CCCE/16

THE CATHEDRAL CLOSE, HEREFORD, HEREFORDSHIRE

ARCHAEOLOGICAL EXCAVATION
VOLUME 1 – TEXT

HFD-MG-2009-122

2012, updated June 2017

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

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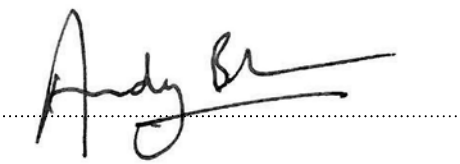

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PROJECT SUMMARY

In September 2009 work began on a £5m project to restore the Cathedral Close as a suitable setting for the Cathedral and more attractive public space. The project involved intrusive ground works for the laying of services and rearrangement of paths and parking areas. Due to the historical importance of the site and the presence of archaeological remains immediately below the surface, the main contactors, C.J. Bayliss, were assisted on the project by a team of professional archaeologists from Headland Archaeology.

The scheme itself was designed to minimise impact upon important archaeological deposits, and where possible to preserve remains in situ. Wherever possible the ground surface of the Close was built up to accommodate the higher curbs on the new and replacement paths. Any works that broke ground were monitored by archaeologists, and where archaeological deposits were revealed that could not be left in place, the archaeologists were afforded the time to remove the deposits and create a full record of their existence.

The renovation of the Close provided a unique opportunity to study the archaeology of a large area of land right at the centre of Saxon Hereford. It was the largest excavation to be carried in Hereford for fifty years and turned out to be one of the largest medieval/post-medieval burial ground excavations undertaken in Britain. A total of 2,453 articulated human burials were revealed during the programme of works, along with the remains of structures and deposits dating from the Saxon through to the late medieval and post medieval period

CONTENTS

LIST OF TABLES

LIST OFCHARTS

THE CATHEDRAL CLOSE, HEREFORD, HEREFORDSHIRE

ARCHAEOLOGICAL EXCAVATION

1 INTRODUCTION

In September 2009 work began on a project to restore Hereford's Cathedral Close as a suitable setting for the Cathedral and more attractive public space. The project involved intrusive ground works for the laying of services and rearrangement of paths and parking areas. Due to the historical importance of the site and the presence of archaeological remains immediately below the surface, a team of professional archaeologists from Headland Archaeology were engaged by the main contactors, C.J. Bayliss.

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The results of the excavation were published in Death in the Close: A Medieval Mystery (Boucher, Craddock-Bennett & Daly 2015). The following report contains text and illustrations from the publication plus additional information not included in the final publication.

2 LOCATION AND GEOLOGY

Hereford Cathedral is located at the historic centre of the City of Hereford (centred on NGR 35100 23977). The superficial geology is recorded as Devensian Sand and Gravel, overlying the Silurian siltstones and mudstones of the Raglan Mudstone Formation (BGS 2014)

3 HISTORICAL BACKGROUND (ILLUS 1)

3.1 PREHISTORIC PERIOD (ILLUS 2)

Hereford would appear to be a prime location for settlement, situated on a well-drained river terrace, with natural springs and a fording place across the River Wye. Chance finds of stone tools confirm there was human activity on the site of the later city during the prehistoric period, but so far no evidence for settlement has been discovered (Thomas & Boucher 2002: 3).

3.2 ROMANO-BRITISH PERIOD

Perhaps the 'Holy Grail' of archaeology in Hereford would be to find definitive proof for Roman occupation of the site. Rarely a major excavation takes place without a few sherds of Roman pottery or building material being found, but as yet there has not been the major discovery of Roman occupation that is almost expected.

The place-name 'Hereford' derives from the Old English for 'army ford', and shows the importance that the natural crossing place across the River Wye had in establishing the settlement. The ford is believed to be located to the south of the Bishop's Palace gardens on a continuation of the line of Broad Street and the northern part of Gwynne Street. It has been suggested that the use of this ford may date back to the Roman period when the river crossing is thought to have formed part of the 'Watling Street' as it passed between Leintwardine and Monmouth (Wood 1903: 188).

In 1920 Alfred Watkins identified an early defensive enclosure with the cathedral at its centre (Watkins 1920). Rectangular in plan, the

enclosure was bounded by the King's ditch in the west (following the line of Aubrey Street down towards the River Wye), and what we now believe to be the Saxon defensive ditch in the north (immediately to the north of the line of East Street and West Street). From the junction of Offa Street and St John Street the line of the ditch was traced southwards to Castle Hill. Watkins was content to leave this early defensive work as undated. George Marshall, however, used Watkins model so suggest a Roman origin for the town (Marshall 1940: 68). Marshall suggested that if the layout of Roman Leintwardine (Bravonium) was imposed onto the centre of Hereford, then Watkin's enclosure mirrored the layout. The central street at Leintwardine was shown to fall on the line of Church Street and the fort's rounded corner corresponded to the junction of Offa Street and St John Street.

To date, no definitive evidence has been found to support Marshall's theory. Excavations by Shoesmith on the northern ditch and Heys and Norwood on the line of the King's ditch have produced no Roman material (Shoesmith 1982: 89), and a Saxon origin (certainly for the northern defensive work) is generally accepted. Shoesmith does however record that the ditches had clearly been re-cut a number of times and this could have removed all trace of their potential Roman origin.

Along with the almost commonplace recovery of stray sherds of Roman ceramics, a number of Romano-British coins have been discovered in Tupsley, Kings Acre and Newton Farm and a hoard of eight coins was discovered in a garden in Hunderton in the 1950s. Whilst these artefacts could have been deposited by people on the move, a number of stone objects discovered in the city suggest a more purposeful Roman presence. Two Roman altars were reused in the construction of two seventh or eighth century grain-drying ovens found close to Victoria Street, and a further altar was found near St John Street. During the extension to the former Woolworths store on Eign Street in 1962, a quern stone dating to the Iron Age or Romano-British period was recovered.

Without the discovery of a building or defensive work dating to the Roman period there is a tendency to explain away stray finds within the city as having been imported from the nearest Roman settlement of Kenchester (Magnis), four miles to the north-west of Hereford. It is not uncommon for Roman masonry to be reused in later buildings, indeed Leland, writing in the early 16th century, speaks of the people of Hereford pulling down the ruined buildings of Kenchester and using the best stone for their own buildings (Shoesmith 1992: 3). Leland's direct reference to the re-use of material from Kenchester by the people of Hereford, provides a convenient explanation for the presence of Roman architectural material within the city. At present, the evidence is simply not there to support anything other than a Saxon origin to the settlement. Leland considered that 'of the decaye of Kenchestre Herford rose and florishyd'.

3.3 ANGLO-SAXON PERIOD (ILLUS 3 AND 4)

As the decline of the Roman Empire became terminal and led to the abandonment of Britain in the early 5th century, petty princedoms emerged to fill the power vacuum. In many parts of Britain, this vacuum was filled by Germanic settlers, but there is evidence to suggest that the Herefordshire region remained largely British. In the land between the Wye and the Severn, covering much of modern Herefordshire, the kingdom of the Magonseate was established, and the southern part of the modern county, known as Ergyng, was ruled by Welsh kings throughout the 6th and 7th centuries (Hooke 2006: 43.). The Old English term '-saete' may indicate people of a British origin, and indeed the first king of the Magonsaete adopted the name Merewalh, which means illustrious Welshman.

In the West Midlands, smaller petty kingdoms were coalescing into more stable kingdoms by the 7th century, with the kingdom of Mercia emerging as the dominant power in the region. By the 8th century, Mercia's sphere of influence extended westwards to the present border with Wales, and by AD800 the sub-kingdom of the Magonsaete had been subsumed.

The documentary evidence for the foundation of Hereford is sparse, obscure, often contradictory and largely concerned with the religious foundation of the city. It has traditionally been held that the foundation of the diocese of Hereford dates to AD676 when Seaxwulf, the Mercian bishop at Lichfield granted a church and land to Putta. Unfortunately Bede, in his Ecclesiastical History of the English People, does not specify the location of Putta's church, however, an episcopal list dating to the early 9th century records Putta as the first bishop of the western Hecani (later known as the Magonsaetan) who are thought to have occupied an area broadly equating to the Hereford diocese. Some historians now question Putta's involvement in the foundation of the diocese (Hillaby 2001) and suggest that the Episcopal lists were fabricated to lend credibility to the rule of Offa and his desire to hand the kingship down to his son. Because Bede had not specified the location of Putta's church, Offa was able to fabricate the Episcopal lists to place Putta at the head of the Hereford diocese and therefore create the illusion of a well-established Mercian diocese dating back to the late 7th century. The purpose of this was to emphasise the extent of the Mercian see to demonstrate the need for an archbishop. The pope agreed and an agreeable archbishop was appointed, with the power to consecrate Offa's son, Ecgfrith as king. The plan worked.

Even if the foundation of the see does indeed date to the late 7th century persuasive arguments have been made for the seat of the Bishop being at Lydbury North, Ledbury or Leominster rather than Hereford (Blair 2001: 11).

Christianity seems to have been well established in the Welsh borderland by the 6th century and it seems probable that the western Hecani were already Christian prior to the conversion of the Mercians, the religion having been established during the Roman period. The organised, politicised Christianity of the Mercians was being inserted into a pre-existing Celtic Christian landscape. Current archaeological evidence points to the Castle Green area of Hereford as the location for a religious establishment with its routes in Celtic Christianity. Excavations on the site in 1960 and 1973 demonstrated the existence of religious buildings, with associated burials dating from the seventh to eleventh centuries (Shoesmith 2000: 293). On the balance of probability, the site, later dedicated to St Guthlac, may have existed throughout its life as a religious establishment separate and distinct from the later cathedral on the close and the wider diocese of Hereford, having its origins in the Celtic rather than the Roman church.

If there was a Bishop of the Magonseate located elsewhere within the diocese, two pieces of evidence suggest that it had been moved to Hereford by the end of the eighth century. The more convincing of these is a document of AD803 in which Wulfheard describes himself as Bishop of the Church of Hereford. The second and slightly more fanciful evidence comes from the Anglo-Saxon Chronicle where it is recorded that in AD794 King Offa of Mercia had Ethelbert, king of the East Angles beheaded. Apparently the young Ethelbert had come to the royal estate at Sutton in Herefordshire in order to obtain the hand of Offa's daughter Elfthryth in marriage. On the instructions of either Offa or his queen, Cwenthryth, the young king was murdered and thrown into the marshes by the River Lugg. The location of the body was miraculously revealed to friends of Ethelbert by a great beam of light and the appearance of a spring. A vision of Ethelbert appeared to a nobleman and instructed him to take his body to Hereford. During the journey, Ethelbert's head fell off the cart and was found by a blind man, who was miraculously restored to sight (Zaluckyj 2001: 153). Approaching Hereford the group delivering the body stopped to rest and another spring miraculously appeared (this is now the site of St Ethelberts well, located on Castle Hill, to the east of Quay Street). The church which was originally dedicated to St Mary, was by the end of the 10th century dedicated additionally to Ethelbert. From a modern perspective, it is difficult to draw too much historical fact from the tale of Ethelbert's demise. The importance of the tale is perhaps in the way it draws a key protagonist, King Offa of Mercia (AD757–96) into the story of Hereford.

Hereford's location on the frontier between the Welsh and the Anglo-Saxon kingdoms clearly made it vulnerable. The Life of St Guthlac, written before AD749, records that at the beginning of the eighth century 'the Britons were troubling the English with their attacks, their pillaging and their devastations of the people'. In AD743 Ethelbald, the king of Mercia, and Cuthred of Wessex campaigned together against the Welsh. The Book of Llandaff records the 'plunderings' of the 'treacherous Saxon nation', and makes specific reference to this happening 'on the borders of Wales and England towards Hereford'. The culmination of these hostilities may have been the battle of Hereford in AD760 which is recorded in several Welsh sources (Whitehead 1982: 13). The extent of Offa's involvement in the battle is unrecorded, however, having come to the throne after the death of Ethelbald in AD757, Offa certainly continued hostilities with the Welsh and completed the settlement of the land beyond the River Severn, defining its western boundary by the construction of the great dyke that bears his name.

There is a strong possibility that the construction of the dyke was part of a wider reorganisation of the political and religious landscape of western Mercia, which led to the development of Hereford under Offa (Blair 2005: 288). Archaeological excavations have indicated that a planned grid system of streets and houses was laid out in the west of the city at some time between the mid-8th and mid-9th century (Shoesmith 2000: 293). Broad Street formed the central north-south thoroughfare and an east-west road joining Castle Street to King Street is believed to have crossed through the area now occupied by the cathedral. Shoesmith also suggests that the remains of the grid system are fossilised in the modern day Berrington Street, Aubrey Street, Church Street and St John Street.

The reorganisation of Hereford as a planned settlement may have afforded the opportunity for the creation of a religious precinct at its heart. The documentary evidence for the cathedral church being established in Hereford at the beginning of the 9th century (rather than the late 7th century) would appear to fit with developments elsewhere within the city and wider region. A gravel rampart excavated on Victoria Street is believed to be the earliest phase of defences for the city and is dated to the mid-9th century (Shoesmith 1982: 74). During the period between AD800 and AD850 the religious, political and strategic importance of the settlement rises to the fore, and it is perhaps to this period more than any other that we can date the emergence of modern Hereford.

Little is recorded about the early development of the cathedral close. The antiquarian John Duncomb, writing in the early 19th century, speculated that the cathedral church during the time of Offa was constructed of wood. His assumption is based on the description of the church that replaced this structure, given by 16th century historian Vergil, as being of a 'marked distinction from that which preceded it'. The replacement, built of stone, was constructed by Milfrid around AD825.

Following a resurgence in warfare with the Welsh during the first half of the 9th century, Alfred emerged as the dominant Saxon king of the latter part of the century and adopted a more conciliatory approach to the Welsh. It is during this period that Mercian supremacy passed to the West Saxons (Whitehead 1982: 14) and Herefordshire comes into being as a tribute area for the town itself. The territory of the region, however, does not extend beyond the River Wye and Hereford finds itself right on the border of the West Saxon state. In truth, both the Saxons and the Welsh had a common enemy during this period so some degree of co-operation was inevitable – it was now Danish raiders who became the predominant threat to the stability of the region. In AD893 Ethelred of Mercia called out the King's thegns 'from every fortress (burh) east of the Parret both west and east of Selwood, and also north of the Thames and west of the Severn together with a section of the Welsh' (ASC 1953: 87) and defeated the Danes at Buttington in Montgomeryshire. Hereford was almost certainly the only Saxon 'burh' west of the Severn and it would seem that by this date the place not only had defences but was an integral part of the West Saxon defensive system (Whitehead 1982: 14).

Danish raids continued into the tenth century and the men of Hereford are specifically mentioned in AD914 when, alongside the men of Gloucester they inflicted a heavy defeat upon the 'great pirate host' which had been marauding in Archenfield and had captured the bishop of that region. Whitehead (2007: 21) suggests that during the early 10th century, Hereford may have been used as a base for the Saxon rulers to launch attacks into Welsh territory. Alfred's daughter Aethelflaed, Lady of the Mercians, oversaw the creation of a series of defended settlements during the late 9th and early 10th centuries, and the defences of Hereford may have been strengthened or extended during this period. Certainly, the town must have been of some prominence, when in c.930 King Athelstan met the Welsh Princes in Hereford for talks.

Dumcumb speculates that the turmoil of the period led to the deterioration of Milfred's cathedral

> '…if the Danes did not offer positive violence to the fabric, the state of continual warfare of alarm must have occasioned a neglect of the common means necessary to

> its preservation. Perhaps to this cause it may be assigned, that the lapidea structura (stone structure) decayed within the short period of two hundred years…' (Duncumb 1804: 522)

Bishop Athelstan (c 1015–56) emerges as a key figure in the history of Hereford cathedral in the early 11th century, at a time when the English crown passed into Danish hands. Victory over the English at Assandum and the subsequent death of King Edmund II led to Cnut (1016–35) assuming the throne and the settlement of the southern part of the west midlands, including Herefordshire, by Danish incomers (Keynes 2000: 16).

Athelstan is variously recorded as either rebuilding the cathedral during his incumbency or 'constructing his minster from its foundations'. It is unclear whether Athelstan built an entirely new cathedral at this time or simply carried out repairs to Milfred's 9th century structure. In either case, the documentary references suggest that his works were extensive. Although the exact dates are unrecorded, it seems likely that Athelstan embarked on the project c AD1020–1040.

Little is known about the form of the late Saxon cathedral and various suggestions have been made for its former location within the close. In their comprehensive assessment of surviving Anglo-Saxon architecture, H.M. and J. Taylor (1965: 295) record that the surviving northern wall of Bishop Robert's chapel (1079–95), now incorporated into the southern wall of the later Bishop's cloister, in turn incorporated the northern wall of an earlier building. The Taylor's believe that two double-splayed, round-headed windows are Saxon in date. If this is the case, the natural conclusion would be that they formed part of Athelstan's minster.

Unfortunately the construction of Athelstan's great minster coincided with a resurgence of Welsh nationalism under Gruffydd ap Llewelyn. It has been suggested that the Welsh perhaps regarded themselves as the rightful rulers of Herefordshire, and Llewelyn's attacks on Leominster in AD1052 and Hereford in AD1055 were part of a deliberate plan of reconquest. The political situation was favourable to Llewelyn, the rule of Herefordshire during this period being divided between the English house of Godwin and a Norman faction led by Ralf, the nephew of Edward the Confessor.

Llewelyn attacked Hereford on the 24th or 25th of October 1055, with the help of Elfgar, a disgruntled Mercian nobleman outlawed by Edward the Confessor who was under pressure from the House of Godwin. The Welsh forces confronted Earl Ralph 'the timid' and an army comprised of both English and Normans two miles distant from the town. Under the control of Ralph, the English soldiers, apparently unused to mounted combat were routed. Florence of Worcester records the events;

> 'Before any spear had been thrown the English army fled because they were on horseback, and many were killed there – about four or five hundred men – and they killed none in return. And then they went back to the town and burnt it with the glorious minster which Athelstan the venerable bishop had built. They stripped and robbed it of relics and vestments and everything, and killed the people and some they carried off.'

The extent to which the cathedral was damaged is not entirely clear. Certainly the attack was violent – Canon Eilmar, four of his sons, and two further canons were murdered while defending the doors of the cathedral. The building did however survive to some degree. Athelstan died the following year and is recorded as being 'buried in the church which he himself had constructed from the foundations'. This would suggest that the cathedral was still standing and in a suitable state to receive the body of a bishop.

The cathedral standing in Hereford today is not that of Athelstan. The earliest parts of the current building are Norman and date to the early 12th century, which raises the question of the whereabouts of the great minster of the 11th century, and indeed, the one, possibly two churches that occupied the site before it. Even if the sacking of Hereford did not destroy the Saxon cathedral, it seems almost certain that it destroyed any contemporary documentary evidence to indicate its location. Other than the Hereford Gospels and Bishop Athelstan's evangeliary, which pre-date the sacking, the existing record of Hereford's cathedral church starts in the 1050s.

Clues as to the location of Athelstan's cathedral exist. The possible Saxon masonry identified in the southern wall of the Bishop's cloister would place the cathedral to the south of the current cathedral in the area between the northern end of the Bishop's Palace and the College of Vicars' Choral. Duncumb records the tantalising tale of 'excavations' undertaken in the 17th century, which also suggests a location to begin the search.

> 'Its position is uncertain, but about 1650 Silas Taylor found, 'beyond the lines of the present building, and particularly towards the east, near the cloisters of the college, such stupendous foundations, such capitals and pedestals, such well-wrought bases for arches, and such rare engravings, and mouldings of friezes' as left little doubt in his mind that they were the foundations of the cathedral destroyed by Alfgar and Griffin' (Duncumb 1804: 523).

If Silas Taylor was correct in his belief that he had found Athelstans' cathedral then it is clear that the Norman cathedral was not built on the same site, but to the north of its Saxon predecessor. According to his description, St John's quad would appear to be a possible location for Taylor's excavations and potentially the Saxon cathedral.

The sacking of Hereford in AD1055 brought about a renewed focus on the defence of the town. After pursuing the Welsh raiders, Harold Godwinson (later to become King Harold II) embarked upon a program of extensive works. Florence of Worcester records that Harold dug a broad deep ditch around the town and fortified it with gates and bars. The documentary sources do not make it clear whether Harold constructed entirely new defences at this time or whether he repaired and refortified an existing defence.

The earliest Saxon defences of Hereford are believed to date to the ninth century. Originally they were formed from a turf and clay rampart with a timber face and exterior ditch (Shoesmith 1982). In the early to mid-10th century, the timber was replaced with a stone wall. By the late 12th century, due to the expansion of the city, the defences were extended to enclose a larger area, which is traceable in the city today as the medieval stone wall (added to the defences

in the mid-13th century). To the east and west, the Saxon defences occupy the same line as the later 13th century wall. The northern line of the Saxon defences lie approximately along the route of East Street and West Street, ie the northern ditch identified by Alfred Watkins. Harold's contribution to the line of the original defences remains uncertain, although evidence for repair of the existing northern defences attributed to Harold, has recently been identified during construction of a sports hall in East Street (Craddock-Bennett 2009).

What we can now confidently attribute to Harold is the creation of a defended area to the south of the River Wye. Recent archaeological work on the defensive circuit to the south of the river known as the King's ditch has returned carbon dates suggesting that this earthwork was part of Harold's refortification, and indeed a concentration of works to the south of the river would seem sensible considering the Welsh threat. Based on the existing evidence, it would appear that Harold repaired the existing defences to the north of the river and created additional defences to the south.

3.4 MEDIEVAL PERIOD

With the consecration of Bishop Robert of Lorraine in AD1079 the fortunes of the diocese and of the cathedral revived (Barrow 2000: 23). Robert came from Lotharingia (a region equivalent to modern day eastern France, western Germany and western Switzerland), and had been trained at the cathedral school in Liege. The new bishop came to an arrangement with William Fitz Osbern, the Norman overlord of the Marches, whereby Robert gained the manor of Eaton Bishop in exchange for an area of land beyond the northern Saxon defences (Whitehead 1982: 17). Fitz Osbern used the newly acquired land to create a Norman suburb and market place and in doing so shifted the commercial heart of the town from the area around the cathedral to the part of Hereford today known as High Town. This shifting of the commercial area could be seen as the first step towards creating the space necessary to rebuild the cathedral on a grand scale. In practice Robert did not get to realise that dream. His contribution to the development of the cathedral was the construction of the Losinga chapel, a square, two-storey building dedicated to St Katherine and St Mary Magdalene (Illus 5). A large part of the building was demolished in the 18th century, but the north wall of the building is still standing and is incorporated into the south wall of the south-west cloister. Perhaps due to the presence of potential Saxon masonry within the surviving wall of the Losinga chapel, it has been suggested that the most likely location for Bishop Athelstan's 'glorious minster' is in the region between Robert's chapel and the Romanesque cathedral to the north. However, the 'Saxon' masonry appears to relate to the northern wall of a former building (Taylor & Taylor 1965) suggesting that the saxon building extended to the south of the suggested location. Shoesmith suggests that the reality of a functioning Saxon cathedral sandwiched between the Losinga chapel and a construction site to the north is unlikely, and in line with Silas Taylor's observations proposes the area of the College of the Vicars Choral as an alternative location. David Whitehead suggests a location closer to the river (2007: 23). The present Cathedral Archaeologist Richard Morris makes the observation that we should keep an open mind regarding the location of the Saxon cathedral and entertain the probability that more than one church or chapel existed in the complex, as at pre-conquest Worcester and Winchester (Morris 2000: 204).

What existed on the site in the years prior to the construction of the Romanesque cathedral is not entirely clear. The sweeping away of the Saxon in favour of the Norman was an experience common to almost all English cathedrals of the late 11th and early 12th century, but there presumably must have been a period when both the Saxon cathedral and the emerging Norman cathedral co-existed on the site. There are no documentary references to a new cathedral building being constructed between the sacking of the Saxon Minster in AD1055 and the construction of the Norman cathedral at the start of the 12th century.

The Norman impact on the layout of the town should not be underestimated. Prior to the conquest it seems likely that the area now occupied by the quiet and tranquil Close was the centre of a busy, crowded Saxon town. The main east-west thoroughfare is thought to have passed beneath what is now the northern side of the Norman cathedral. The area was likely to have been filled with trade, industry, housing and religion – both the spiritual heart and the secular heart of the town existing side by side. The creation of a new market place to the north allowed for the centre of the Saxon town to be swept away, to be replaced by a dedicated ecclesiastical complex on a far grander scale than had existed before. In practice, it would appear that trade, play and even occupation of the Close occurred throughout the medieval period and the dream of a spiritual haven was not entirely realised.

The core of the current cathedral's plan and structure is made up of the Romanesque cathedral built between about 1107 and 1148 (Morris 2000: 204). Bishop Reinhelm, elected in AD1100 but only consecrated in AD1107, was described in the cathedral obit book as fundatoris ecclesiae (founder of the church). Conflicting sources have resulted in debate as to whether Reinhelm or his predecessor Robert actually begun the work, but it seems likely that Reinhelm oversaw the greater part of the project.

Although Athelstan's cathedral was clearly damaged in the Welsh attack, references to Athelstan being buried within the building would suggest that the cathedral was serviceable at the time of his death. What is not clear, is when the structure was finally removed from the site. Did Athelstan's cathedral continue to perform the functions of a cathedral church until the Norman cathedral was completed, or was the Losinga chapel built for this purpose, heralding the end of the Saxon structure even before the foundations of the Romanesque structure had been laid?

The mid-12th century witnessed the removal of St Guthlac's Priory to a new site on the edge of town (the current County Hospital and Bus Station site). This religious community had lost most of its land holdings after the conquest and become encircled by the castle. The arrangement is unlikely to have been satisfactory and things appear to have come to a head during the war of succession (AD1135 – 1153) between King Stephen and the Empress Matilda. In AD1140, in an attempt to gain control of the castle, Matilda's forces took control of the newly built cathedral and established a siege engine on the tower to hurl missiles at the castle. New earthworks were thrown up to attack the king's forces which involved the exhumation of a number of recently buried corpses, much to the horror of the townsfolk. David Whitehead (1980: 5) identifies the site of the exhumations as the burial ground attached to St Guthlac's

on Castle Green. However, considering that the Close is more likely to be the receiver of recently buried corpses at this date, and that Matilda's forces were apparently attacking from the west, it would seem that the cathedral close has an equal, if not greater claim to be the location for the earthworks.

Regardless of whether the bodies were pulled from the Close or Castle Green, it was clear that the location of St Guthlac's within the grounds of a Royal Castle was less than ideal, and the decision was made to move the ancient foundation to the Bye Street suburb of the city (the current site of the county bus station and hospital). The move took place about AD1144, coincidentally around the time of the consecration of the new Romanesque cathedral (Illus 6).

3.5 HISTORY OF BURIAL AT THE CLOSE

The earliest burial ground for the city was almost certainly at St Guthlac's in the present Castle Green area, where burials dating from the 7th to the 12th centuries have been found. The point at which the cathedral replaced St Guthlac's as the main burial place for the people of Hereford is not known, but a date in the 11th or early 12th century seems likely. When St Guthlac's Priory relocated in AD1144, the cathedral was not only claiming exclusive burial rights over the parishes of the city but also several outlying ones. Once the cathedral had achieved a monopoly on burial it fought hard to maintain it – burial fees and legacies were a valuable source of revenue.

Disputes over burial rights did occur. In 1288 when Hampton Bishop made a bid for burial autonomy, an agreement was struck with the cathedral related to the status of the person to be buried. It was agreed that any parishioner whose goods at the time of his death exceeded 6s. in value should be brought to the cathedral cemetery for interment, whilst women and those of lesser means should be buried at home. Allensmore attempted a similar break for burial independence in the fourteenth century. The cathedral, once again determined to maintain control over the high value burials permitted local burial of children and paupers, but no others (Swanson & Lepine 2000: 79). Not to be defeated, the parishioners of Allensmore 'accidentally' buried some of their wealthier dead and no doubt received their burial fees. An agreement of 1348 allowing general burial, provided that the funeral profits went to the cathedral rather than the local church, must be seen as a victory for the cathedral. Not only was the cathedral maintaining a valuable string of income, but it was reducing pressure on what must have been a rather crowded burial ground.

The first documentary reference which specifically mentions the 'Close' dates from AD1389 when a royal licence was given to the dean and chapter to enclose the cemetery and to keep the gates locked after curfew. The reason behind the enclosure was, amongst others, the mischief done by swine and other animals that dragged the dead bodies from their resting places in the ground. Whilst painting a very graphic image of the realities of a medieval urban graveyard, it also suggests that burials were incredibly shallow.

Bishop Spofford's register records that in 1434 he wrote to the dean and chapter that 'he grieved to say that the beauty of our cathedral has long been marred by unseemly trading, and the cemetery desecrated by animals overturning the bodies…and by other servile and unseemly works, so that it more resembles a highway or open ground than a cemetery and holy place dedicated to God.'

The problem of burial crowding got worse through time. The level of the Close prior to landscaping in the 19th century was much higher than today, a result of centuries of burial within a confined area. Various old deeds speak of the ascent to the Close from different sides. Church Street was described as the lane which leads from the cemetery steps, and Speede's 1606 draft map of Hereford (Illus 7) clearly shows steps entering the Close from Broad Street and Castle Street. The English antiquary John Aubrey alludes to the pressure on the graveyard in his descriptions of the Cathedral's crypt,

> 'Under the cathedral-church at Hereford is the greatest charnel-house for bones that ever I saw in England. In 1650 there lived amongst those bones a poor old woman that, to help out her fire, did use to mix the deadmen's bones: this was thrift and poverty: but cunning alewives putt the Ashes of these bones in their Ale to make it intoxicating.'

In addition to conjuring up a macabre image of 17th century poverty, Aubrey's description highlights the pressure on burial space and the disturbance caused to earlier burials by later ones.

By the late 18th century the problem of overcrowding had clearly reached a level where it even outweighed concerns over lost burial revenue. On 11th September 1790 the dean and chapter wrote to the several parishes in the city and suburbs…

> The Dean and Chapter…having very seriously considered the present state of the Minster churchyard and that of the Lady-Arbour (the only places of interment in this populous City) how greatly crowded they are, and have long been with Bodies…how great reason there is to apprehend that some contagious Distemper may arise to the endangering the Health and even the Lives of the Inhabitants have found it absolutely necessary to declare, That from and after the 25th day of March 1791 no bodies can be admitted for Sepulture here, except of those who shall happen to die within the Precincts…' (Morgan 1976: 17)

If the term 'precinct' refers to the boundaries of the Close and associated cathedral buildings then it must be assumed that the number of burials post-dating AD1791 was very few indeed and largely limited to the clergy. Alternatively, it may be that the parishioners of St John's were still allowed to be buried within the Close, as the Cathedral housed their parish church (Hoverd 1998, HAS359). In recalling the Hereford of the early 19th century, F. E. Gretton remembers

> 'The Minster Yard was an untidy and uncared-for place, with pathways made ad libitum in all directions, while the earth was so accumulated round the walls that only an inch or two at the top of the crypt windows…remained, just enough for our marbles to slip through.' (Gretton 1889)

Cathedral records indicate that the Close was cleared of grave-stones in AD1796 and the ground level was lowered in 1850–51. The reduction in ground level was clearly quite significant in places as

subsequent excavations on the Close have encountered burials immediately below the surface. How much soil was removed during the landscaping can be judged by comparison of the present level with that shown in topographical drawings made prior to the landscaping. Buckler's print of 1816 shows that the soil level against the north transept was just below the chamfers on the plinth, indicating that the soil level in this area was later lowered by about 0.7m. There is also agreement in early nineteenth century prints about the soil level around the Lady Chapel, a print from Britton's Hereford Cathedral (1831) indicating a similar reduction in ground level. It seems probable that the level of the Close had already been lowered to some degree prior to the landscaping of 1850–51. The topographical prints show a dearth of headstones within the area of the cemetery, indicating that work of some sort had been carried out previously.

3.6 THE BUILDINGS OF THE CLOSE

It is easy to think of the history of the Close as being about the history of burial. This is not, however, the complete story. A quick look at existing maps of the site shows buildings appearing and disappearing during the last 400 years and there is no reason to believe that this was not the case for the preceding 500 years.

Excavations in and around the Close have so far failed to identify evidence for the canonical properties, that would have been a key feature of the Norman and medieval precinct. Shoesmith (2000: 300) believes that the current buildings forming the northern edge of the Close may well respect the positions of the original Canon's dwellings but suggests that the grounds of the original buildings extended further to the south, meaning that historically the Close covered a smaller area than it does today.

Up until the end of the 12th century references to canons' houses suggest that they were built of flimsy materials (Barrow 2000: 39) and that they were somewhat temporary in nature. A document of 1180–86 records the Bishop ordering the removal of a house built upon the cathedral graveyard by a former Archdeacon. This implies a certain pressure on available space, and can be considered another sound reason for the enclosure of the site in AD1389. We can be fairly confident that historically the Close was a more crowded space. The evidence from Taylor's map of 1757 suggests that the edges of the Close were more rigidly defined by buildings than they are today. The present row of properties on the eastern side of Broad Street previously continued further to the south and encroached onto the north-west corner of the Close. Buildings are indicated in this position on Speede's 1606 draft of the map of Hereford, and are more accurately plotted on Taylor's 1757 map of the city. The buildings were demolished following a fire in 1935, but photographs taken prior to their demolition show street level hatches suggesting that the buildings were cellared.

The north-west corner of the Close has also been suggested as the original location for St Ethelbert's hospital prior to its relocation to Castle Street in the 16th century (Whitehead 1986: 416). In c 1225 a house for the poor is recorded as being founded on lands next to the cemetery of St Ethelbert. Some light is thrown upon the location of the hospital in 1406 when the major of Hereford gave permission for the custodians to make a stone or wooden step measuring four feet in width 'in the street called Brodestrete to aid divine worship in the chapel of the almshouse.'

Buildings also encroached upon the eastern side of the Close, Taylor's map shows a building extending northwards from what is currently 'School House', directly to the east of the Lady Chapel. The additional buildings to the east and west would have narrowed the entry points to the Close, creating a far more enclosed area than today (Illus 8).

The cathedral buildings themselves have of course been altered, modified and added to since the original construction of the Norman building. Certainly the most dramatic event that brought about changes to the original fabric was the structural failure of the west end on Easter Monday 1786 (Illus 9). The western range of the Bishop's cloister which had abutted the west end had been demolished in 1762 to make way for a new school room. The effect of this has subsequently been blamed by some (Roberts 2001: 147) for weakening the foundations of the Romanesque structure and causing the loss of the façade and half of the original nave and aisles. A report of the incident in the Hereford Journal captures the outrage and horror felt by the journalist at what must have been one of the most memorable events in 18th century Hereford;

> 'the ruins though awful, afford a pleasing view, especially to behold the statues of kings and bishops resting one upon another.'

The rebuilding of the west end was entrusted to James Wyatt, who curtailed the nave by one bay and created a bland, much maligned facade that was eventually rebuilt to the design of John Oldrid Scott between 1904 and 1908. By and large, the third and latest incarnation of the west end is tolerated as a slight improvement on Wyatt's attempt but far short of the artistry of the original.

The collapse of the west end seems to have been the catalyst for a change of attitude towards the Close. James Wyatt, in his report into the collapse of the west end, had observed that the gradual raising of the churchyard's level over the centuries, had prevented proper drainage and resulted in the weakening of the foundations. The decision to halt burial occurred within five years of the collapse and the busy crowded space of the medieval and early post-medieval period appears to have given way to a more peaceful, respectful environment culminating in the landscaping and removal of remaining grave stones in 1850–51. Since that time, aside from the removal of properties abutting the Close on Broad Street and Castle Street, the only changes of note have been variations to paths, railings and tree plantings. In essence the renovation works of 2009–11 have not dramatically altered the appearance of the Close in the present, but they have had far reaching consequences for understanding the appearance of the Close in the past.

4 ARCHAEOLOGICAL BACKGROUND (ILLUS 10)

The excavations undertaken on the Cathedral Close between 2009 and 2011 added to a body of work amassed over the previous

decades. The fact that the largest area excavated as part of the latest works was in the far east of the Close is significant. The only other large scale archaeological excavation to be undertaken at the cathedral was at the western side of the Close in advance of the construction of the new chained library building.

4.1 MAPPA EXCAVATION 1993

The Mappa excavation, as it has since become known, was carried out in 1993. The excavation was confined to the footprint of the new library building but the excavation depth was c 2.8m below ground level due to the requirement for a cellar to be built beneath the building.

Roman tile was recovered from the earliest deposits on the site, but the evidence was not suggestive of Roman occupation. The main features of the excavation were a stone-built basement fronting onto a north-south road believed to date to the Saxon period. To the east of these features was a burial ground believed to pre-date the Norman Conquest. Immediately post-conquest a large pit was dug through the cellar and road and subsequently filled with disarticulated human remains representing approximately 5,000 individuals. The area then appears to have been levelled and used as a burial ground for approximately 1100 individuals between the late 12th century and the mid-16th century. 200 were of these individuals were buried communally within three large pits. The foundation trenches for the 18th century music room were identified in the north of the excavated area.

Unfortunately the detailed results of the excavation have not yet been published, as analysis is still being undertaken. The interim findings were published in 1996 and provide the basis for the following discussion (Stone & Appleton-Fox 1996). The archaeological activity was split into five chronological periods (Illus 11).

4.1.1 Period 1 – The earliest settlement

A light brown silt loam overlay the natural gravels of the river terrace. Cut into this deposit were a number of stake-holes and shallow pit features, some containing Roman tile. The largest feature identified was a 2m wide ditch passing through the excavated area on a north-south alignment. Further Roman tile was recovered from this feature.

4.1.2 Period 2 – The late Saxon period

Twenty-one late Saxon burials were excavated in the east of the site, all in clearly defined rows. The level of intercutting between burials was suggestive of three generations of burial (approximately 90 years). Two of the graves contained patches of black staining possibly indicating the presence of a coffin and one burial had 'pillow stones' to hold the head in place in the grave. Iron barrel locks were found in the pelvic region of two of the burials.

To the west of the burial ground and believed to date to the same period was a multi-layered metalled surface believed to be a road. The surface ran broadly parallel to the modern day Broad Street although on a slightly different angle. A drain on the eastern edge of the road separated it from a masonry structure measuring 5.1m by 2.75m internally with stonework surviving to a height of 2.85m. Although the construction date of the basement could not be ascertained, the pottery evidence suggests that it was certainly in use during the 11th century. Cess deposits had filled up the lower part of the basement suggesting that once the overlying building had fallen out of use, the basement had been reused for waste disposal. A Saxon sword was found within these deposits. A stone basement of this period is believed to be unique in Britain. It seems probable that the basement related to a high status structure, one possibility being an early Bishop's Palace, pre-dating the 12th century structure in existence today.

The road and basement were both on the same alignment as the 12th century Bishop's Palace. This alignment tends further towards north-east/south-west than a true north-south orientation, and appears to pre-date the Norman Cathedral. The 12th century Bishop's Palace, although believed to be later than the Norman Cathedral may be replicating the earlier alignment, or may indeed have earlier origins. If the alignment of the road revealed during the Mappa excavation is extended through the city, the road would continue to the river ford in the south, and extend north to meet up with Widemarsh Street. Taylor's map of 1757 appears to support this route, as the rear boundaries of houses fronting onto Broad Street and Church Street appear to match the orientation of the postulated road. The existence of this former road was originally suggested by Alfred Watkins in 1920 and the evidence from the Mappa excavations appears to substantiate the claim. A road on this alignment would appear to pre-date the defences and regular road system in the city which are dated to the late 9th or early 10th century.

4.1.3 Period 3 – The gravel quarry and charnel pit

At some point in the late Saxon or early Norman period a major alteration of the land use occurred. A massive pit measuring 11m by 7m in plan and continuing to a depth of 5.5m was excavated through the road, basement and cemetery. The pit was filled with mainly disarticulated remains of approximately 5,000 people. The disarticulated nature of the remains suggests that they were not originally interred in the pit but had been moved there as part of a mass clearance of burials from another area.

The construction of the Norman cathedral is likely to have altered the landscape of the city more than any previous event and occurs during the period when this large pit was dug. It is commonly accepted that the new cathedral was not built on the site of its Saxon predecessor and therefore it is logical to assume that it occupies a site used for burial during the Saxon period. The excavation of foundations and laying of internal floors for the new structure could conceivably have disturbed a large number of burials which would need to be disposed of. The need for gravel for the construction of the cathedral and the associated development of the new market place in High Town could have necessitated the excavation of large gravel quarries on the river terrace. The pit revealed during the Mappa excavation may then have served a dual purpose – gravel extraction for the building projects, and re-use of the pit for the disposal of human remains disturbed by the same projects.

The location of the pit is interesting. Clearly it is more efficient to extract the gravel as close as possible to its place of use, but if we suppose that the road and basement are still in use or at least still visible when the pit is dug, it is suggestive of an entire disregard for

all that has gone before on the site, and a Norman exertion of power and dominance over the Saxon populace.

4.1.4 Period 4 – The medieval cemetery

After the deposition of the disarticulated material, the pit had been sealed with a substantial layer of soil deposited across the site. This had subsequently slumped into the pit and two levelling deposits were observed. At this point the whole excavated area became part of the cathedral cemetery. 1100 bodies were interred, dating to between the late 12th and mid 16th century. The first burials were encountered within 0.1m of the 1993 ground level, with the earliest burials being revealed at a depth of 1m.

Several of the earliest burials were in stone lined graves and the presence of decorated stone with some of the burials indicated that stone was being re-used from elsewhere to line the graves. All of the burials followed the Christian tradition of being buried in the supine position, and all but two were buried on an east-west alignment with their heads to the west. A variation of burial orientation of up to 30º from true east-west was noted amongst the burials, a result perhaps of aligning burials to buildings or pathways present on the site at the time of burial. Chronological variations in arm position were noted. The earliest burials had their hands placed on their pelvis or arms laid at the side of the torso. On later burials the forearms were placed across the chest or across the stomach.

In terms of the medieval cemetery, perhaps the most interesting discovery of the excavation were three large pits arranged in a row, containing the remains of approximately 200 bodies. Burials from the pits have been radiocarbon dated to the mid-fourteenth century and in all probability relate to the Black Death of AD1348–49. Layers of burials were separated by layers of clay, suggesting that the day's dead were sealed to contain the smell before being added to the following day. After the mass graves had been completely filled, this area of the Close ceased to be used as part of the cemetery although burials continued in the remainder of the excavated area well into the sixteenth century.

4.1.5 Period 5 – The post-medieval use

Further large pits were excavated, and once again gravel extraction has been suggested as the likely purpose – in this case for use by mason's working on the cathedral. It seems that from the mid-sixteenth century onwards the area was used as a garden.

The Mappa excavation of 1993 was extremely important to the excavations of 2009–11 for a number of reasons. It had shown the extent and survival of pre-burial archaeology below the Close, and the importance of it for understanding the formation of the city. Overlying this was a densely packed post-conquest cemetery. Future development works at the Close would involve a greater appreciation of the level of archaeological material present on the site and the need for planning and co-operation between contractor and archaeologist.

4.2 NEW TOILET BLOCK EXCAVATION 2000

In January 2000 a new toilet block was constructed between the south-east transept and the treasury building in Chapter House Yard (Crooks 2000, HAS926). Upon removal of the old toilet building twelve skeletons were found to be in the way of the required foundation depth of 0.5m below ground level (Illus 12). A number of the later skeletons were truncated by the 16th century treasury extension and all are thought to pre-date this building. The shallow depth of the burials, immediately below the floor of the old toilet block, suggests that ground levels in the Chapter House Yard had been significantly reduced since the bodies were interred. This reduction most likely occurred during the landscaping of the Close in the mid-nineteenth century.

The earliest burials were buried in stone lined graves (cists) and occurred at a depth of between 55.87m AOD and 56.17m AOD. Tool marks were observed on the stone. There was no evidence that the stone had been worked specifically for use in the cist and it is more likely that building stone was re-used for the purpose. The cist burials were associated with pottery dated to the 13th and 14th century.

Overlying one of the cists was the coffined burial of an 8–9 year old child, which is slightly anomalous as the eleven other burials were all adult males. The remaining burials were likely to have been interred in shrouds as no material other than the skeleton was present.

Three of the burials excavated each contained a mortuary chalice and paten, indicative of a priest burial (Illus 13). Mortuary chalices of lead alloy are recorded in the cemeteries of several towns, the burials dating from the late 13th century onwards. In 1229 the bishop of Worcester ordered that churches should have two chalices, a consecrated one of silver for use during Mass, and an unconsecrated one of pewter, to be used for the burial of the priest. The presence of three priest burials within such a small assemblage suggests that for a period this area was used as a clerical cemetery.

4.3 CASTLE GREEN EXCAVATIONS 1960, 1973

Castle Green (300m to the east of the cathedral) was the site of a monastic establishment possibly predating the cathedral itself. The site, which is believed to have been dedicated to St Guthlac in the late 9th century, is first mentioned in AD975. Excavations carried out in 1960 and 1973 however, show that the site was being used as a graveyard as early as the late 7th century (Shoesmith 1980). Burial continued on the site until it was relocated to the Bye Street suburb of Hereford in the mid-12th century. Between the mid-11th and mid-12th centuries, St Guthlac's was confined within the outer bailey of the Norman castle. A geophysical survey on the site undertaken in 2008 further highlighted the confused co-existence of priory and castle structures (Illus 14).

In all 85 burials were excavated on the site although density calculations suggest that between 7,000 and 15,000 individuals were buried on the site prior to the construction of the castle in the mid-11th century. The earliest burials, dating to the 7th and 8th century, were all simple interments (no evidence for coffin fittings, stone lining, shroud pins etc.), and were associated with an earth platform on which a timber building stood. The elevated position, the relationship with the burials, and the eventual replacement of this structure with a stone church suggests that the timber building was originally constructed as a church. The stone church is the latest in a succession of religious buildings on the site. It probably replaced

the wooden structure in the second half of the 11th century and survived until the end of the 17th century.

A further building to the south of the timber platform church was believed to have been a mortuary chapel. Crop marks show the building to be rectangular, approximately 8m wide and 20m in length. Burials dating to the 9th or 10th centuries were excavated within the building.

A complex building was revealed in parch marks occupying the land between the timber platform church and the mortuary chapel. It has an east-west orientation and apparently consists of several small rooms surrounding one of two larger ones. It is possible that the remains represent the domestic buildings or communal living quarters associated with the religious settlement.

Thirteen 'charcoal' burials were identified across two burial groups. Large oak timbers appear to have been burnt and the resulting charcoal used to line the grave. The purpose was not clear, but Shoesmith suggests that it was possibly done to soak up decomposing body fluids and control smells. The early charcoal burials were dated to the 9th to early 10th century and the late charcoal burials dated to the 10th and 11th centuries. Over half of the charcoal burials were within coffins, and a separate burial group of coffined burials without charcoal present was contemporary with the early charcoal burials.

Simple burials dated between the mid-10th and mid-12th century were the most frequent type of burial encountered (33). Although it is recorded that three cist burials were encountered during the laying of a main sewer pipe through Castle Green in 1886, only one was revealed during the subsequent excavations. The cist burial was dated to the late 11th to mid-12th centuries. The latest burials on the site were nearly all infants or very small children. Some were buried with care but many were in small, shallow graves dug without regular spacing or consistent orientation. Shoesmith suggests that the 24 infant interments may have been a late use of a consecrated piece of ground for the burial of unbaptised children.

4.4 CATHEDRAL BARN EXCAVATION 2009

Allied to the 2009–11 Cathedral Close project was the restoration of the Cathedral Barn in the north-east corner of the Close. Historic Building Recording and targeted archaeological trenches radically altered the accepted interpretation of the barn as one of the oldest secular buildings in Hereford (Shoesmith 2011).

A detailed survey of the timber framework was carried out by the City of Hereford Archaeology Unit in 1987. The available evidence suggested that the building was probably of 13th century origin with later additions and was perhaps the second-oldest surviving secular building in Hereford. Dendrochronological samples appeared to substantiate this claim. Earlier samples provided a date range of AD1253–88, whilst samples from clearly later timber additions gave a precise date of AD1491. The dates appeared to fit an original use of the barn as a canon's house.

However, test pits excavated in 2009 revealed that the barn was constructed upon an earlier masonry structure. Excavations through the interior floor levels, adjacent to the southern wall uncovered an earlier east-west orientated wall substantially wider (c 0.85m) than the barn wall which was built upon it (Illus 15). The wall cut earlier deposits. Although no dateable material was recovered, substantial amounts of metal working residues including hammerscale and iron slag were identified between 55.30m AOD and 56m AOD. Pottery found within the surface contemporary with the construction of the wall was manufactured between the 13th and 15th centuries. A succession of deposits abutting the wall and pre-dating the construction of the barn were dated to the 16th century.

Further test pits were excavated to establish the extent of the wall which showed it continued west beneath the southern edge of the barn, before meeting an abutting wall of the same dimensions which continued north beneath the western wall of the barn. Where observed, the underlying wall matched the footprint of the later wall. One possible reason for this is that the later barn structure is built upon the lower courses of a previous building.

An alternative interpretation is that the earlier masonry is not the remains of a building, but the remains of a substantial wall that surrounded the Close. The abutting wall to the north could represent the eastern side of an entry to a property further to the north. John Speede's 1606 map of Hereford shows what appears to be a wall surrounding the Close, and yet no building in the north-east corner of the Close that can be clearly identified as the barn. If this interpretation is correct then the cathedral barn was constructed after 1606 using timbers from two much earlier buildings.

4.5 MINOR TRENCHES AT THE EAST END, 1998

During the replacement of electrical cables immediately to the west of the Old Deanery, early archaeological deposits were revealed. A small pit containing animal bone and a sherd of pottery dated to the 10th or 11th centuries was present at a depth of 55.35m AOD.

During the same year depressions appeared in the surface of the Close to the east of the Lady Chapel. Two trial pits were excavated and established that the depressions were caused by the overlying deposits dropping into voids beneath degraded sandstone tomb slabs. In the more northerly of the two trenches a sequence of graveyard deposits were recorded. The use of a hand auger established that natural gravels were present at a height of 54.77mOD. The second trench revealed the presence of an undisturbed lead coffin. The depositum plate recorded the remains as belonging to Mrs. Mary Powell who died on 2nd February 1823, aged 92 years.

The appearance of a further void in 1998 led to the excavation of a trial pit immediately adjacent to the Lady Chapel. Five articulated skeletons were revealed but not excavated. Flowing groundwater was believed to be the cause of the void.

5 METHOD

5.1 SURVEY

A series of survey stations was established on site. These acted as TBMs to ensure that all site work could be recorded using the

OS grid. A Leica total station was used to tie temporary survey/ planning points to the main grid. These points were also recorded photographically and on all drawn records.

5.2 MONITORING AND EXCAVATION

A watching brief was undertaken during all ground-breaking work during the re-development of the Cathedral Close. Modern deposits were removed using mechanical excavators fitted with toothless buckets. As soon as human remains or stratified archaeological deposits were encountered, machine excavation stopped and control of the area containing archaeologically sensitive material passed to Headland Archaeology (UK) Ltd.

- All human remains or stratified archaeological deposits were hand excavated by suitably qualified archaeologists.
- The project osteologist oversaw the osteological procedures employed on site and was permanently available to attend site when required.
- Where possible deposits were excavated stratigraphically.

If archaeological deposits were still present once the level required by the development ('the construction level') had been reached, an additional 25mm of deposits was archaeologically excavated to allow for a protective layer to be deposited prior to construction works.

The protective layer consisted of a geotextile membrane covered with a 25mm layer of sand. A Tensar TX160 geogrid was installed over the deposit of sand to disperse the force exerted by the overlying granular sub-base material.

5.3 RECORDING

A written record of archaeological deposits and features was made using Headland pro forma record sheets. Context, photographic, environmental, drawing and small find registers were maintained throughout the project.

All site paperwork was checked by the project officer before being entered into the site archive.

5.3.1 Photography

All archaeological deposits and features were photographed using black and white 35mm film and a high resolution (7mp) digital camera. A metric scale bar, north arrow and photographic information board were included in each picture.

Each skeleton was photographed with survey control points visible in the photo.

5.3.2 Drawing

Each skeleton was drawn at a scale of 1:10 on drafting film. A minimum of two survey control points was recorded on each drawing including the x, y and z value for each survey point. All small finds associated with an individual burial (including coffin furniture, shroud pins and grave goods) were indicated on the drawing.

All archaeological deposits and features (excluding human remains) were drawn at a scale of 1:20. Section drawings were drawn at an appropriate scale (ie 1:20 and 1:50) depending on the complexity of the stratigraphy.

5.4 SAMPLING

5.4.1 General finds

All finds were collected from deposits predating AD1700.

A sample of finds was retained from 'graveyard' deposits. Material from these deposits was not stratigraphically secure due to the continual redeposition of material as a result of grave digging.

5.4.2 Special finds

The following finds were designated 'special finds' and were assigned a unique 'SF' number and had their position recorded in three dimensions and recorded in a register;

- Those that were typologically distinct and closely dateable
- Those that were likely to require conservation or treatment
- Those that may need specific analysis

5.4.3 Animal bone

All animal bone from securely dated deposits was retained.

5.4.4 Environmental soil samples

Soil samples (20–40 litres) were taken from all stratigraphically secure deposits.

5.4.5 Human remains

Human remains were treated with dignity and respect at all times. Preservation in situ was the preferred methodology throughout the project.

Temporary and permanent screens were used to prevent members of the public for observing the excavation of human remains.

Disarticulated human remains

All disarticulated human remains were collected from site and bagged according to context number. In the initial stages of the project, the project osteologist logged the skeletal elements present within the disarticulated material and carried out an assessment of the significance of the unstratified disarticulated bone. The results indicated that due to the condition of the assemblage the scientific value of the remains was poor as basic osteological analysis could not be ascertained. Based on the project osteologist's recommendations, and the agreement of the Archaeological Advisor

to Herefordshire Council, Mr. Julian Cotton, the methodology was changed on 24th November 2009. From this point, only femurs were retained for further assessment by the project osteologist. All other disarticulated material was reburied without further study.

It is important to note that skulls were treated in the same way as articulated burials, even when no other bones were associated with them.

Disarticulated material was re-buried within the 'soak-away' trenches of areas 2 and 3. Once construction depth had been reached in these trenches, an additional 100mm of deposits was removed. A geotextile membrane was laid over the base of the trench before a 100mm layer of disarticulated human remains was re-deposited in the trench. This in turn was covered with a further layer of geotextile membrane. Control of the trenches was then passed to the principal contractor.

Articulated Human Remains

- All articulated human remains in danger of being impacted upon by the development were recovered from the site;
- Unless deemed archaeologically or osteologically important, burials were not 'chased' beyond the edges of the excavation area, excepting the necessity to recover whole bones;
- Burials were carefully exposed and assigned an individual skeleton (SK) number;
- A project specific pro forma burial recording sheet was completed for each burial;
- A minimum of two survey control points were fixed to the ground at the extremities (head and feet where present) of each burial;
- A photographic record of each burial was made. At least one photo per burial included survey control points, metric scale, north arrow and information board;
- Burials were located by recording the position of the survey control points and entering these details on the relevant drawing; and
- A hand drawn plan of each burial was made on drawing film at a scale of 1:10. The position of all material associated with the burial (eg coffin furniture, shroud pins, grave goods) was indicated on the plan.

In the initial stages of the project, soil samples were taken from the head, abdomen and foot area of each skeleton. An assessment of the material recovered from these samples, led to the discontinuation of this methodology.

Individual burials were lifted from the ground and bagged according to area of the body, eg left arm and hand was bagged separately from right arm and hand. The individual bags were then placed together within a further bag labelled with the unique (SK) skeleton number.

6 RESULTS (PRE-BURIAL)

The Mappa excavation had shown the potential for pre-cemetery remains to exist within the cathedral close. The majority of excavations during the 2009–11 project were not deep enough to reach below the human burials that formed an almost continuous layer across the site, however, where pre-cemetery deposits were revealed the level of preservation was surprisingly good.

From the 12th century onwards, the Close had almost completely been turned over to use as a burial ground, and evidence for activity unrelated to burial during this period was scarce. The burials, which will be discussed later, were tightly packed and intercutting, forming a layer of human remains approximately 0.6m deep. In the north of the Close, where the ground is visibly higher, a soil overburden covered the burials to a depth of approximately 1.2m. In the south of the site, where presumably a greater depth of soil was removed during the mid-nineteenth century landscaping, burials were present within 0.1m of the surface.

The ground-works, which had been designed to cause minimum disturbance to the archaeology rarely impacted below 0.4m and therefore opportunities to investigate the pre-cemetery archaeology were limited. However, these opportunities did arrive, and when they did the results did not disappoint (Illus 16).

The results below form a narrative to the excavations. Appendix 1 provides information on individual contexts.

6.1 ST JOHN'S QUAD (AREA 1)

To allow for the root growth of two trees due to be planted in the centre of a new parking area, a Silva Cell suspended pavement was proposed. The system, which also allows for the dissipation of storm water, entailed the excavation of an area measuring approximately 16m by 16m to a depth of c 1m below the existing ground level. The 'Area 1 deep excavation' as it became known was the largest open area excavation undertaken during the project. The following findings are described starting with the earliest activity identified through to the most recent.

The required excavation depth to install the Silva Cell was not sufficient to enable the full excavation of the site to the level of natural gravels which were present at a depth of approximately 55m AOD. The earliest deposit encountered was a layer of light brown silty clay. Hand augering showed this deposit to be 0.5m deep, but excavation only impacted upon the upper 0.1m of the deposit. Where this deposit was excavated a low density of finds were revealed comprising a small amount of animal bone and traces of metal working residues. A prehistoric flint knife or scraper was recovered along with three sherds of pottery commonly made in the 10th and 11th centuries.

The deposit commonly appears, overlying the natural gravels, throughout the city, and is interpreted as topsoil deposit pre-dating human activity. It is likely that the finds retrieved had been trampled into what was in truth an archaeologically sterile deposit.

6.1.1 Phase 1 – Late 9th century (see lllus 17–20)

The earliest archaeological features on the site were the remains of what must have been a very large structure of foundation trench and post-hole construction (Building 1). The main part of the structure was located on a slightly embanked area in the far north of the deep excavation area.

The longest exposed section of foundation trench was 7.5m long and 0.4 to 0.5m wide and orientated approximately 13.5º askew of true east-west. A line of post-holes was visible in the central portion of the trench. Rather than being centrally placed, the line of posts appears to have been placed tight against the southern face of the trench, and the impressions of the posts were visible in section.

Two shallow beam-slots, at right angles to the east-west foundation, continued beneath the northern extent of the excavation. A compacted mortar floor was evident to the north of the foundation which would suggest that the excavation caught the southern edge of the building. The shallower north-south beam-slots are therefore internal to the structure and are likely to represent the positions of internal partitions within the building, or alternatively the positions of floor joists to support a wooden floor. This may suggest two phases of internal flooring, the mortared floor being earlier than the supported wooden floor.

A circular feature had been dug through the foundation trench at the point where it continued west beyond the limits of the excavation. The feature was interpreted as a post-pit rather than a post-hole due to its scale (1m in diameter and reaching a depth of 1.9m below the top of the beam-slot), and the angled nature of its sides. The soft, dark fill of the feature suggested that the post had decomposed in situ. To better understand this feature, and attempt retrieval of dating evidence, the excavated area was extended slightly to the north. A combination of hand excavation and augering was used to ascertain the true dimensions of the feature. Within the extended northern section, a further north-south beam-slot was visible.

A beam-slot believed to date to the same phase of activity emerged from the northern trench section at a right-angle to the main east-west structure. Evident for a length of two metres the beam-slot was truncated to the south by a later feature before apparently continuing for a further metre before being truncated for a second time. A further truncated beam-slot was present approximately 0.8m to the west of the southern extent of the beam-slot and an unexcavated post-hole lay to the west of this. The relationship between Building 1 and the north-south beam-slots in the west of the site is not clear. The projected convergence of the features was outside the excavated area and therefore a definite relationship could not be established.

To the south of the main east-west foundation trench, and therefore external to the structure, the ground dropped away by approximately 0.2m over a distance of two metres. Set into the slope was a deposit of flat irregular stones, loosely forming an east-west paved revetment to a deposit of gravel occupying the ground between the stones and the building. A post-hole to the west of the stones appears to be unrelated to the beam-slot structure and its purpose was unknown. As it lay below the required construction depth, it was not excavated.

At the base of the main east-west foundation trench a further feature was identified, which appeared to be contemporary with the trench itself. Excavation revealed it to be the grave of a child aged 8–10 years old. The sex of the child could not be determined due to damage to the skeleton caused by later features. The orientation of the grave mirrored the orientation of the foundation trench and no grave cut was visible in overlying deposits. The burial was sealed by a succession of deposits before the area was later used as a cemetery in the early Norman period. Only two feasible alternatives present themselves – either the body was intentionally buried beneath the southern elevation of the structure as it was built, or the burial pre-dates the structure and belongs to an earlier, unexcavated phase of activity.

Lining the base of the main east-west foundation trench and continuing down the eastern side of the large post-pit was an intermittent lens of soil with a high charcoal content. Beyond the presence of charcoal there was no evidence for in situ burning and it seems likely that the lens represents the widely used preservation technique of charring wooden structural elements before placing them in the ground. The soil filling both the post-pit and the post-holes within the foundation trench was incredibly loosely compacted and dark in colour suggesting that the posts had been left to rot in situ.

Assessment of the animal bone assemblage recovered from the phase 1 deposits revealed an unusual dominance of pig bone over cattle and sheep bones. In other Hereford assemblages cattle dominate in all but the smallest and statistically unreliable groups of bone. The bone of an eagle was also identified and is an incredibly rare find.

Discussion

A sample of the soft, organic fill of the post-pit at the western end of the beam-slot was found to contain charred Emmer wheat seed which was subsequently radiocarbon dated to 1156+/-27BP. When calibrated to account for fluctuations in the level of atmospheric ^{14}C, the sample returned a date between the late 8th and mid-10th centuries, with two data spikes of increased probability in the late ninth and early tenth centuries.

A sample of bone taken from the 'beam-slot burial' was dated to 1148+/-28BP. This returned a calibrated date-range almost exactly the same as the sample taken from the post-pit.

If the assumption is correct that the burial represents the foundation date of the building and the seeds recovered from the post-pit represents its demise, then the life-span of the building would appear to be relatively short. However, this apparent closeness in dates could be due to the vagaries of radiocarbon dating. If the earliest date in the range of possibilities is taken for the burial (AD780) and the latest date in the range is taken for the post-hole sample (AD970) then we are left with a wooden building that has lasted for 190 years, before falling out of use. However, the probability of both the dates occurring at the opposite extremes of their date ranges is remote. Closer inspection of the calibration curve reveals two distinct data spikes in both samples. If the burial took place during the earlier spike and the decay and abandonment of the building took place on the second spike, we would have a foundation date for the building of c AD890 and a date for its abandonment of c AD930.

Practical experiment at West Stow Anglo-Saxon village, where a number of Saxon buildings have been reconstructed from archaeological evidence, has shown that a 0.2m square oak post has no structural value after c 20 years (West 2001: 25). It is probable that the larger sectional area of the post which occupied the post-pit would translate into a potential lifespan far exceeding the proposed 40 years.

It is difficult to reconstruct the form of the building with so little evidence to go on. The overall ground-plan is unknown and we do not know what the overall dimensions of the building were.

The presence of post impressions within a foundation trench suggests that the building was of post-in-trench construction. In this method of construction a continuous trench is dug for the closely set posts rather than individual holes. The posts can be set in the centre of the trench, or to one side as was the case with Building 1. Normally load-bearing, the spaces between the posts were filled with planks or other material such as wattle panels. Most of the known examples of this type of construction belong to the late Saxon period and are from urban or aristocratic contexts, although there are earlier examples in rural contexts eg Maxey (Cambridgeshire) and Chalton (Hampshire).

Building 1 shares a number of characteristics with a long hall excavated at Cheddar in Somerset. The hall believed to pre-date AD930 forms part of a Royal Palace complex and is of post-in-trench construction, with the posts set to the side of the trench to take advantage of the additional stability offered by the surrounding soil deposits. Measuring approximately 23m x 5m, the hall was demolished in the 10th century and a new hall built on the site.

The diameter of the post-pit and width of the foundation trench suggest a structure on a massive scale. Post-pits have distinctive sloping sides because the timbers they supported were too large to be dropped vertically into a post-hole. It was instead necessary to excavate a hole larger than the post, with sloping sides to ease the task of levering the timber into an upright position. Post-pits are used where the posts need to be founded deeply, they are also necessary to give manoeuvring space for the erection of uprights which may often have exceeded 10 metres in length (Rahtz 1976: 85). Anglo-Saxon post-pits exceeding 1m in depth are incredibly rare. Where they have previously been identified at sites in Yeavering and Cheddar they have been part of royal halls (Rahtz, 1976: 85).

So what was the building? Due to the limited amount of the structure excavated and the distinct lack of clues as to its purpose, a myriad of possibilities exist, all with some merit. The most attractive proposition is that it is one of the former cathedrals known to have been on the site.

On first impression, Building 1 building would appear to fit the criteria for an early cathedral church. As excavated, the long axis (as excavated) is on an approximate east-west alignment, and the substantial post-pit could represent the corner of a tower. The north-south aligned beam-slot emerging from the section to the west of the post-pit, could be the foundations for a porticus.

Although there was certainly a cathedral church on the site during the late 9th and early 10th century, Duncomb in his interpretation of the accounts of the 16th century historian Vergil is convinced that the existing structure at this time was the stone cathedral (lapidea structura) built by Milfrith in c AD825.

Duncumb's belief that the cathedral of the ninth century was built in stone rather than wood is not grounds to discount the possibility that Building 1 is a former cathedral. It must be remembered, however that like today a cathedral is a complex of many buildings, and in the case of Saxon Worcester and Alfred's Winchester, more than one church. The proportion of the building uncovered by excavation means that it is simply not possible to determine the use of the building, indeed, it is not possible to determine whether we have excavated the long side or the short side of the building. Due to the cathedral setting, there is a tendency to view the excavated foundation trench as the southern wall of a building on an east-west alignment. There is however nothing to prevent the trench relating to the shorter southern wall of a north-south orientated building, more in keeping with the 12th century Bishop's Palace than the cathedral. Certainly, the existence of a Bishop's Palace pre-dating the 12th century is probable. Fenn and Sinclair (1990:1) suggest that a palace is likely to have been present on the site of the present cathedral and palace since the creation of the Saxon burgh in the 8th or 9th century.

A further, intriguing possibility exists – that Building 1 is a royal palace. The similarities in construction and date with the potential royal palace excavated at Cheddar have already been noted. The establishment of the cathedral, the re-organisation of the town and the creation of the defensive circuit through the intervention of the Mercian Kings in the 9th century (Whitehead 2007: 14) all suggest that Hereford was a royal centre. The case for an administrative building, or at least a place where king or his officers could expect hospitality is strong. Whitehead suggests Castle Green as a likely location for such a building, but it would more likely that such a building would be placed at the centre of a newly planned town rather than the periphery. The Close would seem a likely place for such a building.

It is acknowledged that Aetheflaed embarked on a scheme of burgh building and war against the Welsh during the early 10th century and it seems likely that she would have used Hereford as a base from which to launch her attacks into Welsh territory. The radiocarbon dating of Building 1 does not discount the possibility that it is connected to this period and could potentially be the building where Aetheflaed's nephew, King Athelstan signed a treaty with the Welsh princes in c 930.

The 'beam-slot burial'

In the pre-Christian Saxon period, burial of infants in pits, ditches and the floors of buildings was not uncommon, but the burial of a sub-adult within the foundation trench of an ecclesiastical building has, to date, never been recorded.

Foundation burial has been observed in non-Saxon contexts. Excavations at the deserted settlement of Westbury, Buckinghamshire, uncovered a baby buried under the southern wall of a 13th century building. The excavator commented that the appearance of the burial being deliberate, intentional and even purposeful was so strong that it is certainly possible that it represented some sort of foundation deposit (Ivens et al 1995,

145). The function of the medieval building at Westbury was not established, and it was not clear why it alone amongst the buildings excavated received a foundation burial.

Segregation between the burial of adults and sub-adults has been observed at a number of Saxon sites. At the Saxon settlement of Flixborough, a group of burials were found along the internal wall of a structure within an otherwise domestic setting. Of the six burials, five were aged between three and twelve years and showed signs of dietary deficiencies. The only adult burial was of female in her 20s with a foetus buried at her feet. The small inhumation cemetery associated with the site by contrast, contained no burials under the age of seventeen (Crawford 2008, 201).

A similar pattern of segregation was found on the ecclesiastical site of Whithorn, Dumfries and Galloway, dating to the eighth and ninth centuries (Hill 1997, 557). This development included a church, a burial chapel into which four adult burials were inserted, and a burial ground abutting the east wall of the burial chapel containing the graves of about 56 children.

There is clearly a pattern of segregation of adult and non-adult burial within an Anglo-Saxon context and also an element of liminality in the burial of children. Burial of children adjacent to the church walls is widespread in the Saxon period and the wall of the church (and other buildings) appears to represent both a physical and spiritual barrier.

The examples given above of Saxon burials associated with buildings, provide possible explanations for the 'beam-slot burial' but none are entirely satisfactory. As the only Saxon burial revealed during the excavation it is not possible to assess whether the location of the burial was down to segregation. Even if segregation was part of the answer, it is not the whole. The 13th century child burial from Westbury appears to be a closer parallel than the Saxon examples. Other than speculation that the location of the burial relates in some way to the foundation of the building, the reason for this burial remains unknown.

Intentional burial directly beneath the wall of a building must have had a greater meaning than the simple disposal of a body. Was the building planned before the individual died, or was the building constructed in response to the death? Would the body need to be special in some way or could anyone be buried there? Was burial in this position a punishment or an honour?

6.1.2 Phase 2 – Early 10th to early 11th century (Illus 21–23)

An intense phase of industrial activity takes place to the south of the phase 1 structure. The activity appears to be contemporary with the final years of the structure as there is no stratigraphic break between the activity of phases 1 and 2b. Although activity is intense to the south of the phase 1 building, none is taking place within the vicinity of the structure, suggesting that it is still present.

Phase 2a

In the south of the site were beam slots representing a rectangular structure of sleeper beam construction measuring 3.2 by 2.9m? Located centrally within the building, a small pit measuring 0.25m in diameter had been scooped out of the earth floor. The pit contained a range of animal bone (including bird, salmon, perch, cow, pig and sheep) and the broken remains of a knife. A single sherd of pottery was also present within the pit, dated to the 10th/11th century. A flat stone had been placed over the material before it was backfilled.

Immediately to the west of the building was a shallow depression enclosing an area containing features indicative of industrial activity.

Hearth 1 was located within a large sub-circular depression measuring approximately 3m by 3m. Within this depression and around the hearth was a compacted deposit that appeared to represent a working area that had been heavily trampled. Pig and Roe deer bone was identified within the deposit. The baked clay and ash of hearth 1 contained only a small trace of metalworking residue but did contain traces of waste products from the glass making process.

A sub-rectangular pit to the west of Hearth 1 was heavily truncated by later features and only the upper 0.06m of the pit fill was excavated as the remainder of the feature continued below the agreed excavation depth. Smithing slag and vitrified clay were identified within the fill and suggest smithing activity in the vicinity of the feature.

Phase 2b (Illus 24–25)

The square building was truncated by a linear gulley containing material suggestive of domestic and industrial waste deposition, and it must be assumed that the building went out of use at this time. Within the fill was a large amount of industrial residue including both spherical and flake hammerscale, and a small number of smithing slag lumps. Waste from the glass making process was abundant within the feature, as was both burnt and unburnt animal bone. Animal bone species represented included bird, cow, fowl, goose, pig, red deer, roe and sheep/goat. Only two sherds of pottery were recovered from the feature, both of which dated to the 10/11th centuries. Two decorative beads were also recovered, one made of antler tine and apparently unfinished when it was lost or discarded by the owner, and a second made of blue-green translucent glass, typical of a form produced from the Roman right through to the Medieval periods, but most commonly found during the Saxon era.

The density and range of finds within the linear feature suggests that it may have been originally dug for the purpose of rubbish disposal. Immediately to the south of the feature, and overlying Hearth 1, were a series of post-holes appearing to form the north-eastern corner of a structure. With the exception of the north-east corner the post-holes were square or rectangular in form. The building was constructed on the same orientation as the phase 2a building, but the full extent of the structure could not be established due to later truncation and the boundaries of the excavation area.

To the north of the building, two further post-holes were identified. These were identical in form and dimensions to the post-holes representing building 2 and are therefore assigned to the same phase of activity. With only two post-holes identified, however, it is not possible to speculate on the structure they represent. In keeping with the material recovered from the linear ditch, environmental samples recovered from the post-holes contained small amounts of

iron working residue and burnt and unburnt mammal bone.

Phase 2c

A post built structure was constructed on the site previously occupied by the phase 2a building. The structure, measuring 3.5m by 2.3m, overlapped the southern edge of the phase 2b ditch, but like building 3, respects the orientation of the ditch.

Pottery found within the post holes once again dated to the 10th/11th century.

High temperature residues indicative of metal working were present within the majority of the phase 2c deposits and glass waste was present in three of the post-holes. Although not found in any great quantity the presence of these materials suggests a degree of industrial activity occurring within the vicinity of the structure. There are, however, indicators for domestic activity, with animal bone (indicating food consumption) present during this phase of activity.

Phase 2d (Illus 26–29)

A series of deposits indicative of high temperature processes overlay the structures of phases 2a–c. The more concentrated areas of burning appear to be hearth bases.

The deposits are typified by their multi-coloured appearance caused by heating. The nature of the deposits is not entirely clear as they contained both animal bone suggesting domestic activity, and metalworking residues suggesting that they were the product of industrial activity.

Hearth 2 was located within the boundaries of the phase 2a building but stratigraphically the hearth can be shown to post-date the use of the structure. Underlying the hearth material was a grey silty clay layer containing mammal, fish and bird bones and the occasional piece of hammerscale suggesting background industrial activity. A single sherd of pottery was recovered, suggesting a 10th/11th century date for the deposit.

The deposits that comprised hearth 2 were abundant in animal bone. A wide range of species were identified, including cattle, pig, sheep, domestic fowl and salmon. Although animal bone was abundant within the deposits, it seems more likely that the hearth was chiefly of an industrial use. Significant amounts of hammerscale and smithing slag were found within the hearth deposits along with a fragment of horseshoe. Perhaps taken together this could indicate the presence of a blacksmith. The upper layer of soot within the hearth contained a sherd of pottery dated to the 10th/11th century.

A circular bowl-shaped depression contained the remains of hearth 3 which in common with the other hearth deposits contained material relating to both domestic and industrial activity. Moderate amounts of smithing residue were present along with unburnt mammal bones, nutshells and charred cereal grain.

Hearth 4 contained only traces of animal bone but large amounts of smithing slag and a smithing hearth base. The dominant feature of this phase of activity was a firm clay surface overlying hearth 4. Set into the clay were the charred remains of lengths of timber forming an open rectangle (no timber was present at the western end of the feature) measuring 2m by 1.3m. The timber rectangle enclosed an area of the clay floor set with large rounded and sub-rounded cobble stones. The stone surface showed evidence for burning, and the timbers had clearly been burnt in situ. At the western end of the rectangle a sandstone sill appeared to complete the rectangle and enclose the cobbles.

A further wood-lined feature was revealed within the central portion of the excavated area. A smaller hearth deposit was flanked to the north and south by straight timbers which appeared to enclose the burnt material. The feature was dated through pottery to the 10th/11th centuries and the hearth material contained large amounts of smithing slag.

Phase 2e

A group of closely set post-holes forming the north-west corner of a structure or enclosure on the site of the phase 2a and 2c buildings. The feature is truncated to the south and east by later features.

The post-hole fills contained 10/11th century pottery, iron slag and burnt mammal bone. Glass making waste products were also identified.

Discussion

The phase 2 activity appears to be primarily industrial in nature, almost all the deposits contain some form of industrial residue although the presence of animal bone and plant remains suggest an element of domesticity. The dating evidence suggests that phase 2 occurred over a period of a century. The small, insubstantial structures may be small workshops involved in industrial processes related to the cathedral. In a sense this area of the site is comparable to the modern mason's hut enclosure to the north of the current cathedral building. As we have already addressed, the expected life span of a timber post of c 20cm diameter is 20 years. Not only do the post-holes of the phase 2 buildings fall into this category, if we assume that each building was a replacement for the previous building, then approximately 80 years of workshops are represented by the four buildings. This fits comfortably with the pottery evidence and with the radiocarbon dates.

Two radiocarbon dates were obtained from the later phase 2 activity.

Material apparently raked from an episode of burning on the phase 2d clay floor included oat seeds which have been dated to 1039+/-28BP, which when calibrated returns a date ranging between 987–1021 cal AD.

Cereal grain recovered from hearth 3 has been dated to 1026+/-27BP, returning a calibrated date of 992–1023 cal AD, with a date at the start of the 11th century likely.

Perhaps the most enigmatic features of phase 2 are the two wood-lined hearth features. In the case of the larger feature, slots appear to have been carefully cut into a clay base and regular planks slotted in. Only the base of the feature remained, and therefore only the burnt wood level with the top of the clay remained. It is assumed, though that the wood originally stood higher and formed sides to the hearth.

Wood-lined industrial hearths have previously been recorded within

Saxon contexts. A reconstructed smithing hearth at West Stow is built from a square wooden box set into the ground and standing to approximately waist height. The box is lined with clay to contain the embers and to prevent the wood from burning. The remaining wood of hearth 4 had been burnt in situ illustrating the potential risk of using wood in hearth construction. It seems likely that the wood lined hearths would have originally been located within a structure to protect them from the elements, but unfortunately no trace of these structures remain, apparently removed by later activity.

6.1.3 Phase 3 – Early to mid-11th century (Illus 30–36)

The industrial activity of phase 2 and any remains of the phase 1 structure are buried beneath a mid-brown silty clay which covers the excavated area to a depth of between 0.05m and 0.15m.

Pottery recovered from this layer dates to between the 10/11th and 13th centuries. However, 19 of the 21 sherds recovered suggest an 11th century date for this phase, and the remaining sherds, dated to the 12th/14th and L13th /15th centuries are likely to be intrusive, and relate instead to the later burials cutting this deposit.

The distribution of industrial residue within the phase 3 deposits replicates the distribution of industrial features in both the previous and later phases, where it is shown to be largely confined to the south of the excavated area.

The artefacts recovered from the deposits point more to general rather than specific activity in the area. Items recovered include a 'hooked tag', the exact purpose of which is unknown, but believed to be a dress fastening. The use of these tags was dated in Winchester to between the 7th and 11th centuries, and seems to have died out around the time of the Norman Conquest. A knife and an iron arrowhead were also recovered.

A number of post holes, that appear largely sporadic in nature, perhaps due to obliteration of associated post holes by later burials are present, along with two small pits measuring approximately 0.6m in diameter. The more southerly of the pits is notable due to the presence of large amounts of lead working waste. A shallow ditch to the north of this concentration of activity contains a large amount of detritus including animal bone and pottery that shows signs of wear and abrasion indicative of being exposed for a period prior to its eventual deposition in the feature. This is common of yard or midden deposits.

Further soil deposits seal this brief resurgence in activity. A horseshoe dated to the period AD1270–1350 was present but is likely to be intrusive – the result of multiple graves cutting these deposits. Moderate amounts of smithing slag and fragments of furnace lining were present within the deposit. A wide variety of animal bone was also found within this deposit, including two worked pieces; a salmon vertebrae reused as a bead and a sheep/goat tibia sharpened into a pointed implement.

Discussion

The phase 3 deposits represent a marked difference from the intensive phase 2 use of the site. The apparent clearance of the industrial zone and deposition of a relatively clean soil deposit is perhaps better understood when considered alongside the events of phase 4.

6.1.4 Phase 4 – Early 11th century (Illus 37–39)

In the south of the excavated area, a straight sided, regular foundation trench cut through the previous phases of activity (Building 6).

Frustratingly, and in common with Building 1, the feature continued beyond the limits of the excavation to both the west and south. To the east the feature was truncated by later activity. In all, a 7m long section of the feature was available for excavation, the widest point of the foundation measured 1m, but the fill of the feature clearly continued outside the excavated area.

The fill of the foundation was composed of deposits of sandy gravel with frequent mortar inclusions. Tip lines were clearly visible in a section through the deposits. In the uppermost fill, two substantial blocks of worked sandstone were present in association with large pieces of mortar. The largest of the stones had a curved, worked face with both diagonal linear and chevron tool marks. It appeared to have formed part of a circular column. The second block of masonry did not form a distinctive shape, but was faced on one side with tool marks visible.

Discussion

The Building 6 construction cut had clearly been robbed of the majority of its masonry at some point in history, but for some reason two pieces had been returned to the trench when it was backfilled.

It is difficult to resist drawing a parallel with the description of Silas Taylor's excavations in the 17th century;

> 'Its position is uncertain, but about 1650 Silas Taylor found, 'beyond the lines of the present building, and particularly towards the east, near the cloisters of the college, such stupendous foundations, such capitals and pedestals, such well-wrought bases for arches, and such rare engravings, and mouldings of friezes' as left little doubt in his mind that they were the foundations of the cathedral destroyed by Algar and Griffin'. (Dumcumb 1804: 523)

Whilst our 21st century discoveries are apparently not as extensive or varied as Taylor's, we must allow for a little poetic licence on his part, and the excuse of a limited excavation area on ours.

The evidence for the foundation trench relating to Athelstan's Cathedral is compelling. The location matches Taylor's description perfectly, the trench cuts deposits dated to the late 9th or early 10th centuries, and the fills of the trench are in turn cut by a cist burial – a tradition known to date to the 11th to 13th centuries in Hereford.

The orientation of the foundation is also of note. If the line of the trench is projected through the Close, the orientation matches, not the 12th century Romanesque Cathedral, but the 11th century Losinga Chapel, which is believed to have been built whilst Athelstan's Cathedral was still in existence.

6.1.5 Phase 5 – Late 11th to early 12th century (Illus 40–42)

Phase 5 is characterised by the excavation of large features across the site, which have undoubtedly destroyed much of the evidence for pre-11th century activity.

Little is known about the nature of the features as the required excavation level was reached before definite conclusions could be drawn regarding their purpose.

A north-south ditch feature cuts through the phase 4 building. The ditch appears to be present for the full north-south extent of the excavated area, although its relationship with an equally destructive east-west ditch could not be distinguished and the boundaries between the two features are not clear. The width of the north-south ditch measured in excess of 7m, the eastern edge of the feature being beyond the boundaries of the excavated area. Three fills were visible in plan, the boundaries between the fills presumably representing tip lines. The upper c 0.2m of the ditch was hand excavated and pottery dating from the 12th century was recovered.

In an attempt to gain a greater understanding of the nature of the feature, an auger survey of the ditch was carried out. An auger hole bored immediately to the west of the feature encountered natural gravel at 55.03m AOD (the accepted level of undisturbed natural gravels in this part of the Close). A borehole 2.4m to the east of this, and into the feature itself, hit natural gravels at 52.71m giving the ditch a depth of 2.67m. A further borehole within the feature and adjacent to the eastern boundary of the excavation, hit natural gravels at 54.05m AOD, a depth of 1.27m below the top of the ditch fills. Bone was recovered from the head of the auger at depths of 54.92m AOD and 54.52m AOD, unfortunately it was too fragmentary to determine whether or not it was human bone.

The east-west ditch also contained multiple fills from which 12th century pottery was recovered. The auger survey revealed the ditch to be far shallower than the north-south ditch. The base was encountered at 54.9m AOD (c 0.1m below the level of natural gravels) giving the ditch a depth of c 0.5m.

A large pit measuring 4.5m by 3m was present to the south of the east-west ditch. The upper deposits were hand excavated and found to contain pottery dated to the 11th and 12th century. A dark brown stony silt continued down to a level of 54.45m AOD. Beneath this a white mortar deposit was present for a depth of 0.05m. A further deposit of dark clayey silt with a high water content continued to a level of 53.7m AOD at which point natural gravels were encountered. The total depth of the feature was 1.8m.

Two small hearth features containing both iron and lead slag were present during this phase of activity. The pottery recovered dated the features to the 11th or 12th centuries.

Discussion

The scale of the features during this phase of activity is in stark contrast to previous activity on the site. Concentrated, intense land use is superseded by large destructive features that pay no respect to what has gone before.

The activity of this phase has strong parallels with the gravel quarry and charnel pit phase identified in 1993 during the Mappa excavation at the west end of the cathedral. The Mappa quarry pit was similar in scale to the north-south ditch and equally destructive to the late Saxon structures and deposits. It was also the final phase of activity before the west end was turned over to cemetery use – a situation mirrored by the area 1 excavation.

The Mappa quarry pit was reused as a mass charnel pit. The evidence for this occurring in area 1 is not as obvious as the remains of 5,000 individuals contained within the Mappa pit, but bone was indeed present, suggesting that the fills of the feature were not archaeologically sterile. There is, however, no evidence to suggest the reburial of large numbers of individuals. It would be expected that the auger would have met with reduced resistance when encountering concentrated amounts of human bone, and in practice this was not the case.

Even when considered in isolation from the results and interpretations of the Mappa excavation, quarrying does seem to be the only activity that could sensibly explain such large features being excavated at this time. The activity post-dates what is believed to be the early 11th century cathedral church and predates the mid-12th century cemetery. This dates the features to the early Norman period of cathedral building, and indeed the reorganisation of much of Hereford, a time when gravel for building and surfacing must have been in high demand.

6.2 THE NORTHERN CLOSE – AREAS 2 AND 3 (ILLUS 43–49)

Excavations to the north of the current cathedral building involved the excavation of foundations for the new mason's huts, the stripping of former path surfaces and the excavation of soak-away trenches to improve drainage in the Close. It was the excavation of the soakaways that enabled access to the pre-cemetery deposits on the northern side of the Close.

The soakaway trenches were not ideal environments for excavation. At only 0.6m wide, conditions were cramped and interpretation of features and deposits was difficult. The required excavation level within these trenches (c 1–1.2m below ground surface), was almost wholly concerned with the removal of human remains. It was only when the required excavation level had been reached or almost reached that pre-burial ground deposits were encountered. Where open area excavation was required, ie to enable the foundations for the service vehicle roadways to be laid, the required excavation depth was shallow and often disturbed by layers of tarmac and aggregate forming the previous roadways. Excavations in these areas were rarely deep enough to encounter pre-burial deposits.

Although the excavated areas were not conducive to gaining a complex understanding of the pre-burial archaeology, enough was seen to describe the basic nature of the deposits to the north of the cathedral. In addition to this, the fact that the soak-away trenches crossed almost the complete close from east to west, meant that a substantial cross section of the site was observed.

Sufficient amounts of early pottery were present to indicate occupation and almost certainly industrial activity, similar to that present in area 1, continuing on the northern side of the cathedral.

Three sherds of Roman pottery were recovered from the area, one of which was recovered from a deposit which also contained several sherds of a Saxon storage jar. Once again, we are left with hints of Roman activity in the vicinity of the city but not enough to claim Roman occupation of the site.

In both areas 2 and 3 pottery from the 10th and 11th centuries was present. Although some sherds of pottery dated to this period were recovered from stratified deposits, the common occurrence of early pottery in general graveyard deposits indicates the disturbance of early stratified deposits by subsequent grave digging. It seems likely that deposits dating to the 11th century and earlier still remain in situ, below the excavation level required by the development.

Pottery dated to the 12th century was also recovered from stratified deposits. All pottery later than this date was recovered from deposits post-dating the use of the site as a burial ground.

A number of burnt patches in areas 2 and 3 almost certainly indicated the proximity of smithing hearths. The burnt, sooty fill of a shallow, bowl-shaped feature (J9) contained smithing slag and a high density of hammerscale. The area around it had been subjected to considerable heat making it almost certain that the feature was directly involved in the process, although due to the absence of other evidence it was not possible to identify its purpose. Unfortunately, direct dating evidence was not present, but the feature was cut by a stone burial cist suggesting a pre-13th century date.

A sequence of deposits identified in grid squares J6 and J7 gave the most undisturbed impression of pre-cemetery archaeology in the north of the Close. A mid-brown silty clay deposit was observed in the base of the soak-away trench. The top of the deposit was present at 55.27m AOD and is believed to be the same as sterile silty clay observed in the base of the area 1 deep excavation. A red burnt clay deposit, possibly a hearth, was cut into the silty clay and subsequently overlain by a charcoal rich layer containing 11th century pottery. This deposit was present over the full width of the trench for a length of 2.5m and appears to have been caused by a fire. A burnt deposit overlying this appeared to be domestic in origin, containing abundant charred cereal grain, charcoal and animal bone. A further four occupation layers were present in the sequence, containing a mixture of domestic and industrial material including lead slag, iron smithing slag, charred cereals and animal bone. A bone spindle whorl dated to the 10th – 12th century was also recovered. These occupational deposits were sealed by a surface of gravel and flat stones, the top of which was present at 56.03m AOD.

Whilst it is difficult to interpret these deposits due to the limited area of excavation and the truncation caused by later burials, their presence does indicate intense activity on this part of the site prior to the 12th century. The material recovered suggests that this activity was both industrial and domestic in nature. The survival of these deposits to such a high level and lack of their reoccurrence elsewhere in the soak-away trenches also illustrates how much archaeology has been destroyed by later burial activity. Although pre-cemetery deposits are present elsewhere in areas 2 and 3, they rarely manifest themselves as much more than a shallow layer in the base of the trench.

During the excavation of a service trench to the west of the Old Deanery (H17), a wall was revealed on a north-south alignment. The wall was present intermittently over a distance of 25m, heading directly towards the south-east corner of the Cathedral Barn. The wall, as revealed, was 0.98m wide with a dressed face to the east and west and a rubble core. It survived to a height of 0.4m. Although potentially a former boundary wall to the deanery, there is the possibility that it is return of the east-west wall revealed beneath the Cathedral Barn in 2009 (Sect 4.4).

6.3 THE WEST END – AREA 4 (ILLUS 50–54)

Although they covered a larger area than the deep excavation in Area 1, excavations in Area 4 were not as deep. The renovation work at the west end of the Cathedral had been designed so that levels were built up adjacent to the Cathedral, with the intention of minimising the impact upon archaeological deposits. Deeper deposits were removed in the far west of the site adjacent to Palace Yard (the southern continuation of Broad Street), but even here the impact did not exceed a depth of 1m below existing ground level. The required excavation depth graded up from west to east, to the point where adjacent to the cathedral itself only the tarmac surface needed to be removed. Because the base of the excavation was not flat and rose up from west to east, strips of archaeology were revealed getting progressively later from west to east. This meant that the earliest deposits were only encountered in the west of the area (G2, F2). Further to the east, excavation did not continue beneath the depth of burials.

The main focus of pre-cemetery archaeology appears to be occurring in this area during the 10th and 11th centuries and in common with the other areas of the Close appears to be a combination of both domestic and industrial activity.

The earliest deposit excavated was a dark brown sandy silt containing 11th century pottery. Environmental samples recovered from the deposit contained industrial residue and charred seed. The deposit continued below the required excavation depth so the potential exists for earlier deposits in this area. A small hearth cutting into this level appeared to be domestic in nature. Only the upper hearth deposits were available for excavation, but were found to contain fragments of burnt animal and fish bone and a sherd of pottery dated to the 10th or 11th centuries. Although no signs of a structure relating to the hearth were revealed, the evidence for one may have existed below the level of excavation. Immediately to the north of the hearth were patches of heat affected white clay. A linear depression cut into a mounded deposit of white clay may have had an industrial purpose. A sample taken from the clay was found to contain metal-working residues, fragments of glass, mortar and both burnt and unburnt animal and fish bone.

Overlying the earliest deposits was an intermittent layer of charcoal suggesting a widespread burning event. The deposit was up to 0.1m deep in places, and although heavily truncated by later activity it was identified across the full north-south extent of the area. The charcoal

layer was associated with an overlying deposit of fine yellow sand containing slag and other industrial residues.

A deposit of orange gravel containing 11th and 12th century pottery sealed the early industrial activity across the site. In places the deposit was up to 0.1m deep and appears to mark a change in use for the site. In the south of the site the gravel deposit was cut by two large pit features. The relatively clean, organic nature of the fill of the more southerly feature suggests that it may have been a cess pit. Pottery recovered from the feature dated to the 11th century. The presence of a clay lining in the second pit suggested that its purpose may have been to contain liquids, and therefore could possibly have been employed in the tanning process. The feature contained pottery dated to the late 12th or early 13th centuries.

The remains of a stone structure (Building 7) were revealed in the north-west of the excavated area (G2). Preserved to a height of 0.65m, the irregular stones appeared to be part of a foundation course. The arrangement of the stones suggested that they represented the south-east corner to a building. Pottery recovered from between the stones dated to the late 13th century, although the wall was heavily disturbed and therefore the pottery cannot be considered a reliable means of dating the structure.

What appeared to be a patchy road or yard surface comprised of large flat stones, cobbles and gravel was present in the centre of the excavated area (F3). Due to truncation by later burials it was not possible to establish its original extent or orientation.

Discussion

The ground reduction requirements in area 4 were not conducive to achieving a good understanding of the archaeological deposits. Some features of note, however, were observed.

The potential road surface in the centre of the site is of particular interest when considered alongside the pre-conquest road identified during the 1993 Mappa excavation. The surface is broadly similar in appearance and in the correct location to be a continuation of the Mappa road. A comparison of the level the two surfaces appear at reveals that the Mappa surface is present at approximately 0.16m lower than the surface revealed during the 2009–11 excavations. This slight difference in level may represent a slope in the surface as it descends towards the River Wye.

The structural remains identified in grid square G2 relate to a structure that presumably continued to the west, outside the boundaries of the present Close. Historic maps of the Close do not show any structures in this position, and it is therefore assumed that it pre-dates the 17th century. Building 7 would appear to be positioned too far to the west to front onto Palace Yard, so potentially it related to the possible Saxon road identified to the east.

6.4 THE ORIENTATION OF BUILDINGS WITHIN THE CLOSE

The varying orientation of buildings within the Close was originally identified by Alfred Watkins in the 1920s. The Mappa excavation contributed a potential road heading through the Close to join with Widemarsh Street and the basement of a Saxon building matching this orientation (Stone & Appleton-Fox 1996). The current excavations have provided the opportunity to add to this discussion.

It has already been established that the three major ecclesiastical Norman buildings – the cathedral, the Losinga Chapel and the Bishop's Palace – all have slightly different orientations (Stone & Appleton –Fox 1996). The Mappa excavations revealed a Saxon basement fronting onto an early north-south road on an orientation matching that of the Bishop's Palace. (see Table 1)

6.4.1 Orientation A

Prior to the Mappa excavations, the orientation of the Bishop's Palace could well have been considered the most recent orientation to be employed in the Close, as the earliest parts of the building are dated to the 1180s and therefore post-date the cathedral and Losinga Chapel.

The 1993 discovery of a Saxon road and basement matching this orientation, however, put this interpretation in doubt. How could the later Bishop's Palace be referencing the orientation of a road and building that had gone out of use and been buried almost a century previously?

The answer may lie, not in any of the buildings discussed, but in another building that all three buildings took their orientation from. Nothing is known about the Bishop's Palace that predates the current building, but if we assume that such a building existed, and was standing when the early road passed through the site, and survived until the late 12th century when it was replaced with the current building then we have a possible explanation for the continuation of an orientation at odds with the Norman cathedral.

The phase 1 post-in-trench structure excavated during the current excavations is also aligned on orientation A (within a tolerance of 1°). It would then appear that this orientation dates as far back as the late 9th century.

6.4.2 Orientation B

It is logical to assume that Athelstan's 11th century minster was still standing when Bishop Robert built the Losinga Chapel. There is no record of any replacement for the late Saxon cathedral until the early 11th century when work on the Norman building starts.

Considering that the Losinga Chapel is at variance with the orientation of the later Norman Cathedral, there is a strong possibility that it was instead aligned to Athelstan's minster.

The phase 4 foundation trench, which would appear to match the postulated location for Athelstan's minster, is on an identical orientation to the remaining north wall of the Losinga Chapel. The same orientation can also be seen in a wall, partly still standing and partly traced as footings underneath the ruined fourteenth century chapter house. An Examination of the wall by the Royal Commission reported that 'it continued up to and probably beneath the wall of the Vicar's cloister; near this point was found the west splay of a doorway dating from the 12th or 13th century' (RCHME, Herefordshire, i: 116.)

It seems unlikely that the wall running through the chapter house yard directly relates to the phase 4 foundation trench. Although on the same orientation, the walls are on different alignments and yet are too closely spaced to form opposing walls of the same building. If the 12th or 13th century date established by the Royal Commission is correct, then the wall is unlikely to be contemporary with the phase 4 foundation trench. Instead it may belong to a later structure which referenced the orientation of the Losinga Chapel.

One further feature matching Orientation B is the wall revealed in grid square H17 that is believed to have surrounded the Close by the time Speede produced his map of 1606. The wall itself is likely to date to the late 14th century when a Royal charter was granted for the enclosure of the graveyard. It would seem likely however, that a formalised enclosure would be built on the line of an already established boundary. Taylor's map of 1757 shows the 'square' area previously defined by the wall. The enclosure is not, in fact square at all. The east and west boundaries to the Close are parallel and match the orientation of the Losinga Chapel and phase 4 foundation trench. The northern boundary to the Close, and the wall revealed beneath the Cathedral Barn (2009) are not, however, at 90º to the east and west walls, but instead match the alignment of the later Norman cathedral.

If Orientation B was established by the construction of Athelstan's minster church in the early 11th century and subsequently adopted by Bishop Robert during the transitionary period prior to the construction of the Norman cathedral, then it was relatively short lived. However, the matching orientations of the Losinga Chapel and the Close boundaries suggest that Bishop Robert's contribution to the layout of the Close extended beyond the construction of his chapel, and he got some way towards establishing the 'site boundaries' in advance of Bishop Reinhelm's construction work.

6.4.3 Orientation C

With the construction of the Romanesque cathedral, Bishop Reinhelm disregarded the orientation of the Losinga Chapel and presumably the orientation of Athelstan's minster. The reason for this may relate to the need for continuity between the Saxon and the Norman during Robert's transition period, being replaced by an entire disregard for the past and establishment of a new order under Bishop Reinhelm.

The evidence from the 2009 excavation at the Cathedral Barn and analysis of Taylor's map of 1757 suggest that the Norman boundary to the Close was established with reference to the orientation of the Norman Cathedral.

7 RESULTS (BURIAL)

Widespread occupation and industry in the Close appears to have come to an end by the start of the 12th century. The archaeological evidence from both the Mappa excavations and the current project suggest that once the construction of the Norman cathedral got underway little attention was paid to the Saxon layout of the cathedral precinct.

Although the deep quarrying and charnel pit excavated on the Mappa site, and the quarry pits present in area 1 illustrate the destructive impact of the new cathedral on the Saxon town, the process was not immediate and occurred over a generation or more. Bishop Losinga (1079 – c 1095) was the first of the post-conquest Bishops to make a significant impact on the ecclesiastical precinct with the construction of his chapel. However, his greatest contribution to the development of the Close, was the transferral of the commercial centre of the town to the north of the defences following his arrangement with William Fitz Osbern to establish a new market place (Whitehead 1982: 17). Whether Robert or later Bishops actually cleared the site of the Close in preparation for the new cathedral is not clear, but it was not until Bishop Reynelm (1107–1115) was incumbent that work really began (Barrow 2000: 27).

The current excavations have revealed the physical evidence for an extensive burial ground within the Close with the earliest burials dating to the 12th century. There was however, a distinct lack of evidence for burials preceding this date.

The first firm evidence for a church in the immediate vicinity of the Cathedral Close comes from the beginning of the 9th century and we can assume that regular burials were taking place from at least this date. All the burials excavated as part of the current project post-date stratified occupational or industrial deposits of the early 11th century or later. The single exception to this was the 'beam-slot burial' dated to the late ninth/early tenth century. The location of this burial, intentionally placed beneath the foundations of a building, marks it out as exceptional and therefore not representative of widespread burial within area 1. Although not all the excavated areas were reduced to the level of geological deposits and therefore earlier burials may be present, it is thought unlikely. Where the full sequence of deposits was observed, no evidence for burial beneath the stratified domestic and industrial deposits was present.

So where is the Saxon burial ground? The interim report on the Mappa excavations (Stone & Appleton-Fox 1996) records 21 late Saxon inhumations to the east of the north-south roadway identified on the site. A ditch identified between the roadway and the burials has been suggested as a possible western boundary to the burial ground. If this assumption is correct we might speculate that the Saxon burial ground extended beneath the area now occupied by the Dean Leigh library and the southern cloister. The large number of presumably Saxon burials represented by the disarticulated remains within the later quarry pit suggests the clearance of burials from a relatively large site nearby for the purpose of construction. As the current excavations have revealed a paucity of Saxon human remains in contrast to the Mappa excavations, the argument for the Saxon burial ground being confined to the south-west of the Close is strong.

One of the earliest burials in area 1 (SK4993) relating to the use of the site as a burial ground has been radiocarbon dated to cal AD1044–1159. Whilst the date allows the possibility that the burial is pre-conquest, the grave is physically later than the phase 5 quarry pits which are likely to relate to the construction of the Norman cathedral in the early 12th century, therefore the burial is considered to be post-conquest. Without obtaining radiocarbon dates for every skeleton it is not possible to categorically determine whether or not all the skeletons excavated within the course of the current project

post-date the conquest, but based on the information available it is a logical conclusion based on the burial types observed.

From this point on the archaeology of the Close is dominated by human burial. Although burial grounds and cathedral precincts in the Medieval period were undoubtedly social places, used for games animal grazing and trade, the archaeological evidence for these activities is limited to the occasional coin and trade token uncovered within the general soil deposits of the burial ground. A decorative book clasp revealed within St John's quad conjures up a vision of one of the Vicars Choral scurrying from his lodgings to work at the Cathedral and his battered religious text shedding its clasp.

We know that by the time that St Guthlacs Priory was moved off Castle Green in the 1140s, the recently consecrated cathedral was claiming exclusive burial rights over Hereford and some outlying parishes. From the late 13th century onwards there were instances of outlying parishes gaining some concessions from the cathedral with regard to burial rights, but the Close was still the final resting place for the people of the city until it was officially closed to burial in AD1791. After this date burial within the Close was officially restricted to those who died within the precinct, but in practice it seems likely that other burials were still permitted.

Although it is recorded that the Close was cleared of gravestones in 1796, stones recovered during the course of the excavation revealed that burial was continuing on the Close until the mid-19th century. Research into the background of the individuals inscribed on the gravestones reveals them to be of the upper middle class and holders of positions of civic administration within the city. The latest of the dated stones belonged to William Symonds, a doctor who had served as both High Sheriff of Radnorshire and Mayor of Hereford before dying in 1844. It seems that during the first half of the 19th century burial was confined to notable local families, and by the time of the 1853 Burial Act which effectively outlawed inner city burial grounds, burial on the Close had ceased entirely.

7.1 DENSITY OF BURIAL

The 2009–11 Cathedral Close project revealed the articulated remains of 2,453 people. A quick look at the impact plan shows how little of the total Close area was actually excavated.

Observations on the density of burial can give an indication of whether some areas of the Close were more favoured than others. Whilst those of sufficient status or wealth could aspire to burial beneath the floor of the cathedral itself, the middle classes and those below could expect a burial within the graveyard. A hierarchy of burial is expected within the Christian graveyard, with burial at the east end, close to the cathedral building considered the most desirable due to its proximity to the high altar. Increasing distance away from this focal point represents a reduction in desirability with the limits of the burial ground being the least popular. An often repeated belief is that the burial ground to the north side of a church is less popular than the south and was the burial place for thieves, outcasts and clandestine burials of un-baptised children.

Variations were observed in the burial density between different areas of the Close. Density value was calculated by counting the number of partial and whole skeletons present within directly comparable areas. The area was fixed at 10m by 0.7m to enable the comparison of the soak-away trenches of areas 2 and 3 (0.7m wide) with the open area excavations. The sample was always taken from east-west aligned trenches. The burial density of the medieval burial ground revealed during the Mappa excavation is included for comparison. Rather than being measured from a fixed area it is calculated from the total number of skeletons found within the excavated area. (see Table 2)

The burial density results have been used to calculate a broad estimate of the total number of burials within the Close (see Table 3).

To calculate the total number of burials within the Close a number of assumptions were made;

- The Close boundaries have remained approximately the same throughout history
- Burial density remains constant within the areas of excavation
- There is a difference in burial density between the north and south parts of area 4. For this reason the burial density of the 2009–11 excavation was used to calculate total number of burials in grid squares G2–G4, F2–F4. The burial density of the 1993 Mappa excavations was used to calculate the total number of burials for area 4 from E2–E4 and south of this line.
- As no data was available for area 5, an average of the Mappa and area 1 burial density was used.
- No burials pre-dating the Norman redevelopment of the Close are considered.

Clearly the figure for total number of burials must be accepted with caution. Burial densities are likely to vary greatly within the excavated areas, and the extent of the excavations did not allow for these variations to be observed and built into the calculations. Burials that have been entirely removed by later grave digging have not been included in the total, and burials in the chapter house yard have also been omitted. The figure is therefore not definitive, but it is a basis for understanding the sheer level of burial that has taken place on the Close during the post-conquest period.

The results show a far greater density of burial in the north of the Close compared to the south and a comparatively low burial density at the west end of the cathedral adjacent to the western entrance. It is possible that the higher burial density in the north of the Close relates, not to popularity, but a purposeful management of the Close, whereby the populous poor were buried in the expansive area to the north, and the secluded areas to the south, surrounded by cathedral buildings were reserved for the wealthier inhabitants of the city.

7.2 THE BURIAL GROUPS (ILLUS 55–58)

Modern burial grounds appear well ordered, with neatly constructed rows of burials. The majority of graves bear a marker, more often than not giving the name and date of death of the deceased.

Undoubtedly a similar degree of order existed from the earliest days of burial in the Close. Unfortunately when grave markers are periodically cleared, burial plots are used and reused, landmarks used for grave orientation change and preferences regarding burial depth change, the relationship between individual burials can become confused.

An attempt was made to determine the sequence of burial by producing a harris matrix. The level of disturbance caused to earlier burials by later burials and absence of visible grave cuts made the task of identifying a precise order of burial difficult. To determine whether more general trends could be seen in the data, individual burials were assigned a burial group dependent on broad, easily identifiable characteristics of the burial.

These trends had already been identified during excavation and assessment of the data confirmed that they represented a sensible basis for analysis. The trends are based on burial typology and cannot be considered rigidly chronological. There is certainly overlap between the groups and within a particular time period the status or wealth of an individual may have been the determining factor of burial type, rather than a certain time period rigidly employing a particular burial type. Nevertheless, as a means to begin analysis, division of the assemblage into five distinct burial groups was the most appropriate solution.

7.2.1 Group A – 12th century

Group B (stone cist) burials were the earliest burials identified on a typological basis, but a number of simple earth burials were identified that had physically been cut by cists and therefore must be earlier. Because it was not possible to identify group A burials when they were not physically related to a group B burial, there is potential for burials of this group to have been assigned to group C.

Group B – 12th to 13th centuries

The stone cist burials. Determined by the presence of stone slabs placed vertically and lining the edges of the grave. Sometimes present with capping stones – slabs placed horizontally over the burial and resting on the vertical stones.

There is no evidence to suggest that the stones were specifically cut or worked for use in the construction of the cists, and the stones were unmortared. The majority of stones used were un-worked, those that were had clearly derived from elsewhere. The stones were generally broken and the decoration typical of architectural stone.

The cist burial tradition is relatively common in the early medieval period, At Bermondsey Abbey, two examples were cut by the foundations of the 12th century church and cists were present at the pre 12th century church of St Bride's, Fleet Street. They were the dominant form of burial in the 11th century cemetery on the south side of Holy Trinity at Aldgate. A continuing tradition of cist burial is seen at St John's, Colchester where it is thought that the cist burials were later than the 12th century. In Winchester's Paradise cemetery where cist graves ranged in date from about AD1200–1520 they formed about 39% of the burials excavated.

Five cist burials including four children were revealed during the excavations on Castle Green, where they were considered be amongst the final phase of burial before St Guthlac's Priory moved to the Bye Street site in AD1143.

Of the 31 graves excavated at the later St Guthlac's site in Bye Street, four were cists. Two of these cut earlier inhumations and were dated to the second phase of burial making it unlikely that they are earlier than the 13th century.

The radiocarbon dates obtained from two of the burials within this group concur with the results of previous excavations and establishes the cist burial as a long-lived tradition, dating between the 11th and 13th centuries.

The fact that the cists form the earliest (sizable) burial group during the 2009–11 excavations suggest that the saxon burial ground was not present in the areas excavated.

7.2.2 Group C 13th to 17th centuries

The 'bone only' burials. All that remains to form the archaeological record is the bone itself. No evidence for cist stones, coffin fittings, shroud pins or anything to suggest that the burial has been interred in anything other than a simple sewn or tied shroud.

Prior to the emergence of ready-made shrouds in the 17th century it seems likely that shrouds were either made by the deceased during their lifetime or a suitable sheet was acquired from the home to wrap the body in before burial.

The tradition of shroud burial continued well into the 20th century, but certainly from the 17th century onwards the shrouded body would be contained within a coffin.

Of the eight Group C burials sent for radiocarbon dating, six returned dates in the 13th century, the remaining two dated to between the 15th and 17th centuries.

7.2.3 Group D 16th to 18th centuries

The 'simple coffin' burials are those where evidence for simple coffin fittings were found with the skeleton. Iron nails and in some cases coffin handles confirm the former presence of a coffin. Although generally later than the Group C burials there is a degree of overlap.

The use of the 'parish coffin' was common in the 16th and 17th centuries to transport the shrouded corpse to the grave, but rather than being buried with the individual was reused.

Until the mid-16th century the use of the private coffin was limited. Neither of the two prayer books of Edward VI, nor those of Elizabeth I and Charles II make any reference to coffins, and early coffins are generally associated with intramural burial (burial within the church) and high status. Although excavations have revealed instances of pre-16th century coffined burial in churchyards, it was not the predominant form of burial for the common man, and occurrences are rare.

7.2.4 Group E 17th to early 19th centuries

The 'elaborate coffin' burials are those with evidence for highly decorated coffins, using copper alloy upholstery pins for decoration. Coffins where the date had been marked out in upholstery pins had recorded dates of 1736, 1739 and 1743.

By the first quarter of the 18th century the funeral furnishing trade had become firmly established. Most coffins after 1750 were fabric covered with upholstery pins marking out details. Velvet coverings were the preserve of the wealthy, with black baize used to cover the coffins of the common man (Litten 1991: 99).

It is during this period that the brick-lined grave became a popular form of burial within the graveyard. Pressure from the upper and middle classes to be buried in family groups was alleviated by the construction of brick shafts within the cemetery capable of holding more than one coffin. This form of burial bridged the status gap between being buried within the cathedral itself, and being buried within a simple earth grave. The shafts created a re-usable space and had more in common with burial vaults than the common earth grave. The burials were vertically separated from one another by the use of iron or wooden bars fixed horizontally into the sides of the shaft. The shafts were then capped with stone slabs which could be removed to allow later interments.

7.3 RADIOCARBON DATING (ILLUS 59)

Thirteen burials were selected for radiocarbon dating. The 'beam-slot burial' was selected on the basis that it could provide dating evidence for the foundation of the phase 1 building. The remaining burials were selected from 'chains' of intercutting burials in order to provide a temporal cross section of the burial ground, to test the viability of the burial groupings and to establish how quickly areas of the burial ground were being reused.

Only skeletons selected for osteological analysis were considered for radiocarbon dating. There is therefore a bias towards skeletons from area 1 (11 of 13) due to their increased levels of completeness and suitability for analysis.

To address the lack of information regarding the date range of the group C burials, 8 of the 13 dated burials belonged to this group. The coffined burials of groups D and E were assumed to be too late to be suitable for radiocarbon dating. To test this theory a single group D burial was selected for dating. (see Table 4)

The radiocarbon dating program produced some interesting results. The dated skeletons from groups A and B were shown to be very similar in age. Skeleton 4518 (group B) which physically cut through Skeleton 4993 of group A had an almost identical range of radiocarbon dates, suggesting that both burials occurred in the first half of the 12th century, during the building of the Norman cathedral. The possibility that two different burial practices were occurring in the same part of the graveyard at roughly the same time suggested that there had to be an as yet unidentified factor determining which individuals received cist burial and which received a simple earth burial. A further dated group B burial returned a date range between the late 12th and early 13th century suggesting that the cist burial tradition lasted for longer than a single generation.

The group C burials were an unknown quantity prior to radiocarbon dating. It was expected that the burials would span a period of up to four centuries. Analysis of the dated chains, however, produced interesting results. Of the eight dated group C burials, six returned dates firmly in the 13th century. Five of these burials were recovered from Area 1 and suggest a peak level of burial in St John's quad during this period. The remaining two group C burials, both being the final burials of this group in their respective chains were dated between the 15th and 17th centuries, confirming the long lasting tradition of non-coffined burial.

The single group D burial (2121) selected for dating returned a date in the late 13th century. The result was unexpectedly early. Although wooden coffins had been found in late Saxon deposits during the Mappa excavation, and a group of 14th century encoffined burials were discovered at St Augustine-the-Less, Bristol in the early 1980s (Litten 1991: 239), the coffined burial has to date been rare for churchyard burial prior to the mid-16th century. The burial was assigned to burial group D on the basis of two coffin nails found within the fill of the grave. A reassessment of the position of the coffin nails established that they may have been introduced to the grave fill by later disturbance, also the position of the arms folded across the stomach is a type more commonly found in a group C burial. The balance of evidence would appear to suggest that the burial had been originally assigned to the wrong burial group, and Skeleton 2121 was in fact a group C burial.

7.4 ISOTOPE ANALYSIS (ILLUS 60)

The interesting relationship between the group A and group B burials raised the question of why two distinctly different forms of burial should be taking place during the same period. Osteological analysis showed that the choice of one form over the other was not based on sex or age, and if status or wealth was the determining factor it would seem more likely that the different burial groups would have been buried at different locations within the graveyard.

It was considered possible that the burial traditions represented two groups of people that had originated from different areas and isotope analysis was employed to test this theory. Chemical elements from ingested food and water are incorporated into teeth and because the isotope ratios of elements such as strontium and oxygen vary geographically, these differences can be used to draw conclusions about whether individuals were of local or non-local origin. Tooth enamel is highly resistant to change during life and subsequent burial and therefore represents childhood origins and diet. Twenty teeth drawn from skeletons belonging to burial groups A and B were submitted for analysis. (see Table 5)

The isotope results are illustrated in Chart 1. The horizontal red band denotes the expected strontium isotope values for inhabitants of Hereford and its environs located on Old Red Sandstone (red). The vertical coloured bands indicate the range of oxygen isotope ratios which are consistent with Hereford (green) and adjacent areas to the south and west (yellow). Given the large uncertainty on oxygen isotope measurements indicated by the black square and the possibility that medieval people were altering the oxygen isotope ratios of their drinking water by brewing and boiling or drinking milk (Brettell et al 2012), it is probable that people living in Hereford would

have values within the range enclosed by the brown box. (see Chart 1)

The key findings are that:

- Most of the women (7 out of 9) have remarkably similar values and appear to be of local origin whilst most of the men (7 out of 9) appear to have originated elsewhere.

- Four men (SK4424, SK4934, SK11805, and SK31344) and one of the pre-cist children (SK5061) have higher strontium ratios than would be expected from regions of Old Red Sandstone. Such values are usually indicative of origins on granites or ancient Palaeozoic rocks which can only be found in restricted regions of northern and western Britain.

- Three men (SK30197, SK5347, and SK2857) have lower strontium ratios which are consistent with origins on chalks and limestones. One of the females (SK31297) also has low strontium ratios.

- Twenty individuals from the current excavation were compared with seven later medieval children (c 14th century) excavated on the Mappa site. All bar one of these children appear to be of local origin (if measurement uncertainty is taken into account), and they are comparable with the majority of the 12th century women. In a cemetery, it is likely that the young children will be predominantly of local origin given that they have had far less time in their shorter lives to relocate (Montgomery et al 2005).

- Early medieval humans from Sannerville and Giberville in Normandy, France were alos compared with the Hereford group. It is interesting to note that the three men who have low strontium isotope ratios and have not originated in the Hereford region, fall within the Normandy group. However, this is not proof that they have origins in Normandy only that the isotope data would support such a conclusion as it cannot rule it out: there are many other places in southern and central England where chalks and limestones also occur, for example the nearby Mendips and the South Downs, as well as other parts of northern Europe.

- The majority of women analysed from the assemblage appear to have resided in the Hereford region between the ages of 2 and 8 years and are therefore assumed to be of local origin. In contrast, the majority of the men appear to have come to Hereford from elsewhere. The sample size of group A. burials is too small, and the results too inconclusive to support the suggestion that cist burials in Hereford were introduced by the Normans. Although little can be ascertained about burial practices from the results, the contrast in origins between the males and females of this period is striking, and is potentially an indicator of the social upheaval caused by the Norman Conquest and its immediate aftermath.

7.5 FINDS ASSOCIATED WITH BURIALS

In keeping with the Christian tradition few grave goods were found. The level of intercutting between skeletons and the paucity of visible grave cuts meant that assigning finds to burials with any degree of confidence was rare. The majority of finds that were found within burial contexts were generally re-deposited, presumably dug up from the underlying stratified deposits and re-interred when the grave was back-filled.

7.5.1 Evidence for clothing (Illus 61)

During the last quarter of the 17th century, the single piece long-sleeved gown replaced the winding sheet as the burial garment of choice. One problem with this garment was the positioning of limbs. Now that the corpse was more exposed, greater attention had to be paid to posture. One way of doing this was to tie the ankles together and pinion the arms against the side of the corpse with the waist band of the shroud (Litten 1991, 81). Evidence from the excavation suggests that belts may also have been used to secure the body in position. A buckle found adjacent to the left upper arm of SK2008 appeared out of place to be associated with an item of clothing, but its presence may explain why the arms of the skeleton were tucked underneath the pelvis (type 5). Buckles were found associated with three further skeletons, in various positions on the body. Only one was located on the pelvis suggesting a waist belt. It was rare for corpses to be committed to the grave wearing day clothes (Litten 1991, 72), so the use of buckles to secure the shroud seems a likely alternative. The presence of single buttons (5 graves) is also likely to relate to shroud burials and is confined to burials of groups D and E.

7.5.2 Grave goods

Four burials were considered to have genuine grave goods. SK1306 (Group E, C12) was an older male buried with a silver disc or coin in his mouth. The disc, which is likely to be a worn silver coin was bent at the edges and sat directly over the jaw bone as though it had been placed between cheek and jaw prior to death. In addition to the silver coin, was a small crotal/rumbler bell located adjacent to his right knee.

The tradition of placing a coin in the mouth of the deceased has been recognised in various cultures since at least the 5th century BC. The coin was placed with the deceased as a payment to the ferryman who conveyed souls across the river that separated the living from the dead. The tradition continued sporadically up until the early 20th century in Britain.

Crotal/rumbler bells were used for a variety of purposes in medieval and post-medieval Britain. They were commonly attached to the harnesses of animals and were also used for decoration on clothing and as good luck charms on bracelets and necklaces. Devices involving bells were incorporated into coffins during the 19th century as a means to allay fears of being buried alive, although the small bell buried with SK1306 is unlikely to have had any practical use, and appears to be more of a trinket. Taking into account the presence of the silver coin in the mouth of the deceased, the likelihood is that the bell relates to a further tradition or superstition.

In Christianity bells are rung to mark rites of passage such as births, marriages and deaths, and were believed by some to disturb the atmosphere and confuse evil spirits, possibly thwarting their designs on the escaping soul (Richardson 1988: 27). Although it is the more public church bells we usually associate with Christian worship, it may well be this symbolism that the rumbler bell is alluding to. The bell is not a unique or chance find as a further group E burial (SK 10085)

was found with a crotal/ rumbler bell adjacent to the upper left femur of the interred body. Whatever belief the bell alludes to it was clearly knowledge that extended beyond a single individual. (see Illus 62)

One further burial (SK 40564) was found to have a coin in the mouth, although there is some doubt as to whether it was intentionally placed there, or whether it was deposited there through later disturbance of the grave. The silver half coin dated to the reign of Henry III (1216–1272) but the coffin style (Group D) was clearly later and an 18th century button found within the grave appeared to confirm that this was not a 13th century burial. Potentially, an early coin had been placed within an 18th century grave, but evidence for disturbance around the skull suggested that the coin had been introduced to the grave at a later date.

Contained within the Group E coffin of a young male (SK 2063) was a pair of compasses or dividers. The measuring implement which was placed beneath the left lower leg of the body was initially believed to relate to the trade of the individual, with possibilities ranging from cartographer to stone mason. (see Illus 63)

However, another possibility is that the individual belonged to the order of Freemasons, first established in Hereford in 1729. The distinctive symbols of the fraternal society are the square and compasses, and although there is no evidence to suggest that freemasons were buried with identifying symbols, the brotherhood is known to conduct Masonic funerals for members.

A history of the Hereford Lodge was produced by Dr. John Eisel in 2012 to mark its 250th anniversary. The document records that Brother Ross, a founder member of the lodge was buried in October 1763 with full Masonic honours. The place of burial is not recorded but in 1804, at the age of 44, Brother John Coren was buried in the Cathedral Close with full military honours. After the service a Masonic sermon was delivered at the graveside.

The identity of SK 2063 as a Freemason is purely speculation, but the burial type is correct for the period when Masonic funeral rites were being carried out in Hereford and the society is renowned for its symbolism. The Hereford Journal records the funeral procession of John Cann in 1837, leaving from the lodge room at the Green Dragon Hotel on its journey to the place of burial (the location is not recorded). Preceded by a military band and members of the lodge, the coffin is recorded as having 'regalia on top of the pall'. Whether this regalia included a pair of compasses which were subsequently interred with the body is unknown, but it is not beyond the realm of possibility.

7.6 DISTRIBUTION OF THE BURIAL GROUPS (SEE TABLE 6 AND ILLUS 64)

7.6.1 Group A

Burials could only be assigned to this group if there was physical evidence that they pre-dated a cist burial. Therefore, the number of Group A burials identified is entirely dependent on the presence of cist burials.

Those burials that could be proven to pre-date the cist burials were limited in number. Although they formed a larger percentage of the excavated assemblage in Area 1 than they did in Areas 2–4, this could be due to the fact that greater excavation depths were reached in this area and the less confined excavation conditions enabled relationships to be identified more easily.

7.6.2 Group B

Although present across all four areas of the site, the distribution of cist burials is not even. It seems likely that the presence of cist burials is dependent on the level of subsequent burial in the vicinity. It is apparent in areas two and three, where clusters of cist burials appear (J6, J8, and J9) that overlying burials are less dense than in adjacent areas where no cists are present (J7). The suggestion being that cist burials were once more extensive in their distribution, but subsequent burial has removed evidence for this.

In area 1, the level at which cist burials are identified indicates a slope in the ground level from north-west to south-east, with burials in the north-west present at a level of c 55.90m and burials in the south-east present at c 55.30m.

The phase 1 deep excavation area was excavated to a consistent level and we would therefore expect a relatively uniform distribution of group B burials. This is not the case, burials appear to be concentrated around the edges of the trench with an area of c 40m^2 in the centre of the site entirely devoid of group A and B burials. Potentially this is the result of truncation and removal by later burials, but alternatively the burials are referencing a since lost topographic feature in the centre of the site.

7.6.3 Group C

Group C was the dominant burial group accounting for 71.6% of the total assemblage. Unfortunately no variables were observable within the burials of group C to create further stratigraphic sub-groups.

The group shows a consistently high burial density across the site. In the area 1 deep excavation the density increases towards the south-east of the area. This may relate to the slope of the land previously discussed, with a preference to bury the dead on the flatter ground to the south-east. Within the area of greatest density (B14) up to nine generations of intercutting group C burials were identified.

7.6.4 Group D

When considered as a percentage of total burials excavated, Group D burials remain consistent across areas 2, 3 and 4. In area 1, however, the proportion of burials is significantly higher. This may indicate a preference for burial at the south-east of the Close during the 16th to 18th centuries.

The greater proportion of coffined individuals in area 1 may be a function of status and wealth. If as suspected, coffin burial was the preserve of the wealthier individuals in society, then the high numbers identified in area 1 may suggest that it was a preferred area of burial and reserved for those who could afford to be buried there.

7.6.5 Group E

The distribution of group E burials identifies a clear preference for burial at the east end of the Close where they form nearly 13% of all the burials in that area as opposed to less than 5% of burials in area 2 and 3. The complete lack of group E burials within area 4 may indicate that burial had stopped in this area by the 17th century. Indeed, the conclusion reached by the excavators of the Mappa site to the south of area 4 was that the area had ceased to be used as a burial ground by the beginning of the 17th century.

7.7 CONCENTRATIONS OF BURIAL TYPES

An analysis of the distribution of burials by sex did not produce any distinctive patterns. It appears that there were no distinct areas of the burial ground exclusively reserved for the burials of males or females.

Analysis of the distribution of juveniles and adolescents showed them to be evenly distributed within the burial ground, with the exception of a cluster of Group B burials which were all juveniles or adolescents.

Seven burials were identified within an area measuring approximately 1.5m^2. The stature of the individuals suggested that they were all children, and of the three burials that were osteologically analysed, one was classed as an infant and two were younger children.

No adult burials were present and the disordered arrangement of burials and intercutting of earlier burials by later ones, suggested that the practice of child burial within this particular area of the Close had taken place over a considerable period of time.

Of the nine sub-adult burials assigned to Group B, six were excavated from grid square J6. The remaining three sub-adult burials were excavated in grid squares J15, C14 and H12. Although excavations were limited and conclusions tentative, there would appear to be evidence for burial segregation of the young during the period covered by Group B burial (12th – 13th centuries). (Illus 65)

7.8 THE BOUNDARIES OF THE BURIAL GROUND

7.8.1 North

The most northerly burial was encountered in the north of the trench present in grid square L11. The group D burial was revealed at a depth of 1.2m below ground level and further burials were excavated immediately to the south. Due to the increased burial overburden and limited excavation in the north of the Close, little can be said with confidence about the extent of burials in this area.

The most northerly excavations, in grid square M8 revealed evidence for 11th century occupation buried at a depth of 1.5m below the present ground surface. Overlying this was a homogenous brown loam deposit similar to the general graveyard deposit, however no human remains were revealed.

Based on the evidence available it is reasonable to assume that the northern boundaries of the Close have not changed dramatically since the Norman period.

7.8.2 East

The most easterly burial (group C) was excavated in grid square F16. Excavations to a depth of 1.5m were carried out for the creation of parking bays in grid squares G18 and G19 and excavations to a depth of 1.8m took place in grid square F18 for the installation of a petrol interceptor tank. No human remains or archaeologically significant deposits were found during either excavation. The deposits were disturbed and appeared to be comprised of imported material. A number of masonry blocks and a spread of mortar were identified that are likely to relate to buildings that are shown present on this part of the site on Taylor's map of 1757.

The potential boundary wall revealed in grid square H17, would appear to fit both the archaeological and cartographic evidence. If the line of the wall is extended southwards, then it does bisect the region where burials were found to the west and no burials were found to the east. Speed's 1606 draft map of Hereford appears to show a wall enclosing the cathedral precinct passing through this location. The same square area is fossilised in today's layout of the buildings around the green.

7.8.3 South

John Speed's draft map of 1606 appears to illustrate a clearly defined southern edge to the Close. It is however, difficult to place too much faith in Speede's map, as the proportions are askew and key features, such as the south cloister are missing. Given the evidence for potential walls enclosing the north and east of the Close, revealed during the current excavation and the Cathedral Barn excavation of 2009, there is clearly the potential for the southern boundary of the Close to have been marked by a wall.

Analysis of burial distribution in the south of the Close has failed to establish a historic boundary. Burials belonging to groups C, D and E continued up to the southern edge of grid square B13. Ground works to the south of this were low impact and not to sufficient depth to encounter further burials. The fact that burials belonging to groups A and B were not encountered to the south of the deep excavation is believed to be a factor of the limited depth of excavation. Whilst the ground level in grid square B13 was reduced sufficiently to encounter later burials, it was not excavated to a depth where group A and B burials would be expected, so we cannot rule out their continuation beyond the limits of the excavation.

The construction of the College of the Vicars Choral and the south cloister in the 15th century would have formed a natural boundary to the Close, but the extent of burial to the south, prior to the appearance of these buildings is unknown. No southern boundary to the burial ground was identified during the Mappa excavations, with burials continuing to the edge of the excavated area. There is clearly potential for the burial ground to have continued beyond the line of buildings currently forming the southern boundary to the Close.

7.8.4 West

In grid square K3, a deposit of loose stone was identified in the trench section. The stone was not coursed in any way, but it was apparent that burials were not present to the west of this feature. The stone deposit may have been the remains of a robbed out boundary wall,

mirroring the wall revealed in grid square H17. There is however, the possibility that it relates to the buildings that are known to have occupied this part of the Close until the 1930s. What is clear, is that burials continued beneath the Broad Street buildings as shown on Taylors map of 1757. All the burials present within the footprint of the houses belong to group C. Burials belonging to group D were present immediately to the east of the former properties and suggest a boundary for the Close equating to that shown on Taylors map during the period of group D burial.

Although at a greatly reduced density, Group B burials are present in the west of the Close. Two Group B burials were present within grid square F3. The lack of Group B burials to the west of this may suggest that the boundary to the Close was slightly further to the east during the 12th and 13th centuries, but it is difficult to draw such a conclusion based on the evidence of two burials. Later burials of groups C and D continue up to the area of modern disturbance at the western extent of the excavated area.

7.9 ARM POSITION (ILLUS 66–67)

During excavation it was noted that the arms of the dead were placed in different ways. Six major variations in position were noted during excavation.

The Mappa excavations had also revealed variations in arm position and attributed them to changes in burial practice over time. A preference for the arms crossed and resting on the pelvis in the Saxon period was followed by a preference for the arms to be folded across the stomach in the 13th century. Later arms were crossed over the chest, whilst the latest burials had the arms crossed over the chest with the hands placed on the shoulders.

Of the 2453 skeletons excavated during the current project, it was possible to determine the arm positions of 666 (27.1%). The remaining burials were either too badly truncated to determine arm position or the upper part of the skeleton lay outside the excavated area and was therefore not observed.

An analysis of arm position in relation to burial group does appear to show changes in arm position over time, although the changes in preference are not clear cut and instead appear as broad trends. Rather than attaching a symbolic meaning to changes in arm position it is probably more helpful to look at the ways the bodies were deposited in the ground when trying to establish the reason for differing arm positions.

In instances where the shroud or winding sheet is containing and providing support to the body (burial groups A,B and C) the folding of the lower arms over the torso (arm positions 1,2 and 3) is the most popular method of placement. It might be supposed that the arms are placed over the torso and secured by the winding sheet or shroud to prevent limbs falling out of position whilst the body is manoeuvred into the grave. The emergence of coffin burial meant that the position of the arms at burial was no longer such an important consideration and arm positions 4 and 5 become popular. The distribution plot of arm positions within Area 1 confirms the correlation between arm positions 4 and 5 with burial groups D and E.

The relatively equal dominance of arm positions 2 and 3 within burial groups B and C raised the question of whether we were observing the difference between a male and female arm position. However, the osteological data suggested a fairly even number of males and females exhibiting both arm positions. No correlation was evident when arm position was compared to age or sex. (see Table 7)

Variations in arm position would appear to relate to the practicalities of burial rather than having any particular symbolic importance. The placing of the arms over the torso of the body prior to wrapping in a winding sheet would make a corpse easier to handle and prevent arms falling away from the body at inopportune moments. Burial within a coffin reduced the importance of folding the arms over the torso and there appears to be a trend towards placing the arms at the side of the body, a position more in keeping with the shape of the coffin itself.

7.10 BURIAL POSITION

The majority of burials were interred in the Christian tradition, supine and orientated on an approximate east-west alignment with the head to the west. Variations were observed within the orientation of burials, but the reasons appear to be terrestrial rather than spiritual.

Using the area 1 deep excavation as the most complete dataset, there are a number of observations regarding burial orientation.

The general orientation of burial is slightly north-west/south-east of true east-west. This mirrors the orientation of the cathedral which is 2.8º off true east-west.

Burials from groups A, B and C are orientated on a truer east-west alignment than later burials

The maximum variance from east-west within groups A–C is 24º which is less than 6% variance from the orientation of the cathedral.

The orientation of group D and E burials towards the centre of the excavated area display a greater displacement towards a north-west/south-east alignment. The maximum observed variation is 50º from true east-west (14% variance).

Discounting minor variations in orientation which are likely to relate to the varying skills of individual grave diggers, the overall picture is of two major variations. The first of these, east-west with a slight bias to north-west/south-east, clearly uses the cathedral buildings as its guide. The second variation, confined to the burials of groups D and E and showing a far larger bias towards north-west/south-east appears to be referencing a landscape feature not present at the time of excavation.

Taylors 1757 map shows the feature that is likely to have been responsible for this change in burial orientation. A footpath sweeps around the south-east corner of the Lady Chapel and traverses St John's quad before stopping outside the entrance to the college of the Vicars Choral. The path is depicted as tree-lined on both the map and on a drawing of the quad included within the decorative border of Taylor's map where the trees appear to be mature and of long-standing. In September 1726, reference is made (in the Cathedral act books) to the repair and enlargement of the gravel walk leading from the north end

of the college cloister to Castle Street (Morgan 1976: 16).

In drawings of the Lady Chapel dated 1827 and 1842 the path can be seen but the trees are no longer present. Considering that repair and enlargement of the path were called for in 1726, we might assume that it existed for a period of time before this date. Although the remains of the path were not identified during excavation, its former position can be traced using the burials as a guide. The postulated path is approximately 2.5m wide and passes through the centre of the deep excavation area at an angle of 50º. The burials beneath the path and therefore earlier, conform to the orientation of the cathedral. Those burials immediately to either side of the path and belonging to burial groups D and E are generally orientated at 90º to the path. As the distance from the path increases, the group D and E burials appear to revert to the cathedral orientation. (see Illus 68 & 69)

At what point the trees were removed and a different path arrangement was configured is not so clear. The trees were apparently cleared by 1827, but burials may have been orientated to the path until the closure of the burial ground around 1850.

A further example of orientation to pathways can be seen to the north of the deep excavation area, where burials on a north-east/south-west orientation appear to be buried adjacent to the edges of a path running alongside the southern edge of the Lady Chapel. This path is visible on Taylor's map, but considering that group B burials are also aligned to it, a path is likely to have existed in this position since at least the 13th century when the Lady Chapel was constructed.

7.11 ATYPICAL BURIALS

Five burials were found to be buried with their heads at the east end of the grave, the reverse of the standard Christian practice of burying the dead to face the east in preparation for resurrection on the day of judgement. Although it has always been believed that this burial method is indicative of a priest burial (rising up to face his flock), the medieval priestly burials from the cathedral toilet block excavations were all facing the same way as their congregation. The practice of burying priests facing to the west is likely to be a post-medieval custom (Daniell 1997: 149).

Four of the five corpses buried in this manner belonged to group D and one belonged to group E. Other than orientation, there was nothing else within the graves to mark them out as any different from other burials. The five burials amount to 0.2% of the excavated assemblage and the possibility exists that corpses entirely covered by a winding sheet, or contained within a simple wooden coffin, that may have been little more than a rectangular box, would occasionally be buried backwards purely by accident or lack of attention.

A further interment worthy of mention is the burial of a leprosy victim in a slightly flexed position. The only leper burial also being the only crouched burial excavated is presumably not a coincidence, although the reason for burial of a leper in this manner is not entirely clear. (Illus 70)

Attached to the eastern end of a cist in area 1 was an additional stone box containing the disarticulated remains of a further individual. The most likely explanation is that when the digger of the grave encountered the remains of a previous burial, rather than simply removing them and reburying them within the backfill of the grave, the additional stone-lined space was created and the bones laid out in a respectful manner.

The respect shown to the disinterred remains in this instance is not repeated during later use of the burial ground. Excavations carried out at Kellington Church in Yorkshire, identified a major shift in the care of burial that took place in the twelfth century; before that date, bodies were carefully laid out and any bones which were discovered were treated with reverence. After that date less care was taken about cutting through existing graves and disturbed bones were simply thrown back into the grave with the backfill (Daniell 1997: 146). It has been argued that this change in attitude reflected a change in belief from the Day of Judgement (when the deceased would physically rise up) to Purgatory (a more spiritual reckoning of the character of the individual).

8 OSTEOLOGICAL ANALYSIS

8.1 INTRODUCTION

Archaeological excavation of Hereford Cathedral burial ground in 2009–11 resulted in the excavation of 2,453 inhumations. In addition, a significant amount of disarticulated human bone was also uncovered. Sub-sampling of the buried population was carried out following assessment (Boucher et al 2011) and full osteological analysis was undertaken on 710 articulated individuals. The osteological analysis will be considered in light of documentary as well as excavation results to highlight both the health and lifestyle of the inhabitants of the city and liberty of Hereford through the medieval to post-medieval periods.

8.2 BACKGROUND

8.2.1 Population of the cemetery

Documentary evidence indicates that by at least 1108 the Cathedral was claiming exclusive burial rights within the city and from 1143, the Cathedral had such rights over all the (five) city parishes and several outlying ones. However this monopoly, which carried with it mortuary fees, offerings and legacies left for anniversaries, obits and trentals, was frequently contested and with some success. In 1298 in consequence of a protest by the Rector of Hampton bishop, any parishioner whose goods at the time of death exceeds 6s in value was to be taken to the cathedral for burial, while women and children and the poorer folk might be buried nearer home and had to pay 1s a year for this privilege (Shoesmith 2000, 305). In the early 14th century Allensmore made a bid for autonomy leading the Cathedral to permit local burial of children and paupers (Swanson and Lepine 2000: 79) and St Guthlac's managed to secure parochial burial rights for a gap of c 150 years around AD1300. In 1348 due to the 'inadvertent' burial of some of the wealthier individuals within local parish churchyards, the Cathedral gave such churches general burial rights on the obligation that they retained all funeral profits. Furthermore the vicar of St Peter's in Hereford started carrying out

funerals and retaining the profits and although the chapter took him to court, the courts found for Side in 1376 with a papal decree acknowledging funerary autonomy for St Peter's.

Such information indicates that not all individuals from Hereford were buried at the Cathedral and may be an explanation for any biases within the demography of the buried population eg an under-representation of children or an increased male presence. It may also indicate that the individuals buried at the Cathedral were of a higher status or at least could afford the fees for burial.

Further evidence gives us a picture of Hereford Cathedral burial grounds during the late-medieval period. In 1389 a licence was granted to the chapter to enclose the cemetery and lock it at night to stop the burial of unbaptised infants and the exhumation of corpses by swine and other beasts (Friends Annual Report 1976). The reuse of the former consecrated ground at the site of St Guthlac's Priory for the burials of infants may have been a consequence of this act (Shoesmith 1980, 51). However, this seemed a long-standing problem for the cathedral authorities as orders in 1434 by Bishop Spofford and later by the chapter in 1663, 1679 and 1683 all included new orders to enclose the cemetery. John Aubery records that

'under the cathedral-church at Hereford is the greatest charnel-house for bones that ever I saw in England. In 1650 there lived amongst those bones a poor old woman that, to help out her fire, did use to mix the deadman's bones: this was thrift and poverty: but cunning alewives putt the Ashes of these bones in their Ale to make it intoxicating' (ibid).

Burial conditions became so bad that in September 1790 the chapter sent out letters to the rectors and vicars of parishes in the city and suburbs stating that they had 'seriously considered the present state of the minster churchyard…how highly indecent it is and improper to observe the many putrid limbs continually thrown out' and fearing 'contagious Distemper' they had decided that 'after the 25th day of March, 1791 no bodies can be admitted for sepulture here except of those who shall happen to die within the precincts of the Cathedral' (ibid). Cathedral burial registers only relate to individuals who died from 1813 onwards (in accordance with the George Rose's Act).

In 1796 all tombstones and gravestones were removed and 1851 the ground level in the cathedral close was lowered.

8.2.2 Lifestyle

Violence

During the period when the Cathedral Close was an active burial ground Hereford had been the scene of a number of violent acts. In 1138–40 during the civil war period known as 'the anarchy' the armies of Miles of Gloucester and Geoffrey Talbot attacked the royal castle to the east of the Close and set fire to other buildings in the city. Decaying bodies were dug up from the burial ground of St Guthlac's and 'heaped up to form a rampart' from which to attack the castle. Although this grizzly image involved a different burial ground there is the potential for the casualties of this period to be buried within the Cathedral Close.

Due to its strategic position on the banks of the River Wye and the border with Wales, Herefordshire has been the scene of numerous skirmishes with Welsh forces and in the mid-17th century Hereford was fiercely fought over during the English Civil War. Lord Clarendon at the beginning of the civil war described Hereford as having 'many gentlemen of honour and quality, and three or four hundred solders, besides the inhabitants well armed' (Shoesmith 1992, 54). The city was loyal to the King and had already been attacked twice by Parliamentary forces before it was besieged by the Scottish army for five weeks in 1645. Hereford changed hands four times during the Civil war until it was finally occupied by parliament and there is a possibility that this turbulent period may be represented within in the burial assemblage.

Infectious disease and health

During the excavations for the new library building in 1993, a probable plague pit containing the bodies of 300–400 people was discovered. There were no such indications within the current excavations – although grave cuts were impossible to identify – and burial density very high. The Black Death hit Herefordshire in 1348–49 and the Episcopal registers state 'It swept away half the population; land was untilled, and the supply of clergy (and their incomes) was lamentably reduced' (Langford 1956, 147). A second outbreak occurred within Hereford in 1361–2 and spread with the same devastating effect. The name given to the disease probably derives from the black centres of the buboes or abscesses and 'no sooner did these fatal signs appear, than those afflicted dib adieu to the world' (ibid, 146). This was an acute infection resulting in individuals dying before any skeletal changes could occur. Furthermore in the preceding generation early 14th century famines killed one third of the population (Roseff 2003) resulting in a greatly reduced population size recorded in the poll tax of 1377 (Table 8).

Poor living conditions during the medieval period and post-medieval periods was a major cause of outbreaks of infectious disease. In Hereford shortly after the civil war the grand jury recorded

> 'all the streets and back lanes within ye City be very foull and nastye for want of skvengers to keep it clean and hollsom.'

Acute overcrowding occurred in the city of Hereford as for more than five centuries much of the increased population had been concentrated into the 93 acres enclosed by the 13th century walled defences. In the maps by John Speede (1610) and Isaac Taylor (1757) there are signs of overcrowding and a consequent outward movement, many places between the market place and the six gates were severely congested and run-down with poor hygiene and sanitation. Slaughter-houses were situated in the centre of town on Butchers Row and the streets were frequently blocked by cattle being sold. The bacteria-carrying dust from the excrement of livestock and all the transport horses must have caused many respiratory problems. Living in close quarters and working with animals can also promote diseases such as tuberculosis.

Occupations

Historical and archaeological evidence highlights the fact that in Hereford, like in many other medieval towns and cities, individuals were involved in a variety of industrial processes; each often being nucleated and having related street names. Such industries would

have taken place in both rural and urban locations, only differing in scale of activity.

It is considered that 'a specific (skeletal) modification…may not be attributed to a single activity pattern, but rather a wide range of habitual behaviours. Thus, a proper diagnosis may be limited to stating that an individual had engaged in strenuous labour' (Capasso et al 1998, 5). It should be remembered that in the past physical labour was not the confine of adults and involved children of both sexes – strenuous activities that commence early in the lifetime of the individual (before skeletal maturity) will present the greatest osseous response (Knusel 2000).

Historical evidence indicates that Herefordshire has remained a largely rural county throughout its history; the townspeople would also have had common meadows and backyard plots to grow food and rear animals. During the medieval period Herefordshire was synonymous with the wool trade, although it declined in the 17th century due to competition from the North of England. Wool was largely exported to north-west Europe and was the main nationally exported commodity in terms of value in this period (Hurst 2012). Fulling was the process of treating wool for use in the cloth industry and such mills were situated along the River Wye and Lugg. Two fulling mills were located at Hereford in 1527 and six mills present near Hereford by 1690 (Greene 2005); it is likely, however, that there were many more mills in the county – over 100 mills in medieval Herefordshire many of which cannot now be located (Hurst 2012). Many small rural industries employed carders (men who combed the wool), staplers (people who graded and sold the wool), spinners, weavers and dyers who sprang up alongside these watermills. Hemp and flax retting creates pollutants, as did other aspects of textile production (Walton 1991) such as dying and fixing. In 1594–6 fines were imposed for washing flax and hemp in the river Wye at Welsh Bicknor, and at Hereford in 1700 an order was issued restricting the dressing or drying of flax and hemp within the walls of the city (Jenkins 1936) – these orders were presumably made to counteract the pollution of the water supply that would have occurred as a result of these processes. Environmental pollution from leather production through the by-products resulting from soaking and heating would have also been detrimental to health (Cherry 1991). Evidence for tanneries just outside the city walls have been uncovered, most notably at the site of Hereford Magistrates Court dating to the 12th-14th century (Vyce 2001).

Evidence of intensive ironworking, including smithing and smelting, dating to the 10th to 12th century was uncovered during the Cathedral excavation (see Luke's chapter). The fact that dues paid by the smiths in Hereford were specifically mentioned in the Domesday survey appears to be unusual and may be representative of the scale of the industry in the city (Crooks 2012). Further, medieval ironworking sites in Hereford include that at Goal Street/Bath Street (Crooks 2009a), Bewell Street (Crooks 2005) and that on Wye Street and St Martin's Street on the southern bank of the river (Crooks 2009b). A further site at Commercial Street/Union Street (Crooks 2007) uncovered copper or bronze-smithing waste at the rear of medieval tenements – the quantities found did not suggest large-scale industrial activity. Back plot industry was a normal feature of medieval towns and might sometimes have been on a fairly small scale and carried on in conjunction with normal household activities (Vince & Schofield 1994, 101).

Furthermore, constant building and decoration on the Cathedral provided employment for many craftsmen and its liturgical needs, in wax, vestments, incense and wine sustained trade and industry. A variety of work was undertaken by the inhabitants of the city and its liberty and in the latter part of the 16th century a new market hall was built, with the ground floor used for a market and the above rooms for 14 city guilds including bakers, barbers, butchers, clothiers, coopers, glovers, tanners and weavers.

In 1777, downward traffic on the Wye from Hereford included 9,000 tons of corn and 26 tons of cider (Shoesmith 1992, 78). Cider was, and still is, one of the main products of Hereford and the neighbouring areas and it reached its peak production in the 17th century. Evidence of the popularity and profitability of early cider-making within Hereford is present within the Cathedral where a tomb and carved effigy, dating to the 14th century, depicts Andrew Jones a prominent and rich cider-maker with a large money purse and a barrel of cider at his feet. Defoe in the early 18th century wrote 'we could get no beer or ale in their publick houses, only cider, and that so very good, so fine, and so cheap… great quantities of this cider are sent to London, even by land carriage tho' so very remote, which is evidence for the goodness of it, beyond contradiction' (Defoe 1724). The manufacture and trade of gloves also became important in 17th century Hereford.

8.3 RESEARCH QUESTIONS & OBJECTIVES

Analysis of the skeletons should give us an insight into the lives of a large community over a substantial period of time. Several questions and objectives need to be considered:

- The burials excavated consist of a large medieval assemblage and a smaller post-medieval assemblage – assuming that the burial groups (A to D) are chronological, can any differences in health and lifestyle through time be identified? It has to be remembered that burial groups A and B are relatively small and in some instances groups A, B and C have been combined into one medieval group.

- Can information on occupation, lifestyle, diet or health be identified? If so, are there differences between males and females or between different age groups.

- Is there any evidence of violent trauma? If so, which historical period or event (if any) can the incidence be related to?

- The vast majority of the inhabitants of Herefordshire lived in a rural context and in comparison the population of the city of Hereford was relatively small (see Table 8). Those buried at Hereford Cathedral came from Hereford city and its liberty– the latter may have had a more rural character. How do the pathological prevalence rates of the Hereford assemblage compare to sites of both a rural and urban character?

- A comparison of the Hereford Cathedral assemblage to other large-scale contemporary skeletal assemblages will give us a better understanding of the relative health and lifestyle of this population within its national context.

Considering the above questions, seven comparative skeletal assemblages were chosen as they represented relatively large numbers of individuals and were from contemporaneous sites within England. Further, the selection included both rural and urban assemblages to test the hypothesis that Hereford may represent an urban/rural population. Table 9 lists the assemblages referred to in the subsequent text. In addition, where deemed informative, further comparative prevalence are taken from Roberts and Cox (2003) – this text represents the most up-to-date large scale collation of British osteological data. (see Tables 9 and 10)

Aims will be addressed through skeletal analysis which will ascertain:

- Preservation levels of the skeletal remains
- The minimum number of individuals present
- Age at death – within broad age categories listed in Table 10
- An assessment of biological sex
- Adult stature estimations
- Metric and non-metric variation
- Presence and frequency of skeletal and dental pathology present

8.4 METHODOLOGY

8.4.1 Recovery and processing

Individuals were excavated according to the recommendations in McKinley and Roberts (1993). Once located, individuals were fully uncovered before being photographed and lifted. An osteologist was present on site during excavation and the majority of site staff had previous experience in recovery of human remains. Sieves were also employed on-site to ensured that all smaller skeletal elements were recovered, eg wrist bones and the small bones of infants and small children. The various skeletal elements were bagged separately and each individual was labelled with its skeleton number as well as the completeness and the presence or absence of elements which could be used to age and/or sex the individual. Individuals were removed to a temporary storage facility near the Cathedral precinct according to whether they had been selected for processing and analysis.

The human bone was cleaned at Headland Archaeology (UK) Ltd. Hereford office using luke-warm water and soft brushes. Individual burials were kept separate, re-bagged and clearly labelled; all bone recovered was to be reburied and on this basis bone was not marked individually with an ID number. After analysis had been conducted each individual was boxed and placed in short-term storage at the Cathedral barn prior to re-burial. Humidity and other environmental conditions were not measured due to the short-term nature of storage.

8.4.2 Assessment methodology

An assessment was undertaken to ensure that maximum resources were focused on the material that provided the most comprehensive and accurate data set – see Appendix 2.

In summary the assessment concluded that adult individuals over 50% complete and sub-adult individuals over 25% complete provided the best dataset for analysis. The assessment took into account skeletal completeness and preservation and the results indicated that there was a correlation between these two factors, which is also noted in many of the comparative assemblages (eg Blackfriars, Ipswich – Mays 1991). Furthermore, those below the cut-off percentages had very limited potential for demographic and pathological information and would have had little impact on the quality of data obtained. The lower percentage cut-off for sub-adults was implemented due to their under-representation in the assemblage as a whole and also the relative easy in which an age can be obtained for the pre-pubertal skeleton in comparison to an adult individual. In total 710 individuals were analysed which constitutes 29% of the total number of skeletons uncovered on-site.

It must be considered whether this stratified sample will bias the analysis results in comparison to other assemblages in regard to pathology. In general, differing levels of preservation and completeness of skeletons between sites means that the crude prevalence rate (CPR – rate by individual) will not be an accurate representation but a rough guide. The CPR obtained from more complete skeletons, present in this assemblage, may be closer to the actual prevalence for pathologies where the distribution of lesions throughout the skeleton is key to diagnosis; in less complete skeletons distribution cannot be determined yet they are still included in the denominator.

The true prevalence rate (TPR) is stated here for all other pathologies, which is the rate per bone, bone segment or joint surface present. Because this rate is a percentile, as long as sample sizes are big a stratified sampling method should not affect the outcome.

The recording strategy for disarticulated human bone followed the principle that disarticulated material recovered from 'cemetery soil' (rather than discrete contexts) was of limited scientific value (English Heritage 2004). Its potential is limited as it is difficult to date, as well as the fact that age and sex cannot be determined for the majority of single bones and the distribution of pathological lesions throughout the skeleton cannot be assessed. All of these criteria are essential for statistical analysis and adequate diagnosis of pathologies. A 'rapid scan' of this bone was undertaken during excavation to identify any items that might potentially yield higher levels of information, mainly pathological alterations to the bone. Also a count of the bones was undertaken to obtain a minimum number of individuals buried within the excavated areas.

8.4.3 Analysis methodology

The skeletal material was analysed macroscopically and recording was in accordance with the standards recommended by the British Association for Biological Anthropology and Osteoarchaeology (BABAO) in conjunction with the Institute of Field Archaeologists (Brickley and McKinley, 2004) as well as English Heritage guidance (2004).

Surface preservation was recorded using the grading system of McKinley (2004) where 0 indicates no modification to bone and 5+ has extensive penetrating erosion resulting in modification of the bone profile. The degree of fragmentation was recorded using the categories 'low', 'moderate' or 'high' and completeness was expressed as a percentage either <25% complete, 25–50%, 51–75% or >75%. Sex was determined using standard osteological techniques; several morphological differences in the skull and pelvis, as well as the overall size of bones, are considered when estimating sex of an individual (Mays and Cox 2000). Sex was not determined for non-adults as it can only be ascertained once secondary sexual characteristics have developed during late puberty and early adulthood. The presence and preservation of the pelvis is important for the estimation of adult age allowing different stages of bone morphology and degeneration to be identified at the pubic symphysis (Suchey-Brooks 1990) and/or the auricular surface (Lovejoy et al 1985). Estimation of age is based on as many criteria as possible; sternal rib morphology (Iscan, 1984/5) and dental attrition were also considered (Brothwell, 1981). The latter technique was not used as a sole criterion for estimating the age of an individual due to its unreliability, especially in post-medieval assemblages probably as a result of changes in the diet compared to earlier periods (Walker et al 1991, Brickley et al 2006), and it exhibited a tendency to underage within this assemblage. It should be remembered that adult skeletal age-at-death represents physiological age rather than actual chronological age. Several studies (eg Molleson and Cox, 1993, Miles et al 2008) have shown that age-at-death estimations from the skeleton frequently underestimated age for older adults. In non-adults consideration of primary and secondary ossification centres (Scheuer and Black 2000 & 2004, Schaefer et al 2009), dental formation and eruption timings (Ubelaker, 1989) as well as long bone length (Fazekas and Kosa 1987, Maresh 1970) were used to calculate age.

The stature of an individual can only be estimated if at least one complete and fully fused long bone is present and sex is known. The bone is measured using an osteometric board, and stature is then calculated using Trotter's regression formulae (1970). Of the complete bones of a skeleton, the bone which gives the most accurate stature estimation was used in individual calculations eg the femur or the tibia, or a combination of both these bones having the lowest standard deviation. Standard metrical data was recorded, where preservation allowed, following the guidelines of Buikstra and Ubelaker (1994) for infants and Brothwell and Zakrzewski (2004) for adults. The cranial, Meric and cnemic indices were calculated for adults (Bass 2005) and non-metrical traits recorded (Brothwell and Zakrzewski 2004, Finnegan 1978). All pathological manifestations were described in detail (Roberts and Cornnell 2004) and where possible a diagnosis was stated. In statistical analysis a p value of 0.01 or less was considered statistically significant.

8.5 THE ASSEMBLAGE

A summary catalogue of all skeletons analysed (N=710) is present in Appendix 3.

8.5.1 Preservation

Preservation has a large impact on the quality and quantity of information that can be obtained from skeletal remains. A number of factors can influence skeletal preservation; intrinsic factors include age, sex and pathological status of an individual, (eg fragile infant or less dense older adult osteoporotic bone will deteriorate comparably faster) and extrinsic factors including type of burial, materials used, surrounding soils and post-depositional disturbance.

An assessment was made of the state of preservation of each skeleton during excavation as either 'good' (Grades 0–1), 'moderate' (Grades 2–3) or 'poor' (Grades 4–5+). Overall, the majority of individuals were moderately well preserved (Chart 2).

The skeletons located in area 4 of the excavation were less well preserved with 57.3% exhibiting poor preservation. The skeletons in this area lay directly beneath the surface and the construction of paths and earlier landscaping appears to have substantially damaged the burials, especially the uppermost layer where bone was severely crushed making the surfaces of the bones unobservable. The skeletons in area 1 showed the best preservation overall, with 19.7% within the 'good' 'category.

In terms of burial groups, burials within group C had the worst preservation (36.35% poor; 14.45% good) which indicates that preservation may be a result of frequent changes in the burial environment, through repeated disturbance from grave diggers, rather than the result of time interred. However, coffins and cists may also have afforded individuals some protection against the burial environment.

Chart 3 shows that the majority of skeletons uncovered during excavation were less the 25% complete. Area 1 exhibited the most complete individuals, followed by area 4, and this is the result of an open-area excavation strategy within these areas, while in other locations burials were excavated from within narrow drains and soakaways contributing to the lower levels of completeness.

Sub-adults were relatively less complete with poorer surface preservation compared to the adult assemblage, which conforms to the general trend seen in excavated human remains elsewhere.

Of those analysed most exhibited good preservation (Chart 4) – this is in agreement with the assessment results (Appendix 2) and shows that there is a positive correlation between lower skeletal completeness and poorer bone preservation. This implies that poor survival of bone in soil played a part in reducing skeletal completeness. Furthermore, 'Each individual burial exists within its own niche …in an environment in which a complex interactions occurs between a wide range of variables' (Henderson 1987) – therefore disturbance (by gravediggers), removal of parts of the skeleton, and interment of a fresh body no doubt altered the burial environment significantly causing poorer levels of preservation.

8.6 QUANTITY

8.6.1 Articulated material

The total number of articulated individuals excavated was 2,453 and the following osteological analysis is based on 710 of these individuals. Table 4 shows the distribution of these skeletons within

the different burial groups observed on-site. The table reveals the presence of a large medieval assemblage, made up of groups A to C, a later-medieval/early post-medieval group (D) and a later post-medieval group (E).

It must be remembered the pre-cist and cist burials both have a relatively small sample size and any comparative results using these individuals should be considered tentative. (Table 11)

8.6.2 Minimum number of individuals

The minimum number of individuals (MNI) was calculated for both adults and sub-adults. At least some of the disarticulated bone would have originated from the articulated burials which were incomplete and therefore the MNI is calculated by counting and siding all articulated and disarticulated bone elements and the most common element present represents the MNI.

The most common bone part in the adult population was the right proximal epiphysis of the femur and for the sub-adults it was right proximal femoral metaphysis. The MNI for adults is 1763 individuals and for non-adults is 340, giving a total of 2103 individuals.

The MNI represents the absolute minimum number of individuals that can be proven to be present and in reality will be lower than the actual number of skeletons present; it is 350 less than the articulated skeletons uncovered. The excavation strategy within areas 2 & 3, where small sections of differing parts of skeletons were excavated, is likely to have further reduced the MNI for this site.

8.7 DEMOGRAPHY

In total, of the 2,453 articulated individuals excavated, 2,020 were adults and 433 sub-adults. Although the mortality rate of children during the medieval period would have been high, such large numbers of children are rarely excavated. The 17.7% found at Hereford Cathedral, however, is much lower than that at Burton-on-Humber where sub-adults (under 15 years) represented 37.6% (1034/2750) of the assemblage, as well as the 44.6% (327/687) at Wharram Percy, and the 27.3% (291/1068) at St-Helens-on-the-wall. The figure is most similar to the cemetery of St Andrew's Fishergate where 22.4% (90/402; 15% just group 6 – 42/271) of the total excavated population were children but this might be expected due to its monastic association. Elsewhere in Hereford in the medieval period burial took place at St Guthlac's (Hereford County Hospital; Shoesmith 1984 & Crooks 2000) which on excavation produced only 13 sub-adults in total. In recent societies lacking modern medical care and sanitation, about 20–56% of deaths may occur under 16 years of age (Hewlett 1991).

It has been suggested that children may have been interred in areas segregated from the main burial ground perhaps because they were not baptised (Ulrich-Bochsler 1997); in Hereford the use of the abandoned site of St Guthlac's Priory for the interment of 24 infants is interpreted as such (Shoesmith 1980, 51). However, in medieval times baptism was an important sacrament and children could be baptised by a lay-person if the priest was not present. It was usually undertaken one week after birth (Shahar 1990, 46) but if the life of the newborn appeared in danger it would be baptised immediately or if it appeared the child might be stillborn any limb that emerged could be baptised by the midwife (ibid). The sub-adults excavated did not show any clusters but were instead buried throughout the Cathedral burial grounds suggesting they were not treated any differently in regard to burial location in comparison to adults. It may be that there was a lower rate of sub-adult mortality in Hereford, however, the considerably lower prevalence is likely to be the result of a selective excavation strategy at Hereford Cathedral and to some extent preservation (with juvenile bone more susceptible to degradation in adverse soil conditions). Furthermore, another explanation from documentary evidence discussed above, indicates that to some extent children (along with women and the poorer members of society) were allowed to be buried nearer home in parish burial grounds.

All 236 sub-adults analysed could be placed within an age category (Chart 5). The five foetuses and seventeen neonates were either stillborn, or died following birth. Four of the foetuses were between 28–38 weeks old and had been born prematurely, all were within burial group C with the exception of one in group E. One foetus, SK 11311, aged 24–28 weeks old was found within the pelvic cavity of an adult female (SK 11308) shown in illustration 1. The peak in those who died occurred in the 1–6 year age group, accounting for 40.25% of sub-adults. The causes of death in these very young children are likely to have been similar to those in modern developing countries (Walsh 1989; Assefa et al 2001). Breastfeeding protects the infant against diarrhoeal diseases but the child becomes susceptible after it is weaned at approximately one to two years old (Mays 2007, 93). The majority of possible causes do not show skeletal changes including gastro-intestinal and other infections caused by poor nutrition, inadequate sanitation and the absence of a clean water supply (Black et al 2003), in utero infections (including syphilis, toxoplasmosis, rubella and cytomegalovirus infections which can cross the placenta), prematurity and very low birth weight, and respiratory distress in newborn. Furthermore, congenital anomalies may also result in premature death at an early age although in this case skeletal changes can, although rarely, potentially be observed.

It is generally considered that once over the age of 5 years, average life expectancy of an individual would be greatly increased, a fact that is borne out by both demographic and archaeological data (Kausmally 2004, Roberts and Cox 2003). However, within this assemblage a relatively high percentage of sub-adult individuals, 44.92%, were over six years at death. It must be remembered, however, that this pattern may be a result of excavation biases, preservation and burial law (discussed above). It is possible that some of the adolescence deaths in the Hereford assemblage may be accounted for by the complications of pregnancy. However in the adult childbearing age group (18–35 years) the proportion of males dying outnumbers females (54.55% and 45.45% respectively), suggesting it was not a major cause of death in younger women; archaeological and ethnographic evidence have shown that the risks of female mortality as a result of childbirth are lower than previously thought (Wells 1975; Owsley and Bradtmiller 1983). (see Chart 5) (see Illus 71)

The age and sex distribution of the analysed adults can be seen in table 5. There is no statistical difference in the age structure of males and females ($x2= 1.52$, $p= 0.68$). Both, males and females show a peak in adult mortality occurring between the ages of 35 and 45 years. (see Table 12)

It is interesting to note that the peak age of death for the medieval inhabitant of Hereford is higher than that recorded from documentary sources for the period, in which life expectancy, for males at the age of 20 years, was between 24–36 years increasing gradually from the mid-13th to the end of the 15th century (Dyer 1989, 182). However, the figure obtained here from the current excavations do not take into account the demographic results from the previous Cathedral plague-pit excavations, which may potentially lower life expectancy during the medieval period in Hereford; it may to some extent also account for the under-representation of sub-adults - the youngest of whom would have been the most vulnerable to epidemic disease. In the post-medieval period the London Bills of Mortality recorded that the highest percentage of adult deaths occurred within the 30s and 40s during 1728 to 1810, with the number of individuals dying in older adult age increasing during this period (Roberts & Cox 2003, 304).

The male-to-female (1.36:1) ratio in the adult assemblage is slightly in excess of the 1.06:1 expected within any population (Rousham and Humphrey 2002, 128). It has been noted that there is often a bias towards identifying males in a skeletal assemblage, however, the excess is particularly great in some burial groups. Cist burials, by far, have the greatest male majority, however, the small sample size may bias the results; of the cist burials previously uncovered in Hereford five had sex established and include one female and four males (Shoesmith 1984; Shoesmith 1980; Langston & Roberts 2001). Between the groups, groups A and B had a statistically significant difference in the distribution of males to females (x2= 8.65, p= 0.007), as well as groups B and D (x2= 7.32, p= 0.007). There was no evidence for spatial segregation of burials in the Cathedral burial ground in regard to sex and therefore selected excavation of differing areas of the burial grounds is unlikely to play a part in this bias. As mentioned above the preference to let some individuals be buried in local parishes including women may be a possible contributing factor to the lower numbers of females uncovered at the Cathedral. (see Table 13)

8.8 METRIC ANALYSIS

8.8.1 Stature estimation

Stature has been used as a rough yardstick to indicate the overall health of individuals and of populations. Provided the genetic component of the populations does not change (as would happen, for example, with an influx of people of differing average stature), environmental factors play a major role. Everybody has a maximum genetic potential to reach a certain adult stature, however, physical and emotional stressors during childhood and adolescence, such as malnutrition, infection or chronic illness, may prevent individuals achieving this potential. The growing body can 'catch-up' growth after such an event; however, if the stressors are too severe or prolonged the individual will become permanently stunted.

Stature could be estimated for 377 adult individuals including 223 males and 154 females (79.55% of the adults analysed). (see Table 14)

The mean height within the five different burial groups is shown in Table 14, where it can be seen that females are taller in burial groups A and B and show a general decline in height through time, but the difference is not statistically significant (one-way ANOVA F= 0.58, p= 0.68). For the males, there is distinctly less variation in mean stature, however, the mean height is also highest in group B; again no statistically significant difference is present between the groups (F=1.52, p= 0.21). Females had a range of 144.75–176.66cm and males 155.18–189.76cm – this reflects the height differences of a normal population and is consistent with stature distributions from other medieval and post-medieval cemetery populations.

Comparisons between mean statures of populations from different periods has traditionally shown a marked increase of height during the Anglo-Saxon period, with a reduction in height during the later medieval period (Caffell 1997, 48). This reduction in stature has been attributed to increasing urbanization during the medieval period, with its associated problems, including pollution, increased spread of disease and less access to fresh produce (ibid). The mean female stature calculated for a number of sites in the later-medieval period was 159 cm and for post-medieval sites was 1.60 cm (Roberts and Cox 2003) and the male mean was 171cm for both periods. Table 15 shows that the mean stature of the Hereford population is most similar to the urban poor at Fishergate House, and furthermore shows no distinct separation in stature between urban and rural sites. (see Table 15)

8.8.2 Sub-adult growth

Compared to long bone growth, dental development is not severely affected by environmental conditions, and can be used to compare the growth achieved with what would be expected under optimum conditions. It was possible to plot dental age against diaphyseal length in 74 sub-adult individuals (Chart 6). Chart 7 shows that, from groups B through to D, individuals became shorter for their age which may indicate compromised nutrition or health status overtime. This may reflect the impact of disease and famine during the later medieval period as well as temporal change in the status of Hereford as a wealthy royal city to a marginal (poorer) rural centre.

Sub-adult growth in the Hereford assemblage reflects characteristic human growth showing a steep increase during infancy, followed by a slower steady increase until another sharper incline at puberty (Chart 8; Hereford = 42 sub-adults with femoral lengths plotted). The Hereford sub-adults are shorter than modern children of a similar age – it must be remembered that a cemetery population is not a random cross-section of the population and 'some degree of error is introduced by the very fact the sample is skeletal. It does not represent the normal, healthy, population from which it is drawn' (Johnston 1962). Studies of long bone growth in archaeological populations are sparse as large populations with an adequate representation of sub-adults are infrequently available. A comparison of the Hereford sub-adults to that at Wharram Percy indicates that the former are relatively tall from approximately five years onwards compared to contemporary children living in a rural environment. (See Charts 6–8)

8.8.3 Metric indices

Of the various indices that can be derived from the skeletal measurements, three were calculated for this assemblage including the cranial, femoral and tibial index (see site archive for further measurements).

8.8.4 Cranial index

The shape of the cranium, calculated by the cranial index, is determined by genetics but climate and diet may also have a small affect (Mays 2000, Sparks and Jantz 2002). There have apparently been changes in the mean cephalic index from the Neolithic period onwards and early physical anthropologists used it to attempt to define race, and to trace the migration of different peoples (Brothwell 1981, 87). There is a growing body of data indicating a tendency for medieval populations in Western Europe to become increasingly brachycranic, or broad headed (index >80), in contrast with earlier periods, when the greater proportion were dolichocranic (longheaded, index <75) or mesocranic (75–<80) (eg Tattersall 1668a).

At Hereford, only 45 adult skulls were sufficiently intact for measurements to be taken, and further once the data had been grouped by sex and by burial group the number of individuals involved were very low – this must be borne in mind when the results are examined. The indices are shown in Table 16. Both males and females followed a similar pattern, with the greatest number of individuals within the dolichocephanlic range. Individuals in Hereford seem to exhibit a general trend for lower indexes in the chronologically later groups D and E which does not conform to the general trend stated above. (See Tables 16&17)

8.8.5 Femoral and tibial Index

The shape of the femoral and tibial shafts is calculated using the meric and cnemic indices, respectively. The measurement used for the calculation of the femoral index is taken just below the lesser trochanter, however, for the tibia it is taken at the level of the distal edge of the nutrient foramen, which does not occupy a constant position along the shaft of the bone and the utility of this index is open to doubt.

The femoral and tibial indexes have apparently increased in value over time so that the shafts have tended to become more rounded perhaps reflecting a general trend towards a more sedentary lifestyle (eg Buxton 1938; Brothwell 1981). Lower index values show a flatter shaft cross-section and generally tend to indicate greater habitual mechanical forces (Larsen 1997, 222). However, research has shown that bones are far more prone to biomechanical influences during childhood and adolescence than in adult age, and therefore age at the onset of activity may be an important influence on bone shape (Jurmain et al 2011).

In total 645 femora could be measured to obtain the femoral index, of which 364 were males and 281 females (Table 18). The overall mean index for both sexes fall within the platymeric range (broad and flat in shape). The male femora tend to be rounder (higher index) than that of females and the difference is statistically significant (t= -4.18, p= <0.001). Both right and left mean indexes for males and females are platymeric, although the right femur tended to exhibit a higher index (rounder) compared to the left – this is opposed to an often reported pattern where flattening is more pronounced in the right than the left.

The mean index increased over time from the medieval (groups A to C), through the later-medieval/early post-medieval (group D) to the later post-medieval period (group E); this agrees with the general observation noted above. (see Tables 18&19)

The tibial index could be calculated for 412 tibiae, of which 252 were males and 160 females (Table 13). The mean index for both sexes was eurycnemic (of average dimensions). Males tended to have flatter tibia than females, but this difference was not statistically significant (t= 0.05, p= 0.96). Overall, the male mean indexes for the right and left femora are very similar and the females show slightly flatter left femora. The pattern through time for the mean tibial index is less clear than that of the femoral index; males do show a general increase from the medieval to later post-medieval period. (see Tables 20 and 21)

8.9 NON-METRIC TRAITS

There are a number of non-metric traits in both the skull and the post-cranial skeleton; these variables are dichotomous, and therefore they can only be recorded as either present or absent. They have been used in an attempt to measure genetic differences between populations (Berry and Berry 1967; Berry 1974; Hanihara et al 2003) – however, it is still uncertain wither these traits are under direct genetic control and to what extent environmental factors play in their determination or modification.

Eighteen cranial and thirteen post-cranial traits were recorded for adult individuals only and data is collated here with the most significant discussed within the text as 'Some of the non-metric traits are very trivial' (Waldron 2007, 49). The individuals buried at Hereford Cathedral are all considered to be from local origins although we now know that males buried within cists came to Hereford from elsewhere (see isotopic analysis results).

8.9.1 Cranial non-metrics

The cranial non-metrics recorded include additional ossicles within the cranial sutures (wormian bones), extra bones at the junction of sutures, as well as extra foramina, canals, articulations (fronto-temporal) and tori. Frequencies of cranial non-metric traits, among the differing burial groups, and within the population as a whole are presented in Table 22.

Metopism is the retention of the mid-line suture in the frontal bone which normally disappears during the first or second year of life. This characteristic is likely to be genetically determined and it shows considerable geographical variation (Hanihara and Ishida 2001b). The 14.9% seen at Hereford Cathedral is higher than that of the adult population of most comparative sites (Helens-on-the-wall at 11%; At Andrews period 6 at 7.4%; Barton at 3.2–3.6%), with the exception of Fishergate House at 21.7% however this has relatively small numbers of frontal bones observable (13/60).

The lambdoid suture was the most common region for wormian bones to be present, this seems to be a general pattern seen in comparative assemblages. Such extra cranial bones are likely to be genetically determined (O'Loughlin 2004; Hanihara and Ishida 2001a), but have also been suggested to result from stress placed on the growing cranium during foetal life and early infancy (Bennett 1965). At the junctions of sutures the asteronic bone and parietal notch bone were most frequently present; the prevalences for each in this

assemblage are relatively high with a prevalence of between 2.3–8.6%.

Overall, however, the extra-sutural mastoid foramen was the most frequently occurring trait, followed by the presence of parietal foramina and the palatal torus. The latter, is a bony prominence along the mid-line of the palate; and such prominences also occur on the right and left lingual surfaces of the mandible in the molar/premolar region. Both genetic and environmental factors are thought to be involved in their aetiology (Seah 1995) and tori have been associated with high levels of masticatory stress (Roberts and Manchester 1995, 54). A higher prevalence occurs in males in the assemblage and in the mandible the left side, in both sexes, exhibited a higher frequency of tori development.

In the cist burials metopism, lambdoid wormian bones, mastoid foramen extra-sutural and multiple infra-orbital foramen exhibit a relatively high frequency in comparison to the other burial groupings (see Table 22)

8.9.2 Post-cranial non-metrics

Most of these traits are normal variants but the significance of some is still not well understood. A few, however, along with genetic influence are considered to have biomechanical factors involved in their development. (see Tables 23 & 24)

Femoral plaque

Femoral plaque, located at the anterior aspect of the femoral neck, was the most frequently observed post-cranial trait and males had a higher frequency than females. There is no consensus about the exact aetiology of this trait, however, it has been considered as a possible occupational stress marker as femoroacetabular impingement (FAI) may be a possible cause of bony modifications in this region of the femur (Villotte and Knusel 2009). FAI is due to a marginal developmental hip abnormality and environmental factors such as the partaking in activities involving recurrent motion of the legs within a supraphysiologic range eg gymnastics (ibid). The high prevalence within this assemblage, and within other assemblages eg St Andrews Fishergate (71.3–74.1%) suggests it is unlikely that FAI is the cause, although it may be in some cases, – it is clear that further research in needed with this area.

Squatting facets

Lateral squatting facets, represented by indentations at the distal end of the tibia, were the second most frequent trait; overall, 35.77% of adults exhibited either a medial or lateral squatting facet (88/246 in which facets could be observed as present/absent). This trait is thought to be the result of repetitive hyper-extension of the ankle joint during squatting. Tables 24 & 25 show that females had a significantly higher prevalence of squatting facets than males ($x2= 13.3$, $p = 0.00027$) which is a similarly the case at Barton (5.8% and 2.2% respectfully) although with a much lower prevalence. The sex difference may suggest that females attended to tasks lower to the ground such as tending a fire; in the medieval community women were more involved in tasks centered around the dwelling such as caring for infants, cleaning, preparing of food ect. (Bennett 1987). A higher prevalence of facets was found at Fishergate House with 61–62.5% of females and 31.5–38.5% of males displaying this trait and at Wharram Percy where 55% (107/193) of adults had facets. The latter high prevalence was considered in part due to the rarity of chairs in medieval peasant life compared to the middle classes of Spitalfield who had a 2% prevalence (9/455).

Os acromiale

Os acromiale is the non-union of the acromion process which usually fuses between the ages of 22 and 25 years. There is considerable evidence that it may be the result of trauma or be related to occupational factors with chronic stress preventing fusion. Therefore certain habitual activities involving the shoulder may increase the frequency of this condition, for example Stirland (2000) associated the condition with the regular use of bow and arrows from a young age on the Tudor warship the Mary Rose. The condition is sometimes associated with pain and there is a relationship with osteophytic lipping (Edelson et al 1993), tears of the rotator cuff and shoulder impingement syndrome (Mudge et al 1984). This trait has a relatively low prevalence within the Hereford population, but interesting there is a higher prevalence in males and it only occurred in females on the left side. Males were also affected to a greater extent than females at Barton (4.7 and 0.6%) and St Andrews (period 6, 8.4 – 10.3 and 0–5.6%) where it affected the individual's right process more frequently than the left (9.5 and 7.1%). (see Table 25)

Patella bipartition

The patella commonly ossifies from one centre however 15% of patellae may develop from a double ossification centre, with 1–40% of them remaining as separate ossicles (Green 1975) and it is possible that the accessory ossification centre may fail to fuse due to stress or repeated micro-trauma (Oetteking, 1922; Todd & McCally, 1921; Green 1975). It most frequently occurs as a supero-lateral bipartition (Saupe, 1943), it may affect 1–3% of the population (Anderson 2002) and males more than females (9:1, Green 1975) – these facts are borne out within the Hereford population where only four males are affected by a supero-lateral bipartition. Although bipartite patella is usually asymptomatic, it can become painful in subjects following overuse or injury with 2% of bipartite patellae become symptomatic (Weaver 1977).

Most of the traits have a higher frequency on the left side in the Hereford assemblage, with the exception of side equality in medial squatting facets and right side preference for femoral plaque and supra-scapular foramen. The actual meaning of asymmetry in bilateral traits is uncertain, but seems to be related to age or to fluctuating asymmetry by random non-genetic disruptions in development (Tyrell 2000 in Cox & Mays).

It is difficult to carry out comparative analyses, because the selection of traits and recording methods differ substantially – however, where comparison is possible it illustrates that each site has its own non-metric character, which developed as a result of genetic, mechanic and environmental components.

8.10 PALAEOPATHOLOGY

Pathological conditions are identified by characteristic lesions (pathognomic features) and the distribution of these lesions across the skeleton. However, it must be remembered that bone has a limited capacity to respond to pathological insult – new bone is formed, bone is destroyed, or a combination of these occurs – therefore it is not always possible to arrive at a definitive diagnosis. The individuals buried at Hereford Cathedral suffered from a variety

of pathological conditions and the following section describes their skeletal manifestations as well as the clinical impact on the individual/s which is of vital importance in understanding morbidity and getting a glimpse of the life histories within this population.

8.10.1 Abnormal variation – congenital disease

Congenital diseases are conditions that an individual is born with and can either be caused by an inherent genetic defect or by factors affecting the foetus during development eg infection or environmental conditions such as malnutrition. It is estimated that around 40% of congenital conditions affect the skeleton (Aufderheide & Rodriguez-Martin 1998, 51) and range from very slight skeletal changes that are asymptomatic to serious defects that are incompatible with life.

Developmental defects of the vertebral column and rib cage were most prevalent in individuals from Hereford Cathedral and a range of conditions were recorded (shown in Table 25).

Two individuals (SK 31487 and SK 2308) exhibited scoliosis of the spine. Scoliosis is a lateral curvature of the spine with rotation of the vertebrae towards the concavity, usually exhibiting a double curve permitting the head to be located in the mid-sagittal plane (Aufderheide & Rodriguez-Martin 1998, 66). The vertebrae assume a cuneiform shape with T2, T6 and T8 affected in SK 2308 a younger-middle male, and T5, T6 and T10 in SK 31487 an older-middle male. The latter individual also exhibited a butterfly vertebra at T7 which is a sagittal defect in the central part of the vertebral body – compensatory changes in the adjacent vertebral segments can result in scoliosis. Scoliosis can be congenital or idiopathic; the latter is the most common (80%) and usually appears after birth or during childhood and although the aetiology remains obscure some population studies have shown that it is an inherited familial disease in 30% of cases (ibid). The prognosis depends on the age of onset, and is worst if it appears early in life (Adams 1968). (Illus 72&73)

Klippel-Fiel syndrome is characterised by the congenital fusion of two or more cervical vertebrae due to a segmentation failure of the spine between the third and eighth weeks of embryogenesis (Aufderheide & Rodriguez-Martin 1998, 60). This defect results in a 'short neck, low posterior hair line, and limited movement of the neck' (Barnes 1994, 67).

Spina bifida is a cleft in the posterior midline of the neural arch of a sacral or vertebral segment. The symptomatic form is termed spina bifida crystica, when a herniation of the spinal cord and meninges through the defect occurs, however, clefts with no herniation are known as spina bifida occulta. Spina bifida occulta occurs in 5% of modern adult populations and is asymptomatic (Barnes 1994, 120). The most frequent observation in the Hereford Cathedral assemblage was clefts in the sacral arch. In five of these individuals all five sacral segments were affected which is 4.10% of the population (5/122 with a complete number of sacral arches) compared to a 3% prevalence at Wharram Percy (Mays 2007, 130). In the pre-sacral segments, cleft defects were recorded in the first cervical vertebra of two individuals. (Illus 74)

A cranio-caudal border shift is when a vertebra at the border of two spinal regions incorporates the morphological characteristics of parts of the adjacent vertebra in the neighbouring region (Aufderheide & Rodriguez-Martin 1998, 65). In the assemblage border shifts occurred at the thoracic-lumbar region and the lumbo-sacral region, with all but one individual having a cranial border shift. The lumbo-sacral segment of spine was the most commonly involved with the last lumber vertebrae (L5) becoming part of the sacrum; this shift occurs in 3–5% of modern populations (López-Durán 1995). Some individuals exhibited numerical errors in segmentation of the spine; the normal number of pre-sacral segments is seven cervical, twelve thoracic and five lumbar vertebrae. The 34 individuals involved, all had one supernumery vertebrae and most commonly in the lumbar region of the spine. These minor border and segmentation shifts are relatively common and would have had little impact on the individual.

Four individuals had a cervical rib which results from the elongation, usually bilateral, of the transverse processes of the seventh cervical vertebra and demonstrates the features of a true rib (Aufderheide & Rodriguez-Martin 1998, 68). In some cases, especially after trauma, occupational stress or progressive ossification, the cervical ribs can compress the subclavian artery and vein and/or brachial plexus producing obstruction of the blood supply (Wise 2008). Furthermore, the ribs a younger child (SK 11580) exhibited irregular segmentation of the sternal end of the left first and second ribs with a lack of clinical impact.

The sternum of SK 30194, a younger middle male cist burial, had a wide and short sternum with a pronounced anterior curve consistent with pectus carinatum (pigeon chest). The condition may appear as part of a syndrome and may be associated with a number of major health complaints, however, it can also occur alone. Many individuals are asymptomatic, though impaired lung function and subsequent infection may occur (Groves et al 2003). (Illus 75)

Congenital defects of the skull and appendicular skeleton were also observed during analysis (Table 27).

In a young child (SK 30602) the mendosa suture separates the interparietal and supraoccipital areas of the occipital bone of the skull. If the suture fails to unite during normal development, and is retained, then the interparietal remains as a separate bone (Barnes 1994, 142).

Craniosynostoses is the premature closure of one or more cranial sutures which limits growth in the direction perpendicular to the involved suture which is compensated for by increased growth in other directions, resulting in an abnormal head shape (Aufderheide & Rodriguez-Martin 1998, 52). Two individuals in the assemblage had premature fusion of coronal suture which forces the skull to grow wide relative to its length. However, in the Hereford assemblage there were relatively few skulls which were sufficiently intact to observe cranial deformities. Premature cranial fusion is relatively rare with a crude prevalence rate of 0.8% recorded at Blackfriars Friary in Ipswich and 1.33% at the Franciscan Church, Hartlepool (Roberts and Cox 2003, 277).

Several individuals exhibited os hamulus proprium – this is when the hook of the hamate persists as a separate entity rather than fusing to the body between ages 10–12 years. This is usually asymptomatic; however, os hamuli proprium has been associated with tendonitis in the flexor tendons of the fifth finger, ulnar nerve neuropathy, or hypothenar hammer syndrome (Blum et al 2006).

Bipartition of the medial cuneiform is a malsegmentation defect of the foot characterized by separation of the normal cuneiform into dorsal and plantar segments. Bipartite medial cuneiforms are significantly more prevalent in males and are frequently bilateral, perhaps indicating a strong genetic component (Burnett and Case 2011). Frequencies of this variant are consistently less than 1% in most large skeletal samples, with significant frequency differences among samples from around the world being rare (ibid). This type of developmental anomaly of the foot may change the biomechanics of the tarsal bones, which can allow minor injuries to cause disproportionately severe symptoms including chronic inflammation and long-term pain (Fulwadhva and Parker 2007).

Non fusion of navicular epiphysis (os tibiale externum) occurs in approximately 5–10% of the general population (Scheuer and Black 2004, 401). The persistence of a separate bone, which usually fuses between 12–14 years, leads to inflammation of the overlying skin due to shoe pressure, and today it is removed surgically.

Tarsal coalition refers to a union between two or more tarsal bones and although such a fusion may be acquired (eg in rheumatoid arthritis or trauma) the term usually implies a developmental abnormality due to faulty segmentation during development. SK 11886, an older female (group E), exhibited unilateral talocalcaneal coalition in her left foot. Such a tarsal coalition is likely to have caused restrictive ankle movement, pain and can cause a form of painful flat foot called peroneal spastic flatfoot (Leonard 1974). At Wharram Percy nine individuals exhibited tarsal coalition and the CPR for later-medieval sites is 0.34% (Roberts & Cox 2003, 277).

8.11 NEOPLASTIC DISEASE

A neoplasm is a 'new growth' and can be classified as either benign or malignant. Benign tumours are localized and lack the ability to metastasize (spread to other areas of the body) and in general, a benign tumour grows slowly and is not harmful. Malignant tumours may be fast growing and can spread via the bloodstream or lymphatic system. The cause of tumours is unclear; they can be stimulated by physical, chemical, viral or other initiators, although the ultimate expression of neoplastic tissue growth is mediated by genetic mutations (Aufderheide & Rodriguez-Martin 1998, 373). The finding of benign tumours in archaeological skeletons is relatively common, however, since malignant disease becomes common only in the elderly the frequency of cancer in archaeological populations is reduced (compared to modern prevalences) as much fewer people survived an older age.

8.11.1 Benign tumours

Twenty-six cases of benign tumours were found at Hereford (CPR 3.66%) shown in Table 28. Fifteen males and eleven females were affected, from younger-middle adult age to older adult age. These individuals exhibited several different types of neoplasms including bone cysts, osteochondromas, osteomas, an ossifying fibroma and a possible osteoblastoma. (see Table 28)

Bone cysts are fluid-filled spaces within the medullary cavity, which are most commonly located in the proximal humerus and proximal femur (Aufderheide & Rodriguez-Martin 1998, 390). Children are most commonly affected but the lesion may persist into adulthood and they are frequently asymptomatic; some resolving spontaneously (Murray et al 1990), however, others may respond to fluid pressure by expanding and thinning the cortex, which may lead to pathological fracture (Violas et al 2004). Four cases were found at Hereford including two females with cysts present in the ilium, and two males with the proximal humerus and the acromion process of the scapula affected.

An osteochrondroma (or cartilaginous exostosis) is a tumour that forms cartilage; it starts to develop during growth and it is commonly located near the growth plate of long bones (Ortner 2003, 508). The condition only really has an adverse effect on the individual if the swelling is very large or inconveniently located (Roberts and Manchester 1995, 187). Two younger-middle males exhibited this condition within the Hereford assemblage, one in his humerus and the other in the femur; both were enchondromas – they had developed within the substance of the bone. (Illus 76)

Nineteen individuals exhibited evidence for osteomas, these are bone-forming lesions which are usually small and commonly termed 'button osteomas'. The frequency of lesions peaks in individuals in their 30s and 40s and generally occurs on the ectocranial surface of the skull or facial bones. At Hereford 5.34% (19/356) of adults with observable facial or vault bones of the skull exhibited osteomas, with slightly more males affected than females. Interestingly, although the majority of individuals affected had only one or two osteomas, three males exhibited more with SK 30602 having five osteomas, SK 10601 a total of six, and SK 3150 had a profuse scattering of osteomas, approximately 29 in total, all on his frontal bone. Multiple osteomas on the forehead can lead to facial disfigurement. Multiple osteomas of the skull may be associated with an inherited syndrome termed Gardener's syndrome (also known as familial colorectal polyposis) characterized by the presence of multiple polyps in the colon together with tumors outside the colon (Lee et al 2011).

SK 5186, an older-middle female, exhibited a localised subcortical bone-forming lesion on her right frontal bone (adjacent to the coronal suture). It measured 4 by 3 cm and on the endocranial surface there was slight pitted penetration of the cortex. This lesion is too large to be an osteoid osteoma which rarely exceed <2cm in size, and most likely represents an osteoblastoma (also termed giant osteoid osteoma). The principle symptom of such a lesion is localized pain (Aufderheide & Rodriguez-Martin 1998, 376). (Illus 77)

A further male individual, SK 1834 (group D), had a globular mass filling the left maxilla –the entire area between the palatine process and the inferior orbit surface, the maxillary sinus, the lateral wall of the nasal fossa and the anterior surface of the maxilla were involved. This is consistent with an ossifying fibroma (OF), which is classified as, and behaves like a benign bone neoplasm. It affects the jaw in 20–40 year olds and produces large masses (up to 5cm) of osteolytic bone that expand and thin the cortex – the lesion may involve and distort the cortex but seldom penetrates it (Aufderheide & Rodriguez-Martin 1998, 377). The origins of OF is thought to be the periodontal membrane and some OFs do, in fact, contain prevalent cementum-like calcifications and others show only bony material, but a mixture of the two types of calcification is commonly seen in a single lesion (Liu et al 2010). This man, aged 30–35 years old,

would have presented with respiratory difficulties due to maxillary sinus and nasal invasion, a possible facial asymmetry (convexity of the cheek), as well as possible premature loss of teeth; the left Pm2 was lost ante-mortem but the other left maxillary teeth were lost post-mortem. (Illus 78)

8.11.2 Malignant tumours

Three individuals exhibited skeletal changes associated with a malignant neoplastic disease (3/474 adults – CPR 0.63%).

Two male individuals were diagnosed with multiple myeloma in the Hereford assemblage including SK 4486 (48+ years, group 4) and SK 1767 (35–44 years, group 5). The disease is more common in males and usually occurs in individuals over 40 years of age. It represents a malignant transformation of plasma cells, which are distributed widely as focal nodules throughout the marrow (Roberts and Manchester 1995). They secrete a lymphokine that stimulates osteoclasts in the immediate vicinity of such a tumour mass to resorb bone locally – resulting in sharply localized and completely lytic bone lesions, with no reactive bone formation (Aufderheide & Rodriguez-Martin 1998, 351). They are usually 0.5–2 cm in diametereter, although adjacent lesions may coalesce and lesions may have a 'moth-eaten' appearance; the disease affects, in descending order, the spine, ribs, skull, pelvis, femur, clavicle and scapula (ibid). In later stages, sufficient bone destruction can cause vertebral collapse and pathological fractures in long bones. SK 4486 exhibited profuse small lytic lesions (c 2mm diametereter) on both pelvises (ilium and ischium), on vertebral bodies L1 and L2 and on the endocranial surface of the skull – the latter had a singular small lesion on the frontal and a coalesced 'moth-eaten' lesion at the cruciate eminence of the occipital bone. SK 1767 again exhibited characteristic lesions (1.5–4 mm diametereter) on the thoracic and lumbar vertebral bodies and arches (T3–12), on the ribs, left clavicle, both scapulae. Because many organs can be affected by myeloma, the symptoms and signs vary greatly, although bone pain affects almost 70% of patients and is the most common symptom; a mnemonic is sometimes used to remember the common tetrad (four parts) of multiple myeloma which is CRAB: C = Calcium (elevated), R = Renal failure, A = Anemia, B = Bone lesions. (Longo 2010; International Myeloma Working Group 2003). (Illus 79)

8.11.3 Degenerative joint disease

Degenerative joint disease is one of the most common pathological conditions identified in skeletal material and the Herford assemblage was no exception. Degenerative changes to the joints include osteoarthritis and degenerative disc disease, these are strongly age related, but there are many contributing factors including genetic predisposition and trauma, although it seems that mechanical strain on the joints plays an important role (Simon et al 1972; Radin et al 1980; Croft et al 1992; Videman and Battie 1999; Lawrence 1969).

Degenerative disc disease

Degeneration of the discs held between the vertebral bodies results in the discs losing their 'cushioning' and individuals can suffer from neck and back pain as well as possible pain in the corresponding ligaments – the latter symptoms arise as a result of strains or tears of spinal ligaments resulting from stresses produced by the narrow disc and the associated instability (Lawrence 1969). On the vertebral bodies degenerative changes can be seen in the form of osteophyte development (bony projection) around the margins or on the body surfaces accompanied by porosity of the body surfaces (Rogers 2000). (Illus 80)

Overall, 39.70% (183/461) of individuals at Hereford Cathedral, with one or more vertebrae, exhibited degenerative disc disease. This prevalence is slightly higher than the 34.72% (125/360) found at Wharram Percy (who exhibited grades 2 or 3 corresponing to the criteria here), Ipswich Blackfriars 29.48% (51/173), and it is also higher than the mean CPR for the later-medieval period of 20.90% – the only site with a higher prevalence than Hereford is St Bartholomew's Hospital, Bristol, at 53.33% (Roberts and Cox 2003, 281).

At Hereford, as expected degenerative disc disease increased with increasing age. Between the sexes, male individuals were affected to a greater extent (109/264 = 41.29%) than females (71/193 = 36.79%) and also at a younger age; of those <35 years old at death 18.99% (15/79) were males compared to 11.43% (8/70) females. The distribution of degenerative disc disease within the spine is shown in Table 29, which shows that overall the disease is most prevalent within the cervical spine for both sexes. The difference between the sexes is especially marked in the lower spine of the lumbar and sacral vertebrae; males show a 1.36% and 3.2% higher prevalence than females, respectively.

Osteoarthritis (OA)

Osteoarthritis (OA) involves deterioration of the cartilage between synovial joints, and the clearest diagnostic feature of osteoarthritis in bone is eburnation; when a polished surface is created from bone-to-bone contact. Further features of OA include osteophytes on or around the joint margin, porosity on the surfaces, and subchondral cysts (Rogers 2000). OA is characterised by the presence of at least two of these latter features or eburnation even if it occurs alone (ibid). Individuals suffering from OA can experience stiffness and pain in the affected joint, which may become swollen, and in some cases can cause disability and a reduction in the quality of life (Kean et al 2004). Symptoms are not constant in this disease but instead flare up unpredictably and studies have shown no correlation between severity of pain experienced by the individual and the expression of OA (Cockburn et al 1979). (Illus 81)

Osteoarthritis of the spine

The spine is a frequent site of changes related to OA and 31.41% (147/468) of individuals, with one or more vertebral facet, at Hereford Cathedral were affected. Table 30 shows that changes were present in all areas of the spine with the most frequently affected region of the spine being the first sacral facets and the cervical facets; the latter being similar to the higher prevalence seen in degenerative disc disease. Also, like degenerative disc disease, the marked difference between the sexes was present in the lower spine, however, unlike degenerative disc disease it is females who are more commonly affected by OA in this region; females showed a 3.07% higher prevalence than males in the lumbar vertebrae and 1.94% higher prevalence in the first sacral vertebrae. The majority of females with spinal OA in the Hereford assemblage were >45 years of age (30/58 = 51.72%) whereas males exhibited spinal OA at a younger age; 58.44% in those 35–45 years at death (45/77 males compared

to 24/58 females) and 9.09% in those 25–35 years (7/77 compared to 4/70 females). (see Table 30)

Degeneration of the spine – discussion

The difference prevalence between the sexes of degenerative disc disease and osteoarthritis may reflect functional differences between the vertebral bodies (fibro-cartilage intervertebral disc) and neural arch facet joints (synovial joint). The function of the vertebral bodies is primarily support whereas the facets allow varying degrees of movement therefore weight bearing has less of an effect on the distribution of facet joint degeneration (Bridges 1994; Knusel et al 1997). This would indicate that male lumbar spines underwent more weight bearing stress than females, whereas, females had more movement in their lumbar spines.

An examination of the prevalence of degenerative disc disease in occupational groups by Lawrence (1969) concluded that 'the sex distribution probably depends more on occupational differences between the sexes than on any hormonal or other influence' (133). In the case of the lumbar spine, he found that more strenuous occupations, such as coal-mining, outdoor work such as farming and road-making and unskilled labouring are associated with the highest prevalence. Higher mechanical stress may be responsible for earlier degeneration in the lumbar discs (Miller et al 1988) – a pattern seen in the males in the assemblage.

In the cervical spine the occupational factors are less obvious; Lawrence (1969) found the greatest prevalence in miscellaneous manual workers as well as business and professional workers (compared to outdoor workers or those in light or medium industry). Hagberg and Wegman (1987) suggest extreme flexation of the cervical spine as the causative factor for the high prevalence of cervical syndrome (cervical disc disease) in civil servants; the load on the neck is correlated to trunk and head position, and compared to a normal upright position, the forward flexed position creates 3.6 times greater load in the lower cervical vertebrae (Magnusson and Pope 1998).

OA in the cervical spine is not thought to be work related (Punnett 2005; Bernard et al 2010). The head is incessantly mobile to accommodate the demands of the sense organs, and is attached to a relatively fixed support (the dorsal spine) – this commonly results in undue wear of one or more of the intervertebral articulations of the cervical spine with resultant OA of these joints (Habtung 1961).

Mobility of the lumbar spine is greatest during flexion/extension movements and therefore occupations involving repetitive bending have a higher risk factor for lumbar OA; lumbar facets also provide a posterior load-bearing helper and so lifting of heavy objects will also constitute a risk (Kalichman and Hunter 2007). Fujiwara et al (2000) in a cadaveric study found that female spinal segments showed statistically significantly greater motion in lateral bending, flexion, and extension, but not in axial rotation, than male segments; males and females in the study were of a similar age, grade of disc degeneration, cartilage degeneration, and osteophytes formation. However, recent imaging studies found no sex difference in the prevalence of lumbar facet joint OA (Alperovitch-Najenson 2005; Fujiwara 1999, Kalichman et al 2008) which may suggest that differences are not inherent but environmental; it seems more research is needed in this subject.

Extra-spinal osteoarthritis

In the Hereford assemblage a total of 164 adults exhibited extra-spinal OA (34.6%), of which 93 also had spinal OA. Of the 164 adults, 75 were females, 88 were males, and one was an adult of unknown sex. The prevalence of OA in each joint is shown in Table 31. (see Table 31)

Between the sexes, the most significant difference in prevalence of OA is present at the acromioclavicular joint (ACJ), hip, shoulder and knee (Table 32). Males have a higher prevalence of OA at the ACJ and shoulder joints, whereas females have a higher prevalence in the hip and knee.

Epidemiological studies in women suggest that estrogen loss may be accompanied by an increase in the prevalence and incidence of knee and hip OA (Valdes et al 2007; Richette et al 2003). Slightly more females over 45 years were affected (19/35) compared to males (14/27), although of those less than 35 years at death only females exhibited OA in the hip and knee (17.14%, 6/35). Estrogen loss occurs at the time of menopause (occurring at c 40–61 years of age) and therefore those females less than 35 years with knee and hip OA do not fit such an explanation.

OA can develop due to acute joint trauma including articular surface fractures, joint dislocations, and ligament and meniscal ruptures which increase joint instability (Buckwalter and Lane 1997; Honkonen 1995; Hadley et al 1990). Five individuals in the assemblage, including three females and two males exhibited secondary OA due to Legg-Calvé-Perthes disease or slipped capital femoral epiphysis.

Jobs requiring knelling or squatting along with heavy lifting are associated with especially high rates of both knee and hip OA (Felson et al 1991; Coggon et al 1998). Significantly more females (45.61%, 52/114) than males (26.15%, 34/130) exhibited squatting facets in the assemblage, and of the females affected by OA of the knee or hip 25% also had squatting facets (9/36; only 6.45% males with knee/hip OA also had squatting facets).

The acromioclavicular joint was significantly more common in males and had a significantly different distribution by age between the sexes. Only older adult females were affected, whereas of the males affected, the majority (47.83%, 11/23) were aged 35–45 years at death and a further three male individuals were younger including two younger-middle and one younger adult. OA of this joint is often found in association with rotator cuff disease (RCD), but also occurs commonly on its own (ref); four males in the assemblage exhibited both OA of the ACJ and RCD. Potential risk factors for OA of the ACJ include Injury to the joint (today a high prevalence is found in collision sports) or weight lifting (Burbank et al 2008).

The gleno-humeral joint (shoulder) is affected to a lesser extent than the ACJ, and affected individuals 35 years and older; in both sexes the majority were aged 35–45 years. In patients younger than 40 years, gleno-humeral instability generally presents with a history of dislocation or subluxation events (ibid), although certain occupations, such as heavy construction or overhead sports, are also risk factors (Millett et al 2008).

Overall, 45.99% (218/474) of the Hereford population exhibited OA which is higher than the mean for a range of later-medieval

sites at 27.90% (Roberts and Cox 2003, 282), as well as the that at Ipswich Blackfriars (37.92%, 80/211) and Barton (28.28%, 194/686 individuals over 25 years); however at the latter site only eburnation was considered diagnostic which would lower the prevalence. The Hereford prevalence is most similar to and only slightly below the 47.22% (170/360) prevalence at Wharram Percy.

If the primacy of mechanical factors in determining the prevalence of OA and degenerative disc disease at the population level is accepted, then the differences in frequency of the condition illustrate Herefordians had more in common, in terms of lifestyle, with the low status rural people of Wharram Percy than other populations. Furthermore, within the Hereford population individuals in groups C and D were affected to a greater extent by degenerative disc disease (Table 33) and, although OA has a more consistent prevalence, individuals buried in group D had the highest frequency.

8.11.4 Other joint disease

Intervertebral chondrocalcinosis

Chondrocalcinosis means calcification of cartilage (Steinback & Resnick 1996) and this occurred within the intervertebral discs of three individuals in the assemblage. SK 4889, an older-middle female (group C), exhibited chondrocalcinosis in discs T8 to T12 which had caused the vertebrae to fuse together. Vertebral discs T1 to L1 were affected in SK 12383, an adult female (group C), with ankylosis of T10 to L1; and SK 2433, an older adult male (group E), showed involvement of T8 to T12 with no ankylosis. (Illus 82)

Chondrocalcinosis of the intervertebral discs and associated structures may result from a variety of causes (Mays & Dungworth 2009). Minor calcifications are frequent in elderly individuals, however widespread calcification and ankylosis are not characteristic of simple degenerative changes, but rather suggest the presence of some other, systematic disease process (Resnick 1985). The most likely causes of intervertebral chondrocalcinosis in the three skeletons observed in the Hereford assemblage are primary calcium pyrophosphate dihydrate crystal deposition disease (CPPD), primary hydroxyapitite deposition disease (HADD), haemochromatosis and ochondrosis (Mays & Dungworth 2009). Ochondrosis however may be tentatively assumed to be a more consistent diagnosis as in all three individuals extensive calcification of the disc space occurred without accompanying ligamentous ossification – a prominent feature of ochondrosis but not of the other three conditions; SK 2433 exhibited schmorl's nodes which is also a recognised feature of ochondrosis (ibid).

Ochondrosis (or alkaptonuria) is an inherited error of metabolism, permitting the accumulation of homogentistic acid (HA) in connective tissues. HA is deposited in joint cartilage causing a black discolouration and sclerosis of the vertebral end-plates followed by ankylosis (Aufderheide and Rodriguez-Martin 1998, 111). Symptoms usually appear in midlife as a chronic backache due to spinal involvement, pigmentation of the ear or eyelid cartilage can become noticeable and in later life larger joints demonstrate inflammation and osteoarthritis (ibid). SK 2433 had bilateral arthritic changes in his hip joints and SK 12383 had arthritis in the right elbow and left hip, however, in the latter case this was secondary to a slipped capital epiphysis; SK 4889 showed no OA changes which may be due to the slightly younger age of this individual as deposition of pigment usually manifests itself first in the spine.

Diffuse idiopathic skeletal hyperostosis (DISH)

DISH is a progressive ossification of the spinal ligaments, particularly in the thoracic region, which leads to fusion (ankylosis) of the vertebrae body; the intervertebral disc space and facet joints are not affected. The changes have a 'melted candle-wax' appearance and are found only down the right-hand side of the thoracic vertebrae because of the presence of the descending aorta on the left side. Extra-spinal ligaments and tendon insertions also ossify producing spurs and spicules of bone at the sites of entheses. Clinical investigations have demonstrated that the condition is often painless and frequently no symptoms are apparent during the life of an individual affected (Aufderheide and Rodriguez-Martin 1998, 97). The causes of DISH are unknown, however, it had been found in association with a number of other conditions, most notably obesity and late onset (type II) diabetes (Julkunen et al 1971); a degree of inherited predisposition and abnormalities in vitamin A metabolism have also been associated with DISH (Oxenham et al 2006; Abiteboul and Arlet 1985). The current thinking is that DISH is a multi-system hormonal disorder (Denko et al 1994; Rogers and Waldron 2001) and recent studies have established DISH's association with risk factors for stroke and cardiovascular disease, which are similarly related to metabolism (Mader et al 2009; Nobuhiko and Akiyama 2006). (Illus 83)

In the assemblage, DISH was diagnosed by the presence of three or more fused vertebrae with a characteristic DISH morphology (Rogers et al 1987; Julkunen et al 1971). Altogether 22 individuals showed indications of spinal ligamentous ossification consistent with bone formation due to DISH (Table 34). Nine of these individuals meet the criteria for DISH giving a prevalence of 1.8% (of individuals with three or more vertebral bodies). The other 12 skeletons showed an early-stage of the disease where ossification was insufficiently advanced to meet the diagnostic criteria. Of these twelve, two skeletons had only two vertebral bodies fused and the other individuals exhibited characteristic osteophyte formation but without ankylosis.

DISH is more common in males than females and rarely occurs under the age of 40 years. The male dominance is present within the Hereford assemblage and individuals were aged above 35+ years at death. Considering the differing burial groups, from Table 35 it can be seen that the highest frequency of DISH was present within burial group E. A survey by Roberts and Cox (2003) found that there was a rise in the prevalence of DISH through time. Furthermore, while those most affected in the medieval period were from monastic sites (Rogers and Waldron 2001) in the post-medieval period they were the middle classes (eg Spitalfield – Molleson and Cox 1993).

Gout

Gout is a condition which can affect the skeleton as a result of high levels of uric acid in the blood (Hyperuricemia) allowing deposition of uric acid crystals within joints and associated tissues and initiating an inflammatory response (Rogers and Waldron 1995, 78). It is associated with alcohol consumption, obesity, a genetic predisposition, or impaired renal excretion of uric acid (Chen and Schumacher 2008). Acute gout is characterized by severe joint

pain, after which, if chronic gout develops the collection of urate crystals and inflammatory tissue form trophi which erode the areas in and around the joints; the erosions have a punched-out appearance, sclerotic border and overhanging edges (Aufderheide and Rodriguez-Martin 1998, 108). Life expectancy is not materially reduced in patients with gout (Talbott and Lilienfeld 1959), however, deposition of urate crystals in the kidneys of individuals with chronic gout can lead to kidney disease, and if untreated, renal failure and death (Talbott and Terplan, 1960).

SK 11805 exhibited a periarticular lesion with sclerotic borders and overhanging edges at the left first metatarsal head (big toe); this is the most common site of gouty changes in the skeleton. This older-middle male buried within a cist represents the only possible case of gout within the Hereford assemblage (1/474 adults – CPR 0.21%). Gout is fairly rare in archaeological skeletal assemblages, however, ten cases were reported at Burton-on-Humbar. (Illus 84)

Sero-negative arthropathies

This is a group of arthropathies (disease of the joints) which have some features in common including the absence of rheumatoid factor (found in patients with Rheumatoid arthritis) and a tendency to spinal involvement, as well as sharing some clinical and genetic features. The sero-negative arthropathies discussed below includes Ankylosing Spondylitis, Psoriatic arthritis and Reiter's syndrome.

Ankylosing Spondylitis (AS)

AS is an inflammatory disorder which leads to progressive fusion of sacro-iliac joints and the spine. The aetiology remains obscure, although research suggests that it has a strong genetic component; 90+% have antigen HLA-B27 (Aufderheide and Rodriguez-Martin 1998, 102). Two skeletons were recorded as possible cases of AS during analysis of the material from Hereford, SK 40205 an older-middle male, and SK 1679 an older adult female. In both individuals the sacro-iliac joints were fused symmetrically with no spinal involvement. Although a number of other conditions could have caused these changes, the symmetrical involvement of this joint is characteristic of AS (Rogers et al 1987) and the sacro-iliac joint has been noted to be the joint at which changes connected with AS are first manifest (Peh 2002). Clinical symptoms recorded for AS sacro-iliac involvement are aching pain in the lower buttocks radiating only into the upper thighs, frequently bilateral and recurring over months or years; if the disease progresses further symptoms include stiffness, deformity and reduced chest expansion (Wilkinson and Bywaters 1958).

Psoriatic arthritis (PA) and Reiter's syndrome (RS)

Psoriatic arthritis (PA) and Reiter's syndrome (RS) are considered together in this section as they exhibit similar skeletal manifestations making diagnosis between the these two sero-negative arthropathies difficult.

Psoriatic arthropathy is a skin disease which affects about 1% of the population of which around 5% develop joint disease (Manchester and Roberts 1995, 159). The causes of the disease are unknown, although like AS it has a genetic factor; 60+% have antigen HLA-B27 (Aufderheide and Rodriguez-Martin 1998, 104). The disease can affect any of the synovial joints, singly or multiply, and usually asymmetrically (Manchester and Roberts 1995, 159). In the severe form of the disease lytic destruction of the fingers and toes, produces a 'cup-and-pencil' deformity and fusion can occur. In 25% of cases sacroiliac and vertebral lesions occur, which are also asymmetrical, including sacroiliitis and spinal syndesmophyte 'skip lesions' (intermittent bony growth attached to a ligament) – both of which cause ankylosis (Aufderheide and Rodriguez-Martin 1998, 104).

Reiter's syndrome (RS, also termed reactive arthritis) consists of non-specific urethritis, conjunctivitis and polyarthritis. RS may arise from gastro-intestinal infections such as Salmonella or Shigella dysentery, or from sexually-acquired infections related to the bacterium Chlamydia trachomatis causing urethritis (Rogers et al 1987; Aufderheide and Rodriguez-Martin 1998, 104). In London in the 19th century 3% of admissions in three of the largest hospitals were due to venereal disease with associated arthritis (Storey and Scott 1998). The skeletal manifestations of this disease in the sacroiliac joint and spinal are similar to PA. Furthermore, asymmetric erosions of joints are also present, however, in most cases few joints are affected and the arthritis is usually less destructive compared to that in PA. The peripheral joints affected are primarily the feet, ankle and knee and fluffy, periosteal, new bone growth may be present on the metacarpals, metatarsals and phalange shafts, around the knee and at tendons and ligaments (Rogers et al 1987).

In the Hereford assemblage two individuals had skeletal manifestations consistent with a diagnosis of PA or RS; the spines of these individuals were unfortunately poorly preserved and therefore are only possible cases. SK 1323, an adult male, exhibited asymmetrical bilateral sacroiliac fusion and syndesmophytes were observed on three thoracic vertebral bodies and the facets of two thoracic vertebrae were fused. SK 5336, an older-middle male, showed ankylosis of five thoracic vertebrae and the facets of T9 and T10 but with no sacroiliac involvement. Both individuals had arthritic changes in several joints, the former in the knee joints and left wrist, and the latter in the left wrist and right hip joint.

An older adult female, SK 1809 (group E), exhibited erosive joint changes unilaterally in the right wrist, left elbow, right hip and left knee. The right wrist showed multiple small irregular erosions with sclerotic margins on the joint surface and periarticular regions (distal radius, distal ulna, lunate, capitate, distal MC2 to MC5). There is eburnation on the distal radius and capitate, the latter has also fused to the base of MC3. Similar periarticular erosions are also present on the distal first MC and corresponding area of its proximal phalange, the latter also shows eburnation. The left elbow of this individual shows eburnation on all three joint surfaces and the ulna exhibits erosions within the joint surface and a large erosive lesion on the lateral periarticular area; anterior subluxation of the radius occurred due to the position of this lesion at the proximal ulna-radius articulation. The right hip exhibits eburnation and two sub-chondral erosions/cysts within the acetabulum. In the left knee the femur joint surface shows subchondral bone erosion and two small deeper erosions similar to that on the wrist. The severity and involvement of the hands is not consistent with RS or an enteropathic arthropathy (Rogers et al 1987; Aufderheide and Rodriguez-Martin 1998, 105). The asymmetrical joint involvement favours a diagnosis of PA rather than Rheumatoid arthritis, however, no characteristic PA spinal syndesmophyte or 'cup-and-pencil' lesions were observed. This individual would have no doubt have experienced pain and disability – the left arm was more gracile than the right and it is likely

that the inflammation and destruction of the cartilage and bone of this joint made it extremely painful preventing use of the arm causing (slight) atrophy of the bones. (Illus 85)

SK 10037, an older-middle female, may also represent a case of PA. She exhibited unilateral erosive changes to the distal joint surface of the left radius and ulna; similar but not as severe as those observed in SK 1809. Unilateral erosive changes were also present at the left proximal joint surface of MC3 and three left proximal interphalangeal joints (PIP). The changes to the latter joints were particularly severe with the distal joint surface of three proximal phalanges being completely eroded. Furthermore, although the spine was poorly preserved it was observed that four thoracic vertebrae exhibited syndesmophyte formation although had not fused (no sacro-iliac joint was present).

SK 4560, a younger-middle female, had bilateral asymmetrical sacroiliitis, ankylosis of the diarthrodial joints of T3–5 with erosions on the inferior facet of T2 and superior facet of T6. Subchondral bone erosions were present on the right calcaneus, talus and cuboid (the only other tarsal present was the left calcaneus) as well as the proximal joint surface of left MT3 (right and left MT4–5 present with no erosions). Furthermore, fluffy new periosteal bone growth was present on the proximal shafts of the left MT3–4 and right MT3–5, on the right calcareous and the right Ilium adjacent to the retro-articular area. The skeletal manifestations described, as well as the absence of involvement of the hands, may represent a possible case of Reiter's syndrome.

Hallus valgus

Hallux Valgus is commonly termed bunions, located at the first metatarsal-phalange joint/s (big toe/s) with the big toe pointing inwards towards the second digit. It is commonly associated with individuals wearing ill-fitting or pointed footwear (Mays 2005). Of those individuals with a first metatarsal bone (MT1) 37 suffered from hallux valgus (37/220). Females had a higher prevalence (18/99 = 18.18%) than males (19/120 = 15.83%) indicating women may have worn more restrictive shoes. The condition was bilateral in 26 cases and unilateral in four and the prevalence increases through time (group A 0/0; group B 1/18; group C 13/95; group D 10/58; group E 13/46).

8.11.5 Trauma

A wide range of traumatic pathological conditions can be observed in the skeleton, which are discussed in the following section. Firstly, certain types of trauma which occur in younger age groups are discussed including a case of Erb's Palsy and Scheuermann's disease as well as cases of Legg-Clavé-Perthes disease and slipped femoral capital epiphysis. Furthermore, spondylolysis can occur in adult age but has a strong genetic component. Fractures are by far the most frequent form of trauma within skeletal assemblages, and the Hereford assemblage is no exception. Soft tissue injuries, in contrast, are relatively rarely detected in the skeleton but occur more frequently in living populations; in the skeleton it can be inferred from the presence of Myositis ossificans traumatica, rotator cuff disease, ossified haematomas and Schmorl's nodes.

Such conditions are important in the study of past populations as the types of trauma suffered will be related to lifestyle and occupation, or a fracture may be due to an underlying pathological condition which highlights the health of the individual.

Brachial Plexus palsy (Erb's Palsy)

An older adult male, SK 2874, exhibited atrophy of the left upper arm, forearm, hand, scapula and clavicle. There was atrophy of the lateral half of the clavicle while the medial half was similar in size to the right. The scapula had an uneven glenoid surface and the acromion and coranoid processes sat lower on the scapula with the coracoid pointing inferiorly. The humeral head is deformed and flattened with an undefined articular surface and the humeral shaft is more gracile and shorter compared to the right one (by 4.99cm). Both the left radius and ulna are also more gracile and shorter than their right counterpart (by 1.1cm and 1.4cm, respectfully). The left radial head had been dislocated in an anterior superior direction shown by a new joint surface on the Humerus, the radial head was deformed and underdeveloped suggesting lack of use and the neck of the proximal radius was bowed posteriorly. The left ulna exhibits the complete absence of a radial notch indicating no articulation occurred at the proximal radio-ulnar joint. The distal ulna shaft is bowed laterally and the distal epiphysis is deformed, with only a partial facet for articulation with the radius. The left wrist and hand appear unaffected. There was asymmetry of the atlas and axis, both of which slope downwards laterally to the right side and the dens (of the axis) also leans to the right side (the unaffected side). There was also asymmetry to the skull with the right occipital appearing more flattened than the left (the effected side being more rounded) and the right mastoid was relatively long and narrow and inferiorly pointing (left incomplete). These features may indicate that this individual suffered from torticollis – a twisted neck in which the head is tipped to one side, while the chin is turned to the other.

The skeletal manifestations are most consistent with a diagnosis of brachial plexus palsy which is caused by damage to the brachial plexus nerves. The combination of the stunted growth of the arm and the deformities of the epiphyses suggests that trauma occurred at an early age in SK 2874, and most probably at birth; obstetrical injury affects 0.19% of live births (Evans-Jones et al 2003). Brachial plexus injuries at birth most commonly occur when the baby's shoulder becomes stuck against its mother's pubic bone (Shoulder dystocia) and in the process of trying to manoeuvre the child out excessive force is applied to the baby's neck and head resulting in stretching and/or tearing of the Brachial Plexus nerves causing paralysis of the upper limb and torticollis (Becker et al 2002). At this age development of flexion contractures at the elbow is common and can be exacerbated by radial head dislocation caused by forced supination – in such instances individuals exhibit the characteristic deformity commonly termed 'waiters tip' (Semel-Concepcion 2009). (Illus 86)

Scheuermann's disease

Scheuermann's disease usually occurs between 12–18 years of age. It is a condition in which osteochondrosis of the apophyseal rings of the vertebral bodies occurs resulting in loss of height at the anterior-superior aspect of at least 5 degrees in three consecutive bodies, commonly leading to kyphosis (Scoles et al 1991). While familial patterns suggestive of a genetic aetiology have been described, traumatic influences are gradually gaining credibility (Aufderheide and Rodriguez-Martin 1998, 87). SK 2098 showed osteochondrosis with destruction of annular rings on the superior bodies of vertebrae T7 to L5 accompanied by anterior wedging and kyphosis consistent with a diagnosis of Scheuermann's disease (Illus 87)

Legg-Calvé-Perthes disease (LCP)

Legg-Calvé-Perthes disease is a disruption of the blood supply to the growing femoral head, which is probably initiated by trauma, resulting in osteonecrosis (bone death) of the femoral head. The femoral head exhibits a 'mushroom-shaped' appearance as it becomes increasingly deformed and severe osteoarthritis is common (Aufderheide and Rodriguez-Martin 1998, 84). It is commonly unilateral, usually occurring between 5 and 9 years of age, and usually resolves spontaneously (Jaffe 1972, 566; Resnick 1995, 3561). Five adult individuals at Hereford Cathedral exhibited skeletal changes consistent with a diagnosis of Legg-Calvé-Perthes disease, in two cases it was unilateral (the rest having no corresponding femur). In total, three females, including two younger-middle and one older-middle adult (SK 2208, SK 3945, SK 5378), as well as two older-middle males (SK 10457, SK 4641) were affected which gives a prevalence rate of 1.15% (5/434) of individuals with a femoral head (or 5/767 total femur heads).

Slipped femoral capital epiphysis

Slipped femoral capital epiphysis occurs during the rapid growth of adolescence, between 8 and 17 years of age (Aufderheide and Rodriguez-Martin 1998, 90). The primary pathology of this lesion is a stress fracture between the metaphyseal side of the growth plate and the neck of the femur, allowing medial posterior and downward displacement of the head of the femur (Ortner 2003, 347). In the skeleton, displacement, irregularities in the proximal end of the femoral neck due to the fracture and a short thick neck reflecting attrition in the fracture area and loss of endochondral growth for varying lengths of time, are diagnostic (ibid). There is some evidence of an underlying genetic factor, but trauma and obesity are clear contributing factors (Resnick et al 1995, 2647). The most frequent complication of this condition is secondary degenerative joint disease whose severity depends on the degree of head displacement.

In the Hereford assemblage, three individuals showed a slipped femoral capital epiphysis, including one older-middle male (SK 4641), one older-middle female (SK 5143) and an adult female (SK 12383). The prevalence for this assemblage is 0.69% of individuals with a femoral head (or 3/767 total femur heads). (Illus 88)

Spondylolysis

Spondylolysis is the separation of the vertebral body from its arch, usually through the pars interauricularis. This separation is thought to be the result of a stress fracture due to repeated microtrauma from hyperflexation of the lumbar spine with simultaneous extension of the knee (Stewart 1953; Bone 2004). However, a strong genetic component also seems to play a role in its development increasing the risk of arch failure (Turkel 1989). The condition is usually bilateral and most commonly affects the fifth lumbar vertebra. In most cases it is asymptomatic (Logrosino et al 2001), however, if the affected vertebra body slips forwards on the one below (spondylolisthesis) then the individual may suffer back pain as a result.

Eighteen skeletons at Hereford were found with spondylolysis, including seven males, eight females, one adult of unknown sex and one adolescent. Only one individual had two vertebrae affected (L5 and L4), and in all but one case the condition was present in the lumbar spine; female SK 5107 exhibited cervical spondylolysis which is a relatively rare occurrence (Forsberg et al 1990). In 13 vertebrae the condition was bilateral, in five it was unilateral and in one case only one side of the arch was observable. The prevalence of spondylolysis has been reported in 3–7% of modern Caucasian populations (Resnick and Niwayama 1988), at Barton the CPR for adult was 3.8% (47 adults) and at Wharram Percy the prevalence of adults with at least one lumbar neural arch present for observation was 10%. In the Hereford assemblage, using only the adult cohort for comparison purposes the CPR was 3.59% (17/474) and using only those adults with their lumbar vertebrae affected, 3.70% (16/432) out of those with at least one lumbar neural arch present. The Hereford assemblage corresponds well with modern prevalences and is much lower than that at Wharram Percy.

As there is a strong genetic component these skeletons were plotted – one cluster of three skeletons buried directly over one another was observed in area one. SK 5080, SK 2550 and SK 3231 may represent a family group. (see Table 36 and Illus 89)

Fractures

A total of 162 individuals showed fractured bones, including 103 males, 56 females, one unsexed adult and two sub-adults (see Table 37). In total, 38.01% of males and 28.14% of females were affected – a higher prevalence of males with a fracture compared to females is a feature of all the comparative assemblages and suggests that males were more at risk of fracture in the past. The difference is more pronounced in groups B and E (see Table 41), but only in the latter post-medieval group was there a statistically significant difference between the sexes ($x2 = 6.54$, $p = 0.01$).

Only two sub-adult individuals exhibited fractures both healed by the time of death and include an adolescent (SK 40248, group C) with a colles' fracture of the radius, due to a fall onto an outstretched arm, and one older child (SK 10302, group C) with a fracture to the styloid process of the temporal bone of the skull. The styloid process of temporal bone is a slender projection attached to base of the skull and extends downwards and forwards; it lies deep in the wall of the pharynx in the region of the tonsillar fossa between the internal and external carotid arteries. Such a fracture is most often caused by blunt trauma of a serious nature (McCorkell 1985) and pain secondary to fracture of this process is called traumatic Eagle's syndrome (Eagle 1958). Patients with fracture of the process may have a variety of signs and symptoms including pain and swelling in the pharyngeal, tonsillar and perimandibular areas, difficulty swallowing, problems in mouth opening, pain on turning the head, pain in the ear, tinnitus, and headaches (Smith and Cherry 1988; Carro and Nunez 1995). The relatively small number of fractures observed in children may be due to particularly good remodelling of young bones, often causing complete obliteration of the fracture (Roberts 2000, 345; Wakely 1996, 81). (see Table 37)

Seven adult individuals exhibited cranial injuries described in Table 38; four had injuries located on their frontal bone and three on a parietal bone (7/443 individuals with a frontal or parietal bone). All individuals exhibited blunt force trauma with the exception of SK 10601 who had a healed linear wound on his right frontal bone which was likely caused by an edged weapon of some kind. SK 10440 was the only individual to have more than one injury with a depression fracture on his left frontal and right parietal bones. The majority of individuals with cranial trauma were males, interestingly, however, the older-middle female from burial group D (SK 3251)

also exhibited multiple post-cranial trauma including two parry fractures and multiple haematomas. The parry fracture of the ulna (Merbs, 1989; Jurmain, 1991; Webb, 1995) is usually associated with a defensive movement of raising the arm to fend off a blow but it may occur when someone falls on the arm or tries to protect the body against a falling heavy object. The presence of cranial trauma, parry fractures and multiple haematomas indicating blunt force trauma may indicate this individual was a victim of violence. Butler's (2007) study of later-medieval ecclesiastical and criminal court records (from Essex and York) found that domestic violence was considered justified but there were efforts to limit it – the court employed strategies ranging from public humiliation, floggings, and fines to involving the community to correct the abusive spouse while preserving the marriage. (see Table 38 and Illus 90–91)

The most common location, by far, for a fracture in the adults was in the vertebrae, as is clear from Table 39 and Chart 9. In total there were 160 vertebral fractures, with all but three, being compression fractures to the vertebral bodies. Vertebral compression fractures usually result from forced spinal flexion or from vertical compression of the spinal column ie from a fall on the buttocks or blow to the head. Table 40 shows that vertebral compression fractures were more common in males than females and that both sexes were affected to a greater extent in the lumbar and thoracic regions of the spine. It is likely that some of these fractures in older adults are secondary to the vertebrae being weakened by osteoporosis and one individual (SK 4486) by neoplastic disease. In ten individuals (12.05%) compression fractures were severe and/or multiple enough to produce a spinal deformity. Nine individuals (two older females, three older males, three older-middle males and one younger-middle male) exhibited mild to moderate kyphosis, which is an anterior curvature of the spine so the affected individual bends forwards (Ortner 2003, 463) and one individual (older-middle male) had a lateral curvature of his spine (scoliosis). (see Table 40 and Illus 92)

The other fractures found in the spine consisted of three male individuals (burial group C) who had each exhibited a fracture to the spinous process of a thoracic vertebrae; only the spine of SK 10440 was well-enough preserved to determine which vertebrae was affected, which was the first thoracic vertebrae. In two of the individuals (SK 10440, SK 30278) the fractures were well-healed, however, in SK 30220 the bones were un-united at the time of death. This fracture is termed a Clay-shoveller's fracture as it is caused by an overload on the spinous process due to forceful muscular action which has been widely associated with work involving shovelling especially in heavy soils (Knusel et al 1996); drift geology in Herefordshire contains large proportion of heavy bolder clay deposits (along with sand and gravel; Bloodworth et al 1999). Clay quarrying from areas with a river no doubt provided the raw resource for the brick and tile making industries in northern Herefordshire.(see Illus 93)

The second most commonly fractured bones were the ribs with 36 males and 8 females affected; this was the only statistically significantly difference between the sexes in anatomical site affected ($x2 = 8.90$, $p = 0.003$). Of the males, 19 had more than one bone broken: the maximum amount of broken ribs seen in one individual was nine with SK 10457 and SK 5347 both displaying nine rib fractures each. Rib fractures are generally caused by a direct impact, such as a fall against a hard object, or, when multiple, by a crushing injury to the chest. They may also be a result of brawls, usually from a kick when the individual is on the floor, which is more likely to involve male individuals (Sirmali et al 2003); interestingly there were three males (4 fractures), in the assemblage who exhibited boxer's fractures – which is a fracture of the proximal or distal extremity of a metacarpal bone of the hand.

The majority of rib fractures were well-healed at the time of death, however four male individuals, including the latter two skeletons mentioned above, had ribs which exhibited differing stages of healing indicating that more than one episode of trauma occurred. Also in total, these four individuals plus two female individuals exhibited rib fractures which were in the early stages of healing and implying the injury occurred relatively shortly before death (un-united ends with callus or woven bone spicules present). Of these individuals, one female, SK 31645, had a rib fracture possibly associated with osteomalacia. The other female, SK 11116, was the only individual who presented with a commuted rib fracture which was most likely due to direct impact. One mid-rib exhibited a rectangular 'hole' (6.91x3.77mm) on ventral surface, a small amount of woven bone was present around its edges, and radiating fracture lines indicated a commuted fracture in which fragment/s had been lost post-mortem – this individual died approximately one week after the injury occurred. (see Illus 94)

An older adult from burial group B, SK 5347, is of note as along with his nine dorsally located rib fractures, he also sustained a commuted fracture to the right scapula body as well as a fibular fracture. The scapula had been pushed anteriorly and an irregular 'hole' was present in the bone close to the lateral border which exhibited rounded remodelled margins and therefore healed; the hole measured 20mm superio-inferiorly but the medial-lateral extent was unknown due to post-mortem damage. The fracture to the right proximal fibular shaft was also healed by time of death. The location of the rib fractures and the scapula fracture could represent a backwards fall from height with penetration of the scapula by a hard object. (see Illus 95)

Another male, an older adult from group E (SK 5615), exhibited the only fracture to the pelvic bone consisting of a commuted fracture to the left acetabulum (the socket of the hip). A large central triangular fragment/s of the acetabulum is missing and the remaining hole has irregular but well-healed margins. This fracture caused infection (osteomyelitis) around the fracture site, plus secondary osteoarthritic changes to the hip joint (both acetabulum and femoral head exhibit eburnation). Acetabular fractures either occur with high-velocity trauma eg auto collisions in modern populations or falls when the head of the femur is driven into the pelvis or as an insufficiency fracture due to weakened bone as a result of osteoporosis in older adults; the healed nature of this fracture means that it is not possible to know what age this individual was when the fracture occurred.

Overall, males exhibited fractures at a wider range of anatomical sites compared to females. Females tended to exhibited more fractures to their forearms and lower legs than males. The most common arm fracture in both sexes was a colles' fracture – a fracture of the distal radius with dorsal (posterior) displacement of the wrist and hand. The fracture is most commonly caused by people falling onto a hard surface and breaking their fall with outstretched arms;

it is also often associated with osteoporosis (see below). In the ulna Parry (mid-shaft) fractures were the most common type; three female (SK5133, SK 5186, SK 3251) and three male (SK 4237, SK 2609, SK 3053) individuals were affected. In one female (SK 5186) and one male (SK 2533) both the forearm bones were fractured at the mid-shaft position exhibiting spiral fractures indicating a twisting force was involved; in modern times this type of fracture is associated with skiing accidents, in which the lower leg is rigidly fixed and the body twists during a fall (Ortner 2003, 122). (see Illus 96)

In the lower leg the most common site for a fracture in females was the distal fibula and in males was the proximal fibula. In one female and one male a compression fracture of the tibial plateau was observed. The left tibial plateau of SK 10400 and SK 3032 exhibited healed fractures, the former had a healed split fracture of the lateral compartment with the posterior section being depressed and the latter a medial-anterior compression of the plateau (without a split in the proximal tibia). Fractures of the tibial plateau are frequently associated with soft tissue injuries including the ligaments within and without the knee joint (Bennett and Browner 1994). (see Illus 97)

Within the Hereford population individuals in burial group B most frequently suffered from a fracture (Table 41). Through time in males there is a significant drop in fracture prevalence from the medieval groups A–C to the late-medieval/early post-medieval individuals in group D ($x2= 8.64$, $p= 0.003$). In the females, when groups A–C are combined there is a decline in fracture rate through time with a significant difference between the medieval and later post-medieval period ($x2 = 6.65$, $p= 0.009$). (see Table 41)

At Hereford 33.76% (160/474) of adults showed one or more fracture, and in total 0.92% (339/37004) of bones were fractured. The CPR is higher than the canons and wealthy lay at St Andrews Fishergate (65/309 = 21.04%), and the rural populations from Wharram Percy (69/360 = 19.2%; 162/28799 of bones = 0.6%) and Barton-on-Humbar (150/1938 = 7.74%, 15+years).

At St Helens-on-the-wall the prevalence of individuals with one or more long bone shaft fracture (excluding clavicles) was recorded resulting in a prevalence of 4.4% for adults (30/685; Grauer and Roberts 1996). The comparable prevalence at Hereford is 9.6% (45/467; 10.5% including clavicles) so individuals at Hereford also sustained more fractures than low status urban dwellers. Judd and Roberts (1999) found that long-bone fractures were more frequent among rural versus urban medieval groups, they use a denominator including all complete bones plus any incomplete one that show fractures. The recalculated Hereford prevalence using this denominator gives 12.44% (49/394) of individuals affected and 2.95% (55/1864) of bones. This is higher than the range given for urban sites of 4.7% to 5.5%, and fits between the prevalence's for the two rural sites analysed including Jarrow Abbey, with a 10.7% by individual and a 2.2% by bone, and Raunds at 19.4% and 3.5% respectively. Overall, the comparison suggests that Hereford adults exhibited a relatively high rate of fractures in general especially considering it was an urban centre.

Blade injuries

Apart from SK 10601 described above, an older-middle female from burial group C, SK 10400, showed evidence of injuries produced by an edged weapon. The distal ends of her right radius and ulna displayed evidence of angular cut-marks sloping medial to lateral indicating that her forearm had been severed just above the wrist. The ends of both bones were healed by the time of death, but there is evidence that the wound was repeatedly infected with both healed and active infection (periostitis) present around the distal bone shafts; the humerus also exhibited active infection which was possibly related. This individual also had a fracture of her left tibial plateau. (see Illus 98)

Dislocation

Seven individuals showed evidence of a dislocated joint and one partial dislocation (subluxation) described in Table 42. The number of individuals observed with dislocations does not represent the true prevalence within the population as most dislocations will have been reduced promptly leaving no skeletal indicators – it is only untreated prolonged dislocation which can be identified skeletally as a new joint surface will be formed.

Three individuals exhibited dislocation of the temporo-mandibular joint (TMJ); the TMJ is the articulation of the lower jaw and the base of the skull. All individuals exhibited an anterior dislocation, which is the most common type of temporo-mandibular joint dislocation, and may result from excess mouth opening in the case of yawning, laughing, taking a large bite, seizure, or intraoral procedures such as tooth extraction (Ardehali et al 2009).

SK 3085 dislocated her left hip in a posterior-superior direction, shown by the presence of a new joint surface on the ilium. However, the absence of the acetabulum and leg bones of this skeleton means that it is unclear whether this was the result of congenital or traumatic causes. Both SK 30141 and SK 2874 exhibited a dislocation of the radial head which is one of the most frequently recorded dislocations in later-medieval assemblages (Roberts and Cox 2003, 238); in the case of SK 2874 the dislocation is associated with Erb's Palsy. (see Table 42 and Illus 99)

Myositis ossificans traumatica (MOT)

Myositis ossificans traumatica (MOT) is an exuberant ossification in muscle tissue at the site of attachment due to muscle trauma (Ortner 2003, 134). 24 individuals at Hereford exhibited MOT (CPR = 3.38%), all individuals were adults and the vast majority showed trauma to the muscles or ligaments of their legs. Of those individuals with MOT, the medial collateral ligament, as well as the anterior distal tibiofibular ligament were most frequently affected (Table 44). The medial collateral ligament (MCL) is one of the four main ligaments critical for stabilisation of the knee. The MCL is located on the inside (medial) section of the knee joint, and the ligament is usually injured when the outside of the knee is struck causing it to buckle and the inside to widen and if the MCL is stretched too far, it is susceptible to tearing and injury (Singhal et al 2009). The anterior inferior tibiofibular ligament is one of the lateral ligaments that helps to stabilize the fibula and tibia at the ankle joint, and is the most commonly injured ligament in a sprained ankle usually when a plantar-flexed foot (eg standing on tiptoes or when pressing down a car pedal) is forcefully inverted (Takao 2003). (see Tables 43–44 and Illus 100)

Rotator cuff disease (RCD)

Rotator cuff disease (RCD) is damage to the supraspinatus, infraspinatus, teres minor and subscapularis muscles; these four

muscles act as rotators of the humerus and the combined tendinous structure around the shoulder joint is referred to as the rotator cuff. Rotator cuff disease is a frequent cause of shoulder pain and is linked to degenerative causes as the prevalence increases markedly with age, however, studies also report an association with repetitive heavy use of the shoulder complex (Hagberg and Wegman, 1987; Park et al 1994). Skeletal changes of RCD are seen at the insertions of the rotator cuff muscles which exhibit pitting, alteration in the normal bone contour, and the presence of enthesophytes (new bone formation). Sixteen individuals showed skeletal changes consistent with rotator cuff disease, of which eight had a bilateral expression; the prevalence of RCD was 4.05% (16/395 individuals with rotator cuff inserts observable). Five females and eleven males were affected and prevalence increased with age as expected; all individuals were aged over 35 years of age with the exception of one male younger adult. The right shoulder was affected to a greater extent than the left, with the former having a prevalence of 4.14% (13/314) and the latter 3.50% (11/314). Of the inserts affected, the subscapularis muscle insertion most commonly showed diagnostic changes (21/24 inserts observed), followed by the suprascapularis (17/24), with the infraspinatus (8/24) and the teres minor being the least affected (2/24).

Subperiosteal hematoma

Blunt trauma, most commonly to the anterior tibial surface, will frequently generate a subperiosteal hematoma (localized collection of blood) that subsequently is almost invariably ossified by the overlying periosteum (Aufderheide and Rodriguez-Martin 1998, 27); although such changes can also occur in adult cases of healed scurvy (ref). Seven individuals exhibited localized sharply demarcated oval bone lesions which best fit a diagnosis of ossified hematoma. Most lesions were present on the tibiae (6/639 total tibiae) but some were also located on the femur (4/812 total femora). Individuals mostly presented with a single lesion, although SK 2857 had one on each tibia and SK 3251 had one each on both femurs and one on the right tibia; the latter individual also had multiple fractures described above.

Osteochondritis dissecans

Osteochondritis dissecans is a benign, non-inflammatory condition of young adults characterized by a small area of focal necrosis on the epiphyseal surface, resulting in partial or complete detachment of a segment of bone on the convex articular surface. It is thought that the most likely origin of the lesion is some kind of trauma, particularly repeated, low-grade chronic or micro-trauma, that results in a transchondral fracture (Yadao et al 2004). 63 individuals were noted with the lesion, including 20 females, 36 males and seven sub-adults. Of the joint surfaces affected, the most common was the distal Humerus (8/62) and the proximal metatarsals (7), the distal tibia (6) and the medial clavicle (6). Table 44 shows slightly more males are affected than females, which is the case in modern populations (Aufderheide and Rodriguez-Martin 1998, 82), and the condition is more prevalent in individuals buried in group D. (Illus 101)

Schmorl's nodes

Repetitive or acute excessive spinal compression, such as might result from heavy lifting, may cause a rupture of the intervertebral disc. The resulting pressure causes a dent in the vertebral body termed a Schmorl's node. The presence of a Schmorl's node may be associated with pain but is usually asymptomatic (Hamanishi et al 1994).

In the adults, 230 were affected by a Schmorl's node, including 151 males and 79 females, giving a prevalence of 50.12% (230/459) of adults with one or more vertebra present. Furthermore, nine adolescent individuals exhibited nodes on 43 vertebral bodies. Table 45 shows that the thoracic vertebrae were most commonly affected and the cervical vertebrae were not affected at all. Of the adults males were affected to a greater extent than female individuals, although this difference was not statistically significant ($x2= 3.94$, $p=0.05$). The prevalence by group is shown in Table 46 shows that were all affected to a similar extent, although females had a peak in group C (and group A although figures are low) and males in group E. (Illus 102)

Intervertebral osteochondrosis

Intervertebral osteochondrosis is a rugged crescent-shaped lesion at the anterior part of the vertebral body surface (Kelley 1982). Comparable to Schmorl's nodes, intervertebral osteochondrosis is probably caused by stress resulting in herniation of the disc and has been found in populations with more physically arduous lifestyles (ibid). In the Hereford assemblage 31 adults exhibited intervertebral osteochondrosis in 37 thoracic vertebrae and 12 lumbar; a prevalence of 6.75% of adult individuals with at least one vertebra and 0.52% of adult vertebral bodies.

Anterior vertebral body erosions

In the lower thoracic and lumbar vertebra several individuals exhibited erosions of the vertebral body at the superior-anterior region of either one or two vertebrae which are not consistent with osteochondrosis. Individuals affected included two younger-middle males (SK 31470, SK 40198), one younger-middle female (SK 40300) and a younger adult female (SK 2883) all from burial group C, as well as one younger-middle female from group D (SK 31003). They are considered most likely to be the result of anterior herniation of the intervertebral disc due to trauma, termed limbus vertebra (Schmorl and Junghanns 1971). These lesions have been observed more frequently in athletes than non-athletes (Hellstrom et al 1990; Sward et al 1993) and most consider that overload of the spine in flexion is the most probable cause (Greene et al 1985; Mandell et al 1993). Differential diagnosis includes avulsion of the bone at the attachment of the annulus to the vertebral rim margin, due to excessive tensile force. This diagnosis, however, is less likely as the bone flake detached is characteristically rather small, less than 5mm in width, and in these five individuals the erosions are more varied in size and larger – like those seen in traumatic anterior disc herniation (Mays 2007). Erosions of the anterior-superior vertebral body are also known as Pons' sign and have been used to diagnose Brucellosis in skeletal material which is a zoonotic disease (Capasso 1999; Anderson 2003) – 'The location and appearance of this lesion is consistent both with brucellar epiphysitis and with traumatic anterior disc herniation' (Mays 2007, 115). However, no individuals in the Hereford assemblage show more advanced brucellar skeletal lesions, which is curious considering that in the absence of effective treatment, the frequency of advanced bone destruction and involvement of multiple skeletal sites might be expected to be greater than in recent populations (Bosilkovski et al 2004). The lack of variation of the erosions observed also argues against interpreting them as a manifestation of a systematic infectious disease (Mays 2007) and furthermore, four of the five individuals exhibited other spinal trauma including schmorl's nodes and/or compression fractures of the vertebral bodies indicating a traumatic aetiology may be more likely, however brucellosis remains a possibility. (see Illus 103)

8.11.6 Infectious disease

Most of the infections that affected the population would have left no skeletal evidence, either because the infection was of the soft tissue or the gut, or because the individual died early in the course of the disease before skeletal manifestations occurred. Infection observed can be classified as non-specific or specific, the latter is much rarer and it is the morphology and distribution of lesions in the skeleton that permit identification of a particular disease eg leprosy.

Periostitis

Periostitis is an inflammation of the periosteum and causes new bone formation on the cortical surface of the bone. It is generally taken as an indication of bone infection in archaeological material (Ortner 2003), however, conditions other than bone infection which may stimulate periosteal new bone formation include trauma, bleeding, some forms of bone cancer and hypertrophic osteoarthropathy.

In four bones (a right ulna, a right radius, and two left fibulae) periostitis was secondary to fracture and in SK 10400 as a result of a blade injury.

A total of 213 individuals showed non-specific periostitis, including 96 males, 67 females, three adults of unknown sex and 45 sub-adults. Of the bones affected 36.16% (175/484) exhibited active periostitis and the rest showed remodelled (healed) lesions. The prevalence by bone is shown in Table 47.

The most frequent site of non-specific infection was the lower leg, with 137 of the 216 individuals showing periostitis having tibial and/or fibular lesions (63.43%). The tibia lying close to the skin surface is vulnerable to infection, ulceration and undergoes minor injury more frequently (Roberts and Manchester 1993); the latter explanation corresponds with the evidence that MOT was most common in the tibiofibular ligaments and legs in general (see above).

Forty-seven individuals had periostitis on the visceral surface of the ribs, and although there are a number of differential diagnosis (Matos and Santos 2006), the lesions in these individuals are likely to represent a bony response to underlying pleuro-pulmonary infection (Roberts et al 1998). Visceral rib lesions have been found to be more frequent in tuberculosis than in other respiratory diseases (ibid, Roberts et al 1994). (see Illus 104)

Overall, non-specific periostitis affected 29.86% of the population at Hereford (same prevalence by individual if endocranial new bone formation is included – see below). This prevalence was higher than the vast majority of comparative sites, and lay closest to and in between the prevalences of St Helens-on-the-wall at 21.5% (128/1014 – Grauer 1993), St Andrew's Fishergate at 23.98% (59/402) and Fishergate House at 41.8% (102/244); the latter assemblage having the only prevalence higher than that found at Hereford. This suggests that non-specific infection in Hereford is consistent with other contemporaneous urban centres, although at the higher end of the scale. A greater pathogen load in urban environments (versus rural eg Wharram Percy 8.44%, 58/710) no doubt reflects the unhygienic and crowded conditions of medieval towns and cities.

Endocranial lesions

A total of 20 individuals exhibited endocranial lesions which are the result of inflammation or haemorrhage of the meninges but their exact aetiology is unknown; they have been associated with trauma, primary and secondary infections of the meninges, tumours, TB, syphilis and vitamin deficiencies (Lewis 2004). Nine individuals had endocranial new bone formation, of which four had vascular impressions indicative of healed lesions (ibid), however a further eleven individuals had lesions of a differing type, shown in Table 48.

Three adults exhibited lesions but the majority were sub-adults (17 individuals), the prevalence in the latter group of 11.04% (17/154 individuals with skulls) is similar to that found at St Helen-on-the-Walls of 12% (11/92). Most individuals only had a lesion on a single bone including twelve individuals with lesions on the occipital and four individuals with a parietal bone affected. Four individuals had more than one bone involved including SK 5637 (older adult female) with the occipital, right temporal and frontal bones affected by 'hair-on-end' lesions, SK 5061 (older child) had capillary lesions on both parietal and the occipital, SK 12093 (younger child) had capillary lesions on the occipital and woven bone formation on the right temporal, and lastly, SK 31490 (adolescent) exhibited woven bone formation on the occipital, both parietals, both temporal bones and the frontal bone. (see Illus 105)

Hypertrophic osteoarthropathy (HPO)

Three individuals may represent possible cases of hypertrophic osteoarthropathy (HPO). HPO causes clubbing of the hands and feet, joint inflammation, and diffuse sub-periosteal bone deposition (Mays 2002). In the skeleton, however, only the latter criterion usually manifests itself and therefore is observable for diagnosis. Typically, there is sub-periosteal new bone deposition without endosteal changes, the lesions are widespread and show left-right symmetry in paired elements, lesions tend to occur more commonly in the large and small trabecular bones of the appendicular skeleton and are most pronounced in those distal to the elbow and knee (ibid). The lesions on SK2323 an older adult female, SK 5286 a younger-middle male and possibly SK 2654 an adolescent fit best with a diagnosis of HPO when considering differential diagnosis (ibid). All individuals had a disease process that was active at the time of death; in SK 2323 and SK 2654 deposits consisted of woven bone only, although in the tibiae and fibulae of SK 5286 there is both woven and remodelled bone deposits present. Involvement of the ilia (SK 2323) and ribs (SK 5286 and SK 2654) is less typical, although changes here may occur in more advanced cases (Gall et al 1952; Ali et al 1980). HPO has both a primary (pachydermoperiostosis) and secondary form. Primary HPO is rare (3–5% of all cases of HPO) and is genetically transmitted usually with accompanying skin lesions, and although the secondary form has been related to a variety of diseases, intrathoracic cancer, particularly primary lung cancer, is the most common cause (Lax et al 1981; Resnick and Niwayama 1988). The adolescent age (16–18 years) of SK 2654 may indicate primary HPO, however, the ages of SK 2323 (48–55 years) and SK 5286 (30–34 years) makes the secondary form of the disease a more likely diagnosis. Interestingly, tuberculosis caused 22% of secondary HPO in the mid-20th century (Locke 1915) and new bone formation is present on the ribs of SK 5286 (unilateral) and SK 2654 (no left ribs) suggestive of a chronic pulmonary infection (see above). However, none of these three individuals showed any skeletal lesions associated with a diagnosis of TB. Few cases of HPO in skeletal assemblages have been reported, although five individuals from Wharram Percy were diagnosed as having HPO. (see Illus 106)

Ostitis

In Periostitis, the bone immediately below the periosteum is affected but in Ostitis the compact bone (cortex) of skeletal elements is involved in the infection (Roberts and Manchester 1995, 168). Three individuals exhibited ostitis including SK 30949 an adolescent with the right ulna affected, the left radius of SK 3189 an adult female was involved as well as the right tibia of SK 4602 older-middle female (right tibia); this gives an overall CPR of 0.42%.

Osteomyelitis

Osteomyelitis is an infection of the bone and the bone marrow resulting in inflammatory destruction of the bone. Many organisms may cause osteomyelitis but the majority of cases are caused by Staphylococcus aureus which is a pus-producing bacterium which predominately causes localized skin infections such as boils (Ortner 2003, 181; Waldron 2009, 85). There are three ways in which the infecting organisms can reach the skeleton: by spreading through the blood steam from an infection elsewhere (haematogenous spread), by direct extension from adjacent soft tissue, or by direct infection through traumatic wounds. The infected bone may swell and new bone is laid down by the periosteum. A thick collar around the bone may be formed which is known as an involucrum or pieces of the bone may suffer ischemic necrosis forming a sequestrum (an area of necrotic bone surrounded by living bone) that may separate from the rest of the bone. Furthermore, cloacae are formed in the bone; these are channels through which pus drains from the infected bone, with drainage continuing through sinuses which are formed in the overlying soft tissue. Osteomyelitis can persist for years as there was no cure for the disease until the advent of antibiotics; many underwent amputation of the affected area as several complications could occur including malignant change in the tract of the sinus, deposition of amyloid in the kidney or the spread of infection to other organs eg the brain or meninges, which would all be fatal (Waldron 2009, 86).

In the Hereford assemblages seven individuals exhibited diagnostic skeletal changes of osteomyelitis. In five cases the long bones were affected and in the remaining two cases the ribs (SK 4993) and pelvis (SK 5615) were affected. All individuals affected were adults, with an equal no of males and females. In two individuals, the pelvis of SK 5615 and the right tibia of SK 30722, osteomyelitic infection was probably a result of compound (open) fractures which allowed direct contamination of the bone by bacteria. SK 11031 exhibited osteomyelitis in his left distal femur and proximal tibia; post-mortem damage prevented the observation of the joint however if infection had spread to the joint (septic arthritis) ankylosis would have occurred. SK 11031 was the only named individual in the assemblage, his name was Thomas Skyrme and he died 'after a long and painful illness' (Hereford Journal, 1831). This evidence may infer that he suffered from a more generalized bacterial infection only secondarily affecting the bone (through haematogenous spread). (see Illus 107)

Maxillary sinusitis

The maxillary sinuses are located in the area of the upper jaw below the eye sockets and behind the cheekbone. Inflammation occurs as a result of infection in the throat, ear, chest or sinuses themselves (Roberts and Manchester 1995) and can cause pain and pressure in the upper jaw and cheeks, mucus formation and headaches (Melen et al 1986). In the skeleton chronic sinusitis can be inferred by the presence of new bone formation within the sinus cavities. Smoke, dust and environmental pollution can lead to sinusitis; urban sites have a higher incidence of the disease and it is thought to be due to atmospheric pollution in industrial cities and towns (Roberts et al 1998). The true prevalence of such infections is difficult to calculate as new bone will only be visible if the facial bones and sinuses are broken or if radiography or endoscopy are used; neither of the latter two investigative techniques were undertaken on the Hereford assemblage. (see Illus 108)

Forty-two individuals from Hereford Cathedral had evidence for chronic maxillary sinus infection. 44 sub-adult individuals had a sinus to observe and six showed new bone formation in their sinuses including one older child (1/10 OC with 1+ sinus) and five adolescents (5/13 AO with 1+ sinus). In the adult population 20% (36/180) of individuals with one or more sinus observable showed maxillary sinusitis. The maxillary sinuses may become infected by dental disease, and more specifically, by the perforation of the sinus by a dental abscess of the upper jaw (Roberts and Manchester 1995, 176). Such dentally induced sinusitis was found to be the likely cause in three females, three males and an older child.

More females than males were affected with prevalences of 27.78% (20/72) and 14.81% (16/108) respectively; the difference is not statistically significantly ($x2= 4.54$, $p= 0.04$). In the past if women spent more time in their homes than men, at open hearths in the smoky ill-ventilated houses, it would make females more susceptible to this chronic infection. There was a clear difference in the prevalence between the sexes at the urban site of St Helen-on-the-Walls as opposed to the rural site of Wharram Percy which might reflect smoke pollution from urban industry (Roberts and Cox 2003, 233).

The total prevalence of 18.75% of individuals affected (42/224 individuals with 1+ sinus) is relatively low compared to St Helen-on-the–walls where 71.93% (82/114) of individuals had maxillary sinusitis and 50.89% of individuals at Wharram Percy (Roberts et al 1998); the latter suggests that even rural environments was not free of predisposing factors. Table 41 shows the prevalence of sinusitis by burial group and a decrease of sinusitis over time is evident; the lack of heavy industry in post-medieval Hereford, as well as, public health improvements may have contributed to this decline (Currie, 1969). (see Table 49)

Discitis

SK 4622, and older adult female from burial group C, exhibited focal erosions in the end plates of two lumbar vertebrae. The superior end-plate of L3 showed a large erosion of the anterior surface, which was sclerotic with some inflammatory changes (post-mortem damage was present in the central region), with course uneven deposits of new bone and pitting. The L2 vertebrae was poorly preserved, however, the inferior surface showed the remains of a similar lesion and bone formation on the central-posterior body.

The vertebrae in this individual were not well preserved and therefore diagnosis is tentative, however, the most likely diagnosis is discitis. Discitis is a special form of osteomyelitis with S. aureus again the most common infectious agent, however, others include Streptococus viridans (IVDU & immunocompromised), Gram negative organisms and Mycobacterium tuberculosis (Jevtic 2004;

Hopkinson et al 2001). This is primarily a disease of adults, with most patients being over 50 years of age at diagnosis, and presenting with severe localised pain at the spinal level (ibid). (see illus 109)

Poliomyelitis

Poliomyelitis is caused by an RNA virus and is most often spread through fecal-oral transmission (Smallman-Raynor and Cliff 2006). The virus implants itself and multiplies in the epithelial lining of the gastrointestinal or respiratory tract. It is characterised in its mild form by flu-like symptoms however if the disease progresses and the infection spreads to the central nervous system paralysis can occur. The motor cells in the spinal cord may be destroyed and the muscles supplied by these nerves become paralysed. The virus can also destroy motor nuclei in the brainstem and cause fatal complications involving breathing and respiration (Pritchard and Alloway 1999). Early descriptions of polio cited a much higher incidence in children, hence the alternative name of infantile paralysis. Paralysis most often occurs in M. tibialis anterior, M. tibialis posterior, and other long muscles of the toes (Sharrard 1955; Ferguson 1933). In children with paralysed limbs, the bones will fail to develop normally and will be shorter and more slender than those of the unaffected limb.

A child aged 9–12 years at death, SK 11860, had marked inequality in the lower limbs which fits best with a diagnosis of poliomyelitis, compared to alternative diagnoses such as trauma or cerebral palsy. The right femur, tibia, fibula and metatarsals are shorter and more gracile than those on the left side (see Illus 110). The right ischium is also slightly smaller than the left and there is a lack of significant muscle attachments on the lower limbs of the right side compared to left. The paralysis of these muscles would clearly impact the ability of this individual to walk normally. Despite the fact that polio is thought to have great antiquity (Major 1954, 43) and was epidemic in historic times, there are relatively few cases in the archaeological record.

Leprosy

Leprosy (or Hansen's disease) is a chronic infectious disease caused by the bacteria Mycobacterium leprae. The disease is not highly infectious, but is believed to spread mainly through respiratory droplets or possibly via prolonged direct contact with ulcers or open wounds in a person with leprosy (Kjellstrom 2012). Leprosy is the only bacterium that can infect nerves – however, the skin, eyes, bone and testes may also be involved in the disease process (ibid). Leprosy is often acquired in childhood and has a long incubation period of c 2–5 years before symptoms occur and there seems to be a sex-specific prevalence where men are affected more often than females (Roberts & Manchester 2005, 194). The disease was possibly brought from eastern Asia to the Mediterranean by the troops of Alexander the Great and it spread on a large scale to Europe during the 4th century BC (Kjellstrom 2012). During the Medieval period, as the disease became endemic in Europe, the awareness of the disorder increased. By the 12th and 13th centuries leprosy hospitals, as a mean of isolation, were established with patients being interred in the hospital cemetery when they died. The hospital of St Giles (1250 A.D.) and the Lazarus hospital of Hereford were for lepers. There was apparently another St Giles Hospital in St Owen Street (1150A.D.) which may also have been for lepers, and the Corporation manuscripts of Hereford contain a notification in 1547 of the appointment of collectors for 'the house of leprous persons founded in the worship of St Anne and St Loye' (Cule 1977). Due to the slow progress of the disease it has been known almost throughout time as the living death; 'Mundo mortuis sis, sed Deo vivas' – be thou dead to the world but alive unto God – was the Mediaeval pronouncement to those diagnosed with leprosy (Roberts & Manchester 2005, 194).

SK 2971 exhibits rhinomaxillary bone changes pathognomic of leprosy (lepromatous form. He has inflammation and destruction of the hard palate which has an extensive pitted and porous appearance. The margins of the pyriform aperture show resorption and remodelling – with the distance between the aperture margins widened and the margins are thickened and rounded. Resorption of the anterior nasal spine and central part of the alveolar bone of the maxilla is present; minor pitting in both areas is indicative of superficial inflammation (Andersen & Manchester 1992). Clinically, this type of erosion results in 'saddle nose' with the sinking and widening of overlying skin and other soft tissues – this extremely obvious soft tissue deformity constitutes one of the major features of a leprosy-sufferer's facial alterations (Aufderheide and Rodriguez-Martin 1998, 144). Post-cranial bone changes in leprosy are the result of sensory loss due to nerve damage resulting in anaesthesia, circulatory disturbances and local pressure leading to resorption of metatarsals and toes as well as the individual being prone to injury and secondary infection with ulcerations, thrombosis and gangrene (Aufderheide and Rodriguez-Martin 1998 152). SK 2971 exhibited bilateral chronic periostitis of the tibiae and fibulae as well as resorption (and tapering) of the distal ends of the right MT2, MT3, of one right proximal phalange (of MT2) and two distal phalanges (of MT1); the latter also have enlarged proximal ends (cupped). The end result of these tissue losses can change these distal extremities into club-shaped stubs (ibid, 145).

Segregation of leprosy sufferers was routine in the 12th century (Clay 1909), however, despite the fact that skeletal changes indicate that facial signs of leprosy would have been clearly visible SK 2971 was buried centrally within Area one. He was one of only two individuals who were buried in a crouched position (the other SK 30544 did not have any signs of leprosy or any infectious disease). (see Illus 111)

8.11.7 Metabolic diseases

Metabolic diseases include rickets and osteomalacia (vitamin D deficiency), scurvy (vitamin C deficiency), gout (excess uric acid), osteoporosis (age related bone loss) and general stress indicators including cribra orbitalia, porotic hyperostosis and enamel hypoplasia.

Rickets

Rickets is caused by a deficiency in vitamin D during infancy and childhood. Vitamin D is obtained predominately by the action of ultra-violet light on precursors in the skin. The lack of vitamin D causes softening of the bones and cessation in cartilage mineralisation. Subsequent skeletal manifestations include bowing of the weight-bearing long bones or arm bones in crawling infants, distortion of the pelvis, vertebrae and sacrum. Furthermore, porous and flared rib ends and long bone metaphyses, cranial porosity (Ortner and Mays 1998), coxa vara and flattening of the bone beneath the femoral head and medial tilting of the distal epiphysis of the tibia can occur (Mays et al 2006). Retardation in growth may be apparent, however, bowing of long bones cannot occur if the growth is very retarded, as some bone growth needs to take place to cause bowing deformities

(Stuart-Macadam 1989, 208). The number of cases of Rickets is unlikely to represent the prevalence in the living population as once a child is exposed to the sun again the condition is rapidly reversible, although some bending deformity may still be evident in adulthood (ibid, 209).

Seven sub-adults exhibited skeletal manifestations which are likely the result of rickets, shown in Table 50 (CPR = 2.97%). In three infants and one younger child the disease was active at the time of death and in one adolescent and two younger children it was healed. Furthermore, three adults also exhibited possible bending deformities associated with residual rickets. It is interesting to note that of those affected, all the sub-adult individuals were from group C and all the adults were in group E.

Rickets is infrequently observed in medieval cemeteries in comparison to post-medieval; there was a great rise in rickets in the 19th century and this is mainly due to the high amounts of urban atmospheric pollution blocking sunlight. Rickets is more prevalent in winter when people spend less time outside, it may be the result of swaddling of infants or seen in sick children who are kept indoors to recover from another disease (Mays et al 2006; Stuart-Macadam 1989, 202). The prevalence within the Hereford assemblage fits with that found at other sites (Roberts and Cox 2003, 247–8); at Wharram Percy eight individual exhibited active rickets all between the ages of 3–18 months (1.16%), ten at Barton-on-Humbar (0.36%), Fishergate House had six possible cases (5.31%) and St Helens-on-the-wall two cases (0.19%). (See Table 50 and Illus 112)

Osteomalacia

In osteomalacia the accumulation of unmineralized osteoid replacing bone mineral leads to a generalized softening and weakening of the skeleton (Brickley et al 2007). This weakening leads to 'pseudofractures' (or Looser's zones) which are streaks of decreased density, possibly the result of stress fractures that have failed to heal which can progress to full fractures with minimal trauma. They occur symmetrically at specific locations throughout the skeleton; the scapula and ribs are two of the predilect areas affected by this disease (ibid).

Two adult females from burial group C were diagnosed with osteomalacia. The left scapula of SK 31645 and both scapulae of SK 31232 exhibited a crack in the cortical bone at the posterior aspect of the base of the scapula spine with reactive, irregular bone spicules indicative of a pseudofracture (broken post-mortem; left scapula absent). Also, SK 31645, although the ribs were very poorly preserved, one un-united fracture of a right rib was observed, which had limited evidence of healing, comprising spicules of woven bone at the fracture site. (see Illus 113)

Along with the high risk of fracture, symptoms include muscle and bone weakness and/or pain (Holick 2005). As well as pollution and low levels of nutrition, a loss of calcium and phosphorus due to closely spaced pregnancies and prolonged lactation in the past would have made females especially vulnerable to a vitamin D deficiency (Prentice 2003). In older individuals osteomalacia can also be a result of a decrease in intestinal absorption of vitamin D with age (Reginato and Coquia 2003). SK 31232 was within the childbearing age (25–29 years) however SK 31657 could not be aged more specifically than 18+ years.

Scurvy

Scurvy is caused by a vitamin C deficiency – Vitamin C is required for collagen synthesis, which is the main protein component of connective tissue, including bone. Production of defective collagen leads to fragile blood vessels that rupture easily, leading to haemorrhages either spontaneously or following minor trauma/ normal stress and strain. The inflammatory and hemorrhagic response to chronic bleeding on or near a bone surface is increased vascularity, causing an area of abnormal porosity in the cortical bone (Ortner and Ericksen 1997; Ortner 2003). Sub-periosteal haemorrhage may also result in the loosely attached periosteum becoming stripped from the underlying bone, activating bone formation and is commonly symmetrical (Aufderheide and Rodriguez-Martin 1998, 311). In adults these lesions are usually diaphyseal and restricted to a moderate size, however, in infants the periosteum is much more easily separated from the cortex and a sub-periosteal haemorrhage often involves a proportionately much greater area and volume (ibid). Where chronic bleeding occurs at the joints of infants, widening of the long bone metaphysis (fusion sites near the long bone ends) and of the costo-cartilage junctions of the ribs occurs (Jaffe 1972, 449; ibid). An expansion of the zone of calcification occurs as the osteoblastic activity (deposition of bone) is impaired however the osteoclastic phase (removal) of bone remodelling continues, producing a fragile region where fracturing can occur. Furthermore, the densely collegenous periodontal ligament, which anchors the teeth, loses its integrity and teeth become loosened with infection and haemorrhage around the roots resulting in exfoliation of the teeth (Aufderheide and Rodriguez-Martin 1998, 312).

Vitamin C whilst present in marine fish, and as varying amounts in numerous vegetables, is highest in citrus fruits. Vitamin C is destroyed at high temperatures and by exposure to air – boiling destroys 50% of C effect and an additional 75% of that remainder is lost under usual conditions of ship storage (Wyatt, 1976) – and therefore populations in areas that are not fruit-abundant (colder climates) and that consume mainly cooked foods are prone to develop a deficiency. Scurvy is also associated with hardship, famine, and war, as well as prolonged trips at sea (in the 15th – 18th centuries). Infantile scurvy (or Moller-Barlow disease) is seen primarily in infants with low birth weight, such as premature babies, or twin births, as well as infants who are fed prepared food or condensed milk (Stuart-Macadam 1989, 202).

Clinical manifestations of scurvy can appear allowing as little as 2–4 months of inadequate intake of vitamin C (Tamura et al 2000). The most rapid proportionate growth occurs in infancy and early childhood, and therefore the probability of forming defective blood vessels in this age group is the greatest (Ortner et al 2001). Clinical manifestations include ulceration, swollen and bleeding gums, fracturing and re-fracturing and death (Stuart-Macadam 1989, 202).

In the assemblage four cases of possible scurvy were recorded and include individuals aged between 6 months and 2 years; one infant had scurvy concurrent with rickets. (see Table 51)

8.11.8 Osteoporosis

An individual's maximum bone mass (MBM) is achieved at about 30–40 years of age, after which bone is lost with increasing age.

Women lose bone at a faster rate than men at all ages and their rate of loss tends to increase further after menopause, when the protective effect of oestrogen is lost. Bone turnover and therefore potential bone loss is greater in the trabecular bone than cortical bone and therefore regions of the skeleton with a high proportion of trabecular bone are more susceptible to osteoporosis-related fractures (Brickley 2000).

To date, there is no agreed way to diagnose osteoporosis in the skeleton – in macroscopic examination a number of factors should be taken into account when considering a diagnosis of osteoporosis, for example, location of the fracture and estimated age and sex of the individual. The regions of the skeleton with high trabecular bone content and where osteoporosis-related fractures are frequently recorded as having occurred include the proximal femur (hip), distal radius (wrist; also known as colles' fractures) and vertebral bodies (spine; crush fractures; Brickley 2002). Further, although more subjective, observations of reduced cortical thickness or thinning of the trabecular network within bones has been used to diagnose osteoporosis (ibid).

No individuals in the assemblage had proximal femur fractures, although 11 individuals exhibited a colles' fracture including 5 males and 6 females. Most fractures were present in individuals between the ages of 35–44 years at death (8/11) and only two males of an older age at death exhibited this fracture. It is unknown if any of these represent osteoporotic fractures, with the exception of one female older-middle adult (SK 5186) who had both a colles' fracture and two biconcave vertebral fractures, plus a thinned trabecular network observed on broken vertebrae.

Vertebral compression fractures were observed on a total of 83 individuals in the assemblage and older adults have the highest prevalence; 26 of 100 older adult individuals exhibited compression fractures (26%). However, biconcave vertebral fractures or 'cod-fish vertebrae' are more likely associated with osteoporosis which were present in eight of these individuals. Seven females of which all were of an older adult age, with the exception of SK 5186, and one older adult male were affected. However, malignant neoplastic lesions in the spine of one of the female individuals (SK 4486) may have also exacerbated bone loss and fracture.

Overall, taking these latter eight individuals as cases of osteoporosis the prevalence within the assemblage is 1.69%, and occurred within the bone only (4), simple coffin (2) and elaborate coffin burial groups (2).

Hyperostosis frontalis interna (HFI)

Hyperostosis frontalis interna (HFI) is a thickening of the endocranial (inner) surface of the frontal bone (although it can spread to other cranial vault bones) and has been associated with hormonal changes, especially in females due to pregnancy or menopause (Aufderheide and Rodriguez-Martin 1998). It is asymptomatic; however, in rare cases if the new bone formation is extensive it can cause compression of the underlying cerebral cortex which may result in some cognitive impairment (Zubicaray et al 1997). HFI was present in 13 adult individuals out of a total of 293 with frontal bones (4.44%). Of these individuals, one was male and 12 were female and all were over 35 years at death; given the younger age of childbirth in the past, the age of the female individuals indicates they were most likely multiparous.

Paget's disease

The disease presents as a localized disruption of normal bone remodelling with an increase in osteoclast-mediated bone resorption and a compensatory increase in new bone formation. This process results in the increased formation of osteoid which is softer and weaker than normal, with the affected bone is often becoming enlarged and prone to bending or fracture under gravitational stress (Wade et al 2011).

The changes of SK 1823, an adult female, represent a probable case of Paget's disease. The distal and mid-shaft of the right tibia was enlarged due to periosteal bone formation replacing the normal tibial shape with a smooth rounded appearance. The cortex is made up, almost entirely, of poorly organized pumice-like porous bone with the medullary cavity intact. The popliteal surface of the distal right femur also displays a lesion formed of compact porous bone of a pagetic appearance.

The cause of paget's disease is, as yet, unclear but geographic distributions imply a genetic component; with as much as 6% of the population in areas of Great Britain affected (Monfort et al, 1999) and similarly common in Western Europe (Resnick, 1988), but rare in indigenous populations in China, Japan and Africa (ibid; Ralston, 2002). Paramyxoviruses, such as measles and canine distemper virus (CDV), have also been suggested as activating factors (Meunier, 2002). The clinical, symptomatic form of the disease is one of older people; however, this is often preceded by a decades-long asymptomatic period by which it is found incidentally on radiographs obtained for other reasons (Aufderheide and Rodriguez-Martin 1998). Clinical symptoms of the disease include bone pain, fracture and deformity, and in a small proportion of cases, osteosarcoma may develop (Kaplan and Singer 1995).

Cribra orbitalia and porotic hyperostosis

Cribra orbitalia consists of pitting in the roof of the orbits and porotic hyperostosis pitting on the parietal and/or occipital bones. These conditions are indicators of general stress in childhood and are the result of iron deficiency anaemia (Stuart-Macadam, 1992) due to a diet deficient in vitamin B12 (in animal products) and/or folic acid but can also be caused by chronic disease, particularly gastro-intestinal parasites or other gut infections (Walker et al 2009; ibid). The porosity is a result of the thinning of the outer table of the cranium due to the expansion of the dipole (trabecular bone between the cranial tables) produced by the body's expansion of the marrow to increase production of red blood and iron levels (Roberts and Manchester 1995).

When cribra orbitalia was present, lesions were classified as porotic, cribriotic or trabecular, according to the scheme of Brothwell (1981, fig. 6.17) and remodelled lesions were also distinguished from those which were active using the criteria of Mensforth et al (1978). Lesions are generally present in both orbits when they occur and therefore individuals with one or more orbits observable were scored for cribra orbitalia. The results are shown in Tables 52 and 53. (see Illus 114)

The overall prevalence of 38.44% at Hereford is relatively high, in a comparison of 34 later-medieval assemblages, being closest to the prevalence at Doonbought Fort, Co. Antrum at 33.33% (7/21; Roberts and Cox 2003, 234) and Wharram Percy at 33.16% (125/377). Within the assemblage the prevalence of cribra orbitalia was slightly greater in females than in males but not statistically significant (x2= 0.01, p=

0.914); women are generally more susceptible to developing iron-deficiency anaemia especially if pregnant. A higher frequency in females than in males is found elsewhere, occurring in seven of nine sites listed by Stuart-Macadam (1985).

The majority of individuals exhibited porotic type lesions, only sub-adults exhibited trabecular lesions and just 18.45% (19/103) of individuals had remodelled lesions, all of whom were adults.

Cribra orbitalia is more frequent in sub-adults than adults: it was found in 57.78% of sub-adults and 31.28% of adults. The highest prevalence was present in the younger child cohort (Table 54); the pattern here fits with the findings of a number of previous studies in which it is noted that the condition was most common in individuals under twelve and decreases with advancing age (Roberts and Manchester 1995, 169). The greater frequency in sub-adults may be the result of those individuals suffering from anaemia being more likely to die prematurely, however, progressive obliteration of lesions by bone remodelling in adult life may also produce such a pattern.

Iron deficiency anaemia does not normally occur prior to six months of age unless iron stores at birth are inadequate (Mensforth et al 1978) but prematurity and low birth weight can cause a deficiency. At Hereford Cathedral, no individual under nine months of age exhibits either cribra orbitalia or porotic hyperostosis. The lack of both in early infancy may indicate that at birth iron stores were generally adequate and therefore low birth-weight was not a regular problem. It should be considered, however, that individuals could have died before developing lesions.

The majority of younger children with cribra orbitalia were aged between 1 to 3 years old (20 1 to 3 year olds affected). A potential cause of anaemia at this age is 'weanling diarrhoea' as weaning onto adult food exposes the child to a range of gastro-intestinal pathogens (Mittler and van Gerven 1994). It may be that this was a significant contributor to morbidity in young children in this population.

Porotic hyperostosis was present in 144 individuals out of 463 with either a parietal or occipital present (31.10%). Although recording methods are different between sites, it can be seen that the Hereford assemblage sits closer to, although still significantly higher than the prevalence at rural Wharram Percy (Table 55). Of those affected, at Hereford, 54 were sub-adults and 76 adults; in the adults there is a decrease with age and 57.90% (44/76) of lesions were remodelled at the time of death, however, in sub-adults it increased in frequency from a younger child age to adolescence (Table 54).

In 331 individuals where both the orbit/s and parietal/occipital were observable 63 individuals exhibited a co-occurrence of cribra orbitalia and porotic hyperostosis (19.03%). It has been suggested that porotic hyperostosis requires more prolonged and severe disease to develop (Hengen 1971).

8.11.9 Dental enamel hypoplasia (DEH)

Dental defects of enamel are an important indicator of general health in a population as they represent a growth disruption in the enamel, resulting from stress such as malnutrition, disease or low birth weight (Lewis 2007, 105). Defects are only accumulated during enamel formation, up to around the age of approximately twelve years and defects are observable as lines, grooves or pits on the surface of the crown (Hillson 1996). Dental enamel hypoplasias were recorded by the number of observable teeth including partially erupted teeth as these teeth exhibited pathology DEH.

In total, 83.48% of the population were affected by one or more DEH episode including 135 sub-adults (of 142 sub-adults with one or more tooth surface observable) and 239 adults (of 306). Individuals in group C and D were the most frequently affected (Table 59) and the late post-medieval group E exhibited a much lower prevalence which was statistically significant both compared to the medieval assemblage (A–C combined; x2= 61.97, p=0.0001) and the later medieval/early post-medieval group D (x2= 33.01, p= 0.0001). The total number of DEH in Table 56 shows males were affected by 'stress' more often than females in Hereford and this difference is highly significant (X2= 12.44, P= 0.0004). The canine teeth were the most commonly affected, especially the mandibular canines, in both the permanent and deciduous dentitions (Tables 57 and 58). The former develop between the ages of approximately 6 months to seven years and the latter from 5 months in utero until approximately nine months after birth (Scheuer and Black 2004) therefore children experienced stress to a greater extent during this time in their lives. Of a comparison of 23 later-medieval assemblages Hereford tops the list, the closest being a 75.95% at St Mary's Kirk Hill, St Andrews or the 61.54% at St Bartholomew's hospital, Bristol (Roberts and Cox 2003, 264). (see Illus 115)

8.12 DENTAL DISEASE

The dentition survives the rigours of the burial environment relatively well, being less prone to demineralisation and weathering than bone, so the dental health of a population can be studied with a greater degree of confidence. Caries and calculus were scored as absent or present for each erupted tooth. Ante-mortem tooth loss and periapical abscesses were recorded as absent/present for each erupted tooth position and periodontal disease by erupted teeth present within a socket. The severity of calculus and periodontal disease were recorded following Brothwell (1981). The tooth surfaces affected were also noted for both calculus and caries and this information can be found in the site archive.

8.12.1 Dental caries

In total 275 individuals with dentition exhibited caries, females to a slightly increased frequency compared to males and adults a higher frequency compared to sub-adults. The difference between the sexes by individuals affected was not statistically significant in this assemblage (x2= 0.153, p= 0.7), however, it has been found in several studies that females tend to have a higher caries rate (refs). In the adult dentition, the maxillary dentition was affected to a greater extent than the mandibular, the molars were the most frequently affected tooth type and of these the second molar most commonly exhibited carious lesions. In the sub-adult permanent dentition the same pattern occurs as in the adult teeth, and the deciduous teeth again have a similar pattern with the exception that the mandibular teeth were more frequently affected than the maxillary. (see Tables 60–62)

Bacteria within dental plaque cause destruction of the tooth leading to the formation of a cavity in the crown or root surface (Hillson, 1996).

Carious lesions can cause severe pain, infection, and tooth loss. Caries are multifactorial in aetiology, however, sugar is the main cause of caries; and is found occurring naturally in foods such as fruits, vegetables and honey as well as in carbohydrates such as cereals. Small amounts of sugar began to be imported into England in the 12th century, sugar in the medieval period was a scarce luxury, and it was not until 1700 that sugar imports increased dramatically because of imperialist policies (Moore and Corbett 1978). This may account for the fact that individuals in burial group E, of a later post-medieval date, exhibited the highest frequency of caries although the rate was not significantly different from that found in medieval individuals in groups A–C (x2= 3.581, p= 0.0585).

The prevalence at Hereford is 61.52% of individuals and 13.19% of teeth affected. There is considerable range in caries prevalence in the later-medieval period (Roberts and Cox 2003, 258) with a range of 5.56% to 84.62% of individuals affected (53% mean) and 0.96% to 40.66% of teeth affected (5.6% mean).

8.12.2 Dental abscesses

Dental abscesses form as a result of caries, high levels of wear, trauma to the teeth or periodontal disease, as all of these can allow bacteria to enter the pulp cavity. The bacteria cause inflammation and pus accumulates; once pressure builds up the pus is drained out by the formation of a hole in the surrounding bone (Roberts and Manchester 1995, Hillson 1996).

Five sub-adult individuals were affected by an abscess (out of 127 with erupted tooth position/s) including one younger child (group 4), two older children (group 3) and two adolescents (groups 3 and 4). This includes two deciduous teeth (RM2 and RC1) and three permanent teeth (LC1, LM2 and RM1) of 1577 total sub-adult erupted tooth positions.

The results for adults are shown in Tables 63 and 64. The maxilla is affected more so than the mandibular tooth positions and the pre-molars are the most commonly affected tooth type. Male individuals are affected to a slightly greater extent by abscesses than females but this is not a significant difference (x2= 0.033, p= 0.855). There was also no statistically significant difference in the presence/absence of abscesses by individual between the groups (x2= 3.15, p= 0.533)

8.12.3 Calculus

Calculus (tartar) is mineralised plaque and forms concretions around the crowns or roots of teeth; the build-up of plaque is associated with carbohydrate consumption and a lack of oral hygiene (Hillson 1996). Dental hygiene is believed to have been not much practised at this time although toothpicks are known to have been used (Ring 1985). The teeth closest to the salivary glands (anterior teeth of the mandible) tend to have the greater calculus deposits as saliva is a source of minerals (Hillson 1996, 255).

Male individuals (147/172) were affected by calculus more so than females (111/134) but the difference was not statistically significant (x2= 0.394, p= 0.530). A total of 80 Sub-adults had calculus with 174 of 1170 deciduous teeth affected and 453 of 1807 permanent teeth. The majority of teeth exhibited only slight calculus deposits, however, males showed a higher frequency of moderate (grade 2) to considerable (grade 3) expressions of calculus. Most of the deposits were supra-gingival and affected the mandible teeth (1742/2786 teeth; maxillary teeth = 1037/2133). The incisors were the most commonly affected tooth type within the total population with frequency of calculus deposits declining towards the back of the mouth so that the molars were the least affected tooth type. Individuals in burial groups B and C were affected by calculus to a greater extent, although there was no statistically significant difference between the groups in the prevalence of calculus deposits by individual (x2= 7.168, p= 0.127). (see Tables 66–69 and Illus 116)

8.12.4 Periodontal disease

The bacteria within accumulations of plaque and tartar can infect the gingival tissues and cause inflammation – gingivitis (Hillson 1996). In consequence, the bone around the tooth is resorbed (destroyed) creating an increasing distance between the bone and the cemento-enamel junction of the tooth, and the tooth is eventually lost. This process is largely painless although symptoms include swelling of the gums and halitosis (Scully and Cawson 1996).

Of the sub-adults, with one or more erupted teeth within a socket, seven exhibited periodontal disease (7/110 = 6.36%). This included two younger children (six deciduous teeth), one older child (three permanent teeth) and four adolescents (19 permanent teeth); the vast majority of whose teeth only showed slight periodontal disease (Table 70). In the adults, 60 female individuals (of 124) were affected and 78 males (of 166) and female teeth exhibited a higher prevalence of severe periodontal disease (grade 3) than males. Chi-square tests indicate no evidence for any difference in prevalence of periodontal disease in terms of its presence/absence in individuals with respect to sex or group. In the total assemblage, the mandibular dentition were affected to a slightly greater extent (536/3221= 16.66%) compared to the maxillary (263/1738= 15.13%) and the posterior teeth more so than the anterior (65.38%; molars = 303; pre-molars = 273). (see Tables 70 and 71)

Ante-mortem tooth loss (AMTL)

Of the 127 sub-adults with one or more erupted tooth positions observable, two showed AMTL; both teeth lost were first molars. There is a clear increase with increasing age for AMTL prevalence in the adult assemblage, as would be expected. The prevalence in the adult population is 80.54% of individuals and 25.82% of teeth (Table 72). Male and females had a similar prevalence rate by individual, however, females tended to have more teeth affected than males. The mandibular teeth were the most frequently affected, and the most common tooth type lost ante-mortem were the molar teeth, especially the first molars (Table 73). Burial group E has the highest prevalence of AMTL which is significantly different to the combined medieval groups A–C (x2= 13.63, p=0.0002) and also group D (x2= 8.85, p=0.0003) (Table 74).

AMTL can be a result of dental disease, trauma, or teeth could have been extracted. In the mid-15th century the Royal Commonality of Barber Surgeons was created and by 1551 the first specified 'tooth-drawer' was mentioned, suggesting the beginnings of dentistry as a specialisation (Ring 1985).

8.12.5 Other dental observations

Eight individuals had impacted teeth which are teeth that fail to erupt as it is 'physically' blocked in its path of eruption. This is usually due to a lack of space in the jaw or teeth may also become twisted, tilted, or displaced as they try to emerge, resulting in impacted teeth. Two individuals had impacted canines with the left maxillary canine affected in SK1116 and all four canines in the dentition of SK 11614. Five individuals had embedded third molars; in three cases the mandibular molars were affected, in one case a maxillary molar and one individual all four molar teeth were affected. Furthermore one older child had an impacted deciduous mandibular left first molar.

Rotation of teeth occurred in 14 individuals with 20 teeth affected; most teeth were rotated distally (15 teeth) and by approximately 45 degrees. The incisors, canines and pre-molars were involved, however, the canines were affected to the greatest extent. Three individuals had symmetrical bilateral rotation of teeth.

Congenitally absent teeth were present in 21 individuals including 10 maxillary third molars, 27 mandibular third molars, one mandibular second molar, three maxillary premolars and two maxillary second incisors.

Two male individuals, one from burial group C and one from group D, retained the deciduous mandibular left first molar amongst their permanent dentition.

Eight individuals had evidence of pipe facets in their dentition including six males and two females. These individuals were in burial groups C, D and E; one individual in group C, three individuals in group D and four in group E. In Britain, pipe-making began soon after the introduction of tobacco from North America in the mid-sixteenth century. Smoking, or 'tobacco drinking' as it was known, was believed to bring medicinal benefits. Writing his Great Chronologie in 1573, William Harrison noted that: 'In these daies the taking-in of the Indian herbe called 'Tobaco' by an instrument formed like a little ladell, whereby it passeth from the mouth into the hed and stomach, is gretlie taken up and used in England, against Rewmes and some other diseases engenderd in the longes and inward partes and not without effect.' (see Illus 117)

8.13 CONCLUSION

The human skeletal remains provide a tantalising glimpse into early Hereford life. Interrogation of the population of the cemetery revealed that there appear to be slightly more male burials than female, something that might be explained by allowances to bury women and children in other burial grounds outside of Hereford. A proportionately lower number of children in the assemblage possibly also underline this. An alternative explanation might be one of status, based on an assumption that the south-east part of the graveyard is commonly reserved for higher status citizens. With the exception of the cist burials, where within the small number excavated there was a predominance of males (a wider volume of data within the city supporting this selectivity), there was no apparent distinction between the sexes across the burial ground.

In the sub-adults, and in particular the under 12's, there appears to be an increase in life expectancy in the post-medieval period. The under 5's in the medieval population have a life expectancy much in line with that of the plague pit burials excavated in 1993. Despite the life expectancy being five years less in the 35–45 age band in both medieval and post-medieval populations (from the 2009–11 excavations by comparison to the 1993 excavation), overall life expectancy appears to be higher than that observed elsewhere in medieval populations.

The Hereford population clearly has similarities with other contemporary groups and this is very much underlined by the estimated stature (height) of individuals; with men being taller than women and a slight reduction in the height of both from the medieval period through to the post-medieval. Factors that have been cited for this (increased urbanisation, poor health and pollution) could be prevalent within Hereford City and, in particular in the medieval period, which would have seen population growth. Following its sacking by the Welsh just prior to the Conquest, which decimated the population, it increased to an all-time medieval high in the 13th century. Considered alongside this data the population appears to most closely match assemblages such as urban poor at Fishergate. Also, Hereford children appeared to be slightly taller than those from rural communities, like the one at Wharram Percy, perhaps corroborating this.

There is some evidence to suggest some degree of racial distinctiveness in Hereford. The cranial shape is possibly slightly narrower than elsewhere in the country and there seems to be a higher prevalence of non-metric skeletal traits in cist burials than in other burial types, again suggesting this group (or elements of it) may be racially distinct. It was also interesting to note that despite there being very few cases of one type of condition (spondylolysis), which is considered to be hereditary, a group of three individuals buried in the same part of the cemetery all exhibited this.

With regard to the cist burials, there appears to be a significant difference between how males and females were treated during the early medieval period, the Cist burials exhibiting a greater than three to one ratio in favour of males. A less pronounced but still notably similar trend was observed in the Elaborate Coffin burials. There is a general consideration that these two classes of burial are likely to be of higher status with respect to others on the site, and if this were the case then they could reflect a very real bias towards higher status males in society than females.

Whilst there is sufficient evidence to suggest that the high number of manual tasks expected of a Medieval community were shared fairly equally between the sexes, some distinction in the nature of these tasks is evident in the skeletal record.

One area where there appears to have been a clear distinction between male and females across the whole assemblage is the location of fractures. Men appear to experience breaks in the extremities (hands, wrists and feet) where women had none, whilst broken legs and arms were much more common in women than men. The other significant bias occurred in a marked increase in broken ribs in men. This may go some way to identifying variations in occupational risk between the sexes (although there are other better indicators of this), or might relate to higher levels of violence in men with the ribs hands and feet more likely to be broken in brawls than other limbs. The coincidence of squatting facets and osteoarthritis of

the knee in women does tent to suggest females were undertaking tasks nearer to the ground than men. In general osteoarthritis seems to affect the upper parts of the body more in men and lower parts in women. Whilst the onset of the condition is potentially more related to hereditary or dietary factors, the locations where it manifests itself in many cases could well indicate occupational stress and thus such distinctions may well be demonstrating variations in activities between the different sexes.

It also appears that young women were more active than young men in respect to tasks that involved using their legs. Men, on the other hand, demonstrated greater evidence for lifting as well as manual jobs that involved repetitive stress on the shoulder joint and spine. One condition, associated with archers seems to have affected more men than women. The few cases of bunions, more prevalent in women, seem to imply either ill- fitting shoes, or continued use of shoes from adolescence into adulthood.

In terms of the dietary health of the population, there are hints that childhood illness may have been prevalent, both through the presence of dental enamel hypoplasia on the teeth as well as the rare cases of rickets and scurvy in very young children; possibly implying they were bed ridden for a period before dying at a very young age. Dental enamel hypoplasia could also indicate periods of malnutrition and other indications for iron or vitamin B12 deficiency were also observed within the population, indicating dietary deficiency at various stages in life. A greater than 90% prevalence in the main bulk of the Bone Only burial groups revealed evidence of dental enamel hypoplasia, implying that the general population of Hereford suffered some levels of stress, such as malnutrition, at some point in their life. This does appear to have improved slightly in the post-medieval period and in those burials that might be classed as being higher in status, which have much lower percentage of occurrences. In the case of iron deficiencies, some individuals were displayed evidence of having recovered, whilst in others the deficiencies seem to continue through to death. Cribra orbitalia seems to reduce in prevalence with age whilst the other indicator, porotic hyperstosis, peaks in the younger to middle adult age band. If the coincidence of caries in teeth and sugar in diet are to be believed, then the increase in caries from the early medieval period through to the later burials could imply that more refined sugar was finding its way into the diet of individuals during the later periods.

There were very few instances of violent trauma within the excavated population. The instance of a female adult, from a Bone Only medieval burial, who had a completely severed arm is interesting. She was buried on the north side of the cathedral but very close to it. Had she been a thief, it would seem unlikely that she would have been afforded such a prominent burial location. One female within the post-medieval population could have been a victim of domestic violence. She exhibited blunt force trauma to her skull and has parry fractures, which can occur when the arms are raised to protect the head from blows, on both arms. Given the turbulent history surrounding Hereford it is notable that there are very few injuries that might be classed as battle wounds. Perhaps one blade injury to a skull and a projectile wound in another instance. One cist burial stands out with multiple wounds to various locations of his anatomy, and he will be discussed in more detail in the following chapter.

Many illnesses and injuries do not leave a trace in the skeletal record. The archaeological record above does indicate that many disabled or otherwise afflicted individuals were integrated into society, the above documentary account seems to support this. One exception in the archaeological record seems to be where the result was a disfigurement to facial features.

The difficulties in interpreting the skeletal record are all too clear. Once consideration is given to how representative of the living population the cemetery population is, problems in understanding the assemblage and comparing it to others become considerably magnified.

Regarding whether this assemblage is more like rural or urban ones recorded elsewhere; the first challenge is to find reliably consistent indicators from other populations. Certainly stature does not appear to hold any clues here as there is too much variability across both types of population. The Hereford assemblage appears to be slightly taller with respect to the comparative assemblages considered and the medieval burials at Hereford are also slightly taller than their later counterparts in the same burial ground. The number of fractures present within the assemblage could be more indicative of manual rural type activities, or simply a function of a rougher urban lifestyle.

A holistic view of people living in medieval and later Hereford would not place them significantly apart from other contemporary populations.

However, there are some indications that in the early Norman period there were possibly some distinctive racial differences. Hard work seems to have been relatively evenly distributed between the sexes although younger women perhaps did more fetching and carrying than their male counterparts and older men undertook slightly heavier tasks and jobs involving more repetitive strain to the upper body, whilst women did more jobs nearer the ground.

9 FINDS

9.1 INTRODUCTION AND METHODOLOGY

The finds assemblage from the cathedral close excavations includes finds dating from the Prehistoric to early modern periods. By far the majority are medieval or Post-medieval in date and derive from contexts associated with burials. There is however a group of material that predates burial within the close and is of late Saxon origin.

The finds have been grouped by function rather than by material, so that items such as textile working tools made of a variety of materials can be discussed together. These sub-headings are as follows: Coins & Tokens; Dress Accessories & Toilet Items; Household Tools & Furnishings; Pottery; Bottle & Vessel Glass; Clay Pipes; Textile & Leather Working; Metalworking; Horsegear; Miscellaneous Finds, including an arrowhead and a pair of dividers as well as finds relating to reading, writing and gaming; Lithics; Funerary Finds, related to coffins and shrouds; Structural Finds; and lastly a section on Unidentified finds. Of all these, the Funerary Finds was the largest group, making up the vast majority of the assemblage, though somewhat lacking in variety.

Descriptions of finds are given as in-text catalogue entries, except where a number of very similar finds were recovered, and the detail was better shown in tabular form. Individual methodologies for different material types are given under those sub-headings. Burials are referred to by skeleton number (prefixed SK), unless otherwise stated, for ease of cross referencing with the osteological report.

9.2 COINS AND TOKENS

BY NICHOLAS HOLMES, ROBERT THOMPSON, JULIE FRANKLIN

Identifications of the coins and tokens up to the mid-17th century were by Nicholas Holmes. Identification of later coins was by Julie Franklin. The Hereford token was identified by Robert Thompson.

There were 19 coins and tokens in all, ranging from the 11th to the 19th century, though all appeared to be residual, either in the general graveyard soil or in graves post-dating the finds. The earliest coin, was a silver penny of Cnut (1024–30, SF0818), found redeposited in the graveyard soil of Area 1. It is likely to derive from the activity in that area pre-dating the construction of the present Cathedral. The 13th and 17th centuries were those most commonly represented by coins or tokens, with a curious rarity of anything in between. A 16th century jeton was the only find dating to between the mid-14th and the mid-17th centuries. A similar late medieval numismatic gap was noted in earlier Hereford archaeological work (Symons 2002, 151), where adverse soil conditions were suggested as a possible explanation. This, however, seems unlikely to be a factor in the current assemblage, where the preservation of non-ferrous metal was, for the most part, very good.

Coins SF0172 and SF1209 have both been deliberately pierced. The hole in Commonwealth silver penny SF0172 is towards the edge probably to convert the coin to a pendant. This is unlikely to have been the case for the George I halfpenny SF1209, as the hole is centrally placed. Instead, it is possible that the coin was threaded on a string for safe-keeping.

The Hereford token (SF0211) would have had a local value as currency, but with a very limited circulation. An identical token was recovered from the Hereford Tesco Site (Symons 2002, 154). The issuer was a Henry Jones, probably the same Henry Jones, glover and swordbearer (a local ceremonial appointment) who was recorded in Bysters ward in 1664 and buried in the Parish of St John the Baptist [ie the cathedral burial ground] in 1689 (Williamson 1967, Robert Thompson pers com).

The lead tokens are very crudely made one sided designs. Tokens of this type have a long history, though are most prevalent in contexts of 16th to 18th century date (Egan 2005, 167–72; Hume 1969, 173–4). Later examples, from the end of the 17th century onwards are more likely to be one sided, suggesting both these finds are late. Possible uses include communion or tavern tokens, or to signify work done (or in the context of wharves, items loaded or unloaded); the tokens then being redeemable for wages. In the context of a Cathedral graveyard, communion tokens is possibly the more likely suggestion for these finds. The design of the eight-spoked wheel is interesting as it is familiar from local clay pipe heel stamps of the 17th century (see Clay Pipes, below).

The silver disc found in the grave SK1306 (SF0165) is of note. It was found bent over the jaw of the body and conceivably was originally placed in the deceased's mouth. It bears no coin markings and though possible that it is a very worn example, given its otherwise very good condition, it seems more likely that it was manufactured as a flat disc. This then may have been a token coin, a piece of silver to pay the Charon the ferryman for passage across the river Styx. The popularity of classicism in the 18th century led to a certain amount of classical pagan imagery and superstitions in burial rites.

9.2.1 Coins

SF0818 Context 1003, Area 1, graveyard soil; Cnut, silver penny, 'pointed helmet' type (1024–30). Eadwold, London. 18.5mm, 0.89g. In four fragments, buckled, corroded, probably only slightly worn. (see Illus 4)

SF1341 Context 40564, Area 4, Grid E2, SK40564, Elaborate Coffin; Henry III, silver cut halfpenny, long cross class 5 (1251–72). Uncertain sub-class and moneyer, London. 19.5mm, 0.74g, die axis 350°. Slightly uneven striking; slight wear.

SF0580 Context 2377, Area 1, Grid C13, gravel layer (18th century pottery); Henry III, silver cut farthing, long cross class 5g (1251–72). Uncertain mint and moneyer. 0.38g. Slight to moderate wear.

SF1033 Unstratified; Edward I, silver penny, class 4d (c 1286–7). London. 20.0mm, 1.33g, die axis 180°. Slightly buckled, moderate wear.

SF0330 Context 1003, Area 1, graveyard soil; English silver farthing, probably of Edward III, 3rd ('Florin') coinage (1344–51). London. 12.5 x 11.0mm, 0.27g, die axis 180°. Bent; uneven striking; moderate wear.

SF0054 Context 1067, Area 1, Grid B12, SK1067, Elaborate Coffin; Charles I, copper royal farthing token, type 1(c) (Richmond 'round') (1625–34). Uncertain initial mark. 16.5mm, 0.62g, die axis 180°. Slight wear.

SF0423 Context 1003, Area 1, graveyard soil; Charles I, copper royal farthing token, type 3(c) (Maltravers 'round') (1634–6). Initial marks harp/billet. 17.0mm, 0.56g, die axis 0°. Unworn.

SF0172 Context 1312, Area 1, SK1312, grave not analysed; Commonwealth, silver penny (1649–60). 14.0mm, 0.41g, die axis 0°. Bent twice, pierced towards edge, fairly worn.

SF1227 Unstratified; William and Mary, copper halfpenny (1694).

SF0074 Context 1010, Area 1, graveyard soil; William and Mary, copper farthing (1694).

SF0360 Context 1003, Area 1, graveyard soil; William III, copper halfpenny (1695–1701). Very worn

SF0151 Context 1003, Area 1, graveyard soil; William III, copper halfpenny, third issue (1699).

SF1209 Context 30003, Area 3, graveyard soil; George I, copper halfpenny, second issue (1724). Hole pierced off-centre, through king's head.

SF0754 Context 1003, Area 1, graveyard soil; George III, copper halfpenny, (probably 1806–7). Very worn.

SF1208 Context 30004, Area 3, Grid J7, layer; Copper coin/token, farthing? worn almost smooth on both sides, and surface spalling on one side, unidentified, probably post-medieval or modern.

9.2.2 Jetons

SF0400 Context 1003, Area 1, graveyard soil; Brass jeton of Nuremberg, anonymous 'rose/orb' type (probably first half of 16th century). 24.0mm. large piece missing, buckled, fairly worn.

9.2.3 Tokens

SF0211 Context 1003, Area 1, graveyard soil; Copper farthing trade token of H. Jones, Hereford (1662). (SCBI 43, no 2051). Obv. H : IONES . SWORDBERER rosette, upright sword flanked by H and I. Rev. HEREFORD. ARMES rosette, shield bearing three lions passant to left, [166]2 above. 16.5mm, die axis 0°. Slightly corroded, slight wear. (see Illus 118)

SF0361 Context 1003, Area 1, graveyard soil; Circular lead token. Obv. stylised fleur-de-lis. Rev. blank. 22.0mm, 8.18g.

SF0965 Context 10840, Area 2, graveyard soil; Circular lead token. Obv. eight-spoked wheel design with pellet in each angle. Rev. blank. 21.0mm, 8.96g. (see Illus 119)

SF0165 Context 1306, Area 1, Grid C12, SK1306, Elaborate Coffin; Circular disc of ?silver. Flat featureless surfaces. Bent at opposing sides, otherwise good condition with no corrosion. 20.6mm.

9.3 DRESS ACCESSORIES AND TOILET ITEMS

9.3.1 Hooked tags

The exact function of hooked tags is uncertain. They are of relatively flimsy construction and as no rivets have ever been found in the plate perforations, it is assumed they were sewn into place. Some sort of light weight dress fastening is then implied and the current consensus of opinion is that they were probably fasteners for purses (Rogers 2007, 134). The use of these tags was dated in Winchester to between the 7th and 11th centuries, and seems to have died out around the time of the Norman Conquest (Hinton 1990, 548–52; Mainman & Rogers 2000, 2576). They can be found with triangular or round plates, most frequently with two holes in the plate but sometimes three and occasionally one, and are sometimes decorated, though there seems to be no significance in terms of dating to these variations.

Five tags were found during the excavations. They range from the small SF0903 to the rather substantial SF0596. The most ornate (SF1045) is simply decorated with incised rings around the perforations. This was found in a grave fill in Area 2 of Bone Only burial SK11788 and may therefore have been buried with the body, but unfortunately less than half the skeleton was present and no information can be gleaned about where the tag was found in relation to the body. Two tags were found in two separate early layers: SF0903 was from layer [5150], on the south-east side of the cathedral, assigned to Phase 3a and containing pottery dating to between the 10th and mid-11th century; SF2191 was found in layer [40378], also associated with 11th century pottery. Other finds were found in the general graveyard soil in Area 1 and may derive from graves or from earlier occupation in that area. Similar tags were found in 11th century contexts at Berrington Street, Hereford (Shoesmith 1985, 9–10, fiche M4.G3) but examples from St Guthlac's Cinema, Trinity Almshouses and Wall Street all appeared to be residual in 13th century deposits (Thomas 2002, 155). (see Illus 31)

SF0596 Context 1010, Area 1, graveyard soil; Hooked tag. Copper alloy. Round plate, two perforation, irregularly placed, substantial hook. Length 32, plate width 13.

SF0903 Context 5150, Area 1, Grid B14, Phase 3a, layer (10th–m.11th century pottery);

Hooked tag. Copper alloy. Narrow triangular plate, single perforation. Hook broken at tip. Length 23+, plate width 5.

SF1045 Context 11790, Area 2, Grid J13, SK11788, Bone Only; Hooked tag. Copper alloy. Round plate, three perforation with incised ring decoration around each. Length 21, plate width 12.

SF2105 Context 1003, Area 1, graveyard soil; Hooked tag. Copper alloy. Round plate, two perforations. Hook missing. Length 10+, plate width 10.

SF2191 Context 40378, Area 4, Grid F3, layer (11th century pottery); Hooked tag. Copper alloy. Triangular plate, two perforations. Hook and top of plate missing. Length 22+, width 12+.

9.3.2 Bone pin

Perforated pins made from pig fibulae are a regular find in early historic and early medieval contexts. They are generally recognised as dress pins, the lack of wear to the head discounting them from most craft activities. Pig fibulae are ideal for the purpose, needing minimal modification. The perforation would have held a thong which passed over the tip of the pin to secure it in place. They can be found in contexts as late as the 13th century (Oakley 1979, 310; MacGregor 1985, 120–1; Margeson 1993, 13). This example is from a pre-cemetery habitation layer of early to mid-11th century date.

SF2003 Context 4539, Area 1, Grid C13, Phase3a, habitation layer beneath graves (10th–12th century pottery); Pin. Bone, pig fibula, left, midshaft. Round sectioned shaft, broken at tip. Spatulate head with drilled hole. Moderate wear-polish on shaft but not on head. Length 79+, head width 12. (see Illus 33)

9.3.3 Beads

Three beads were found, two of glass, one humbler version made

from a fish vertebra. Potentially the earliest was a blue-green annular bead (SF0909) from the fill of a linear feature. Annular beads were a long-lived type, from Roman times through to the medieval period (Mainman & Rogers 2000, 2591–6), though are most common between the 5th and 10th centuries (Biddle & Creasey 1990, 659). The yellow globular bead (SF1134) is not closely datable and was found in the general graveyard soil.

The fish vertebra needed no shaping to fashion it into a bead, only a hole drilled through the narrow centre. The finished effect is not particularly decorative but this was probably not its intended function. Fish vertebra beads have been noted at several sites in Britain and Europe, including a 13th or 14th century chapel site in Northumberland (Stallibrass 2002; 2005), a late medieval monastery in Iceland (Hamilton-Dyer 2010, 48–51) and a Saxon context in Southampton (Hamilton-Dyer 1997). While these sites are all notably close to the sea, the salmon which provided the raw material for this bead would have been available locally and was probably fished out of the River Wye. Fish bone necklaces have been associated with fertility and with warding off evil (Hamilton-Dyer 2010, 51) and are known to have been used for rosaries. A 15th century Portuguese painting shows such a rosary in use (fishermen panel in St Vincent polyptych by Nuno Gonçalves, Museu Nacional de Arte Antiga, Lisbon, detail reproduced in Stallibrass 2002). Rosary beads began to appear in England from the 11th century onwards (Biddle & Creasey 1990, 660). The very humility of the material may have made it attractive to the more ascetic Christians of the age, as would the symbolism of Christ as 'fisher of men'. A further two possible bone rosary beads are described elsewhere (see Unidentified below).

SF0909 Context 5344, Area 1, Grid B13, Phase 2b, fill of linear feature; Bead. Blue-green translucent glass. Annular bead. Broken in half. Diameter 20, length 8 (see Illus 25)

SF1134 Context 10840, Area 2, graveyard soil; Bead. Yellow opaque glass. Globular. Diameter 5, length 4,

SF2246 Context 4834, Area 1, Grid C14, Phase 3a, layer (13th century pottery); Bead. Bone, salmon vertebra. Natural bone with hole drilled through centre. Slight wear to edges. Diameter 9, length 7. (see Illus 32)

9.3.4 Finger Ring

The only finger ring recovered was a plain band of copper alloy. It cannot be closely dated and was unfortunately unstratified.

SF2100 Unstratified; Finger ring. Copper alloy. Ring made from rounded sectioned shaft, thicker in middle, tapering gradually towards ends. Overlapping ends, corroded together. Slight blue colour to corrosion products suggests some tin or silver context or plating. Diameter 21, internal diameter 16, max thickness 3.

9.3.5 Buckles and strap fittings

Five buckles, were found as well as the fragmentary remains of a possible further two. Three of the buckles dated to the 18th century, two were earlier. A strap loop of uncertain date was also found.

The most distinctive of the early buckles is SF1303. An identical buckle was published by Whitehead (1996, 25, no.122) who dates this type to c 1450–1550. It was found within a Bone Only burial (SK31467) on the right pelvis of an adult man and it is possible therefore that this was used in the grave, either to fasten clothing that the body was buried in (though this would be unusual and there was no other evidence for clothing) or a strap to secure a shroud. Either way it does provide the best finds dating evidence for any of the Bone Only burials. Buckle SF0383 is a plainer form and not closely datable. It could date anywhere from the mid-14th to late 17 centuries (Whitehead 1996, 52; Egan 2005, 35). It was also found in a grave, but is likely to be residual in an Elaborate Coffin burial (SK1848).

Buckles SF0085, SF1041, SF1210 are all of 18th century types. The earliest is SF1210. The shape and small size of this buckle suggests it is a shoe buckle, dating between c 1690 and c 1720 (Whitehead 1996, 96–7). The slightly larger and more rectangular SF0085 is of later date, though not as large and ornate as shoe buckles of the later 18th century. It is most likely to date to c 1720–50 (Whitehead 1996, 103). The use of decorative shoe buckles began in the later 17th century and by c 1720 was standard dress for all but the very poor (Swann 1981). SF1041 is a knee breech buckle, the combination of anchor chape with pitchfork tongue and a frame wider than it is long are all characteristic of buckles used to fasten knee breeches. It can be dated to between c 1720 and c 1800, after which breeches fell out of fashion in favour of long trousers. SF0085, was found in Elaborate Coffin burial (SK4185) with which it could easily be contemporary. However, as it was broken and its pair missing, it seems unlikely this was a deliberate inclusion in the burial, and is almost certainly residual. The other two were found in mixed deposits.

Finds SF0413 and SF0817 are both incomplete and their function is uncertain. The frame appears to be circular and they could be part of plain finger rings. However, their relatively flat section suggests they are more likely to be annular or spectacle buckle frames or strap loops (cf Whitehead 1996, 43–57).

Strap loops are metal strap fittings to hold down loose strap ends. The function today tends to be served by loops of leather rather than metal. Strap loops could be fixed or movable. SF0676 would have been fixed to a strap via the rivet hole in the back. Such objects have a long history and are known from the Viking period onwards (Egan & Pritchard 1991, 229). It cannot be closely dated but it is probably earlier than the Elaborate Coffin burial (SK10135) in which it was found.

SF1303 Context 31469, Area 3, Grid K4, SK31467, Bone Only; Buckle. Copper alloy. Single looped D-shaped frame with plano-convex section and moulded ropework decoration. Iron pin, still largely intact, though has been displaced onto side of frame and tip is missing. Length 33, width 26. (see Illus 61)

SF0383 Context 1848, Area 1, Grid B13, SK1848, Elaborate Coffin; Buckle. Copper alloy. Double-looped symmetrical sub-rectangular frame, with trapezoidal section and slight curve to outer edges and one side. Fairly crudely made and finished. Pin missing. Length 30, width 28.

SF1210 Context 30003, Area 3, graveyard soil; Buckle. Copper alloy. Part of decorative shoe buckle. Bevelled rectangular frame with

curving profile. Drilled holes in edge for insertion of steel chape, though this is missing but for stump within hole of intact side. Moulded decoration on top of frame. Length 30+, estimated complete length 32, width 25.

SF0085 Context 1118, Area 1, Grid C14, SK4185, Elaborate Coffin; Buckle. Copper alloy. Part of a decorative shoe buckle. Rectangular frame with curving profile. Drilled for insertion of steel bar though centre, though this is missing but for a stump within hole on intact side. Restrained engraved detail on top of frame. Length 35+, estimated complete length 44, width 29

SF1041 Context 5366, Area 1, Grid C13, stony layer (mixed pottery, 15th/16th century to modern); Buckle. Copper alloy. Part of decorative knee buckle. Drilled frame with steel anchor chape and pitchfork tongue and double pin still in place. Moulded decoration on top of frame. Length of frame 29+, estimated complete length of frame 37, overall length including chape 38, width 40.

SF0413 Context 1912, Area 1, Grid B13, SK1910, Bone Only; Buckle? Copper alloy. Part of rounded frame, rounded rectangular section. Length 13+, width 20.

SF0817 Context 1010, Area 1, graveyard soil; Buckle? Copper alloy. Part of rounded frame, rectangular section. Length 9+, width 20.

SF0676 Context 10136, Area 2, SK10135, Elaborate Coffin; Strap loop. Copper alloy. Rectangular frame, with hole for missing separate rivet. Decoration of milled lines on front edge. Length 17, with 21.

9.3.6 Rumbler/Crotal Bells (HL3)

The rumbler bells are of fairly standard form, with a ridge running around the middle where the two halves of the bell were joined and a dumbbell shaped slot in the bottom. They were used as dress accessories from the late 13th century, at first only by jesters, acrobats, pilgrims and priests, but from the late 14th century they became fashionable in the general populace (Egan & Pritchard 1991, 336). They could be hung from girdles and belts and were particularly popular at festivals. They could also be hung from the collars of hunting dogs, birds, pets or horse harnesses (ibid, 337). Their form has changed little to the present day. Both bells were found in late Elaborate Coffin burials, both next to the leg. It is conceivable that they were deliberately included in the coffin, sewn to the cloth dressing the body, to alert bystanders to movement of the body within as a guard against being buried alive. Should the interned be alive but unconscious, the leg, as the part of the body most likely to have freedom of movement in the confines of a coffin, could still twitch and sound the bell. Had the bells had any kind of decorative or religious significance, it is more likely that they would be attached somewhere on the upper body or head.

SF0173, Context 1306, Area 1, Grid C12, SK1306, Elaborate Coffin, next to the leg; Rumbler bell. Copper alloy. Loop made from strip, with ends secured through top of bell. Decorated on both halves with several lightly incised circumferal lines and with two symbols stamped into top of loop, '?XY', possibly a maker's mark. Broken at base with pea missing. diameter 17, height 20.

SF0667 Context 10086, Area 2, Grid H11, SK10085, Elaborate Coffin, next to leg; Rumbler bell. Copper alloy. Large heavy-duty bell, cast with integral square ended loop. Two holes pierced in top half. Decorated with incised radial lines on top and bottom halves. Worn, but intact with iron pea still in place and still mobile. diameter 27, height 33. (see Illus 62)

9.3.7 Buttons

The most common type of button found were plain disc buttons with a fixing loop at the back. These are typical of the 18th and early 19th centuries. The larger examples (SF0418, SF1130, and SF1342) are more likely to be later 18th century, when overly large buttons were popular (Bailey 2004, 40–2). The silver colour of SF0501 suggest this was made of a zinc-copper alloy. The others are all corroded copper alloy green. Only SF0418 bears any surviving trace of surface plating. Two buttons are of a different type, hollow with a four-holes pierced in the convex back. These are unlikely to be earlier than the 19th century.

Most buttons were found in graves, either Simple Coffins or Elaborate Coffins, though as they were single examples it seems unlikely that they were attached to garments deliberately interred, but rather accidental losses in the graveyard. The exception is SK1952, where five buttons (SF1293), all of the same type, and all probably deriving from the same garment were found. Their size and weight suggests a coat or waistcoat. Interestingly, one of the buttons is slightly mismatched, though appearing identical from the front, and was probably a replacement used for a repair during the lifetime of the garment. It is likely then that this garment was used to dress the body for burial. Though highly unusual for bodies to be buried wearing regular clothing, it was known on occasions during the 18th and 19th centuries (Reeve and Adams 1993, 110–1). (see Table 75)

9.3.8 Cuff-link

The cuff-link is of later 19th or 20th century origin and was probably an accidental loss in the graveyard.

SF0152 Context 1003, Area 1, graveyard soil; Cuff-link. Copper alloy. Part of a cuff-link. Hollow oval with loop at back attached to long chain link. Machined decoration depicting garter. Some surface damage but otherwise good condition. Length 18, width 14.

9.3.9 Ceramic hair-curlers

Ceramic hair-curlers are regular finds in 18th century contexts. They are typically made of pipeclay and are thought to be made by certain clay-pipe manufacturers. Some have maker's marks stamped into the ends. These two examples are both unmarked. Their regular form suggests a mid to late 18th century date (Le Cheminant 1982, 349).

SF2179 Context 13906, Area 2, void context; Hair-curler. White ceramic. Regular shape, bulbous terminals with knife cut flat ends, waisted middle. Unmarked. Broken at one end. Length 49+, max diameter 13.

SF1161 Context 30003, Area 3, graveyard soil; Hair-curler. Pale orange ceramic. Regular shape, bulbous terminals with knife cut flat ends. Unmarked. Broken at one end. Length 36+, max diameter 16.

9.4 HOUSEHOLD TOOLS AND FURNISHINGS

9.4.1 Keys

Two rotary keys and a slide key were recovered. The slide key was for use with a barrel padlock. The bit was inserted into a key hole and slid along, compressing the springs of the bolt and allowing it to be drawn out of the bolt hole on the opposing end (see Ottaway & Rogers 2002, 2866–7 for diagram of the working of a similar padlock and key). This example is of the most common type of medieval slide key (Goodall's Type A, Goodall 1990, 1020–2, fig.322–3; ibid 1005–6). At Winchester they were found in contexts from the 10th to the 15th century. This one was found in the fill of a linear feature assigned to Phase 5 and associated pottery of 12th century date and a knife which was possibly slightly earlier (SF0866, see Knives below).

The two examples of rotary keys are both large and solid stemmed and were for use with mounted locks. The symmetrical bit of SF2169 indicates it was most likely for a door, rather than a cupboard or chest, as it could be used from both sides. They are not closely datable. These types of large solid stemmed keys (Goodall's Type 8, 1990, 1032–4, fig.329) first become common in the 12th century and continued in use through to the post-medieval period (Goodall 1990, 1007; Ottaway & Rogers 2002, 2867–9). Both finds were associated with graveyard deposits, and thus in keeping with a 12th century or later date. SF2169 was from a charnel pit while SF0856, was residual in a grave fill.

SF0867 Context 4831, Area 1, Grid B13, Phase 5, fill of linear feature (12th century pottery); Slide key. Iron. Square-sectioned stem. Bit set laterally to stem, slightly distorted. Ring-shaped bit with cross-shaped hole to fit padlock with single spring-spine with two opposing springs. Shaped terminal, with broken hook. Length 139+. (see Illus 35)

SF0856 Context 4842, Area 1, Grid B13, SK4840, not analysed; Rotary key. Iron. Fragment, part of solid stem and fragment of bow. Length 71+.

SF2169 Context 10281, Area 2, Grid I14, fill of charnel pit; Rotary key. Iron. Solid round sectioned stem with moulded detail, projecting beyond the end of the bit. Part of bow, probably oval. Complex symmetrical bit. Length 125+.

9.4.2 Casket fittings

Two finds can be tentatively linked to caskets or chests. The first is a small strip of decorated bone (SF1171). It's plano-convex section and slight curve to one edge is reminiscent of a side-plate from a single-sided composite comb (Ashby 2007; MacGregor et al 1999, 1926–34). It is, however, rather thin for the purpose and would not have provided much reinforcing strength. The lack of tooth saw marks on the edge of the piece also counts against this idea. A fragment of comb case is a possibility, these can sometimes be made from split ribs (MacGregor 1985, 96). However, assuming the curve is incidental, unrepresentative of the larger piece, or caused by post-depositional distortion, other possibilities suggest themselves. A handle scale from a knife handle is unlikely due to its fineness but a decorative casket mount is a distinct possibility (cf. MacGregor et al 1999, 1959, fig.918). A number of these, including a complete lid, covered in bone mounts were recovered from excavations in York (MacGregor et al 1999, 1954–9) from contexts as early as the 10th century.

The decoratively scrolled terminal of strap SF0881 might also suggest it derives from a casket or chest, though equally it may be part of an ornate strap hinge from a door or shutter. There were no other finds associated with this strap to aid in dating, but it was found in a context assigned to Phase 5 (late 11th to early 12th century) stratified alongside 12th and 13th century.

SF1171 Context 30003, Area 3, graveyard soil; Casket mount/comb case. Bone, probably cattle-sized rib. Thin plano-convex section. One long edge displays slight convex curve, opposite edge appears to be straight. Incised decoration, double line along centre and simple line borders dividing area into two strips, zig-zags along each half. Length 35+, width 13, thickness 4.

SF0881 Context 4538, Area 1, Grid C13, Phase 5, primary pit fill; Strap hinge or binding strip. Iron. Fragment of strap, broken at nail hole. Tapering to scrolled terminal. Length 73+

9.4.3 Knives

Six knives were identified from the assemblage. Two of these (SF0902, SF0866) have angled backed blades. These are known from Roman and Saxon times and continue in common use through to the 11th century, though later examples are known (Ottaway 1992, 562–4).

Post-conquest knives more typically have straight or gently convex blade backs. Early knives all have whittle tangs; that is tangs narrower than the handle. Scale tangs, where the tang is the same width as the handle first appear in the mid-14th century and are the dominant form by the early 15th century (Cowgill et al 1987, 25), though never completely supplanting whittle tangs. All but one of the knife tangs present are of the whittle variety. The only scale tang present is SF1223, from the fill of a drain cut [30335], providing a terminus post quem of the mid-14th century for this feature. The whittle tanged knives, both angled and straight backed are all associated with 12th century pottery in Area 1 and are likely to belong to the phase of industrial activity pre-dating the cemetery.

Knives are usually the most common tool found on medieval sites. They were regularly carried by both men and women and used for dining, self-defence and other general purposes (Cowgill et al 1987, 51–7). The small size of SF0880 might indicate it had a more specialist use.

SF0902 Context 5432, Area 1, Grid B14, Phase 2a pit fill (late 11th – early13th century pottery); Knife. Iron. Blade with angled back, 12°. Broken tip. Whittle tang with mineralised organic remains, broken at end. Length 133, max blade width 18. (see Illus 23)

SF0866 Context 4831, Area 1, Grid B13, Phase 5 fill of linear feature (12th century pottery); Knife. Iron. Blade back with slight angle, 6°. Worn blunted tip. Broken at wide end, no tang. Length 96, max blade width 15.

SF2009 Context 40351, Area 4, Grid F2, layer (12th century pottery); Knife. Iron. Complete straight backed blade, tapering to pointed

tip. Whittle tang, missing tip. Length 172+, blade length 88, max blade width 16.

SF0880 Context 4539, Area 1, Grid C13, Phase 3a, habitation layer beneath graves (10th–12th century pottery); Knife. Iron. Complete straight backed blade, tapering to pointed tip. Whittle tang. Length 84, blade length 48, max blade width 10. (see Illus 36)

SF1223 Context 30335, Area 3, fill of drain cut; Knife. Iron. Scale tang and bone handle. Bulbous handle terminal, each scale secured by series of copper alloy and iron rivets in row along centre, generally alternating between the two metals. Four copper alloy rivets in wider butt end of handle in lozenge pattern. Blade missing. Length 69, max width 18.

SF1317B Context 40062, Area 4, Grid G2, SK40059, Simple Coffin; Knife. Iron. Blade, tapering to point, broken at wide end, no tang. Length 71+, max blade width 15.

9.4.4 Stone Hones

There were four whetstones found. Two were found in general soil layers. One was in a Simple Coffin burial, between the legs of the body of a young adult woman (SF0398, SK1875) though it seems likely that it is residual. The best stratified is also the finest made. This is a miniature whetstone (SF0906) with perforation for suspension from a belt. At 44mm it is almost too small for practical use, though it has clearly been used, presumably for sharpening small blades such as knife SF0880. It was found in a deposit of hearth scrapings [5305] where it was associated with 10th or 11th century pottery. It is likely the tool was dropped near the hearth and being nearly black in colour was lost in the soot.

SF0398 Context 1875, Area 1, SK1875, Simple Coffin; Hone. Stone, siltstone, local drift. Flat pebble, unmodified. Wear on both sides but not edges. Length 64, Width 30, Thickness 9.

SF0906 Context 5305, Area 1, Grid B13,Phase 2d, layer of hearth scrapings (10th/11th century pottery); Hone. Stone, slate, local drift or nearby outcrops. Very small and well-made stone. Rectangular section, tapering to rounded corners at both ends. Perforation in top. Shows wear on all four sides. Length 44, Width 6, Thickness 5. (see Illus 29)

SF2180 Context 30003, Area 3, graveyard soil; Hone. Stone, siltstone, local, probably drift. Flat pebble, unmodified. Worn smooth on both sides and wear planes along edges. Length 90, Width 30, Thickness 9.

SF2185 Context 40001, Area 4, Grid G2, subsoil; Hone. Stone, siltstone, local. Rectangular section. Wear visible on three sides. Length 95, Width 30, Thickness 24.

9.4.5 Stone Quern

The quern is clearly part finished. It is still slightly irregular in terms of diametereter and thickness. Possibly it was broken during manufacture or abandoned for some other reason. The smoke blackening on one side suggests it was reused as a hearth edging stone. It was found in an early (Phase 0) layer, predating activity on site. It may well therefore be of Roman or even Iron Age origin. However the presence of 10th or 11th century pottery in the same deposit suggests a certain amount of disturbance and it may be contemporary with these finds. It may of course have been of some age when reused or deposited. Rotary querns were used for grinding cereals and other foodstuffs from the Iron Age through to the medieval periods. Their use began to decline from the 12th century onwards as prohibitions began on home milling for reasons of taxation (Ottaway and Rogers 2002, 2799). It is made from locally available sandstone.

SF0887 Context 5244, Area 1, Grid C13, Phase 0, layer (10th–m.11th century pottery); Rotary quern. Stone, coarse arkosic sandstone, local. Half quern, partly finished. Formed into imperfect circular shape with edges slightly angled and part sanded smooth. Both faces and central hole still retain clear peck marks from initial shaping. No trace of wear. Smoke-blackened on one face. Diameter 320–335, central hole diameter 50, thickness 45–62.

9.5 POTTERY

BY KATH CROOKS

9.5.1 Introduction and methodology

A total of 1,551 sherds or 14.3kg of pottery were recovered from the Cathedral Close, site ranging in date from as possibly as early as the late 9th century to as late as the early 20th century, with five sherds of residual Roman wares.

All pottery was washed, marked and sorted into fabric types and forms using the classification established by Vince (1985; 2002). For the purposes of cataloguing, the material was divided into two groups: pottery from bulk deposits, such as the graveyard soil and topsoil; and pottery from stratified contexts.

The mixing in the bulk deposits and lack of well-defined stratigraphy means this material is of limited value either for the interpretation of the site or for pottery studies. The pottery, numbering 529 sherds, was quickly sorted by fabric, counted, weighed and examined for any notable sherds. The material was bulk recorded on a separate database to the stratified pottery.

The other pottery was recorded individually by sherd. There were 1,022 sherds in this group, including 237 from grave fills. The material from the grave fills was again, of limited use, though is included in the quantification for stratified pottery. In many cases the mixture of material present clearly indicated the cutting of a later grave through a number of deposits of different date; for instance grave fill [3000] (SK2999) contained pottery dating between the 10th and the 18th centuries. However, in some cases it was clear from the pottery that graves immediately post-dated the early industrial and occupation activity. The best examples of this are grave fills [12283] and [4719] containing four and three sherds respectively, all dating to the 10th century.

The bulk of the pottery was found in Area 1, but this is probably due to the excavation strategy (a larger volume of material being hand excavated in this area than elsewhere) rather than a real distribution pattern. Area 3 in particular produced very little pottery but it is almost certain that early deposits remain in situ beneath the depth at which excavation stopped. Sufficient Saxon and Saxo-Norman pottery was recovered from the other areas to indicate that activity similar to that in Area 1 continued all around the cathedral. (see Table 76)

9.5.2 Roman

Five sherds of pottery dating to the Roman period were recovered from Areas 1 and 4. All were of Severn Valley type wares. All were residual in later contexts. Two of these have been worked into spindle whorls (see Spindle Whorls below).

9.5.3 Saxon (10th to 11th centuries)

Saxon pottery was found in all excavated areas, though was concentrated in Area 1. The pottery may date as early as the very end of the 9th and is certainly present from the 11th century onwards. It is apparent that considerable activity was taking place around the Saxon Cathedral and the types of ceramics present imply domestic occupation as well as industrial activity.

Early Cotswold ware cooking pots (fabric D1) date from as early as the late 9th century in Hereford (Vince 1985, 54) and may have gone out of use in the city by the late 11th century. Hereford seems to have lain at the western limit of ceramic use during the late Saxon period (Vince 2002, 66) and D1 was some of the earliest pottery to be used in the city. This fabric was found in deposits predating the earliest medieval burials, in Area 1. Six sherds contained 'kettlefur' type deposits within, indicating use in cooking. Further sherds from Areas 2 and 4 were sufficient to indicate activity from the earliest period extending around the north and west sides of the cathedral.

Stafford-type ware (fabric G1) is thought to date in Hereford between the 10th and 11th centuries. In early 11th century deposits in Hereford it forms up to 70% of the material declining to about 12% of sherds by the late 11th century (Vince 1985, 62). Excluding redeposited material found in the graves the total from Area 1 deposits and features likely to date to this period was about 60%. Sherds of this fabric are frequently found with external sooting and with white 'kettlefur' type deposits as was the case at this site. One sherd was heavily burnt and a number were well sooted. Sherds from pit fill [30034] were from a larger vessel, almost certainly a storage jar, and showed no signs of sooting. An unusual form in this fabric was recovered from the general graveyard soil in Area 1 [1010].

A sherd of Herefordshire early pitcher (fabric A7a) was recovered from general graveyard deposit [12128]. This is an uncommon ware usually found associated with Stafford type wares. Although it was found in a general deposit its presence indicates disturbance of 11th century deposits by subsequent grave digging.

No Stamford ware (fabric E1b) jars were found. These are also considered to be of 10th to 11th century date in Hereford, but generally only found in fairly small quantities in the city, no doubt due to the distance from their Lincolnshire source. The lack of sherds associated with 12th century types suggests that the jars may no longer have been imported into the city by c 1100 (Vince 2002, 84–5).

Layer [40313] contained the largest context assemblage of Saxon wares: 31 sherds of fabrics D1 and G1. The pottery from this and underlying contexts suggests a date in the 11th century, however, also present were six sherds of Malvernian fabric B1 of 12th century or later date. This suggests later disturbance of an otherwise 11th century deposit. Three associated horseshoe nails either suggest the deposit dates to the second half of the 11th century (see Horsegear, below), or are also intrusive alongside the 12th century material.

9.5.4 Saxo Norman (11th to 12th centuries)

It is likely that the use of Stafford-type ware (fabric G1) continued after the Conquest. It was found associated with some Saxo-Norman wares such as fabrics D2 and E1b.

Worcester-type unglazed ware (fabric C1) is first found in Hereford during the latter part of the 11th century. At the end of the century it typically forms about 6% of local assemblages (Vince 1985, 53). Here it was associated with fabrics E1b, B1 and G1.

Cotswold cooking pots and pitchers (fabric D2) also date from the late 11th century, continuing through the 12th and into the early 13th century in Hereford. Most sherds appeared to be from jars rather than pitchers. Only one sherd from Area 1 and two from Area 4 appeared to derive from pitchers, identifiable by form, level of oxidisation and by the leaching of limey inclusions on the interior surface. All these are features of pitchers rather than jars (Vince 2002, 84).

Stamford type spouted pitchers (fabric E1b), like the jars (noted above), are not found in large quantities in Hereford. Unlike the jars, however, they are present in small quantities at this site. They were found in contexts with fabrics D1 and G1, but also with later fabrics C1 and B1. At least two vessels must be represented in Area 1, one with a clear olive green and the other with a pale yellow lead glaze. Both glazes are classified as Glaze 1 (Kilmurray 1977) and can be dated to the late 11th to 12th centuries. A further sherd was found in Area 2.

Three joining sherds of pitchers of similar date in a Malvernian fabric (fabric B2) were also found, though clearly residual in a post-medieval grave fill.

Malvernian cooking pots (fabric B1) were first used in Hereford in the early to mid-12th century. They seem to have quickly gained in popularity: at the beginning of the 12th century they typically make up 1% of assemblages, rising to 77% by the early 13th century, before gradually falling over the course of the 13th and 14th centuries (Vince 1985, M6.D7–9). It was the most common medieval fabric found at the site, accounting for 39% of all medieval pottery in Area 1. Of the 13 rims present, eight were cordon rims, which are confined to the early to mid-12th century (Vince 1985, 46). All of the three rims in Area 4 were of this type. A dripping dish of this fabric was also found in cobbled surface deposit [3718]. Fabric B1 sherds were found in association with fabrics D2 and C1, as well as with, probably residual, G1.

9.5.5 Later medieval (13th to 15th centuries)

The majority of pottery from this period was of Herefordshire later wares (fabric A7B) and Malvernian oxidised glazed wares (fabric B4). Forms in fabric B4 include jugs, a possible colander and a possible skillet (Vince 1985, fig. 42.10), while a sherd in fabric A7b is from a chafing dish. However, there was comparatively little pottery dating between the beginning of the 13th century and the advent of fabrics A7b and B4 in the later 13th and the 14th centuries respectively.

Several sherds may fill this gap. It is possible that some of the sherds of Fabric B1 may date to this later period, although they are more likely to be earlier than the mid-12th century. Other sherds that are most probably late 13th century or later include sherds of Worcester glazed ware jugs (fabric C2), Herefordshire siltstone tempered ware (fabric A4) jugs and jars, and sherds of Brill/Boarstall ware (fabric E3). Brill/Boarstall ware is usually found in late 13th to early 14th century contexts in Hereford (Vince 2002, 70) and can be highly decorated in contrast with most of the contemporary wares found in the city. One sherd found during the cathedral excavations has applied and knife cut decoration.

9.5.6 Post-medieval to modern

The post-medieval and modern fabrics were, for the most part a typical cross section of those found in Hereford. Wares from Herefordshire (fabric A7d/e), Cistercian-type wares, and Staffordshire slipwares were particularly prevalent. Of special note were two large sherds in a very coarse fabric, possibly a medieval or early post-medieval flowerpot (from context 12626).

9.5.7 Bulk deposits

The largest proportion of pottery from the bulk deposits dated to the 17th to 18th centuries and consisted of sherds of local coarsewares and Staffordshire slipwares. Three notable sherds stood out in this group. The earliest was a sherd of a Stamford ware pitcher (fabric E1b, 11th–12th centuries) from [1003], decorated with an applied thumbed strip beneath the clear yellow glaze. There was also an unusual rim form in fabric G1 possibly similar to the Stamford-type high necked jars, found in the general graveyard soil [2010]. Lastly, there was a sherd of Valencian 'Azul y Morada', maiolica with purple and blue painted decoration previously found in small quantities in Hereford (Vince 2002, 90). It was recovered from [1000] and is likely to date to the 16th century.

9.5.8 Discussion of pottery

The range of fabrics was not wide, a result of the early date of the excavated deposits and the later use of the site as a burial ground. However, most of the fabrics, associated with the Saxon period in Hereford were present in quantities suggesting domestic rather than purely industrial activity. The site would have lain in the centre of the later Saxon city. The date suggested by the earlier pottery predates the construction of the Norman Cathedral and the use of the area as a burial ground. There is a suggestion that domestic occupation may have continued into the late 11th century, with fabrics E1b and D2 present.

It is interesting that a larger number of sherds of late medieval fabrics B4 and A7B were found on the site when few wares dating to the earlier part of the 13th century were found. One possibility is that the ubiquity of these fabrics is such that they were imported with later landscaping material. Alternatively they may reflect a considerable increase in the amount of pottery generally available in the city from the later 13th century onwards.

9.6 BOTTLE AND VESSEL GLASS

9.6.1 Methodology

The assemblage of bottle and vessel glass numbered 280 sherds, the vast majority of which was made up of sherds of green wine bottles dating between the late 17th and the 19th centuries. Few sherds were from secure contexts and most were small and largely undiagnostic. Any diagnostic sherds, large rims, neck and bases, were catalogued in detail. A complete list of all the glass can be found in the general finds database. The dating of the wine bottles is from the typology produced by Dumbrell (1983).

9.6.2 Wine bottles

The wine bottles numbered some 267 sherds. Based on a count of rims and bases from each context, these may represent as few as 17 bottles, though given the scattered and disturbed nature of the assemblage it is likely that it is a fragmentary assemblage representing small pieces of many more vessels.

The earliest bottle sherd is was from the graveyard soil [1003] comprising a base from a shaft and globe bottle dating to c 1660–80. These were the earliest type of glass wine bottle produced in Britain, from the mid-17th century onwards. This layer provided the largest single context assemblage (113 sherds), though clearly of mixed date. The majority of bottles from the layer were a little later, mostly onion bottles, ranging in date from 1690 to 1730, with one base sherd from a slightly later mallet bottle (c 1725–60). A number of mallet bottle bases dating c 1725–60 were found in subsoil layer [40001], though again, one sherd was from a later type of moulded cylindrical bottle (1820–1900).

There were two context assemblages which seemed to be better stratified. The bottles from layer [12619] and equivalent deposit [12626] may be termed either mallet or squat cylindrical (typically c 1740–60). They are associated with a sherd of Staffordshire slipware tankard (fabric E6; 17thC.–18thC. See Pottery above). Lastly a demolition deposit [40418] contained a neck and shoulder from a cylindrical bottle (c 1750–80)

But for the one sherd from [40001], and five modern sherds, there were no other moulded bottles and thus there is unlikely to have been much deposition on site after c 1820.

Drinking Vessels and Phials

Only eight sherds were found from these smaller vessels. However, the disturbed contexts and the fineness of the glass meant that no vessel was represented by more than a small sherd. The phials are hand made with kicked bases and probably of equivalent date to the wine bottles from the same contexts (ie late 17th or 18th century) but other than that no useful diagnostic detail could be gleaned from them.

However, the vessel sherds do include one decorated sherd. This was a small rim sherd decorated with wrythen ribs (SF2198, [40269]. The inturned angle of the rim suggests a pedestal beaker (cf Willmott 2002, 47, fig.30), though a barrel-shaped or squat beaker, or a roemer are also possibilities. It is likely to date to between c 1550 and c 1650 (Willmott 2002, 47). The glass is of potash or mixed-alkali, and is in relatively poor condition. The context is a layer, containing 17th or 18th century pottery and thus a 17th century date seems the most likely for its deposition. The glass however, would have been an object of some value, albeit a very delicate one, and it could have been of some age by the time it was damaged and discarded.

9.6.3 Discussion of bottle and vessel glass

Few finds were from secure contexts, most were from graveyard soils and other general deposits. A number were scattered through grave fills, including one sherd from Bone Only SK30560 and one from Simple Coffin SK30044. Both these were fragments of green bottle glass and may be intrusive. The remaining sherds were all associated with Elaborate Coffins, though only one provided tight dating evidence. This was a small but very thick base sherd, probably from an onion bottle, and probably dating to c 1680–1730 from the fill of grave SK1849. A clay pipe bowl from the same grave was of similar date (c 1680–1710) and thus it seems likely that these finds represent a terminus post quem for this burial.

The cylindrical bottle sherds from demolition deposit [40418] are consistent with the dating of the associated pottery and thus it would seem likely that these all date to the final use or demolition of the associated structure, placing this in the late 18th century. The deposit contained one of the larger context assemblages at 30 sherds as well as a similar number of sherds of contemporary stoneware vessels. It is possible that the glass and ceramic vessels represent items which were stored or used in the structure, though equally they may be part of midden material used as backfill.

9.7 CLAY PIPES

9.7.1 Methodology

There were 357 sherds of clay pipe recovered from the excavations (see Table 77). A complete list of all the pipes was made in the general finds database. Analysis was concentrated on the 44 bowls, or marked heel sherds which could provide close dating evidence. A detailed catalogue was made of these pieces, with dating evidence taken largely from Peacey's (1985) typology of Hereford pipes and pipemarks. Most of the pipes fitted this typology. Only two pipe marks did not, and these may derive from elsewhere, possibly Broseley, Shropshire.

9.7.2 Bowl types, marks and makers (Illus 120–121)

The majority of pipes date to the late 17th century, with a few earlier bowls, lesser numbers of 18th century finds and only one 19th century bowl. The end of the 17th century has been identified as the peak of local clay pipe production with the local industry superseded in the 18th century by pipes from Bristol and later Broseley (Peacey 1985, 82).

The assemblage is dominated by pipes marked with wheel stamps (17 examples) and variants on the rose and crown motif (5 examples). Wheel marks are common finds in Hereford and their numbers and variety indicates they must have been used by several different local makers from about 1650 to about 1710 (Peacey 1985, M8.A14–B8). Almost all were of the Type 1 variant, with eight spokes, interspersed with shorter dashes. They were most commonly found on Type F bowls but also on Types J and M.

Four different variants of the rose and crown motif were found, marked sometimes on the heel, sometimes on the back of the bowl. All were found on Type K bowls, dating 1680–1710. Two of these contained maker's initials indicating they were probably made in North Herefordshire: IG, possibly John Grub of Leominster (Type RC22, on heel); RO? (Type RC14, on back of bowl), possibly Richard Overton of Birtley. Non-initialled rose and crown marks include Type RC2 (on heel) and Type RC9 (two examples both on the back of the bowl). Two bowls were marked 'WC' (Type 15, also on Type K bowls). This is possibly the mark of William Caldewell of Leominster (Peacey 1985, M8.B1).

Two marks remain unattributed. The first is marked simply 'OP' within a circular stamp on the heel. It is on a bowl of relatively early date (Type C, 1620–60; or Broseley Type 1A, 1630–40, Atkinson 1975, 24). No pipemaker of those initials is known from Herefordshire. There was a maker called Oliver Price, working in Broseley in the late 17th century but this seems a little late for the type of pipe bowl.

A less clear mark was found on a later bowl (Type N or Broseley Type 5b; Oswald 1975, 50–51; Atkinson 1975, 25). This was a large square mark on the enlarged heel with lettering in three lines, though only the top 'THO' was clear. This type of large full name mark is common at Broseley on the enlarged heels of Type 5 pipes (Atkinson 1975, 38–9). The first name, 'Thomas', is reasonably certain, but the last line is largely illegible. It may be a date such as 1696 or 1699, but a surname such as Groom or possibly Pool seems more likely. There are no such makers recorded in Broseley or Herefordshire contemporary with the pipe bowl. There was a maker Robert Pool, making Type 5 pipes in Broseley between c 1680 and c 1720 (Atkinson 1975, 73) and there was a Thomas Groom, also in Broseley in the early 19th century (Atkinson 1975, 55). A pipe with a similar unclear mark, possibly 'LA-POOL' was found in Hereford during excavations at Bewell Square, Hereford (Thomas 2002, 100–101).

9.7.3 Stratigraphy and dating

The majority of pipes derived from the graveyard soils and other mixed deposits. A number of pipes (70 sherds) were found in 30 individual grave fills. There were no groups of pipes from well stratified layers or sealed features and thus they are of limited potential in terms of either dating features or of adding dating information to the Herefordshire pipe sequence.

The earliest stratified sherd is intrusive. It was a stem sherd found in a kerb or revetment structure [4954], interpreted as of Anglo-Saxon date (Phase 1).

Finds from phased graves were all associated with Elaborate Coffins. Only three bowls were found in these fills and may be used with

caution as apparent terminus post quem of 17th or early 18th century for SK1138, SK1536 and SK1849.

9.7.4 Discussion of clay pipes

The pipes are mostly of local manufacture. Most appear to have been produced in Herefordshire, with two possibly imported from further afield. The assemblage is comparable to others recovered from excavations within Hereford, but its lack of well stratified context groups limits its interpretive value.

9.8 TEXTILE AND LEATHER WORKING

A number of finds could be related to textile working, particularly spinning. A single awl was the only suggestion of leather working. All are likely to date to the 11th century or earlier.

9.8.1 Heckle or wool comb tooth

Heckle and wool combs were for untangling fibres of flax or wool respectively. The iron teeth can be round or square sectioned and were typically mounted in wooden blocks (Goodall 1990, 214–5). SF0608 was found in the graveyard soil and is thus of uncertain date. It's extremely good condition might suggest it is actually a more recent tool.

SF0608 Context 1003, Area 1, graveyard soil; Heckle or wool comb tooth. Iron. Narrow square sectioned tooth, tapering to a point. Broken at wide end. Very good condition, little or no corrosion. Length 74+

9.8.2 Spindle whorls

There were nine spindle whorls in all, three each fashioned from pot sherds and bone, two of stone and one of clay. The pot sherd whorls were all made from sherds of Roman Severn Valley ware. Two of these were found in Bone Only burials (SF0570, SK2623; SF2240, SK3930) though as one was unfinished and the other broken they were possibly abandoned during manufacture. Both are likely to be residual finds. The small (5mm) spindle hole SF2240 is more typical of Roman whorls than Saxon or later (Rogers 2007, 23) and thus it seems likely that this is in fact a residual Roman whorl. The remaining example (SF2012) by contrast is finished and well used and is more likely to represent Saxon reuse of a Roman sherd. It was found in a layer [40378] with 11th century pottery and a hooked tag (see Hooked Tags, above) and is probably contemporary with this date. The reuse of Roman pot sherds in this way is regularly noted during the Saxon and Medieval periods (Rogers 1997, 1735; Evison 1987, 112–3) and the use of Severn Valley Ware in this respect has been noted in Hereford at Maylord Street (Stone 2002, 147).

The three bone whorls were all made from the proximal ends of cattle femurs (SF0855B, SF1169, SF2001). The ends have been sawn off and a perforation made, but they are otherwise largely unmodified. SF2001 is missing its caput. The bone used was unfused and the caput (head) probably fell off during manufacture or use which presumably led to it's being discarded. Cattle femurs were commonly used for whorl production between the 10th and 12th centuries, though earlier and later examples are known (Rogers 2007, 25–6). The most complete example, SF1169 was found in a layer [30135] though with no associated finds dating. SF0855B was found in an industrial deposit [4836] associated with 11th and 12th century pottery. SF2001 is either later or residual, associated with late 13th century pottery in rubble spread [30437].

The stone and clay whorls are all of similar shape, being wider on one side than the other. Two fall into Roger's Type A1 (Rogers 2007, 24–5), with only one flat face, forming a plano-convex or conical profile. The other is of Type A2, with two flat faces of unequal size and curved sides. These types are the predominate form from the 7th to 10th centuries, declining in favour of more symmetrical profiled whorls over the course of the 11th century (Rogers 2007, 24; Rogers 1997, 1736).

The most decorative is the clay whorl (SF0855A) which was associated with one of the cattle femur whorls in an early 10th to early 11th century (Phase 2d) industrial deposit [4836]. It is decorated with crosses and arcs. The three crosses and three triple arcs are possibly a reference to the holy trinity. The object superficially appeared to be of stone, but lithological examination revealed the material totally lacked any layering and the base of object shows shrinkage due to desiccation which rules out solid rock. Also, the central perforation is straight sided, suggesting it is a moulded rather than drilled. However, neither has it been fired. Given this the find is in remarkably good condition. But for a small amount of surface loss on its flat side, it is complete and undamaged.

The more simply decorated SF0800 was made of siltstone, a locally available stone, very similar lithologically to that used for three of the hones (see Hones above). It was found in a Simple Coffin grave, SK1815, beside the right shoulder of the skeleton of a middle aged woman and may have been a personal possession, buried with her.

The last whorl (SF883), is plainer still, and more crudely made but it has a story to tell geologically. It is made of a Jurassic oolitic limestone the nearest source for which is the Cotswolds. However, the stone, termed 'Cotswold stone' is soft and easily carved and was widely used for architectural details and sculpture. It is known to have been used in the Cathedral at Hereford, with carved fragments found during the excavations. Thus it would have been available locally in the form of imported blocks of raw stone and stone masons waste during the construction of the Cathedral. This whorl then seems likely to date to the period of the cathedral's construction, from the early 12th century onwards. However, it was found in a feature assigned to Phase 2d (early 10th to early 11th century), a date in keeping with its typological dating evidence (as outlined above) and thus it seems an earlier date is the more likely. Thus it may imply its owner hailed from the Cotswolds area, or possibly that there was a regional trade in stone spindle whorls.

In terms of weight the pot sherd whorls are the lightest (c 8–12g), the bone intermediate (c 15–26g) and the stone whorls the heaviest (28–31g). Lighter whorls were used for finer yarns, heavier for heavier yarns or for plying yarns together (Woodland 1990, 216–7). (See Illus 24)

SF0570 Context 2624, Area 1, Grid B13, SK2623, Bone Only; Spindle whorl. Pot sherd, Severn Valley Ware. Red unglazed sherd, hole drilled, edges roughly cut and sanded. May have broken during manufacture. Diameter 35–38, hole diameter 11, Thickness 6, Weight 4, Estimated Complete Weight 8.

SF2012 Context 40378, Area 4, Grid F3, layer (11th century pottery); Spindle whorl. Pot sherd, Severn Valley Ware. Buff sherd with grey core, hole drilled, edges roughly rounded and sanded. Diameter 32–38, hole diameter 8, Thickness 9, Complete Weight 12.

SF2240 Context 3932, Area 1, Grid C14, SK3930, Bone Only; Spindle whorl. Pot sherd, Severn Valley Ware. Red unglazed sherd, hole drilled, roughly square shape, trimming possibly begun on edges. Abandoned during manufacture, possibly too small. Hole diameter 5, Thickness 5, Weight 7.

SF0855B Context 4836, Area 1, Grid B13, Phase 2d, industrial deposit (11th/12th century pottery); Spindle whorl. Bone, cattle femur proximal caput, fused. Hemispherical whorl, broken and abraded. diameter c 43, Hole diameter 12.0, Thickness 19, Weight 7, Estimated Complete Weight 18.

SF1169 Context 30135, Area 3, Grid J6, layer; Spindle whorl. Bone, cattle femur proximal caput, fused. Hemispherical whorl using natural shape of bone. Cut and sanded down on flat side. Damage to one side. Diameter 43, hole diameter 9, Thickness 26, Weight 25, Estimated Complete Weight 26.

SF2001 Context 30437, Area 3, building rubble spread (late 13th century pottery); Spindle whorl. Bone, cattle femur, below the caput, unfused. Part of whorl. Diameter 36, Hole diameter 9, Thickness c 21, Weight 6, Estimated Complete Weight 15.

SF0800 Context 1815, Area 1, Grid B13, SK1815, Simple Coffin (17th/18th century finds); Spindle whorl. Stone, siltstone, local drift or outcrop. Plano-sub-convex whorl. Lathe-turned. Decorated with one circumferal line close to central hole. Rogers Type A2. Diameter 36, hole diameter 9, Thickness 14, Complete Weight 29.

SF0855A Context 4836, Area 1, Grid B13, Phase 2d, industrial deposit (11th/12th century pottery); Spindle whorl. Stone/clay, unlithified pale greyish-buff clay, probably local. Plano-convex whorl. Lathe-turned or moulded. Straight-sided perforation. Incised decoration or three crosses with dots in interstices and three arcs at edges, each made of three concentric lines. Rogers Type A1. Diameter 38, hole diameter 9, Thickness 19, Weight 27, Estimated Complete Weight 28.

SF0883 Context 5162, Area 1, Grid B13, Phase 2b, fill of L-shaped cut; Spindle whorl. Stone, oolitic limestone, Cotswolds. Conical whorl. Hand-made, slightly irregular shape with hole at slightly oblique angle, but well sanded and possibly worn from use. Rogers Type A1. Diameter 42, hole diameter 9, Thickness 14, Weight 29, Estimated Complete Weight 31.

9.8.3 Weaving tools

Three, or possibly four, pointed tools are likely to have been used in weaving. Two of these tools (SF0662, SF1050) are typical of the type termed flat pin-beaters (Rogers 1997, 1755) or picker-cum-beaters (Brown 1990, 228). This type of tool was in use between the late 9th or 10th centuries and the 13th or 14th centuries (Rogers 1997, 1755). Observation of the wear patterns on excavated examples and experimental work with reconstructed looms has led to the theory that these were used with two-beamed looms to pick out small groups of warp threads in order to pass the weft behind them for patterned weaves. The flat end may have been used to beat down the weft threads after they had been threaded through, which would explain the concave wear sometimes seen on these ends (Brown 1990, 227). Two-beamed looms became popular after the introduction of the horizontal loom had made the vertical warp-weighted loom obsolete. The horizontal loom was used by professional weavers for making cloth in quantity. The two-beamed loom by contrast was used for making tapestries and other patterned weaves, probably by women in the home (Brown 1990, 228). SF1050 was found in the same industrial deposit as two spindle whorls (SF0855A, SF0855B) and thus clearly indicate textile working in the vicinity. The deposit can be dated by pottery within it to the 11th or 12th centuries. SF0662 had been probably redeposited in a more recent context.

A third pointed tool, SF1051 could also be dated by associated pottery to the 11th or 12th century but is of less certain identification. It is single ended and though polished in a similar way to the other tools, the knife cuts across the pointed end may suggest a different use, or possibly a reuse of one tool as another.

SF2014 is superficially very similar to pig fibula pin SF2003. However, it is sturdier and has some wear to the head indicating a different use. It is also not made from a pig fibula. A pin beater is a possible use with the perforation made for suspension from a belt or from the side of the loom, to keep the tool to hand. It may also have been a needle for netting or rush work (Rogers 1997, 1783; Keene 1990, 232–3). It was found in a layer associated with 12th century pottery. A similar find from a late 14th to early 15th century context at Maylord Street, Hereford was also made from a horse metapodial and was also interpreted as a possible weaving tool.

SF1050 Context 4836, Area 1, Grid B13, Phase 2d, industrial deposit (11th/12th century pottery), Pin-beater. Bone, cattle/horse sized limb shaft fragment. Flat-sectioned tool, with one flat end and the other narrowing to round sectioned blunt point. Slight longitudinal curve. Well polished over whole surface, particularly on concave side and point, with side adjacent to flat end worn slightly concave. Possible traces of wear to flat end. Length 94, max width 10, max thickness 4. (see Illus 28)

SF0662 Context 10002, Area 2, deposit underlying topsoil; Pin-beater. Bone, cattle metatarsus shaft fragment. Sub-oval sectioned tool, coarsely modified from long bone with tool marks still visible and concave groove from bone interior still extant along one side. Flat along one side, convex along other. One end narrowing to rounded point the other narrows to flat chisel edge. Well polished along whole length with possible traces of wear to flat edge. Length 119, max width 16, max thickness 10.

SF1051 Context 5195, Area 1, Grid C13, Phase 3b, fill of E-W ditch cut (11th/12th century pottery); Pin-beater? Bone, cattle/horse sized limb shaft fragment. D-sectioned tool, narrowing to blunt point at one end, with other end blunt. Much spongy tissue from bone interior still retained on wide end of flat side. Moderate polish over most of surface. Several lateral grooves across pointed end on both sides appear to be knife cuts softened through

wear-polish rather than grooves worn through use. Length 99, max width 12, max thickness 10.

SF2014 Context 40351, Area 4, Grid F2, layer (12th century pottery); Pin-beater/netting needle? Bone, horse peripheral metapodial 'splint' bone. Roughly made piece, with irregular sectioned shaft, tapering to blunt point. Spatulate head with drilled hole. Moderate wear-polish on shaft and head. Length 99, head width 12.

9.8.4 Awl

The awl SF0895 is simply made but parallels for this are known (eg Goodall 1990, 248, fig 53b:332). As a largely functional tool, it cannot be closely dated, but could easily be contemporary with its early context.

SF0895 Context 5062, Area 1, Grid C14, Phase 1, revetment for path alongside Anglo-Saxon building (10th/11th century pottery); Awl. Iron. Square sectioned shaft, thickest in middle. Tapering to point at one end, broken at other. Bent in middle. Length (straightened) 104, thickness 6.

9.9 METALWORKING

BY KATH CROOKS

9.9.1 Introduction

There was evidence for ironworking in all four of the main excavation areas (Areas 1–4) and it seems apparent that ironworking took place all around the Cathedral. The largest quantities recovered come from the south-western part of Area 1 and from Area 4. The 7.371kg of material retrieved is likely to be only a fraction of that present, particularly in Areas 2 and 3 where excavations were very limited. In addition, there has been considerable disturbance over the period since ironworking ceased, with a number of the early hearths and deposits cut by later grave digging. The presence of hammerscale suggests that the process represented was almost certainly smithing and both higher and lower temperature processes were present. However, a small number of pieces of slag usually considered to be diagnostic of smelting were also found in Area 1. Medieval smithing hearths were usually constructed at waist height and are therefore unlikely to survive in identifiable form. The proximity of a hearth and nearby anvil can however be estimated using the density of the hammerscale in the surrounding contemporary surface deposits.

There was also some evidence to suggest lead working in Areas 1 and 2, albeit on a smaller scale.

The material was quantified by weight. No attempt was made to count fragments as a number of these, particularly those from the soil samples, were very small, but any diagnostic or notable fragments were recorded.

9.9.2 The evidence for iron-working

Area 1

Of the total ironworking debris from the site, 42% was recovered from Area 1. Ironworking took place here from at least the 11th century, and possibly earlier. The two C14 dates associated with ironworking debris [4570, 4990] (Wk34566, Wk34567) both returned a late 10th to early 11th century date for this activity. Associated pottery evidence suggests that ironworking ceased at some point in the 12th century, presumably when use of the area as a burial ground commenced.

In the south-western part of Area 1 burnt areas were associated with slag. The majority of the slag was non-diagnostic, or was indicative of smithing. However, layer [5196] contained three extremely dense fragments of a type more usually associated with smelting. It is not out of the question that this process was taking place in the vicinity, as seems to have been the case in other parts of Hereford during the 11th to 12th centuries (Crooks 2005; Crooks 2009), but it is also possible that it was a 'slag flow' which can be morphologically identical to smelting slag (Crew 1996). Burnt or vitrified furnace lining was found in a number of deposits but in insufficient quantities to be used to establish the proximity of hearths. The presence of two 'hearth bases' in a cobbled surface [4779] and fill of a cut for a sub-rectangular stone floored, wooden walled possible industrial hearth [5278] also indicates smithing. Also a 'smithing pan' (a conglomeration of slag and anvil debris) was residual in the fill of a grave.

Hammerscale was widely spread across this area, with material recovered from almost all the soil samples from the south-west of Area 1. Hammerscale can be indicative of what type of process was taking place. Spherical fragments usually result from welding, where the flux is expelled from between the two items being welded together or alternatively it may consist of small particles of slag squeezed out from a bloom during initial refining. Flake hammerscale results when the hot iron is struck with the hammer, with the glossy type indicating a high temperature process such as the edging of tools.

Layer [4571] is thought to derive from raking out hearths and abundant large flake hammerscale of the dull type was recovered from it. No slag was found in it. Although the deposit itself contained no dating evidence it was sealed by a layer C14 dated to the late 10th or early 11th century. A number of deposits were found to contain abundant small flakes of hammerscale, light enough to float, and generally of the glossy variety. These deposits included dumps of industrial debris [4731], [4570], ash [4733] from a hearth and the fill [5344] of a possible beamslot.

Area 2

A number of burnt patches in Area 2 were almost certainly associated with smithing hearths. The burnt, sooty fill [11101] of a shallow bowl-shaped feature [11100] contained smithing slag and a high density of hammerscale as well as a sherd of iron sheet. The area around it had been subjected to considerable heat and thus it seems certain that the feature was directly involved in smithing. Unfortunately there was no associated finds dating evidence, but the cutting of this feature by a stone burial cist suggests a pre-13th century date at the latest.

Area 3

Ironworking deposits in Area 3 were of similar date, lying beneath and disturbed by later grave-digging. Few contained finds dating evidence, but those that did were in the 11th and 12th centuries.

Area 4

This part of the site also yielded deposits containing slag and hammerscale dated by associated pottery to the 11th to 12th

centuries. An area of apparently more mixed deposits at the western edge of the site contained burnt patches which may have resulted from the raking out of hearths or ovens. Glossy hammerscale with a higher proportion of the spherical fragments suggests that high temperature processes were taking place in this area. Two hearth bases were found, one of which was residual in a grave fill.

9.9.3 The evidence for lead-working

Lead was essential in medieval buildings. The Cathedral was roofed in lead and it would also have been required for the window cames. There was no evidence for lead smelting on the site. This would have taken place close to the source of the ore most probably in Derbyshire.

The evidence for lead working included melt and offcuts. Melt was in particular associated with an area around hearth [4945]. A single sherd of pottery from the hearth suggested a date in the 11th century. Offcuts were widely scattered in a number of contexts and probably relate to various phases of construction work and repairs throughout the history of the cathedral.

9.9.4 Discussion of metalworking

It seems apparent that ironworking took place all around the Close. Similar material was recovered from samples during the Mappa Mundi excavations (WCC 2003, 12) and suggests that the Saxon cathedral was in the vicinity of a substantial ironworking complex.

Industrial activity can all be dated to the late 10th and early 11th centuries, predating the existing cathedral. Some of this may relate to the construction and maintenance of the Saxon Cathedral. Smiths would not only have made the nails used during construction work, but would have been necessary on site while building was taking place, for edging tools used by masons and carpenters. It is possible that some of the glossy hammerscale found on the site results from this process. On the other hand, the industry may have been largely secular in nature, making and maintaining tools and goods for the general populace. This apparent juxtaposition of ecclesiastical and industrial was probably less jarring than in later times when more distinction was made between the two.

The fact dues paid by the smiths in Hereford were specifically mentioned in the Domesday survey (Williams and Martin 2000, 493) is unusual. Gloucester (ibid, 445) is the only other example noted and that too would have had access to ores from the Forest of Dean. The large scale of ironworking in the town during this period has been noted from excavations at Bewell Street, Wye Street and St Martin's Street on the southern bank of the river (Crooks 2005; 2009).

9.10 HORSEGEAR (ILLUS 122)

Three horseshoes and four horseshoe nails were found. They have all been classified according to Clark's typology (1995, 85–91). Probably the earliest is a fragment SF2160. Its typological classification is uncertain but it was found in a stratified layer [5305] well dated by pottery to the 10th or 11th centuries. Though Saxon horseshoes are uncommon, they have been found at a number of sites from 10th and 11th century contexts, largely on urban sites (Clark 1995, 93).

The second example, SF0543 was less well stratified, being residual in a Simple Coffin burial. However, its distinct wavy outline and round nail holes clearly mark it as a Type 2A. These were the predominant type from c 1050 to c 1150, though they continued as late as c 1350 (Clarke 1995, 91–96).

The last shoe (SF0824) is complete and of the 13th and 14th century Type 3, predominant between c 1270 and c 1350 (Clark 1995, 96). It was found, incongruously, in an industrial deposit [4500] directly cut by the early 11th century late Saxon Cathedral (Phase 4). The area however is massively truncated located on the interface with the graveyard soil and it is likely that this shoe was redeposited during the digging of a later grave. Alternatively it is conceivable that this is an atypical example of an earlier shoe.

The horseshoe nails are all of 'fiddle key' type. These are particularly associated with Type 2 horseshoes, but have been found with Type 3 shoes. The heads fitted into the rectangular countersunk slot, protruding from the underside to give the shoe added grip. The heads are often worn down to a T-shape as is the case in two of these examples (SF2189B and SF2189C). (see Table 78)

The distribution of these finds is very much concentrated in Area 1, Grid B13, including all three horseshoes and one nail, and it is likely that the finds are associated with the evidence for smithing in that area, indeed two of the shoes are directly associated with industrial and hearth deposits, [4500] and [5305].

A second smaller concentration was in Area 4, where three horseshoe nails were all found in the same layer. Again, these are probably associated with industrial activity in the area, though the nails can only indicate a date between c 1050 and c 1350.

SF2160 Context 5305, Area 1, Grid B13, Phase 2d, sooty layer, hearth scrapings (10th/11th century pottery); Horseshoe. Iron. Clark Type 1? Part of one branch, broken at wide end and possibly also at heel. Features two rectangular countersunk nail holes. Length 76+, max width of web 30.

SF0543 Context 2506, Area 1, Grid B13, SK2505, Simple Coffin; Horseshoe. Iron. Clark Type 2A. Part of one branch. Narrow web, with distinct wavy exterior edge, tapering to narrow heel, no calkin. Features two round countersunk nail holes. Length 94+, max width of web 26.

SF0824 Context 4500, Area 1, Grid B13, Phase 4, industrial layer; Horseshoe. Iron. Clark Type 3. Complete, broad web, tapering to square heel, no calkin, slightly worn at toe. Rectangular countersunk nail holes, three to each branch. Length 117, width 107, max width of web 39, weight 175g (post conservation).

9.11 MISCELLANEOUS

9.11.1 Arrowhead (Illus 123)

The arrowhead is in the form of a simple point expanding to a socketed tang. The type is known from pre-conquest times through to the 14th century (Ottaway 1992, 714; Ottaway and Rogers 2002,

2968; Goodall 1990, 1073). Crossbow bolt heads can also take similar form (Biddle 1990, 1076–80). Here it is from an occupation layer predating the cemetery dated to the early to mid-11th century (Phase 3a) and associated with 11th century pottery and finds, including a bone pin and a knife (see Bone Pin and Knives above).

SF2143, Context 4539, Area 1, Grid C13, Phase 3a, habitation layer beneath graves (10th–12th century pottery); Arrowhead. Iron. Socketed tang, tapering to solid point. Length 106, length of point 62, length of socket 44.

9.11.2 Toys and gaming

Pierced pig metapodials, such as SF2007, are regular finds in medieval contexts and have at various times been interpreted as bobbins for thread or toggles for fastening clothing (MacGregor 1985, 102–3). However, it has been argued convincingly that they are in fact toys or primitive musical instruments (Lawson 1995; MacGregor et al 1999). A cord would be passed twice through the hole in a large figure-of-eight shape. It could then be twisted, and when pulled and released would send the bone spinning, making a whirring sound. Pierced discs could be used in the same way and can still be found as children's toys today. This use is consistent with the slight wear around the hole but complete lack of it on the ends.

Two gaming counters were found, one purpose made in white pipeclay, the other fashioned from a sherd of a possible Willow pattern plate. Both are unlikely to be earlier than the 19th century. Both are probably gaming pieces and being found in the graveyard soil, might be indicative of games played within graveyard. Three ceramic marbles were also recovered from the graveyard soil. Again these are made of pipeclay and are likely to be 19th century.

SF2007 Context 40311, Area 4, Grid F3, pit fill (12th century pottery), Buzz-bone. Bone, pig third metatarsus, right, unfused. Unmodified but for single hole drilled through in approximate centre. Slight wear-polish on surfaces adjacent to hole. Length 62, max width 17. (See Illus 52)

SF0814A Context 1003, Area 1, graveyard soil; Counter. White ceramic. Circular counter. Design scratched into one side after firing. Diameter 32, thickness 5.

SF2241 Context 12128, Area 2, Grid K8, graveyard soil; Counter. Pot sherd, blue transfer printed. Fragmentary but with some of sanded edge still visible. May have formed circle or round-cornered square. Length 27.

9.11.3 Book clasp (Illus 124)

The book clasp is beautifully made and decorated and despite being found in the general graveyard soil is in remarkably good condition, though of course it could have been of some age when deposited. Book clasps were riveted to the bindings of books to secure them shut. The fish tail end of this example is fairly typical of 16th and 17th century examples (Margeson 1993, 74–5; Biddle and Hinton 1990, 755–8; Woodfield 1981, 92–4). A similar though less elaborate clasp was recovered from a 16th or 17th century context at the Hereford Tesco site (Gaimster 2002, 162).

SF0150A Context 1000/1003, Area 1, graveyard soil, Book clasp. Copper alloy. Decorative plate with fish-tail end and hooked narrow end. Decoration in form of diagonal hashers, rings, pierced holes and wheatear motifs. Plain back-plate, with leather strap sandwiched between two and held in place by two rivets at wide end, one at narrow end. Length 59, width 36+ (reconstructed 40).

9.11.4 Writing equipment

Two finds were related to writing though some centuries separate them.

The earliest is of bone (SF1197). There has been considerable debate about the function of these types of find. Current consensus is that they were probably styli used for writing on wax tablets (Biddle and Brown 1990; Egan 1998, 272; MacGregor et al 1999, 1974–6). The bone shaft would have been tipped with a metal pin. They are generally found associated with ecclesiastical or educational establishments, in the medieval period, to possibly as late as the 16th century (Egan 1998, 272). This find is missing its metal tip. The cleft break at the lower end of the shaft was probably caused when the pin broke away. Conceivably this could have occurred when the pin was initially inserted, though a degree of polish to the shaft suggests the object was used. Unfortunately it was not well stratified, but found in the general graveyard soil. It is likely that it dates to the working life of the medieval cathedral. Similar finds have been recovered from the Palace Yard site, directly adjacent to Hereford Cathedral, with another from the more domestic setting for the Tesco site, though both were misidentified as pins (Thomas 2002, 120, fig 7.21:17–18).

The second find (SF2106) is a slate pencil. These were used to write on slate tablets and are synonymous with Victorian schools. Despite making an unpleasant screeching sound against the slate, they were preferred to chalk as they were longer lasting. Broken pencils are regular finds in 19th century contexts and this one perhaps derives from the neighbouring school.

SF1197 Context 30003, Area 3, graveyard soil; Stylus. Bone, cattle/horse sized limb shaft fragment. Turned bone shaft, with rounded head above double ridged collar, four turned grooves at irregular intervals towards top of shaft. Broken at lower end. Length 53+, max diameter 6. (Illus 125)

SF2106 Context 1003, Area 1, Grid H15, graveyard soil; Slate pencil. Narrow cylinder of slate, broken both ends. Length 33, diameter 5.

9.11.5 Dividers

The dividers are probably related to stonemasonry or woodworking rather than navigation or map-making. They do not have the bow hinge that allows them to be used one handed, as often found on seafaring dividers (eg Redknapp & Besly 1997, 198–9; Price & Muckelroy 1974, 264). This type, as depicted in the c 1668 painting 'The Geographer' by Johannes Vermeer, are frequently illustrated on post-medieval maps and familiar from the symbolism of the Freemasons. It might be assumed that the relative plain functionality of these dividers is more likely associated with stonemasonry or carpentry rather than map-making. Findings in archaeological contexts are infrequent but some are known, such as a 16th or 17th century example from Ireland (Manning 2009, 71–3) or an 18th century example from Winchester (Goodall 1990,

277). They cannot be closely dated, as similar tools are still in use today. They were found in a late grave SK2063, an Elaborate Coffin burial of a young adult man, albeit under the right lower leg. It is possible that they represented a tool of the man's trade. It is also possible that he was a Freemason, buried with a symbol of the order. The Freemasons were first established in Hereford in 1729. Although there is no evidence to suggest that freemasons were buried with identifying symbols, the brotherhood is known to conduct Masonic funerals for members. The Hereford Journal records the funeral procession of John Cann in 1837, leaving from the lodge room at the Green Dragon Hotel on its journey to the place of burial (the location is not recorded). Preceded by a military band and members of the lodge, the coffin is recorded as having 'regalia on top of the pall'. Whether this regalia included a pair of compasses which were subsequently interred with the body is unknown, but it is not beyond the realm of possibility.

SF0443 Context 2063, Area 1, Grid C13, SK2063, Elaborate Coffin; Dividers. Iron. Two arms of plano-convex section. Top of one arm divided in two to fit around top of opposing arms when closed. Hinged at top within rounded knop. Corroded in part-open position. Length of arm 146mm. (see Illus 63)

9.12 LITHICS

BY JULIE LOCHRIE

Twenty-five chipped stone artefacts were retrieved during excavation. All are of flint typically of a mottled grey or grey brown colour, found locally. The flint finds were from various contexts with no marked distribution. Most are clearly prehistoric artefacts residual within later contexts. The assemblage does not allow detailed analysis of technology as the group is small with very little debitage present. For the same reasons it does not appear to be representative of a substantial flintworking industry. Nineteen of the pieces collected were tools. Very few are datable, however, SF569, SF646, SF849, SF2013, SF2146 are all probably later Neolithic or early Bronze Age in date. This clustering of dates would seem to suggest the material is representative of nearby or underlying activity from this period. If the material had been transferred in with topsoil or collected as medieval curiosities, the date and condition of the assemblage would probably be more diverse.

SF0569 Context 2624, Area 1, Grid B13, fill of linear feature; Knife. Fresh, dull grey brown, fine grained flint. Broken, medial and distal section of trapezoidal sectioned, secondary blade. Semi abrupt, almost scalar retouch to entire remaining left lateral. Thick, cortical right lateral. Length 33, width 7, thickness 8.

SF0646 Context 3373, Area 1, Grid D12, grave fill; Knife. Lightly patinated, medium-grained grey mottled flint. Inner, hard hammer blade with direct abrupt and acute inverse retouch to the right and left lateral. Length 35, width 17, thickness 6.

SF0849 Context 4557, Area 1, Grid C14, pit fill containing skulls; Scraper. Fresh, medium-grained, grey mottled flint. Large, sub-circular, inner, hard hammer flake with semi-abrupt retouch to the lateral edges becoming more abrupt at the distal end. Length 46, width 45, thickness 11.

SF0911 Context 4574, Area 1, Grid B13, Phsae 0, background deposits; Knife/Scraper. Lightly patinated, medium-grained, dull grey brown flint. Inner blade with semi abrupt, bifacial edge retouch to left lateral and direct abrupt retouch to right. The left lateral is gently concave whilst the right is straight. Could be used as knife or possibly even a side/distal scraper. Length 35, width 16, thickness 8.

SF2013 Context 40312, Area 4, Grid F3, pit fill; Arrowhead, barbed and tanged. Patinated medium-grained, grey/brown and cream mottled flint. Oblique barbs and a sub- square tang. Length 34, width 23, thickness 5, tang 9 x 7, barbs 5 x 4. (see Illus 2)

SF2146 Context 4579, Area 1, Grid C14, pit fill containing skulls; possible preform concave arrowhead. Translucent, fine-grained, dull brown flint. Hard hammer, secondary flake. This is triangular in shape with the 'point' at the proximal end. The distal end is concave. All direct retouch is abrupt and occurs on all edges. There is also a small amount of acute and semi abrupt inverse retouch to the left lateral. The flake has a longitudinal curvature which would not function well as a projectile. The inverse retouch may have been an attempt to rectify this. Length 28, width 21, thickness 6.

9.13 FUNERARY FINDS

This section covers all the finds which were associated with the burial rites and coffins themselves. Naturally most of the evidence relates to later burials with more substantial coffin remains. This took the form of nails, wire pins, studs, grips and grip plates. Very few coffins could be dated, either directly from information on the coffin itself or indirectly, via the use of decorative motifs known from dated graves elsewhere. In addition, none of the burials containing finds were C14 dated, but for one Simple Coffin (SK2121, Wk34553) which contained three nails. However, broad typologies have been devised for the various types of find and dating evidence presented or hypothesized as far as possible.

The size of the assemblages for these classes of finds is huge, making up the vast majority of the total finds assemblage. It was decided to focus analytical efforts on finds only from graves where the skeletal remains were analysed; that is those which were reasonably complete. Not only is the quality of finds data from these graves higher, but there are also osteological results with which to supplement it.

Three further graves were included in the finds study group, SK1721, SK2137 and the graves represented by wooden and lead coffins 4016 and 4015. These graves contain poor skeletal remains but both had good finds dating evidence. The former two both had information spelled out in studs, the latter had decorative coffin grips and grip plates which could provide dating evidence by association. There are two convincing examples of grave goods being deliberately placed in the burials. Discounting the rumbler bells whose presence can be argued to be functional rather than ritual, there are the dividers (SK2063) and the coin (SK1306) (both discussed above). A number of other finds were found in graves, though most are demonstrably residual. One belt buckle (SF1303) and one set of buttons (SF1293) may relate to clothing used to dress the interred bodies. These have been discussed above (See Dress Accessories & Toilet Items).

9.13.1 Lace tags

There were 15 copper alloy lace tags recovered from the site, though most or all are residual. Lace tags are small tubes of copper alloy used to bind the ends of laces to prevent fraying and ease threading. As laces became increasingly used in late medieval dress, for bodices, shirts and other garments, a similar increase in the number of lace tags is observed in archaeological contexts. They are known from the mid-14th century onwards, though there are occasional earlier finds (Egan & Pritchard 1991, 281), and their use continues into the 17th century (Margeson 1993, 22). The frequent finding of them in burial contexts indicates that laces were also sometimes used to secure shrouds.

Some of these finds might have been accidental losses, but given the history of the excavated area it is likely that many of these derive from burials, though only two are potentially in situ. Of the ten finds from graves, eight are associated with Elaborate Coffins which are too late to be contemporary with the use of lace tags. Two were found within Simple Coffins (SF0204, SK1373; SF0213B, SK1375). These coffins were poorly preserved, but appeared to be lacking coffin furniture and thus may be relatively early and the tags may have secured a shroud within them. Other finds came from post-medieval deposits [1063], [1071]) or the general graveyard soil [1003]. (see Table 79)

9.13.2 Wire pins

A large number of copper alloy wire pins were found during the excavations. Wire pins were used as dress accessories and as sewing aids from as early as the 13th century (Biddle and Barclay 1990, 561), becoming increasingly common during the late medieval and particularly the post-medieval period. Their use in a funerary context dates back at least as far as the 14th century (Nicolson 1997, 361). They are found singly or in small numbers in early graves and it is assumed that they were used to secure shrouds, more quickly and conveniently than by sewing (Litten 1991, 59). In later coffined burials, the large numbers of pins sometimes found suggests they were used to secure the textile coverings and linings of the coffin.

At Hereford Cathedral it seems likely that all the pins are funerary in origin. The vast majority were found in burials, with others deriving from the general graveyard soils and charnel pits. It is likely that their use dates back at least as far as the 16th century, with pins associated with 16th and 17th century pottery ([1204], [40197], [40325]), though it is possible that some are older still.

All statistics refer to minimum number of pins, calculated by number of heads. There were 998 pin fragments within the study group, from a minimum of 601 pins (the number of pin heads present). These were spread among 118 graves, though it is possible that many of these are residual. However, where large numbers of pins were found it seems likely that they were used within that grave.

Of the five Bone Only burials containing wire pins (SK3634, SK30949, SK30953, SK30993, SK31011), four were found in Area 3. The most found in a Bone Only burial is seven pins (SK31011) within a juvenile burial. The most found in a Simple Coffin burial (SK3696) was 12. It seems likely that in both cases, the pins were used to secure a shroud. Several elaborate coffins however, contained very large number of pins, up to 57 (SK1231) and here it seems likely that the pins were used to secure a textile lining within the coffin. (see Table 80)

9.13.3 Coffin grips and grip plates

Introduction

Grips is the terms generally given to the coffin handles. Sometimes, though not always these were set within reinforcing and decorative grip plates. All but one of the grips at the site were made of iron, as were all but a handful of the grip plates. Compared to other 18th and 19th century graveyard assemblages the assemblage contained very few of the moulded brass and tin grip plates found at sites such as Spitalfields (Reeve and Adams 1993). The non-ferrous plates in particular are very thin and delicate and it is likely that many have been completely destroyed. Fragmentary remains were found in a few graves.

Typological classifications were hindered by the poor preservation of some finds and it was not possible to undertake x-ray analysis of more than a handful of grips. However, it is not likely that this would have made the picture that much clearer. There is a generally lack of conformity in the grips and grips plates. Those used on the same coffin are generally the same shape. But between different coffins, though most are of broadly similar shape, few if any are exactly the same. It is possible that rather than being mass produced by coffin furniture makers these were in fact produced by local blacksmiths. This would explain the conformity of convention, but the lack of exact patterns.

Grips

The broad typology of the Hereford furniture is set out below. The grips all had out-turned terminals and were secured to the coffin via looped staples fixed through holes in the grip plate (where these are present) with the staple arms clenched on the interior to secure them in place. The typological variation is largely in the shape of the handle itself, from straight to rounded. However, some were clearly distorted from use, and bent distinctly out of symmetry. The original shape has been surmised where this was possible.

Quantifications note the number of such coffins on which these grip types have been used. Only coffins on which two or more of the same type of handle have been found are noted to avoid counting residual finds. Dating evidence noted at this and other sites. Grips are of iron unless otherwise stated. Hereford types are prefixed by HFD to distinguish them from other typologies. Where types have been found at other sites, or are similar to other examples known, then reference has been made to those typologies as follows: CCS = Christ Church, Spitalfields (Reeve and Adams 1993, 144–7, fiche 1–2); OLR = St Luke's Church, Old Street, Islington (Boston and Boyle 2005); Rycote = Rycote Chapel, Oxfordshire (Boston 2008); Kingston = Quaker Burial Ground, Kingston-upon-Thames (Bashford and Sibun 2007).

Most of the grips are of simple type and it seems likely that they had a long life span. Most can be dated to the 18th or 19th centuries, based on associations at other sites but the use of most on Simple Coffins implies that dating may reach back into the 17th century. HFD Grip 6 is the only distinctive decorative type, though even these have been shown to have a long life span elsewhere (1743–1847 at Spitalfields). It is possible that at Hereford, their use is limited to the 19th century.

Coffins had up to eight grips, that is three along each side and one at each end, though only one (SK12237) was found with this full complement and

it is possible that six was a more usual number. (see Table 81)

Grip plates

Most of the Hereford grip plates (HFD Grip Plates 1–3) were of the sam basic form. They all had a long central section, with expanded rounded terminals at either end. Some may also have cut-out decoration in the middle, though corrosion tends to obscure this or reduce it to ragged holes. They have been divided into three types based on the shape of the upper edge (the shape of the lower edge being generally obscured by the handle edge) and the shape of the terminals. However, there may be a functional element to this distinction as the larger plates (up to 220mm long) are generally of HFD 3 and the smaller (as little as 160mm) of HFD 1.

It seems likely that these three types had a long history and little chronological distinctiveness. No convincing differences were observed between types associated with Simple Coffins and those with Elaborate Coffins. Only two were associated with direct dates, both in the 1730's and 40's. However, it seems likely that the earliest date back to around the mid-17th century when the use of coffins becomes near universal (Litten 1991, 57). It is unclear whether they continue past the mid-18th century. There is no firm evidence for it, though similar simple plates have been found in 19th century coffins at other sites (Boston 2008; Bashford and Sibun 2007). The lack of decoratively moulded plates is perhaps more interesting, though this may simply be a matter of differential survival.

The only identifiable decoratively–moulded, non-ferrous grip plates present (HFD Grip Plate 4) were of CCS type 3, dated at Spitalfields to 1768–1847. At Hereford, these were exclusively associated with HFD Grip 4 and their use may be limited to the 19th century. (see Table 82)

Quantifications note the number of such coffins on which these grip plate types have been used. Only coffins on which two or more of the same type of grip plate have been found are noted to avoid counting residual finds. Dating evidence noted at this and other sites. Grip plates are of iron unless otherwise stated. Where types have been found at other sites, or are similar to other examples known, then reference has been made to those typologies as follows: CCS = Christ Church, Spitalfields (Reeve and Adams 1993, 144–7, fiche 1–2); OLR = St Luke's Church, Old Street, Islington (Boston and Boyle 2005); Rycote = Rycote Chapel, Oxfordshire (Boston 2008); Kingston = Quaker Burial Ground, Kingston-upon-Thames (Bashford and Sibun 2007).

Associations between grips and grip plates

There are few clear distinctions in terms of associations between grips and grip plates. Both the decorative HFD Grip Plate 4 were found with moulded HFD 6 grips. Some grips were more frequently associated with plates than others. Grip Plate 1 types are only associated with Grip 1, while Grip 5 are rarely associated with any plates at all. (see Table 83)

9.13.4 Studs

The studs (sometimes termed upholstery nails) were all of the same form, a domed head with integral square sectioned shaft generally of similar length to the head diameter. The size of the head varied considerably, with studs of different dimensions sometimes being used together. They are the same type of studs used commonly during the post-medieval period as upholstery studs for furniture. Evidence from other burial sites shows they were also used in a number of ways in coffin construction. Their basic function was to secure textile coverings to the exterior of the coffin, but the use of them went beyond the functional. They could be positioned in decorative patterns, sometimes highly elaborate (Litten 1991; Boston 2006, fig A2.41–8), and could also be used to spell out biographical information on the coffin lid (Litten 1991, 99; Bashford & Sibun 2007), usually in the simplified form of initials and date of death.

There was little evidence at Hereford for elaborate decorative designs in stud work, though a few of the coffins were well preserved enough for such detail to survive. Certainly the number of studs found associated with some burials implies there were some elaborate designs interred. The best preserved is SK11031 (described below). There were however seven examples of studs used to mark details on the coffin lids. All but one of these are tightly clustered between 1736 and 1746 (see Table 10). The last example (SK2137) is over a century later and would seem to be a conscious effort to return to an earlier tradition following the mid-19th century backlash against over-elaborate coffins (Reeve and Adams 1993, 77–8). (see Table 84)

The practice of using studs in this way however, has a much longer history than that implied here. It can be dated back to the second half of the 17th century (Bashford & Sibun 2007, 113), continuing throughout the 18th century, contemporary for a long period with the use of depositum plates to record the same information. While it was easier to record more detailed information on a depositum plate, the use of studs seems likely to have been a cheaper alternative.

The studs themselves can be made of either iron or copper alloy. A black coating on the heads of some of the iron studs is visible and it is possible that all were in fact painted black. The same does not appear to have been true of the copper alloy studs. The better condition exampled are still shiny brass in colour. Though problems of residuality mean it is difficult to make any definitive statements about the use of different type studs on different coffins, it seems that while different sized studs could be used for different details on the same coffin, on the whole they were either of iron or copper alloy rather than mixed use. There are a few cases of studs which seem to have been joined together in a row. This does not appear to be corrosion, but the original state of the studs. This is noted elsewhere and termed 'coffin lace' to ease the work in securing rows of studs to the wood.

In all 2313 studs were recorded in the study group, of which 70% were of copper alloy, the remainder of iron. Both had a similar size range from about 5mm to 22mm, though the larger studs were more likely to be of iron. The size of the iron studs averaged 14.2mm, as opposed to the copper alloy studs at 9.7mm (see Chart 10) for the range of stud sizes found in the two metals).

The distinction between Simple and Elaborate Coffins was in part defined by the presence or not of large numbers of studs, thus plotting the use of studs by burial phase forms a largely circular argument. However, studs were found in sufficient quantities associated with several of the Simple Coffins. The most notable of these was SK3756 featuring 57 large iron 16mm studs. However, the distinction was made that here the studs were arranged functionally

around the outside edges of the coffin to secure textile to the exterior, rather than being used decoratively.

9.13.5 Coffin decoration

But for the studs, very little remained of objects which could be termed coffin decoration, and fewer still were found associated with their coffins. A small square copper alloy mount was found in the grave fill of SK1849. This was decorated with pressed rings of beading, however, it seems unlikely that it would have been used alone and as it was unaccompanied by any other decorative finds, it cannot be securely associated with this burial

The exception was SK11031, from which a near complete set of decorative plates was recovered, though this may well not be representative of coffins at the site as a whole. It is described in detail below.

9.13.6 The coffin of Thomas Skyrme, 1831 (SK11031)

This was the best preserved of all the coffins, an Elaborate Coffin protected by a brick vault which had preserved large pieces of the coffin wood in sturdy enough condition to lift intact. It was the only coffin from the site with brass grips. Six were found, spaced out along the sides, all of HFD Type 6 (or CCS Type 4, dated at Spitalfields 1743–1847). All were fixed to HFD Type 4 brass grip plates (CCS Type 3, dated at Spitalfields to 1768–1847).

On the lid over the chest, was a very sturdily made shield-shaped brass depositum plate. The shield is of a type classified as Type 1 at St Martin's in the Bullring excavation in Birmingham, where it's use was dated between 1827 and 1862 (Hancox 2006, 159). Lastly there were two lid motifs: one, over the lower leg area was in the form of a large urn (CCS lid motif 2, 1795–1847); the other, was over the head area and was more fragmented but showed angels supporting a crown (CCS lid motif 6, 1779–1847).

Typologically then the coffin is likely to date between 1827 and 1847 and rather gratifyingly the clear engraved inscription on the depositum plate confirms just that. It reads "Thomas Skyrme, died 18 March 1831, aged 72 years". (see Illus 58)

There were also hundreds of brass studs used over the surface of the coffin These appeared to cover most areas, not taken with other plates and decorative motifs, arranged at approximate one inch intervals. The decay and collapse of the coffin means that not all areas are clear, but the studs formed a wide band, two rows thick along the edges of the sides and lid. They also infilled the corners and middle areas of the lid, and on the sides, infill the corners and between the grip plates.

The overall effect of this coffin when new would have been very brassy, certainly compared to the more restrained iron fittings used on most other coffins. The weight of brass in the depositum plate and handles means these fittings would have been costly. It seems that Thomas Skyrme or his family at least were keen to publicly demonstrate their wealth.

9.13.7 Coffin nails and other fittings

A detailed typology of the coffin nails was not attempted as it was unlikely to produce any useful data. The fittings did all appear to be nails rather than screws. The locations of nails within the coffins was not recorded in enough detail to reconstruct joinery techniques and it is unlikely that the retained finds represent a complete complement of nails for any of the coffins. The coffins were probably held together using medium sized woodworking nails, with small nails used to secure the lid. As many as 102 nails were found associated with a single coffin (SK1536), though the number retained was typically a great deal less, and no nails at all were recovered from many coffined burials.

There were very few other structural fittings associated with the coffins, no corner strap or large strap hinges. Two coffins were associated with finds of small butterfly hinges two were found with Elaborate Coffin SK3221, while another possible though less well preserved example (SF0535) was found with Simple Coffin SK2493. It seems likely that these hinged the lid, though this appears to have been a relatively rare feature.

Staples were also found in three burials, all of different phases. SK1282 was a U-shaped staple from Bone Only burial (SK31156) and may therefore be a residual structural fitting. A square staple SF0109, from Simple Coffin burial (SK1167) was possibly a joinery fitting used in the construction of the coffin. Lastly there were two large U-shaped staples (SF0603C) from Elaborate Coffin SK3221, both have out-clenched arms and may have been used to secure one of the grips.

9.13.8 Discussion of funerary finds

A summary of the finds evidence from all the burials is shown in Table 11. No finds at all, not even residual fragments, were associated with the Pre-Cist or Cist burials. Only one find was possibly directly associated with a Bone Only burial, buckle SF1303 (SK31469) which dates to between 1450 and 1550. However, the Bone Only burials are likely to have begun earlier than this, either during or before the construction of the Cathedral, continuing into the post-medieval period and petering out during the course of the 17th century (Litten 1991, 57). The latest C14 dates associated with Bone Only burials place them possibly as late as the early 17th century (SK10400, Wk34564; SK2654, Wk34556).

The earliest dating evidence for the Simple Coffins indicates a medieval origin (SK2121, Wk34553, 1259–1384). The majority of these coffins had no associated finds. The earliest of the finds dating evidence is not until the 17th century. Early coffined burials were likely to be for the wealthier members of society, while they became more universal during the post-medieval period. The use of Simple Coffins probably continues into the 18th century. (see Table 85)

The Elaborate Coffins have all the best associated dating evidence, including several coffins with firm dates. It seems likely that coffins became more elaborate over the course of the 18th century. The earliest firmly dated Elaborate Coffin comes with the first stud inscription in 1736 (?). Stud inscriptions seem to have come late to Hereford and lasted only a decade or so before being replaced in the mid-18th century with more decorative schemes in moulded metal.

It is the iron plate grip plates which form the largest and most distinctive part of the Hereford coffin furniture assemblage. It is possible that these date only as late as the mid-18th century with

1743 (?) being the latest date associated with them. However, there are suggestions at other sites that these type of fitting continue into the later 18th and 19th centuries (Boston 2008; Bashford and Sibun 2007). They may have been a cheaper or more sedate alternative to the decorative moulded fittings more familiar from that period.

The lack of decoratively moulded fittings is unusual. It is likely that this represents a real difference, the preservation of non-ferrous metal generally at the site was very good and even if the plates had crumbled, it is likely that some trace of them would be preserved as an impression within the iron corrosion associated with the handle (cf Franklin, in prep, All Saints Church, Headland Archaeology). The only coffin with a complete set of copper alloy grip plates, lid plates and depositum plate (SK11031) was protected by a brick vault. However, a further six coffins also found in brick vaults failed to show any evidence for moulded non-ferrous grip plates, but instead either simple iron plates or no plates at all. Preservation factors though must also have played role, exaggerating the rarity of these finds; some non-ferrous plates were found reduced to crumbs, and it is possible that some were not identified at all.

The far greater proportion of iron plates might be due to dating, to a larger proportion of 17th and early 18th century coffins than found at comparative sites. It may be due to the relative status of the individuals interred. Alternatively it may represent a real regional difference in burial tradition, whether due to simpler or more sedate sensibilities or the strength of the local ironworking industry.

9.14 STRUCTURAL FINDS

9.14.1 Window glass

BY RACHEL TYSON

Methodology

A total of 93 fragments of window glass were submitted for specialist examination. A further 87 plain sherds that were clearly of modern origin were not examined. The finds derived from Areas 1, 2 and 3. The glass was untreated. Most of the fragments were small and in a deteriorated and friable condition. The total area of the fragments came to only 323cm2, the equivalent of a panel measuring approximately 18cm x 18cm. The glass has been catalogued. Record sketches have been made of the painted fragments. Each individual sherd has been given its own catalogue number prefixed by GL, and they are referred to by these numbers in the text.

Historical background

The medieval window glass in Hereford Cathedral has had an unfortunate history, of vandalism and architectural disaster. For example, a letter from Henry VIII in 1547 required the removal of all images including stained glass (Whitehead 2000, 243), and in 1786 the west front of the cathedral collapsed. It is perhaps remarkable that any medieval glass is left installed in the cathedral. Reputedly the oldest glass from the cathedral, dating to the late 13th or early 14th century, is now installed in the east end of Allensmore church (Iles 2000, 314). The late 13th-century windows in the south side of the Lady Chapel are imports from St Peter's church in Hereford, installed in the 1850s (Iles 2000, 316). Victorian glazier William Warrington found several boxes of 14th-century glass in the cathedral, which he incorporated with new glass in his glazing schemes in the south choir aisle and north-east transept (Iles 2000, 314). The medieval glass currently visible therefore offers only 'tantalising glimpses' of the original schemes (Iles 2000, 214). Further glazing is documented in the following centuries, and on a larger scale in the 19th century. This report considers the fragments excavated in this assemblage, their origins, styles and relationship with the cathedral's known glass.

The excavated glass

At least 62 fragments are likely to be medieval. The earliest date to the 13th and 14th centuries, and measure up to 3.8mm thick. Their condition is typical of medieval window glass: friable with opaque brown surfaces, often crystallized in the centre, with the result that the original glass colour cannot always be seen; where it can it is usually greenish-colourless. 22 fragments have been painted with a red/brown pigment; other fragments have no visible decoration. They often have deep pits on the external surface of the glass. The best preserved fragment is also from this date, but a different glass type: rich cobalt blue in colour (GL47), it is a glass type often known as 'durable blue', and is the only complete quarry, grozed on all sides. GL73 (grave fill [4218]) is a crumbly collection of fragments with bright turquoise internal crystallization, and this unusual colour may indicate that the original glass was coloured, although not turquoise.

Later medieval glass (15th or 16th century) is generally a little thinner, and the flaky or iridescent weathering may only affect the surfaces rather than the glass core. Where the glass colour can be seen, most are greenish-colourless. Two fragments (GL9–10, graveyard soil [1003]), are a pale bluish colour. None of these fragments show any painted decoration.

Some of the fragments examined are much thinner and more likely to be post-medieval; again they have no painted decoration. Two later decorated fragments of interest are discussed below.

13th to 14th-century Grisaille

The decoration is very fragmentary and it is difficult to identify the larger pattern from which it comes, but several of these fragments have bold lines and curves typical of the grisaille style, probably from foliage or fruit designs (GL1, GL27, both from graveyard soil [1003]; GL28/29, GL32, GL43, GL74, GL93, from grave fills [1017], [1021], [1242], [4863] and [30415] respectively). Painted fragments GL28–29 show a thin line adjacent to a thicker curving line that may represent veining. Stiff-leaf grisaille was common from the early to mid-13th century in cathedrals such as Lincoln, Salisbury and York, and other religious foundations across Europe at that date (Marks 1993, 131–3). At this date the foliage often has a cross-hatched background; no grisaille with a cross-hatched background is represented amongst the excavated fragments here, although admittedly it is only a small sample. Similar stiff-leaf foliage continued but favouring a clear background in the later 13th century (Marks 1993, 141–2), and these fragments may belong to this style. By the end of the 13th century and into the 14th century, foliage is more naturalistic, as seen in the north aisle east window (Cowen 2012, Hereford Cathedral S3a) but not evident on any of the excavated fragments.

Fragment GL77 (layer [10023]) has two adjoining pairs of straight thin and thick lines, again consistent with a grisaille style. It is comparable

to the 14th-century stem-like decoration in the central diameteronds of the north-east transept window (Strong and Tavinor 2007, 17; Cowan 2012, Hereford Cathedral, S3a).

Complete blue quarry GL47 (grave fill [1314]) has one curved and two straight sides, and is an intense shade of cobalt blue. Geometric grisaille designs incorporating pot metal blue and flashed red glass with 'white' glass were favoured by the Cistercians in the 12th and early 13th centuries, but blue and red quarries of this shape were also popularly incorporated with painted glass in the mid-13th and 14th centuries. This quarry is similar to the red and blue pieces positioned between the foliage in the borders up the sides of the windows in the cathedral's 14th-century north aisle east window (Cowen 2012, Hereford Cathedral, S3a) and the north-east transept (Strong and Tavinor 2007, 16–17).

Other 14th-century designs

GL8 (graveyard soil [1003, Illus 126) shows a small border section painted within a quarry, with a serpentine line curving between a row of dots. The area to the side of this 'border' is painted in a matt black wash. Its small scale, and position as part of a quarry, suggests that it is a detail of a picture window, rather than a separate border quarry. The pattern is similar to that found on a border design that originates in the early 13th century, for example around the bakers' oven in a window showing the life of St John the Evangelist at Bourges Cathedral (Brisac 1984, 53, above); a similar fragment has been found with 13th-century grisaille at Battle Abbey (Kerr 1985, 134–5, no 30). Both of these have serpentine lines curving between small circles, rather than dots as here. The Hereford fragment is closer to a mid-14th century version, with dots rather than circles between the serpentine lines, as seen in a window at Kingerby church (Marks 1993, 161, fig. 128 left).

Black wash is also seen on other excavated fragments. GL57 (grave fill [1572], Error! Reference source not found.) has a black wash background, with part of the separate petals of a quatrefoil picked out. Similar quatrefoils can be found on a 14th-century window with a coat-of-arms in the Lady Chapel of Bristol Cathedral (Crewe 1987, 24, fig. 10). GL85 (fill of brick lined tomb [12144], Error! Reference source not found.) has an unidentified design, with stylised black wash areas also consistent with 14th-century designs (cf Crewe 1987, 25, fig. 11). (see Illus 126–128)

Enamel-painted design

GL79 (rubble layer [10180]) is a later fragment, but of interest as it shows a technique that became popular in the 17th and 18th centuries (continuing to a lesser extent in the 19th century), of painting designs onto plain glass using coloured enamel (Brown 1994, 28, 113–23). This fragment shows part of a large red star on plain yellow glass.

Victorian Grisaille (Illus 129)

Large fragment GL82 (fill of well [10800], Error! Reference source not found.) is in very good condition, still translucent with no external pitting. It is painted with bold red-brown lines of a grisaille stiff-leaf-style fleur-de-lis with fruits, within a thick and thin-lined border. Its condition suggests it is likely to be a Victorian replication. The Victorian glaziers, inspired by, and having great respect for the medieval glass, combined medieval glass with their new designs. William Warrington for example was well-known for his imitation of the grisaille foliate style, and installed designs in the north-east transept (Strong and Tavinor 2007, 16–17). It is possible that this fragment was painted in medieval style as part of one of these schemes. There is a (? medieval) quarry in the north-east transept, in the border to the above right of St Michael, showing a similar grisaille-style fleur-de-lis (Strong and Tavinor 2007, 16).

Conclusions

The window glass recovered from the Hereford cathedral excavations is a small sample giving 'tantalising glimpses' of the cathedral's former glazing schemes. The medieval glass shows evidence of later 13th and 14th century grisaille stiff-leaf foliage and a durable blue quarry consistent with grisaille glazing, and other 14th-century painted designs as well as some unpainted late medieval glass. Later glass of interest includes an enamel-painted star no earlier than the 17th century, and a probable Victorian replication of a grisaille-style fleur-de-lis. Most of the glass is from Area 1, to the east end of the cathedral outside the Lady Chapel and south-east transept, with particular concentrations in grid C12 and C13. However as most of the glass derived from grave fills and graveyard soils, it is likely to have been redeposited a number of times and thus may not relate to its original position in the windows. The circumstances of deposition likewise are unknown.

9.14.2 Ceramic Building Material

BY KATH CROOKS

Introduction

Ceramic building material was recovered from all four main excavation areas, ranging from the Roman to post-medieval periods. The majority of the material was in a very fragmentary state with few diagnostic fragments. A total of 169 fragments were identified as roof tile, of which 28 could be seen to be ridge tile. There were 91 fragments of floor tile and four fragments of brick, while 32 could not be identified. The medieval and post-medieval tile was sorted into fabrics using Vince's classification (Vince 1985, 65–71) and weighed by fabric.

Roman tile

A single fragment of flue tile with incised wavy lines for keying plaster was recovered from layer [5788], associated with Saxo-Norman pottery. A further fragment of Roman building material was used in the stony revetment of a series of late Saxon and medieval surfaces [4954]. It was covered in cement on both sides, and may have been part of a pilae stack or an arch. A Roman brick or tegula fragment was also found in gravel surface [3718], again residual, associated with later 12th century pottery.

Medieval roof tile

Few of the fragments of roof tile were diagnostic and no complete or near complete tiles were found on the site. Much of the tile was recovered from bulk graveyard soil deposits (eg [1003], which contained 58 pieces of roof tile, eight of which were ridge tiles).

Two medieval tile fabrics were represented: Herefordshire fabric A7b; and Malvernian fabric B4. Although coarser, the fabrics used for the

tiles are more or less identical to those of the pottery of the same type. Glaze was thin and patchy throughout making quantification of glazed and unglazed material difficult.

There were 113 tile sherds of Herefordshire Fabric A7b tile, including six sherds with knife cut crests. Four of these were very similar in form to another published tile from Hereford Castle (Vince 1985, fig 60.3). About half the tiles bore traces of glaze. In the majority of cases this was patchy, varying from clear to olive coloured. Tiles of this type have been dated from the late 13th to 15th centuries (Vince 1985, M7.E4).

There were a further 53 fragments of Malvernian fabric B4, of which 17 were identified as ridge tiles. One of these was decorated with a hand-formed crest (Vince 1985, fig 60.7). The proportion of ridge to flat tiles is higher than in the local Herefordshire tiles. The Malvernian ridge tiles seem to be thinner and lighter and it is possible that they were considered preferable. A lower proportion of these tiles were glazed, with only six sherds showing traces, though, the small number and size of the sherds mean that this might be unrepresentative. Malvernian ridge tiles of this type have been found in Hereford dating from the late 14th century into the post-medieval period (Vince 1985, M7.E8).

Medieval floor tile

There were 91 fragments of floor tile from the site, twelve of which showed evidence for encaustic decoration, with white clay inlaid into the red body of the tile. Designs could be made out in only eight sherds and there were no complete or nearly complete decorated tiles. Two examples had heraldic designs, one had three lions or lioncels, while another may be a stag. The remainder are floral or foliate. In most cases, tiles were glazed either a plain dark green or with a clear glaze over a white clay slip.

The largest group, 44 sherds, including all the decorated examples, were of Bredon type (Fabric A9). This is probably the earliest type of decorated floor tile to be found in Hereford, dating to the middle of the 14th century. Their petrology suggests that they were produced in the local area (Vince 1985, 70). Bredon type tiles have been found at a number of Hereford sites, including Greyfriars where their presence probably indicates plundering of monastic sites after the Dissolution (Vince 2002, 95).

Other types of tile were all plain. Most were of Malvernian fabric B4, with others of local Fabric A7b.

Post-medieval tile and brick

The majority of the remaining tile and brick from the site was in local fabric A10. One diagnostic fragment was present, a nib similar to a published example from Berrington Street, Hereford (Vince 1985, fig 60.11). The fabric is dated to between the mid-16th and the 18th centuries.

Discussion of ceramic building material

Roman tile was found in Saxon or Saxo-Norman contexts. Its presence, together with that of a small amount of Roman pottery, suggests that a Roman building may have been present somewhere close to the site. A considerably greater quantity of this material was found during the Mappa Mundi excavation (Vince 1994). It seems likely, therefore, that any building lay to the south and west of the areas excavated.

Very little medieval roof tile and brick was found on the site, probably a result of continued use of the area as a burial ground through the medieval and post medieval periods. The few decorated floor tiles showed signs of heavy wear. They must have continued in use until the design was worn away or they were broken. Eight of the decorated fragments were from Area 1, of which six were from general graveyard deposit [1003]. Their distribution probably indicates general dumping outside the building of material considered too worn or damaged for continued use inside.

9.14.3 Ironwork

There were few finds of structural ironwork. A number of the nails might relate to the fabric of the building, though it was impossible to distinguish these from coffin nails. A few staples too might be structural in origin. These have been discussed above (see Coffin Nails and Other Fittings). Hinge SF0691C was found with an Elaborate Coffin burial, but as it was alone, it is more likely to be a residual find from a door rather than a coffin fitting.

SF0691C Context 3642, Area 1, Grid C14, SK3640, Elaborate Coffin; Hinge. Iron. Large strap hinge. Two rectangular strips, probably broken at ends, joined at right angles. Two nails remaining in one strip, one in the other. Detail obscured by corrosion. Length of straps 82, 62, width 34

9.15 UNIDENTIFIED

The following finds were of uncertain function.

9.15.1 Copper alloy

The three perforations in the terminal of SF0607 were reminiscent of hooked tags and might suggest the object was fixed to something. SF0424 was clearly meant to be attached to something, but it is not clear what or if it served any function other than decoration.

SF0424 Context 1003, Area 1, graveyard soil; unidentified fitting. Copper alloy. Concavo-convex fitting, with flat strap emerging from one end. Three fixing loops at end and at two either side of strap junction. Strap curving and broken at end, possibly end originally hooked, possibly this is later distortion. Length 43, max width 19.

SF0607 Context 2719, Area 1, Grid C13, graveyard soil; unidentified tool/fitting. Copper alloy. Thick round sectioned shaft, expanding to flatter terminal at both ends. One end broken, the other flat and rounded with three perforations. Slightly distorted. Length 70, max width 12.

9.15.2 Iron

The pointed shaft of SF0899 might suggest it was fitted into a wooden handle or piece of joinery. The copper alloy bead is a decorative feature. Without the shaft it might be a fitting from a sword or a strap slide from a horse harness. With a hooked end it might be a hasp. It may have been intended for a fitting for the end of a chain.

SF0899 Context 5385, Area 1, Grid C13, Phase 1, fill of linear cut for revetment; unidentified fitting or tool. Iron. Elongated loop with straight sides, one rounded end and one square end, forming narrow slot in middle. Shaft or tang emerging from squared end, tapering to a point. Small bead of copper alloy fitted over shaft/tang at mid-point. Length 110, length of loop 64, length of slot within loop 36, max width 16.

9.15.3 Bone and antler

The remaining objects are clearly worked. Three appear to be unfinished, while the others are minimally modified.

The two possible beads are of similar form and were found close to each other (grid B13) and may conceivably have been made by the same hand. SF0864 was associated with 12th century pottery. Both are comparatively large but would have been suitable for use as part of a rosary. Both are handmade. A more practical method of manufacture would be to make the perforation first in a roughed out shape and then shape the bead on a lathe. It would at least seem prudent to drill the hole before polishing the surface as it is most likely to split at this point. This may well be the case with SF0908, where the attempts at drilling the perforation may have caused the longitudinal split in the bone. A bone peg inserted into the end might be an attempt to repair this. SF0864 seems to have been abandoned after an even more perfunctory attempt to drill a perforation, though it is not clear exactly why. The large size of both objects together with this seemingly unusual method of manufacture might suggest they have another function entirely. The association of SF0908 with a glass bead (SF0909) however, may suggest a comparative use.

A perforated bone may possibly have been an unfinished flute or pipe. These were made from perforated and finished long bones during the medieval period. However, it is relatively thick compared to other known excavated examples (eg Megaw 1990; Egan 1998, 287–8; MacGregor et al 1999, 1977). The slight wear around the middle of the bone might suggest another function.

Crude pointed tools such as SF2242 are known from contexts dating from the Anglo-Scandinavian period to the 13th or 14th centuries (MacGregor et al 1999, 1988–90). Their function remains obscure, though a use in leatherworking or basketry have been suggested (MacGregor 1985, 174–5).

Bone SF2243 appears to have been used to as a polisher or burnisher. The wear is consistent with being held in the hand at either end and rubbed from side to side over the surface of some object, possibly to finish wooden or pottery vessels.

The wear on SF2244 is quite different. One side has been worn completely flat with fine striations running the length of the bone. It has therefore been rubbed lengthways across a flat surface for some time. It is possibly a bone skate, though it lacks certain features often found on identified skates (MacGregor 1985, 141–4; MacGregor et al 1999, 1985–9). The upper surface has not been trimmed at all to fit the foot better, the worn surface does not curve up at the toe, and there are no strap holes. However, none of these features are essential to the function of a skate. Another possible explanation is as a smoothing or polishing tool, possibly for leatherworking.

SF0864 Context 4832, Area 1, Grid B13, Phase 2d, possible levelling deposit (12th century pottery); Unfinished bead? Antler tine, presumed red deer. Barrel-shaped, polished with flat ends. Indentation drilled into one end. Length 32, diameter 20.

SF0908 Context 5344, Area 1, Grid B13, Phase 2b, fill of linear feature; Unfinished bead? Antler tine, presumed red deer. Barrel-shaped, polished with flat ends. Indentation at one end with inserted bone peg. Damage to opposing end, longitudinal split, and burning to one side. Length 27+, diameter 16.

SF1284 Context 30003, Area 3, graveyard soil; perforated bone. Bone, cattle radius, right, distal missing. Long bone with two knife cut perforation towards one end. Broken at one end, saw cut in other. Slight wear-polish to central part of shaft. Length 191+, max width 67.

SF2242 Context 4834, Area 1, Grid C14, Phase 3a, layer (13th century pottery); Pointed tool. Bone, sheep/goat left tibia, distal end. Bone split at oblique angle to form crude pointed tool. Traces of wear along sides, including exterior of pointed end, but little to the point itself. Length 96, max width 20.

SF2243 Context 12108, Area 2, Grid K8, layer; Polished bone. Bone, cattle left metatarsus, distal unfused. Unmodified long bone, with considerable wear polish on one side. Wear in form of flattened area, with lateral striations, smoothed and polished from subsequent use. Wear visible at both ends, surface damaged in middle. Slight polish on sides. Length 166, max width 39.

SF2244 Context 30088, Area 3, Grid J6, layer (10th/11th century pottery, Polished bone. Bone, cattle radius. Large unmodified long bone, though on the worn side, traces of modification would be obscured. Worn completely flat on one side, into the spongy interior at either end and through the whole thickness of the bone wall towards one end. Fine longitudinal striations visible on worn side. Traces of lesser wear polish on edges and opposing side. Length 187, max width 61.

9.16 DISCUSSION

9.17 INTRODUCTION

The finds assemblage is both large and varied, though in common with many graveyard assemblages suffers from disturbance and residuality. Few finds were well stratified meaning they are of limited value in terms of dating. For finds such as the pottery, ceramic and glass building material this means small sherd size and a lack of joining sherds which could have provided more insight into the types of finds and designs in use. The preservation of metalwork, conversely, was, for the most part, very good, particularly for the non-ferrous metals, but also for some iron finds. Particularly remarkable in terms of condition were a copper alloy rumbler bell (SF0667) with an iron pea, still mobile within it, a copper alloy book clasp (SF150A) in near perfect condition and an iron heckle or wool comb tooth, with hardly a speck of corrosion. It seems however, that the coffin furniture has not fared so well, with very few decoratively moulded coffin plates surviving.

The excavation strategy also had a large bearing on the nature of the assemblage. The most comprehensive excavations were undertaken in Area 1 and hence the assemblage from this area makes up approximately 75% of the whole. About half of the rest is from Area 2, with the remainder split between Areas 3 and 4. The apparent concentration of activity in Area 1 is therefore not representative of the real picture.

9.17.1 Early finds

The earliest finds recovered are of prehistoric date. These amount to a collection of residual lithic artefacts, most notably a number of scrapers, knives and an arrowhead dating to the later Neolithic or early Bronze Age, in areas 1 and 4. It seems likely that these represent residual material from nearby activity of this period.

The next period represented is Roman, though again, all are residual in later contexts. Finds include a sherd of box flue tile and a possible pilae, both parts of hypocaust systems, implying a bathhouse or structure of some status. Larger quantities of Roman finds were recovered from the Mappa Mundi excavations (Vince 1994) and thus it seems likely that there may be a nearby structure of this date. Roman pottery was clearly to be found during the medieval period at the site, with at least one Roman pot sherd used to manufacture a spindle whorl (SF2012). A partially formed rotary quern apparently reused as a hearth edging stone may also belong to this period, though it cannot be closely dated.

9.17.2 Late Saxon (late 9th to 11th century)

The earliest stratified finds on site potentially date back as far as the 10th century, possibly earlier. However, few finds are closely datable and the only find of note from Phase 1 deposits, dated to the late 9th century is an iron awl which cannot be dated at all.

Finds generally characteristic of this late Saxon period include pottery fabrics D1 and G1, a number of hooked tags, an annular glass bead (SF0909), two knives with angle-backed blades (SF0902, SF0866), and several spindle whorls (SF0800, SF0855A, SF0883) as well as a coin of Cnut dating to the 1020's (SF0818). Several of these were stratified in Phase 2 and 3 deposits confirming the early 10th to mid-11th dating of those phases.

The finds from these early layers imply a mixture of domestic occupation and iron-working. The pottery is largely made up of jars and cooking pots. There is evidence for both blacksmithing and textile working. The blacksmithing evidence includes an early fragmentary example of a horseshoe (SF2160). Several stone hones are also likely to be related to ironworking, though they could equally have had a domestic use. The textile-working tools are in the form of two spindle whorls (SF0855A, SF0855B) and a pin-beater (SF1050) all from the same industrial deposit [4836]. However, the type of textile working represented is likely to have been from domestic occupation, rather than any large scale industry. A hooked tag (SF0903) and pig fibula pin (SF2003) from habitation layers also more likely relate to general occupation. An arrowhead is a more unusual find (SF2143) and perhaps a product of one of the site blacksmiths.

9.17.3 Saxo-Norman (L.11th to 12th century)

The construction of the present Cathedral began in either the late 11th or early 12th century and this period is likely to be represented by Phases 5 to 8. The Cathedral's construction does not necessarily bring the end of occupation and industry on the site. The long programme of building works would have necessitated dwellings for the craftsmen and labourers and a large support network to feed and provision them and to supply the tools and materials needed.

Blacksmithing probably continued into this period, making both the constructional iron components needed as well as making and repairing tools, though none of the industrial waste could be demonstrably tied to this period, two horseshoes (SF0543, SF0824) may be the products of local smiths. The quantity of pottery also shows continued domestic occupation, though perhaps with certain aspects of the finds assemblage are missing from this later phase. The standard female pursuit of spinning is not represented at all in 12th century deposits. None of the spindle whorls are definitively datable to this period. The presence of children on site though might be surmised by the buzz-bone toy (SF2007). The influx of newcomers to the area that the construction work would have brought is perhaps reflected by the first instance of a security-related find, a padlock slide key (SF0867).

9.17.4 Later medieval to early post-medieval (13th to mid-17th century)

From the 12th and 13th centuries onwards, activity in the excavation area is almost exclusively in the form of burials and thereafter the finds evidence becomes more piecemeal. Evidence of 13th century activity comes largely from coins, with comparatively little pottery. The reverse is true in the 14th century where there is a larger pottery assemblage but only one coin, while nothing at all can be definitively dated to the 15th century. The 16th and first half of the 17th centuries are also poorly represented by a small collection of pottery, a drinking glass sherd, two coins (SF0054, SF0423), a jeton (SF0400), and a single clay pipe bowl.

A few finds of dress accessories of this period may have been accidental losses in the churchyard or have been interred with the dead. The buckle, SF1303 is the best candidate for the latter, but it is likely that a number of the wire pins and lace tags also derive from this source. The rumbler bells are more likely to have been worn by church goers on festival days.

There are a number of building related finds belonging to this phase. No pieces could be dated back to the original 12th century structure, with the earliest being fragments of 13th century window glass. It is notable that Area 1 where more deposits were excavated is some distance from the Norman parts of the cathedral. From the 14th century there are floor tiles, roof tiles and further window glass. Deposition of the finds is probably indicative of on-going repairs and alterations to the original building. Other finds clearly relate to the use of the cathedral, most notably two rotary keys and a bone stylus (SF1196).

9.17.5 Later post-medieval (mid-17th to 19th centuries)

The levels of deposition from the mid-17th century increase. There are two aspects to this deposition: burials; and midden material.

Though the burials had clearly been going on for some centuries, it is only from the later 17th century that they become highly visible in the finds assemblage. Coffin burials become standard over the course of the 17th century. Coffin fittings of wrought iron grips and grip plates are commonplace from at least the early 18th century, probably earlier, as are metal upholstery studs. There are some interesting differences between this funerary assemblage and those from other 18th and 19th century cemetery excavations which are discussed above (see Discussion of Funerary Finds).

The midden material includes a good many finds that relate to general domestic occupation, most of it spread through the general graveyard soils. There may be a concentration of material in the second half of the 17th century, though this is most dramatically demonstrated by the clay pipe assemblage, and it may simply be due to the peak in local clay pipe production at this time. As well as clay pipes, other domestic, or at least non-funerary finds include: as many as ten coins and tokens; glass wine bottles; local and Staffordshire pottery bowls, jars, flagons, bottles, cups, tankards, dishes and plates; buttons; buckles from shoes and knee breeches; hair curlers; and gaming counters. Some of these are doubtless accidental losses in the graveyard. In the case of the pipes, bottles and gaming pieces, there may also be an element of the undertaking of these vices within the graveyard itself, either by gravediggers or members of the general populous. Other material may have been brought in as midden mixed with landscaping deposits and spread though the soils by continual grave cutting.

An apparently undisturbed assemblage was found in the late 18th century demolition deposit [40418] associated with a structure in Area 4. The finds include 30 sherds of glass and a further 25 of pottery, mostly from stoneware and glass bottles and also a tin-glazed jar and a Staffordshire slipware tankard. It is conceivable that these finds are part of a collection of items that were stored in the structure, though equally they may simply be midden material discarded as backfill.

10 PALAEOENVIRONMENTAL SAMPLE ASSESSMENT

BY SARAH-JANE HASTON AND DR SCOTT TIMPANY

10.1 INTRODUCTION

Archaeological excavation at Cathedral Close, Hereford prior to landscaping around the cathedral led to the discovery of a large number of graves and below these hearth, posthole and structural features, relating to the development of this area from the Anglo-Saxon periods onwards. During the course of the excavation bulk samples were taken for the retrieval of palaeoenvironmental and archaeological materials that may provide dating evidence for these features.

This report presents the results of the bulk sample assessment from these features. A total of 233 bulk samples were taken during investigations of which 145 were processed for assessment. The aims of the assessment were to:

- Assess the presence, preservation and abundance of any palaeoenvironmental materials within the samples.
- Assess the potential of the material for any indications of the use of these features.
- Assess whether a proxy-date for these features can be provided based on any palaeoenvironmental materials present.

10.2 METHOD

Samples were processed in laboratory conditions using a standard floatation method (cf. Kenward et al, 1980). All plant macrofossil samples were analysed using a stereo-microscope at magnifications of x10 and up to x100 where necessary to aid identification. Identifications were confirmed using modern reference material from the collection at Headland Archaeology and seed atlases including Cappers et al (2006).

After processing a small number of bulk samples from the grave fills (see Tables 87 and 88) it was decided that processing would concentrate on the earlier deposits rather than these fills. This decision was taken on the basis that only a small quantity of charred plant remains were returned from the samples and these provided little interpretative evidence for the site. Their presence within grave fills, which are likely to consist of reworked and mixed material; therefore there is no stratified security of the contexts.

10.3 RESULTS

The results of the sample processing are provided in Table 86 (Radiocarbon dating results), Table 87 (Retent finds) and Table 88 (Flotation finds). Suitable material for AMS dating is also identified within each table. All plant remains were preserved through charring.

10.3.1 Radiocarbon dating

Material from three samples was sent for radiocarbon dating in order to gain a better idea of the chronology for the activity on the site. All dates in the text are presented using the 2 σ calibrated age ranges. The dates are given in conventional age following Stuiver and Polach (1977).

The earliest dates from the site was returned from charred emmer wheat (Triticum dicoccum) grain in Sample 580, taken from posthole [5250] which gave an Anglo Saxon date of cal AD778–970 (Wk34568; 1156±27 BP). Two further Anglo Saxon dates were provided from charred oat (Avena sp.) grains from samples 475 and 486. Sample 486 was taken from ash layer [4570] and returned a date of cal AD899–1033 (Wk34566; 1039±28 BP). Sample 475 was taken from was taken from the fill (4990) of hearth [4991] and produced a date of cal AD902–1040 (Wk34567; 1026±27 BP). The full results of the radiocarbon dating are shown in Table 87.

10.3.2 Charred plant remains (CPR)

Charred cereal grain was found in eighty of the samples processed (see Table 88). The grain assemblage includes, primarily, oat (Avena sp.) and hulled barley (Hordeum vulgare). The majority of the oat

grains did not have the diagnostic parts of the flower base preserved, which restricted identification to genus level. Lesser amounts of wheat grains were also identified in the form of bread/club wheat (Triticum-aestivo-compactum), emmer wheat (Triticum dicoccum) and wheat sp. (Triticum sp.) where poor preservation made the species uncertain. Cultivation of these cereals is generally associated with Later Prehistoric, Anglo-Saxon and Medieval periods and cultivation of oat and barley has continued up to the present day in the British Isles (Hinton 1991). A small number of grains were in such a poor state of preservation that identification was not possible; these are shown as indeterminate cereal (Cerealia indet.). Preservation of the grain was generally good and a high proportion of the grain was excellently preserved.

A range of wild taxa are present within the assemblage, however, the majority occur with concentrations of cereal grains in a small number of samples (Table 88). The fruits, seeds, achenes, etc (henceforth referred to as seeds) present are typical ruderal/segetal species of the British Isles, ie species associated with agricultural fields and disturbed ground. Those present include: common fumitory (Fumaria officinalis), common nettle (Urtica dioica), fat-hen (Chenopodium album), pale persicaria (Persicaria lapithifolia), knotgrass (Polygonum aviculare), docks or sorrel including common sorrel (Rumex acetosa L.) and sheep's sorrel (Rumex acetosella L.), wild radish (Raphanus raphanistrum L.), pea/vetch (Vicia/Lathyrus), cleavers (Galium aparine), nipplewort (Lapsana communis L.), corn marigold (Chrysanthemum segetum), scented mayweed (Tripleurospermum inodorum), sedges (Carex sp.) and small grained grasses (Poaceae sp.). The cleavers, field pea/vetch and siliqua segments (seed pod fragments) of the wild radish are fairly large and may represent elements of the weed flora that were close in size and density to the grain and therefore more difficult to remove during processing (Hillman, 1982).

Also of interest is the occurrence of a number of scrub and hedge bank species such as elder (Sambucus nigra) fruits, blackthorn or sloe (Prunus spinosa) fruit stones, and woodland species such as fragments of hazel (Corylus avellana) nutshell (see Tables 87 and 88). These remains suggest that native woodland or hedgerow fruits and nuts were also being gathered and consumed.

Wood charcoal fragments are present in all but eight of the samples (447, 485, 573, 597, 630, 635, 697 and 721), often of a size and condition suitable for identification and/or Accelerated Mass Spectrometry (AMS) radiocarbon dating (see Tables 87 and 88). The large quantities of wood charcoal fragments present in a range of sizes above 1cm^2 and up to 5cm^2 are suggestive of in situ primary refuse from features or deliberately dumped fire debris. The majority of the charcoal fragments recovered were, however, of small sizes (<1cm) with a large number of fragments identified as roundwood, suggesting that the bulk of the material represented small branches or twigs (see Tables 86 and 87).

10.3.3 Other finds

Burnt bone fragments were recovered in rare to abundant quantities in 133 samples, while unburnt bone fragments were retrieved from 110 samples. Bone fragments within the samples have been identified to the level of mammal and fish (see Table 87). Lithics were present in just two samples (579 and 606). Potential domestic evidence in the form of medieval to post-medieval pottery sherds were present in 25 samples, while ceramic building materials (CBM) in the form of tile fragments and non-ceramic building materials were found within 9 and 12 samples, respectively (see Table 87). Other evidence for building materials in the form of mortar fragments were retrieved from 7 samples. Glass sherds and glass waste which may be representative of building materials and/or industrial waste were recovered from 10 and 9 samples, respectively. Further evidence of industrial activity is present with the occurrence of iron (Fe) slag in 31 samples, lead (Pb) slag in 17 samples and magnetic residue (Mag res) in 2 samples (see Table 87). Metal objects were also recovered from the processed samples with copper (Cu) objects retrieved from 7 samples and iron objects from 24 samples. Cinders were recovered from a small number of the samples and probably originated from hearth sweepings, which were incorporated into rubbish pits. For further information on the recovered pottery and other finds please refer to the finds report.

10.4 DISCUSSION

A brief overview of the palaeoenvironmental evidence is discussed in relation to the four main areas (Areas 1–4) and associated sub-phases of the site that bulk samples were taken from.

10.4.1 Area 1: St John's Quad

Five phases of activity have been identified in Area 1 (see Tables 87 and 88). The earliest phase of activity in this area (Phase 1) is associated with the remains of a burnt down structure (Building 1). A returned radiocarbon date from charred emmer wheat from posthole [5250] indicates this building was active in the medieval period around cal AD778–970 (Wk34568; 1156±27 BP) (see Table 86). A small quantity of charred cereal grains were recovered from associated features of this structure. Oat and hulled barley were present in the majority of samples, with lesser amounts of emmer wheat and club/bread wheat recovered (see Table 88). It is likely the charred grain from these deposits relate to food waste, with both burnt and unburnt mammal bone retrieved from this area in rare to abundant abundances, together with a small quantity of unburnt fish bone. The occurrence of a small quantity of charred hazel nutshell also within posthole [5250] is also likely to represent food waste and is a ubiquitous find in Anglo-Saxon plant assemblages (Green, 1994). Charcoal fragments were present in all but one of the samples (573) from this phase, with fragments up to 5cm in size indicating they are likely a mix of structural and fuel timbers.

The second phase of activity (Phase 2) relates to a number of short-lived structures and industrial deposits, including hearth features. Activity from this phase has been dated from pottery and finds evidence to the 10th to 11th centuries, with radiocarbon dates from charred oat grain from samples 475 and 486 narrowing down the timeframe to between cal AD899–1033 (Wk34566; 1039±28 BP) and cal AD902–1040 (Wk34567; 1026±27 BP), respectively (see Table 86). The industrial nature of these structures is highlighted by the recovery of iron slag within each of the sub-phases (Phases 2a–2e) from this period; especially in the latter sub-phases (2d–e) where the largest quantities of iron slag were retrieved. Charcoal fragments present across these sub-phases are likely to largely represent wood

fuel used in metal working activities. Associated features such as hearths and rake-out deposits are seen to contain abundant charcoal fragments of up to 3.2cm in size. The presence of CPR, including hazel nutshell, field pea (Pisum sp.), blackthorn fruit stones and cereal grain together with burnt mammal bone from within these deposits (see Tables 87 and 88) suggests domestic (food) debris may have been burnt alongside wood fuel in the hearths. However, the presence of unburnt bone also within these deposits indicates that a general layer of domestic debris may cover this area following these structures and features going out of use.

Charred grain is present in all of the sub-phases but is particularly sparse in Phase 2a, where only a rare abundance of indeterminate cereal was recovered (see Table 88). Across the sub-phases oat is seen to be the commonest cereal type recovered, with smaller quantities of hulled barley, wheat sp. and club/bread wheat, suggesting oat was the main cultivar during this period. The occurrence of field pea in the CPR assemblage from this phase also provides some evidence for mixed farming of cereals and legumes in this period. Ruderals are also present across the sub-phases with the presence of arable weeds such as common nettle, pale persicaria, common sorrel and corn marigold present (see Table 88). Abundant oat was recovered from black silt deposit [4571] in sub-phase 2d; this deposit also contained small quantities of hulled barley and wheat sp. together with abundant burnt and unburnt mammal bone, abundant fish bone and abundant charred hazel nutshell. Charcoal fragments were also present in this deposit in rare to common abundances (see Tables 87 and 88). The deposit would appear to represent a midden of food debris with no other materials present in the sample.

The third phase of activity (Phase 3) in this area is represented by a spread of dark brown silty-clay, which overlies the Phase 2 features. Two sub-phases were identified (Phases 3a–b) within this period (see Tables 87 and 88). No radiocarbon dates are available for this phase; however, pottery sherds from this deposit indicate a most likely date of early to mid-11th century. Pottery sherds dating from 12th to 15th century were also recovered from this layer but are thought to represent intrusive material associated with later burial activity. Charred cereal grain was found to be scarce within sub-phase 3a, with only a small quantity recovered from Sample 465 taken from burnt deposit [4957]. The largest quantity of material retrieved from features in this sub-phase was faunal bone and in particular unburnt mammal bone, which was found within all contexts (see Table 87). Abundant charcoal was also recovered from burnt deposit [4957] with fragments up to 3.0cm in size indicating deliberate disposal. The materials recovered from sub-phase 3a indicate a general spread of domestic waste over the site.

Charred cereal grain is more abundant in sub-phase 3b, particularly in Sample 466 from the fill (4945) of pit [4944], which was found to contain abundant oat grain, together with a small quantity of hulled barley (see Table 88). This pit also contained an abundant quantity of lead slag and thus may have had an industrial function. Charcoal of up to 2.0cm in this pit may be related to such activity as much as to the spread of general domestic debris. As well as the charred grain, this debris can be seen from the abundant burnt and unburnt mammal bone present within pit [4944], together with a small quantity of charred hazel nutshell and pottery sherds. Faunal bone was also recovered from the other two features from this sub-phase. The materials from these features are similar in composition to the assemblages from sub-phase 3a and again suggest a spread of general domestic waste across the site during this period. The abundance of lead slag within pit [4944] provides some evidence of potential metal working.

The fourth phase of activity (Phase 4) is associated with a foundation cut for a large structure, which cuts through the previous phases of activity and is thought to be of early 11th century date. Abundant charred oat grain was recovered from silty clay layer [4498], together with a small quantity of wheat sp. grain and a range of arable weeds' including: wild radish, corn marigold, nipple wort and grasses (see Table 88). The presence of small amounts of light chaff elements in the form of palea and lemma fragments, together with culm nodes within this assemblage indicates some probable small-scale (eg domestic) processing of grain at or neat to the site (Boardman and Jones, 1990). A significant quantity of oats, together with smaller quantities of hulled barley and club/bread wheat were also recovered from clayey sand layer [4693] within this phase.

As with the previous phase (Phase 3) burnt mammal bone is present in significant quantities across the Phase 4 features, with unburnt mammal and fish bone both restricted to clayey sand layer [4963] again suggesting this layer is largely a spread of domestic refuse (see table 87). There is also evidence for industrial activity within this layer with abundant iron slag recovered, whilst a small quantity of lead slag was retrieved from clayey sand layer [4963]. Probable building materials in the form of ceramic tile and other ceramics were also recovered from features in this phase. Overall the assemblage from Phase 4 is similar to that of Phase 3 and appears to represent a further spread of midden material across the site.

The final phase at Area 1 (Phase 5) is associated with a large ditch feature of unknown function, which cuts through the underlying Phase 4 structural features. A large pit, furnace and two small hearths present also relate to this phase of activity. No radiocarbon dates are available for this phase but pottery dates indicate that activity took place in the late 11th to early 12th century. A similar mix of materials was recovered from samples taken from features belonging to this phase as the previous two phases (Phases 3–4). Evidence for industrial activity was present with the recovery of common to abundant iron slag in hearth [4749] and furnace [4771] indicating they may have been used for metal working. A small quantity of lead slag was also retrieved from the upper fill (4732) of hearth [4749].

Probable domestic debris was also recovered from the hearth and furnace deposits, including small quantities of charred oat cereal grain along with burnt mammal bone and unburnt mammal and fish bone. The presence of charred food waste within these features is similar to that seen in Phase 2 (see above) and may relate to domestic waste being burnt in the hearths and furnaces or that it represents a general spread of material after these features had gone out of use. Abundant burnt mammal bone together with a small quantity of oat was also present in the cobbled surface deposit [4773], which is again suggested to relate to this general spread of domestic debris across the area. Charcoal fragments present within these samples are likely to relate to a mixture of wood fuel used in the hearths and furnaces and domestic fuels mixed in with the spread of refuse materials.

10.4.2 Areas 2 and 3: the Northern Close

The earliest deposits in this area are thought to be of early medieval date and in Area 2 are associated with grave fill samples and Area 3 with a pit and clayey-silt and charcoal layer. The grave fill samples (639 and 640) in Area 2 contain a mix of materials. Sample 639 is seen to contain abundant iron and lead slag (see Table 87), together with small quantities of unburnt mammal bone, club/bread wheat and charcoal. The abundant slag within this deposit indicates the grave has either cut into industrial deposits or later intrusive industrial material has subsequently accumulated in the grave fill. Sample 640 also contains some industrial waste in the form of a small quantity of lead slag, together with a mix of burnt and unburnt mammal bone, small quantities of charcoal and cereal grain of oat, wheat sp. and club/bread wheat. The grave fills are likely to contain a mix of reworked and redeposited material. In Area 3 small quantities of potential food waste in the form of burnt and unburnt mammal bone together with charred grain was recovered from pit [30233], while abundant iron objects were present within deposit [31105] along with smaller quantities of burnt and unburnt mammal bone.

The next phase of activity dates to the 10th to 11th century and is present within Area 2. Here burnt deposit [1113] was found to contain abundant charred oat and hulled barley grains, together with a small number of arable weeds, such as corn marigold and fat hen (seeTable 88). Also within this deposit were small quantities of burnt and unburnt mammal bone together with iron objects. This spread may relate to waste from a cereal-drying kiln as it largely consists of charred grain. The presence of few arable seeds indicates this was a clean crop prior to drying, with most ruderals and chaff having been removed. It may be that the probable hearth demarked by a red burnt clay deposit in this area was either a cereal drying kiln or used as one.

The majority of the features in these areas date to the 11th to 12th centuries (see Tables 87 and 88). For the most part charred cereal grains predominantly of oat and hulled barley are seen to be scattered across the features, while club/bread wheat is occasionally present; indicating oat and hulled barley are the main cultivars during this period. This is similar to Area 1 although there is a stronger presence of hulled barley in Area 2. A large quantity of hulled barley was recovered from burnt occupation layer [12088] in Area 2, together with significant oat grains (see Table 88). Small quantities of burnt and unburnt mammal bone were also recovered from this layer. The presence of such a large quantity of grain and the absence of weed seeds again suggests represents a clean crop prior to charring and may again be representative of cereal drying kiln waste or from a feature such as hearth used to dry grain at the site. A mixture of materials was recovered from across samples of this date in both Area 2 and 3 with domestic refuse highlighted by the occurrence of burnt and unburnt mammal bone and smaller quantities of unburnt fish bone, pottery sherds and glass. Industrial materials are also present with the recovery of lead slag, iron slag and magnetic residue, together with copper and iron objects.

Some potentially later deposits were also identified in these areas with a probable 13th to 14th century pit in Area 3 containing small quantities of burnt and unburnt mammal bone together with pottery, glass, indeterminate cereal and abundant charcoal suggesting a fill of domestic waste. In Area 2, pit [1126] is of potential 18th to 19th century date and was found to contain abundant charcoal fragments up to 3.4cm in size, together with smaller quantities of burnt mammal and fish bone and unburnt mammal bone. The assemblage from this pit together with the large size of the charcoal fragments recovered indicates it may have been used either as a charcoal production pit or as a place to discard fuel waste.

10.4.3 Area 4: the West End

The earliest phase of activity at Area 4 is thought to be of possible early medieval date and relates to charcoal rich deposit [40091] and burnt deposits [40070] and [40354] (see Tables 87 and 88). These deposits were found to contain mainly charcoal fragments, the majority of which were small-sized fragments (<1.0cm) and burnt and unburnt mammal bone; a small quantity of unburnt fish bone and indeterminate cereal was also recovered from charcoal-rich deposit [40091]. This material appears similar to the spreads of domestic debris seen in Areas 1–3.

Features within this area are thought to be mainly of 11th to 12th century date, the same period most of the features in Areas 2–3 are believed to date to. No radiocarbon dates are available for these features and thus they have been dated based on pottery recovered from the site. Two features from this period produced abundant cereal grain, silt and charcoal layer [40373] and sandy silt layer [40394] (see Table 88). These deposits contain abundant oat and common to abundant hulled barley grain, with abundant indeterminate cereal grain also recovered from deposit [40373]. No wild taxa were present in either deposit indicating that the grain was a clean crop prior to becoming charred. The dominance of oat and hulled barley in these samples again suggests they were the main cultivars of the period, which was also evidenced in Areas 2–3, while in Area 1 oat was seen to be the main cultivar (see above). A mix of other materials were also retrieved from the samples (737 and 740) from these deposits, with small quantities of burnt mammal bone in each deposit along with common abundances of unburnt mammal bone and small quantities of charcoal. Again these deposits appear to be spreads of domestic debris, although the abundance of grain suggests this may relate to the dumping of kiln waste as indicated in Areas 2 and 3. Silt and charcoal layer [40373] also contained abundant other ceramic, a small quantity of glass waste and a copper object. There is some evidence of industrial waste in sandy silt layer [40394] with a common abundance of lead slag contained, together with a small quantity of pottery sherds of probable domestic origin.

Small quantities of charred cereal grain of oat, hulled barley and club/bread wheat are present in three other samples (720, 723 and 729) from this period (see Table 88). Other probable food debris of burnt and unburnt mammal and fish bone, together with charred hazel nutshell fragments were also found in the samples from this period (see Table 87), which as in Areas 2–3 suggests a general spread of domestic debris across the site. There is further evidence of industrial activities with lead slag recovered in occasional to common amounts from clay surface [40069], yellowish sand layer [40081] and the fill (40152) of industrial feature [40153]. The latter feature was also found to contain abundant iron objects, together with ceramic building tile, pottery sherds and other ceramics. A small quantity of iron objects were also contained in yellowish sand layer [40081]. It is likely the charcoal fragments recovered from across the features of this period again represent a mix of industrial and domestic fuels.

There is some evidence for later activity within Area 4, with possible tanning pit/ditch [40379] containing pottery of 12th to 13th century date. The feature was only found to contain small quantities of charred oat grain, burnt and unburnt mammal bone, together with charcoal fragments. From these remains and the absence of any waterlogged material it cannot be positively concluded that the feature is a tanning pit. Two further samples were taken from possible wall construction layer [40406] and masonry layer [40419], which are thought to be of possible later medieval date (12th to 15th century). The bulk samples taken from these features produced similar assemblages to those from the 11th to 12th century deposits (see above) and may represent reworked material. The presence of 13th century pottery within these layers also suggests probable reworked or redeposited materials. The assemblages contain a mix of probable food debris in the form of burnt and unburnt mammal bone, unburnt fish bone and charred hulled barley grain, together with other probable domestic materials such as pottery sherds and ceramic tile. Potential industrial materials in the form of lead slag and iron objects were also recovered, together with charcoal fragments, which may represent a mix of domestic and industrial fuels.

10.5 CONCLUSIONS

- Radiocarbon dates of Anglo Saxon date were returned for charred grain from the earliest deposits on the site, showing activity from cal AD778–970 to cal AD902–1040.
- Charred grain of oat and hulled barley were the dominant grain types recovered from the samples across all periods and suggests these were the dominant cultivars through these periods.
- Wild taxa present show the consumption of hazel nuts and probable field peas. A number of ruderals are also present in the samples.
- Samples are present containing abundant clean crops of grain, which have the potential to represent cereal drying waste, which may have been undertaken in kilns or in hearths present at the site.
- Spreads of domestic debris are present across most areas of the site, containing significant quantities of burnt and unburnt mammal and fish bone together with charred cereal grain, charcoal fragments and pottery.
- Industrial waste in the form of lead and iron slag together with magnetic residue and iron and copper objects were also recovered from the samples.
- Statement of potential

There are a small number of samples from the features excavated at Cathedral Close which contain high concentrations of carbonized plant remains. Further analysis of these samples has the potential to provide additional information on the agrarian economy of the site by comparing actual numbers of grain rather than abundances. Further analysis may also increase the wild taxa count for these samples to test the theory that they are clean crops as suggested by the assessment. This data can then be compared, to other Anglo Saxon grain assemblages in this region and across the British Isles.

Charcoal is present in a number of samples of a size and abundance suitable for analysis. This material has the potential to provide complementary data to pollen diagrams as often insect-pollinated taxa (eg willow, ash) that are under-represented in pollen studies appear more frequently in charcoal records and thus add valuable information to the palaeoenvironmental reconstruction of areas. Analysis of the charcoal fragments from these deposits would provide information on the tree types being used for fuel, together with timber size and gathering methods (eg coppicing, deliberate selection).

Faunal bone is abundant across the site, together with smaller quantities of fish bone. This material has the potential to provide data on the livestock economy (eg species present, age) across all periods of the site as well as having the potential to inform on diet and butchery practices (eg which parts of the animal were being consumed).

11 ANIMAL BONE REPORT

BY S. HAMILTON-DYER WITH CLARE HAMILTON-DYER

11.1 INTRODUCTION AND METHODOLOGY

Animal bones were recovered, by hand collection, during extensive excavations undertaken as part of the redevelopment of Cathedral Close. The faunal remains come from all four areas excavated, with the majority from Area 1 where full excavation was carried out. Areas 2 and 3 were larger but only service trenches were excavated. The excavation of Area 4 was carried out only to a shallow depth after the removal of burials.

Taxonomic identifications were made using the author's modern comparative collections. All fragments were counted and identified to species or general taxonomic group for all the excavation areas. Detailed individual specimen recording was carried out only for the Area 1 material, for the other areas this was restricted to mandibular toothwear, selected measurements and minor species. Number counts in tables refer to individual specimens (NISP).

Where possible sheep and goat were separated using the methods of Boessneck (1969), Payne (1985) and Halstead & Collins (2002). Recently broken fragments were joined and have been counted as single bones. Tooth eruption and wear stages of cattle, sheep and pig mandibles were recorded following Grant (1982). Measurements mainly follow von den Driesch (1976) for mammals and birds and Morales & Rosenlund (1979) for fish and are in millimetres unless otherwise stated. Withers height calculations of the domestic ungulates are based on factors recommended by von den Driesch and Boessneck (1974). The archive includes details of metrical and other data not presented in the text.

11.2 RESULTS

An overall total of 5285 individual specimens was recorded, 3504 from Area 1. The material comes from deposits ranging in date from a late 9th / early 10th century context in Area 1 to a 19th century

pit in Area 4, but most bones are from Saxo-Norman deposits of the 11th and early 12th centuries. The totals of specimens from the areas and phase-date groupings are given in Table 89. Material from grave contexts and other presumed redeposited contexts has been designated as Period 6. From the three main period groups (1, Saxon; 2, Late Saxon; 3, Saxo-Norman) most of the bones are from layers, with linears and pits contributing much of the remainder (Table 90). The condition of the material is generally quite good with bones from many contexts well preserved and having only minor surface damage. In some contexts the individual bones were rather variable, both in colour and hardness. This probably indicates that they had come from different disposal activities and were later mixed in the final deposit. A combination of midden, yard and fresh bone material could have been cleared away and disposed of together. It is also possible that, for some contexts such as graves, the mixed materials are not contemporary. For a few contexts, the preservation of the bones was considered only 'fair' with noticeable surface damage to most of the material (Table 91). For the Area 1 material taphonomic traces were recorded for individual bones, including burning, gnawing, butchery and so on. A comparison of the condition of the bones from the period groups in Area 1 is given in Table 92. The proportions of the condition types are broadly similar for the four period groups and, therefore, should not overly affect period comparisons. The amount of canid gnawing and erosion appear to be the most variable, with almost 12% of bones gnawed in the Saxon group compared to 7% – 8.2% for the other periods. The percentage of bones with eroded surfaces is 11.5% in the Late Saxon group but is 4.1% – 5.2% otherwise. A high proportion of erosion can obscure other traces but even for the Late Saxon period this is a low amount. The number of loose teeth can also indicate the condition of the material and again this is quite low, with the highest proportion of 6% in the redeposited material. The bones were hand-collected and there will be an inevitable recovery bias against the small taxa, especially fish, and against small or fragile elements.

The bones are, as expected, dominated by the main domestic taxa, ie, cattle, sheep/goat and pig. Bones of the minor domestics, horse, dog and cat are present in small numbers. Wild mammals are represented by bones of deer, hare, rabbit, fox and some of smaller species. Bird bones are mostly of domestic fowl and geese but at least nine other species are represented including ducks, waders, eagle and raven. Fish bones are rare in this, hand-collected, assemblage; a few vertebrae of salmon and one of perch (Table 93).

11.2.1 Taxa distribution by period

Period 1, Saxon (9th – 10th centuries, Phase 1 in Area 1)
There are 585 bones recorded for this period, all from Area 1.

The taxa distribution is unusual in this period group as the bones are dominated by those of pig with cattle in second place and sheep/goat third; in other Hereford assemblages cattle dominate in all but the smallest and statistically unreliable groups of bone. Other mammals in this group are represented by a few bones of horse, red deer, roe, cat, hare and rabbit. Most of the bird bones from this group are of domestic fowl. There are also a few bones of goose, swan and woodcock. Another unusual feature of this group is the find of a complete ulna of a large eagle (see bird section below).

Period 2, Late Saxon (Early 11th century, Phase 2 in Area 1)
The 733 bones are mainly from Area 1, with 129 from Area 2 and a further 65 from Area 3.

Cattle bones are numerically the most frequent at 101 specimens, pig are next most frequent at 84 and sheep/goat are 55 bones in total. There is also a fragment of red deer antler, three bones of roe and one of hare. The 34 bird bones are mainly of domestic fowl. Goose, a plover-sized wader and a small passerine are also present. The seven fish bones are all vertebrae, six of salmon and one of perch.

Period 3, Saxo-Norman (Late 11th / early 12th century, Phases 3–5 in Area 1)
This period group contains the bulk of the material, 3025 bones; 1845 from Area 1, 822 from Area 4 and smaller amounts from the other areas.

Cattle is clearly the dominant species at 548 bones with pig second at 330 and sheep/goat in third place with 258 bones. Deer are mainly represented by roe with four bones of red deer and one of fallow. Other mammals are uncommon but of several different taxa; horse, dog, cat, fox, hare and woodmouse were identified. The bird bones are mainly of domestic fowl with a good number of goose in second place. Other birds are represented by a few bones of ducks and waders. Fish are represented by three salmon vertebrae and four indeterminate fragments.

Period 4, post-medieval
The 287 bones in this period group come from all areas except Area 1. In addition to the usual mix of the main domestic mammals there are a few bones of other taxa. These include 12 bones of a subadult cat from (502) and one from (30495). A femur from a large fallow deer was found in (40269), probably a buck and one of only two bones from the site. A mustelid tibia from (40325) is probably of a male stoat. The five bird bones are three of goose, one of fowl, and a raven coracoid from (30526). This latter is the only one for this site.

Period 5, 19th century pit fill (40268)
There are 61 bones from this pit in Area 4, mostly of cattle with a few of sheep/goat and pig together with indeterminate large mammal fragments. There are also four bird bones, including the tarsometatarsus of a turkey. This bone has rodent gnaw marks, giving indirect evidence for rats.

Period 6, redeposited material from graves and other contexts.
The 594 specimens are spread across the excavation and are included here only for the sake of completeness. None of the bones that were found in the grave cuts or within charnel deposits are thought to be deliberate depositions. Rather, these bones are likely to have been from grave digging through the underlying deposits and the backfilling of the burials. The taxa distribution is similar to that of the three main period groups with the main domestic mammals dominant and with some bones of roe, hare and birds included.

11.2.2 The main domestic ungulates

Cattle
The anatomical distribution of the 489 bones (for Area 1) is broad and indicates the use of whole animals, presumably brought in on the hoof and slaughtered locally. There is some expected bias

against the least robust and the smaller elements, for example the numbers of the phalanges should be equal, as there are eight of each in the animal, but the larger 1st phalanx is almost twice as frequent as the 2nd. The 3rd (hoof) phalanx is almost absent – this rather porous bone may suffer from several taphonomic losses. There are some differences between the three main period groups but nothing marked, for example no concentration of the prime meat joints over lower value or waste. The most notable difference between this assemblage and many others from Hereford is the paucity of horncores, they are present but uncommon and there are none from period 2, admittedly a rather small sample of just 71 bones (Table 94).

Split across the groups, the aging data from epiphyseal fusion for the bones in Area 1 is limited but the pattern is similar for the three main periods. Almost all of the cattle bones represent animals that were at least a year old at slaughter and most were over three or four years (Table 95). Mandible aging data was recorded for all the areas but is not a large group; 14 mandibles and eight loose teeth spread across all the groups but mainly period 3 (Saxo-Norman). Several of the mandibles only have one tooth still present, further limiting the available data. The third molar is in full wear in the majority and in one case the teeth are much worn with the root arch visible above the alveolar border (stage z, Jones & Sadler 2012). In two cases, one from period 2 and one from period 3, the mandibles are from sub-adults with the third molar not yet in full wear. In this respect the two types of aging data are in broad agreement; most of the cattle are fully adult but some were killed at an earlier stage and a few are aged. This is a typical pattern for medieval urban sites but, unlike some other assemblages from Hereford, veal calves are not apparent other than a single fragment from a neonate/foetal animal from (3718).

The bones show a low incidence of abnormalities. One pelvic fragment has slight eburnation and lipping indicating arthritis and one mandible has a 3rd molar with an extra pillar. A few of the foot bones have arthopathies including three 1st phalanges that have spread proximal articulations with new bone growth and lipping. This has been described as being associated with working animals (Bartosiewicz, Van Neer & Lentacker 1997). There are also three metacarpals with similar indications of draught use. These include a complete bone with an estimated withers height of 1.071 m. The length/distal breadth index of this bone is 35, indicating a male (Howard 1963). Measurements were taken on the bones from all areas and the size of the cattle fits with other data from Hereford (details are given in archive).

Sheep and goat

The ovicaprid bones include 53 that could be positively identified as sheep and 26 as goat, the bulk being typically indeterminate. At most urban sites goat remains are rare and usually restricted to horncores and foot bones, having arrived attached to skins (Albarella 2003). This site in Hereford has a few more goat than expected, and the bones do include a few of forelimb and pelvis as well as the horncores and feet (Table 96). Some of the sheep were horned animals, one of which may have had some nutritional stress as the horncore has 'thumb' marks (Albarella 1995). In Area 1 the anatomical distribution of the ovicaprid bones varies between the three main groups, with foot bones more frequent in period 2 deposits and scapula and pelvis absent. Bones of pelvis are quite frequent in the other two periods and feet are much less frequent than in period 2 (Table 97). With relatively small numbers of bones in the samples it is difficult to judge whether these differences are meaningful; the foot bones in period 2 have an MNI (minimum number of individuals) of just three.

Aging data from epiphyseal fusion is extremely limited for period 2 and only slightly improved for period 1. In period 3 the fusion data indicates that most were over a year old, thus contributing at least one wool clip before being sent for slaughter. The next fusion group is split 75–25 implying that a quarter were slaughtered between 18–30 months. In the 30–48 month fusion group about half the bones were fused, indicating that a good proportion of the flock were kept on beyond this age (Table 98). Information from toothwear and eruption stages is also restricted; including mandibles from all areas there are six from period 2, only one mandible with teeth from period 1 and eleven from period 3. At least three of the period 2 mandibles are definitely of sheep and still retain the deciduous 4th premolar; these animals would have been under two years old. There are also three mandibles at this stage in the period 3 group but at least four were older and have the permanent premolar in wear. Three of the mandibles have well-worn 1st molars but none of the mandibles are from aged animals. Two of the sheep radii have a bony extension of the medial proximal tendon (photo), a condition sometimes known as penning elbow (although it can exist in animals that are not penned, Clark 1994). It seems likely that these animals are older adults as it would presumably take some time for the condition to develop. One of these radii is complete and the total length gives an estimated withers height of 0.534 m. Withers heights of two other complete radii from the Saxo-Norman period are calculated as 0.551 m and 0.595 m. A metatarsus gives a similar height of 0.571 m. In comparison two complete metatarsi identified as goat give heights of 0.629 m and 0.643 m. Other than these examples, complete ovicaprid bones are infrequent but measurements were taken on many of the fused bones were possible, for example on the distal tibia; as with the cattle the measurements fit with previous data from Hereford and are available in archive.

Pig

The anatomical distribution of the bones in the three main period groups (from Area 1) shows that all parts of the pig are represented, implying the use of complete carcasses rather than just hams for example. The calculations are from the NISP and have a typically frequent count of head and foot bones. There are some, minor, differences between the groups, with period 2 having slightly more foreleg and foot bones and period 1 having more elements from the head and neck (Table 99).

Epiphyseal fusion data (Table 100) indicate that most of the animals were slaughtered between 1–3 years old; none of the bones are from very young piglets. The data from the mandibles ranges from animals with no permanent dentition to one of an old sow. There are only five mandibles from period 2, including a pair from a sow over one year and the older one mentioned above. In period 1 there are four mandibles from animals under two years, one a male, and three over this age but not having very worn teeth. Period 3 is a slightly larger sample of 20 mandibles, six identified from the canines as male and two as female. The two females would have been over a year but at least two of the males were younger and one less

than six months. Few of the toothrows are complete but most of the mandibles have at least one molar or the 4th premolar in wear, indicating animals of over a year, as indicated in the fusion data. None of the mandibles have much wear on the 3rd molar, where present. Pigs are usually killed before full maturity, keeping only a few adults for breeding, as they are not used for secondary products such as wool or milk. As indicated above, most of the bones are not fully fused and, therefore, not measured. The few measurements are available in archive. One of the mandibles from period 1 (context 5062) is abnormal with a short 3rd molar, which is missing two of the last cusps. There is a similarly shortened one from period 3 context 30251, in this case with an extra cusp on the lingual side. Kratochvil reported variations in the cusp number at a Czechoslovakian site (Hillson 2005) and Warman (2000) has investigated the incidence of variation in mandibles of modern breeds. It seems likely that these variations arise in genetically related stock.

Other Taxa

Horse remains are rare at this site, just 12 specimens in total. Loose teeth account for five specimens and six are foot elements, the remaining bone is a partial scapula. The metapodial from medieval context 307 has been modified as a linen/parchment smoother. Horse is clearly not part of the household consumption refuse here and their large carcasses must have been disposed of elsewhere, such as in ditches or even the river.

Deer

Deer are represented by a total of 44 bones, mainly of roe. In the Late Saxon period red deer is represented only by an antler fragment, which does not necessarily indicate hunting. The radius from the Saxon group and the four bones from the Saxo-Norman group do imply hunted game and, while the two ankle bones could be associated with skins, the scapula, radius and pelvis are all from meat joints and are not trimming waste. Just two bones were identified as fallow, a radius from a Saxo-Norman context and a femur from a post-medieval one. Although fallow bones do occasionally turn up in earlier contexts it is generally accepted that they are primarily a post-conquest introduction. At 35 bones roe is the most frequent species, especially in the Saxo-Norman period 3. There are elements from most areas of the body but with a notable bias towards the forelimb (Table 101). Measurements and other details of individual bones are in archive. At other Hereford sites deer remains are usually found as single bones accounting for considerably less than 1% of the identified large mammal total. Here the percentage is 2.5% for period 1, 1.6% for period 2 and 2.6% for period 3. These amounts, though still small, offer an opportunity to analyse the deer remains further. Chronological change in the relative proportions of the species has been observed at several other sites; a pre to post-Conquest shift with roe becoming more frequent in 11th–12th century urban assemblages and less common at elite sites (Sykes 2005). This is thought to be related to the change in status of the animals, with red deer and the imported fallow more important for the elite Norman hunt than the roe. There is also evidence for differences in the division of the carcass; at the culmination of the hunt the haunches were reserved for the nobility but the shoulders were given to the foresters, parkers and hunters as dues according to the Norman 'unmaking' ritual (Sykes 2007). Although this is mainly related to the higher status red and fallow, it presumably extends to the roe as well. The forelimb is well represented in the deer remains at urban sites, with a bias towards the right (hunter's portion). In this assemblage both sides of the roe are present, but it is not yet clear whether the left/right division applies to roe. These gifted portions were not meant to be sold but there is evidence for the illicit sale of these in towns, and of poached venison (Sykes 2007). The red deer pelvis from (4539) may be an indication of this, since the bone was supposed to be left at the slaughter site for the crows and ravens. In the Domesday Book entries for Hereford there are mentions of obligations of the hunt, including the supply of men to perform hunting duties but also that venison was brought to Hereford from Treville Forest (near Kingstone) as the only due paid (Faith 1997). Whole animals and butchered venison may thus have arrived in Hereford by several routes, both legal and illicit. People involved directly and indirectly with the hunt may, therefore, have lived on or near the Cathedral Close site.

Medium and small mammals

Just one dog bone fragment was recovered, from the Saxo-Norman context (40313), but indirect evidence in the form of canid gnawing was widely observed. Two bones from the same context match fox rather than dog and include a radius with cut marks consistent with skinning. Another fox bone was recovered from (40335) in the same area. Cat bones were identified in three period groups and include a partial sub-adult from a post-medieval context. None of the bones at this site had evidence of skinning. A stoat bone was recovered from another post-medieval context. Hare bones were recovered in small numbers from four of the period groups, three bones have cut marks consistent with trimming and preparation for the table. Another leporid bone, from period 1 context (5317), is of rabbit rather than hare. Like fallow, the rabbit has only rarely been found pre-conquest and, with the burrowing habits of rabbits in mind, remains are usually interpreted as intrusive. Stratigraphically secure Saxon finds are very rare; one was found in a middle Saxon pit in Southampton (Bourdillon 1981, Morton 1992). Just a few bones of small rodents are present, as expected in a hand-collected assemblage. Rat is not included and only one bird bone was observed with rodent gnaw marks.

Birds

The 174 bird bones are dominated by those of domestic fowl (87), as is typical of most Saxo-Norman and medieval assemblages. Most of the indeterminate material is probably also of fowl and includes phalanges, ribs and vertebrae as well as fragments of limb bones. Goose bones are frequent at 30 specimens. These are assumed to be also domestic birds but it is difficult to separate the bones from those of the ancestral greylag, no smaller species of geese are present. A few of the indeterminate elements are also of goose size. Ducks are less common at eight specimens' two of which match teal, the other six are of domestic duck/mallard size. At least seven other species are present in small numbers including swan, eagle, woodcock, a plover-sized wader, raven and a small passerine. Most of these bones come from the main late Saxon and Saxo-Norman periods. There is also a turkey bone from a 19th century context. The anatomical distribution of the fowl and goose bones is biased, as expected, in favour of the largest and sturdiest of the elements (Table 102). The smallest elements are likely to be missed in a hand-collected assemblage and many may also be taken by scavengers. The porous bones of young birds are probably underrepresented too but there are some of fowl present but none of goose. Laying hens are indicated by a

few bones containing medullary deposits (Driver 1982). Three of the fowl tarsometatarsi have spurs, indicating probable males. There are very few butchery marks on the bones but an axially chopped goose furcula indicates division of the bird in half. It is likely that at least some of the fowl were kept in the town itself, both for eggs and meat, whereas the geese were probably mostly grazed outside and brought in. In addition to the meat, geese were an important source of feathers. These could be plucked from live birds but also taken from the carcass as a secondary product. The primary wing feathers were favoured for quills and fletching for arrows and at some sites the ulna and carpometacarpus are common elements, bone flutes are also made from the ulnae of large birds (Serjeantson 2009). In this assemblage there are none at all, perhaps indicating that these had already been removed elsewhere.

Almost all of the bird bones will be from food remains but there are two birds present that were unlikely to have been eaten. One is the raven, a coracoid of which was found in the post-medieval pit fill (30526). Whether this bird was scavenging in town or was a kept bird cannot be said from a single bone. The other remains are of an eagle. There is a complete right ulna, together with the distal third of the radius from the same wing, from the Saxon layer (5062). The ulna has many very fine marks on the shaft, probably indicating where the primary flight feathers and membrane had been removed. Presumably, because the bone was then discarded without further modification, it was the feathers that were of interest rather than the ulna itself, perhaps for a rather exclusive arrow fletching set. The ulna has a greatest length of 259 mm and fits within the range for white-tailed eagle; although the archaeologically rarer golden eagle is not entirely excluded, the scavenging habit of the white-tailed makes it a more likely find in an urban context (Mulkeen & O'Connor 1997). Eagle bones have not been reported from Hereford before and are very rare in early medieval assemblages from England (Yalden & Albarella 2009). Remains of a young white-tailed eagle were recovered from Roman Caerleon (Hamilton-Dyer 1993) and are relatively common at Roman sites in general but the few later examples are from much further away from Hereford – from 9th-11th century York for example. The only other, closer, reported find is from Nantwich in Cheshire. This find was dated to the 13th-14th century and is also of wing bones (Fisher 1986). Together with this new find the evidence suggests that they were still to be found in Wales and/or the Welsh Border area in the Saxon period. It is tempting to suggest that it was killed or found by the deer hunters but it could equally have been found scavenging on the town middens along with the raven. Another possibility is that they were traded; Reichstein (1974, Reichstein & Pieper 1986) reporting on the large number of eagle wing bones from Haithabu, and especially of ulnae, considers that there is good evidence that eagle wings were traded across Europe for fletching.

Fish

Fish bones are very rare in the assemblage, just 15 in total from all periods and areas. There are six salmon vertebrae from period 2 contexts, three from period 3 and one from the redeposited material. A perch vertebra was recovered from period 2 pit fill (5432) and four indeterminate fragments from period 3 contexts. Hand-collected material will rarely contain the bones of small species and the eel, herring and cyprinids that are usually recovered from sieved samples from Hereford (Hamilton-Dyer 2002) are absent here. Other assemblages from Hereford have also contained a few gadids, flatfish and other marine species but they are never common.

11.3 CONCLUSIONS

In general the faunal assemblage is typical of Saxon to early medieval urban assemblages from Hereford and elsewhere; the bulk of the bone is of the main domestic food mammals, cattle, sheep/goat and pig. Other mammal taxa include the minor domesticates, deer and some other wild species. The bird bones are mainly of domestic poultry with some input from fowling and a few bones of other species. Fish are rare at this site, mainly because the material was hand-collected. Beyond this overview, the assemblage has several interesting aspects.

Animal bone assemblages from Hereford are usually rather homogenous with waste from several types of activity, including butchery and tanning, mixed together with household refuse in each assemblage (Noddle 2002). The almost total lack of cattle horncores in this assemblage implies that tannery waste is not being disposed of here and, therefore, this activity is probably not being carried out in the immediate vicinity.

Previously there has been little evidence of chronological change within the broad period of 'medieval', or at least that could be detected in the sometimes small samples. Most changes that have been observed, for example an increase in cattle size and more evidence of veal, do not occur until after the 15th century. Here there are definite differences between the three main periods, although most are reliant on statistically small samples. Pig is, unusually, dominant over cattle in one period, the Saxon period 1 group (Table 103), but the most interesting observations concern the hunted mammals. Deer bones, although still only a minor component of the assemblage, are not only more common than elsewhere in the town but they are also biased in favour of roe in the period 3 Saxo-Norman group. There is also a higher representation of roe forelimb rather than the haunch, an indication of consumption by the lower social orders rather than the elite.

The eagle wing bone is a rare find; by the medieval period eagles appear to have almost disappeared from England. This find here probably indicating that they were still found somewhere near the Welsh border area but trade from elsewhere in Britain or the continent is also possible.

The data from this site contribute to the growing corpus of faunal information for Hereford and will be useful for future investigations of area and social divisions, hitherto largely undetected.

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13 TABLES

ORIENTATION A	ORIENTATION B	ORIENTATION C
Tending to SW-NE from true N-S by 12.5°	Tending to SW-NE from true N-S by 7.5°	Tending to SW-NE from true N-S by 2.8°
Bishops Palace	Losinga Chapel	Norman Cathedral
N-S Road from Mappa excavation	Chapterhouse yard south wall	Cathedral Barn
Saxon basement from Mappa excavation	Wall revealed in H17	Northern Close boundary
Phase 1 construction trench in area 1	Phase 4 foundation trench in area 1	–

TABLE 1 Orientation of buildings within the Close

AREA	GRID SQUARES	SAMPLE AREA (M^2)	NUMBER OF BURIALS	DENSITY (BURIALS PER M^2)
Area 1 deep excavation	B13,B14	7	46	6.57
Area 2 soak-away trench	J13,J13	7	68	9.71
Area 3 soak-away trench	K3,K4	7	52	7.42
Area 4 West front	F3	7	22	3.14
Mappa	C3,D3	200	1085	5.43

TABLE 2 Density of Burials

AREA	AREA AVAILABLE FOR BURIAL (M^2)	BURIAL DENSITY (PER M^2)	ESTIMATED TOTAL NUMBER OF BURIALS
Area 1	1615	6.57	10,610
Area 2	4434	9.71	43,054
Area 3	2097	7.42	15,559
Area 4 (North)	420	3.14	1,318
Area 4 (South)	700	5.43	3,801
Area 5	945	6	5,670
	10,211		**80,012**

TABLE 3 Broad estimate of total number of burials in The Close

SKELETON NO	BURIAL GROUP	CHAIN	LABORATORY REFERENCE	UNCALIBRATED RADIOCARBON DATE (BP)	CALIBRATED DATE WITH A PROBABILITY OF		AGE/SEX
					68.2% (AD)	95.4% (AD)	
5061	A	–	Wk- 34563	1148±28	830-837 (3.1%) 868-903 (25.4%) 916-968 (39.7%)	780-792 (3.6%) 805-974 (91.8%)	Older Child/M
10400	C	Chain 1	Wk- 34564	372±29	1455-1516 (50.8%) 1597-1618 (17.4%)	1447-1526 (57%) 1556-1633 (38.4%)	Older Middle Adult/F
10528	C	Chain 1	Wk- 34565	757±34	1228-1232 (4.8%) 1241-1280 (63.4%)	1217-1288	Older Middle Adult/F
2121	D	Chain 2	Wk- 34553	711±27	1270-1292	1259-1303 (87.6%) 1366-1384 (7.8%)	Older Middle Adult/F
2962	C	Chain 2	Wk- 34559	759±28	1229-1232 (3.4%) 1241-1280 (64.8%)	1221-1283	Young Adult/F
4518	B	Chain 2	Wk- 34561	943±30	1032-1052 (15.2%) 1081-1128 (38.2%) 1133-1152 (14.8%)	1025-1159	Older Adult/M
4993	A	Chain 2	Wk- 34562	917±29	1044-1099 (42.1%) 1119-1142 (17.3%) 1147-1159 (8.8%)	1030-1185	Young Adult/F
2323	C	Chain 3	Wk- 34554	816±28	1212-1261	1171-1268	Older Adult/F
2329	C	Chain 3	Wk- 34555	791±26	1225-1261	1211-1278	Older Middle Adult/F
2857	B	Chain 3	Wk- 34557	844±25	1171-1221	1157-1259	Older Middle Adult/M

SKELETON NO	BURIAL GROUP	CHAIN	LABORATORY REFERENCE	UNCALIBRATED RADIOCARBON DATE (BP)	CALIBRATED DATE WITH A PROBABILITY OF		AGE/SEX
					68.2% (AD)	95.4% (AD)	
2654	C	Chain 4	Wk- 34556	302±29	1522-1575 (47%) 1584-1590 (4.1%) 1625-1645 (17%)	1490-1603 (70.4%) 1611-1652 (25%)	Sub Adult/M
2908	C	Chain 4	Wk- 34558	771±26	1226-1274	1219-1279	Younger Middle Adult/M
2992	C	Chain 4	Wk- 34560	807±26	1219-1258	1185-1271	Older Middle Adult/M

TABLE 4 Radiocarbon dated skeletons

SKELETON	SEX	AGE	BURIAL GROUP	POTENTIAL ORIGIN	RADIOCARBON DATE
2542	–	9-11	A	East of Hereford	–
5061	–	8-10	A	Northern or Western Britain	830-968 calAD
4344	F	20-35	A	Local	–
4993	F	18-23	A	Local	1044-1159 calAD
2115	F	18+	B	Local	–
4323	F	40-44	B	Local	–
4391	F	16-17	B	Local	–
4625	F	24-30	B	East of Hereford	–
4845	F	20-35	B	Local	–
11153	F	25-35	B	Local	–
31297	F	18-25	B	Normandy	–
2857	M	35-44	B	Normandy	1171-1221 calAD
4270	M	21-24	B	Local	–
4424	M	25-30	B	Northern or Western Britain	–
4934	M	45-49	B	Northern or Western Britain	–
5347	M	35-39	B	Normandy	–
11805	M	40-45	B	Northern or Western Britain	–
30194	M	35-39	B	Normandy	–
30690	M	25-34	B	Local	–
31344	M	45-49	B	Northern or Western Britain	–

TABLE 5 Results of Isotope analysis

AREA	GROUP A		GROUP B		GROUP C		GROUP D		GROUP E		TOTAL
1	16	1.4%	50	4.5%	671	60.2%	235	21.1%	142	12.8%	1114
2	2	0.3%	18	2.8%	513	79%	86	12.3%	30	4.6%	649
3	2	0.5%	14	3.1%	364	80.7%	57	12.6%	14	3.1%	451
4	0	0%	2	0.83%	210	87.9%	27	11.3%	0	0%	239
TOTAL	20		84		1758		405		186		2453

TABLE 6 Distribution of burial groups

ARM POSITION	GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
1	3	7	25	5	–
2	3	16	126	26	1
3	2	10	140	30	10
4	–	2	19	36	42
5	–	–	17	29	34
6a	1	2	11	6	–
6b	1	3	19	–	–
7	1	2	30	6	1
No Data	9	42	1371	267	98

TABLE 7 Arm positions relative to burial group

YEAR	POPULATION	URBAN POP.	RURAL POP.	URBAN POP. AS % TOTAL
1086	32,556	558	32,075	2
Pre-Black death & early C14th famine	81,696	–	–	–
1377	30,636	6568	24,068	21
1664	65,505	9145	56,360	14
1801	88,436	19,831	68,605	22

TABLE 8 Herefordshire population statistics (from Roseff 2003)

*Figures estimated from the Doomsday Survey of 1086, the poll tax in 1377, the Hearth Tax of 1664 and in 1801 the first official national census.

SITE	DATE (CENTURY)	TYPE	NO SKELETONS	REFERENCE
St Andrew's, Fishergate, York	11th – 16th	Urban lay & canons, wealthy	402	Stround and Kemp 1993
St Helen on the Walls, York	10th – 16th	Poor urban parish	1068 1014	Dawes & Magilton 1980 Grauer 1993
St Peter's, Barton-on-Humbar	8th – 19th	Rural, Anglo-Saxon to post-medieval	2,750	Waldron 2007
Wharram Percy		Rural medieval, late Anglo-Saxon to post-medieval	687	Mays 2007
Blackfriars, Gloucester	13th – 16th	Urban medieval	129	Wiggins et al 1993
Fishergate House, York	Medieval	Urban medieval, low socio-economic status	244	Holst 2005
Blackfriars, Ipswich	13th – 16th	Lay benefactors of the priory, middle class traders and craftsmen	250	Mays 1991a

TABLE 9 Main comparative assemblages referred to in the text

CATEGORY	ABBREVIATIONS	AGE
Sub-adult	Sub-AD	<18 years
Foetus	F	3rd foetal month- 40 weeks in utero
Neonate	N	Birth +/- 2 months
Infant	I	Birth -1 year
Younger child	YC	1 - 6 years
Older child	OC	7 - 12 years
Adolescent	AO	13 - 17 years
Adult	AD	18+ years
Younger adults	Y AD	18 - 25 years
Younger-middle adults	Y-M AD	25 - 35 years
Older-middle adults	O-M AD	35 - 45 years
older adults	O AD	45+ years

TABLE 10 Age categories and abbreviations

BURIAL GROUP	GROUP ALPHABETIC DESIGNATION	TOTAL NO	TOTAL NO.* %	NO. ANALYSED
Pre-cist	A	20	0.8%	8
Cist	B	84	3.4%	44
Bone only	C	1,758	71.67%	409
Simple coffin	D	405	16.51%	153
Elaborate coffin	E	186	7.58%	96
Total		**2453**	**100**	**710**

TABLE 11 Articulated burials

AGE CATEGORY	MALE		FEMALE		UNKNOWN		TOTAL	
	No.	%	No.	%	No.	%	No.	%
Y AD	21	7.7	41	7.04%	1	25.0	36	7.6
Y-M AD	57	21.0	51	25.63%	0	0.0	108	22.8
O-M AD	116	42.8	81	40.70%	2	50.0	200	47.2
O AD	57	21.0	47	23.62%	1	25.0	104	21.9
AD	20	7.4	6	3.02%	0	0.0	26	5.5
Total	**271**	**100**	**199**	**100**	**4**	**100**	**474**	**100**

TABLE 12 Adult age & sex distribution

BURIAL GROUP	MALES	FEMALES	RATIO (M:F)
Pre-Cist (A)	1	5	0.20
Cist (B)	27	8	3.38
Bone Only (C)	132	98	1.35
Simple Coffin (D)	59	56	1.05
Elaborate Coffin (E)	52	32	1.63
Total	**271**	**199**	**1.36**

TABLE 13 Male-to-female ratio by burial groups

BURIAL GROUP	MALE			FEMALE		
	Mean	No.	SD	Mean	No.	SD
Pre-Cist	-	0	-	162.06	4	3.09
Cist	172.25	26	5.27	161.19	6	4.05
Bone Only	169.76	105	5.44	159.45	73	5.83
Simple Coffin	170.51	52	5.32	158.67	44	4.46
Elaborate Coffin	170.65	40	5.47	159.13	27	6.39
Total pop.	**170.38**	**223**	**5.44**	**159.30**	**154**	**5.51**

SD = standard deviation

TABLE 14 Adult stature (cm)

SITE	CONTEXT	MALE		FEMALE	
		Mean	No.	Mean	No.
St Andrew's Period 6	Urban	171.0	205	159.0	73
Hereford Cathedral	Rural/urban	170.4	223	159.3	154
Fishergate House	Urban	170.1	48	159.1	42
Barton-on-Humber	Rural	170	216	158	156
Blackfriars, Gloucester	Urban	169.7	25	155.4	19
St Helens-on-the-wall	Urban	169.3	Not stated	157.4	Not stated
Wharram Percy	Rural	168.8	169	157.8	119

TABLE 15 Stature comparison of urban and rural archaeological assemblages (cm)

INDEX	MALE		FEMALE	
	No.	%	No.	%
Dolichocephalic (<75)	11	37	6	40
Mesocephalic (75-80)	7	23	5	33
Brachycephalic (80-85)	6	20	2	13
Hyperbrachycephalic (85+)	6	20	2	13
Total	**30**	**100**	**15**	**100**

TABLE 16 Cranial Index

BURIAL GROUP	MALE				FEMALE			
	Mean	No.	SD	Range	Mean	No.	SD	Range
Pre-Cist (A)	-	-	-	-	-	-	-	-
Cist (B)	79.06	6	10.49	73.73-90.36	-	-	-	-
Bone Only (C)	79.41	11	6.86	73.58-93.91	82.57	7	7.43	74.71-95.09
Simple Coffin (D)	72.31	4	7.90	63.92-81.49	70.17	6	8.61	60.21-83.5
El Elaborate Coffin (E)	77.82	9	4.54	72.48-87.2	73.82	215	2.00	71.82-72.82
Total pop.	**77.91**	**30**	**7.68**	**63.92-93.91**	**76.44**		**9.49**	**60.21-95.09**

TABLE 17 Mean cranial index by burial group

INDEX	MALE		FEMALE	
	No.	%	No.	%
60-	17	4.7	31	11.0
70-	121	33.2	121	43.1
80-	162	44.5	92	32.7
90+	64	17.6	37	13.2
Total	**364**	**100**	**281**	**100**

TABLE 18 Femoral index

	MALE				FEMALE			
	Right		Left		Right		Left	
	Mean (n)	SD	Mean (n)	SD	Mean (n)	SD	Mean (n)	SD
A	85.52 (1)	-	95.9 (1)	-	77.78 (4)	11.48	88.75 (4)	37.08
B	79.32 (20)	8.78	77.41 (22)	5.65	81.11 (5)	8.20	84.66 (4)	6.77
C	83.87 (85)	8.30	81.21 (88)	8.11	79.67 (70)	9.09	78.28 (71)	7.97
A-C	83.02 (106)	8.55	80.51 (111)	7.92	79.67 (79)	9.19	79.13 (79)	8.58
D	84.79 (41)	10.42	82.32 (39)	7.24	79.74 (35)	7.67	79.63 (38)	8.28
E	87.64 (30)	10.81	87.36 (37)	10.54	83.88 (25)	13.16	82.48 (25)	8.14
Total	**84.22 (177)**	**9.57**	**82.24 (187)**	**8.78**	**80.44 (139)**	**9.83**	**79.85 (142)**	**8.51**

TABLE 19 Mean femoral index by burial group

SEX		<60-	70-	80-	90+
Male	n (%)	94	133	22	3
		(37.30)	(52.78)	(8.73)	(1.19)
Female	n (%)	50	94	14	2
		(31.25)	(58.75)	(8.75)	(1.25)

TABLE 20 Tibial index

	MALE				FEMALE			
	Right		Left		Right		Left	
	Mean (n)	SD	Mean (n)	SD	Mean (n)	SD	Mean (n)	SD
A	–	–	–	–	74.75 (2)	3.31	80.07 (1)	–
B	68.96 (15)	4.97	70.15 (16)	6.41	74.34 (4)	1.59	73.65 (6)	4.36
C	72.92 (59)	7.21	72.70 (52)	6.91	74.79 (34)	6.66	70.97 (34)	8.03
A-C	72.12 (74)	6.99	72.10 (68)	6.88	74.74 (40)	6.20	71.59 (41)	7.68
D	72.35 (25)	5.83	71.43 (24)	6.60	72.61 (20)	7.03	70.87 (24)	5.89
E	73.28 (30)	7.31	74.30 (31)	6.79	71.83 (17)	6.11	72.36 (18)	6.12
Total	72.43 (129)	6.88	72.52 (123)	6.89	73.54 (77)	6.54	71.62 (83)	7.02

TABLE 21 Mean tibial index by burial group

TRAIT		GROUP A R L	GROUP B R L	GROUP C R L	GROUP D R L	GROUP E R L	TOTAL R L
Metopism	P	0	4	19	6	8	37
	A	2	17	115	68	46	248
	%	0	23.5	16.5	8.8	17.4	14.9
Bregmatic bone	P	0	0	1	0	1	2
	A	1	16	89	41	36	183
	%	0	0	1.1	0	2.8	1.1
Saggital wormians	P	0	1	1	1	3	6
	A	2	19	118	70	46	255
	%	0	0.3	0.9	1.4	6.5	2.4
Lambdoid bone	P	0	3	8	7	3	21
	A	1	18	104	59	39	221
	%	0	16.7	7.7	11.9	7.7	9.5
Coronial wormians	P	0	0	1	1	1	3
	A	0	0	0	1	1	2
	%	2	15	100	53	44	214
		2	17	100	58	44	221
		0	0	1.0	1.9	2.3	1.4
		0	0	0	1.7	2.3	0.9
Lambdoid wormians	P	0	2	20	12	7	41
	A	0	2	8	11	7	38
	%	2	20	115	65	43	245
		2	19	112	62	42	237
		0	10.0	17.4	18.5	16.3	16.7
		0	10.5	6.1	7.7	16.7	16.0
Occipito-mastoid ossicles	P	0	1	2	2	1	6
	A	0	1	3	0	0	4
	%	2	15	77	36	28	158
		2	4	82	41	25	163
		00	6.7	2.3	5.6	3.6	3.8
			7.1	3.7	0	0	2.5
Epiteric bone	P	0	0	2	1	2	5
	A	0	1	1	0	2	4
	%	1	10	41	19	22	93
		1	13	41	20	24	99
		0	0	4.9	5.3	9.1	5.4
		0	7.7	2.4	0	8.3	4.0
Asteronic bone	P	0	1	5	5	2	13
	A	0	1	9	4	3	17
	%	0	7	43	24	19	93
		0	10	42	23	22	97
		0	14.3	11.6	20.8	10.5	14.0
		0	10.0	21.4	17.4	13.6	17.5
Parietal notch bone	P	0	1	6	1	4	12
	A	0	0	10	1	3	14
	%	1	8	41	24	22	96
		0	6	39	20	23	88
		0	12.5	14.6	4.2	18.2	12.5
		0	0	25.6	5.0	13.0	15.9
Fronto-temporal artic.	P	0	0	2	1	2	5
	A	0	0	2	0	2	4
	%	1	9	39	17	19	85
		1	10	41	17	20	89
		0	0	5.1	5.9	10.5	5.9
		0	0	4.9	0	10.0	4.5
Parietal foramen	P	0	4	45	22	15	86
	A	1	5	44	20	17	87
	%	1	18	108	58	40	225
		1	18	108	57	43	227
		0	22.2	41.7	37.9	37.5	38.2
		100.0	27.8	40.7	35.1	39.5	38.3
Multiple infraorbital foramen	P	0	2	4	1	3	10
	A	1	2	5	3	2	13
	%	1	10	26	14	16	67
		1	6	38	14	13	72
		0	20.0	15.4	7.1	18.8	14.9
		100.0	33.3	13.2	21.4	15.4	18.1
Mastoid foramen ex-sutural	P	1	14	72	40	22	149
	A	1	14	74	39	21	149
	%	3	17	109	59	40	228
		2	17	106	55	35	215
		33.3	82.4	66.1	67.8	55.0	65.4
		50.0	82.4	69.8	70.9	60.0	69.3
Double hypoglossal canal	P	0	2	12	6	3	23
	A	0	1	14	5	5	25
	%	1	11	86	50	26	174
		3	12	88	46	31	180
		0	18.2	14.0	12.0	11.5	13.2
		0	8.3	15.9	10.9	6.5	13.9

TRAIT		GROUP A R	GROUP A L	GROUP B R	GROUP B L	GROUP C R	GROUP C L	GROUP D R	GROUP D L	GROUP E R	GROUP E L	TOTAL R	TOTAL L
Auditory torus	P	0		0		0		0		0		0	
	A	0		0		0		0		0		0	
	%	3		22		122		67		44		258	
		3		20		118		69		38		248	
		0		0		0		0		0		0	
		0		0		0		0		0		0	
Palatal torus	P	0		2		11		3		3		19	
	A	0		7		41		19		21		88	
	%	0		28.6		25.0		33.3		14.3		21.6	
Mandibular torus	P	0		1		3		1		0		5	
	A	0		1		3		2		0		6	
	%	3		25		151		84		51		314	
		3		22		143		89		51		308	
		0		4.0		2.0		1.2		0		1.6	
		0		4.6		2.1		2.3		0		2.0	

TABLE 22 Cranial non-metric traits

TRAIT		GROUP A R	GROUP A L	GROUP B R	GROUP B L	GROUP C R	GROUP C L	GROUP D R	GROUP D L	GROUP E R	GROUP E L	TOTAL R	TOTAL L
Sternal foramen	P	0		2		4		1		0		7	
	A	1		16		74		44		23		158	
	%	0		12.5		5.4		2.3		0		4.4	
Septal apeture	P	0		3		10		6		12		31	
	A	0		4		15		9		14		42	
	%	4		28		149		72		55		308	
		3		29		143		73		54		302	
		0		10.7		6.7		8.3		21.8		10.1	
		0		13.8		10.5		2.3		25.9		3.9	
Supra-scapular foramen	P	1		0		5		4		2		12	
	A	0		0		6		2		1		9	
	%	2		8		54		34		34		132	
		2		8		46		35		23		114	
		50.0		0		9.3		11.8		5.9		9.1	
		0		0		13.0		5.7		4.4		7.9	
Femoral plaque	P	1		11		70		27		15		124	
	A	2		10		64		24		20		120	
	%	3		18		141		69		43		274	
		3		19		148		59		51		280	
		33.3		61.1		49.7		39.1		34.9		45.3	
		66.6		52.6		43.2		40.7		39.2		42.9	
Double superior atlas facet	P	0		0		17		6		1		24	
	A	0		1		22		5		0		28	
	%	4		16		112		50		26		208	
		2		15		115		44		22		198	
		0		0		15.2		12.0		3.9		11.5	
		0		6.7		19.1		11.4		0		14.1	
Posterior atlas bridge	P	0		4		7		3		2		16	
	A	0		2		12		0		2		16	
	%	4		14		98		45		23		184	
		2		12		107		39		21		181	
		0		28.6		7.1		6.7		8.7		8.7	
		0		16.7		11.2		0		9.5		8.8	

TRAIT		GROUP A R	GROUP A L	GROUP B R	GROUP B L	GROUP C R	GROUP C L	GROUP D R	GROUP D L	GROUP E R	GROUP E L	TOTAL R	TOTAL L
Accessory transverse foramenia in cervical vertebrae	P	1		9		29		14		5		58	
	A	1		9		31		11		5		57	
	%	2		18		143		61		29		253	
		2		18		137		58		28		243	
		50.0		50.0		20.3		23.0		17.2		22.9	
		50.0		50.0		22.6		19.0		17.9		23.5	
Supracondylar process	P	0		0		0		0		0		0	
	A	1		0		2		1		0		4	
	%	5		31		163		81		65		345	
		4		31		160		81		71		347	
		0		0		0		0		0		0	
		25.0		0		1.3		1.2		0		1.2	
Vastus notch	P	1		4		27		13		14		59	
	A	0		5		34		17		10		66	
	%	3		18		106		57		44		228	
		3		20		110		59		45		237	
		33.3		22.2		25.5		22.8		31.8		25.9	
		0		25.0		30.9		28.8		22.2		27.9	
Bipartite patella	P	0		0		0		1		0		1	
	A	0		0		1		1		1		3	
	%	3		17		109		56		45		230	
		3		20		115		59		46		243	
		0		0		0		1.8		0		0.4	
		0		0		0.9		1.7		2.2		1.2	
Medial squatting facets	P	0		1		4		2		0		7	
	A	0		1		6		0		0		7	
	%	3		16		95		46		42		202	
		3		16		94		46		41		200	
		0		6.3		4.2		4.4		0		3.5	
		0		6.3		6.4		0		0		3.5	
Lateral squatting facets	P	1		6		37		11		4		59	
	A	2		7		39		8		5		61	
	%	3		16		95		46		42		202	
		3		16		99		44		41		203	
		33.3		37.5		39.0		23.9		9.5		29.2	
		66.7		43.8		39.4		18.2		12.2		30.1	
Os Acromiale	P	0		1		3		2		0		6	
	A	0		1		3		4		0		8	
	%	3		22		139		59		35		258	
		4		23		135		64		36		262	
		0		4.6		2.2		3.4		0		2.3	
		0		4.4		2.2		6.3		0		3.1	

TABLE 23 Post-cranial non-metrical traits

TRAIT		MALE		FEMALE	
		R	L	R	L
Palatal torus	P	13		6	
	A	54		34	
	%	24.1		17.7	
Mandibular torus	P	3	4	2	2
	A	175	171	139	137
	%	1.7	2.3	1.4	1.5
Femoral plaque	P	83	84	41	35
	A	151	62	122	116
	%	55.0	51.9	33.6	0.2
Squatting facets (either medial or lateral)	P	24	27	38	39
	A	108	105	92	96
	%	22.2	25.7	41.3	40.6
Os Acromiale	P	6	6	0	2
	A	147	51	110	109
	%	4.1	4.0	0	1.8
Bipartite patella	P	1	3	0	0
	A	130	133	97	106
	%	0.8	2.3	0	0

TABLE 24 Selected non-metrical traits by sex

CONDITION	MALE				FEMALE			
	R		L		R		L	
	No.	%	No.	%	No.	%	No.	%
Squatting Facets	208/108	25.9	29/105	27.6	38/92	41.3	39/96	40.6
Os acromiale	6/147	4.1	6/151	4.0	0/110	0.0	2/109	1.8

TABLE 25 Prevalence of squatting facets and Os acromiale by sex

CONDITION	NO OF CASES	PREVALENCE CALC. BY	PREVALENCE
Congenital scoliosis	2	461 individuals with 1 + vertebrae	0.4%
Klippel-feil syndrome	4	394 individuals with 2+ cervical vertebrae	1.0%
Cleft cervical arch	2 cervical	401 cervical arches (older child +)	0.5%
	2 C1	194 individuals with C1	1.0%
Cleft sacral arch	69	250 individuals with sacral arches (adult)	27.6%
C8	3	427 C7 present	0.70%
L6	20	568 L5 present	3.5%
T13	11	526 T12 present	2.1%
Cranial border shift at the thoracic-lumbar junction	3	427 C7 present	0.7%
Caudal border shift at thethoracic-lumbar junction	1	563 L1 present	0.2%
Sacralisation of L5	26	364 individuals with S1 present	7.1%
7th cervical rib	4	427 C7 present	0.9%
Rib segmentation error	1	661 individuals with 1+ ribs	0.2%
Pigeon chest	1	305 individuals with a sternum	0.3%

TABLE 26 Congenital defects of the spine and rib cage

CONDITION (EXTRA-SPINAL)	NO OF CASES	PREVALENCE CALCULATED BY	PREVALENCE
Mendosa suture retained	1	316 individuals with an occipital (adults)	0.32%
Craniosynostoses (brachycephaly)	2	45 individuals with intact cranial vaults	4.45%
Agenesis of hamate hook	6 individuals	133 individuals with a hamate (adults)	4.50%
	9 hamates	482 total adult hamates	1.87%
Bipartite medial cuneiform	3 individuals	258 individuals with a medial cuneiform	1.16%
		409 total medial cuneiforms	0.73%
Non fusion of	1 individual	224 individuals with a navicular (adults)	0.45%
navicular epiphysis	2 naviculars	356 total naviculars	0.28%
Tarsal coalition –	1	346 individuals with 2 plus tarsal bones	0.29%
Calaneo-navicular	1	355 individuals with a calcareous or navicular	0.28%

TABLE 27 Defects of the skull and appendicular skeleton

SK	BURIAL GROUP	SEX	AGE CATEGORY	TUMOUR TYPE & LOCATION
4934	B	M	0 AD	Osteoma, frontal bone
1790	B	M	18+	Osteoma, right mandible
12276	C	F	0-M AD	Bone cyst, left ilium
12383	C	F	18+	Bone cyst, right ilium
12313	C	M	0 AD	Bone cyst, left proximal humerus
11398	C	M	Y-M AD	Enchondroma, right humeral head
5186	C	F	0-M AD	Osteoblastoma, frontal bone
10440	C	M	18+	Osteoma, right parietal
2227	C	M	0-M AD	Two osteomas, frontal bone
3150	C	M	0 AD	Multiple osteomas (c.29), frontal bone
4566	C	F	0 AD	Osteoma, frontal bone
10478	C	F	Y-M AD	Two osteomas, frontal bone
40300	C	F	Y-M AD	Two osteomas, frontal & left parietal bones
40600	C	M	0-M AD	Osteoma, right parietal bone

SK	BURIAL GROUP	SEX	AGE CATEGORY	TUMOUR TYPE & LOCATION
4602	C	F	O-M AD	Osteoma, mandible
31232	C	F	Y-M AD	Osteoma, left parietal bone
10601	C	M	O-M AD	Multiple osteomas, both parietals (5) & mandible (1)
30173	C	M	O-M AD	Two osteomas, frontal bone
11969	D	M	O-M AD	Osteoma, left parietal bone
30602	D	M	18+	Multiple osteomas (5), left & right parietals
30066	D	F	O-M AD	Osteoma, right parietal bone
2087	D	F	O-M AD	Osteoma, frontal bone
3508	D	M	O-M AD	Osteoma, mandible
2999	D	F	O AD	Osteoma, zygomatic bone
11548	E	M	Y-M AD	Enchondroma, left femoral head
11408	E	M	O-M AD	Bone cyst, left acromion process of scapula

TABLE 28 Cases of benign tumours

	CERVICAL VERTEBRAE		THORACIC VERTEBRAE		LUMBAR VERTEBRAE		FIRST SACRAL VERTEBRA		TOTAL	
	N	%	N	%	N	%	N	%	N	%
Male	134/858	15.6	175/2196	8.0	84/968	8.7	15/200	7.5	408/4022	10.1
Female	102/615	16.6	131/1671	7.8	42/741	5.6	9/162	5.6	284/3027	9.4
Total adults*	236/1480	15.9	307/3883	7.9	128/1715	7.5	26/364	7.1	697/7078	9.8

*figures for total adults includes data from four unsexed adults

TABLE 29 Degenerative disc disease in differing regions of the spine: prevalence by vertebrae

	CERVICAL VERTEBRAE		THORACIC VERTEBRAE		LUMBAR VERTEBRAE		FIRST SACRAL VERTEBRA		TOTAL	
	N	%	N	%	N	%	N	%	N	%
Male	146/3413	4.3	204/7200	2.8	89/3772	2.4	10/378	2.6	449/14713	3.0
Female	85/2494	3.4	173/5541	3.1	108/2906	3.7	18/288	6.3	384/11229	3.4
Total adults*	231/5936	3.9	380/12792	3.0	200/6729	3.0	281/616	4.5	839/26073	3.2

*figures for total adults includes data from four unsexed adults

TABLE 30 OA in differing regions of the spine: prevalence by vertebral facets

JOINT	MALE	FEMALE	UNKNOWN SEX	TOTAL % PREVALENCE	R+L TOTAL % PREVALENCE
R TMJ	3.6% (5/138)	1.8% (2/114)	-	2.8%	3.0%
L TMJ	2.9% (4/140)	3.9% (4/102)	-	3.3%	
R ACJ	6.4% (12/188)	4.4% (6/36)	0% (0/1)	8.0%	7.0%
L ACJ	8.2% (15/183)	3.7% (5/134)	0% (0/3)	6.3%	
R SCJ	2.9% (5/172)	1.6% (2/128)	0% (0/1)	2.3%	2.3%
L SCJ	2.9% (5/171)	1.6% (2/126)	0% (0/2)	2.3%	
R Shoulder	2.9% (6/206)	0.6% (1/158)	0% (0/2)	1.9%	1.8%
L Shoulder	2.0% (4/202)	1.3% (2/151)	0% z(0/3)	1.7%	
R Elbow	6.3% (14/223)	5.5% (9/165)	33.33% (1/3)	6.1%	5.1%z
L Elbow	4.5% (10/221)	3.6% (6/168)	0% (0/3)	4.1%	
R Wrist	9.8% (24/246)	9.2% (17/184)	25% (1/4)	9.7%	9.8%
L Wrist	10.3% (25/242)	9.1% (16/175)	25% (1/4)	10.0%	
R Hand	4.2% (10/237)	5.1% (9/176)	25% (1/4)	4.8%	4.7%
L Hand	4.4% (10/229)	4.6% (8/175)	25% (1/4)	4.7%	
R Hip	6.4% (15/235)	9.9% (18/182)	0% (0/3)	7.9%	8.7%
L Hip	7.4% (18/243)	12.6% (23/182)	0% (0/4)	9.6%	
R Knee	4.0% (8/201)	5.1% (8/158)	0% (0/4)	4.4%	4.0%
L Knee	2.0% (4/194)	5.5% (9/163)	0% (0/4)	3.6%	
R Ankle	0% (0/153)	0% (0/129)	0% (0/3)	0%	0.3%
L Ankle	0.7% (1/153)	0% (0/132)	0% (0/3)	0.3%	
R Foot	6.4% (9/141)	5.8% (7/121)	0% (0/3)	6.0%	5.9%
L Foot	5.5% (8/145)	6.3% (8/126)	0% (0/3)	5.8%	

TMJ = temporomandibular joint; ACJ = acromioclavicular joint; SCJ = sternoclavicular joint; Wrist joint = distal radius, distal ulna, carpals & proximal MC; Hand = distal MC & phalanges; Ankle = distal tibia, distal fibula and corresponding surfaces of talus.

TABLE 31 Prevalence of OA in all joints (extra-spinal)

SITE	MALE % (N)	SITE	FEMALE % (N)	% DIFFERENCE BETWEEN THE SEXES
ACJ	10.4% (23/222)	ACJ	4.3% (7/161)	6.0
Hip	10.0% (26/260)	Hip	14.2% (28/197)	4.2
Shoulder	4.0% (10/241)	Shoulder	1.6% (3/184)	2.4
Knee	4.1% (9/219)	Knee	6.3% (11/174)	2.2
Hand	6.2% (16/257)	Hand	7.8% (15/192)	1.6
SCJ	3.9% (8/206)	SCJ	2.6% (4/154)	1.3
TMJ	5.2% (8/154)	TMJ	3.9% (5/127)	1.3
Spine	31.7% (85/268)	Spine	30.6% (60/196)	1.1
Wrist	13.4% (35/261)	Wrist	12.4% (23/185)	1.0
Foot	9.0% (14/156)	Foot	8.3% (11/133)	0.7
Ankle	0.6% (1/169)	Ankle	0% (0/143)	0.6
Elbow	6.9% (18/260)	Elbow	6.8% (13/190)	0.1

*including unsexed adults; Spine= individuals with one or more vertebral facet affected of those individuals with one or more facet

TABLE 32 OA in male & female individuals ranked by difference in prevalence

BURIAL GROUP	A	B	C	D	E
DDD	33.3% (2/6)	29.4% (10/34)	45.7% (105/230)	39.8% (43/108)	27.7% (23/83)
OA	33.3% (2/6)	48.6% (17/35)	44.4% (104/234)	49.12 (56/114)	45.9% (39/85)

DDD= degenerative disc disease, for inclusion individuals had one or more vertebral bodies

TABLE 33 Prevalence of adults with degenerative disc disease & spinal OA by burial groups

	O-M MALE	O AD MALE	ALL MALE	O-M FEMALE	O AD FEMALE	ALL FEMALE
Early-stage DISH %* (n)	4 3.8% (106)	5 9.8% (51)	9 3.7% (244)	2 2.8% (71)	1 2.4% (41)	3 1.7% (176)
DISH %+ (n)	5 4.9% (102)	1 2.2% (46)	7^ 3.0 % (231)	2 3.0% (66)	0 -	2 1.2% (168)

*Prevalence by individuals with one or more thoracic vertebrae; +prevalence by individuals with three or more thoracic vertebrae; ^ includes one adult of unknown age.

TABLE 34 Prevalence of 'early-stage DISH' and DISH by age and sex

BURIAL GROUP	A	B	C	D	E
Early-stage DISH	0/5	1/32 3.1%	5/209 2.4%	4/99 4.0%	2/77 2.6%
DISH	0/5	0/29	1/197 0.5%	3/97 3.1%	5/73 6.8%

TABLE 35 Prevalence of 'early-stage DISH' and DISH by burial group

LEVEL OF LESION	MALE	FEMALE	SUB-ADULT
C5	0	1	0
L3	1	0	0
L4	3	2	0
L5	4	6	1
Total	**8**	**9**	**1**

TABLE 36 Vertebrae affected by spondylolysis

AGE	NO OF INDIVIDUALS AFFECTED	PREVALENCE BY INDIVIDUAL	
		N	%
F	0	0/5	0%
N	0	0/17	0%
I	0	0/13	0%
YC	0	0/95	0%
OC	1	1/68	1.5%

AGE	NO OF INDIVIDUALS AFFECTED	PREVALENCE BY INDIVIDUAL	
		N	%
AO	1	1/38	2.6%
All sub-adults	2	2/236	0.8%
Y AD male	2	2/21	9.5%
Y AD female	1	1/14	7.1%
Y AD unsexed	0	0/1	0%
Y-M male	22	22/57	8.6%
Y-M female	9	9/51	7.6%
O-M AD male	40	40/116	34.5%
O-M AD female	30	30/81	37.9%
O-M AD unsexed	0	0/2	0%
O AD male	31	31/57	54.4%
O AD female	15	15/47	31.9%
O AD unsexed	1	1/1	100%
AD male	8	8/20	40%
AD female	1	1/6	16.7%
All adults	160	160/474	33.8%
Total	**162**	**162/710**	**22.8%**

TABLE 37 CPR of fractures of any type by age and sex

SK	SEX	AGE CAT.	BURIAL GROUP	DESCRIPTION
2098	M?	O AD	A	Blunt force trauma to left frontal bone; oval depression measuring10.8 x 7.0mm with edges well-remodelled but porosity and woven bone within central region. Two Rib fractures.
5336	M	O-M AD	B	Blunt force trauma to left parietal boss region; well-healed circula depression measuring 8.4 x 7.1 mm. Fracture of MC5; rotator cuff disease.
10440	M	AD	B	Blunt force trauma to central-left frontal bone; 28.1 x 14.8 mm in size, well-healed, exhibiting some porosity at base of depression.Blunt force trauma to right parietal; superior to parietal boss, 8 x 9 mm, well- healed. Clay-shoveler's fracture
10601	M	O-M AD	B	Sharp force trauma on right frontal boss ; linear depressed area measuring 17.4 x 6.8 mm, well-healed. Two rib fractures.
30173	M	O-M AD	C	Blunt force trauma to left frontal; oval lesion 19.0 x 13.9 mm. Two vertebral fractures and OD lesion.
31558	F	Y-M AD	C	Blunt force trauma to left parietal?; anterior to parietal foramen close to sagittal suture, semi-circular depression broken post-mortem so extent unknown, healed. One vertebral fracture.

SK	SEX	AGE CAT.	BURIAL GROUP	DESCRIPTION
3251	F	O-M AD	D	Right parietal, blunt force trauma; posterior to parietal boss, partial depression but broken post-mortem so extent unknown, on the endocranial surface vascular impressions are located around site of trauma. Bilateral ulna parry fractures; two vertebral fractures; haematomas bilateral femora and right tibial shaft.

TABLE 38 Cranial injuries

ANATOMICAL SITE+	MALE	FEMALE	UNSEXED	SUB-ADULT	TOTAL	% OF TOTAL
Skull	6	2	0	1	9	4.23
Spine	54*	31*	0	0	85	39.91
Rib	35	8*	1	0	44	20.66
Clavicle	3	1	0	0	4	1.88
Scapula	1	3*	0	0	4	1.88
Humerus	1	1	0	0	2	0.94
Radius	9	8	0	1	18	8.45
Ulna	7	6	0	0	13	6.10
Carpals	2	0	0	0	2	0.94
Metacarpals	7	0	0	0	7	2.29
Phalanges	1	0	0	0	1	0.47
Acetabulum	1	0	0	0	1	0.47
Patella	1	0	0	0	1	0.47
Tibia	1	5	0	0	6	2.82
Fibula	5	8	0	0	13	6.10
Metatarsals	3	0	0	0	3	1.41
Total	**137**	**73**	**1**	**2**	**213**	**100**

+Fractures of the ribs and vertebrae have been counted as a single occurrence, irrespective of how many bones were broken; * 3

Scapula and 1 rib are a result of osteomalacia and in the spine 7 females and 1 male had fractures associated with osteoporosis.

TABLE 39 Distribution of fractures by anatomical site

	CERVICAL VERTEBRAE		THORACIC VERTEBRAE		LUMBAR VERTEBRAE		TOTAL	
	N	%	N	%	N	%	N	%
Male	2/858	0.23	66/2196	3.01	29/968	3.00	97/4022	2.41
Female	4/615	0.65	38/1671	2.27	18/741	2.43	60/3027	1.98
Total adults*	6/1480	0.41	104/3883	2.68	47/1715	2.7	157/7078	2.22

*figures for total adults includes data from unsexed adults

TABLE 40 Adult prevalence of vertebral body fractures in differing regions of the spine

BURIAL GROUP	A	B	C	D	E
Males % N	0% (0/1)	40.74% (11/27)	44.7% (59/132)	22.03% (13/59)	38.46% (20/52)
Females % N	0% (1/5)	25% (2/8)	36.74% (36/98)	23.21% (13/56)	12.5% (4/32)
Total no. affected % (adults & sub-adults) N	12.5% (1/8)	29.55% (13/44)	23.96% (98*/409)	16.99% (26/153)	25% (24/96)

*includes one unsexed adult and the two sub-adults affected

TABLE 41 CPR of fractures by burial group

SK	SEX	AGE	BURIAL GROUP	DESCRIPTION
11805	M	O-M AD	B	Left TMJ – (right not present) new joint surface formed on the articular eminence anterior to mandibular fossa and inferior to zygomatic process.
5151	F	Y-M AD	C	Right TMJ - defined indentation and porosity present anterior to mandibular fossa (mandible not present).
2204	M	O-M AD	D	Right TMJ – (left not present) new joint surface formed superio- lateral to mandibular fossa, secondary OA present.
30141	M	Y AD	C	Left radial head - small oval depression present superior to the capitulum where the radial head fits, OA on radial head and capitulum.
2874	M	O AD	C	Left radial head – new joint surface formed superior To capitulum and lateral to coronoid fossa.
3213	M	Y AD	C	Right distal radius – new joint surface on anterior of ulna with secondary OA; right scaphoid healed fracture.
3085	F	O-M AD	C	Left hip joint - left ilium has a new joint surface formed superio-posterior to the acetabulum which exhibits secondary OA.
3032	M	O-M AD	C	Right talus - medial subluxation with secondary OA

TABLE 42 Cases of dislocation

SK	BURIAL GROUP	AGE CATEGORY	SEX	SITE	SIDE
1386	E	Younger Middle Adult	M	Femur - medial collateral ligament	R
2501	C	Older Middle Adult	M	Femur – vastus medialis	L
3749	C	Older Middle Adult	M	Femur – gluteus maximus	L
11785	B	Older Middle Adult	M	Femur – vastus lateralis	L
11713	D	Older Middle Adult	M	Femur – gluteus maximus	R
40318	C	Younger Middle Adult	M?	Femur - gluteus maximus	R
11479	C	Older Middle Adult	M	Femur - distal medial adductor tubercle	R
31344	B	Older Adult	M	Femur - short head of triceps	R
40303	C	Older Middle Adult	M	Tibia - soleal	L
1544	E	Older Middle Adult	M	Fibula – proximal postero-superior tibiofibular ligament, with ankylosis of the tibia and fibula	L
11850	C	Older Middle Adult	M	Tibiae – proximal postero-superior tibio-fibular ligament, pseudoarthrosis with left fibula	R+L
4242	C	Older Middle Adult	M	Tibia – medial collateral ligament	R
2310	D	Younger Middle Adult	M	Tibia - medial collateral lig.	L
1549	E	Younger Middle Adult	M	Tibia - medial collateral ligament	R
12590	E	Younger Middle Adult	F	Tibia - vastus medialis	R
3622	D	Older Middle Adult	M	Tibia - distal posterior tibiofibular ligament	R
31571	C	Older Middle Adult	M	Tibia - distal anterior tibiofibular ligament	R
40656	D	Older Middle Adult	M?	Tibia - distal anterior tibiofibular ligament	L
2181	D	Older Middle Adult	F	Tibia – distal anterior tibiofibular ligament	R
3032	C	Older Middle Adult	M	Tibia + fibulae – posterior + anterior tibiofibular lig.	L R
40612	C	Older Middle Adult	F	Fibula - distal anterior tibiofibular ligament	R
3897	C	Older Adult	M	Fibula - flexor hallicus longus	R
30390	C	Older Middle Adult	F	Clavicle - deltoid	R
40104	D	Younger Middle Adult	M	Rib - intercostal muscle (assos. rib fracture)	L

TABLE 43 CPR of Osteochondritis dissecans

BURIAL GROUP	MALE		FEMALE		SUB-ADULT		TOTAL	
	N	%	N	%	N	%	N	%
A	0/1	0	1/5	20	0/2	0	1/8	12.5
B	3/27	11.11	0/8	0	1/9	11.11	4/44	9.09
C	14/132	10.61	8/98	8.16	5/176	2.85	27/406	6.65
D	12/58	20.69	9/56	16.07	1/37	2.7	22/151	14.57
E	7/53	13.21	2/32	6.25	0/12	0	9/97	9.28
Total	**36/271**	**13.28**	**20/199**	**10.05**	**7/236**	**2.97**	**63/710***	**8.87**

*includes four unsexed individuals

TABLE 44 Cases of MOT at Hereford

	CERVICAL VERTEBRAE		THORACIC VERTEBRAE		LUMBAR VERTEBRAE		TOTAL	
	N	%	N	%	N	%	N	%
Male	0/858	0.0	505/2196	23.0	181/968	18.7	687/4022	17.1
Female	0/615	0.0	183/1671	11.0	66/741	8.9	250/3027	8.3
Total adults*	0/1480	0.0	688/3883	17.7	247/1715	14.4	937/7078	13.2
Adolescents	0/102	0.0	34/266	10.9	8/119	6.7	37/518	7.1%

*figures include data from four unsexed adults

TABLE 45 Prevalence of Schmorl's nodes: by vertebrae

BURIAL GROUP	MALE		FEMALE		TOTAL ADULTS*		ADOLESCENT	
	N	%	N	%	N	%	N	%
A	0/1	0	3/5	60.0	3/6	50.0	0/0	-
B	12/26	46.15	1/8	12.5	13/34	38.24	1/1	100.0
C	73/129	56.59	48/96	50.0	121/229	52.84	7/23	30.44
D	33/55	60.0	16/52	30.77	49/107	45.79	1/9	11.11
E	33/52	63.46	11/31	35.48	44/83	53.01	0/2	0
Total	**151/263**	**57.42**	**79/192**	**41.15**	**230/459**	**50.11**	**9/35**	**25.71**

*includes four individuals of unknown sex in burial group C

TABLE 46 Prevalence of individuals with Schmorl's nodes by burial group

BONE	MALE			FEMALE			SUB-ADULT			TOTAL	
	No.	%	Individuals	No.	%	Individuals	No.	%	Individuals	No.	%
Maxilla	1/148	0.7	1	0/111	0.0	0	2/92	2.2	2	3/351	0.9
Mandible	1/189	0.5	1	0/144	0.0	0	0/2,142	0.0	0	1/476	0.2
Zygomatic	2/254	0.8	1	0/188	0.0	0	4/126	1.6	2	6/568	1.1
Scapula	0/428	0.0	0	1/322	0.3	1	3/282	1.1	3	4/1,307	0.4
Clavicle	0/384	0.0	0	2/303	0.7	2	1/268	0.4	1	3/960	0.3
Humerus	4/440	0.9	5	0/328	0.0	0	2/301	0.7	2	6/1,075	0.6
Radius	2/445	0.4	2	5/332	1.5	4	2/196	1.0	2	9/1,100	0.8
Ulna	1/447	0.2	1	4/337	1.2	3	2/311	0.6	2	7/1,101	0.6
Ribs	30/3,361	0.9	8	33/2,343	1.4	8	39/2,899	1.3	9	102/8,636	1.2
Sacrum	0/219	0.0	0	0/173	0.0	0	1/144	0.7	1	1/539	0.2
Pelvis	3/469	0.6	3	3/353	0.8	3	2/353	0.6	2	8/1,182	0.7
Femur	32/463	6.9	23	17/341	5.0	11	19/342	5.6	14	68/1,154	5.9
Tibia	88/349	25.2	57	68/284	23.9	45	15/252	6.0	12	175+/891	19.6
Fibula	41/175	23.4	29	29/144	20.1	24	9/277	3.2	7	79/860	9.2
Calcaneous	0/255	0.0	0	1/244	0.4	1	1/115	0.9	1	2/599	0.3
Metatarsals	3/872	0.3	2	5/1,009	0.5	1	0/512	0.0	0	10/2,401	0.4

* Adults of unknown sex are included in the total prevalence; + includes two individuals of unknown sex with 4 bones affected; indiv = number of individuals affected

TABLE 47 TPR of Non-specific periostitis by bone

AGE	POROUS LESIONS	FIBRE BONE FORMATION	FIBRE BONE FORMATION WITH VASCULAR IMPRESSIONS	CAPILLARY LESIONS	'HAIR-ON-END LESIONS'
I	2	1			
YC	2	2	2	3	2
OC			1	2	
AO		1	1	1	
Older-middle male		1			
Older adult female					2

TABLE 48 Type of endocranial bone lesions present (three individuals have two types of lesions present)

BURIAL GROUP	NO.	%
Pre-Cist (A)	0/3	0.0
Cist (B)	4/15	26.7
Bone Only (C)	26/134	19.4
Simple Coffin (D)	9/48	18.8
Elaborate Coffin (E)	3/23	13.0
Total	**42/223**	**18.8**

TABLE 49 Total prevalence of maxillary sinusitis (of individuals with at least one sinus present to observe)

SK	BURIAL GROUP	AGE	SEX	DESCRIPTION OF SKELETAL MANIFESTATIONS	STATUS*
1998	C	1.5 - 6 mths (I)	-	Lateral bowing of the right radius and left ulna; porous flared rib ends; porotic lesions on ectocranial surface of cranial vault fragments and on the squama of the temporals.	Active
5215	C	6mths-1yrs (I)	-	Marked lateral bowing of the radii and ulnae; medial tilting of tibal distal growth plates; porosis of cranial fragments (parietals & occipital?); porotic rib ends; marked porosity in the orbits; porotic woven bone bilateral at greater wing of sphenoid around foramen rotundum; marked porosity in inferior-anterior right temporal; marked porosity on the infra and supra spinous areas of both scapulae (L small frag); reactive periosteal pumice bone on posterior humeral shafts and post-medial tibial shafts, porosity tibial diaphyseal shaft (proximal, lateral), cribra femora and humeri.	Active; May also have scurvy (see below)
12455	C	6mths (I)	-	Bowing of humeri laterally, posterior radii and ulnae and tibiae anterior-medially, flaring of metaphyseal distal ends of radii and femurs, porosity of the metaphyseal ends of long bones, flared sternal rib ends with highly porotic ends, medial tilting of the distal tibiae and radii epiphyseal surfaces, marked roughening of the bone underlying growth plate in humeri, radii, femurs, tibiae and fibulae, porosis of ectocranial surface of cranial frags (parietal?).	Active
40187	C	1.5-2 yrs (YC)	-	Medial bowing tibiae and fibulae and anterior bowing femora, medial tilting of distal tibial growth plate, femoral neck coxa vara and flattening of the bone beneath the femoral head. Roughening of bone underlying the growth plates. Cribra orbitalia.	Active
10431	C	1.5-2 yrs (YC)	-	Right femur anterior bowing with a thickened diaphysis, and coxa vara of proximal femoral neck. Cribra orbitalia.	Healed?
10290	C	3-4 yrs (YC)	-	Medial bowing of right tibia and lateral bowing of right fibula (L NP), active woven bone on concavity of bending of shafts, short limb bone length for age.	Healed
30016	C	15-17 yrs (AO)	-	Severe anterior bowing and thickening as well as medial-lateral flattening of the proximal left femur.	Healed.
1514	E	35-39 yrs (O-M)	F	Lateral bowing of the femurs, anterior bowing of tibiae and fibulae.	
5611	E	45-49 yrs (O AD)	M	Left femur anterior bending, lateral bending right fibula and tibia	
11548	E	30-34 yrs (Y-M)	M	Posterio-medial bowing of tibiae, lateral bowing of femora, femoral neck coxa vara (near 90 degree angle).	

*Active and healed rickets was diagnosed on the basis of criteria presented by Mays et al (2006).

TABLE 50 Individuals exhibiting skeletal manifestations of rickets

SK	BURIAL GROUP	AGE	DESCRIPTION
1155	D	1.5-2 yrs (YC)	New woven bone in right orbit, increased porosity on frontal above right orbit, endocranial frontal abnormal new bone formation.
1433	E	6-9 months (I)	New woven bone and abnormal porosity within the left orbit (R NP) and on the right maxilla molar region,. Abnormal porosity of the right greater sphenoid wing, Bilateral symmetrical 'reactive periosteal pumice bone' ectocranial parietal bosses, lateral-ramus region of mandible, the mastoid squamous, lateral surfaces of the iliae just superior to acetabulum, distal metaphyseal-diaphyseal area of humeri and proximal meta-diaphysis of left radius.
31703	C	6 months (I)	Abnormal porosity on right greater sphenoid wing, frontal process and palate of right maxilla, and coronoid region of right mandible. Reactive periosteal pumice bone on distal metaphysis-diaphysis of humeri, femora, fibula, and right tibia.
5215	C	6 mths – 1 yr (I)	? see above

TABLE 51 Individuals exhibiting scurvy

LESION	MALES	FEMALES	TOTAL ADULT	SUB-ADULTS	TOTAL
Absent	100	67	167	38	205
Porotic	25	23	48	33	81
Cribriotic	6	3	9	13	22
Trabecular	0	0	0	6	6
Remodelled	12	7	19	0	19
Total	**43/143 (30.07%)**	**33/100 (33.0%)**	**76/243 (31.28%)**	**52/90 (57.78%)**	**128/333 (38.44%)**

TABLE 52 Cribra Orbitalia lesion type

BURIAL GROUP	CO	N INDIV*	%	PH	N INDIV+	PH
A	1	3	33.33%	3	4	56.25%
B	5	20	25.00%	10	31	32.26%
C	90	180	50.00%	94	254	37.01%
D	26	83	31.33%	30	111	27.03%
E	6	47	12.77%	7	63	11.11%
Total	**128**	**333**	**38.44%**	**144**	**463**	**31.10%**

*individuals with orbits; + individuals with parietal and/or occipital

TABLE 53 Cribra Orbitalia & porotic hyperostosis by burial group

AGE GROUP	CO	N	%	REMODELLED	PH	N	%	REMODELLED
F	0	2	0.0	-	0	4	0.0	-
N	0	7	0.0	-	0	12	0.0	-
I	2	7	28.57	0	0	11	0.0	0
YC	28	40	70.00	0	7	62	11.29	0
OC	12	18	66.67	0	10	29	34.48	1
AO	10	16	62.50	0	9	22	40.91	0
Y AD	7	16	43.75	0	10	19	52.63	5
Y-M AD	16	59	27.12	2	31	77	40.26	8
O-M AD	33	101	32.67	11	54	132	40.91	17
O AD	16	52	30.77	3	15	72	20.83	8
AD	4	15	26.67	3	8	23	34.78	6
Total	**128**	**333**	**38.4**		**144**	**463**	**31.1**	**45**

TABLE 54 CO and PH by age

SITE	PRESENT	N	%	REMODELLED	ACTIVE
Hereford Cathedral	144	463	31.10%	45 (31.25)	99 (68.75%)
Wharram Percy	125	502	24.90%	52	73 (58.40%)
St Helen-on-the walls	267	460	58.04%	203	64 (23.97%)

*differing recording methods used – Wharram Percy prevalence by parietal; St-Helens-on-the-wall by frontal and/or parietal; Hereford Cathedral by parietal and/or occipital.

TABLE 55 PO comparison with other sites

	NUMBER OF LESIONS ON EACH TOOTH WITH OF DEH					TOTAL DEH %
	1	2	3	4	5	
Males	300	179	44	17		540 37.42%
Females	213	92	12	3		320 22.18%
All adults	513	271	56	20		860 59.60%
Sub-adults	404	130	45	2	2	583 40.40%
Total	**917**	**401**	**101**	**22**	**2**	**1443 100%**

TABLE 56 Frequency of DEH lesions by teeth

SIDE	RIGHT								LEFT							
Tooth	M3	M2	M1	PM2	PM1	C	I2	I1	I1	I2	C	PM1	PM2	M1	M2	M3
	Maxilla															
DEH	8	21	30	47	62	143	65	85	89	76	126	75	47	31	16	9
% of total DEH	0.4	1.0	1.5	2.3	3.0	6.9	3.1	5.0	4.3	3.7	6.1	3.6	2.3	1.5	0.8	0.4
	Mandible															
DEH	4	13	23	52	73	189	117	88	83	112	208	82	55	28	12	5
% of total DEH	0.2	0.6	1.1	2.5	3.5	9.1	5.6	4.2	4.0	5.4	10.0	4.0	2.7	1.4	0.6	0.2

TABLE 57 Distribution of DEH defects by tooth position in the permanent dentition (adults & sub-adults)

SIDE -	RIGHT					LEFT				
Tooth -	M1	M2	C	I2	I1	I1	I2	C	M1	M2
	Maxilla									
Carious teeth	0	3	4	1	1	4	1	3	0	2
%	-	6.5	8.7	2.2	2.2	8.7	2.2	6.5	-	4.4
	Mandible									
Carious teeth	3	2	8	0	0	0	1	7	1	4
%	6.5	4.4	17.4	-	-	-	2.2	15.2	2.2	8.7

TABLE 58 Distribution of DEH defects in the sub-adult deciduous dentition

BURIAL GROUP	NUMBER	%
Pre-Cist	4/6	66.7
Cist	13/33	39.4
Bone Only	136/248	54.8
Simple Coffin	57/108	52.3
Elaborate Coffin	14/53	26.9
Total	**224/448**	**50.0**

TABLE 59 Prevalence of DEH in the total population by burial group

	INDIVIDUALS			TOTAL TEETH		
	Present	Total N	%	Present	Total N	%
Male	121	172	70.35%	406	2988*	13.59%
Female	97	134	72.39%	355	1931	18.38%
All adults	218	306	71.24%	761	4919	15.47%
All sub-adults	57	141	40.43%	148	1977	7.49%
Total population	**275**	**447**	**61.52%**	**909**	**6896**	**13.18%**

*included two adult deciduous teeth which have been retained in two male individuals

TABLE 60 Prevalence of dental caries at Hereford Cathedral

SIDE -	RIGHT								LEFT							
Tooth -	M3	M2	M1	PM2	PM1	C	I2	I1	I1	I2	C	PM1	PM2	M1	M2	M3
	Maxilla															
Total teeth	109	114	120	156	168	171	125	121	133	121	174	154	149	114	118	109
Carious teeth	23	32	31	28	28	24	10	14	16	11	27	35	30	32	30	22
%	21.1	28.1	25.8	17.9	16.7	11.7	8.0	11.5	12.0	9.1	15.5	22.7	20.1	28.1	25.4	20.2
	Mandible															
Total teeth	150	161	112	191	208	219	193	158	165	190	235	218	192	138	162	140
Carious teeth	22	38	27	31	27	13	14	9	4	8	22	29	27	26	49	22
%	14.6	23.6	24.1	16.2	13.0	5.9	7.3	5.7	2.4	4.2	9.4	13.3	14.1	18.8	30.2	15.7

TABLE 61 Distribution of dental caries by tooth position in the adult permanent dentition

BURIAL GROUP	INDIVIDUALS			TOTAL TEETH		
	Caries	Total No	%	Caries	Total No.	%
A	3	6	50.00%	5	87	5.75%
B	18	33	54.55%	50	618	8.09%
C	143	248	57.66%	441	4020*	10.97%
D	74	109	67.89%	254	1487*	17.08%
E	37	52	71.15%	159	684	23.25%

*includes an adult deciduous tooth which has been retained

TABLE 62 Prevalence of dental caries in total population by burial group

	INDIVIDUALS			TOTAL TEETH		
	Present	Total N	%	Present	Total N	%
Male	44	189	24.14%	85	4182*	2.03%
Female	35	145	23.28%	49	3011	1.63%
Total	79	334	23.65%	134	7193	1.86%

TABLE 63 Prevalence of abscesses in the adult permanent dentition

SIDE	RIGHT								LEFT							
TOOTH	M3	M2	M1	PM2	PM1	C	I2	I1	I1	I2	C	PM1	PM2	M1	M2	M3
ADULT	MAXILLA															
Total teeth	111	150	164	189	215	218	211	204	201	211	206	202	185	166	139	105
Carious teeth	0	3	10	3	12	4	6	7	3	7	7	8	6	5	9	2
%	**0**	**2.0**	**6.1**	**1.6**	**5.6**	**1.8**	**2.8**	**3.4**	**1.5**	**3.3**	**3.4**	**4.0**	**3.2**	**3.0**	**6.5**	**1.9**

SIDE	RIGHT								LEFT							
TOOTH	M3	M2	M1	PM2	PM1	C	I2	I1	I1	I2	C	PM1	PM2	M1	M2	M3
								MANDIBLE								
Total teeth	234	286	287	284	280	278	265	256	259	265	271	282	274	284	284	225
Carious teeth	0	0	6	4	2	4	3	2	3	4	2	3	3	4	2	0
%	**0**	**0**	**2.1**	**1.4**	**0.7**	**1.4**	**1.1**	**0.8**	**1.2**	**1.5**	**0.7**	**1.1**	**1.1**	**1.1**	**1.4**	**0**

TABLE 64 Distribution of abscesses by adult permanent tooth position

BURIAL GROUP	INDIVIDUALS			TOTAL TEETH		
	Abscess	Total No.	%	Abscess	Total No.	%
A	2	4	50.00%	2	91	2.20%
B	6	25	24.00%	11	622	1.77%
C	40	157	25.48%	67	3472*	1.93%
D	22	95	23.16%	36	1892*	1.90%
E	9	53	16.98%	18	1114	1.62%

TABLE 65 Prevalence of abscesses in adults by burial group

	INCISORS	CANINES	PRE-MOLARS	MOLARS
Adults	63.21% (763/1207)	60.33% (479/794)	51.85% (743/1433)	53.54% (794/1483)
Sub-adult permanent	47.98% (166/346)	41.38% (60/145)	34.42% (95/276)	32.75% (132/403)
Sub-adult deciduous	16.74% (40/239)	18.92% (28/148)	-	25.24% (106/420)
All teeth	54.07% (969/1792)	52.16% (567/1087)	49.03% (838/1709)	44.75% (1032/2306)

TABLE 68 Calculus prevalence by tooth type

	GRADE OF DENTAL CALCULUS			TOTAL TEETH AFFECTED BY CALCULUS
	1	2	3	
Male	72.01% (122/1704)	23.94% (408/1704)	4.05% (69/1704)	57.03% (1704/2988)
Female	78.70% (846/1075)	19.23% (211/1075)	1.67% (18/1075)	56.20% (1075/1913)
All adults	74.60% (2073/2779)	22.27% (619/2779)	3.13% (87/2779)	56.50% (2779/4919)
Sub-adults	89.47% (561/627)	10.53% (66/627)	-	31.72% (627/1977)
Total	77.33% (2634/3406)	20.11% (685/3406)	3.13%	49.39% (3406/6896)

TABLE 66 Degree of calculus deposits by total teeth affected and prevalence by total teeth

BURIAL GROUP	INDIVIDUALS			TOTAL TEETH		
	Calculus	Total No.	%	Calculus	Total No.	%
A	4	6	66.67%	35	87	40.23%
B	28	33	84.85%	307	618	49.68%
C	194	248	78.26%	1977	4020*	49.18%
D	74	109	67.89%	724	1487*	48.69%
E	36	52	69.23%	363	684	53.07%

TABLE 69 Prevalence of dental calculus in total population by burial group

	SUPRA-GINGIVAL	SUB-GINGIVAL	SUB- & SUB-GINGIVAL
Adult	62.14% (1727/2779)	19.58% (544/2779)	18.28% (508/2779)
Sub-adult	92.03% (577/627)	2.23% (14/627)	5.74% (36/627)
Total	**67.66% (2304/3406)**	**16.38% (558/3406)**	**15.97% (544/3406)**

TABLE 67 Location of calculus by teeth affected

	GRADE OF PERIODONTAL DISEASE			TOTAL TEETH AFFECTED BY PERIODONTAL DISEASE
	1	2	3	
Male	8.54% (223/2612)	8.08% (211/2612)	3.18% (83/2612)	19.75% (516/2612)
Female	8.15% (135/1657)	7.85% (130/1657)	4.28% (71/1657)	20.33% (337/1658)
All adults	8.39% (358/4269)	7.99% (341/4269)	3.61% (154/4269)	19.98% (853/4270)
Sub-adults	82.14% (23/28)	17.86% (5/28)	-	2.42% (28/1158)
Total	8.87% (381/4297)	8.05% (346/4297)	3.61%	16.23% (881/5428)

TABLE 70 Grade of periodontal disease by teeth affected and prevalence by total teeth

BURIAL GROUP	INDIVIDUALS			TOTAL TEETH		
	Perio.*	Total No.	%	Perio.	Total No.	%
A	1	4	25.00%	5	63	7.49%
B	13	30	43.33%	87	503	17.30%
C	80	221	36.20%	483	3074	15.71%
D	34	98	34.69%	185	1184	15.63%
E	17	47	36.17%	121	603	20.07%

*Perio. = periodontal disease

TABLE 71 Prevalence of periodontal disease in total population by burial group

	INDIVIDUALS			TOTAL TEETH		
	Present	Total N	%	Present	Total N	%
Male	152	189	80.42%	965	4182*	23.08%
Female	117	145	80.69%	892	3011	29.63%
Total	**269**	**334**	**80.54%**	**1857**	**7193**	**25.82%**

*includes an adult deciduous tooth which has been retained

TABLE 72 Prevalence of AMTL in the adult permanent dentition

SIDE	RIGHT								LEFT							
Tooth	M3	M2	M1	PM2	PM1	C	I2	I1	I1	I2	C	PM1	PM2	M1	M2	M3
ADULT								MAXILLA								
Total teeth	111	150	164	189	215	218	211	204	201	211	206	202	185	166	139	105
Carious teeth	25	50	61	44	47	29	32	32	29	38	31	50	48	67	41	29
%	22.5	33.3	37.2	23.3	21.9	13.3	15.2	15.7	14.4	18.0	15.1	24.8	20.3	40.4	29.5	27.6
								MANDIBLE								
Total teeth	234	286	287	284	280	278	265	256	259	265	271	282	274	284	284	225
Carious teeth	102	130	170	76	53	30	40	41	35	30	22	39	71	146	119	101
%	43.6	45.5	59.2	26.8	18.9	10.8	15.1	16.0	13.5	11.3	8.2	13.8	25.9	51.4	51.4	44.9

TABLE 73 Distribution of AMTL by adult permanent tooth position

BURIAL GROUP	INDIVIDUALS			TOTAL TEETH		
	AMTL	Total No.	%	AMTL	Total No.	%
A	3	4	75.00%	14	91	15.38%
B	17	25	68.00%	83	622	13.34%
C	120	157	76.43%	704	3472*	20.28%
D	77	95	81.05%	643	1892*	33.99%
E	52	53	98.11%	414	1114	37.16%

TABLE 74 Prevalence of AMTL in adult permanent dentition by burial group

SF NO.	CONTEXT	AREA	GRID	SKELETON	BURIAL PHASE	TYPE	DESCRIPTION	D*	ILLUS
0418	1952	1	B14	SK1952	Simple Coffin	Disc & loop	Remains of gilding	31	
0460	2133	1	-	SK2133	Simple Coffin	Disc & loop	Slightly concavo-convex	17	
1293	31356	3	K4	SK31354	Simple Coffin	Disc & loop	Four identical buttons, loop attached to central boss	18	P2
1293	31356	3	K4	SK31354	Simple Coffin	Disc & loop	Slightly concave back	17	incl above
0427	2009	1	B14	SK2008	Elaborate Coffin	Hollow	Bone back, concavo-convex, four holes, stained green	16	
0949	5618	1	F15	SK5615	Elaborate Coffin	Hollow	Back of hollow button, four-holed, thin copper alloy reinforced by wooden interior	16	
1130	12425	2	K7	SK12425	Elaborate Coffin	Disc & loop	Loop missing	27	

1342	40566	4	E2	SK40564	Elaborate Coffin	Disc & loop	Plain	27	
0501	1003	1	Area 1	graveyard soil	-	Disc & loop	Loop attached to central boss. Engraved flower decoration. Silvery finish	18	P3

TABLE 75 Catalogue of buttons

FABRIC CODE	COMMON NAME	AREA 1	AREA 2	AREA 3	AREA 4	OTHER	TOTAL	DATING
ROMAN								
A1/SVW	Severn Valley Ware	4	-	1	1	-	6	Roman
Saxon	10th to 11th century	-	-	-	-	-	-	-
D1	Cotswold Wares – cooking pots	44	14	-	29	-	87	L9/11
G1	Stafford-type ware	70	18	14	15	-	117	10/11
A7a	Herefordshire Wares – early pitchers	-	1	-	-	-	1	11/12
Saxo-Norman	11th to 12th century	-	-	-	-	-	-	-
C1	Worcester Wares – cooking pots	34	5	6	6	1	52	L11/13
D2	Cotswold Wares – cooking pots & pitchers	55	25	6	32	-	116	L11/12
E1b	Stamford Wares – spouted pitchers	13	3	-	-	-	16	11/12
B2	Malvernian Wares – tripod pitchers	3	-	-	-	-	3	12
B1	Malvernian Wares – cooking pots	108	18	6	36	-	168	12/14
LATER MEDIEVAL / 13TH TO 15TH CENTURY								
C2	Worcester Ware - jugs	1	5	-	2	-	8	13
B3	Malvernian Wares	3	1	-	-	-	4	13
A2	Herefordshire Wares	2	-	-	-	-	2	13
A3	Herefordshire Wares	-	2	-	-	-	2	13
E3	Brill/Boarstall Ware	3	3	-	-	-	6	13/14
A6	Herefordshire Wares	1	1	1	1	-	4	13/14
A4	Herefordshire Siltstone-tempered Ware	2	4	1	1	-	8	13/14
A5	Herefordshire Wares	4	-	1	-	-	5	M13/E15
A7b	Herefordshire Later Wares	36	22	6	8	3	75	L13/15
B4	Malvernian Oxidised Glazed Wares	37	26	1	3	1	68	14/17
POST-MEDIEVAL & MODERN / 16TH CENTURY ONWARDS								
G6/TUDG	Tudor Green Wares	2	2	-	-	-	4	15/16
B4/B5	Malvernian Wares	-	-	-	2	-	2	16/17
G8/CSTN	Cistercian-type ware	27	4	2	7	-	40	16/17
F2	Rhenish Stoneware	12	3	2	-	-	17	16/18
MY	Midlands Yellow Ware	-	-	2	1	-	3	L16/17
BORDB	Border Ware - brown glazed	2	-	-	-	-	2	L.16/18
BORDY	Border Ware - yellow glazed	2	-	-	-	-	2	L.16/18
A7d/e	Herefordshire Wares	22	8	3	23	1	57	17/18
E6	Staffordshire Wares	17	8	4	6	1	36	17/18
G5	Tin-Glazed wares	3	2	-	1	2	8	18

FABRIC CODE	COMMON NAME	AREA 1	AREA 2	AREA 3	AREA 4	OTHER	TOTAL	DATING
Modern Wares	Creamware, Transfer Printed Modern Stoneware, Modern Whiteware	16	9	2	28	6	61	m.18+
U/I	Unidentified	24	9	3	4	-	40	-
Total		86	36	5	62	10	199	

TABLE 76 Stratified pottery distribution by sherd count and area

AREA	CONTEXT	GRID	CONTEXT NOTES	BOWL TYPE	MARK TYPE	MAKER	DATE
1	1000	C13	modern surface	C	'OP' (heel)	?	1620-60
1	1000	C13	modern surface	F	1? (heel)	local	1650-80
1	1000	C13	modern surface	F	1 (heel)	local	1650-80
1	1000	C13	modern surface	J	1 (heel)	local	1670-1700
1	1000	C13	modern surface	J	1 (heel)	local	1670-1700
1	1000	C13	modern surface	O/P			1690-1720
1	1000	C13	modern surface	N (or Broseley 5b)	'THO ?AS		
?000ll' (heel)	? Broseley?	1680-1720					
1	1003	Area 1	graveyard soil	-	1 (heel)	local	1650-1710
1	1003	Area 1	graveyard soil	-	1 (heel)	local	1650-1710
1	1003	Area 1	graveyard soil	C			1620-60
1	1003	Area 1	graveyard soil	E			1650-80
1	1003	Area 1	graveyard soil	F	1 (heel)	local	1650-80
1	1003	Area 1	graveyard soil	F	1 (heel)	local	1650-80
1	1003	Area 1	graveyard soil	F	1 (heel)	local	1650-80
1	1003	Area 1	graveyard soil	F	1 variant (heel)	local	1650-80
1	1003	Area 1	graveyard soil	F	1? (heel)	local	1650-80
1	1003	Area 1	graveyard soil	F	1 (heel)	local	1650-80
1	1003	Area 1	graveyard soil	F			1650-80
1	1003	Area 1	graveyard soil	F	1 (heel)	local	1650-80
1	1003	Area 1	graveyard soil	F/H			1650-1700
1	1003	Area 1	graveyard soil	F?			1650-80
1	1003	Area 1	graveyard soil	G	4? (heel)	local	1670-1700
1	1003	Area 1	graveyard soil	G			1670-90
1	1003	Area 1	graveyard soil	H			1670-1700
1	1003	Area 1	graveyard soil	J			1670-1700
1	1003	Area 1	graveyard soil	K	RC9 (back of bowl)	local	1680-1710
1	1003	Area 1	graveyard soil	K	RC22 (heel)	possibly John Grub, Leominster	1680-1710
1	1003	Area 1	graveyard soil	K	15 (heel)	possibly William Caldewell, Leominster	1680-1710
1	1003	Area 1	graveyard soil	M	1 (heel)	local	1660-80
1	1003	Area 1	graveyard soil	M			1660-80
1	1003	Area 1	graveyard soil	O			1690-1720
1	1003	Area 1	graveyard soil	R			1720-60
1	1003	Area 1	graveyard soil	R/S			1720-1800
1	SK1138	C13	Elaborate Coffin	-	1 variant (heel)	local	1650-1710
1	SK1536	C12	Elaborate Coffin	C	-		1620-60

AREA	CONTEXT	GRID	CONTEXT NOTES	BOWL TYPE	MARK TYPE	MAKER	DATE
1	SK1849	B13	Elaborate Coffin	K?	15 (heel)	possibly William Caldewell, Leominster	1680-1710
2	10840	Area 2	graveyard soil	K?	RC14 (back of bowl)	Possibly Richard Overton, Birtley	1680-1710
2	10840	Area 2	graveyard soil	K??	RC9 (back of bowl)	local	1680-1710
2	10840	Area 2	graveyard soil	V			1820-70
2	10903	J9	brick lined tomb	R/S			1720-1800
3	30003	Area 3	graveyard soil	K	RC2 (heel)	local	1680-1710
3	30161	K5	stony layer	J	1 (heel)	local	1670-1700
4	40001	G2	subsoil	-	39? (heel)	RE?, local	1670-1710
4	40167	G2	layer below topsoil	R			1720-60

TABLE 77 Summary of Clay Pipe Bowl Types and Marks

Typological classifications derived from Peacey 1985, unless otherwise stated

SF NO	CONTEXT	AREA	GRID	CONTEXT DESCRIPTION	TYPE	CONDITION	LENGTH
0850	4733	1	B13	Fill of hearth	Fiddle-key	Curving shaft	42
2189A	40313	4	F3	Layer	Fiddle-key	Shaft broken	34+
2189B	40313	4	F3	Layer	Fiddle-key	Shaft bent, head broken	36+
2189C	40313	4	F3	Layer	Fiddle-key	Shaft straight and complete, head broken or worn	41+

TABLE 78 Catalogue of horseshoe nails

SF NUMBER	CONTEXT	AREA	GRID	CONTEXT DESCRIPTION & DATING	BURIAL PHASE	NOTES	LENGTH
0150B	1003	1	-	graveyard soil	-	inturned seam, tapering, well made	39
0107	1063	1	C14	deposit	-	broken	23+
0107	1063	1	C14	deposit	-		22
2121	1171	1	-	deposit underlying 1063	-	inturned seam	24
2121	1171	1	-	deposit underlying 1063	-		22
0204	1374	1	C12	SK1373	Simple Coffin		25
0213B	1375	1	-	SK1375	Simple Coffin		27
0131	1217	1	-	SK1216	Elaborate Coffin	lace preserved inside	15
0313C	1626	1	C13	SK1626	Elaborate Coffin	tapering	21
0382B	1839	1	B13	SK1836	Elaborate Coffin	broken, distorted	13+
0382B	1839	1	B13	SK1836	Elaborate Coffin	damaged	17+
0438	2063	1	C13	SK2063	Elaborate Coffin	very narrow	22
0438	2063	1	C13	SK2063	Elaborate Coffin	broken?	15+?
0546	2586	1	B13	SK2586	Elaborate Coffin	distorted at wide end	23
1277B	31130	3	K4	SK31130	Elaborate Coffin	broken? distorted at wide end	14+?

TABLE 79 Catalogue of Lace Tags

BURIAL PHASE	BONE ONLY	SIMPLE COFFIN	ELABORATE COFFIN	TOTAL
No of burials with pins	5	49	64	118
No of burials with 5 or more pins	2	18	29	49
No of burials with 10 or more pins	-	5	14	19

TABLE 80 Wire Pins from burial contexts

HFD TYPE	DESCRIPTION	SIMPLE COFFINS	ELABORATE COFFINS	CONCURRENCE WITH OTHER TYPOLOGIES WITH ASSOCIATED DATING	ASSOCIATIONS WITH DATED HEREFORD BURIALS
HFD Grip 1	Straight lower edge, slightly convex upper edge, with sharp external corners	11	17	OLR 4, used 1846 & 1852 & associated with other fittings 1729-1815	1739? (SK3370) ?743? (SK4560) 1746 (SK1721) 1853 (SK2137)
HFD Grip 2	Straight upper edge, lower edge expanded in middle to point, rounded corners	1	-	CCS 5, 1744-1835	-
HFD Grip 3	Straight upper edge, convex lower edge, rounded corners	-	1	-	-
HFD Grip 4	Relatively straight edge, sometimes expanding in middle, with rounded ends	3	6	CCS 3, 1729-1827	-
HFD Grip 5	Rounded, with no perceptible corners	6	14	CCS 1-2, 1747-1847	-
HFD Grip 6	Rounded with decorative moulding	-	3 (one of copper alloy)	CCS 4, 1743-1847	1831 (SK11031)
Total	-	**21**	**41**	-	-

TABLE 81 Coffin grip typology

HFD TYPE	DESCRIPTION	SIMPLE COFFINS	ELABORATE COFFINS	CONCURRENCE WITH OTHER TYPOLOGIES WITH ASSOCIATED DATING	ASSOCIATIONS WITH DATED HEREFORD BURIALS
HFD Grip Plate 1	plates with straight or relatively straight top edge and ovoid terminals	1	5	similar to OLR 1 (dated at least 1815, possibly earlier to 1852); similar to Rycote Type 68 & 69 (found on 'earliest and latest' coffins of 1649-1884 assemblage; similar to Kingston Type IVa (1680 onwards)	1739? (SK3370)
HFD Grip Plate 2	plates with curving upper edge and ovoid terminals	3	7	similar to Kingston Type IVb, 1680 onwards	?743? (SK4560)
HFD Grip Plate 3	plates with curving upper edge and round terminals	2	4	-	-
HFD Grip Plate 4	Large oval plate with moulded decoration	-	2 (both non-ferrous)	CCS 3, 1768-1847	1831 (SK11031)
Total	-	**6**	**18**		

TABLE 82 Coffin grip plate typology

	HFD GRIP PLATE 1	HFD GRIP PLATE 2	HFD GRIP PLATE 3	HFD GRIP PLATE 4	FRAGMENTARY NON-FERROUS	FRAGMENTARY FERROUS	NO PLATE	TOTAL
HFD Grip 1	7	9	4			8	15	43
HFD Grip 2						1		1
HFD Grip 3						2		2
HFD Grip 4		2	5			1	3	11
HFD Grip 5			3		1	2	25	31
HFD Grip 6				2			1	3
Total	**7**	**11**	**12**	**2**	**1**	**14**	**44**	**91**

TABLE 83 Associations of Grips and Grip Plates

BURIAL	INSCRIPTION	DATE OF COFFIN
1090	C? G 1736?	1736?
30378	B 173/87	1737?
30284	T/F E 1?7?3?8?	1738?
3370	ET 1739?	1739?
4560	? ? ?743?	1743?
1721	M 1746 +	1746
2137	1816 1853 R W	1853

TABLE 84 Coffin Stud Inscriptions

BURIALS PHASE	PRE-CIST	CIST	BONE ONLY	SIMPLE COFFIN	ELABORATE COFFIN	TOTAL
No of SK in study group	9	46	406	154	101	716
Grips (2+)	-	-	-	21	40	61
Grip Plates (2+)	-	-	-	6	18	24
Pins	-	-	5	49	64	118
Studs (10+)	-	-	-	9	49	58
Nails (10+)	-	-	-	26	31	57
Other Decoration	-	-	-	-	2	2
Other Fittings	-	-	1	2	2	5
Finds Dating	-	-	Medieval pottery (12th-e.13th) and spindle whorl. Buckle possibly interred with SK31469 (1450-1550)	c.1650 onwards (typological dating of grip plates)* Other finds include 18th century buttons and medieval pottery and small finds	1736? (studs, SK1090) 1737? (studs, SK30378) 1738? (studs, SK30284) 1739? (studs, SK3370) 1743? (studs, SK30378) 1737? (studs, SK4560) 1746 (studs, SK1721) 1743-1847 (typological dating SK1395) 1768-1847 (typological dating Coffin 4016) 1779-1847 (typological dating SK1100 1831 (depositum plate, SK11031) 1853 (studs, SK2137)	

TABLE 85 Summary of finds evidence from burials

SITE CODE	LAB CODE	SAMPLE ID	MATERIAL	Σ13C	RADIOCARBON AGE BP	CALIBRATED AGE RANGES (1 ó)	RELATIVE PROBABILITY	CALIBRATED AGE RANGES (2 Σ)	RELATIVE PROBABILITY
CCCE09	Wk34566	Sample 486 Context 4570	Charred Avena sp. grain	-24.3±0.2‰	1039±28	cal AD 987-1021	68.2%	cal AD 899-919	5.8%
								cal AD 963-1033	89.6%
CCCE09	Wk34567	Sample 475 Context 4990	Charred Avena sp. grain	-25.0±0.2‰	1026±27	cal AD 992-1023	68.2%	cal AD 902-915	2.0%
								cal AD 968-1040	93.4%

CCCE09	Wk34568	Sample 580 Context 5250	Charred Triticum dicoccum grain	-21.6±0.2‰	11566±27	cal AD 783-788	2.3%	cal AD 778-794	6.1%
						cal AD 816-843	14.4%	cal AD 800-905	57.8%
						cal AD 859-899	29.8%	cal AD 912-970	31.6%
						cal AD 919-950	21.7%		

TABLE 86 Radiocarbon dating results for Cathedral Close, Hereford

TABLE 87 Retent sample results

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery	CBM																					
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
AREA 1																									
Phase 1																									
5062	600	10	–	–	–	++++	–	–	+	–	–	–	–	–	+	–	++++	–	–	–	–	–	Unburnt bone ++++	–	–
5077	615	1	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+	–	–	–	+	<1	Unburnt bone +	–	–
5251	580	2	–	–	–	–	–	–	–	–	–	+	–	–	++	–	++	–	+	–	++	2	Charcoal ++ Burnt bone ++ Unburnt bone ++	–	–
5219	581	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+++	–	–	–	+	<1	Unburnt bone +++	–	–
5034	508	1	–	–	–	–	–	–	–	–	–	+	–	–	+	–	+	–	–	–	++++	5	Charcoal ++++ Burnt bone +	–	–
5034	509	1	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	++++	3	Charcoal ++++	–	–
5034	573	1	–	–	–	–	–	–	–	–	–	–	–	–	++++	–	–	–	–	–	–	–	Burnt bone ++++	–	–
5221	510	1	–	–	–	–	–	–	++	–	–	–	–	–	+	–	++++	+	–	–	+++	2.5	Charcoal + Unburnt bone++	–	–
5301	617	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	Unburnt bone +	–	–
Phase 2a																									
5312	598	1	–	–	–	–	–	–	–	–	–	+	–	–	++	–	+++	–	–	–	++	5	Charcoal ++ Burnt bone ++ Unburnt bone ++	–	–
5517	625	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+++	–	–	–	++	1.5	Charcoal + Unburnt bone +	–	–
5319	607	1	+	–	–	–	–	+	–	–	–	–	–	–	++++	–	++++	–	+	–	–	–	Unburnt bone ++ Burnt bone +++	–	–

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery	CBM																					
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
5320	606	1	–	–	–	–	+	–	–	–	–	–	–	–	++++	–	++++	–	–	–	–	–	Unburnt bone ++++ Burnt bone ++++	–	–
5432	618	1	–	–	–	–	–	–	–	–	–	+++	–	–	++	+	++++	++++	+	–	++	<1	Unburnt Bone ++++ Burnt bone +	–	–
5523	631	1	–	–	–	–	–	–	–	–	–	+	–	–	+	–	–	–	+	–	+	<1	Burnt bone +	–	–
Phase 2b																									
5272	584	2	–	–	–	–	–	–	–	–	–	+	–	–	+	–	+++	–	–	–	+	1	Charcoal + Unburnt bone ++	–	–
5276	585	2	–	–	–	–	–	–	–	–	+	–	–	–	+++	–	+++	–	–	–	++	<1	Unburnt bone ++ Burnt bone +	–	–
5344	626	20	+	–	–	–	–	–	+++	–	+	–	–	–	+++	–	++++	+++	–	–	++++	2	Charcoal ++++ Unburnt bone ++++ Burnt bone +++	–	–
Phase 2c																									
5515	624	1	–	–	–	–	–	–	–	–	–	+	–	–	+++	–	++	–	–	–	+	2	Charcoal + Unburnt bone + Burnt bone ++	–	–
5436	620	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	1	Charcoal +	–	–
5438	621	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	Burnt bone +	–	–
5502	619	1	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+++	–	–	–	+	1	Charcoal + Unburnt bone ++	–	–
5504	628	1	–	–	–	–	–	–	+	–	–	+	–	–	+	–	+	–	–	–	+++	2	Charcoal +	–	–
5526	629	1	–	–	–	–	–	–	+	–	–	–	–	–	+	–	+	+	–	–	+	1	Charcoal +	–	–
5537	633	2	–	–	–	+	–	–	+	–	–	++	–	–	+	–	+++	+	–	–	+	1	Charcoal + Unburnt bone ++	–	–

Phase 2d

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery		CBM																				
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
4990	475	2	+	–	–	–	–	–	–	–	–	+	–	–	++	–	–	–	–	–	+	1	Charcoal + Burnt bone ++	–	–
4992	474	2	–	–	–	–	–	–	–	–	–	++	–	–	–	–	++	–	–	–	–	–	Unburnt bone +	–	–
4992	487	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	++	1	Charcoal + Unburnt bone +	–	–
5268	583	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	–	–	Unburnt bone +	–	–
5277	597	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
5341	605	1	–	–	–	–	–	–	–	–	–	–	–	–	++++	–	–	–	–	–	–	–	Unburnt bone +++	–	–
5234	579	2	+	–	–	–	–	–	–	–	–	+	–	–	++	–	++++	–	–	–	–	–	Unburnt bone ++++ Burnt bone +	–	–
4572	497	1	–	–	–	–	–	–	–	–	+	+	–	–	+	–	–	–	–	–	+	1.5	Burnt bone + Charcoal +	–	–
4570	485	1	–	–	–	–	–	–	–	–	–	–	–	–	+++	–	–	–	–	–	–	–	Burnt bone ++	–	–
4570	486	1	–	–	–	–	–	–	–	–	–	–	–	–	+++	–	–	–	–	–	–	–	Burnt bone ++	–	–
4570	491	2	–	–	–	–	–	–	–	–	–	–	–	–	++	–	++	–	++++	–	–	–	Unburnt bone ++ Charred nutshell ++++	–	–
5305	603	1	–	–	–	–	–	–	–	–	–	–	–	–	+++	–	++	–	–	–	+++	2	Charcoal + Unburnt bone + Burnt bone +	–	–
5305	622	1	–	–	–	–	–	–	–	–	–	–	–	–	++++	–	+++	–	–	–	+	1	Charcoal + Unburnt bone ++ Burnt bone ++	–	–
5192	503	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	++++	4	Charcoal ++++	–	–
4573	498	1	–	–	–	–	–	–	–	–	–	+++	–	–	+++	+	++++	+	++	–	+	1	Charcoal + Nutshell ++ Burnt bone ++ Unburnt bone +++	–	–

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery	CBM																					
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
4697	484	1	–	–	–	–	–	–	–	–	–	–	–	–	+++	–	+++	–	–	–	+	2	Burnt bone +++ Unburnt bone+++ Charcoal +	–	–
4697	488	1	–	–	–	–	–	–	–	–	–	–	–	–	+++	–	+	–	–	–	++++	2.5	Charcoal +++	–	–
4697	575	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+++	+	–	–	+	1	Unburnt bone ++	–	–
5228	512	1	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+	–	–	–	Charred nutshell +	–	–
5281	582	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	+	1	Burnt bone + Charcoal +	–	–
4731	444	10	–	–	–	+	–	–	–	–	–	+++	–	–	+++	–	++++	+	+	–	+++	0.90	Burnt bone +++ Unburnt bone++++	–	–
4571	502	2	–	–	–	–	–	–	–	–	–	–	–	–	++++	++++	++++	–	++++	–	+	1	Burnt bone ++++ Unburnt bone ++++ Nutshell + Charcoal +	–	–
5196	577	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	++++	<1	–	–	–
5223	578	1	–	–	+	+	–	–	–	–	+	++	–	–	++	–	+++	+	+	–	+++	1.5	Charcoal + Unburnt bone ++ Burnt bone +	–	–
5314	601	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	++++	+	–	–	+	1	Charcoal + Unburnt bone ++++	–	–
Phase 2e																									
5352	608	1	+	–	–	–	–	–	–	–	–	++++	–	–	+++	–	–	–	+	–	+	1	Charcoal + Burnt bone +++	–	–
5382	611	2	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	++	2	Charcoal + Unburnt bone +	–	–
5406	613	1	–	–	–	–	–	–	–	–	–	+	–	–	+	–	+	–	–	–	+	2	Charcoal + Unburnt bone +	–	–
5417	614	1	–	–	–	–	–	–	+	–	–	–	–	–	+	–	+	+	–	–	–	–	Unburnt bone + Burnt bone +	–	–

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery	CBM																					
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
Phase 3																									
5518	630	10	–	–	–	–	–	–	–	–	–	++	–	–	–	–	+	–	–	–	–	–	–	–	–
Phase 3a																									
5150	599	3	–	–	–	–	–	–	–	–	–	–	–	–	+	–	++	–	–	–	–	–	Unburnt Bone ++	–	Burnt bone not retained.
5150	602	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+++	+	–	–	+++	<1	Unburnt bone +	–	–
5304	596	10	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+++	–	–	–	–	–	Unburnt bone ++ Burnt bone +	–	–
4694	467	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+++	–	–	–	–	–	Burnt bone + Unburnt bone +++	–	–
4957	465	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	++	–	–	–	++++	3	Charcoal ++++ Burnt bone + Unburnt bone ++	–	–
Phase 3b																									
4829	458	1	–	–	–	–	–	–	–	–	–	–	–	–	++++	–	–	–	–	–	–	–	Burnt bone ++++	–	–
4945	466	1	+	–	–	–	–	–	–	–	–	–	++++	–	++++	–	++++	–	+	–	+	2	Charcoal + Burnt bone +++ Unburnt bone +++,	–	–
5260	579	5	–	–	–	–	+	–	–	–	–	–	–	–	++	–	+	–	–	–	+	1.5	Burnt Bone ++	–	–
Phase 4																									
4500	417	3	–	–	+	–	–	–	–	–	–	–	–	–	++	–	–	–	–	–	–	–	Burnt Bone +	–	–
4498	463	10	+	+	–	–	–	–	–	–	–	++++	–	–	++++	–	++++	++	–	–	+++	<1	Burnt bone ++++ Unburnt bone ++++	+	–

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery	CBM																					
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
4693	464	2	+	–	–	–	–	+	–	–	–	–	+	–	++++	–	–	–	–	–	–	–	Burnt bone ++++	–	–
Phase 5																									
4732	446	2	–	–	–	–	–	–	–	–	+	+++	+	–	+	–	–	–	–	–	+	1.5	Charcoal +	–	–
4733	447	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile
4758	448	10	–	–	–	–	–	–	–	–	–	+++	–	–	++	–	++++	+	+	–	+	1	Charcoal + Burnt bone + Unburnt bone ++++	–	–
4482	454	2	–	–	–	–	–	–	–	–	–	++++	–	–	+	–	–	–	–	–	–	–	Burnt bone +	–	–
4773	453	1	–	–	–	–	–	–	–	–	–	–	–	–	++++	–	–	–	–	–	–	–	Burnt bone ++++	–	–
Grave fills																									
4845	455	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile
SK5615	652	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	++	–	–	–	+	<0.5	Unburnt Bone ++	–	–
SK5637	653	10	–	–	–	–	–	–	–	–	+	–	–	–	–	–	++	–	–	–	+	<0.5	Unburnt Bone ++	–	–
Other																									
5829	658	2	–	–	–	–	–	–	–	–	–	–	+	–	++	–	–	–	+	+	+	0.5	Charred Nutshell + Burnt Bone ++	–	–
5120	490	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	1	Charcoal +	–	–
5224	574	1	–	–	–	–	–	–	–	–	–	++	–	–	+	–	+	–	–	–	+	<1	–	–	–
5367	616	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	+	<1	–	–	–
5834	659	2	+	–	–	–	–	–	–	–	–	–	+	–	+	–	++	–	+	+	+++	1	Charcoal ++ Charred Nutshell +	–	–
AREA 2																									

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery	CBM																					
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
Grave fills																									
11101	639	1	–	–	–	–	–	–	–	–	–	++++	++++	–	–	–	++	–	–	–	+	1	Burnt bone ++ Charcoal +	–	–
11103	640	1	–	–	–	–	–	–	–	–	–	–	+	–	++	–	+++	–	–	–	+	1	Charcoal + Unburnt bone ++	–	–
10/11th Century																									
11183	649	1	–	–	–	–	–	–	–	–	+	–	–	–	+	–	+	–	+	++++	+	1	Charcoal + Unburnt bone + Burnt bone + Charred cereal ++++	–	–
11208	651	1	–	–	–	–	–	–	–	–	–	+	–	–	+	–	+	–	–	–	++++	2.5	Charcoal ++++	–	–
11th Century																									
12056	673	5	–	++	–	–	–	–	–	–	–	–	–	–	–	–	++	–	–	–	+	1.5	Unburnt Bone + Charcoal +	–	–
12064	676	5	–	–	–	–	–	++++	–	–	–	–	–	–	+	–	++	–	+	+	+	<0.5	Unburnt Bone + Burnt Bone +	–	Oyster shell not retained.
12436	684	5	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	++	1	Charcoal ++	–	–
12445	685	<1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+	0.5	Unburnt Bone +	–	–
12717	707	10	+	–	–	++++	–	–	–	–	–	–	–	–	++	–	+	–	–	–	++++	3	Burnt Bone ++ Charcoal ++++	–	–
11/12th Century																									
12563	687	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	+	+	<0.5	Charred Cereal Grain + Charred Nutshell +	–	–
12561	686	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	–	–	+	0.5	–	–	–
12674	689	5	+	–	–	–	–	–	–	–	+	–	–	–	+	–	+++	–	–	–	+	2	Unburnt Bone ++ Charcoal +	+	Cinders not retained.

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery	CBM																					
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
12666	690	20	–	+	++	–	–	+	–	–	+	–	–	–	–	–	++++	–	–	–	+	<0.5	Unburnt Bone +++	–	Charcoal not retained.
12676	691	5	+	–	–	–	–	–	–	++	–	–	++	–	–	–	++++	+	+	+	++	0.5	Unburnt Bone ++ Charred Nutshell +	–	–
12675	692	5	+	–	–	–	–	++	–	–	+	–	–	–	++	–	++	++	–	+	++	1	Charcoal + Unburnt Bone ++ Burnt Bone +	–	–
12011	671	20	++	++	–	–	–	++	–	+	+	–	+++	+	+++	–	++++	+	+	++	+++	1	Burnt Bone + Charred Nutshell + Charred Cereal Grain + Unburnt Bone +++	–	–
12088	680	10	–	–	–	–	–	–	–	–	–	–	–	–	++	–	++	–	–	–	–	–	Unburnt Bone ++ Burnt Bone ++	–	–
12th Century																									
11820	670	20	+	–	+	–	–	–	–	+	–	–	–	–	+++	–	++++	–	–	–	+	1	Unburnt Bone ++++ Burnt Bone + Charcoal +	–	–
18/19th Century																									
11127	646	1	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	–	–	++++	3	Charcoal ++ Burnt bone +	–	–
Unknown																									
10931	635	1	–	–	–	–	–	–	–	–	–	++++	–	–	–	–	–	–	–	–	–	–	–	–	–
11385	656	–	–	–	–	–	–	–	–	–	–	–	–	–	++	–	++	–	–	–	+	2	Charcoal + Unburnt Bone ++ Burnt Bone ++	–	–
11118	642	2	+	–	–	–	–	–	–	+	++++	+++	+	++	++	–	++++	–	–	–	–	–	Burnt bone + Unburnt bone ++++	–	Metallic objects include boot studs and Cu pin

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery	CBM																					
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
11153	648	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	1	Charcoal +	–	–
12719	688	20	+	–	+	–	–	+	–	–	–	–	–	–	++	–	++++	+	–	–	+	1	Unburnt Bone +++ Burnt Bone + Charcoal +	–	–
AREA 3																									
Early medieval																									
30234	711	5	–	–	–	–	–	–	–	–	–	–	–	–	+	–	++	–	–	–	+	1	Unburnt Bone +	–	–
31105	717	10	–	+	–	–	–	–	–	–	++++	–	–	–	+	–	+	–	–	–	++	2	Charcoal ++	–	–
11th Century																									
30034	693	2	–	–	–	–	–	–	–	–	–	–	++	–	+	–	+++	++	–	+	++	1	Charred Cereal Grain + Unburnt Bone ++ Charcoal +	–	–
30134	706	5	–	–	–	–	–	–	–	–	+	–	–	–	+	–	+	+	–	+	++++	3	Charcoal +++	–	Charred cereal grain, seeds and nutshell present.
30034	696	5	–	–	+	–	–	–	–	–	–	–	–	–	+	–	++	–	–	+	+	1	Charred Cereal Grain + Charcoal +	+	Cinders not retained.
30526	710	2	–	–	–	–	–	+	–	–	–	–	–	–	–	–	++	–	+	+	++	<0.5	Unburnt Bone +	–	Charcoal not retained.
11/12th Century																									
31591	718	10	+	+	–	++++	–	–	–	–	++	+	–	–	+	–	–	–	–	–	++++	3	Charcoal ++	–	–
30057	698	8	–	–	–	+	–	–	–	–	–	–	–	–	+	–	+	–	–	++ ++	+++	2.5	Charred Cereal Grain ++++ Charcoal ++ Burnt Bone + Unburnt Bone +	–	–

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery		CBM																				
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
30043	697	3	–	–	–	–	–	–	–	–	–	–	–	–	++	–	+	–	–	–	–	–	Unburnt Bone + Burnt Bone ++	–	–
30062	699	5	–	–	–	–	–	–	–	–	–	–	–	–	++	–	+	–	++	–	+	1.5	Charred Nutshell + Burnt Bone +	–	–
30073	703	2	–	–	+++	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	<0.5	Charred Cereal Grain +	–	Charcoal not retained.
30035	694	2	–	–	–	–	–	–	–	–	+	–	–	–	+	–	++	–	–	–	–	–	Unburnt Bone +	–	–
30036	695	5	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	0.5	–	–	–
30088	704	5	–	–	–	–	–	–	–	+	+++	–	–	–	+	–	++	+	–	+	+++	1	Charcoal + Unburnt Bone ++	–	–
30123	705	10	–	–	–	–	–	–	–	–	+	–	–	–	+	–	++	–	–	–	+	1.5	Unburnt Bone ++	–	–
30734	713	5	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+	–	–	–	–	–
30735	714	2	–	–	–	–	–	–	–	–	+	–	+	–	+	–	+	+	–	++	++	1	Charcoal + Cereal Grain ++	–	–
30740	715	2	–	–	–	–	–	–	–	–	–	–	–	–	+	–	++	–	–	+	+	0.5	Unburnt Bone + Charred Cereal Grain +	–	–
30741	716	2	–	–	–	–	–	–	–	–	–	–	–	–	++	–	–	–	–	+	+	<0.5	Burnt bone + Charred Cereal Grain +	–	Charcoal not retained.
13/14th Century																									
30494	709	3	+	–	–	–	–	+	–	–	–	–	–	–	+	–	+	–	–	–	++++	3	Charcoal +++	–	–
Unknown																									
30212	708	10	+	–	–	–	–	–	–	–	–	–	–	–	+	–	++++	–	–	–	++	2	Charcoal + Unburnt Bone ++++	–	–

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery	CBM																					
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
30063	701	2.5	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+++	–	+	+	+	<0.5	Charred Nutshell + Burnt Bone +	+	Charcoal and cinders not retained.
AREA 4																									
Early medieval																									
40091	719	3	–	–	–	–	–	–	–	–	–	–	–	–	+	–	++	+	–	–	+++	<0.5	Unburnt Bone +	–	Charcoal not retained.
40070	725	10	–	–	–	–	–	–	–	–	–	–	–	–	++	–	+	–	–	–	+	2	Charcoal + Burnt Bone +	–	–
40354	731	5	–	–	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+	<1	Unburnt Bone +	–	Charcoal not retained.
11/12th Century																									
40156	724	2	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	<0.5	–	–	Burnt Bone and Charcoal not retained.
40337	729	5	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	+	–	+	1	Charred Nutshell + Burnt Bone + Unburnt Bone +	–	–
40144	721	1	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	–	–	–	–	–
40146	722	1	–	–	–	–	–	–	–	–	+	–	–	–	+	–	++	–	–	–	–	–	Unburnt Bone +	–	–
40360	734	20	–	–	–	–	–	–	–	–	–	–	–	–	+++	–	+++	–	–	–	++	<0.5	Burnt Bone +++ Unburnt Bone +++	–	Charcoal not retained.
40152	723	10	+	+	+	–	–	–	–	–	++++	–	++	–	+	–	+	–	–	–	+	<0.5	Unburnt Bone +	–	Charcoal not retained.
40380	739	5	–	–	–	–	–	–	–	–	–	–	–	–	++	++	–	–	–	+	–	–	Burnt Bone +	–	–

CONTEXT	SAMPLE	VOL (L)	CERAMIC			BUILDING MATERIAL	STONE	GLASS		METAL OBJECT		MWD			BURNT BONE		UNBURNT BONE		CHARRED PLANT		CHARCOAL		AVAILABLE FOR AMS	CINDERS	COMMENTS
			Pottery		CBM																				
			Medi-PM	Tile	Other ceramic	Mortar	Lithics	Glass	Glass waste	Cu object	Fe object	Fe slag	Pb slag	Mag res	Mammal	Fish	Mammal	Fish	Nutshell	Cereal	Qty	Max size (cm)			
40355	733	10	–	–	+	–	–	–	–	–	–	–	–	–	+++	–	+++	+	–	–	+++	1.5	Charcoal + Unburnt Bone ++ Burnt Bone ++	–	–
40373	737	30	–	–	++++	–	–	–	+	+	–	–	–	–	+	–	+++	–	–	–	++	<0.5	Unburnt Bone +++	–	Charcoal not retained.
40113	720	3	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	1	Charcoal +	–	–
40069	726	5	–	–	–	–	–	++	–	+	–	–	++	–	+	–	++	–	–	–	–	–	Unburnt Bone +	–	–
40081	727	2.5	–	–	–	–	–	–	–	–	+	–	+++	–	++	+	+	–	–	–	+	0.5	Burnt Bone + Unburnt Bone +	–	–
40081	728	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	++++	5	Charcoal ++++	–	–
40394	740	30	+	–	–	–	–	–	–	–	–	–	++ +	–	++	–	+++	–	–	+	+	<0.5	Burnt Bone + Unburnt Bone ++	–	Charcoal not retained.
12/13TH CENTURY																									
40311	736	5	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	–	–	–	+++	2	Charcoal ++	–	–
Late medieval																									
40406	741	30	+	+	–	–	–	–	–	–	++++	–	–	–	++++	–	++++	–	–	–	+	1	Burnt Bone ++++ Unburnt Bone ++++ Charcoal +	–	–
40419	742	40	+	++	–	–	–	–	–	–	++	–	++	–	+++	–	++++	++	–	+	+	1	Burnt Bone + Charred Cereal Grain + Unburnt Bone +++	–	–

Key: + = rare, ++ = occasional, +++ = common and ++++ = abundant

NB charcoal over 1cm is suitable for identification and AMS dating

TABLE 88 Flotation sample results

CONTEXT	SAMPLE	TOTAL FLOT VOL (ML)	CEREAL GRAIN						OTHER PLANT REMAINS	CHARCOAL		AVAILABLE FOR AMS	COMMENTS
			Avena sp.	Hordeum vulgare	Triticum sp.	Triticum aestivo-compactum	Triticum dicoccum	Cerealia indet.		Qty	Max size (cm)		
AREA1													
Phase 1													
5062	600	70	–	+	–	+	–	+	–	++++	<1	–	–
5077	615	5	–	–	–	–	–	–	–	+++	1	Charcoal +	–
5251	580	60	+	+	–	–	+	–	–	++	2.7	Charcoal +	Charcoal includes large fragments of roundwood
5219	581	30	–	–	–	–	–	+	–	+++	1.2	Charcoal +	–
5034	508	5	–	+	–	–	–	–	–	+	<1	–	–
5034	509	5	+	+	–	–	–	–	–	+	<0.5	Charred cereal +	–
5034	573	10	–	–	–	–	–	–	–	–	–	–	Sample contains unburnt bone fragments ++
5221	510	10	+	–	–	–	–	–	–	++	<1	–	–
5301	617	15	–	–	–	–	–	–	–	+++	<0.5	–	–
Phase 2a													
5312	598	20	–	–	–	–	–	–	–	+++	3.2	Charcoal +	One fragment of charcoal is of worked wood
5517	625	10	–	–	–	–	–	+	–	+	<0.5	–	–
5319	607	20	–	–	–	–	–	–	–	++++	<1	–	–
5320	606	20	–	–	–	–	–	–	–	++++	<1	–	–
5432	618	30	–	–	–	–	–	–	–	++++	2	Charcoal ++	–
5523	631	5	–	–	–	–	–	–	Vicia/Lathyrus sp. +	++	<0.5	–	–
Phase 2b													
5272	584	20	+	–	+	–	–	–	–	++++	1.5	Charred cereal grain + Charcoal +	–
5276	585	10	–	–	–	–	–	–	–	++	<0.5	–	–
5344	626	20	+	–	+	–	–	–	–	+++	1.5	Charred cereal + Charcoal +	–
Phase 2c													
5515	624	5	–	+	–	–	–	–	–	–	–	–	–

CONTEXT	SAMPLE	TOTAL FLOT VOL (ML)	CEREAL GRAIN						OTHER PLANT REMAINS	CHARCOAL		AVAILABLE FOR AMS	COMMENTS
			Avena sp.	Hordeum vulgare	Triticum sp.	Triticum aestivo-compactum	Triticum dicoccum	Cerealia indet.		Qty	Max size (cm)		
5436	620	2	–	–	–	–	–	–	–	++	<0.5	–	–
5438	621	10	+	–	–	–	–	–	–	++	<0.5	Charred cereal +	–
5502	619	5	–	–	–	–	–	–	–	+	1	Charcoal +	–
5504	628	5	+	–	–	–	–	–	–	–	–	–	–
5526	629	2	+	–	–	–	–	+	–	++	<1	Charred cereal +	–
5537	633	10	++	–	–	–	–	–	–	+++	1.1	Charred cereal grain ++ Charcoal +	–
Phase 2d													
4990	475	40	+++	+	–	–	–	–	Chenopodium album + Poaceae indet + (small) nutshell indet + culm node +	++++	1.0	Charred cereal grain +++ Charcoal +	–
4992	474	10	+	–	–	–	–	+	Chenopodium album ++ Chrysanthemum segetum + Galium aparine + Marticaria recutita +	+++	1.3	Charred cereal + Charcoal +	–
4992	487	30	–	–	–	+	–	–	–	+++	1.2	Charcoal +	Charcoal includes twigs
5268	583	8	–	–	–	–	–	–	–	+++	1.0	Charcoal +	–
5277	597	2	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile
5341	605	4	–	–	–	–	–	–	–	+	<0.5	–	–
5260	579	10	–	–	–	–	–	–	–	–	–	–	–
4572	497	50	+	–	–	–	–	–	–	++++	2	Charred cereal grain+ Charcoal ++	–
4570	485	30	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile
4570	486	70	+++	–	–	+	–	–	–	++++	3.2	Charred cereal grain +++ Charcoal +++	Charcoal includes roundwood and branchwood
4570	491	80	++	+	–	–	–	–	Pisum sp. + Carex sp + Prunus spinosa fruit stone ++ Corylus avellana nutshell ++	++++	1.4	–	Charcoal includes twigs and larger roundwood

CONTEXT	SAMPLE	TOTAL FLOT VOL (ML)	CEREAL GRAIN						OTHER PLANT REMAINS	CHARCOAL		AVAILABLE FOR AMS	COMMENTS
			Avena sp.	Hordeum vulgare	Triticum sp.	Triticum aestivo-compactum	Triticum dicoccum	Cerealia indet.		Qty	Max size (cm)		
5305	603	15	++	–	–	+	–	–	Vicia sp +	++++	1.1	Charred grain ++ Charcoal +	–
5305	622	30	–	–	+	–	–	–	–	–	–	–	–
5192	503	–	–	–	–	–	–	–	–	–	–	–	–
4573	498	30	+	–	–	–	–	–	–	++++	<1	–	–
4697	484	90	++	–	+	–	–	–	–	++++	2.0	Charred cereal grain ++ Ccharcoal +++	–
4697	488	30	–	–	–	–	–	–	Vicia/Pisum sp.+	–	–	–	–
4697	575	6	–	–	–	–	–	–	–	+++	<0.5	–	–
5228	512	10	+	–	–	–	–	–	–	++	<1	–	–
5281	582	10	–	–	–	+	–	–	–	++	<1	–	–
4731	444	170	+	–	–	–	–	–	–	++++	2	Charcoal +++	–
4571	502	40	++++	+	+	–	–	–	Rumex sp.+	+++	<1	Charred cereal grain ++++	–
5196	577	200	–	–	–	–	–	–	–	++++	1.4	Charcoal ++	–
5223	578	10	+	–	–	–	–	–	–	++	<0.5	–	–
5314	601	2	–	–	–	–	–	–	–	+	<0.5	–	–
Phase 2e													
5352	608	10	+	–	–	–	–	–	–	+++	1.2	Charcoal +	–
5382	611	10	–	–	–	–	–	–	–	++	2	Charcoal +	–
5406	613	50	+	+	–	–	–	–	Chrysanthemum segetum ++ Fumaria officinalis + Persicaria lapithifolia + Rumex acetosa + Urtica dioca +	++	<1	Charred cereal grain +	–
5417	614	8	–	–	–	–	–	–	–	+++	<0.5	–	–
Phase 3													
5518	630	2	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile

CONTEXT	SAMPLE	TOTAL FLOT VOL (ML)	CEREAL GRAIN						OTHER PLANT REMAINS	CHARCOAL		AVAILABLE FOR AMS	COMMENTS
			Avena sp.	Hordeum vulgare	Triticum sp.	Triticum aestivo-compactum	Triticum dicoccum	Cerealia indet.		Qty	Max size (cm)		
Phase 3a													
5150	599	15	–	–	–	–	–	–	–	+++	<0.5	–	–
5150	602	5	–	–	–	–	–	–	–	+	<0.5	–	–
5304	596	2	–	–	–	–	–	–	–	+	<0.5	–	–
4694	467	20	–	–	–	–	–	–	–	++++	<0.5	–	–
4957	465	10	+	–	–	–	–	–	Persicaria lapithifolia +	++	<0.5	Charred cereal grain +	Sample contains bone fragments +
Phase 3b													
4829	458	15	+	+	–	–	–	–	Raphanus raphanistrum +	+++	1.1	Charcoal +	–
4945	466	50	++++	+	–	–	–	–	–	+++	2	Charred cereal grain ++++ Charcoal +	Sample contains bone fragments +
5234	579	40	+	+	–	–	–	–	–	+++	<1	Charred cereal grain +	–
Phase 4													
4500	417	5	–	–	–	–	–	–	–	+	<.5	–	–
4498	463	100	++++	–	++	–	–	–	Fumaria officinalis + Vicia/ Lathyrus sp.+ Raphanus raphanistrum + Chrysanthemum segetum + Lapsana communis + Fungal sclerotia + Poaceae + (small) Lemma and palaea fragments +	+++	1.4	–	Oat grain is in very good condition
4693	464	40	+++	+	–	+	–	–	–	++++	<1	Charred cereal grain +	–
Phase 5													
4732	446	10	–	–	–	–	–	–	–	++	<0.5	–	–
4733	447	2	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile
4758	448	30	+	–	–	–	–	+	Galium saxatile + Rumex acetosella +	++++	1.0	Charred cereal grain + Charcoal +	–

CONTEXT	SAMPLE	TOTAL FLOT VOL (ML)	CEREAL GRAIN						OTHER PLANT REMAINS	CHARCOAL		AVAILABLE FOR AMS	COMMENTS
			Avena sp.	Hordeum vulgare	Triticum sp.	Triticum aestivo-compactum	Triticum dicoccum	Cerealia indet.		Qty	Max size (cm)		
4482	454	4	+	–	–	–	–	–	–	+	<0.5	Charred cereal grain +	–
4773	453	5	++	–	–	–	–	–	–	++	<0.5	Ccharred cereal +	–
Grave Fills													
4845	455	2	–	–	–	–	–	–	–	++	<0.5	–	–
SK5615	652	5	–	–	–	–	–	–	–	++	<.5	–	–
SK5637	653	5	–	–	–	–	–	–	–	+	<1	–	–
Other													
5829	658	5	+	+	–	–	–	–	–	+++	<.5	–	–
5120	490	20	–	–	–	–	–	–	–	+	<0.5	–	sample contains cinders +
5224	574	2	–	–	–	+	–	–	–	+	<0.5	Charred grain +	–
5367	616	5	++	++	++	–	–	+	Chenopodium album + Chrysanthemum segetum + Persicaria lapithifolia +	++	<1	–	–
5834	659	5	–	+	–	–	–	–	–	+++	1.5	Charcoal ++	–
AREA 2													
Grave fills													
11101	639	10	–	–	–	+	–	–	Chenopodium sp. + Urtica dioca +	+++	1.3	Charcoal +	–
11103	640	5	+	–	+	+	–	–	–	+	<0.5	Charred grain +	–
10/11th Century													
11183	649	10	++ ++	++++	–	–	–	–	Chrysanthemum segetum + Chenopodium sp. + Chenopodium album +	++	<0.5	Charred cereal grain ++++	–
11208	651	10	++	–	–	–	–	–	Carex sp. + Tripleurospermum inodorum + Polygonum aviculare + Rumex sp. + Rumex acetosella +	–	–	–	–

CONTEXT	SAMPLE	TOTAL FLOT VOL (ML)	CEREAL GRAIN						OTHER PLANT REMAINS	CHARCOAL		AVAILABLE FOR AMS	COMMENTS
			Avena sp.	Hordeum vulgare	Triticum sp.	Triticum aestivo-compactum	Triticum dicoccum	Cerealia indet.		Qty	Max size (cm)		
11th Century													
12056	673	25	–	+	–	–	–	–	–	++++	1.5	Charred cereal grain +, Charcoal ++	–
12064	676	25	–	–	–	–	–	–	–	++++	2	Charcoal ++	–
12436	684	5	+	–	–	–	–	–	Polygonum aviculare +	++	<1	–	–
12445	685	5	–	–	–	–	–	–	–	+++	<.5	–	–
12717	707	25	+	++	–	–	–	+	Persicaria lapithifolia +, Chenopodium sp.+	++++	4	Charred cereal grain ++, Charcoal +++	–
11/12th Century													
12563	687	2	–	–	–	–	–	–	–	+	<.5	–	–
12561	686	5	–	–	–	–	–	+	–	+	<10	–	–
12674	689	5	–	–	–	–	–	–	–	+++	<1	–	–
12666	690	4	–	–	–	–	–	–	–	+++	2	–	–
12676	691	5	+	–	–	–	–	–	–	++	<1	–	–
12675	692	5	–	+	–	–	–	–	Culm node +	++++	2	Charcoal +++	–
12011	671	5	+	+++	–	–	–	+	–	++	<1	Charred cereal grain ++++	–
12088	680	15	+++	++++	–	–	–	–	–	++	<1	Charred cereal grain ++++	–
12th Century													
11820	670	20	–	–	–	+	–	–	–	+	<1	–	–
18/19th Century													
11127	646	50	–	–	–	–	–	–	–	+++	3.4	Charcoal ++	–
Unknown													
10931	635	2	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile
11385	656	5	+	–	–	–	–	+	–	++	1	Charcoal +	–

CONTEXT	SAMPLE	TOTAL FLOT VOL (ML)	CEREAL GRAIN						OTHER PLANT REMAINS	CHARCOAL		AVAILABLE FOR AMS	COMMENTS
			Avena sp.	Hordeum vulgare	Triticum sp.	Triticum aestivo-compactum	Triticum dicoccum	Cerealia indet.		Qty	Max size (cm)		
11118	642	30	–	+	–	–	–	–	–	++	<1	–	Sample contains unburnt bone fragments ++
11153	648	5	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile
12719	688	5	+	+	–	–	–	+	–	++	1	Charred cereal grain++, Charcoal+	–
AREA 3													
Early medieval													
30234	711	10	–	+	–	–	–	–	–	+	<1	–	–
31105	717	15	–	–	–	–	–	–	–	+++	1	Charcoal +	–
11th Century													
30034	693	5	–	+	–	–	–	–	–	+	<1	–	–
30134	706	5	–	+	–	–	–	–	Persicaria lapithifolia +, Carex sp +	++++	1.5	Charcoal ++	–
30034	696	5	–	–	–	–	–	–	–	++	<1	–	–
30526	710	5	–	–	–	–	–	–	–	++	1	Charcoal +	–
11/12th Century													
31591	718	10	+	+	–	–	–	+	–	++	<1	Charred cereal grain +	–
30057	698	15	+	++	–	+	–	–	–	++	<1	Charred cereal grain +	–
30043	697	5	+	+	–	–	–	–	–	–	–	Charred cereal grain +	–
30062	699	5	–	+	–	–	–	+	–	+	<1	Charred cereal grain +	–
30073	703	5	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile
30035	694	5	–	–	–	–	–	–	–	++	1	Charcoal +	–
30036	695	5	–	+	–	–	–	+	–	+	<1	Charred cereal grain +	–
30088	704	5	–	+	–	–	–	–	–	+	<1	–	–
30123	705	5	–	+	–	–	–	–	–	+	<1	–	–

CONTEXT	SAMPLE	TOTAL FLOT VOL (ML)	CEREAL GRAIN						OTHER PLANT REMAINS	CHARCOAL		AVAILABLE FOR AMS	COMMENTS
			Avena sp.	Hordeum vulgare	Triticum sp.	Triticum aestivo-compactum	Triticum dicoccum	Cerealia indet.		Qty	Max size (cm)		
30734	713	10	–	–	–	–	–	–	–	+	<0.5	–	–
30735	714	10	+	–	–	–	–	–	–	+	<0.5	–	–
30740	715	5	–	–	–	–	–	–	–	+	<0.5	–	–
30741	716	5	–	+	–	–	–	–	–	++	<1	–	–
13/14th Century													
30494	709	5	–	–	–	–	–	+	–	++++	1	Charcoal ++	–
Unknown													
30212	708	10	–	+	–	–	–	–	–	++	2	Charcoal +	–
30063	701	5	–	–	–	–	–	–	–	+++	<.5	–	–
AREA 4													
Early medieval													
40091	719	5	–	–	–	–	–	+	–	+	<1	–	–
40070	725	8	–	–	–	–	–	–	Persicaria sp.+, Polygonum aviculare +, Stellaria media.+	–	–	–	–
40354	731	5	–	–	–	–	–	–	–	++++	<1	–	–
11/12TH CENTURY													
40156	724	5	–	–	–	–	–	–	–	+	<1	–	–
40337	729	5	+	–	–	–	–	–	–	++	1	Charcoal+	–
40144	721	2	–	–	–	–	–	–	–	–	–	–	Archaeologically sterile
40146	722	4	–	–	–	–	–	–	–	+	<1	–	–
40360	734	15	–	–	–	–	–	–	–	++++	2	Charcoal++	–
40152	723	4	+	+	–	+	–	–	–	++	<1	Charred cereal grain+	–
40380	739	5	–	–	–	–	–	–	–	+	<0.5	–	–
40355	733	10	–	–	–	–	–	–	–	++++	1	Charcoal+	–

CONTEXT	SAMPLE	TOTAL FLOT VOL (ML)	CEREAL GRAIN						OTHER PLANT REMAINS	CHARCOAL		AVAILABLE FOR AMS	COMMENTS
			Avena sp.	Hordeum vulgare	Triticum sp.	Triticum aestivo-compactum	Triticum dicoccum	Cerealia indet.		Qty	Max size (cm)		
40373	737	25	++++	+++	–	–	–	++++	–	++++	1	Charred cereal grain++++, Charcoal+	–
40113	720	2	+	–	–	–	–	–	Polygonum aviculare.+	+	<1	–	–
40069	726	5	–	–	–	–	–	–	–	+	<1	–	–
40081	727	2	–	–	–	–	–	–	–	++	<1	–	–
40081	728	90	–	–	–	–	–	–	–	++++	4	Charcoal++++	–
40394	740	5	++++	++++	–	–	–	–	–	–	–	Charred cereal grain++++	–
12/13th Century													
40311	736	5	+	–	–	–	–	–	–	++++	1	Charcoal++	–
Late medieval													
40406	741	20	–	++	–	–	–	–	–	++++	2	Charred cereal grain+, Charcoal++	–
40419	742	15	–	–	–	–	–	–	–	++++	–	–	–

		AREA	1	2	3	4	OTHER	
Date group	Period							NISP
Saxon	1		585					585
Late Saxon	2		539	129	65			733
Saxo-Norman	3		1845	157	76	822	125	3025
post-medieval	4			53	15	172	47	287
19th century	5					61		61
redeposited grave material	6		535	51	8			594
		NISP	3504	390	164	1055	172	5285

TABLE 89 Total NISP by period

PERIOD	PIT	LAYER	LINEAR	POST HOLE	INDUSTRIAL FEATURE	SURFACE	NONE/ OTHER	GRAVE & DSK	NISP
1		566	19						585
2	48	463	175	28	14	5			733
3	250	2022	306	25	50	200	172		3025
4	97	136				7	47		287
5	61								61
6	34	13	413				4	130	594
NISP	490	3200	913	53	64	212	223	130	5285

TABLE 90 Total NISP by feature type

NISP	GOOD	QUITE GOOD	FAIR	MIXED	NOT RECORDED	TOTAL
Layer		1948	57	1046	149	3200
Linear	3	659	21	154	76	913
Pit		164	53	215	58	490
Surface		162	12	38		212
Industrial Feature		10	1	50	3	64
Post Hole		26		27		53
Grave & DSK		88	26	7	9	130
other		63	35	125		223
total	3	3120	205	1662	295	5285

TABLE 91 Bone preservation

FRAGMENTS	FRAGMENTED	BUTCHERED	DOG GNAW	ERODED	CHARRED	CALCINED	IVORIED	TOTAL EXCL. TEETH	TOTAL	LOOSE TEETH
Saxon	30	45	67	23	11	1	9	565	585	20
Late Saxon	32	36	37	61	16	13	25	530	539	9
Saxo Norman	108	161	146	92	25	3	43	1771	1845	74
redeposited	27	36	37	24	6	0	3	502	535	33
total	**197**	**278**	**287**	**200**	**58**	**17**	**80**	**3368**	**3504**	**136**

TABLE 92 Bone condition (Area 1)

TAXON	PERIOD	1	2	3	4	5	6	NISP
horse	Equus caballus	2		7	2		1	12
cattle	Bos taurus	84	101	548	70	14	116	933
sheep/goat	Ovis/Capra	35	44	211	42	6	64	402
sheep	Ovis aries	4	8	28	1	0	12	53
goat	Capra hircus	2	3	19	2			26
pig	Sus domesticus	117	84	330	30	4	87	652

TAXON	PERIOD	1	2	3	4	5	6	NISP
red deer	Cervus elaphus	2	1	4				7
fallow	Dama dama			1	1			2
roe	Capreolus capreolus	6	2	23			4	35
large mammal, cattle-sized		117	176	773	79	16	149	1310
large mammal, sheep/pig sized		134	147	629	25	12	102	1049
mammal, indeterminate		60	125	334	15	5	30	569
dog	Canis familiaris			1				1
fox	Vulpes vulpes			3				3
cat	Felis catus	1		4	13			18
mustelid, indeterminate					1			1
hare	Lepus europaeus	1	1	7			4	13
rabbit	Cuniculus oryctolagus	1						1
hare/cat sized mammal				2				2
woodmouse	Apodemus sp.			1				1
small mammal, indeterminate				6			1	7
swan	Cygnus sp.	1						1
goose, greylag Anser anser/domestic		4	2	16	3	1	4	30
duck, mallard Anas platyrhynchos/domestic				3			3	6
duck, teal	Anas crecca			1			1	2
eagle	cf. Haliaeetus albicilla	2						2
domestic fowl	Gallus gallus	7	17	47	1	2	13	87
turkey	Meleagris gallopavo					1		1
woodcock	Scolopax rusticola	2		1			1	4
wader			1	3				4
raven	Corvus corax				1			1
small passerine			1					1
bird, indeterminate		3	13	16	1		1	34
salmon	Salmo salar		6	3			1	10
perch	Perca fluviatilis		1					1
fish, indeterminate				4				4
	total bones	**585**	**733**	**3025**	**287**	**61**	**594**	**5285**

TABLE 93 Species present by period

	PERIOD 1		PERIOD 2		PERIOD 3	
Area of body	Total	percent	Total	percent	Total	percent
head & neck	12	14.5	7	9.9	65	19.4
teeth	8	9.6	6	8.5	38	11.3
shoulder	6	7.2	6	8.5	29	8.7
pelvis	9	10.8	5	7.0	20	6.0
foreleg	12	14.5	15	21.1	63	18.8
hindleg	11	13.3	7	9.9	31	9.3
hindleg (small bones)	1	1.2	0	0.0	1	0.3
feet	24	28.9	25	35.2	88	26.3
total NISP	83	100	71	100.1	335	100.1

TABLE 94 Cattle anatomy (area 1)

	PERIOD 1			PERIOD 2			PERIOD 3		
		epiphysial state			epiphysial state			epiphysial state	
	element	fused	unfused	element	fused	unfused	element	fused	unfused
group 1	distal scapula	3		distal scapula	3		distal scapula	17	
	pelvis acetabulum	5	1	pelvis acetabulum	3		pelvis acetabulum	11	1
group 2	proximal radius	3		proximal radius	1		proximal radius	11	
	distal humerus			distal humerus	3		distal humerus	9	4
	proximal phalanx	10	1	proximal phalanx	11	1	proximal phalanx	27	2
group 3	distal metapodial	2	3	distal metapodial	2		distal metapodial	9	4
	distal tibia	2	1	distal tibia	1	1	distal tibia	1	
group 4	femur			femur		1	femur	5	8
	proximal tibia		1	proximal tibia			proximal tibia		
	proximal calcaneus			proximal calcaneus			proximal calcaneus	2	2
	distal radius	1		distal radius	1		distal radius	5	1
	proximal humerus			proximal humerus	1		proximal humerus	1	2
	ulna			ulna			ulna	1	
	totals	26	7	totals	26	3	totals	99	24

	PERIOD 1			PERIOD 2			PERIOD 3		
	survival percentages cattle age (months)			survival percentages cattle age (months)			survival percentages cattle age (months)		
group 1	7-10 months	88.9	11.1	7-10 months	100	0	7-10 months	96.6	3.4
group 2	12-18	92.9	7.1	12-18	93.8	6.3	12-18	88.7	11.3
group 3	24-36	50.0	50.0	24-36	75.0	25.0	24-36	71.4	28.6
group 4	42-48	50.0	50.0	42-48	66.7	33.3	42-48	51.9	48.1
	Age classes adapted from Silver (1969)								

TABLE 95 Cattle bone fusion

PERIOD	1	2	3	4	TOTAL			
goat element					NISP		Total	percent
horncore		2	10		12	area		
skull			1		1	head & neck	14	50.0
lower dp4			1		1			
radius	1			1	2	foreleg	3	10.7
ulna	1				1			
pelvis			2		2	pelvis	2	7.1
metacarpus			3		3			
metatarsus			2		2			
calcaneum				1	1	feet	9	32.1
phalanx 1		1	1	1	3			
Total	**2**	**3**	**20**	**3**	**28**	**total NISP**	**28**	**99.9**

TABLE 96 Goat anatomy (all areas

PERIOD	1			2			3			TOTAL			PERIOD 1		PERIOD 2		PERIOD 3
	All	sheep	goat	All	sheep	goat	All	sheep	goat	NISP		Total	percent	Total	percent	Total	percent
horncore	1	1		1		1	7	3	4	9	area						
skull							3	2	1	3	head & neck	5	12.2	5	15.2	29	17.9
maxilla	1						3			4							
mandible	2			3	2		10	3		15							
lower premolar							1			1	teeth	2	4.9	1	3.0	14	8.6

PERIOD	1			2			3			TOTAL			PERIOD 1		PERIOD 2		PERIOD 3
lower dp4				1	1					1							
lower molar							3			3							
lower molar 3							1			1							
lower incisor							1			1							
upper premolar	1									1	shoulder	3	7.3	0	0.0	9	5.6
upper deciduous premolar							1			1	pelvis	6	14.6	0	0.0	18	11.1
upper molar	1						6			7							
tooth frag							1			1	foreleg	14	34.1	6	18.2	35	21.6
humerus	3			3	1		13	5		19							
radius	9	1	1	2			18	5		29							
ulna	2	1	1	1			4	1		7							
scapula	3						9	2		12							
pelvis	5						17			22	hindleg	7	17.1	7	21.2	36	22.2
sacrum	1						1			2							
femur	2			1			6			9	hindleg (small bones)	0	0.0	1	3.0	0	0.0
tibia	5			6			30			41							
patella				1						1	feet	4	9.8	13	39.4	21	13.0
metacarpus	3			2	1		7	1	3	12							
metatarsus				4	1		6	1	1	10							
astragalus	1	1					3	2		4							
calcaneum				3	1		5	2		8	total NISP	41	100	33	100	162	100
phalanx 1				4		1				4							
atlas	1						4			5							
axis				1			2			3							
Total	**41**			**33**			**162**			**236**							

TABLE 97 Sheep and goat anatomy (Area 1)

GROUP	ELEMENT	EPIPHYSIAL STATE NISP		APPROX. AGE AT FUSION IN MONTHS	SURVIVAL PERCENTAGES	
		fused	unfused		fused	unfused
group A	proximal radius	11		0-6 month	100	0
group B	distal scapula	5	1	6-12 months	86.2	13.8
	pelvis acetabulum	12	1			
	distal humerus	8	2			
group C	proximal phalanx			12-18 months	0	0
group D	distal metapodial	3		18-30 months	75.0	25.0
	distal tibia	6	3			
group E	proximal calcaneus	4	1			
	femur	1	3	30-48 months	52.4	47.6
	proximal tibia	3	3			
	distal radius	2	2			
	ulna	1	1			
group F	proximal humerus	1		48+	100.0	0.0
	totals	57	17			

TABLE 98 Sheep and goat bone fusion

PERIOD	1	2	3	TOTAL			PERIOD 1		PERIOD 2		PERIOD 3
						Total	percent	Total	percent	Total	percent
skull	8	2	11	21	area						
skull fragment	9	1	6	16	head & neck	41	35.0	12	20.0	59	25.9
maxilla	14	3	11	28							
mandible	10	4	22	36							
lower premolar	1			1	teeth	10	8.5	3	5.0	23	10.1
lower deciduous incisor	1		1	2							
lower canine	1	1	5	7							
lower molar	1		2	3							
lower molar 3	1		1	2							
lower incisor	1	2	10	13							
upper premolar	1		1	2	shoulder	4	3.4	3	5.0	19	8.3
upper canine	2		2	4	pelvis	13	11.1	5	8.3	18	7.9
upper incisor	1		1	2							
humerus	11	5	16	32	foreleg	20	17.1	15	25	44	19.3
radius	5	6	14	25							
ulna	4	4	14	22							
scapula	4	3	19	26							
pelvis	13	5	18	36							
femur	5	1	11	17	hindleg	8	6.8	5	8.3	27	11.8

PERIOD	1	2	3	TOTAL			PERIOD 1		PERIOD 2		PERIOD 3
tibia	3	4	16	23							
fibula	4	4	7	15	hindleg (small bones)	4	3.4	4	6.7	7	3.1
metacarpus	7	3	8	18							
metatarsus	2	7	9	18	feet	17	14.5	13	21.7	31	13.6
astragalus	2		2	4							
calcaneum	1		4	5							
lateral metapodial	4	2	5	11							
phalanx 1	1	1	1	3	total NISP	117	99.8	60	100	228	100
phalanx 2			1	1							
phalanx 3			1	1							
atlas		1	7	8							
axis		1	2	3							
Total NISP	**117**	**60**	**228**	**405**							

TABLE 99 Pig anatomy (area 1)

DISTAL TIBIA	0	1	DISTAL TIBIA	3	1	DISTAL TIBIA	5	7
femur	0	3	femur	0	1	femur	1	4
proximal tibia	0	0	proximal tibia	0	2	proximal tibia	0	1
distal radius	0	2	distal radius	0	1	distal radius	0	2
proximal humerus	0	0	proximal humerus	0	0	proximal humerus	0	2
ulna	0	1	ulna	0	2	ulna	0	4
totals	**19**	**19**	**totals**	**12**	**15**	**totals**	**43**	**42**

SURVIVAL PERCENTAGES			SURVIVAL PERCENTAGES			SURVIVAL PERCENTAGES		
pig age (months)			pig age (months)			pig age (months)		
12	71.4	28.6	12	80.0	20.0	12	79.1	20.9
24-30	36.4	63.6	24-30	36.4	63.6	24-30	28.6	71.4
36-42	0	100	36-42	0	100	36-42	7.1	92.9

Age classes adapted from Silver (1969)

TABLE 100 Pig fusion

RED DEER							
Element	Period1	Period2	Period3	Period4	Period5	Period6	NISP
antler	1	1					2
scapula			1				1
radius	1						1
pelvis			1				1
astragalus			1				1
calcaneum			1				1
							7

ROE							
Element	Period1	Period2	Period3	Period4	Period5	Period6	NISP
antler			1			1	2
maxilla		1					1
upper premolar			1				1
scapula	1		4				5
humerus	1	1	1			1	4
ulna	1					1	2
radius	1	1	9				11
metacarpus			2			1	3
pelvis			1				1
femur			1				1
metatarsus	1		3				4
							35

FALLOW							
Element	Period1	Period2	Period3	Period4	Period5	Period6	NISP
radius			1				1

femur				1			1
							2

TABLE 101 Deer element count

DOMESTIC FOWL							
Element	Period1	Period2	Period3	Period4	Period5	Period6	NISP
humerus	1	1	8			1	11
radius		2	6			1	9
ulna	1	2	3			2	8
scapula		1	3				4
coracoid	1	2	1			1	5
furcula		2	2				4
femur	2	1	7			3	13
tibiotarsus	1	2	7	1	1	3	15
fibula						1	1
carpometacarpus		1	3				4
tarsometatarsus	1	2	4		1		8
synsacrum			2				2
sternebra/ sternum		1	1			1	3
							87

GOOSE, DOMESTIC/GREYLAG							
Element	Period1	Period2	Period3	Period4	Period5	Period6	NISP
mandible	1		1				2
humerus	1		4			1	6
radius	1		1		1	1	4
scapula	1	1	1	1			4
coracoid				1		1	2
furcula			1				1
pelvis			1				1
femur				1		1	2
tibiotarsus			4				4
tarsometatarsus		1					1
synsacrum			1				1
sternebra/ sternum			1				1
limb shaft fragment			1				1
							30

TABLE 102 Bird element count

PERIOD 1		CATTLE	SHEEP & GOAT	PIG	TOTAL
	area 1	83	41	117	
	Total NISP	83	41	117	241
	percent	34.4	17	48.5	

PERIOD 2		CATTLE	SHEEP & GOAT	PIG	TOTAL
	area 1	71	31	60	
	area 2	16	17	17	
	area 3	14	5	7	
	Total NISP	101	53	84	238
	percent	42.4	22.3	35.3	

PERIOD 3		CATTLE	SHEEP & GOAT	PIG	TOTAL
	area 1	335	162	226	
	area 2	23	14	16	
	area 3	31	4	8	
	area 4	116	65	73	
	other	43	13	6	
	Total NISP	548	258	329	1135
	percent	48.3	22.7	29	

PERIOD 4		CATTLE	SHEEP & GOAT	PIG	TOTAL
	area 2	15	13	8	
	area 3	2	2	3	
	area 4	42	29	17	
	other	11	1	2	
	Total NISP	70	45	30	145
	percent	48.3	31.0	20.7	

Period 5		cattle	sheep & goat	pig	Total
	area 4	14	6	4	

	Total NISP	14	6	4	24
	percent	58.3	25	16.7	
PERIOD 6		CATTLE	SHEEP & GOAT	PIG	TOTAL
	area 1	85	65	82	
	area 2	29	8	3	
	area 3	2	3	2	
	Total NISP	116	76	87	279
	percent	41.6	27.2	31.2	

TABLE 103 MDA by period and area

14 CHARTS

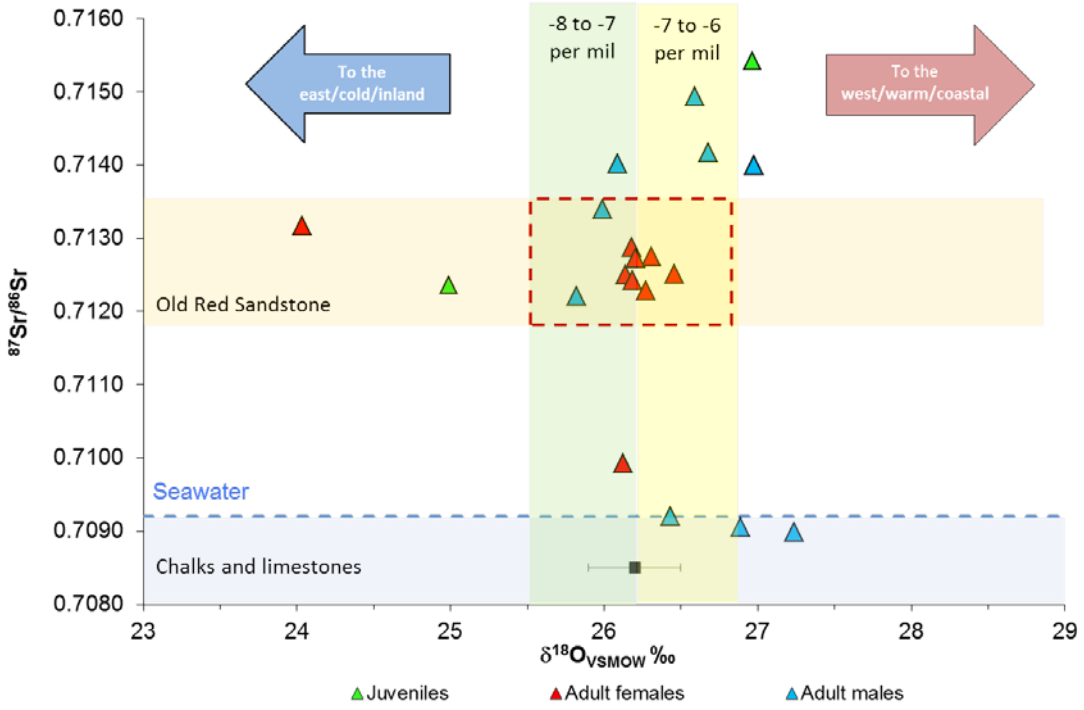

CHART 1 results of isotope analysis

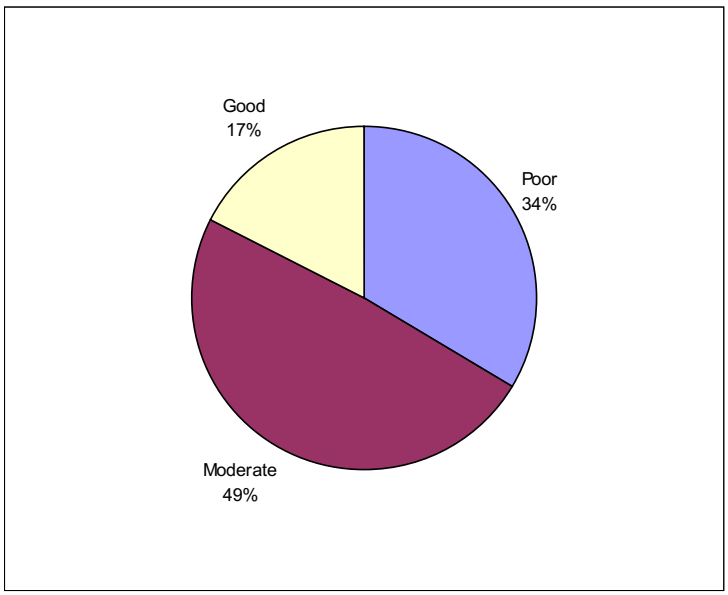

CHART 2 Preservation of excavated skeletons

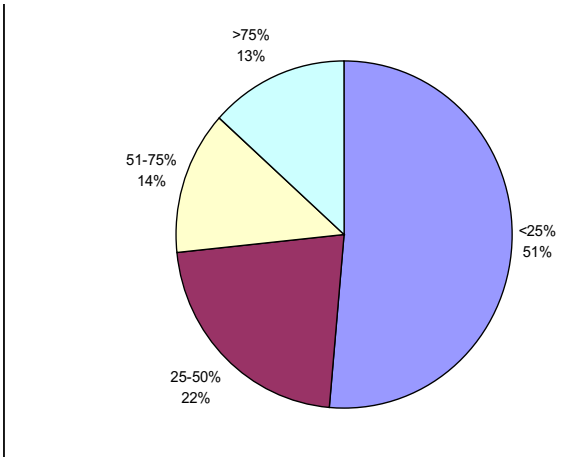

CHART 3 Completeness of excavated skeletons

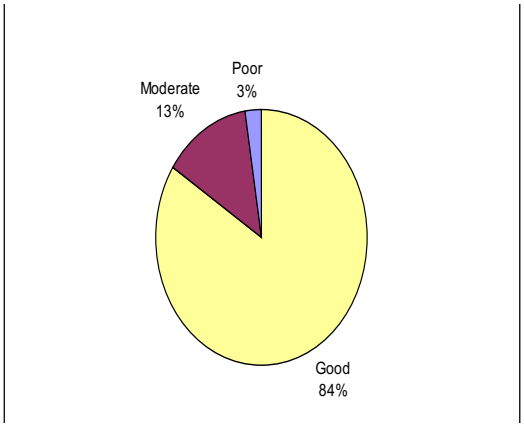

CHART 4 Preservation of analysed skeletons

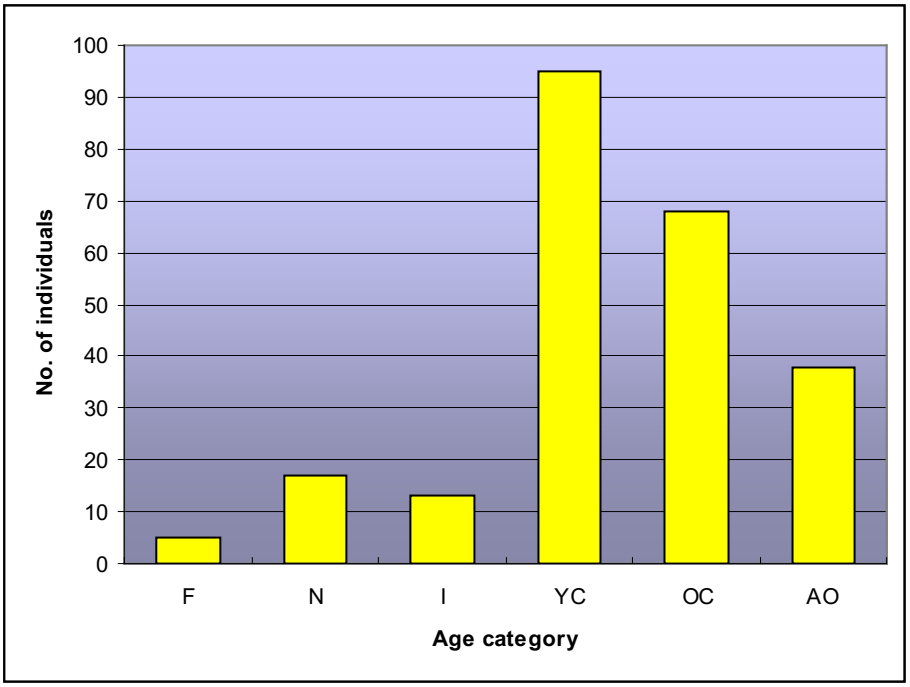

CHART 5 Sub-adult age distribution

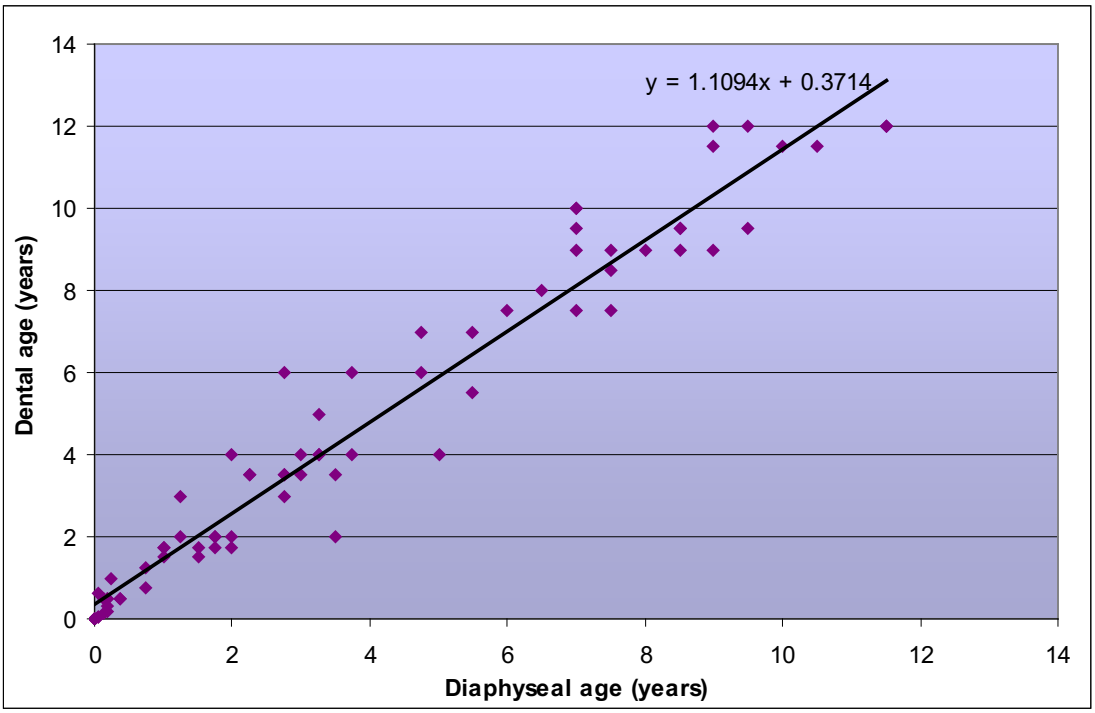

CHART 6 Sub-adult growth by dental age

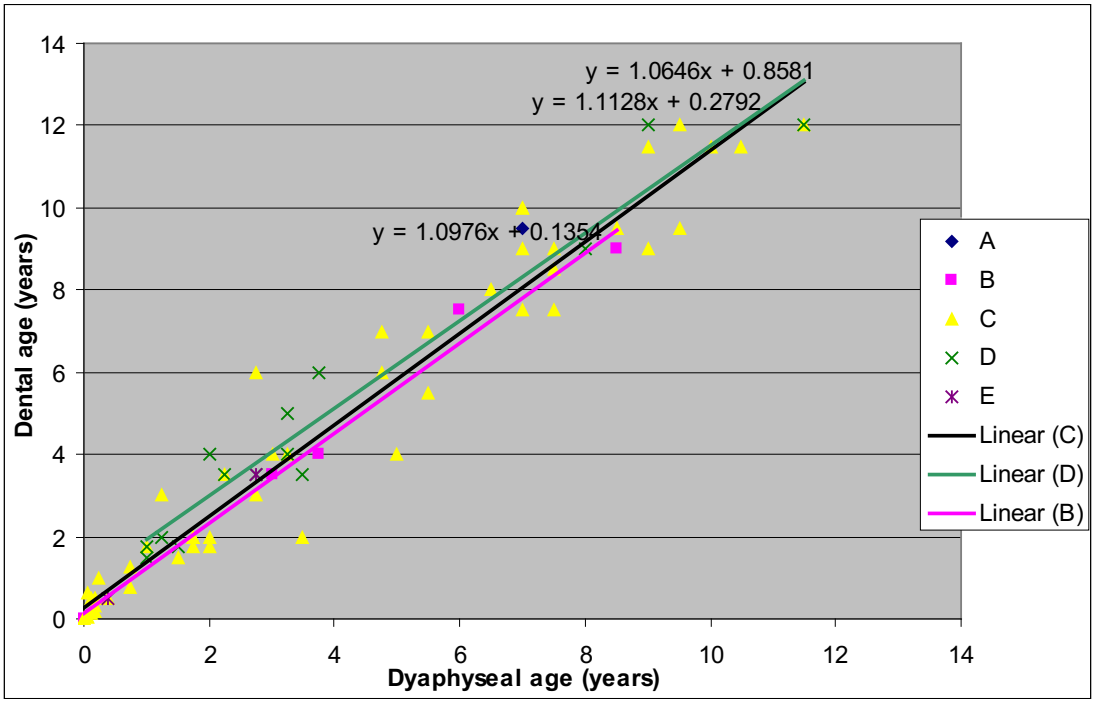

CHART 7 Sub-adult growth by dental age within different burial groups

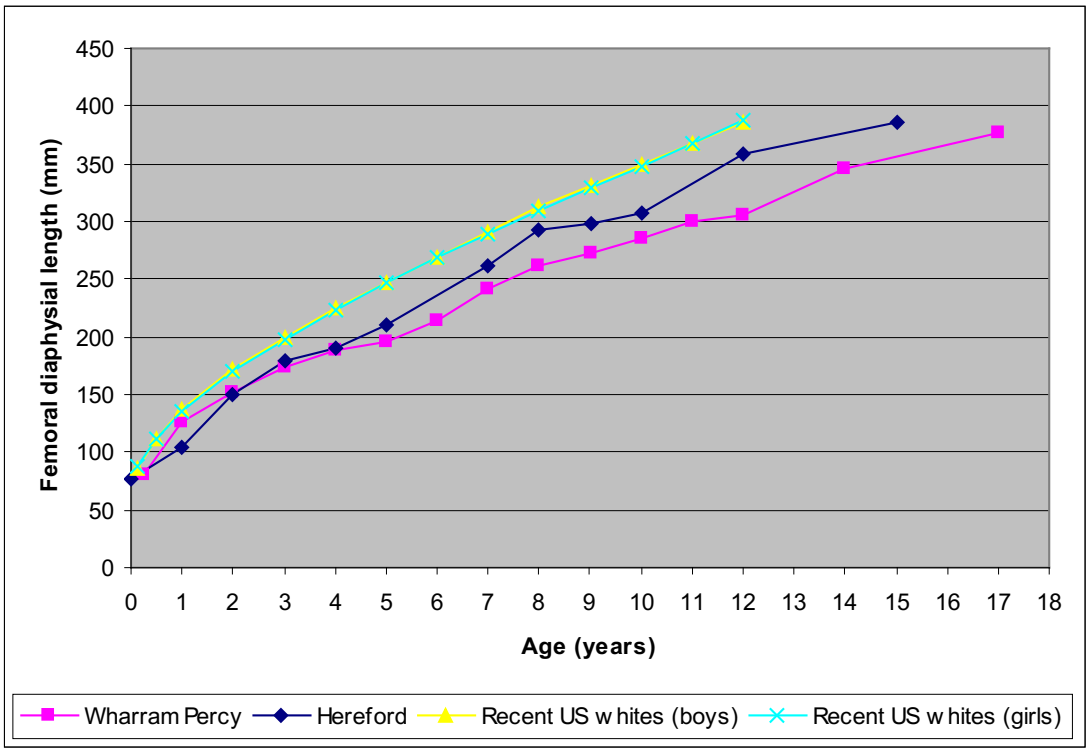

CHART 8 Comparison on sub-adult growth by dental age between populations

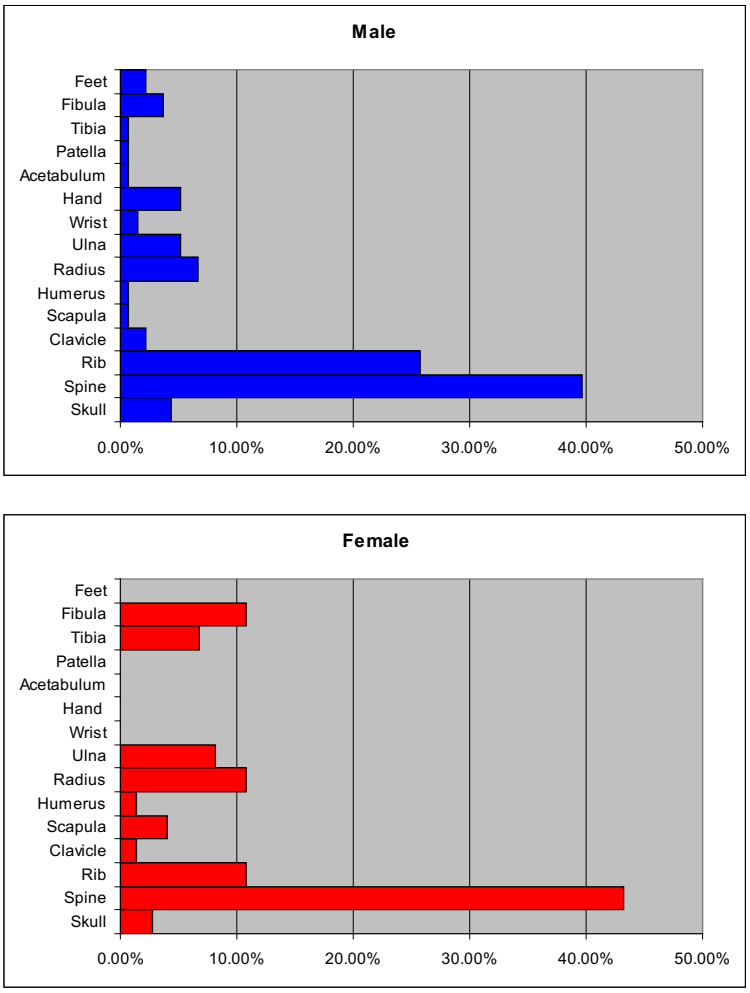

CHART 9 Distribution of fractures at Hereford Cathedral by sex

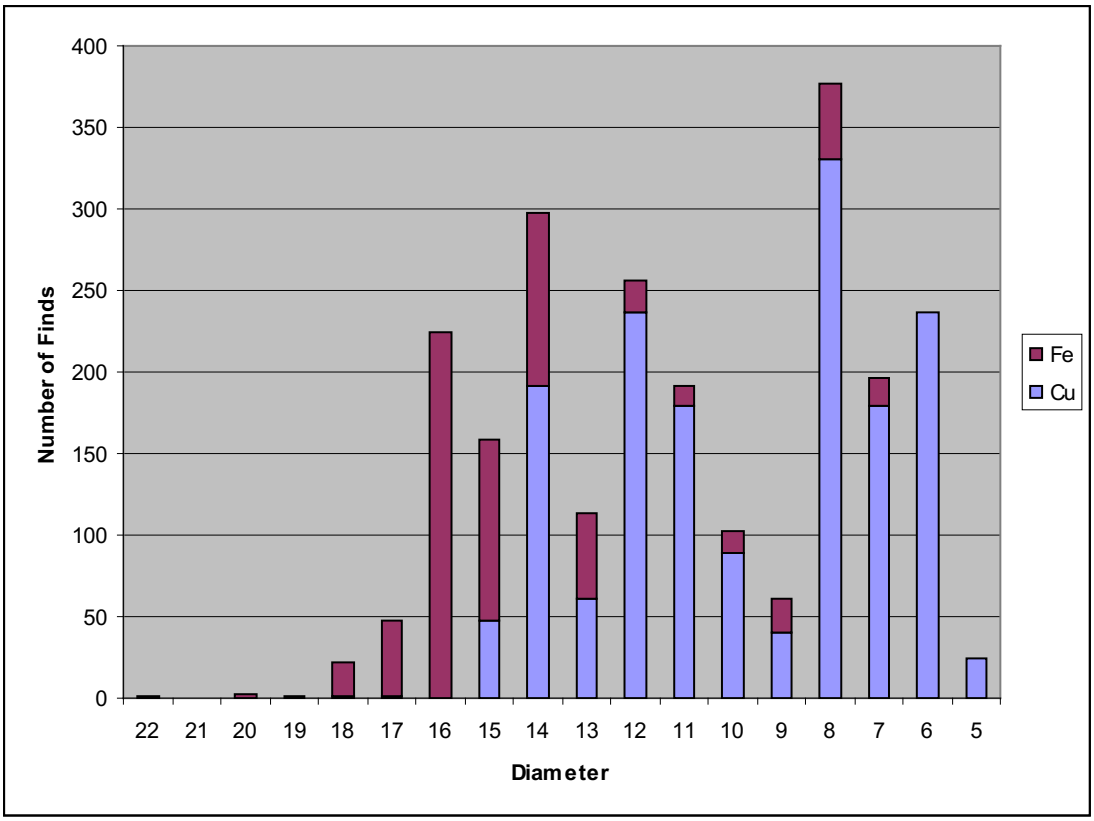

CHART 10 Coffin stud diameter range

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