable artefacts from the Cleatham cemetery. Combs were the most common type of artefact identified from the site and were documented from 288 burials (Fig 7.29). Beads and rings also occurred in high numbers. In contrast, objects such as decorated strips, coins, girdle hangers, bracelets and latch lifters occurred in significantly lower frequencies.

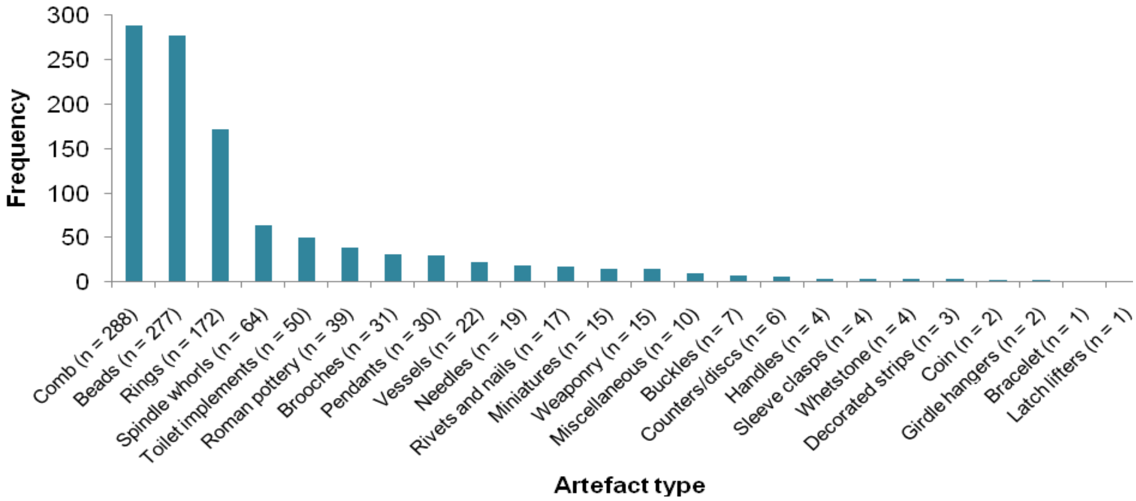


Fig 7.29 Histogram highlighting the frequency of pyre and grave goods identified from the Cleatham cremation burials

Artefact categories	Objects within artefact categories
Beads	Glass, crystal, coral, bone
Bracelet	
Brooches	Cruciform, penannular, square-headed, bow, annular, small-long, disc, brooch pins
Buckles	Belt plates, buckles, strap ends
Coin	Copper-alloy
Comb	Worked bone/antler
Counters/discs	Bone, copper-alloy, polished limestone, polished quartzite,
Decorated strips	Bone, copper-alloy
Girdle hangers	
Handles	Bone, antler, iron
Latch lifters	
Miniatures	Toilet sets, combs
Needles	Awls, points, pins, pin beaters
Pendants	Bone, antler, ivory
Rings	Antler, bone, iron, copper-alloy
Rivets and nails	
Roman pottery	Vessel sherds, tile
Sleeve clasps	
Spindle whorls	Antler, stone, lead, clay
Toilet implements	Tweezers, shears, spoons/earscoops, razors
Vessels	Glass vessels, iron rim bindings, copper-alloy rim bindings
Weaponry	Knives, blades, spearheads
Whetstone	Stone, sandstone
Miscellaneous	Firesteels, potboilers, metal fittings, metal staples, fossils

Table 7.13 Pyre and grave goods identified from the Cleatham cremation burials

The material of grave furnishings, whether in a molten, burnt but identifiable or unburnt state, was identified from 625 burials. Material types that were recorded from the Cleatham cremation burials included: iron, copper-alloy, lead, glass, silica frit, crystal, worked bone/antler, ivory, coral, cowrie, Roman pottery, clay, slate, (worked) flint and a variety of different stones (Fig 7.30). Worked bone/antler, followed by glass, was the most common material type found in these burials. Copper-alloy, ivory and iron also occurred in high frequencies. Stone and slate were the least common material types that were recorded from the Cleatham cremation burials. The subsequent sub-sections will present the results from analyses that were conducted on pyre and grave goods, in conjunction with the demographic attributes of the Cleatham burial population, to establish whether there were any underlying artefact groupings based on biological and social identity. Furthermore, multiple burials were discounted from all of the following analyses, similar to the strategy employed in the Spong Hill assessment, since the interment of a subadult and adult, or a male and a female, within a single burial would have obscured any statistically significant results concerning artefact groupings and specific biological attributes (McKinley 1994, 88).

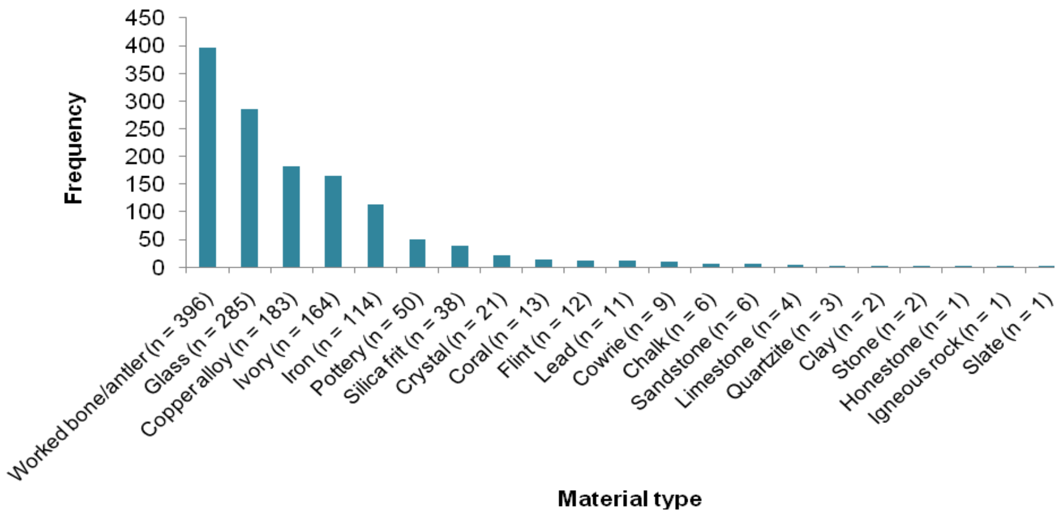


Fig 7.30 Histogram illustrating the frequency of pyre and grave goods categorised by material type from the Cleatham cremation burials

7.5.1 Biological age vs. pyre and grave goods

At the Cleatham cemetery, artefacts were buried with 781 biologically aged individuals, which comprised of 319 subadults and 462 adults (Fig 7.31). Combs occurred in the highest frequency in adult burials. However, combs and beads were found in equally high numbers in subadult interments. Coins were only identified on two occasions, both of which were recorded from two subadult burials. Artefacts that were only discovered in adult burials included: three decorated strips, three handles, one bracelet, one latch lifters and one sleeve clasp. It was difficult to establish whether these were, indeed, age-specific artefacts owing to the low frequencies that were recovered from the

Cleatham burials. A Pearson Chi-square test was conducted to determine whether there was an association between biological age and the deposition of pyre and grave goods. This analysis produced a statistically significant value at the 0.05 level ($X^2 = 10.365$; $p = <0.05$). This result highlighted that there was a relationship between the age of an individual and burial of associated artefacts. It was also of interest to determine whether adolescents were culturally identified as adults at the Cleatham cemetery. Therefore, a second Pearson Chi-Square test was carried out which incorporated adolescents into the 'adult' age category. This analysis generated a statistically significant value at the 0.05 level ($X^2 = 14.153$; $p = <0.01$) which illustrated that the inclusion of adolescents in the 'adult' category strengthened the association between age and grave provision. An interpretation of these results will be offered in the discussion chapter (chapter eight) of this thesis.

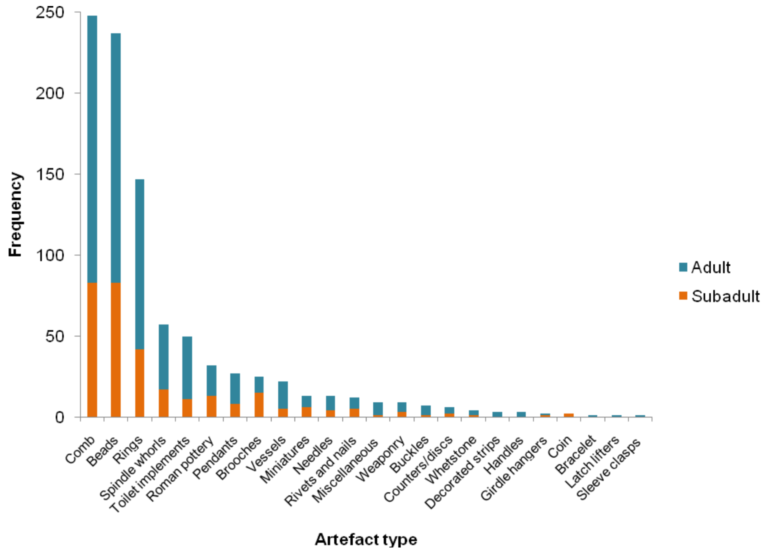


Fig 7.31 Stacked graph showing the frequency of pyre and grave goods in biologically aged cremation burials from Cleatham

Correspondence and cluster analyses were employed to explore discrete associations between artefact types, animal bone, and biological age. A total of 585 individuals, which included 215 subadults and 370 adults, were incorporated in this analysis. The quantification plot, which was produced by correspondence analysis, depicted an association between spindle whorls, toilet implements, rings and, to a lesser degree, beads, along dimension one of the plot (group one) (Fig 7.32). A clear association between animal bone and vessels (group two), which is positioned along dimension two, was also identified on the same plot. Correspondence analysis highlighted that, in group one, beads and rings were most frequently found together within the same interment. Cluster analysis showed that this artefact combination occurred in 45 adult and 18 subadult burials. Spindle whorls and toilet implements were found in smaller numbers in burials allocated to group one. The funerary offerings identified in group two were found together in 15 separate interments, which comprised of three subadult and 12 adult burials. The application of cluster analyses to these data illustrated that only two of these adult burials solely contained animal bone and a vessel(s); the remaining graves were afforded additional artefacts. The object score plot illustrated a random distribution of subadult and adult

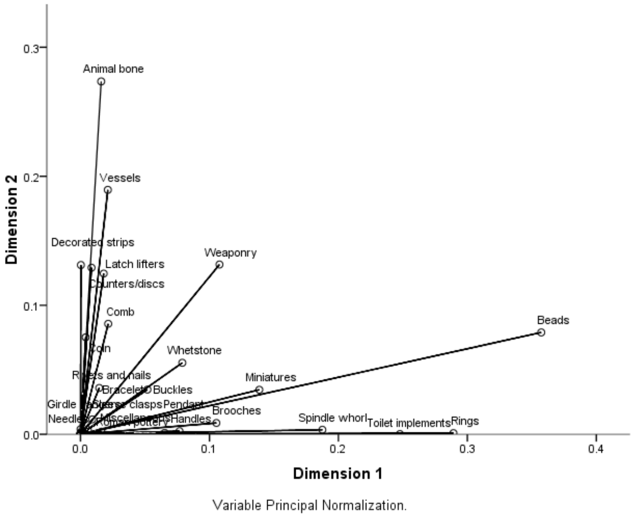


Fig 7.32 Quantification plot displaying discrimination measures based on artefact type and biological age from Cleatham

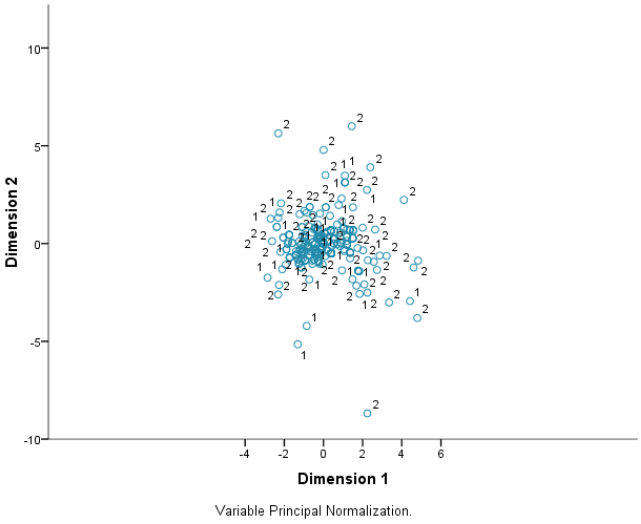


Fig 7.33 Object score plot highlighting object points based on artefact type labelled by age (1 = subadult; 2 = adult) from Cleatham

cases which also included numerous outliers, which appear to represent burials from groups one and two that contain unique artefact assemblages (Fig 7.33). This disorganised cluster of points indicated that there was an insignificant relationship between biological age and the type of artefact(s) interred with the deceased, which is particularly evident given the high frequency of artefact types that were afforded to both subadults and adults. Correspondence and cluster analyses were performed again to establish whether adolescents were culturally identified as adults based on the deposition of artefact types. Thus, adolescents were reclassified from the ‘subadult’ group to the ‘adult’ age category. The results from both statistical methods showed that the inclusion of adolescents in the ‘adult’ age category did not significantly alter the artefact groupings that were identified in the initial correspondence and cluster analyses. In sum, there were no clear differences regarding the type of artefacts that were afforded to subadults and those offered to adults at the Cleatham cemetery. These results also highlighted that adolescents were not necessarily culturally viewed as adults based on the artefact types that were interred with this age group.

7.5.2 Biological age vs. material type

The following sub-section will explore whether there was a relationship between biological age and the material of artefacts that were interred with the deceased. This analysis included 781 individuals which comprised of 319 subadults and 462 adults (Fig 7.34). An initial examination of these data highlighted that worked bone/antler was the most prevalent material that was found in both subadult and adult burials. High frequencies of glass, copper-alloy, ivory and iron were also identified in both subadult and adult interments. Clay

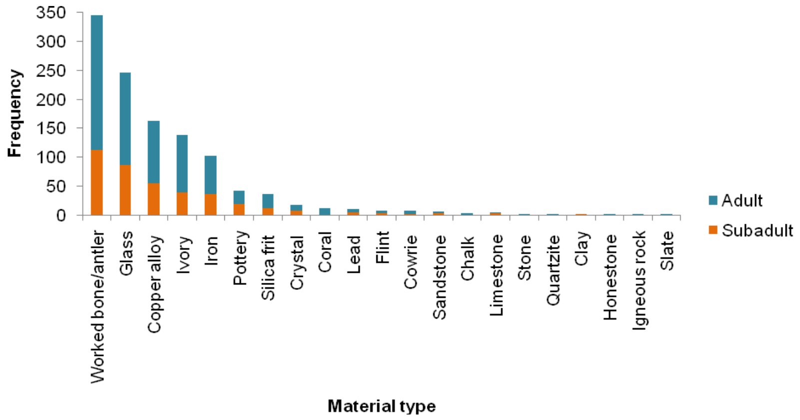


Fig 7.34 Stacked graph illustrating the frequency of pyre and grave goods categorised by material type in subadult and adult graves from Cleatham

was only recorded from a subadult burial while honestone, igneous rock and slate were exclusively found with adults. However, these associations were identified in very low frequencies and, consequently, may not have represented any significant relationship between biological age and the material of artefacts that were interred in the Cleatham cremation burials. The notion that exotic materials, such as cowrie, were only afforded to adults can be discounted since ivory was documented from both adult and subadult burials. Nonetheless, the frequency of exotic materials that were identified in subadult and adult burials was variable, for example coral was recorded from 11 separate adult interments but was only noted on one occasion from a subadult burial.

Correspondence and cluster analyses were employed to explore discrete associations between biological age and artefact material type, which includes unworked animal bone. In total 781 individuals, which included 319 subadults and 462 adults, were incorporated in the following analyses. The quantification plot, which was generated through correspondence analysis, showed evidence of two distinct groupings. An association between ivory and glass along dimension two of the quantification plot (group two) (Fig 7.35). Cluster analysis highlighted that a total of 90 separate burials, which comprised of 24 subadults and 66 adults, contained artefacts that were made out of ivory and glass. Limestone, quartzite, sandstone, igneous rock and (worked) flint formed a group along dimension one of the quantification plot (group one) (Fig 7.35). These types of stone were deposited together in varying quantities and were identified in four subadult burials and one adult interment. The inclusion of these stones created a skewed

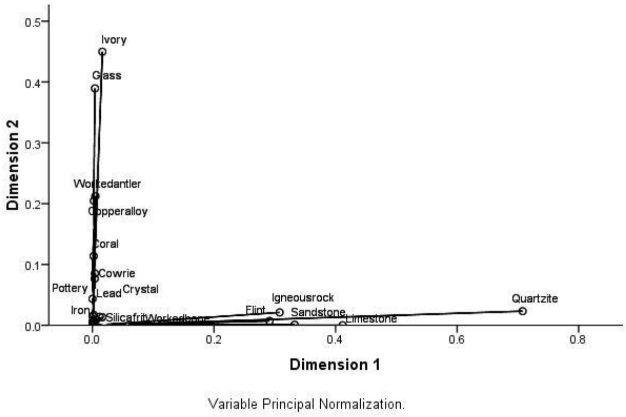


Fig 7.35 Quantification plot displaying discrimination measures based on artefact material and biological age from Cleatham

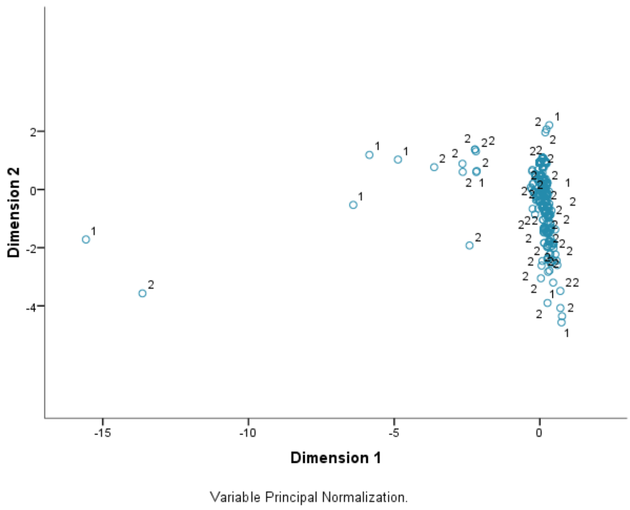


Fig 7.36 Object score plot highlighting object points based on artefact material labelled by age (1 = subadult; 2 = adult) from Cleatham

distribution of the data on the object score plot (Fig 7.36). Consequently, this analysis was carried out again but excluded limestone, quartzite, sandstone, igneous rock and (worked) flint. Group two, which contained ivory and glass, was originally positioned along dimension two of the original quantification plot (Fig 7.35) but on the reassigned plot this group is located along dimension one (Fig 7.37). In addition, a new grouping emerged on dimension two of the amended quantification plot (Fig 7.37). This group comprised of animal bone, silica frit and cowrie, and will be referred to as group three to avoid confusion. Cluster analysis highlighted that cowrie and animal bone were found together on one occasion and belonged to a subadult burial. Silica frit and animal bone were identified together in 13 adult and eight subadult burials. The amended object score plot illustrated a less skewed distribution and a more random dispersion of subadult and adult cases, which included a small number of outliers, that represent unique burial assemblages identified in groups two and three (Fig 7.38). These results highlighted that there was an insignificant relationship between biological age and artefact material.

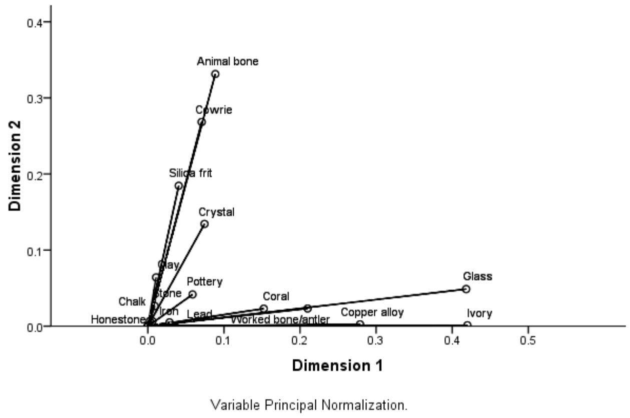


Fig 7.37 Quantification plot displaying discrimination measures based on artefact material and biological age (excluding flint, limestone, sandstone, igneous rock and quartzite) from Cleatham

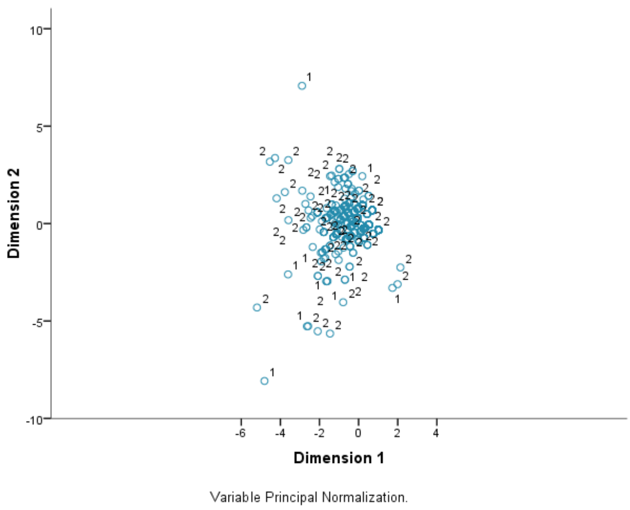


Fig 7.38 Object score plot highlighting object points based on artefact material (excluding flint, limestone, sandstone, igneous rock and quartzite) labelled by age (1 = subadult; 2 = adult) from Cleatham

Correspondence and cluster analyses were also performed to explore whether the inclusion of adolescents in the ‘adult’ age category – since they may have been viewed culturally as adults – affected the deposition pattern of artefact material types. These analyses were conducted on two occasions, one analysis included limestone, quartzite, sandstone, igneous rock and (worked) flint and the second assessment excluded these materials. In both cases, the results illustrated that the reclassification of adolescents from the ‘subadult’ group to the ‘adult’ age category weakened all associations between material type and biological age. These analyses added further support to the previous conclusion that there was an insignificant relationship between age and artefact material type. In addition these results also demonstrated that adolescents were not culturally viewed as adults based on the material of artefacts that were interred with this age group.

7.5.3 Biological sex vs. pyre and grave good type

A total of 128 biologically sexed individuals, which comprised of 51 females, 28 males, 34 probable females, and 15 probable males, and their accompanying grave assemblages were assessed to determine whether there was an association between biological sex and artefact type (Fig 7.39). Probable males and probable females were included in these analyses as they reinforced conclusions that were produced in initial analyses which solely employed confidently assigned males and females. Combs were the most frequently occurring artefact in male burials, while beads were the most common type of grave provision in female burials. However, both male and female burials contained combs, beads,

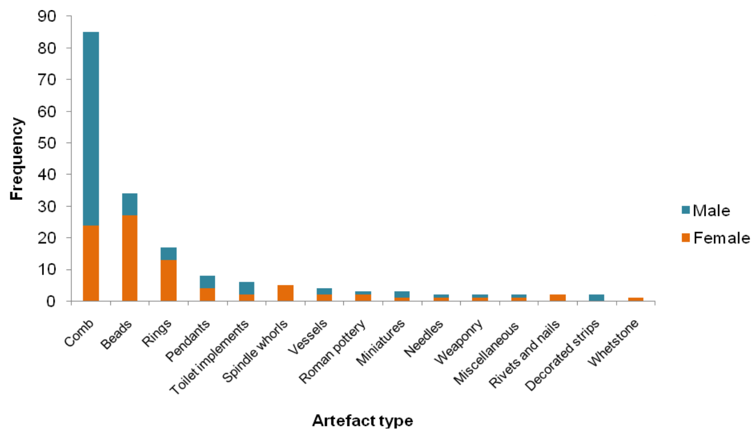


Fig 7.39 Stacked graph highlighting the frequency of pyre and grave goods in male and female cremation burials from Cleatham

rings, pendants, toilet implements, Roman pottery, miniatures, needles, weaponry and miscellaneous objects. Spindle whorls (nine), brooches (four), rivets and nails (four), buckles (one) and whetstones (one) were only identified in female burials, while decorated strips were confined to male interments (two). The majority of these 'sex-specific' artefacts occurred in such low frequencies that it was not possible to attach any degree of significance to these associations. A Pearson Chi-square test was carried out to determine whether there was a relationship between biological sex and the deposition of pyre and grave goods. Statistical testing generated an insignificant value at the 0.05 level ($X^2 = 0.066$; $p = >0.05$), which highlighted that there was no association between biological sex and the deposition of artefacts in the Cleatham cremation burials.

Correspondence and cluster analyses were employed to explore discrete associations between artefact type, animal bone and biological sex. In total 112 individuals, which included 46 females, 26 males, 29 probable females and 11 probable males, were incorporated in the following analyses. The quantification plot that was produced through correspondence analysis produced a number of discrete sex-related artefact groupings (Fig 7.40). Group one comprised of pendants and toilet implements. This grouping is positioned along

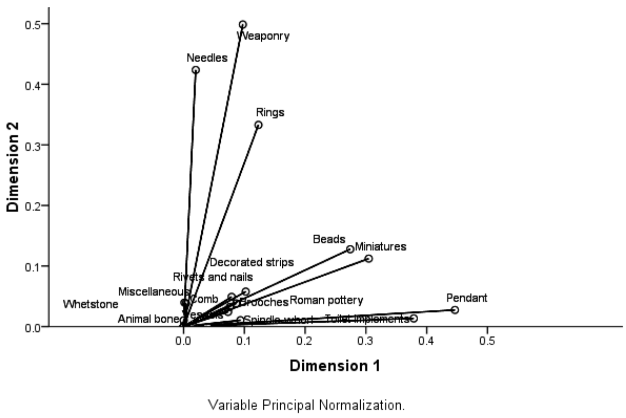


Fig 7.40 Quantification plot highlighting discrimination measures based on artefact type and biological sex from Cleatham

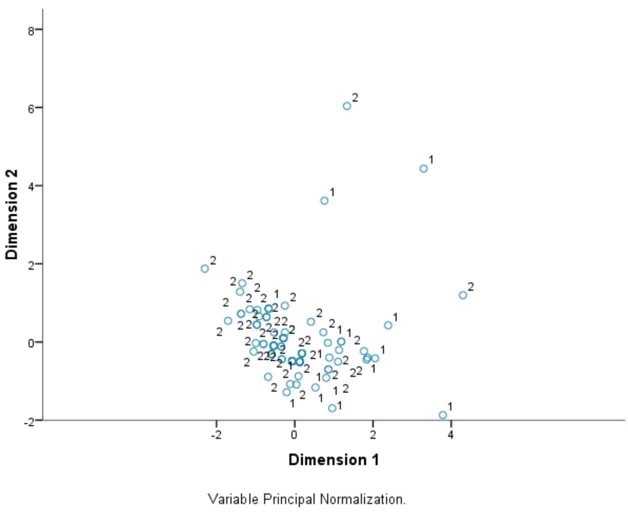


Fig 7.41 Object score plot displaying object points based on artefact type labelled by sex (1 = male; 2 = female) from Cleatham

dimension one of the quantification plot. Cluster analysis highlighted that objects belonging to group one were found together in three male and one female burial. Group two contained needles, weaponry and rings. These associated artefacts are positioned along dimension two of the quantification plot (Fig 7.40). Cluster analysis illustrated that only on one occasion, which was a female burial (MT85LK [urn 375]), did all three objects from group two occur in the same grave. A third grouping (group three), which consists of miniatures and beads, was also identified on the quantification plot and is located in between groups one and two (Fig 7.40). However, both miniatures and beads were only found together in one burial, which contained the cremated remains of a male (MT89BLD [urn 887]). The object score plot, which was also generated through correspondence analysis, depicted patterns among male and female cases based on the artefacts that were interred with these individuals (Fig 7.41). This plot exhibited a random distribution of cases with a number of outlying points, which comprised of four males and two females. These outliers are the result of unique grave assemblages that were buried with these individuals. The results that were obtained through these statistical methods illustrated that there were no clear differences regarding the type of artefacts that were afforded to males and those offered to females at the Cleatham cemetery.

7.5.4 Biological sex vs. material type

The following analyses will attempt to establish whether there was a relationship between biological sex and the material of artefacts that were interred with the deceased. This analysis assessed 128 individuals, which comprised of 51 females, 28 males, 34 probable females and 15 probable males, and their accompanying grave assemblages (Fig 7.42). Worked bone/antler was found in the highest frequency in both male and female burials. All material types were buried with both males and females, though there were some exceptions. Chalk, sandstone and limestone were exclusively found with females while the sole occurrence of crystal and (worked) flint were only recorded from male interments. However, these 'sex-specific' types of material were identified in very small numbers and, consequently, may not have represented any significant relationships between biological sex and the material of artefacts that were interred in the Cleatham cremation burials.

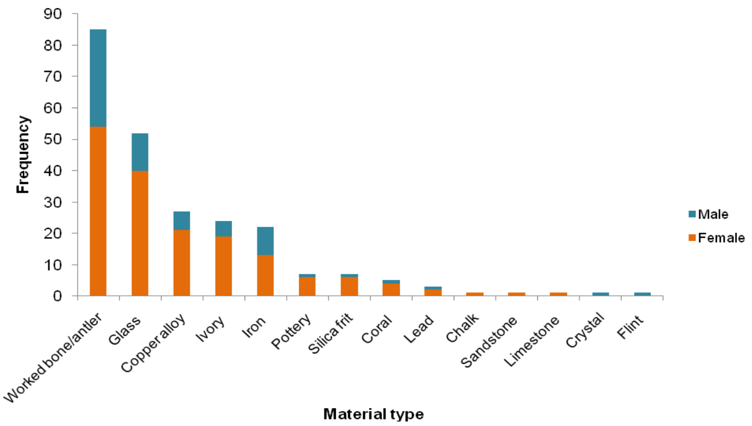


Fig 7.42 Stacked graph illustrating the frequency of pyre and grave goods categorised by material type in male and female graves from Cleatham

Correspondence and cluster analyses were employed to identify any discrete associations between biological sex and material type of pyre and grave goods. Unworked animal bone was also included in this analysis. A total of 117 sexed individuals, which included 48 females, 25 males, 30 possible females and 14 possible males, were used in this analysis. The quantification plot, which was generated through correspondence analysis, depicted an association between ivory, glass and coral along dimension one of the plot (group one) (Fig 7.43). Cluster analysis illustrated that these materials were collectively retrieved from four female and one male burial, although one female interment only contained glass and coral. A total of 19 burials, which consisted of 14 female and five male deposits, contained both glass and ivory. Group two comprised of

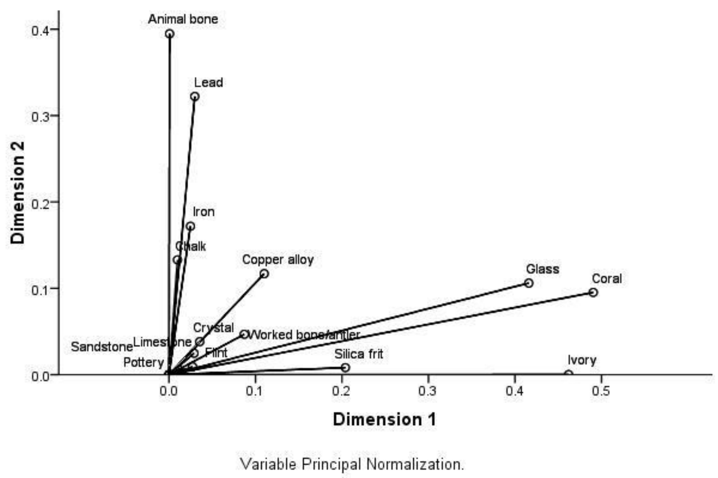


Fig 7.43 Quantification plot displaying discrimination measures based on artefact material and biological sex from Cleatham

unworked animal bone and lead and is located along dimension two of the quantification plot (Fig 7.43). These types of material were found together in two female and one male burial. The object score plot displayed a random distribution of female and male cases (Fig 7.44). This illustrated that there was no strong association between biological sex and the material of pyre and grave goods. A number of outliers were identified on the plot and belonged to individuals that were buried with unique combinations of artefacts found in groups one and two. The results that were obtained through these statistical methods illustrated that there was no clear relationship between biological sex and artefact material type. The final section of this chapter will examine the spatial distribution of cremation burials at the Cleatham cemetery.

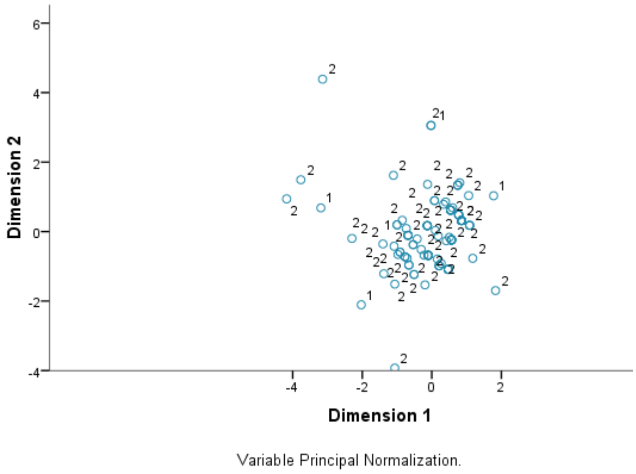


Fig 7.44 Object score plot highlighting object points based on artefact material labelled by sex (1 = male; 2 = female) from Cleatham

7.6 Cemetery organisation

Cemetery organisation was examined in order to establish whether there were any distinctive burial clusters, based on multiple deposits, age and sex, at the Cleatham cemetery. The co-ordinates of 966 cremation burials were available for the subsequent analyses. An examination of the Cleatham site plan provided evidence for a separation between the northern and southern halves of the Cleatham cemetery. Consequently, this division was assessed to establish whether there were any underlying reasons for this split pattern of disposal. A total of 118 burials were interred in the southern half of the cemetery while 848 cremation deposits were buried in the northern half of the site. It was apparent that the northern part of the cemetery was used to a greater extent than the southern area of the site and was taken into account when conducting spatial analysis. To begin the distribution of multiple deposits will be examined.

7.6.1 Multiple deposits

A total of 20 confirmed and 20 probable multiple deposits were included in this analysis. An assessment of these burials showed that the vast majority of multiple deposits were located in the northern half of the cemetery (Fig 7.45). Two multiple burials were identified in the southern half of the cemetery while 38 deposits were found in the northern half of the site. A Pearson Chi-square test was carried out to determine whether there was an association between multiple burials and the location of their interment. This statistical test produced an insignificant value at 0.05 level (X^2 = 2.069; p = >0.05) which illustrated that there was no relationship between multiple burials and location of their interment at the Cleatham cemetery.

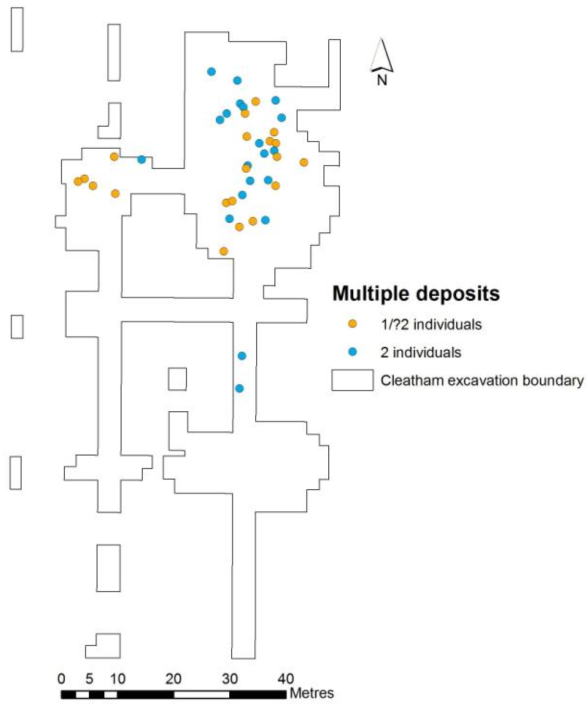


Fig 7.45 Spatial distribution of multiple deposits at Cleatham

Spatial cluster analysis was applied to these data to illustrate the presence of any significant and insignificant groupings on the basis of multiple burials at the Cleatham cemetery. This statistical assessment did not generate any significantly high positive or low negative Z scores (Fig 7.46) (section 5.4.3 of this thesis provides further details concerning Z scores). A high positive Z score would have provided evidence that neighbouring burials were extremely similar in nature and would have possessed comparable Z values. In contrast low negative Z scores would have indicated that a burial was surrounded by dissimilar interments. Nonetheless two groups of multiple burials that both possessed positive Z scores (1.0-2.0) were examined in more detail. The first cluster of burials was located in the north-western section of the cemetery and comprised of five probable multiple deposits. Each of these interments contained a subadult alongside a possible second individual that was identified as an adult, a second subadult or an individual who was not assigned biological age owing to the lack of diagnostic elements. These multiple deposits were assigned similar Z scores and, as a result, formed a discrete cluster of burials. In the most northern area of the cemetery a positively associated group of four (definite) multiple deposits were recorded. Each of these burials contained the cremated remains of an adult alongside a subadult or a second adult. The remaining multiple deposits that did not fall into these burial clusters

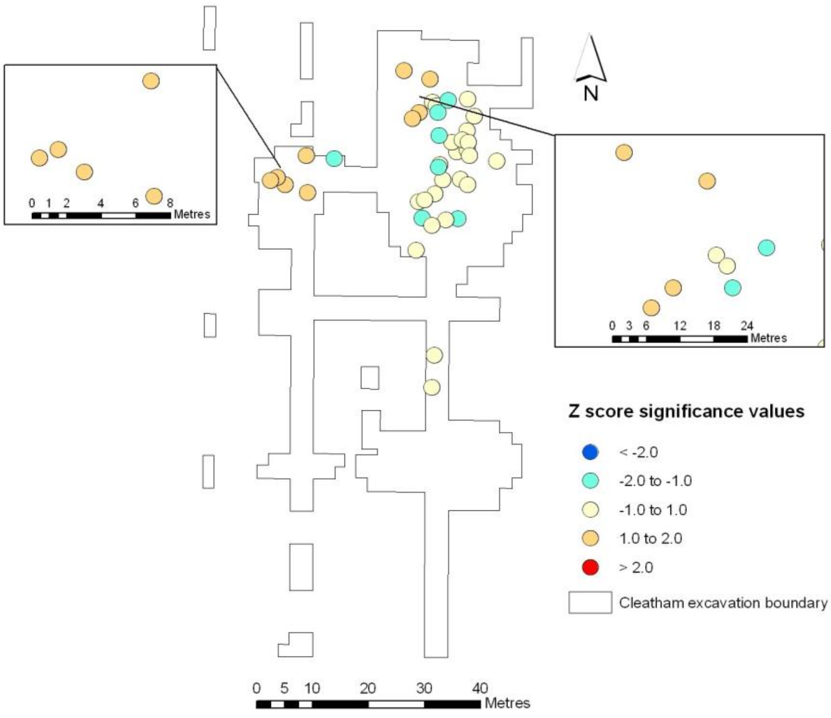


Fig 7.46 Spatial cluster analysis of multiple deposits at Cleatham

possessed negative Z scores or values that indicated no strong association between neighbouring multiple deposits. The results from these analyses indicated that multiple burials were not interred in a designated area of the Cleatham cemetery, though there was a concentration of multiple deposits in the northern half of the cemetery. In addition cluster analysis highlighted that there were only two, relatively small, positively associated multiple burial groupings at the Cleatham cemetery.

7.6.2 Age

The co-ordinates for 855 biologically aged individuals were available for this analysis. Initially analyses were conducted on three foetuses, 99 infants, 71 children, 54 adolescents, 164 young adults, 185 younger mature adults, 23 older mature adults, three older adults, 131 subadults and 122 adults (co-ordinates were not provided for one adult burial, MT86TL [no urn number]). However, owing to the presence of numerous age categories, it was difficult to identify any clear spatial patterning. Therefore this analysis was disregarded. Consequently broader age categories (subadults and adults) were employed in this study which aimed to provide an unambiguous depiction of the spatial deposition of aged individuals at the Cleatham cemetery. Foetuses, infants, children and adolescents formed the 'subadult' group, which contained 358 individuals, while young adults, younger mature adults, older mature adults and older adults were placed in the 'adult' category, which consisted of 497 individuals (Fig 7.47). A total of 35 subadults and 52 adults were identified in the southern half of the cemetery while 324 subadults and 444 adults were located in the northern half of the site. A Pearson Chi-square test was carried out on these data to establish whether there was an association between biological age and the location of interment. The results from this statistical test generated an insignificant value at the 0.05 level ($X^2 = 0.123$; $p = >0.05$). These data demonstrated that burial in the northern or southern half of the cemetery was not dependent on the biological age of an individual at the Cleatham cemetery.

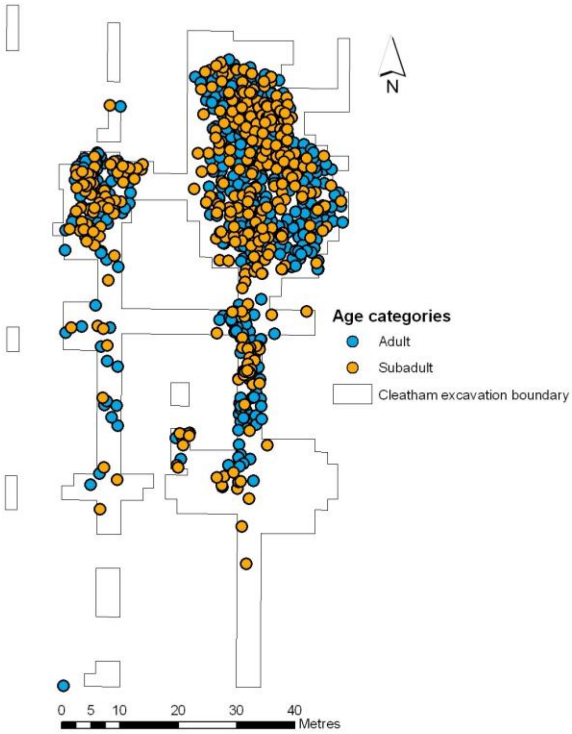


Fig 7.47 Spatial distribution of subadult and adult burials at Cleatham

Spatial cluster analysis was employed to produce a clearer picture of the significant and insignificant associated burials based on biological age at the Cleatham cemetery (Fig 7.48). The most significant associations will be outlined in this chapter and will start with an assessment of burials in the south of the cemetery. The first significant cluster of burials comprised of eight strongly associated adult interments. These burials were surrounded by 14 adult deposits that were ascribed positive Z scores of 1.0-2.0. In addition one adult burial that was identified among this group was assigned a low negative Z score (a second adult burial possessed a positive Z score of 1.89 but ArcGIS assigned the wrong colour [dark blue] to this deposit). A strongly disassociated subadult burial, which was allocated a Z score of -2.9, was recorded south of the aforementioned adult burial cluster. Moving to the north-eastern area of the cemetery, a large statistically significant cluster of adult burials, which were assigned high positive Z scores, was identified in this analysis. This burial cluster also contained a number of strongly disassociated subadult burials, which possessed very low negative Z scores, and illustrated that these deposits possessed dissimilar values to the surrounding adult interments. A cluster of 12 strongly associated subadult burials, which were assigned high positive Z scores, was recognised in the extreme north of the cemetery. A number of adults were found in this area and, interestingly, the majority of these older individuals were females; this group of deposits will be explored further at a later stage in this chapter. The final cluster of burials that was detected in this analysis was located in the north-western area of the cemetery. This grouping comprised of 15 positively associated adult burials and two strongly disassociated subadult interments. An initial assessment of these data highlighted that subadult and adult burials were dispersed throughout the Cleatham cemetery. However spatial cluster analysis illustrated that there was a number of discrete statistically significant burial clusters based on biological age of the burial population.

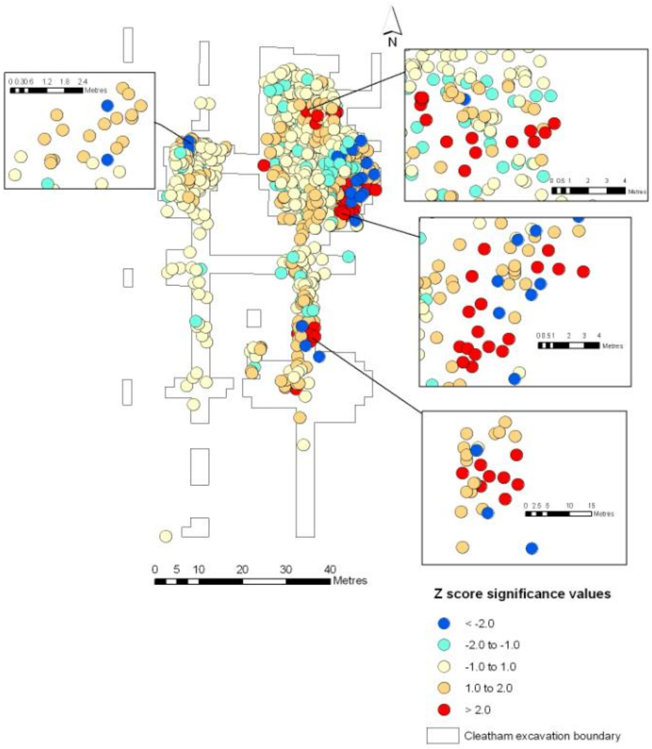


Fig 7.48 Spatial cluster analysis of subadult and adult burials at Cleatham

The following analyses were conducted to examine whether adolescents were culturally viewed as adults, as opposed to subadults, and if this had an influence on the spatial distribution of burials at the Cleatham cemetery. Therefore foetuses, infants and children were assigned to the 'subadult' age group, which contained 304 individuals, while adolescents, young adults, younger mature adults, older mature adults and older adults were allocated the 'adult' age category, which consisted of 551 individuals. In total 29 subadults and 59 adults were interred in the southern half of the cemetery while 275 subadults and 492 adults were interred in the northern half of the site (Fig 7.49). A Pearson Chi-square test was carried out on these data to determine whether there was an association between age (when adolescents are classified as adults) and the location of interment. The results from this statistical analysis produced an insignificant value at the 0.05 level (X^2 = 0.290; p = >0.05). Again, these data demonstrated that burial in the northern or southern half of the cemetery was not dependent on the age of an individual, even when adolescents were classified as adults, at the Cleatham cemetery.

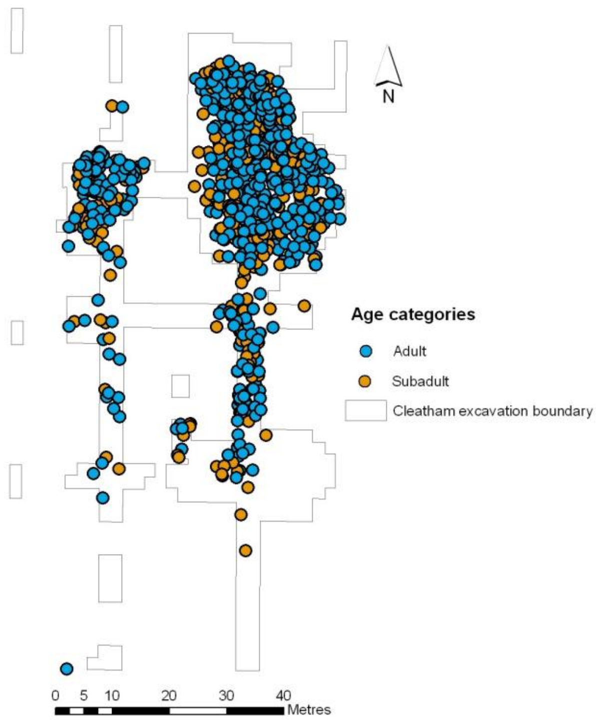


Fig 7.49 Spatial distribution of subadults and adults at the Cleatham cremation cemetery when adolescents are classified as adults

Spatial cluster analysis was applied to these data to illustrate the presence of any significant and insignificant groupings based on the age of the Cleatham burial population (Fig 7.50). The inclusion of adolescents in the adult age category has weakened many associations between the adult deposits, which is particularly evident in the previously identified burial clusters located in the south, north-west and north-east of the cemetery. However a statistically significant group of 11 subadult interments emerged to the west of the weakened north-eastern cluster of burials. These (subadult) deposits possessed very high positive Z scores, though a number of unassociated adult burials were also identified among this group of burials. The statistically significant cluster of subadult interments from the extreme north of the site, which was illustrated in the previous spatial cluster analysis, reduced in size from 12 associated deposits to five affiliated burials. On the whole these results have demonstrated that the inclusion of adolescents in the 'subadult' age category generated stronger associated burial clusters than the placement of adolescents in the 'adult' age group. Therefore it appears that adolescents were more akin to younger subadults than adults with regards to the spatial distribution of this age grouping. However the burial associations that were observed in this analysis may also have been the result of increased adult and decreased subadult sample sizes.

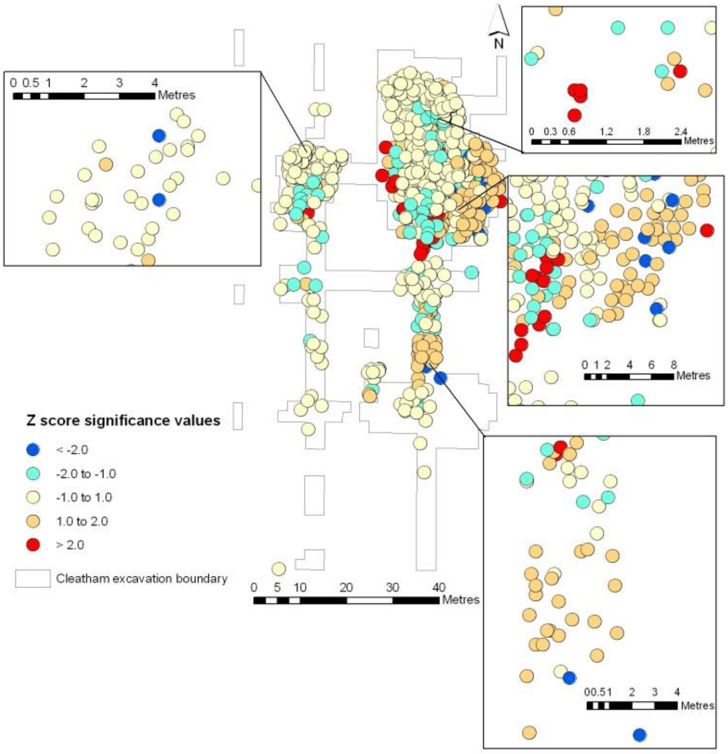


Fig 7.50 Spatial cluster analysis of subadult and adult burials at Cleatham when adolescents are classified as adults

7.6.3 Biological sex

The final spatial analysis that was conducted on the Cleatham assemblage assessed the distribution of cremation burials based on biological sex. Co-ordinates were available for 58 females, 40 probable females, 67 indeterminates, 32 males and 17 probable males; which produced a total of 214 individuals. These burials were plotted on to a distribution map which illustrated that males and females were, on the whole, randomly dispersed throughout the cemetery (Fig 7.51). 'Confidently assigned' and 'probable' males and females were incorporated into the same group for the purpose of statistical testing. The southern half of the cemetery contained eight females and four males while a total of 90 females and 45 males were identified in the northern half of the site. A Pearson Chi-square test was performed to determine whether individuals were interred in the northern or the southern half of the Cleatham cemetery on the basis of their biological sex. The results from this statistical test generated an insignificant value at the 0.05 level ($X^2 = 1.000$; p = >0.05). This analysis highlighted that burial in the northern or southern half of the cemetery was not dependent on the biological sex of an individual.

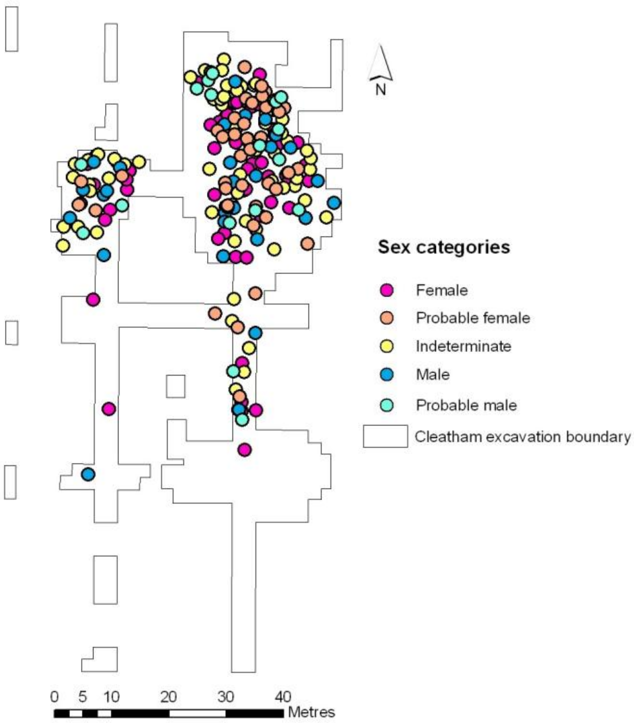


Fig 7.51 Spatial distribution of male and female burials at Cleatham

Spatial cluster analysis was employed to produce a clearer picture of the significant and insignificant associated burials based on biological sex at the Cleatham cemetery. A cluster of female interments were identified in the extreme north of the cemetery (Fig 7.52). This grouping comprised of nine female and two probable female burials. Three of the confidently assigned females were assigned Z scores of 2.0 (and above) while the remaining individuals in this group were ascribed Z values of 1.0-2.0. Two confidently assigned male burials, which possessed positive significance values, were found to the east of the aforementioned female burial cluster. In addition two male interments were identified in the south-western corner of the female burial group and were ascribed very low (negative) Z scores. On the whole male and female burials were randomly distributed throughout the Cleatham cemetery, although there was a strongly associated group of females in the extreme north of the site. However females were buried throughout the Cleatham cemetery and were not solely confined to the northern area of the site. In sum these results suggested that biological sex was not an influential factor in the burial location of individuals at the Cleatham cemetery.

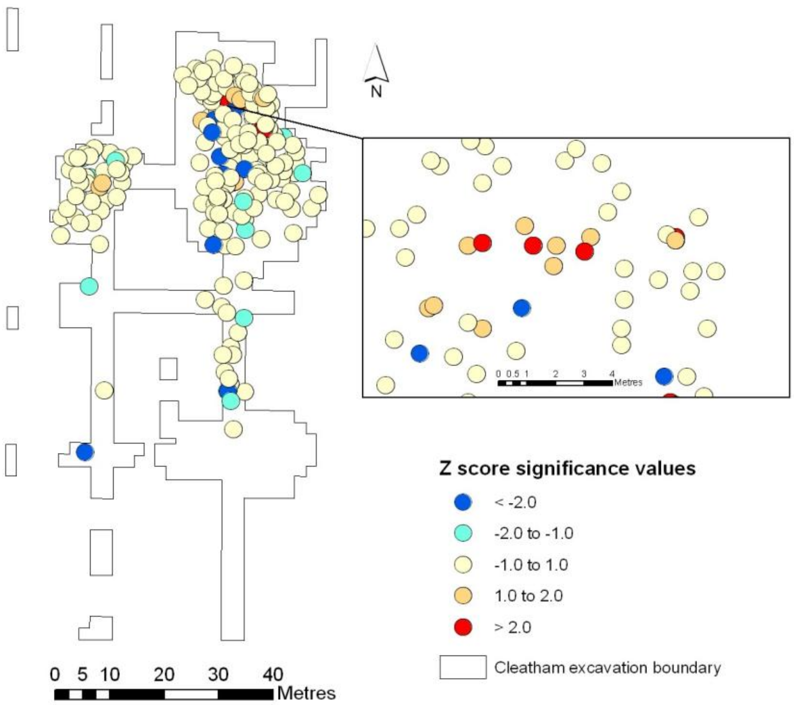


Fig 7.52 Spatial cluster analysis of male and female burials at Cleatham

7.7 Summary

An osteological assessment of the unburnt bone fragments from the Cleatham cemetery highlighted that preservation at the site was relatively poor and, consequently, little information could be extracted from these skeletal remains. In contrast an in-depth osteological analysis of the cremated bone generated a detailed insight into both the demographic nature of the burial population and the cremation rite that was conducted at the Cleatham cemetery. The demographic structure at this site was comparable to age and sex profiles that were identified from other Anglo-Saxon cremation cemeteries. Stringent criteria were employed during osteological assessment to reduce the possibility of misidentifying individuals and may have contributed to the low frequency of biologically sexed individuals from Cleatham. The weight, maximum fragment size, shrinkage, warping and fissuring of burned skeletal remains all suggest that pyre technology and the subsequent treatment of bone was very similar at the sites examined in this thesis.

A recurrent problem that was encountered during the analysis of the Cleatham cremation assemblage was the fact that, in most instances, only small sample sizes could be included in statistical testing owing to the dearth of osteological and/or artefact data. Nevertheless, some interesting results were generated in these analyses, for example biological age appears to have played a more important role in the selection of cinerary urns and the deposition of animal offerings and grave furnishings than biological sex. The reclassification of adolescents from the 'subadult' grouping to the 'adult' age category did strengthen a small number of statistical relationships, for example the association between age and presence of animal bone and age and deposition of pyre and grave goods. However, these strengthened associations could have been the result of increased adult and decreased subadult sample sizes. Similar to the results that were obtained from the Elsham analyses (chapter six) there were no clear cut relationships between grave provision type and material of pyre/grave goods and biological attributes of the burial population. This may, in part, be due to the loss of material culture in the cremation rite and/or archaeological record or, alternatively, other means were employed to convey identity in the Anglo-Saxon cremation rite. These analyses also highlighted that multiple deposits, age and sex were not influential factors in the burial location of individuals at the Cleatham cremation cemetery. The following discussion chapter will interpret the results that were obtained from the Elsham and Cleatham cemeteries.

Chapter 8: Discussion

The key issues that have been explored throughout this thesis include the demography of early Anglo-Saxon cremation practising communities, identity, symbolism and pyre technology. These aspects of Anglo-Saxon funerary archaeology can be examined through an osteological assessment of cremated bone and accompanying grave assemblages. Burned skeletal remains can tell us a great deal about group and individual identity, social structure, ideological beliefs, economy, trade, labour, perceptions towards other members of society and technological understanding with regards to pyre construction and the cremation process. After presenting the results from the Elsham and Cleatham cremation cemeteries in the two preceding chapters of this thesis, this chapter will place the data from these cemeteries into the context of contemporary cremation sites. A discussion and interpretations of these results will be offered in response to the data acquired from Elsham and Cleatham on an intra- and inter-site level. Primarily, this discussion will explore the demography of Anglo-Saxon cremation cemeteries. Subsequently, an interpretative exploration of the symbolism of cremation burials, with a strong focus upon associations between biological attributes of an individual, such as age and sex, and grave provision. This chapter will conclude with a detailed examination of pyre technology and the social implications that may have been involved in this funerary practice.

8.1 Cultural implications of the demography of Anglo-Saxon cremation cemeteries

The first section of this chapter will focus upon the demographic nature of the Elsham and Cleatham burial populations. Detailed interpretations will centre on the most prolific findings concerning the age, sex and overall health of individuals from these sites. In addition, the discussion examines multiple deposits and the spatial distribution of these cemeteries in conjunction with demographic data to establish whether individuals were afforded differential funerary treatment based on their biological attributes.

8.1.1 The underrepresentation of infants from the Elsham and Cleatham cemeteries

The absence of infants from cemetery sites is a recurring theme within early Anglo-Saxon funerary archaeology. Cremation has been suggested as an alternative mortuary rite that was afforded to infants, which might explain the low frequency of infants encountered in early Anglo-Saxon inhumation cemeteries (Crawford 1999, 76; Leahy 2007, 60). Sally Crawford (1999, 76) has proposed that '[o]ther methods may have been used to dispose of infants, such as cremation without subsequent burial' while Kevin Leahy (2007, 60) has suggested that the low frequency of children at Cleatham 'may be due ... to a tendency to cremate children's bodies'. However, based on the evidence from Elsham, Cleatham and other Anglo-Saxon cremation cemeteries observed in the previous results chapter (chapter seven), the deficiency of infants from these sites does not account for the missing individuals from inhumation cemeteries. These results have illustrated that infants were treated in a similar manner among communities practicing both inhumation and cremation (Squires, forthcoming). A number of alternative suggestions have been put forward as to the whereabouts of these missing individuals. These explanations will be assessed in turn to gain a better understanding of the funerary treatment afforded to infants during the early Anglo-Saxon period.

Taphonomy and preservational bias are the most practical explanations for the poor survival of infant skeletal remains. The reasoning behind such explanations is based upon the notion that infant bones are more fragile and, thus, more prone to taphonomic decomposition than the remains of older individuals. For example, infants that were buried at sites with acidic soils and the interment of young individuals in shallow graves, which consequently led to post-depositional disturbance, are thought to have affected infants to a greater degree than adults who were afforded the same burial treatment (Crawford 1993, 84; Scott 1999, 121). Furthermore, recovery bias is dependent on the research interests of the excavator, area of excavation and time constraints upon archaeological recovery and post-excavation processing of skeletal remains, which may influence the amount of infant skeletal material identified from an archaeological site (Buckberry 2000). A good example of recovery bias has been identified from the Caistor-by-Norwich (Norfolk) cremation assemblage (Figure 59). The excavator of this cemetery had a particular interest in the skeletal remains of children (Wells 1973, 120). An examination of the Caistor-by-Norwich osteological material has highlighted that there was a clear preference towards the collection of unerupted teeth and unfused bones from this site (Wells 1973, 120). This observation would explain why there were an unusually high number of children from the Caistor-by-Norwich cemetery. A more in-depth discussion about the preservation, taphonomy and recovery of infant skeletal remains can be found in Squires (forthcoming).

The lack of infants from both types of cemetery may be the result of a conscious decision not to inter these individuals within the community cemetery. There are many cultural explanations for the exclusion of infants from large cemetery sites and each of these will be examined in turn. The notion that infants were deposited in water has been suggested as an explanation for the low frequency of infants in early Anglo-Saxon inhumation cemeteries (Molleson 1991). Based on Etter and Schneider's (1982, 53) work, which deals in part with the treatment of infants on the Continent from the period in question, Molleson (1991, 118) suggests that the Saxons brought the custom of so-called 'fitness testing' to Britain. This practice may have involved subjecting newborn babies to cold water, which was likely to have been a stream or river (Molleson 1991, 118). If the infant survived it is thought that the baby was kept, but if not the individual was left in the body of water. This procedure may have been perpetuated to control population numbers for social or economic reasons or may have been a means of ensuring that only the strongest individuals survived (Molleson 1991, 120). It is also possible that cremated and unburnt skeletal remains were deposited in bodies of water.

This practice has been identified in ethnographic studies from Nepal (Oestigaard 2000, 27), China (Fengming 2005, 120) and Japan (Bernstein 2005, 279). Examples of bodies that have washed up in riverine deposits and skeletal remains from underwater archaeological contexts have been identified in the past, which suggests that the deposition of cadavers in watery deposits could survive to the present day (Than 2010). However, there is no archaeological evidence from the early Anglo-Saxon period, to date, proving that this practice took place.

It has recently been suggested that the low frequency of infants from early Anglo-Saxon inhumation and cremation cemeteries can be accounted for by their differential burial within settlements and buildings, a practice that has also been identified on the Continent (Hamerow 2006; Crawford 2008), and in both the Iron Age (Armit and Ginn 2007) and the Roman (Moore 2009) periods. Helena Hamerow (2006, 13) points out that one third of human deposits from settlement contexts belonged to infants, which is a higher frequency than is usually found in contemporary cemeteries, and, while it is a small sample, the percentage is closer to expected rates of infant mortality than is reflected in cemeteries. The discovery of infants interred in domestic contexts has been linked to the practice of infanticide and fertility ideology (Scott 1999, 122; Hamerow 2006, 28). It has been proposed that the presence of infants within the domestic sphere may represent an offering to ensure future fertility of the community and protect stored grain (Hamerow 2006, 28). A similar practice has been observed among the Hindu practicing communities in Nepal, where children are buried close to non-arable land adjacent to the home (Oestigaard 2000, 24). Alternatively, infanticide may have been a means of controlling the size of a family unit or disguising the conception of an illegitimate child. If infanticide was carried out it is possible that this would have been a secretive act and was performed in private. There is a possibility that infanticide may have been carried out during the early Anglo-Saxon period, though it is apparent that, based on the results outlined in this thesis, victims of infanticide were not interred in community cemeteries. It is worth highlighting that the ethnographic examples noted in this discussion provide an alternative perspective of funerary practices in Anglo-Saxon England. However, as outlined in chapter one of this thesis, no two societies are the same and it would be an error to conclude that ethnographic accounts can ever be directly applied to archaeological data without some degree of reinterpretation.

An alternative explanation for the deposition of infants in domestic contexts is that these individuals may have been viewed as ‘outsiders’ by the rest of the community, for example these infants may have been illegitimate, (born as) slaves or disabled. Consequently these individuals may have faced hardship, ill treatment and had few rights during life, while in death a careless and concealed burial within domestic contexts was deemed the most appropriate form of funerary treatment for these infants (Kuefler 1991, 828). Interestingly, adult skeletal material has also been found within these settlement deposits, and, in the vast majority of cases, appear to have been adult females (Crawford 2008, 202). An example of this type of interment was identified at the settlement of Sutton Courtenay (Berkshire). This deposit was found in a pit and consisted of the skeletal remains of an adult female, who was placed in a twisted position and her arms were half out-stretched, and an infant alongside two oxen and a horse skull (Leeds 1947, 86). These infants, children and female adults may have belonged to a denigrated social group and, as a result, were not afforded the same burial rite that was provided for the rest of the community.

There is a possibility that this subgroup may have comprised of females, and their offspring, that were involved in textile or some other form of craft production. Section 8.1.2 of this thesis will address this theory (and its potential flaws) in further detail. This notion may also explain the associated grave assemblage, which includes animal bone, spindle whorls, loom weights, pins, combs, and broken pots, found with these individuals and their interment within buildings that may have once been allocated for manufacturing craft products (Crawford 2008, 198). Interestingly, Nick Stoodley (1999, 110-111) has proposed that artefacts related to textile production, for example spindle whorls and weaving batons, that have been found with infants and children in early Anglo-Saxon inhumation cemeteries could illustrate that economic and social roles were ascribed to these individuals at a very young age. This explanation could also be used to explain the deposition of infants and children that were interred in domestic contexts. However, the fact that some infants were interred in cemeteries and others were buried in domestic contexts, despite being afforded similar grave assemblages, may point to differences in social status. It has been suggested that individuals who were buried within community cemeteries were of a higher social standing than persons who were excluded from burial at these sites (Scott 1999, 122). Whatever the case may be, it is apparent that infants and children were, for the most part, accepted members of the community but due to their age and social standing, their funerary treatment sometimes, but not inevitably, differed from the rest of society (Sofaer Derevenski 1994, 15; Chamberlain 1997, 249).

8.1.2 Sex

At both Elsham and Cleatham there was a higher frequency of females than males, which was similarly noted at Sancton (East Riding of Yorkshire) (McKinley 1993, 294) and Spong Hill (Norfolk) (McKinley 1994, 69) (Fig 7.14). In all cases it is possible that the high frequency of females may have been due to a preservational bias; for example many of the individuals without surviving sexually diagnostic elements may have been males. Thus there remains a possibility that the sex ratio of males and females was more even than is illustrated by the data, although this is difficult to say with any degree of confidence. There is also a possibility that young adult males from the Elsham and Cleatham cemeteries were classified as females as a result of shrinkage that was caused by the cremation process. Shrinkage of bone may have caused undeveloped diagnostic features to look more gracile than the characteristic male robustness and traits commonly identified on inhumed individuals. However, a number of contemporary inhumation cemeteries and the inhumations among mixed rite cemeteries produced a greater number of females than males. These cemeteries include: Great Chesterford

(Essex) (Waldron 1994, 52); Castledyke South (North Lincolnshire) (Boylston, Wiggins and Roberts 1998, 222); Lechlade (Gloucestershire) (Harman 1998, 44) and Spong Hill (Norfolk) (Ravn 2003, 102) while a similar ratio of male and female burials were observed at Berinsfield (Oxfordshire) (Harman 1995, 107); Edix Hill (Cambridgeshire) (Duhig 1998, 157) and Worthy Park (Hampshire) (Wells, Denston and Chadwick Hawkes 2003, 153). In contrast, 22 of the 37 identifiable inhumed individuals from the Cleatham cemetery were assigned to the male category while the remaining 15 individuals were ascribed to the female group (Leahy 2007, 60). These observations highlight two main points. Firstly, shrinkage of cremated bone was not a significant factor in the identification or, indeed, misidentification of male skeletal remains from Elsham and Cleatham. Secondly, the notion that males were inhumed as opposed to cremated, which may have explained the shortage of males from cremation cemeteries, can be dismissed.

Male mortality rates within each age category appear to have followed a similar demographic model to the female mortality profiles from Elsham and Cleatham, though males are found in smaller numbers in each age grouping. Therefore, it is feasible that males were buried elsewhere, for instance if these individuals were involved in battles or economic activities, such as trade. Roberta Gilchrist (1997, 45) highlighted that the paucity of female graves from middle Saxon burial grounds that were located in towns of this period may have represented a male-orientated domain. It is possible that males moved to larger town sites or ports in order to trade at certain times of the year (Huggett 1988, 93; Yorke 1990, 40). Consequently, females would have been left behind at the settlement sites to continue fulfilling their economic and social roles. There is a possibility that males were buried elsewhere but, unlike the middle Saxon period (Yorke 1990, 40; Gilchrist 1997, 45), large graveyards that are associated with areas of trade and primarily consist of males have not been found from the early Anglo-Saxon period.

In contrast to the low frequency of male burials that were identified from Elsham and Cleatham, a high frequency of females was recorded from both sites. Biological and cultural factors will be considered to explain the possible reasons for this demographic trend. The risk of maternal death may provide an explanation for the high frequency of females, particularly those who fell into the ‘younger mature adult’ (26-30 years) age category, from early Anglo-Saxon cremation cemeteries. Modern studies in advanced maternal birth have repeatedly found that females who give birth at an older age face a greater risk of mortality than women who give birth at a younger age (Alexander *et al.* 2003; Temmerman *et al.* 2004; Luke and Brown 2007). The danger of maternal mortality continues to be a problem around the world despite improvements in medical care and a greater understanding of pregnancy (Hogan *et al.* 2010). The elevated risk of childbirth complications during the Anglo-Saxon period is best suited to a comparison with countries, or localised areas, that have poor medical facilities. Females that live under such conditions face a greater risk of death during childbirth owing to a multitude of factors, which include age, social status, wealth, medical facilities and age of marriage and, subsequently, of conception, which, in turn, are all connected (Shen and Williamson 1999). Females from these communities frequently marry and have their first child at a younger age than their counterparts living in developed countries or more affluent areas (Shen and Williamson 1999, 199). This may also have been the case during the early Anglo-Saxon period though marriage and, subsequent, conception at an early age was equally as likely to have been due to cultural beliefs and social protocol.

As outlined in chapter three of this thesis, historical documentation illustrates that individuals were culturally identified as adults at a younger age than those who live in developed countries in the 21st century. Based on seventh-century law-codes, it is possible that similar legal and cultural values were held in the fifth and sixth centuries, and older childhood and adolescence may have been important thresholds with regards to marriage and social role (Orme 2003, 322). However, if we are to take this standpoint, childbirth complications that resulted in death would be highlighted by a high frequency of adolescents from Elsham and Cleatham, which is not the case. Evidence that females died as a result of childbirth during the early Anglo-Saxon period is scanty. In addition, the apparent paucity of foetuses and infants from contemporary cremation and inhumation cemeteries, as discussed earlier in this chapter, does not provide sufficient evidence to support the idea that childbirth complications resulted in high female mortality rates. Maternal mortality was undoubtedly a problem encountered during the early Anglo-Saxon period though this explanation alone does not appear to be the primary underlying reason for the high frequency of females from the sites in question.

Textile production, such as spinning and weaving, is an activity closely associated with females during the Anglo-Saxon period as spindle whorls, loom weights and weaving batons have been found in a number of female inhumation burials (Boyle *et al.* 1998; Foreman 1998, 292-294; Härke 2011). The similarity of artefact assemblages found in domestic deposits and cremation burials, for example combs, spindle whorls and animal bone, supports the idea that cremation practicing communities were involved in craft production. This type of labour would have been carried out by females who had lived in the community all of their life and this type of activity would have been carried out in the settlements of Anglo-Saxon England. Textile production would have been time consuming. This is exemplified by modern productions of Anglo-Saxon dress, which in one instance took 200 hours for one individual to produce a completed garment (Walton Rogers 2007, 250). Males would also have contributed to the textile industry, though this appears to have been centred on outdoor and more laborious work, such as attending to the livestock (Walton Rogers 2007, 45). Nevertheless, that is not to say that females did not partake in so-called male economic roles (especially if males had to leave the settlement for economic or military duties), or vice versa, and we must keep an open mind regarding the social roles and gender of individuals.

There is a plethora of documentary evidence from later Anglo-Saxon England and contemporaneous sources from the Continent that highlight the use of slaves by households that were involved in weaving and textile production (Owen-Crocker 1986, 290; Walton Rogers 2007, 45-46). However, there is insufficient evidence from this period to suggest that textile production was carried out on a large-scale. Instead, it appears that this type of craft production was conducted on a smaller scale to accommodate the needs of the local populace. Thus, there is not enough evidence to suggest that females were being brought into settlements to participate in textile, or other craft, production and this explanation cannot account for the high frequency of females from Anglo-Saxon cremation cemeteries. To conclude, preservation bias (of sexually diagnostic bones) appears to be the main cause for a higher frequency of females than males from Anglo-Saxon cremation cemeteries. However, biological (e.g. maternal mortality) and cultural (i.e. males travelling away from settlements for economic and social reasons) factors are also likely to have contributed to the unbalanced sex ratios that have been identified from the Elsham and Cleatham cemeteries.

8.1.3 Health and disease of individuals from Anglo-Saxon cremation cemeteries

Health-related conditions that affected individuals from Elsham and Cleatham correspond with pathological indicators identified from contemporary cremation cemeteries (Harman 1989; McKinley 1993; McKinley 1994). As previously mentioned in the methodology chapter of this thesis, the examination of health and disease was not a primary research theme in this study, but nonetheless deserves a brief discussion. The most common conditions identified among the Elsham and Cleatham skeletal assemblages included periostitis, dental caries, Schmorl’s nodes, osteoarthritis, cribra orbitalia, large musculoskeletal markers (MSMs) and exostosis. It has been established that the early Anglo-Saxon period was dominated by rural agricultural communities (McKinley 1994, 118; Roberts and Cox 2003, 164). Based on the high frequency of faunal remains recovered from Elsham and Cleatham, alongside other early Anglo-

Saxon cremation cemeteries (Bond 1993, 300; Bond 1994, 135), it is evident that domesticated animals played an important part in the daily lives of these communities. Livestock would have been kept for a variety of reasons including food, traction and secondary products, for example skins and wool would have been used for clothing while animal bones were worked into a variety of tools and craft products (Bond 1994, 135; Roberts and Cox 2003, 183). In addition to raising livestock, crops were also cultivated in early Anglo-Saxon England. Charred remains excavated from archaeological contexts and evidence from later documentary sources have highlighted that wheat, barley and oats appear to have been the most popular types of crop owing to the temperate climate of the British Isles (Green 1993, 268; Van der Veen 1993, 80; McKinley 1994, 91; Pearson 1997, 4; Hagen 2010). It is expected that these agricultural communities would have suffered from a multitude of degenerative conditions that affected the joints and spine since heavy manual labour places the body under significant physical pressure. Furthermore, pronounced musculoskeletal markers would have also developed on the bones of individuals that participated in strenuous activities, particularly males who were involved in farming, as a result of the mechanical stress placed on bone (Weiss 2007).

Dental conditions, such as carious lesions, ante-mortem tooth loss and abscesses, are most commonly caused by poor dental hygiene, infection, trauma and diet. Archaeological evidence from this period, alongside later documentary sources, point to a diet consisting of meat, fish, dairy products, cereals, fruits, vegetables, nuts, legumes and possibly honey (Privat, O'Connell and Richards 2002; Hagen 2010). Diets that relied heavily upon coarse foodstuffs, especially cereals that would have been (coarsely) ground using a quern stone, would have given rise to an array of dental conditions (Hagen 2010, 449). Palaeopathological indicators identified from Elsham and Cleatham fit into the categories expected of an agricultural society, which is a deduction analogous to the conclusion made regarding the Spong Hill skeletal assemblage (McKinley 1994, 118). Due to the condition and nature of cremated remains it is not possible to gain a truly representative understanding of health and disease from cremation practicing communities. However, any information that can be extracted from cremated remains will contribute to our ever-increasing understanding of palaeopathological conditions and the lifestyles of individuals from these early Anglo-Saxon societies.

8.1.4 Multiple deposits

Multiple deposits were examined to establish whether this type of burial was afforded to specific individuals, based on their biological age and sex, at the Elsham and Cleatham cemeteries. The following sub-section will explore the relationships between individuals that were interred in multiple burials from Elsham and Cleatham and whether these deposits correlate with contemporary examples from inhumation and cremation cemeteries. The most common type of multiple burial from inhumation and cremation cemeteries contained an adult, regardless of biological sex, and an infant or child (under 12 years of age) (Crawford 2007, 84). Stoodley (2002, 121) has suggested that infants and children were often interred with an adult because '... the responsibilities, and security, provided by older members of the community were believed to extend into the realm of the dead'. However, there are examples of multiple burials containing two adults (McKinley 1994, 100; Timby 1996, 17; Drinkall and Foreman 1998, 45) and graves that comprise of two subadults (McKinley 1994, 100; Boyle and Dodd 1995, 119; Duhig 1998, 161) from a number of early Anglo-Saxon cemeteries, including Elsham and Cleatham. Therefore the concept that individuals were buried together for protection or security in the afterlife cannot necessarily be applied to a multiple burial that contained two adults. Consequently, alternative explanations for this funerary practice will be examined in turn.

The notion that these multiple deposits represent members of the same family has been discussed in the past (Crawford 1993, 85; Stoodley 2002, 115; Crawford 2007, 86). This is in particular reference to the burial of adult females who were accompanied by a foetus or infant, which have been suggested to be a mother and child (the female possibly dying in childbirth), and the incidence of a male and female which possibly hints at the presence of a married couple (Stoodley 2002, 115). However, caution must be exercised when interpreting the relationship between individuals who were interred in a multiple burial as there is no way of knowing with confidence how these individuals were related or otherwise associated in life without the use of scientific techniques such as DNA and isotope analysis. The application of DNA analysis would determine whether individuals (in multiple burials) were related maternally or paternally while stable isotope analysis can provide information regarding place of birth, residence and diet which may show relationships between individuals, whether biologically related or not. In the case of burials containing individuals of the same biological sex, Evison (1987, 126) has interpreted them as possibly representing the acceptability of homosexuality in early Anglo-Saxon England. However, it is not possible to prove this idea and it is, to some extent, clutching at straws. On the other hand, these same-sex burials may represent individuals who were friends, practiced the same religion, came from the same ethnic background, or may have shared the same profession and social status (Stoodley 2002, 117). For example, documentary sources from the Roman period highlight that soldiers who died together in battle were collectively cremated or inhumed (Toynbee 1971, 55).

Multiple deposits may have also been employed when the simultaneous death of two individuals, regardless of age or sex, occurred. Concurrent deaths could have been the result of acute illness or an incident that caused multiple fatalities. The cremation and interment of two individuals within one grave may have been a practical decision, to save time and expenditure, by the deceased's family and/or the community (Stoodley 2002, 116). Furthermore, it is difficult to prove that two individuals were cremated on the same pyre and the colour of bone should not be used to reach definite conclusions. The possibility of the accidental inclusion of bones from a second individual is also worth noting. Accidental inclusion of bone can be caused by post-depositional disturbance of burials, though the collection of cremated bone from a pyre site may also result in the inclusion of bones from a second individual that were left behind from a previous cremation (McKinley 1989, 69). This is one of the reasons why multiple elements must be recorded during osteological analysis as this form of assessment can be used to establish whether more than one individual was intentionally placed in a cremation burial.

Stoodley (2002, 106) notes that only 23.7% of the sample he examined, in a study that focused upon inhumation multiple deposits, displayed evidence of grave reopening which would have permitted the insertion of an additional individual into a burial at a later date. Interestingly, Homer makes reference to the placement of cremated remains, from different individuals, within a cinerary urn on separate occasions in *The Odyssey* (Book 24, Lines 70-80). Homer (*The Odyssey*, Book 24, Lines 70-80) mentions that the bones of Achilles and Patroclus were initially deposited in a golden urn and the cremated bones of Antilochus were later added to the same funerary vessel. It is also worth pointing out that these individuals were not related but were close friends. The use of this source cannot contribute to our understanding of multiple burials during the early Anglo-Saxon period, though it does make us aware that the subsequent interment of an additional individual(s) within a single cinerary urn may have been carried out by different societies in the past.

8.1.5 Spatial distribution of Anglo-Saxon cemeteries

Based on the large number of individuals that were interred at the Elsham and Cleatham cemeteries it appears that these sites served the local area. One large cemetery may have operated as a large community cemetery, not exclusive to one village, but to a number of settlements that may have shared similar beliefs, ethnicity or ties with other kin groups. An analogous suggestion has been put forward for the Sancton (McKinley 1993, 315), Spong Hill (McKinley 1994, 119) and Mucking (Essex) cemeteries (Hirst and Clark 2009, 760). Williams (2002, 341) has suggested that early

Anglo-Saxon cremation cemeteries were central places where communities gathered for mortuary rites and ancestral ceremonies. These sites were frequently located on strategic and prominent settings or near rivers, while the burial of individuals near prehistoric monuments, Roman routes and settlements also appears to have held some significance (Fennell 1964, 77; Webster and Cherry 1977, 210; Kinsley 1989, 3; Filmer-Sankey and Pestell 2001, 236; Leahy 2007, 5, Hirst and Clark 2009, 772). The Anglo-Saxons may have used landmarks, such as prehistoric monuments or unusual geological features, as a means of locating communal cemeteries (Williams 1997, 23). It is also possible that settlements were built in the surrounding area of these archaeological and geological features to facilitate easy navigation and access to such central meeting places. In contrast to the Mucking cemetery, there is no evidence for associated settlements with the Elsham and Cleatham cemeteries. To date it is unclear whether the dearth of such evidence is due to the fact that possible settlement sites have not yet been excavated or rather that these cemeteries served as central burial grounds for nearby settlements.

The association of cemeteries with prehistoric structures, especially barrows, ditches and tumuli, and the construction of burial mounds during the Anglo-Saxon period may have been intended to reinforce ancestral links and construct social and ethnic identities that, in contrast to the actual funerals, were constantly visible (Williams 1998, 103). During the fifth and sixth centuries, burials were primarily focused around these features, though in the seventh century monument reuse and interment within these structures became more popular. A number of scholars have proposed that, as a result of increased social stability by the seventh century, members of the elite were interred in burial mounds as a visual display of their power, control and connections with ancestors and heroes of the past (Hills 1997, 301; Stoodley 1999(b), 104-105; Härke 2001, 30). Further evidence to support this point can be found in the *Beowulf* poem which is thought to have been written at some point between the seventh and eleventh century (Orchard 2003, 6). This poem states that following Beowulf’s death, the hero was cremated and, subsequently, a mound was constructed over his grave which was positioned in a prominent location (*Beowulf* 43; Hills 1997, 301). It is notable that Beowulf was afforded an elaborate burial owing to his status and popularity among his peers. If burial customs did, indeed, change in response to increased social stratification during the Anglo-Saxon period it is apparent that the type of funerary treatment afforded to an individual conveyed a multitude of important social, ideological and political messages to the living.

An examination of the spatial distribution of burials from Elsham and Cleatham aimed to provide information concerning the choices that were made when burying individuals in a community cemetery, particularly to establish whether there were any over-riding preferences with regards to the location of burials. The results from the Elsham and Cleatham cemeteries highlighted that there was no major segregation within these cemeteries on the basis on multiple deposits, age or sex, though some small discrete burial clusters were observed through the use of spatial cluster analysis. No such patterns were identified from contemporary cremation cemeteries. It was briefly noted that there was no segregation of burials, based on age, at the cremation cemetery at Newark (Nottinghamshire) (Harman 1989, 24). In addition, no isolated burial clusters were identified on the basis of age and sex among the cremation burials from Mucking cemetery II (Hirst and Clark 2009, 627). Mads Ravn (2003, 118) observed that the spatial distribution of individuals, who were assigned biological age and sex, at Spong Hill were evenly spread throughout the site. These studies did not use spatial cluster analysis and, as a result, any possible discrete burial groupings from these sites went undetected.

In contrast to cremation cemeteries, a greater amount of work has been conducted on the spatial organisation of contemporary inhumation cemeteries. When considering the distribution of age groups within inhumation cemeteries it has been noted that, overall, there was no obvious segregation of infants and children at these sites (Boyle and

Dodd 1995, 133; Timby 1996, 17; Boylston, Wiggins and Roberts 1998, 222; Carver 2009, 102). Similarly, the spatial distribution of individuals who were assigned biological sex illustrated that males and females were, on the whole, evenly dispersed throughout these cemeteries (Boyle and Dodd 1995, 133; Evison and Hill 1996, 33; Timby 1996, 17; Boylston, Wiggins and Roberts 1998, 222; Carver 2009, 102). However, a number of sites do show some evidence for burial clusters based on the sex, gender or age of the cemetery population. Unfortunately these burial groupings are discrete, similar to those identified at the Elsham and Cleatham cemeteries, and highlight that specific social groups who were interred at these sites, such as infants and children, were not segregated from the rest of the burial populace (Evison and Hill 1996, 33; Penn and Brugmann 2007, 86). Ravn (1999, 51) points out that the lack of segregation among cremation and inhumation cemeteries supports the notion that these sites were household or family orientated cemeteries and were possibly influenced by other internal social divisions, for example within a farmstead, in which these communities lived. Subsequently, Ravn (1999, 52) goes on to state that, based on an assessment of the Spong Hill cemetery, the poorly furnished graves that occurred among the cremation burials belonged to the less important individuals who lived on the farmsteads. Despite possible social divisions between these groups, individuals at the bottom of this social hierarchy were still considered to have been an important part of the household unit or extended family, which may be the result of close family ties, similar ethnic origins or reflect the fact that they held the same ideological and belief system (Ravn 1999, 52).

As previously mentioned in the Elsham results chapter (chapter six), no information is available concerning the depositional location of the inhumations from the Elsham cemetery and, therefore, no interpretations can be offered with regards to the spatial distribution of these burials. Furthermore, the minimal amount of demographic data that was gleaned from an osteological analysis of the Elsham inhumations does not contribute to our understanding of the site. Nevertheless, an examination of the use of differential funerary rites, that is, inhumation and cremation, at Cleatham and similar mixed-rite cemeteries may provide additional evidence for the social structure of these sites. Mixed-rite cemeteries are interesting in that individuals who were interred within the same community cemetery were afforded different burial rites, which, in most cases, were practiced simultaneously, for example at Spong Hill (Ravn 2003, 99), Cleatham (Leahy 2007, 29) and Mucking (Hirst and Clark 2009, 727). Martin Carver (1989, 156) has interpreted the individuals buried in the inhumation section of the Spong Hill cemetery as possible aristocracy based on the small numbers interred in the north-eastern area of the site. During the later sixth and seventh century, inhumation burials at Cleatham were also concentrated in the north-eastern corner of the cemetery, though in earlier periods inhumation was distributed more evenly throughout the site (Leahy 2007, 29).

Carver (1989, 150; 1992, 350) highlights that socially stratified groups became more visible after the late sixth century, especially among the aristocracy who manifested their social position through the inhumation rite. In addition, Ravn (2003, 128-129) has proposed that inhumation burials became increasingly popular with groups of social elite as they wished to express their power, ideological beliefs and ethnic identity, that is, the belief that their family originated from the continent. A similar transition from the practice of cremation to inhumation among high-status groups has been identified from the Roman period. Arthur Nock (1932, 358) has suggested that Roman cremation was gradually phased out because of the prestige associated with the inhumation rite. The transition to widespread inhumation during the Roman period can therefore be explained by the increased popularity, among the wealthiest members of society, of interring the dead in sarcophagi and mausolea (Nock 1932, 358). Finally, it is also worth considering how individuals of different social standings were differentiated from each other, during the early Anglo-Saxon period, in the earlier inhumation and cremation burials. The use of accompanying grave assemblages may have been a means of displaying an individual's social position within the community. In contrast, cremation may have been viewed as the normal burial rite while inhumation was afforded to specific individuals based on ethnic identity, status and/or ideological beliefs.

8.2 The symbolic nature of cremation burials

The following section of this chapter will explore the symbolic nature of cremation burials, particularly how grave assemblages were used to convey messages about the identity of the Elsham and Cleatham burial populations. An in-depth discussion will deal with the animal offerings, specific urn types and grave and pyre goods that were afforded to certain social groups, which aims to contribute to our understanding of the identity of cremation practicing communities.

8.2.1 The relationship between animals and humans

The frequency of cremation burials that contained animal bone from Elsham and Cleatham is comparable in number to those recorded from Sancton (McKinley and Bond 1993, 308) and Spong Hill (Bond 1994, 121). The high frequency of faunal remains from these burials highlights the importance of animals in life and death within cremation practicing communities during the early Anglo-Saxon period. Animals that could be identified to a specific species from the Elsham and Cleatham cemeteries consisted of a variety of domesticates, such as sheep, horse, cattle, pig and dog, and wild animals, including bear and bird. Crustaceans were also noted from both sites which points to the exploitation of marine resources for food. The species that were recorded from Elsham and Cleatham correspond to the range of domesticate and wild animals that have been identified from contemporary cremation cemeteries, which are discussed in chapter three of this thesis.

At Elsham, a high prevalence of sheep bone was analogous to the evidence from contemporary cemetery sites, such as Newark (Harman 1989, 25), Sancton (McKinley and Bond 1993, 309) and Spong Hill (McKinley 1994, 92). High ratios of sheep and cattle were also noted from a number of settlement sites of the same period including Chalton (Hampshire) (Addyman, Leigh and Hughes 1972, 31), West Stow (Suffolk) (Crabtree 1995, 23) and Mucking (Done 1993, 77). As Ann Hagen (2010, 89) points out, sheep would have been the most profitable livestock since they would have provided meat, milk, wool and skins and this is likely to explain the high numbers of sheep from both cremation cemeteries and settlement sites. It is interesting that settlement sites produced sheep of mature age, around the age of six years, and the evidence from these settlement sites points to the exploitation of these animals for their wool and dairy products (Hamerow 2002, 148; Hagen 2010, 92). Based on the evidence at hand, there is a strong possibility that cremation practicing communities reared sheep for wool. This notion is supported further by the presence of spindle whorls from both cremation burials and settlement sites, for example a possible (heat-damaged) spindle whorl was identified from cremation 701 at Mucking cemetery II while five shale spindle whorls were recorded from the Mucking settlement (Hamerow 1993, 65; Hirst and Clark 2009, 619). In contrast to the sheep from settlement sites, the sheep present within cremation burials died at a much younger age, usually between one to three and half years (Bond 1994, 128; Hagen 2010, 92). This suggests that these domesticates were slaughtered for meat, which may have been consumed as part of the funerary feast, or as a sacrifice for the funeral (Bond 1994, 128).

There was a clear relationship between the presence of animal bone and age of individuals from the Elsham and Cleatham cemeteries. Adults were more likely to have been interred with animal bone than infants and children. Interestingly, adolescents were also more likely to have been afforded animal offerings than infants and children. Therefore adolescents were more similar to adults in the respect that individuals who belonged to these age categories were more likely to have been afforded at least one animal in the cremation rite than the youngest members of the Elsham and Cleatham burial populations. Similar results have been observed from Sancton (McKinley 1993, 311) and Spong Hill (McKinley 1994, 99). This, indeed, may be the result of an increased adult sample size but, from a cultural stand point, it is possible that adolescence was an important stage in the lifecycle where new social roles were ascribed to individuals. During this age threshold, roles and responsibilities may have been assigned to these individuals, such as managing livestock and participating in economic activities, including weaving (supported by the high incidence of sheep bone and spindle whorls from both cemetery and settlement contexts) and working of bone (Richards 1987, 125). Therefore, animal offerings may have been deemed an appropriate part of the grave assemblage of adolescents given their newfound social identity.

The deposition of animal remains within the burials of infants and children may have been a means of showing their intended future roles within the community but, owing to their age, had yet to take up these responsibilities. On the other hand, families, or the wider community, may have been more reluctant to provide animal offerings in the cremation rite of infants and children as they had yet to fulfil their future social role. This could also be related to the amount of economic investment that was spent on the cremation of infants and children. A smaller pyre may have been employed for individuals belonging to these age groups due to their immature physique. A larger pyre would have been required to accommodate animal offerings, either as joints of meat or as whole bodies (McKinley 1993, 311). The construction of a bigger pyre would have called for additional labour and economic investment, which may not have been viable or deemed necessary for such young individuals. Consequently, many infants and children may not have been afforded animal offerings on the grounds of practicality.

In comparison to the strong associations that have been identified between age and the deposition of animal remains, no significant relationships were found between biological sex and the presence of animal bone in cremation burials from the Elsham and Cleatham cemeteries. The burials of males from both Sancton (McKinley 1993,

311) and Spong Hill (McKinley 1994, 99) produced slightly more animal bone than those of females, though this was not a significant association. This may indicate that males and females worked, interacted or had similar associations with livestock, such as farming and weaving. However, certain individuals may have had stronger associations with one, or more, species based on their economic activities. Therefore, it is possible that, due to the economic importance of domesticates in early Anglo-Saxon society, these animals accompanied individuals into the afterlife.

Accessory vessels, which primarily comprise of animal bone though disturbed human bone from associated burials are also recorded from these deposits, were identified at the Elsham and Cleatham cemeteries. These animal offerings were frequently interred in a cinerary urn, but were sometimes deposited in a unurned state, at the side or below an accompanying burial that contained human skeletal remains. Adult burials were most commonly associated with accessory vessels than subadults from the Elsham, Cleatham and Spong Hill (McKinley 1994, 93; Williams 2005(c), 33) cemeteries. A range of species were found in these accessory vessels including horse, cattle, pig, sheep and dog. Horses occurred in the highest frequency, with regards to identifiable species, in accessory vessels from the Elsham cemetery. The amount of cremated animal bone found in accessory vessels varied, though horses produced the largest quantity of cremated bone than any other animal. This suggests that horses were cremated whole as opposed to domesticates, for example sheep and pig, which were butchered and joints of meat (from these animals) were then placed on the pyre. Horses may have been cremated whole due to the status and importance of this species in Anglo-Saxon society. The fact that the bones of horses are rarely found at settlement sites may suggest that they were killed when their owners died to accompany them into the next life (Crabtree 1995, 25). This could explain the high frequency of horses that were found with adults from Elsham and Cleatham. Older members of Anglo-Saxon society would have used horses for a variety of purposes, such as traction, transportation and hunting, while younger individuals are unlikely to have been involved in these activities (Bond and Worley 2006, 94). Consequently, the sacrifice of horses may have been deemed inappropriate in the cremation rite of infants and children, though exceptions are notable.

Animals may have also been used in the cremation rite as a means of showing the social status of an individual (Williams 2005(c), 33; Bond and Worley 2006, 94). For example, a person of low social standing may have been afforded a joint of meat. On the contrary, a whole animal, such as a horse, and joints of meat may have been provided for a more prominent member of society. The cremation, collection and subsequent deposition of a whole animal would have shown that additional investment was placed into a funeral, particularly when an animal was buried in a separate urn. Therefore, the use of accessory vessels may have been reserved for individuals of a high social standing. Wild animals may have also played an important role in the cremation of high-status individuals. Bear phalanges have been found in cremation burials from Elsham, Cleatham, Sancton (McKinley 1993, 307) and Spong Hill (McKinley 1994, 92, 99) and are thought to have derived from pelts (Crabtree 1995, 25; Bond 1996, 85). As outlined in chapter three of this thesis, the inclusion of bear pelts in the cremation rite would indicate that the deceased was of a high social standing since these articles would have been difficult to acquire in Anglo-Saxon England (Schönfelder 1994, 224; Pluskowski 2010, 117).

The inclusion of animals in the cremation rite may also highlight their importance in ideological beliefs and funerary rituals of cremation practicing groups. This is in contrast to communities who practiced the inhumation rite and is manifested by the low frequency of animal bones deposited in such burials (Williams 2001, 197, 201; Bond and Worley 2006, 90). Certain animals that were employed in a cremation rite may have been selected based on their ideological associations. These kinds of associations perhaps had a perceived purpose in the creation of a new ancestral identity for the deceased (Williams 2001, 207; Pluskowski 2010, 116). The inclusion of wild animal pelts (as opposed to whole animals and joints of meat) may similarly have been associated with the perceived ideological characteristics of the animal. Again, these may have been of particular importance to the identity and/or role of the deceased in the afterlife. It is important to note that animal skins were only found with a small number of individuals and may represent a restricted social group. As previously mentioned, priests may have used the skins of wild animals as a ritualistic disguise (Pluskowski 2010, 114). Adults are more frequently associated with bear pelts than subadults. Although only a small number of adults were afforded bear pelts this number far exceeds that of subadults. These adults, therefore, may well have been a group of individuals with strong ideological roles in life. However, bear phalanges have also been found with a child (MT84LA [urn 92]) and two adolescents (MTDA/MTDE [urn 5] and MT88ABG [urn 719]) from the Cleatham cemetery. These individuals may have belonged to high-status families given the nature of this grave furnishing (Schönfelder 1994, 224). Furthermore, the deposition of these animal remains may have been a way of offering protection to the young in the afterlife given the ferocious and protective nature of bears (Meaney 1981, 136). The talon of an osprey was found in a subadult burial (EL75OK [FN 250]) from the Elsham cemetery while canine teeth were most commonly associated with individuals under the age of 18 years from both Elsham and Cleatham. Both types of these animal remains have been suggested to hold amuletic properties and may have been intended to protect these young individuals in the afterlife (Meaney 1981, 138, 144). Animal remains that were afforded to a variety of social groups may have held different properties or purposes for different individuals based on their specific social identity and status. For example, subadults may have been afforded the tooth of a wild animal for protection in the afterlife while the same remains may have been an important constituent in the creation of a new identity for adults in the next life.

8.2.2 *Cinerary urns*

The associations between the demographic attributes of individuals and the cinerary urns that held their cremated remains may point to either practical or cultural considerations, the latter of which will be the primary focus of this sub-section. Statistically significant associations between the height of cinerary urns and the biological age of the interred individuals were identified from the Elsham and Cleatham cemeteries. Significant relationships between these two variables have also been recorded in Richards' (1987, 137) inter-site study and from the Sancton (McKinley 1993, 314), Spong Hill (McKinley 1994, 102) and Mucking (Hirst and Clark 2009, 630) cemeteries. Similarly, strong associations have been identified between age and cinerary urn rim diameter from Cleatham and Mucking (Hirst and Clark 2009, 630). However, an insignificant relationship between rim diameter and age has been noted from the Elsham and Sancton (McKinley 1993, 314) cemeteries and in Richards' (1987, 139) inter-site study. In sum, vessel height was associated with age at all sites, and rim diameter was only associated at some. This evidence implies that there is an association between age and variables that directly relate to the size of the vessel. However this does not necessarily seem to manifest in the same way at every cemetery.

Recent research into the pre-depositional use of funerary vessels by Gareth Perry (forthcoming) has highlighted that over two thirds of a sample of 116 cinerary urns from Cleatham showed evidence of domestic use prior to their employment in the cremation rite. This significant finding may point to a possible relationship between the individual interred within a funerary receptacle and the pre-depositional function of the vessel, whether for use in the production of foodstuffs or consumption (Perry, forthcoming). The statistical analyses that were conducted on the Elsham and Cleatham data imply that as an individual passed through various age thresholds they were afforded taller pots. The significant association between age and urn height may have been based on the foods that an individual could eat, which is most fitting for infants after weaning, activities within the household and community or as a sign of social standing based on age (Richards 1987, 136; Hagen 2010, 426).

Lead plugs were identified in the base and/or walls of seven urns from Elsham and 10 receptacles from Cleatham. In the past these perforation have been mainly linked to ritual activity (Richards 1992, 136). For example, Kenneth Fennell (1964, 109) has proposed that these holes allowed the deceased's spirit to escape into the afterlife. However such explanations are weak. There is increasing amounts of evidence to support the notion that holed vessels were initially intended for a domestic purpose, for example in the production of dairy products and the brewing of beer (Lethbridge 1951, 13; Perry, forthcoming (b)). Evidence from Elsham and Cleatham show that lead plugs were used to fill these perforations and this suggests that the modification of these vessels was required for the funerary rite. In light of new research, there is a strong possibility that cinerary vessels were not necessarily produced solely for the mortuary rite, but rather, urns were selected from the domestic sphere (Perry, forthcoming). There is no clear association between lead plugged funerary vessels and the biological attributes of their occupants from Elsham and Cleatham. These types of modified urns may have been afforded to certain individuals who belonged to households that were involved in brewing and/or dairying. Burial within one of these vessels may have functioned as a means of communicating an individual's role or associations with certain tasks in the household.

In contrast to the strong association identified between cinerary urn measurements and age, the associations between biological sex and cinerary urn dimensions were weak in all but one case from the Elsham and Cleatham cemeteries. The absence of strong relationships could be explained by the general lack of corresponding demographic information and cinerary urn measurements in these data. A statistically significant relationship between urn height and biological sex was identified from the Elsham cemetery and illustrates that males were interred in taller vessels than females. This association corresponds to the findings of Richards' (1987, 137) inter-site study and more recent work from Mucking (Hirst and Clark 2009, 630). However, despite this strong association, age still appears to have been a more influential factor in the selection of a cinerary urn than biological sex.

8.2.3 The role of pyre and grave goods in the cremation rite

Pyre and grave goods from Elsham and Cleatham were examined to establish whether certain artefacts were afforded to specific groups based on their social identity. Bone/antler combs, followed by beads, were the most commonly identified artefacts from both sites. The high frequency of combs that were recorded from Elsham and Cleatham concurs with findings from contemporaneous cremation cemeteries (Williams 2003, 101). Combs were the most common item found among subadult and adult categories as well as in male and female burials from the Elsham and Cleatham cemeteries. It is evident that combs were an integral part of the grave assemblage afforded to cremation practicing groups and may suggest these objects played an important role in the cremation rite, which is not seen in the contemporary inhumation ritual (Williams 2003, 101). The most basic explanation for the high frequency of combs observed from cremation sites is the availability of such an item. However, as outlined in chapter three of this thesis, it appears that combs had a symbolic purpose in the cremation rite. Williams (2003, 116-117, 123-124; 2010, 75) has proposed that these objects may have been related to the idea of bodily and hair transformation and were used to create a 'new' body for the deceased. Therefore, given the destructive nature of cremation, combs also appear to have played an important role in remembering and forgetting the social identity of the dead (Williams 2003, 127).

The majority of grave and pyre goods from Elsham and Cleatham appear to have been functional objects with the primary exception of miniatures. Archaeological evidence from Newark (Kinsley, 1989, 18), Sancton (Timby 1993, 281), Spong Hill (McKinley 1994, 90) and Mucking (Hirst and Clark 2009, 586), has also demonstrated that artefacts that were most commonly placed on the funerary pyre were taken from everyday contexts, for example dress accessories and items that were used in economic and domestic activities such as spindle whorls (Crawford 2004, 89-90). The functional nature of pyre goods suggests that these objects were associated with the deceased's social identity in life. Therefore, the cremation of both the deceased and their personal belongings may have been seen as a symbolic act that destroyed the physical remains of the person as well as their social identity. This ritual would have removed and separated the deceased and their possessions from the living sphere, thus preventing the living from reusing these items (Van Gennep 1960, 164; Devlin 2009, 33). Alternatively, as has been discussed with respect to animal bone, personal objects may have had an intended functional purpose in the afterlife. Cremation practicing groups may have believed that the concurrent transformation of the dead and their accompanying possessions permitted the immediate use of these items in the afterlife (McKinley 2006, 8).

It is notable that there was no clear-cut relationship between biological age and artefact type at the Elsham and Cleatham cemeteries. However, some underlying patterns were observed from these sites. At Elsham handles and whetstones were confined to adult burials while purse mounts were assigned solely to subadults. At Cleatham, coins were only identified in subadult graves. Artefacts confined to adult burials at Cleatham included decorated strips, handles, bracelet, latch lifters and sleeve clasps. However, it is difficult to establish whether these were, indeed, age-specific artefacts owing to the low frequencies that were recorded from these sites. At Elsham there was no significant relationship between age and the deposition of pyre and grave goods. In contrast the results from Cleatham highlighted that there was a statistically significant association between age and the deposition of grave assemblages. This relationship was strengthened further when adolescents were classified as adults. These results indicate that adolescents and adults were more likely than infants and children to have been afforded grave provisions at Cleatham. The differential provision of older individuals may have been based on their roles within the community and social identity, that is, how society viewed an individual based on their personal attributes such as social standing, ethnicity, ideological beliefs and family affiliations.

There is a possibility that infants and children were more likely to have been afforded perishable offerings, such as foodstuffs, leather, textiles and wooden objects, than their adult counterparts. Small amounts of charcoal were found in a number of cremation burials from the Elsham and Cleatham cemeteries. These fragments of charcoal may have derived from wood that was used for fuel in the cremation process. On the other hand, there is a chance that surviving pieces of charcoal may represent the remnants of a wooden object that was placed on the pyre. Evidence of wooden vessels from Cleatham was noted in the form of copper-alloy mounts, which were found with five adults and two subadults (Leahy 2007, 217-218). Perishable artefacts may have been afforded to the youngest members of the community owing to their age and social position, while older individuals were more likely to have been cremated and buried with artefacts that were more durable and archaeologically visible. Crawford (1999, 29) points out that wood would have been in greater supply and easier to obtain and craft than other, more precious material types, such as metals. Therefore, items made out of perishable materials may have been favoured funerary offerings to infants and children owing to their availability. However, it should be reiterated that numerous young individuals from Elsham and Cleatham were also found with archaeologically visible artefacts, which may be related to the social standing and ideological beliefs of their family. In sum, it appears that subadults and adults were afforded a similar range of artefacts, though the grave provisions of adults from Cleatham were more likely to have survived the cremation process and in the archaeological record.

Julian Richards (1987, 130) has suggested that status was ascribed at birth based on the fact that, in most instances, subadults and adults were provided a similar range of grave and pyre goods. Consequently, Richards (1987, 130) refers to infants and children from Anglo-Saxon cremation cemeteries as ‘small adults’. Sally Crawford (1999, 169) has pointed out the many flaws of Richards’ (1987) theory. For example, Crawford (1999, 169) states that ‘they (children) could never be ascribed the highest adult status while they were young because some grave goods – horse and cow bone in cremations, or swords in inhumations, for example – were never buried with infants and younger children’. In addition, after examining the cinerary urns and presence of animal bone from the burials of the youngest and oldest individuals from the Elsham and Cleatham cemeteries, this notion can be dismissed due to its simplicity. The burial of infants and children within the community cemetery may have been based on family ties while grave assemblages were an expression of an individual’s identity, which would account for the interment of young individuals in smaller urns. Based on this evidence it appears that the lifecycle was an important factor in Anglo-Saxon society. During infancy and childhood, individuals regardless of sex, appear to have been viewed as ‘gender-neutral’ and of a different social-standing to older members of the community. As individuals passed through the adolescent age threshold they may have been assigned grave provisions that reflected their new social role(s) and identity, such as dress accessories or functional objects that were related to economic and domestic activities. Therefore social standing is likely to have changed throughout an individual’s life.

Statistical analyses have highlighted that males and females were equally as likely to have been afforded grave assemblages at the Elsham and Cleatham cemeteries. However, no clear-cut associations were identified between biological sex and artefact type from these sites, though some discrete patterns were recorded. Artefacts that were recovered in higher frequencies from female deposits at Elsham and Cleatham include spindle whorls, beads, brooches and rivets/nails and relate to a female gender. At Spong Hill, there is also a strong association between brooches, beads, spindle whorls and female burials, though rivets/nails were more commonly found in male burials (McKinley 1994, 89). Counters/discs and decorated strips were highly correlated with females at the Elsham cemetery, while at Cleatham, a buckle and a whetstone were only recorded from female deposits. Males, on the other hand, were buried with a more limited range of objects. Needles, weaponry and handles were found in a higher frequency in male burials from Elsham while decorated strips were only identified in male burials from the Cleatham cemetery. These associations also correspond to the observations made from the Spong Hill cemetery (McKinley 1994, 89). Unfortunately, the majority of these ‘sex-specific' artefacts occurred in such low frequencies that it was not possible to attach any degree of significance to these associations. In contrast to early Anglo-Saxon inhumation burials, the grave assemblages from Elsham and Cleatham highlight that sex and gender were not dominant considerations for the selection of artefacts that were chosen to accompany cremation burials. Instead, the evidence implies that other aspects of an individual’s identity, such as age, economic role, status, ethnicity and ideological beliefs, played a more influential role in the selection of grave provisions for the dead.

Glass, followed by worked bone/antler, was the most commonly identified artefact material type from the Elsham cemetery. A similar pattern was identified from the Cleatham cemetery, though worked bone/antler was found on more occasions than glass. Nonetheless, the high frequency of worked bone/antler and glass from both sites is likely to have been the result of availability, cost of materials and links to craft-workers and traders. In most instances, archaeologically visible materials were found with subadults, adults, males and females. However, there were some notable exceptions. The most unusual materials that were found from the Elsham and Cleatham burials included ivory, coral and cowrie. The origins of these materials are unknown but it has been suggested that ivory possibly came from India, Siberia or Africa (Leahy 2007, 204), while coral may have originated from India and the Indian Ocean (Leahy and Coutts 1987, 7) and cowrie shells are thought to have been imported from areas around the Red Sea (Leahy 2007, 171).

Ivory bag rings (or frames), coral and cowrie shell were particularly common in female cremation burials from Elsham and Cleatham. Similarly, ivory was more frequently found with females than males at the Spong Hill cemetery (McKinley 1994, 89). The strong association between ivory and females may indicate the economic role and social standing of these individuals within the community (Hills 2001, 143). Ivory rings appear to have been used as a frame for textile pouches (Owen-Crocker 1986, 69). These bags are thought to have once contained objects, such as amulets or tools, that had important personal meanings or purposes to their owner (Owen-Crocker 1986, 71; McKinley 1994, 91). Therefore, females may have worn ivory framed pouches on a daily basis for functional purposes and, if these bags were visible, possibly as a means of conveying their social identity (Owen-Crocker 1986, 71).

Cremation practicing groups may have believed that these imported materials, such as ivory and cowrie, possessed special attributes due their appearance and perceived origin and, as a result, acquired ideological and/or amuletic values. For example, Audrey Meaney (1981, 127) has suggested that cowrie shells may have been used as fertility amulets based on their appearance and the fact that these objects have been found in a number of Anglo-Saxon burials that contained females of child-bearing age. It is possible that individuals, particularly females, were afforded certain types of imported material on the basis of their ideological beliefs.

In addition, these exotic materials would have been difficult to get hold of and would no doubt have been prized possessions. Consequently, the provision of imported materials in the grave assemblage may have indicated the social standing of an individual. For example, the use of ivory bag rings, as opposed to wooden rings, may have been seen as a status symbol owing to the nature of its acquisition (i.e. trade from the continent) as well as the overall aesthetic appeal of this particular material (Owen-Crocker 1986, 69). These imported materials point to long distance trade, which was potentially facilitated by valuable social links with individuals able to provide such materials.

8.3 Pyre technology during the early Anglo-Saxon period and its cultural implications

The final section of this discussion will deal with the complete cremation ritual, from the pyre to the cinerary urn, its interment and the cultural implications of the whole process. The discussion will be based on evidence from the Elsham and Cleatham cremated bone assemblages.

8.3.1 Pyre construction and the cremation process

Unfortunately, like the majority of early Anglo-Saxon cremation cemeteries, there is currently no evidence demonstrating that cremation pyres were constructed within the cemetery boundaries at Elsham and Cleatham. Consequently, this leaves a gap in our knowledge regarding the location of pyre sites; whether they were close to these cemeteries or were located elsewhere and the cremated remains were transported to their final resting place in cinerary urns is still unclear (Oestigaard 1999, 350). Nevertheless, bone and pyre debris from the Elsham and Cleatham cremation burials can provide a significant amount of information with regards to pyre construction during the Anglo-Saxon period.

The majority of cremated bones from Elsham and Cleatham were white in colour, which indicates the overall high efficiency of cremation and oxidising conditions that were achieved in this process. Pyre construction and the position of the deceased on the pyre appear to account for the successful oxidation of skeletal remains from Elsham and Cleatham. Charcoal has been found in a number of cremation burials from these sites, which suggests that wood was the most likely source of fuel in the cremation process, though, as outlined above, this is not to say that these charred remnants did not originally belong to a wooden artefact that was placed on the pyre.

The use of under-pyre scoops or pits would have aided the flow of oxygen and may have been employed by Anglo-Saxon cremation practicing groups to ensure successful cremation (McKinley 1994, 80). However, during the cremation process these pits would have filled with wood ash and, consequently, oxygen flow would have ceased; thus creating reducing, or deoxidising, conditions. If under-pyre scoops were employed in the Anglo-Saxon cremation process certain individuals may have been responsible for removing ash from these pits to encourage oxidising conditions. The amount of time that was spent clearing under-pyre scoops during the cremation process obviously contributes to the overall labour investment of the rite. The work and time expended on a cremation will be explored in more depth below.

Despite the high frequency of bones that were completely cremated, skeletal remains that were exposed to deoxidising conditions were also recorded among the Elsham and Cleatham skeletal assemblages. Vertebrae, os coxae, proximal femora and certain bones of the crania (in particular the occipital and petrous portion of the temporal bone) were frequently identified as skeletal elements that endured incomplete cremation. These bones showed minimal amounts of shrinkage and ranged in colour from brown to black. The fact that these bones presented little evidence of shrinkage illustrates the potential of employing osteometric techniques as an additional means of establishing the biological sex of individuals that were afforded the cremation rite (Thompson 2002; Gonçalves 2011). Thompson (2002, 50-51) has identified that bones that experience a greater degree of shrinkage, particularly those that are heated to temperatures over 800˚C under oxidising conditions, are more difficult to use in studies that explore the metric differences between male and female skeletal remains. Furthermore, alterations must be made to osteometric methodologies to factor in significant degrees of shrinkage (Thompson 2002, 51). However, the application of metric methods must be applied with caution since many factors, such as the physique of the deceased and the variable burning conditions of an open pyre, will result in varying degrees of shrinkage even where burned bone is incompletely cremated (Thompson 2005, 1009).

The anatomical location of bones that experienced incomplete cremation and the position of the deceased on the pyre can account for their exposure to deoxidising conditions. This is particularly noticeable on the dorsal surfaces of these bones, which of course would have been in direct contact with the pyre structure and therefore would have been subject to a lesser oxygen flow. Similar observations have been noted from Sancton (McKinley 1993, 296), Spong Hill (McKinley 1994, 83) and Snape (Steele and Mays 2001, 227). Large fragments of trabecular bone survived in a number of cremation burials from Elsham and Cleatham. As outlined in chapter four, this type of bone contains an elevated amount of organic components compared to cortical bone and, as a result, trabecular bone takes a longer period of time to oxidise (McKinley 2000(b), 405). Therefore, curtailed cremation may explain why numerous burials contain large fragments of trabecular bone (and bones that are made up of a high proportion of trabecular bone such as the vertebrae and pelves) that display signs of incomplete oxidisation.

In addition to the macroscopic assessment that was carried out on the cremated remains from Elsham and Cleatham, histomorphometry and Fourier Transform Infrared Spectroscopy (FTIR) was conducted on a sample of burned bones from the Elsham cemetery. The application of these three methods illustrates that the temperatures achieved on early Anglo-Saxon funerary pyres ranged from 600°C to over 900°C. This temperature range is further supported by the discovery of glass and copper-alloy globules and fuel ash slag, which form at temperatures between 800-1084˚C, from a number of the Elsham and Cleatham cremation burials (Holck 1986, 42; Henderson, Janaway and Richards 1987, 93; Mays 2009, 439). On the whole, the cremated bone from Elsham and Cleatham showed minimal amounts of fissuring (or fracturing) and warping which highlights that the oxidation of these skeletal remains occurred at a steady rate and at relatively high temperatures. Radiating fractures were identified on a number of the Elsham thin-section samples and have been interpreted as indicating burning at an increased temperature over a prolonged period of time (Holden, Phakey and Clement 1995(b), 40). However, as outlined above, not all of the bones from Elsham and Cleatham were completely cremated, and this was also identified in a number of the Elsham thin-sections. This indicates that the duration of cremation varied. Longer periods of time would have allowed complete cremation as heat would have permeated through the bone at a relatively constant rate. In contrast, shorter periods of time (or curtailed cremation) would have caused differential burning patterns on the inner and outer cortical bone. The inner cortical bone would have endured lower temperatures and, as a result of deoxidising conditions, would not have experienced complete incineration. It is difficult to provide an accurate estimate for the duration of the Anglo-Saxon cremation process. However, based on the evidence from the Elsham and Cleatham cemeteries, it appears that cremation would have lasted until the pyre died out. If the pyre was left to run its course, a number of factors could have affected the duration of cremation, such as weather conditions, size of the pyre and the physique of the deceased. Curtailed cremation, by our definition, was not necessarily significant or even regarded in the past. A heavy downpour would have shortened the cremation process and mourners may have taken this cue to collect and inter the bones (providing they appeared to be burnt), regardless of our scientific definitions of complete cremation. The variables outlined above would have been different for every cremation and can explain why some individuals appear to have been cremated for longer periods of time than others.

An examination of the burning patterns on a sample of upper and lower limb bones from Elsham has illustrated that the cremation process affected the latter more than the former. These burning patterns can be explained by the placement of the limbs on the pyre. Initially, the upper limb would have been exposed to intense temperatures. Throughout the cremation process the arms and hands would have fallen away from the body due to the cremation of ligaments and muscles. Consequently, these skeletal elements would have been exposed to the less intense heat. Complete, relatively unburned, phalanges were identified in a number of burials from Elsham and Cleatham, which shows that the arms and hands fell towards the peripheries of the pyre. Furthermore, the bones in the lower limb, particularly the femur, are surrounded by thick layers of soft tissue and take longer to cremate than skeletal elements of the upper limb, especially the radii and ulnae. Therefore, bones of the lower limb would have taken longer to move away from the centre of the pyre. Consequently, the lower limb would have been in direct contact with extremely high temperatures for a longer period of time than the upper limb. This would explain why the femora and tibiae exhibit more intense burning patterns than bones of the upper limb.

In contrast, if a body was placed underneath the pyre the upper and lower appendages would have been exposed to similar temperatures and oxidising conditions. As outlined in chapter four, the distal epiphyses of the radii and ulnae are extremely vulnerable to heat modification as these bones are surrounded by less soft tissue (Symes *et al.* 2008, 31-33). Hence, if an individual was placed underneath a pyre, the radii and ulnae would show evidence for complete cremation as these bones are exposed at an early stage of the cremation process and would have been directly exposed to high temperatures for longer periods of time than the femora and tibiae. In sum, an examination of cremation intensity on the upper and lower limbs added further support to the notion that bodies were placed on top of Anglo-Saxon funerary pyres.

The presence of iron and copper-alloy staining on cremated bone, alongside adhering globules of metal and glass, can also contribute to our understanding of the placement of the deceased and associated artefacts on the pyre. Metal staining was most frequently identified on cranial bones, ribs and the upper limb, and, in particular, bones of the hand from the Elsham and Cleatham assemblages. These observations agree with the patterns of artefact staining on burned bone from the Sancton (McKinley 1993, 298) and Spong Hill (McKinley 1994, 83) cemeteries. The location of staining on skeletal elements can provide evidence for the type of artefacts that accompanied the deceased on the pyre (McKinley 1994, 83). For example, copper-alloy staining and adhering globules were identified on a number of metacarpals and hand phalanges from the Elsham and Cleatham skeletal assemblages. This evidence suggests that some individuals were wearing finger-rings at the time of cremation. Interestingly, a metacarpal and a cervical vertebra were fused together by molten glass (in burial 1895 from Spong Hill), which is thought to have derived from glass beads (McKinley 1994, 83-84). McKinley (1994, 83-84) has proposed that this individual was placed on the pyre in a supine position with their arms folded across their torso. As mentioned in chapter four of this thesis, if the body was positioned on the pyre prone or on its side, dress accessories (usually situated on the upper torso or waist) would have fallen away from the body, which would have prevented staining and the adherence of artefact debris to bones (McKinley 1994, 84). Discolouration and the adherence of metal and glass globules to bone from Elsham and Cleatham suggests that intentional manipulation of the pyre, for example tending the fire to encourage oxidising conditions, does not appear to have been carried out. However, the discolouration of bone and adherence of artefact debris to it could have occurred once the ligaments of the cadaver had loosened and bones had fallen away from the body. At the base of the pyre these skeletal elements may have come into contact with molten metal and glass which subsequently cooled and fused to fragments of bone (McKinley 1994, 83). The burning patterns and staining caused by artefacts identified on the Elsham and Cleatham skeletal remains runs counter to Calvin Wells' (1960, 34) theory that cadavers were placed underneath funerary pyres in the Anglo-Saxon cremation rite. Instead, it appears that bodies were placed on top of the cremation pyres in an extended supine position.

8.3.2 Cultural implications of the cremation process

The following sub-section will briefly explore the cultural implications of the Anglo-Saxon cremation process, focusing on the position of the body itself, and the labour investment involved in the construction of a pyre. The decision to place the deceased on top of the pyre in a supine position, with their hands placed on their torso or, alternately, at the side of their body, cannot be entirely explained by practical reasons. Cultural practices may have also influenced the position of the dead on the funerary pyre. However, some basic practical concerns needed to be met. Once the cadaver was placed on top of the pyre, the mourners appear to have paid special attention to the positioning of the deceased, and their accompanying artefacts, to ensure the body underwent a successful cremation. If the body was placed on the pyre in a haphazard manner this could have resulted in an incomplete cremation, which may have implied a lack of respect for the dead. In more ideological terms, communities that practiced cremation may have held the belief that this process was a means of releasing the spirit from the physical body (Oestigaard 2004, 25). Therefore, the decision to place the dead specifically in a supine position at the very top of the pyre may have been seen to facilitate the safe passage of the soul into the afterlife (Meaney 2003, 238; Richards *et al.* 2004, 96).

A more impressive mortuary display may have been considered appropriate for the funeral of an individual who was deemed to be a great loss to the community. Such an event may have required a more substantial expenditure of resources. For instance, a larger fire that burned for a longer duration would have required the community to invest more time in the collection of fuel and the construction of the pyre. In addition, more attention may have been paid to its maintenance (such as removing wood ash from under-pyre pits). It could even have been the case that the subsequent collection of cremated material was particularly thorough (see below). Rather than basing our understanding on grave assemblages alone it is equally likely that the time and resources expended on the cremation process were just as valuable to early Anglo-Saxon communities.

A large funerary pyre may have paralleled contemporary richly furnished inhumation burials with regards to a visual experience. From a mourner’s standpoint, weapon burials were likely to have been visually impressive, especially on the rare occasions when a horse was included. In contrast, mourners participating in the cremation rite would not have had a clear view of the dress and accompanying artefacts of the deceased given that the body would have been positioned on top of the pyre. If a large pyre was constructed and animals were placed on its top, either at the sides or by the feet of the deceased (McKinley 1994, 98), this would create a visually impressive spectacle that would have undoubtedly become a part of a collective social memory. Part of the importance of such an impressive sensory experience may have been to evoke and create personal memories of the deceased (Williams 2004, 273).

In sum, the construction of larger pyres may have been afforded to more important members of the community. The construction of grander pyres and the placement of animal offerings may have been an important means of ensuring that the community remembered this individual. A large pyre would have burned for longer and required more fuel. These conditions could explain why some burials produced greater quantities of completely cremated bone.

8.3.3 Collection of cremated bone from the pyre site

During the Anglo-Saxon period, the colour of bone may have been used as a guide to indicate when a cremation was complete. When the bones turned white in colour, this may have signified that the cremation was complete. However, a white appearance on the surface of the bone only indicates that the outer cortical exterior had been affected by high temperatures under oxidising conditions. For example, an individual who was afforded a large pyre under favourable weather conditions would have produced ‘completely cremated’ bones that were entirely white in colour. On the other hand, the cremation of an individual on a smaller pyre under the same weather conditions would have lasted for a shorter period of time, but would have produced bones that were similarly white. However, this colour would only have extended to the outer surface cortical surface, while the trabecular bone and inner cortical bone would have experienced incomplete cremation and would still have been darker in colour. In sum, the evidence suggests that mourners probably only used the surface colour of the bone to establish when a cremation was complete (McKinley 2008, 165).

As previously mentioned in this chapter, whole animals were often cremated and interred with the deceased. The identification of these animals, in particular horses, would have been notable as they produce large bone fragments, which are frequently blue/grey in colour, and often exhibit incomplete cremation owing to their peripheral position on the pyre (McKinley 1994, 98). Human bone was generally whiter in colour and more intensely cremated than the burned bone that derived from animal offering(s). The peripheral location of animals on the funerary pyre therefore would have facilitated the identification of the more thoroughly burnt human remains. It appears that, regardless of the animal's size, these creatures were cremated for the same length of time as the deceased. This would also account for the less intense burning patterns identified on burned faunal remains compared to cremated human bones from Elsham and Cleatham.

An assessment of 114 cremation burials from Elsham has illustrated that there was no partiality towards the collection and subsequent burial of bones from one particular skeletal area. This observation also corresponds to the findings from the Sancton (McKinley 1993, 298) and Spong Hill (McKinley 1994, 85) cemeteries. Therefore, it appears that the primary objective during the collection process was to gather a representative amount of bone from each part of the skeleton. Given the small fragment sizes and representative amounts of cranial, axial and limb bones that have been recovered from early Anglo-Saxon cremation burials there is a possibility that implements such as rakes, shovels and tongs, were used to collect cremated bone from the pyre site (McKinley 2006, 85). Not only would the use of such tools facilitate the collection of cremated bone but this process also would have contributed to the fragmentation of these remains. However, to date, no surviving evidence of these tools has been found. The lack of archaeological evidence for these tools may suggest that they were fashioned out of wood or another perishable material. Alternatively, they could have been made out of metal but were dismantled when they fell out of use and were subsequently crafted into new objects. On the other hand, cremated bone may have been collected from the pyre site by hand. This method would have resulted in less fragmentation but would have taken several hours and required more labour than the collection of cremated bone using tools (McKinley 1997(b), 68). Though it might have been more time consuming, it is perfectly possible that cremated bone was collected by hand. Further support for the collection of cremated remains by hand is suggested by the fact that only small amounts of pyre debris, such as charcoal and fuel ash slag, have been recorded from the Elsham and Cleatham cremation burials. This implies that the cremated material was sorted by hand to some degree at the pyre site.

The biological sex of individuals does not appear to have influenced the amount of cremated material collected and interred at the Elsham and Cleatham cemeteries. The same was found to be the case at Spong Hill (McKinley 1994, 85) and Mucking (Hirst and Clark 2009, 630). However, age seems to have been an influential factor. An analysis of the weight of cremated bone from Elsham and Cleatham has highlighted that there is a significant relationship between age and cremation weight. It was notable that infants and children were represented by a smaller amount of cremated bone than adolescents and adults. This trend can be explained by the fact that the cremation of infants and children would obviously produce a smaller quantity of skeletal remains than older adolescents and adults. In addition, fragment size of adult cremated bone would have been larger and easier to identify than the burned remains of an infant or child, which may also account for the weight discrepancy between these age groups. At Elsham and Cleatham the differences in cremation weight appear to be related to the significant association between cinerary urn height and the biological age of the interred individuals. Aside from cultural reasons, taller funerary vessels would have been a more practical choice of urn for adults as they could accommodate larger quantities of cremated material.

In addition, it is possible that the amount of labour investment in the collection of cremated bone was also related to factors such as the perceived importance of an individual. The death of particularly important members of society may have attracted a large number of mourners to attend and participate in the cremation rite (McKinley 2006, 85). If this was the case, a significant number of mourners may have been involved in collecting the cremated bone after the cremation process, perhaps resulting in a greater quantity of cremated bone to be placed in the urn. In sum, the quantity of cremated bone collected from the pyre site appears to have been largely dependent on the amount skeletal material an individual would produce. This is obviously directly related to the size of an individual, which naturally depends on their age. However, cultural factors, such as social status, may have also influenced the amount of cremated material that was collected and buried after the cremation rite.

8.3.4 Burial of the cremated remains

The overall weight of cremation burials from Elsham and Cleatham correspond with the mean cremation weights from Sancton (McKinley 1993, 296) and Spong Hill (McKinley 1994). In contrast, Mucking produced an extremely low mean weight of 147.4g, which appears to have been the result of deep ploughing that caused severe disturbance to the burials from this site (Mays 2009, 438). It is of interest that the mean and median weights of urned and unurned deposits from Elsham and Cleatham are similar, though unurned deposits do tend to produce a slightly smaller amount of bone than their urned counterparts.

The demographic data from the Elsham and Cleatham unurned deposits (which can be found in the appendices of this thesis) show that these individuals were largely adults regardless of biological sex. Unfortunately, these data do not shed any direct light onto possible cultural reasons why this practice took place and if – or why − it was only afforded to certain individuals within a community.

There is a possibility that unurned deposits were originally placed in organic containers, such as wood or textiles, but due to poor preservation these have not left a trace in the archaeological record. An organic receptacle may have been employed to hold the remains of burial EL76PE (FN 579) from Elsham, since no disturbance was noted and this burial was found in a v-shaped pit. However, the use of organic containers does not appear to have been the norm based on the small number of possible unurned deposits. The use of organic vessels may have been employed due to a number of factors, such as the availability or cost of a ceramic container. Another possible explanation could be whether the individual was a permanent member of the community. For example, if an individual died while visiting a settlement, a member of the local populace may have provided an alternative container of lesser value. However, it is also perfectly plausible that unurned deposits were placed in a pit without a container of any sort.

The weights of many urned and unurned cremation burials from Elsham and Cleatham do not contain the expected weight of a complete individual. Of course, post-depositional disturbance may account for the low weight of many of these burials. It is also possible that these interments represent token deposits (McKinley 1998, 19). An explanation for this practice, as mentioned in chapter four, is that only a proportion of the cremated bone was buried for the purpose of the funeral. A small amount of cremated bone may have been distributed among mourners which was kept and later buried, sometimes along with the remains of others (Williams 2004, 282). Very small deposits of cremated bone may represent skeletal remains that were collected during the cleaning of the pyre site on a later occasion. The burial of such a small quantity of bone may not have warranted reopening a grave, even if the individual from whom this skeletal material derived was known, but its interment was still felt to be necessary.

The fragment size of cremated bone is another subject that requires consideration. The average maximum fragment size of cremated bone from Elsham, Cleatham and contemporary cremation sites, which were examined in chapter seven of this thesis, provided evidence that some degree of pre- and/or post-depositional fragmentation took place. Fragmentation that may have occurred on the pyre and during the collection process has been discussed. However, increased fragmentation may have also been caused by the processes involved in the interment of cremated bone in a vessel as well as post-depositional disturbance. The placement of cremated bone in a cinerary urn, particularly a vessel with a small rim diameter, may have resulted in the accidental or intentional fragmentation of burned skeletal remains. In support of this explanation, Williams (2004, 280) has pointed out that numerous ethnographic cases from the American Southwest record the deliberate fragmentation of cremated bones so that they may fit into a cinerary urn. Though this offers a potential explanation it is difficult to say if accidental or intentional fragmentation took place during the burial process with regards to the cremated bone from Elsham and Cleatham.

A number of unurned deposits that were examined from Elsham and Cleatham were found lying to the side or below a funerary vessel. In some cases, the excavators recorded evidence of post-depositional disturbance to these burials. This disturbance may have been caused by ploughing or the insertion of later burials. In the absence of evidence for post-depositional disturbance it is possible that these remains were buried in this manner intentionally. As previously mentioned, unurned deposits from both Elsham and Cleatham produced slightly lower average and median weights than deposits of cremated bone interred within cinerary vessels. To an extent, this could be explained by the additional protection offered by a pottery vessel against taphonomic and post-depositional disturbance. Interment within an organic container, such as a textile bag, or, indeed, no receptacle at all, would have provided a lesser barrier to these processes. However, there is also some evidence against the differential taphonomic protection of cremations in urned and unurned contexts. The average maximum fragment size of bones from urned and unurned burials is extremely similar and this may not only represent similar pre-depositional processing but also suggests that unurned deposits were just as susceptible to post-depositional disturbance (McKinley 1994, 85).

8.4 Summary

The results that were obtained from osteological and statistical analyses of the Elsham and Cleatham cremated bone assemblages, in most instances, strongly agrees with the demographic profile and funerary treatment of the dead that have been identified from contemporary cremation cemeteries. The Anglo-Saxon cremation rite appears to have held a number of subtle underlying messages different to those involved in inhumation rites that tended to focus on age, sex and gender. Each aspect of the cremation rite appears to have conveyed a multitude of meanings to the mourners that witnessed the ritual process. The unique combination of funerary offerings that were afforded to the dead appears to have represented different elements of the deceased's social identity. In addition to grave provision, the burning patterns on cremated bone from Elsham and Cleatham have provided further evidence for the differential treatment of individuals in the cremation rite. It is clear that a certain level of investment would have been required to carry out the cremation rite. However, the amount of economic resources and labour that was invested in a cremation seems to have varied based upon an individual's age, the associations of their kin, social status and role within the community. In sum, the Anglo-Saxon cremation rite was not only a means of destroying the physical body but conveyed messages about an individual's social identity and also hints at the ideological beliefs of these societies. The following, and final, chapter of this thesis will draw upon all of the findings that have been made in this study and provide suggestions for future research based on the results of this research.

Chapter 9: Conclusion

The primary objective of this thesis was to carry out a much needed osteological assessment of the cremated bone from the Cleatham cemetery in order to contribute to our understanding of early Anglo-Saxon funerary practices and its implications for some wider aspects of Anglo-Saxon society. A reassessment of the burned bones from Elsham was also conducted in compliance with modern methods in order to produce a dataset that could be reliably compared with other sites, in particular, the Cleatham cemetery. The (human) skeletal remains from 1521 cremation burials were examined from these sites. Because a number of multiple deposits were identified, these cemeteries provided evidence for 1573 individuals. This analysis has not only contributed to the osteological dataset of individual cremation burials from early Anglo-Saxon England, but because so few similar sites have been analysed in this manner, our understanding of the cremation rite has also significantly increased on a site level. This chapter will summarise the key findings of this research while addressing the questions that were posed at the beginning of this thesis. The first half of this chapter will be split into three sections based on the underlying research themes that have run throughout this study, which are the demography of cremation cemeteries, the symbolism of the cremation rite and pyre technology. Finally, potential future avenues of research that were identified while undertaking this thesis will be proposed.

9.1 Demography

A comprehensive osteological assessment was conducted on the skeletal remains from eight inhumation burials from the Elsham cemetery, six of which were dated to the Anglo-Saxon period while two were identified to be from the Bronze Age. Subadults and adults, including both males and females, were afforded the inhumation rite at this site. As a result of the small number of inhumation burials from Elsham, the demographic data that was acquired through their osteological analysis was not statistically interrogated. Unfortunately, these burials do not add a great deal to our demographic knowledge of the Elsham cemetery. Nonetheless, they still have some importance in showing that both cremation and inhumation took place at this site, and their mere existence merits their inclusion in this thesis.

Osteological analyses that were conducted on the cremated bone from Elsham and Cleatham provided a multitude of interesting results concerning the demography of these sites. In the first instance, the estimated population size and actual extent of the Elsham and Cleatham cemeteries suggests that these sites served a number of small settlements in the surrounding area. An assessment of palaeopathological indicators on the cremated bone indicated that a portion of these individuals experienced heavy manual labour, perhaps suggestive of involvement in agricultural activities. The demographic profiles of the two principal case studies are extremely similar in nature and correspond with population structures that have been identified from other contemporary cremation cemeteries. A high frequency of young adults and younger mature adults were found to be present at Elsham and Cleatham. In contrast, there was a clear under representation of infants from both sites, which is a recurrent theme in early Anglo-Saxon funerary archaeology. The results of the demographic analysis refute any notion that the ‘missing’ infants from inhumation cemeteries were buried in contemporary cremation cemeteries. Instead, it appears that some infants were not buried in community cemeteries of any sort. There are a number of possible explanations for this exclusion of infants. For example, they may have been illegitimately conceived, belonged to a denigrated social group (such as the offspring of a slave class) or alternatively, were victims of infanticide. Therefore, archaeologists need to look beyond cemetery contexts to establish where these missing infants were buried (if they were buried) and why they were not afforded the same funerary treatment as the rest of society. While burial in settlement contexts may account for some of the infants missing from community cemeteries (Hamerow 2002) it does not fully explain the deficiency from burial sites.

A major problem that was encountered during the osteological analyses was the lack of sexually diagnostic skeletal elements that, in conjunction with a stringent methodology, meant that only a relatively small proportion of the Elsham and Cleatham cemetery populations could be assigned to a biological sex category. The low frequency of identifiable males and females led to difficulties when conducting statistical analyses. Primarily it hindered some attempts to establish strong associations between sex and grave assemblages. Nevertheless, an interesting pattern emerged with respect to the ratio of males and females from Elsham and Cleatham. It is clear that there was a strong bias towards biological females and this concurs with observations that have been made from other contemporary cremation cemeteries. Due to the large number individuals who could not be assigned biological sex, there is still a possibility that a relatively equal number of females and males were buried at these sites. It is also true that the effects of burning on bone may have contributed to the misidentification of males as females, but this alone cannot explain such a large discrepancy. Therefore, it is probable that biological and cultural factors may have affected the proportion of females and males buried within these cemeteries. The low frequency of males may suggest that this social group travelled away from their settlements, for either economic (e.g. trade) or social reasons (e.g. strengthening social ties with other communities) and, as a result, some of these individuals may have been buried elsewhere than the cemetery in which the rest of the community were interred following cremation. Maternal death would have contributed to an over-representation of young females, although this cannot be the sole explanation for the high frequency of females at Elsham and Cleatham. However, it appears that the unbalanced sex ratios from Elsham and Cleatham are most likely explained by a combination of preservation bias alongside biological and cultural factors.

A subadult (individuals under the 18 years of age) in combination with an adult, regardless of biological sex, was the most common grouping of individuals found in multiple burials from Elsham and Cleatham. The same combination is often noted at contemporary inhumation and cremation cemeteries. However, it is not yet possible to confidently establish the biological relationship between two individuals that were buried in a multiple interment without the use of more advanced methods of analysis, which will be discussed later in this chapter. The burial of an infant or child (under 12 years of age) with an (older) adolescent or adult may reflect the social responsibility of older individuals, regardless of family ties, to protect and care for the young in death as well as in life (Stoodley 2002, 121). The simultaneous death of two (or more) members of a community, regardless of age or sex, may have warranted the cremation of these individuals on the same pyre and therefore their interment in a single urn. This practice may have been viewed as more economically viable than constructing two pyres and burying the burnt bones in separate funerary vessels. Such practice, due to the frequency of its occurrence, may, then, be regarded as a culturally acceptable funerary rite. However, it is possible that these individuals died at different times. Perhaps the ashes of the first individual had been placed in a cinerary urn, which was either kept by the living or buried in the cemetery, and following the death and cremation of a kin-relation or other associated individual their cremated bones were subsequently deposited in the same funerary vessel that had either been kept aside or was exhumed for this purpose.

The spatial distribution of cremation burials at Elsham and Cleatham suggests that individuals were interred in familial or household groupings. A small number of discrete burial clusters, associated by age or sex, or alternatively defined by concentrations of multiple deposits, were identified in varying frequencies at these cemeteries. However, these small burial groups did not provide sufficient evidence to support the notion that certain members of the population were buried in segregated areas of the site. Nonetheless, simply being buried within one of these large cemeteries may have signified that an individual was a member of the group represented by the site's burial population in its entirety. Such members of the cremating community may have been related by kin affiliation, ethnicity and possibly even ideological beliefs. If an individual did not fall in to any of these categories they may have been excluded from the community cemetery.

9.2 Symbolism of cremation burials

Infants and children were less likely to have been afforded animal offerings than adolescents and adults at the Elsham and Cleatham cemeteries. One reason for this may have been that it was deemed unnecessary and not economically viable to construct the larger pyre that would be required to accommodate additional provisions alongside an infant or child. The relatively few instances of younger individuals being cremated with animals may represent a means of expressing their intended future roles within the community but, due to their age and untimely death, had yet to take up these responsibilities. However, most of the time it appears that these resources were not spent on the cremation rites of infants and children, perhaps because these young individuals had not yet become actively involved in the economic activities that warranted the inclusion of animals on the pyres of adolescents and adults. Statistical analyses have also highlighted that females were equally as likely as males to have been afforded animal offerings. The absence of a clear association between sex and the presence of animal bones may have been a way of showing that males and females had similarly close ties with animals in life and death.

The use of animals in the cremation rite also appears to have conveyed messages about the social status and ideological beliefs of the deceased. The cremation of a whole animal would have shown that additional resources and labour had been invested in a funeral, particularly when animals were subsequently buried in a separate cinerary urn (known as an accessory vessel). Therefore, whole animals on the pyre and separate vessels for their remains may have been a means of communicating a particularly valued social status. In addition, specific animals may have had a perceived purpose in the afterlife and were buried with particular individuals based on their ideological associations. Thus, animal offerings may have also played an important role in the cremation rite due to the ideological beliefs of these communities.

An examination of cinerary urns and the biological attributes of the interred individuals has highlighted that the age of the deceased was a significant consideration in the choice of vessel at Elsham and Cleatham. In particular, the height of cinerary urns was strongly associated with the age of the deceased. This observation has also been identified at a number of contemporary cremation cemeteries, for example at Sancton (McKinley 1993, 314), Spong Hill (McKinley 1994, 102) and Mucking (Hirst and Clark 2009, 630). The fact that infants and children produce a smaller quantity of cremated bone than older subadults and adults appears to be the most logical reason for selecting shorter urns for younger members of society. This may explain why age was a more influential factor in the selection of a cinerary urn than biological sex. However, cultural factors may have also influenced this decision. Suitable vessels that were available within the domestic sphere may have been selected for use in the cremation rite based on social organisation and what was felt to be appropriate for a certain individual. For example, the identity and role of individuals within society appears to have changed as they passed through different age thresholds which may have warranted their burial in taller pots.

Males and females were equally as likely to have been afforded artefacts at the Elsham and Cleatham cemeteries. In addition, there was no significant relationship between deposition of pyre or grave goods and biological age at Elsham. However, at Cleatham it is notable that infants and children were less likely to have been provided with artefacts than adolescents and adults. The lack of pyre and grave goods associated with infants and children at Cleatham could be explained by their age and subsequent social standing in the community as well as their family affiliations. As a result of the social position of these young individuals, it is possible that they were afforded objects fashioned out of perishable organic materials (i.e. wood) that were widely available to cremation practicing groups. Consequently, these artefacts, if used, are not archaeologically visible as such material types are susceptible to destruction owing to the cremation process and/or burial environment. More durable, and therefore *perhaps* items of a greater value, were more commonly provided for older individuals.

Overall, a similar range of artefact and material types were afforded to the majority of individuals, regardless of age and sex, at both Elsham and Cleatham. However, there were some exceptions. While some weak associations were identified between age and artefact type, as well as sex and artefact type, in most instances these were statistically insignificant due to the low frequency of sex- and age-specific objects. Nonetheless, spindle whorls, beads, brooches and imported materials, such as ivory and cowrie, were found in higher frequencies in female burials, than they were in male interments at both Elsham and Cleatham. This strong link between certain types of item and particular females may correspond to gender-specific identities, social statuses and roles within the community.

Combs appear to have been an object integral to the grave provision of the vast majority of individuals, regardless of age and sex, from the Elsham and Cleatham cemeteries. The provision of combs for the deceased may have served the purpose of creating a new identity that was shared by all of the dead (Williams 2003, 123-124). However, the deposition of varying combinations of artefacts, some of which may have only been available to certain individuals (e.g. exotic materials), appears to have conveyed different messages about an individual's social identity, aside from a status based directly on age or sex. This could explain why there are few strong associations between artefact and material type and the biological attributes of the deceased. If this complex range of items, in particular, were used to construct or display social identities, they were perhaps ones that cut across age and sex categories.

The majority of artefacts employed in the cremation rite at Elsham and Cleatham appear to have held a functional purpose in life. These objects were possibly personal possessions of the deceased that were used to display an individual's social role and identity. However, the cremation of both the deceased and their personal belongings may have been seen as a symbolic act that destroyed the physical body as well as their social identity (see section 8.2.3 for further details). The destruction of an individual's belongings at their funeral may have acted to draw a line under their use among the living, and may have also facilitated the passage of the deceased and their possessions into the afterlife. In addition, the use of specific artefacts in the cremation rite, such as combs, may have been employed as a means of constructing a new identity and form for the deceased (Williams 2003, 124). The cremation process destroys the physical body so a new form, or body, in the afterlife may have been deemed necessary if the deceased was to take on an ancestral identity (Williams 2003, 123). This ideological belief also appears to explain the notable absence of weapons from cremation burials (see section 3.1.2 for further details). As mentioned above, objects that are employed in the cremation rite appear to have played an important role in the formation of a new 'body' for the deceased so they could adopt an ancestral identity. In contrast, it seems that groups that practiced the inhumation rite did not consider the destruction of the physical body and the reconstitution of the deceased into a new form an important part of their ideological beliefs. Instead, the human form and an individual's social identity may have been viewed as an idealised state to enter the afterlife (Williams (2005(b), 269). Therefore, these individuals were afforded weaponry as opposed to objects relating to fragmentation, transformation and the creation of a new body or form.

9.3 Pyre technology

There is no surviving evidence for pyre sites from the excavated areas at Elsham and Cleatham. However, the cremation process may have taken place on the peripheries of these sites or somewhere else altogether. Despite the absence of direct evidence for pyres, information can be gleaned from the osteological analysis of skeletal remains. The burning patterns that were identified on bone and an examination of associated pyre debris from the Elsham and Cleatham cemeteries has suggested that the dead were placed on top of funerary pyres in an extended supine position, with their arms on their torso or at the sides of their body. Globules of glass and metal from jewellery or other artefacts were occasionally found adhering to cremated bone and this suggested that intentional disturbance of the pyre was minimal. Despite the apparent lack of deliberate manipulation of the pyre, oxidising conditions appear to have been very good. This suggests that pyre construction and the position of the deceased on the pyre were carefully planned to achieve the most successful combustion. Furthermore, the placement of the deceased, and their accompanying grave provisions, at the very top of the pyre may have also been to maximise the visual spectacle of the cremation rite and perhaps even to facilitate the upward journey of the soul into the afterlife.

The bones from Elsham and Cleatham appear to have been exposed to temperatures ranging from 600°C to over 900°C. The duration of the cremation process at these sites appears to have varied significantly and would have depended on the resources and labour invested in a funeral. This, in turn, may have been related to the social status and perceived importance of the deceased. A larger pyre would have lasted for a longer duration and would have resulted in a higher frequency of completely cremated bones. In contrast, curtailed cremation appears to have caused the incomplete cremation of bone, which may have been the result of a relatively small pyre, the physique of the deceased or environmental conditions. It appears that the mourners may have used the colour of the bone's surface as an indication as to when the cremation was complete since the vast majority of human bone from Elsham and Cleatham was white in colour. This evidence highlights that even if the inner cortical bone was incompletely cremated and darker in colour, the outer cortical bone appeared white and signalled that the cremation was a success. Given the adherence of molten glass and metal to bone it seems that the skeletal remains were left at the pyre site to cool. This evidence supports the notion that pyres would have been left to run their course, and would have been returned to when the bones were cool enough to handle.

At the two principal case-study sites, animal bone was often incompletely cremated. The burning patterns identified on these faunal remains suggest that animals were exposed to lower temperatures, deoxidising conditions and were not cremated for the time required to achieve their complete cremation. If these animals were cremated for the same length of time as the deceased, which seems likely in cases where they were placed on the same pyre, then the fact that animals were rarely completely cremated may suggest that they were placed on the peripheries of the pyre. The placement of animals in such a location would have also allowed easier distinctions to be made between human and animal bone during the collection process at the pyre site.

The general absence of pyre debris in the cinerary urns at Elsham and Cleatham has highlighted that the burned remains were processed to some degree before they were buried. The amount of processing and the quantity of cremated bone that was collected from the pyre site may be related to the amount of labour that was invested in a funeral based on the perceived importance of the deceased, but does not seem to have been significantly influenced by the biological sex or age of the individual. Infants and children tended to be represented by smaller amounts of bone but this can be explained by their smaller physique. The collection and interment of a representative proportion of bone from each skeletal area (cranial, axial and limbs) was noted at the Elsham cemetery and has also been noted to be the case at other early Anglo-Saxon cremation cemeteries (McKinley 1993, 298; McKinley 1994, 85). The average maximum fragment size of cremated bone from Elsham and Cleatham suggested that pre- and/or post-depositional disturbance had caused increased fragmentation of the burned skeletal remains. The collapse of the funerary pyre, collection and burial processes, ploughing and archaeological interference could all have contributed to the fragmentation of burned bone from the Elsham and Cleatham sites.

9.4 Summary

A recurrent trend that has been identified in this thesis is the remarkably uniform results gained from the Elsham and Cleatham cemeteries as well as other contemporary cremation cemeteries, in particular, Sancton (McKinley 1993) and Spong Hill (McKinley 1994). This demonstrates that the cremation rite appears to have had a general structure or protocol that was common to early Anglo-Saxon England. However, differences between these sites were also recorded, for instance the relationship between biological age and the rim diameter of cinerary urns is not present at all cemeteries. Such disparities (between cemeteries) may highlight localised variations of the cremation rite. This research has suggested that burial within a cemetery illustrated the inclusion and acceptance of an individual in society. Within this general community the various combinations of artefacts that made up an individual's grave provision were used to convey a more specific social identity.

The early Anglo-Saxon cremation and inhumation rites were different in many respects. The most notable difference between these funerary rites is the different ideological beliefs held by inhumation and cremation practicing groups. Sex and gender do not appear to have played such a significant role in the cremation rite compared to contemporary inhumation burial, though some discrete trends were identified, particularly among females who were afforded more gender specific items than males (such as spindle whorls and brooches). Instead, age appears to have been more clearly marked. Infants and children seem to have been provided with quite different funerary assemblages than older individuals from Elsham and Cleatham. Other aspects of an individual's identity, such as sex, gender, ideological beliefs and family affiliations, also seem to have been displayed through grave provision and aspects of the cremation process. However, these associations were subtler than the relationship that has been identified between age and funerary assemblages. Importantly, this research has illustrated that status was not ascribed at birth at the Elsham and

Cleatham cemeteries but rather it appears that social identity, roles and status changed throughout an individual’s life.

This research has attempted to gain a more comprehensive understanding of the Anglo-Saxon cremation rite through osteological analyses and a subsequent social investigation of the cremated bone the Elsham and Cleatham cemeteries. The osteological data from these sites were scrutinised to broaden our knowledge of the demographic profile of Anglo-Saxon cremation cemeteries as well as to enhance our understanding of the cultural and technological implications of the cremation rite during this period. It has shown that gender, stage in the lifecycle, ideological beliefs, ethnicity, kin ties and social roles all appear to have been inter-related in this period in the construction of an individual’s identity. These complex relationships can be seen in the many, and varied, combinations of grave provisions and the entire cremation process through to the burial of the individual’s remains. Despite the unique identity of each individual from the Elsham and Cleatham cemeteries, the burial populations of these sites were united in that they were afforded the cremation rite and burial within a large community cemetery.

9.5 Future research

Detailed analyses of the Elsham and Cleatham cemeteries have identified some interesting results on an intra- and inter-site level that would benefit from further research. The final section of this chapter will suggest future research based on the results produced in this thesis.

One of the priorities within Anglo-Saxon funerary archaeology is the investigation of sites yet to be afforded a comprehensive osteological analysis (such as Loveden Hill), as well as the reassessment of others that were examined a long time ago (such as Caistor-by-Norwich). The skeletal remains from such sites, where they survive, require analysis using up to date osteological methods. This will enhance our understanding of early Anglo-Saxon social structure, funerary rites and cremation techniques. Due to the shortcomings of some past studies (see chapter two for details) it is recommended that future research complies with a homogenous methodology, for example, the use of standard age categories. Not only is this good scientific practice, but it will also allow inter-site comparisons to be conducted with greater ease and a higher degree of accuracy. Inter-site comparison is desirable as it will potentially reveal further regional variation in the cremation practices of early Anglo-Saxon England.

There are also some aspects of cremation cemeteries that would benefit from deeper intra-site analysis. First and foremost a detailed examination of the animal bone assemblages from Elsham and Cleatham needs to be undertaken. This will allow a more in-depth analysis and will greatly contribute to our knowledge of the relationship between different groups of society and the various species of animal with which they were cremated. Isotope analysis could provide further information concerning the diet of those interred at Elsham and Cleatham. Such research might reveal differences in dietary habits among the burial population. Isotope analysis also has the potential to establish whether the high frequency of females commonly identified at Anglo-Saxon cremation cemeteries could be explained through the movement of women into communities that practiced this funerary rite. DNA analysis could be employed to obtain a greater amount of information and accuracy concerning the biological sex of individuals from these sites, and especially from burials where sexually diagnostic skeletal elements did not survive. In addition, the use of DNA analysis on multiple deposits has the potential to demonstrate whether or not individuals within the same burial were biologically related.

This thesis has approached Elsham and Cleatham synchronically. A chronologically sensitive assessment of the spatial distribution of biological and cultural variables may show changes in spatial distribution over time and could possibly show the segregation of certain groups more clearly. Chronological changes in grave provisions might also be investigable, and this could shed some light on whether the provision of certain artefacts reflects chronological variation or recurring social identities. Further studies of the cinerary urns from these sites are also desirable. In particular, a detailed comparison of the decoration of funerary vessels with the biological attributes of the interred individuals may provide more information on the meaning of this ornamentation. In addition, it would be interesting to establish whether or not this decoration was related to the grave assemblages that accompanied the deceased, such as animal remains and pyre or grave goods. Combining this kind of detailed knowledge concerning every aspect of a grave assemblage will provide a more comprehensive understanding of the complex levels upon which identity was constructed and displayed at the mortuary ritual.

An analysis of the charcoal from the Elsham and Cleatham burials would also shed some light on the types of wood that were used by these communities to construct pyres, as well as the varieties used for the production of wooden objects that may have also been burnt along with the deceased. From these data we could also get an idea of the natural resources that were exploited from the local area. A variety of more advanced forms of analysis, such as small-angle X-ray scattering (SAXS) and Fourier Transform Infrared Spectroscopy (FTIR) may also contribute to our understanding of pyre technology. Such research would also produce more accurate estimates of the temperature ranges that were achieved on Anglo-Saxon open pyres, as well as the likely durations for which they burnt. If these methods are used on a larger sample of cremated bone and are taken from different skeletal elements of the same individual our understanding of burning patterns on cremated material will be significantly enhanced. Consequently, such an in-depth analysis will provide further details concerning the position of the body on the pyre, for example if the cadaver was placed in a supine or a crouched position. These advanced forms of analysis could also be used in conjunction with macroscopic assessments to establish how the cremation process differed for infants and children compared to older members of the community.

In conclusion, an assessment of the Elsham and Cleatham cremation burials has illustrated that a detailed osteological analysis, in conjunction with the use of standardised methodology, can provide valuable information concerning the demographic profile of burial populations from cremation cemeteries. The provision of grave assemblages in cremation burials appears to have conveyed a variety of messages about the deceased's social identity, in particular their stage in the lifecycle. It is clear that cremation practicing communities had a good understanding of the factors that were required for a successful cremation. The cremation process and artefacts that accompanied the deceased on the pyre, and in the grave, also appear to have played an integral role in the ideological beliefs of these communities. In light of this research it is apparent that the cremation and inhumation rite can provide an equally valuable insight into early Anglo-Saxon society. It is hoped that after reading this thesis others will also see the potential of conducting detailed analyses on cremation assemblages as opposed to solely relying on inhumation burials for evidence of early Anglo-Saxon demography, social identities and funerary rites.

Appendices

A.1 Appendix I: Elsham database

The raw data that was gathered through osteological analyses of the individuals that were afforded the inhumation and cremation rite at Elsham can be found on the accompanying CD-ROM at the back of this thesis.

A.2 Appendix II: Cleatham database

The raw data obtained through osteological analyses of the skeletal remains from Cleatham can be found on the accompanying CD-ROM at the back of this thesis.

A.3 Appendix III: Descriptions of the Elsham thin-section samples

The following appendix provides more detailed information regarding the macroscopic and microscopic observations that were made during analyses of a sample of cremated bone from the Elsham cemetery. Micrographs under plane and cross polarised light of each sample, with the exception of EL75GA (FN 101), can be seen in Table 6.18 and appendix IV.

A.3.1 Burial EL75AM (FN 5)

A completely cremated femur fragment was selected from burial EL75AM (FN 5) and was cut at 100 microns (Fig A.3.1). Under plane and cross polarised light it is apparent that a significant amount of mineral content has been lost throughout this femur fragment. No osteons have survived the cremation process and hydroxyapatite crystals have subsequently fused as a result of exposure to high temperatures. Thus, over 50% of the microstructure has been destroyed in this bone sample. A small

Fig A.3.1 A completely cremated femur fragment from EL75AM (FN 5) number of heat-induced fractures are identifiable throughout this section. The bone fragment is white in colour, although a section of the inner cortical bone is dark grey. It is clear that the macroscopic and microscopic appearance of this section do not concur on this occasion. Furthermore, these observations do not correspond with Shipman, Foster and Schoeninger's (1984) five stages of burning. These results suggest that this bone was exposed to temperatures over 900°C.

A.3.2 Burial EL75AO (FN 7)

A completely cremated tibia fragment was selected from burial EL75AO (FN 7) and was cut at 75 microns (Fig A.3.2). Under plane polarised light it is clear that a great deal of mineral content had been lost as a result of the cremation process. Under cross polarised the loss of mineral content is also noticeable and is represented by areas that are lighter in colour. No Haversian systems have been preserved in this section of bone and hydroxyapatite crystals have completely fused. Therefore, over 50% of the microstructure has been destroyed. Heat-induced radiating fractures are identifiable in the outer cortical region of this bone. The skeletal element in question is white in colour. Therefore, the colour and bone microstructure of this sample correspond with Shipman, Foster and Schoeninger's (1984) five stages of burning. These results indicate that this bone was exposed to temperatures over 900°C.

Fig A.3.2 A completely cremated tibia fragment from EL75AO (FN 7)

A.3.3 Burial EL75BK (FN 22)

A completely cremated humerus fragment was selected from burial EL75BK (FN 22) and was cut at 60 microns (Fig A.3.3). Under plane and cross polarised light it is notable that a great deal of mineral content has been lost as a result of the cremation process. In addition, there is no evidence of surviving osteon structures and the hydroxyapatite crystals have fused together. Consequently, 100% of the microstructure has been destroyed. However, no heat-induced fractures are apparent in this section. The outer cortical region of this bone is white, although the inner section of bone is grey in colour. Therefore, the combined application of macroscopic and microscopic examination of cremated bone does not agree in this instance. These results indicate that this bone was exposed to temperatures in excess of 900°C.

Fig A.3.3 A completely cremated humerus fragment from EL75BK (FN 22)

A.3.4 Burial EL75BQ (FN 21)

A completely cremated tibia fragment was selected from burial EL75BQ (FN 21) and was cut at 60 microns (Fig A.3.4). Under plane polarised light it is clear that a great deal of mineral content had been lost. Under cross polarised the loss of mineral content is also noticeable and is represented by areas that are lighter in colour. There are no surviving Haversian systems in this section and the majority of hydroxyapatite crystals have fused. Therefore, over 50% of the microstructure has been destroyed. Heat-induced radiating fractures are abundant throughout this section. The bone fragment is white in colour. Thus, macroscopic and microscopic examinations of this section agree on this occasion and concur with Shipman, Foster and Schoeninger's (1984) five stages of burning. These observations indicate that this bone was exposed to temperatures over 900°C.

Fig A.3.4 A completely cremated tibia fragment from EL75BQ (FN 21)

A.3.5 Burial EL75BY (FN 32)

An intensely cremated humerus fragment was selected from burial EL75BY (FN 32) and was cut at 100 microns due to the fragile nature of the bone (Fig A.3.5). Under plane and cross polarised light a number of Haversian systems are identifiable, though this bone contains a low mineral content. Many of the hydroxyapatite crystals have fused together, which appears to have contributed to the microstructure's disorganised appearance. Thus, it is notable over 50% of the bone microstructure has been destroyed. Under cross polarised light, a number of heat-induced radiating fractures have also been identified in this section of bone. This fragment is primarily grey in colour, but the outer cortical bone is white in appearance. Therefore, macroscopic and microscopic examinations of this section agree on this occasion and concur with Shipman, Foster and Schoeninger's (1984) five stages of burning. This bone appears to have been exposed to temperatures between 600-900°C.

Fig A.3.5 An intensely cremated humerus fragment from EL75BY (FN 32)

A.3.6 Burial EL75CR (FN 43)

An intensely cremated radius fragment was selected from burial EL75CR (FN 43) and was cut at 60 microns (Fig A.3.6). Under plane polarised light, osteons and a relatively well preserved microstructure was identified throughout this section of bone. Haversian systems are defined and are brown in colour under plane polarised light. Under cross polarised light it is notable that the mineral content of this bone is still relatively high, though some areas of reduced inorganic content are identifiable in the endosteal and periosteal regions of this bone. Over 50% of the bone microstructure has been destroyed as a result of heat modification. No obvious heat-induced fractures are distinguishable from these micrographs. The central section of this bone is black in colour but the endosteal and periosteal regions of this bone are white. Therefore, an examination of the macroscopic and microscopic features of this sample agrees with Shipman, Foster and Schoeninger's (1984) five stages of burning. Glass globules were also found with this

Fig A.3.6 An intensely cremated radius fragment from EL75CR (FN 43) burial and suggest that the pyre reached temperatures of 700-1000°C. However, a small amount of this bone's microstructure is still intact. Thus, it appears that this bone was exposed to temperatures between 600-900°C.

A.3.7 Burial EL75GA (FN 101)

An intensely cremated radius fragment was selected from burial EL75GA (FN 101) and was cut at 60 microns (Fig A.3.7). Under plane polarised light it is notable that the microstructure of the periosteal region and external cortical bone has been destroyed. This observation illustrates that the outer cortical bone was heated to temperatures over 900°C. In contrast, the inner cortical bone contains surviving osteons and the microstructure closely resembles that of the experimental section fired at 600°C. However, the endosteal region of this bone exhibits a smaller number of osteons and the microstructure is less organised, which indicates that the hydroxyapatite crystals had commenced fusion. These observations illustrate that this section of bone was exposed to temperatures of at least 900°C. Unfortunately a cross polarised micrograph of this sample was unavailable for analysis. Over 50% of the bone microstructure has been destroyed as a result of heat modification. A number of heat-induced fractures are distinguishable on the plane polarised micrograph of this sample. The central section of this bone fragment is black in colour but the endosteal, periosteal and outer cortical bone regions of this bone are white. Therefore, the colour and bone microstructure of this sample correspond with Shipman, Foster and Schoeninger's (1984) five stages of burning. These observations suggest that this bone was exposed to temperatures between 600-900°C.

Fig A.3.7 An intensely cremated radius fragment from EL75GA (FN 101)

A.3.8 Burial EL75HL (FN 130)

An intensely cremated radius fragment was selected from burial EL75HL (FN 130) and was cut at 75 microns (Fig A.3.8). Under plane and cross polarised light this section of bone is quite unusual in that, from the periosteal to endosteal surfaces, numerous Haversian systems have survived the cremation process, although many hydroxyapatite crystals show evidence of fusion which has caused a disorganised arrangement of the bone's microstructure. However, the microstructure in the central section of this bone has been completely destroyed despite the fact that this area of bone is (macroscopically) black in colour. Over 50% of this bone's microstructure has been destroyed as a result of the cremation process. There is no evidence of heat-induced fractures from the micrographs examined. This thin-section is primarily black in colour, although the periosteal region of this bone is white, which corresponds to the microstructure of this bone. The burning patterns identified in this thin-section disagree with Shipman, Foster and Schoeninger's (1984) classification system. Glass globules were also found with this burial and indicate that the pyre reached temperatures of 700-1000°C. Based on the categories employed to classify cremated bone in this study, a temperature range of 600-900°C was allocated to this sample.

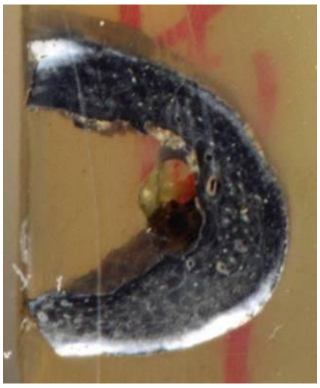


Fig A.3.8 An intensely cremated radius fragment from EL75HL (FN 130)

A.3.9 Burial EL75PF (FN 268)

An intensely cremated tibia fragment was selected from burial EL75PF (FN 268) and was cut at 100 microns (Fig A.3.9). Under plane polarised light, a band of osteons have survived the cremation process and are arranged in a disorganised fashion in the periosteal region of this bone. The remaining section of this bone displays no structure; this is exemplified under cross polarised light. Therefore, it is notable that over 50% of the bone microstructure has been destroyed as a result of heat modification. The colour of this fragment ranges from mid grey to black. The only area of bone which corresponds with Shipman, Foster and Schoeninger's (1984) five stages of burning classification is the periosteal region which is mid grey in colour and contains a small number of surviving Haversian systems. Therefore, this bone fragment appears to have been exposed to temperatures ranging from 600-900°C.

Fig A.3.9 An intensely cremated tibia fragment from EL75PF (FN 268)

A.3.10 Burial EL75PM(b) (FN 273(b))

An intensely cremated humerus fragment was selected from burial EL75PM(b) (FN 273(b)) and was cut at 60 microns (Fig A.3.10). Under plane polarised light it is notable that the central section of this bone contains many osteons and some degree of structure, though many hydroxyapatite crystals have fused and this has caused a disorganised arrangement of the bone's microstructure. Decreased mineral content is identifiable in the two darker areas located at either side of the central section of bone (discussed above). The outer cortical bone is white in colour and, under cross polarised light, it is clear that this area of bone contains no surviving osteons. A small number of Haversian systems are arranged in a disorganised fashion in the endosteal region of this bone and suggests that this section of the bone has been exposed to high temperatures, which led to the fusion of hydroxyapatite crystals. Over 50% of this bone's microstructure has been destroyed as a result of the cremation process. The micrographs of this sample do not show any evidence of heat-induced fractures. This section of bone ranges in colour from black to white and corresponds to the bone microstructure. However, a section of the inner cortical bone is black in colour and contains no surviving microstructure. Therefore this pattern of burning disagrees with Shipman, Foster and Schoeninger's (1984) classification system. Thus, it appears that this humerus fragment was exposed to temperatures between 600-900°C.

Fig A.3.10 An intensely cremated humerus fragment from EL75PM(b) (FN 273(b))

A.3.11 Burial EL76CA(a) (FN 355(a))

A completely cremated femur fragment was selected from burial EL76CA(a) (FN 355(a)) and was cut at 75 microns (Fig A.3.11). Under plane and cross polarised light, it is clear that this bone has lost a great deal of mineral content as a result of the cremation process. There are no surviving Haversian systems in this section and hydroxyapatite crystals have completely fused. Thus it is notable that 100% of the bone microstructure has been destroyed as a result of heat modification. Heat-induced radiating fractures are noticeable throughout this section of bone. This bone fragment is white in colour. Therefore, the colour and bone microstructure of this sample correspond with Shipman, Foster and Schoeninger's (1984) five stages of burning. Glass globules and fuel ash slag were found in this burial. The remnants of pyre debris illustrate that the funerary pyre, which was used to cremate this femur fragment, reached temperatures of 700-1200°C. These observations suggest that this bone was exposed to temperatures in excess of 900°C.

Fig A.3.11 A completely cremated femur fragment from EL76CA(a) (FN 355(a))

A.3.12 Burial EL76EI (FN 406)

A completely cremated femur fragment was selected from burial EL76EI (FN 406) and was cut at 100 microns due to the fragile nature of the bone (Fig A.3.12). Under plane and cross polarised light, it is clear that there are no surviving osteons in the inner cortical bone. However, the outer cortical bone surface does contain a small number of osteons and fused hydroxyapatite crystals. Thus, it is notable that over 50% of the bone microstructure has been destroyed as a result of the cremation process. One heat-induced radiating fracture has

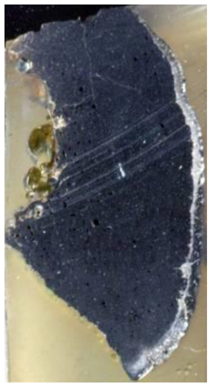


Fig A.3.12 An intensely cremated femur fragment from EL76EI (FN 406) been identified in this thin-section. The outer cortical bone surface is white to medium grey in colour. Therefore, the microstructure and colour of the outer cortical bone surface corresponds with Shipman, Foster and Schoeninger's (1984) study, which demonstrates that this bone was heated to over 940°C. The mid- and inner-cortical bone of this sample is black in colour though there is no evidence of surviving microstructure in these areas. Thus it would appear that this burning pattern disagrees with Shipman, Foster and Schoeninger's (1984) classification system. These observations suggest that this femur fragment was exposed to temperatures over 900°C under deoxidising conditions given the destruction of bone microstructure and the black colour of the mid- and inner-cortical bone.

A.3.13 Burial EL76EQ (FN 414)

A completely cremated femur fragment was selected from burial EL76EQ (FN 414) and was cut at 60 microns (Fig A.3.13). Under plane and cross polarised light there is no evidence of surviving osteons in this section of cremated bone. Furthermore, it is notable that most of the hydroxyapatite crystals have fused together and the majority of the bone's mineral content has been destroyed as a result of the cremation process. Consequently, over 50% of the bone microstructure has been incinerated due to heat modification. No heat-induced fractures have been identified in this section of bone. The colour of this femur fragment ranges from pale grey to white and corresponds to the bone microstructure. The burning patterns identified in this thin-section agree with Shipman, Foster and Schoeninger's (1984) classification system. Copper-alloy globules were also found in this burial and indicate that the funerary pyre reached temperatures of 700-1000°C. Thus, this bone appears to have been cremated at temperatures over 900°C. These observations suggest that this bone was exposed to temperatures between over 900°C.

Fig A.3.13 A completely cremated femur fragment from EL76EQ (FN 414)

A.3.14 Burial EL76MQ (FN 526)

A completely cremated tibia fragment was selected from burial EL76MQ (FN 526) and was cut at 100 microns (Fig A.3.14). Fusion of hydroxyapatite crystals and an overall lack of microstructure have been identified throughout this thin-section. In addition, a significant amount of the bone's mineral content has been destroyed as a result of the cremation process. Therefore, it is notable that over 50% of the bone microstructure has been destroyed as a result of heat modification. A number of heat-induced fractures are evident in this section of bone. The colour of this tibia fragment is white. Therefore, the colour and bone microstructure of this sample agree with Shipman, Foster and Schoeninger's (1984) five stages of burning. Thus, it appears that this tibia fragment was exposed to temperatures over 900°C

Fig A.3.14 A completely cremated tibia fragment from EL76MQ (FN 526)

A.3.15 Burial EL76NA (FN 536)

This intensely cremated ulna fragment was selected from burial EL76NA (FN 536) and was cut at 100 microns (Fig A.3.15). Under plane polarised light it is evident that there are only a few surviving osteons located in the endosteal region of the bone. The fusion of hydroxyapatite crystals in the mid cortical section of this bone seem to have contributed to the microstructure's disorganised appearance. Under cross polarised light it is clear that the bone microstructure in the outer cortical region of this sample has been completely destroyed as a result of the cremation process. Therefore, over 50% of the bone microstructure has been incinerated due to heat modification. Numerous heat-induced radiating fractures are notable throughout this thin-section. The outer cortical bone is white in colour, while

Fig A.3.15 An intensely cremated ulna fragment from EL76NA (FN 536) the mid cortical bone is mid grey and the inner cortical bone is light grey. The colours identified in this thin-section correspond to the bone's microstructure. Thus, the colour and bone microstructure of this sample concurs with Shipman, Foster and Schoeninger's (1984) five stages of burning. These observations suggest that this bone was exposed to temperatures between 600-900°C.

A.3.16 Burial EL76NN (FN 549)

An intensely cremated femur fragment was selected from burial EL76NN (FN 549) and was cut at 100 microns (Fig A.3.16). A significant proportion of the bone's microstructure has been destroyed as a result of the cremation process. However, the mid cortical bone contains two areas that are comprised of surviving osteons. Over 50% of the bone microstructure has been incinerated due to heat modification. A small number of heat-induced fractures are notable in this section of bone. The colour of this femur fragment ranges from white to black and corresponds to the bone microstructure. The burning patterns identified in this thin-section agree with Shipman, Foster and Schoeninger's (1984) classification system. These observations suggest that this ulna fragment was exposed to temperatures between 600-900°C.

Fig A.3.16 An intensely cremated femur fragment from EL76NN (FN 549)

A.4 Appendix IV: Enlarged images of the Elsham micrographs

Descriptions of the 16 bone samples that were selected from the Elsham assemblage for the purpose of histomorphological analysis can be found in Table 6.18 and appendix III. Appendix IV contains enlarged micrograph images of these bone samples and can be found on the accompanying CD-ROM at the back of this thesis. These images have been provided in an enlarged, electronic format to facilitate the identification of microscopic details that have been mentioned in section 6.9.1 and appendix III of this thesis.

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