ACSW12/002

ABBEY CHURCH, PERSHORE

Subsidence Works

for The Vicar & Churchwardens of Pershore Abbey

January 2013

HEADLAND ARCHAEOLOGY Ltd

REGISTERED IfA ORGANISATION

ABBEY CHURCH, PERSHORE

Subsidence Works

for The Vicar & Churchwardens of Pershore Abbey

January 2013

HA Job no.: ACSW12/002
HAS no.: 963
NGR: SO 947 457
Parish: Pershore
Local authority: Worcestershire County Council
OASIS ref.: headland3-140482
SMR no.: WSM46475
Archive will be deposited with Hartlebury Museum, Worcestershire

Project Manager	Mike Kimber
Author	Jason Murphy
Fieldwork	Kath Crooks & Tegan Daly
Graphics	Caroline Norrman & Julia Bastek
Specialists	Jason Murphy & Tegan Daly – Osteology Laura Bailey – Environmental Julie Franklin – Finds
Approved by	Mike Kimber – Project Manager

Headland Archaeology (UK) Ltd

Midlands & West

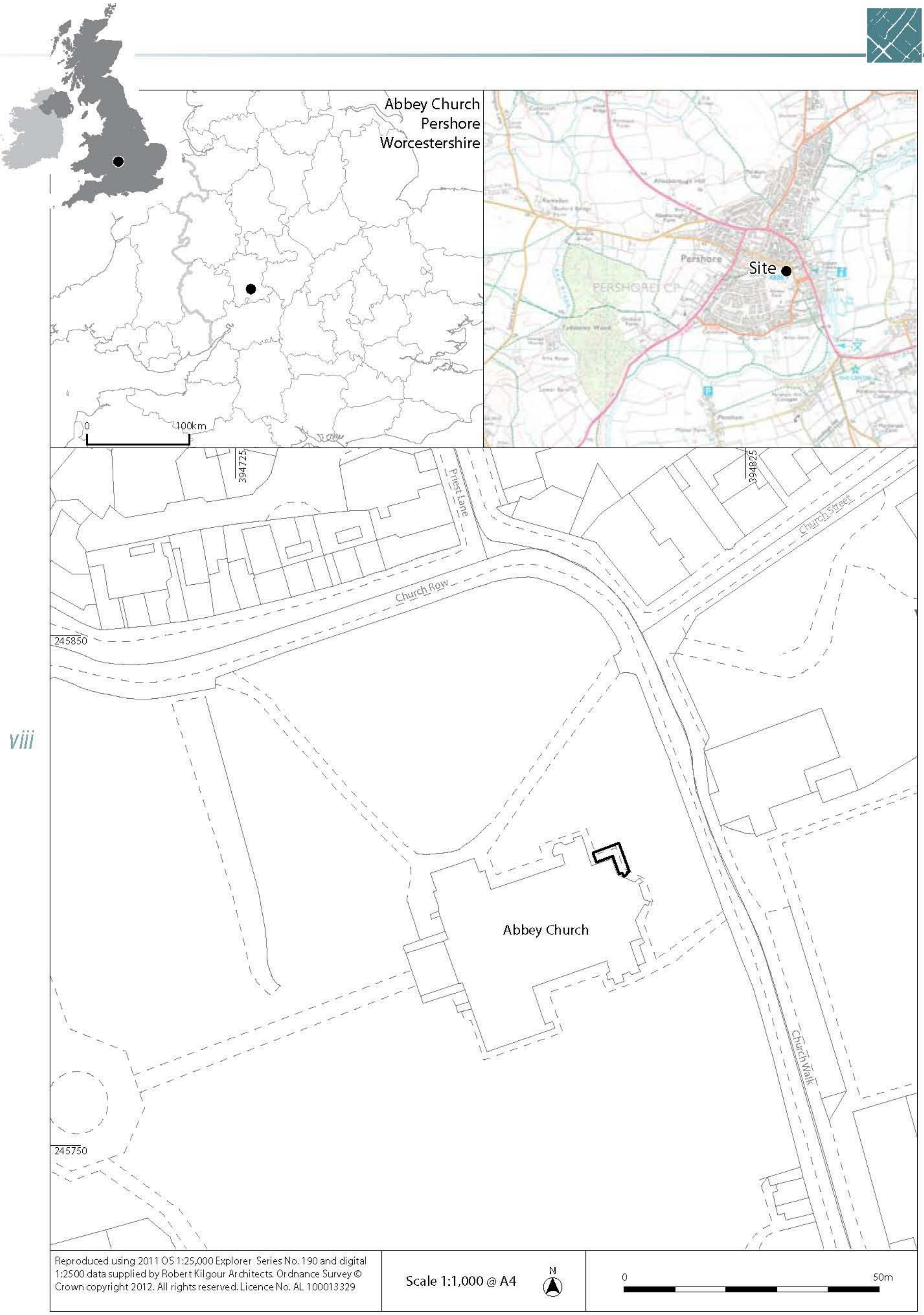
Headland Archaeology
Unit 1, Premier Business Park, Faraday Road
Hereford HR4 9NZ
01432 364 901
hereford@headlandarchaeology.com

www.headlandarchaeology.com

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES



Illus 1

Site location

ABBEY CHURCH, PERSHORE

Subsidence Works

1. INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned to undertake an archaeological excavation and watching brief at Pershore Abbey Church, Worcestershire.

The north-east chapel was suffering from subsidence caused by desiccation of the surrounding soil by tree roots. It was proposed to underpin the foundations of the north-east chapel. This would impact upon burials and potentially other archaeological remains within the footprint of the works.

The site (NGR SO947457 site centre) is currently part of the Abbey Church burial ground and lies outwith the scheduled part of the Abbey Church precinct. Underlying geological deposits comprise Quaternary sands and gravels.

Work began on the 7th June and ended 20th June 2012.

2. ARCHAEOLOGICAL BACKGROUND

Pershore has Roman and Anglo-Saxon antecedents, with a minster church founded in c AD 698, but the present town is likely to have grown in the main following the foundation of the Benedictine Abbey in c AD 970 as a small rural settlement adjacent to its north gate (Dalwood 1996: 2). Following its establishment as a burgh after 1065 Pershore became moderately prosperous via the wool trade, but declined towards the end of the medieval period. The abbey was dissolved in 1539, with much of its grounds becoming those of a private house (Dalwood 1996:2).

The abbey has had a long history, from Saxon religious house, via a Norman and later medieval structure to the rather truncated remnants now forming the present abbey church. A Saxon foundation is preserved within the present-day nave (the choir of the pre-dissolution building), while Norman architecture is visible within the south transept. The area of the proposed works lies at the eastern end of the Abbey and could be expected to disturb burials from a high-status part of its burial ground.

The north-east, or St John's chapel is thought to date from the early 13th century when the east end of the Abbey underwent alterations. The chapel has a restored lancet window in the east wall and an original window on the north side (Page 1924). Part of the chapel was underpinned in the 19th century by the architect Gilbert Scott, and this work appears to have caused some disturbance to burials in the churchyard.

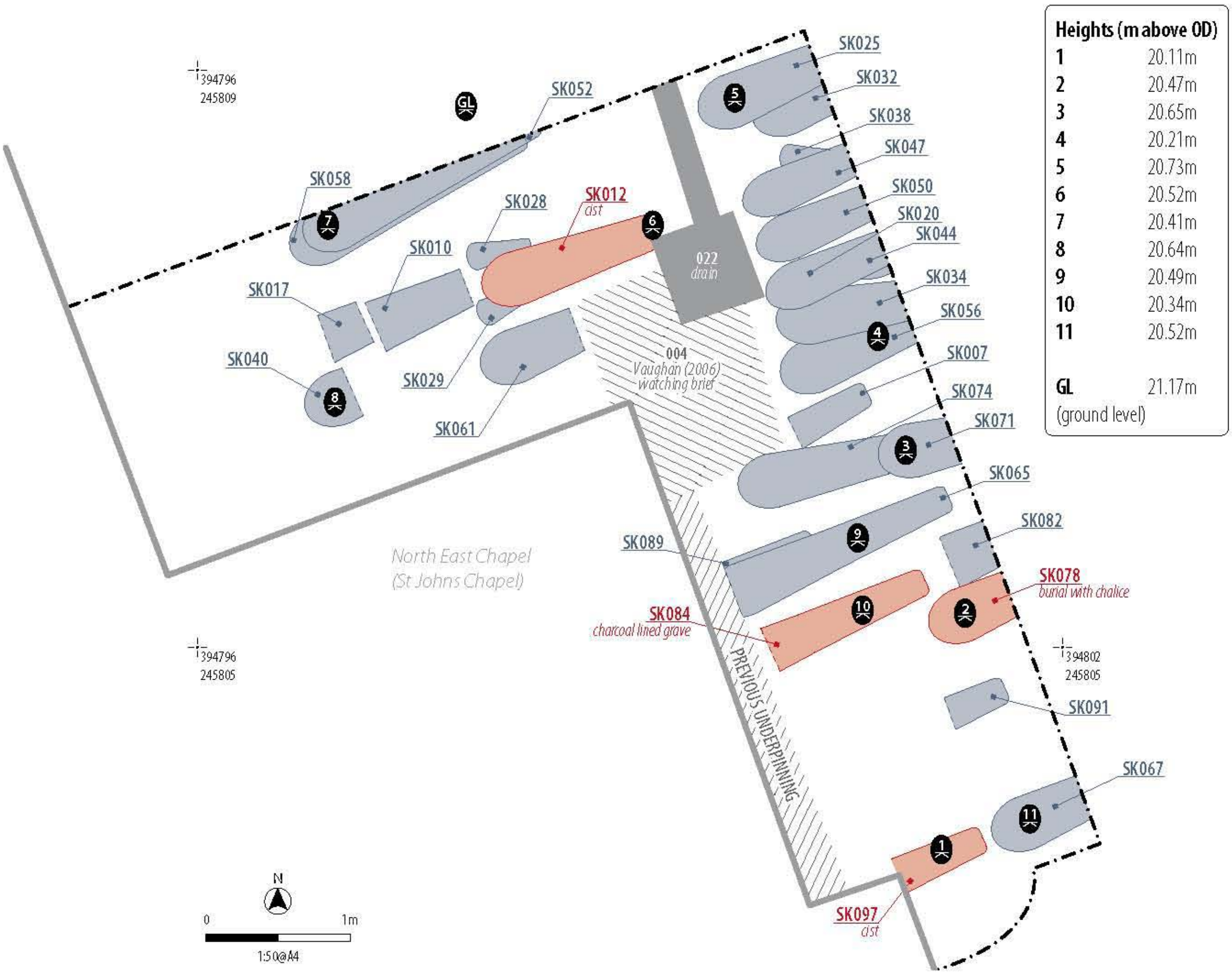
2.1 Previous work

Recent archaeological work undertaken in and around the abbey church includes an evaluation at the west end of the Abbey (Napthan 1997); watching briefs on works to assess subsidence at the north side of the church (Sworn 2005; Vaughan 2006) and an evaluation within the current nave of the church (Blockley 1996). These investigations have collectively demonstrated the presence of an earlier Anglo-Saxon structure underlying the present-day church; the extents of the northern transept and the western end of the original nave; and the presence of both *in situ* and disarticulated human remains at a shallow depth.

Evaluation work undertaken by Vaughan (2006) and Craddock-Bennett (2012) has established the presence of *in situ* Christian burials within the footprint of the underpinning works. The earlier work at the north-east corner of the chapel revealed four articulated inhumations buried between 0.17m and 0.6m below ground level (Vaughan 2006). Two of these burials were truncated by the chapel structure – probably by the 19th century underpinning work.

During 2012 works two test pits were dug, one at the point where the North Chapel abuts the North-East Chapel, and one where the North-East Chapel meets the apsidal end of the presbytery. A possible stone cist burial was discovered, adjacent to the foundations of the former Lady Chapel at a depth of approximately 1.5m. The lower limbs of a burial were observed within this cist, extending out from beneath the foundations of the north-east chapel.

3. OBJECTIVES



Illus 2

Plan of burials

The primary objectives of the project were:

- To ensure that any human remains encountered in the course of the works were recovered respectfully for appropriate reburial at a later date.
- To mitigate the destruction of archaeological remains by the underpinning works by means of excavation, recording, dissemination and deposition of an archive.
- To advance understanding of the development of the Abbey Church
- To advance understanding of the burial ground, specifically the date of burials around the Abbey, and the health etc of the individuals there buried.

Following completion of the excavation work, an updated project design was produced for agreement with the project stakeholders.

4. METHOD

The footprint of the underpinning works consisted of a 1m wide strip around the north-east chapel with the addition of a further 1m wide strip creating a stepped area to allow for access to the depth of the foundations of the chapel. The total excavation footprint comprised an area of 19m².

Excavation proceeded mainly by hand, although a mini-excavator was used under close archaeological supervision to remove superficial deposits. Any areas that were previously excavated and backfilled were excavated by the main contractor under archaeological supervision. Excavations beneath the chapel foundations were undertaken by the main contractor under archaeological supervision.

There were no structural engineering constraints on the size of the archaeological excavation areas provided they did not extend deeper than the chapel foundations.

The area was dug in an open plan, single context fashion with levels taken on individual skeletons. Selected levels are displayed in metres above ordnance datum on Illus 2 to assist in future management purposes. All levels are given in the context register in Appendix 6.

All recording followed IfA Standards and Guidance. All contexts, small finds and environmental samples were given unique numbers. Recording was undertaken on Headland Archaeology *pro forma* record cards. Digital, 35mm colour transparencies and black-and-white prints were taken with a graduated metric scale clearly visible within. Digital photographs, on a 7.2mp camera, were taken for illustrative purposes only and will not form a part of the site archive.

Illus 3
Work in progress outside the north-east chapel

An overall site plan at a scale of 1:50 was produced indicating the location of each archaeological feature and burial encountered. The burial position and any associated information were recorded on site and individual skeleton plans were drawn at a scale of 1:10. Articulated skeletons and grave assemblages were recorded in situ in accordance with the Guidance for best practice for treatment of human remains excavated from Christian burial grounds in England (CoE and English Heritage 2005) and IfA Technical paper No. 13 (McKinley and Roberts 1993).

All articulated skeletons were lifted and bagged and were removed to the offices of Headland Archaeology (UK) Ltd. Hereford for further analysis by qualified osteologists. Disarticulated human remains were collected and returned to church officials for reburial at a later date. No further analysis was carried out on this material.

5. RESULTS

A total of 29 burials were recovered within the excavation area (see Appendix 1 for full osteological assessment). Features associated with later works at the abbey church were encountered such as a modern drain [022], a previous trench [004] filled with rubble modern refuse, and 18th/19th century activity possibly associated with previous underpinning attempts.

5.1 Phase 1 – medieval burial activity

All of the burials cut into [002], a medium orange-brown clay silt subsoil, which contained frequent disarticulated human bone.

The uppermost articulated skeletons were located at a depth of 20.86m OD. These burials cut into the subsoil [002]. The lowest burials were located at a depth of 19.84m OD. Six burials were seen to be cutting into the geological deposit [003].

All burials were supine and in an extended position and aligned roughly east-west, with the head situated at the west of the grave, in the typical Christian manner. The main concentration of burials lay c.0.5m out from the eastern wall of the north-east chapel, and was arranged in a row running north-south.

Whilst a degree of overlapping between graves was common, three groups of individuals displayed evidence of stacked burials i.e. graves placed directly on top of one another. One group was comprised of three stacked individuals (SK012, 028, 029), while the remaining two groups were made up of two successive burials (SK025, 032 and 052, 058).

A variety of hand positions were noticed in the burials. Eight individuals were buried with their hands resting on the proximal (or top part) of the femur. Seven individuals had their hands resting within their pelvic cavity, possibly indicating hands being clasped at the level of the waist. Two individuals were buried with their arms crossed at the waist (i.e. left hand rests at level of right elbow). Two individuals lay with their hands resting at their sides and one individual lay with his hands crossed at the chest region.

Two burials [SK020 and 025] contained evidence for the presence of coffins in the form of iron nails at the perimeter of the skeleton. Two individuals [SK012 and 097] were buried within mortared stone lined graves or cist, a tradition which dates to the 12th/13th century. These cists were well constructed, built from large limestone pieces and mortar was inserted where the stones met. The cist of [SK012] had evidence for the stone being worked on the interior surfaces, located in the region of the head. It was located above burials [SK028] and cut [SK010], therefore indicating that these pre-date the insertion of the cist.

The cist burial [SK097], which was uncovered in the previous evaluation (Craddock-Bennett 2012), was thought originally to have been cut by the foundations of the St Johns Chapel. However, its subsequent full excavation revealed that it had more probably been truncated by the construction of rounded apse end of the abbey church which was built in 1847.

One individual (SK084) was found with a layer of charcoal lining the grave (see Appendix 3). Charcoal within an ecclesiastical context may suggest a symbolic association with the penitential ashes on which dying monks were sometimes placed. The presence of charcoal indicates that additional effort had gone into the burial of the individual therefore suggesting it was someone of status (Hadley 2001).

One individual (SK078) was buried with a chalice clasped in its hands. The chalice was badly corroded and fragmentary. The stem of the chalice itself was recovered (see Appendix 2).

5.2 Radiocarbon and isotopic analysis results (see Appendix 4)

A sample of bone from [SK084] was sent for radiocarbon dating and isotopic analysis. A radiocarbon date of 1019–1155 cal AD, with a 95.4% probability, was obtained; the detailed probability curve suggests date of death is more likely to have been after the Norman Conquest than before. Isotopic analysis indicated a higher protein diet with a small "*aquatic*" component. The presence of aquatic carbon can make radiocarbon dates appear earlier than they actually are; therefore it seems reasonable to suggest the date of death may have been as late as the end of the 12th century.

Illus 4

Cist burial [SK012] in situ

Illus 5

Charcoal lined burial [SK084]

5.3 Phase 2 – post burial activity

Topsoil [001] was a dark brown loam and comprised the uppermost deposit on site. The latest activity on site within the excavation area was the immediately preceding archaeological evaluation (Craddock-Bennett 2012), Previous to this test pits were excavated during a watching brief, at the north east corner of St John's Chapel, in 2006 (Vaughan 2006). These were also identified during the current excavations. During the 2006 excavations four partial burials were recorded and removed so work could continue. [SK034, 056, 084 and 089] were in the area of the previous test pits and are believed to have been partially truncated as a result. During the 2006 watching brief an osteologist was not present on site; therefore no information was obtained from the skeletal remains except that they were assumed to be adult, based on size. These remains were returned to the Church for reburial.

A post-medieval brick lined drain was encountered 0.6m out from the north-east corner of St John's chapel which cuts [SK020, 025, 047, 050, 061] and the foot of the stone lined cist burial [015]

A pit of post-medieval date was discovered outside the east wall of the chapel and seemed to cut [SK078] to the south, at the level of its right arm.

Evidence of Victorian underpinning along the eastern foundation of the North-East Chapel was observed and cut three burials [SK065, 084, 089].

6. DISCUSSION

Much disturbance has occurred within the area around the north-east chapel in an attempt to strengthen its foundations and prevent collapse. As a result the burials located around the abbey church have been impacted upon. Post-medieval activity in the form of a drain [022] and a possible pit [076] as well as more recent activity from archaeological work has also caused previous disturbance.

There seems to be a moderate density of burials within this area of the church with few intercutting burials, whereby a new grave was probably dug down until a previous burial was reached and the deceased placed within. There is evidence that the burials date to the medieval period. The two cist style burials indicate a 12th/13th century origin. [SK012], buried within a cist, had two further burials beneath it. This indicates that the burials below the cist predate it and are 13th century or earlier.

The grave with the charcoal lining [SK084] is part of a common tradition within ecclesiastical contexts during the medieval period with dates ranging as early as the 8th century until as late as the 12th or 13th centuries (Holloway 2010). The practice of lining the grave with charcoal was common across northern Europe, and within England alone over 30 sites have produced evidence for over 300 excavated examples of the practice (Holloway 2008, p. 142). Charcoal within an ecclesiastical context may suggest a symbolic association with the penitential ashes on which dying monks were sometimes placed. The presence of charcoal indicates that additional effort had gone into the burial of the individual therefore suggesting it may have been someone of status. The significance of the charcoal burial is 'probably therefore a combination of social status and religious belief' (Daniell 1997, p. 160). In contrast it does not seem that the stone cist graves were usually important in signifying status (Daniell 1997: 163).

The radiocarbon date of [SK084] suggests a post-Conquest date of death is most likely. The individual – at 35–44 years of age – may even have been born post-Conquest. The burial was cut at waist level by the previous underpinning works undertaken in the 19th century; however, judging from what remained of the skeleton it is possible that it was also truncated by the medieval structure. St John's Chapel is thought to have been rebuilt no later than AD 1210 (Page & Bund 1924) the Norman abbey was built in 1090-1130. This suggests that the individual was probably buried no later than the early 13th century.

The results obtained during isotopic analysis may indicate a small aquatic (freshwater diet) or a diet with a high level of protein. Benedictine monks were only allowed to eat fowl or fish (Roberts & Cox 2003), which are both high in protein. It is suggested that the individual is likely to have been a member of the early Norman Benedictine Abbey, who for some reason was buried according to a pre-Conquest burial tradition.

There was evidence for one burial with a mortuary chalice clasped in its hands. The burial in question may have been a clergyman. Excavations at Whithorn Priory (Lowe 2009) revealed two individuals buried within stone lined cists both clasping chalices, in a similar manner to [SK078]. These burials also contained silver patens and gold finger rings therefore indicating high status individuals within an ecclesiastical context. Both of these individuals were dated to the 13th century. The burial at Pershore Abbey, with a chalice clasped in its hands, may indicate a high ranking monk or abbot associated with the priory.

The evidence for the presence of coffins was scarce, and when it was found only a few coffin nails remained. There were none of the elaborately decorated coffins found which one might expect from post-medieval coffins, suggesting that burials in this area are all medieval in date.

6.1 Summary of osteological results

Skeletal preservation was excellent, meaning that a range of pathological conditions could be observed. The presence of females and non-adults within an ecclesiastical context may indicate burials of members of the laity. The assemblage of skeletons assessed from the excavation, although small, shows some interesting features; notably similar levels of trauma prevalence in comparison to other assemblages of this period. There was a high prevalence of upper limb fractures, specifically to the radius and ulna, which is quite common within the late medieval period (Roberts and Cox 2003, 279) and may be associated with accidental trauma or occupational activities. Individuals from Pershore suffered low levels of infectious disease and vitamin D deficiencies indicating a general healthy lifestyle reflecting reasonable living conditions and low levels of air pollution. A moderate prevalence of degenerative disc disease, Schmorl's nodes and OA suggest an active lifestyle.

A full osteological analysis is included as Appendix 1.

7. CONCLUSION

Immense care and respect was given to the human remains encountered during the course of archaeological excavations at Pershore Abbey. Any archaeological material impacted upon was recorded and excavated in order to avoid destruction by future underpinning works. The excavation has provided a glimpse into the history of Pershore Abbey, its burial ground, burial styles, and the people who are buried within them.

No archaeological deposits pre-dating the use of the site as a burial ground were revealed during the course of the excavation.

8. ARCHIVE

The archive will be deposited at Worcestershire County Museum within on year of the completion of fieldwork.

9. BIBLIOGRAPHY

Archaeological Archives Forum Archaeological Archives: a guide to best practice in creation, compilation, transfer and curation (published by the IfA 2007).

Blockley, K 1996 *Pershore Abbey Excavations 1996: Interim Report*, Cambrian Archaeological Associates.

Brickley, M & McKinley, J 2004 *Guidelines to the standards for recording human remains* (IfA Paper no 7).

Craddock-Bennett, L 2011 *The Abbey Church, Pershore: Archaeological Evaluation*, Headland Archaeology HAS882.

Craddock-Bennett, L 2012 *Pershore Abbey Church, North-east chapel underpinning: Archaeological Evaluation*, Headland Archaeology HAS929.

Dalwood, H 1996 *Archaeological Assessment of Pershore, Hereford and Worcester*, Central Marches Historic Towns Survey, Hereford and Worcester County Council.

Daniell, C 1997 *Death and Burial in Medieval England 1066–1550*, London, Routledge.

English Heritage 2004 *Human Bones from Archaeological Sites: Guidelines for producing assessment documents and analytical reports*, English Heritage (in association with The Biological Association of Biological Anthropology and Osteoarchaeology, BABAO).

English Heritage and Church of England, 2005 *Guidance for best practice for treatment of human remains excavated from Christian burial grounds in England*, English Heritage (complied by Mays).

Glyde, M 2012 *Requirements for a programme of archaeological evaluation n advance of groundworks at Pershore Abbey, Pershore, Worcestershire*, Worcestershire County Council, WSM46475.

Hadley, D M 2001 *Death in Medieval England*, Stroud, Tempus Publishing Ltd.

Holloway, J 2010 'Material Symbolism and Death: Charcoal Burial in Later Angle-Saxon England', in Buckberry, J & Cherryson, *A Burial in Later Anglo-Saxon England c.650–1100 AD*, pp.83–92, Oxbow Books: Oxford.

Holloway, J 2008 'Charcoal Burial: a minority burial rite in Early Medieval Europe', in Murphy EM (ed) *Deviant Burial in the Archaeological Record*, pp.131–147, Oxbow Books: Oxford.

Lowe, C 2009 *Clothing for the Soul Divine, Burials at the Tomb of St Ninian Excavations at Whithorn Priory, 1957–67*, Edinburgh, Historic Scotland.

McKinley, JI 2004. 'Compiling a skeletal inventory: disarticulated and co-mingled remains' in 'Guidelines to the Standard for Recording Human Remains', *BABAO and IfA paper no. 7*.

Napthan, M 1997 *Evaluation of the West End of Pershore Abbey, Pershore*, County Archaeology Service report 616.

Page, W & Willis-Bund, JW 1924 'A History of the County of Worcestershire: volume 4 pp.155–163. [accessed on the 09/01/2013 at http://www.british-history.ac.uk/report.aspx?compid=42873&strquery=pershore abbey church].

Sworn, S 2005 *Archaeological Watching Brief at Pershore Abbey, Worcestershire*, Historic Environment and Archaeology Service report 1348, Worcestershire County Council.

Vaughan, T 2006 *Archaeological Watching Brief at Pershore Abbey, Holy Cross, Pershore, Worcestershire*, Historic Environment and Archaeology Service report 1439. Worcestershire County Council.

Watkinson D & Neal V *First aid for finds, (Third Edition 1998)*.

10. APPENDIX 1 – OSTEOLOGICAL ANALYSIS

Jason Murphy

A trench measuring 19m² was excavated outside the northwest corner of Pershore Abbey, Worcestershire. A total of 29 articulated skeletons, dated to the late medieval period, were assessed.

Methodology

All individuals were removed from site for further analysis to the human bone laboratory at Headland Archaeology Ltd. Based on skeletal material collected from recent sites excavated by it was thought that it would generally not be possible to determine age and/or sex of remains under 50% complete. However, the <50% skeletons recovered from Pershore Abbey included – fortuitously due to the position of burial stacks in relation to the excavated area – sufficient cranial and pelvic material to make ageing and sexing possible in the majority of cases. Therefore this information was recorded, along with the presence of any pathological indicators. Any additional metric data collected from these remains is likely to be so fragmentary as to preclude the construction of a useful picture of the individual's life and health. The individuals over 50% complete had greater potential to yield osteological information and therefore warranted determination of age and sex, and full analysis.

Osteological 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). Reporting followed English Heritage guidelines (2004) and considering the small sample size, statistical comparison was not undertaken.

Aims and objectives

The aim of the skeletal assessment was to determine the age, sex and stature of the skeletons, and also to record and diagnose any pathology present.

Furthermore, comparative analysis will enable the skeletal assemblage from Pershore Abbey to be placed within its regional and national context. *Table A1.1* lists the comparative sites referred to in the subsequent text. It includes mainly assemblages from monastic sites within the same chronological period as Pershore Abbey, which also generally have a similar small sample size

Preservation

Surface preservation was recorded using the grading system of Brickley and McKinley (2004) where 0 indicates no modification to bone and 5+ exhibits 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.

Of the 29 skeletons recovered from site, sixteen had been truncated by modern disturbance in the form of a drain [022], a backfilled trench [004] and a concrete underpinning inserted beneath the abbey during the 19th century. Fifteen individuals extended beyond the limits of the trench. Two skeletons were undisturbed and three were cut by a cist or stone lined grave. This high level of disturbance across the site has greatly affected the completeness of the skeletal remains (See *Table A1.2*).

Surface preservation was generally extremely good with the majority of skeletons observed at grade 0 (13.8%) or 1 (62.1%) and 24.1% of skeletons were observed at grade 2. The surrounding soils seem to have preserved the skeletons extremely well; the presence of root action within the trench caused drying out of the soils possibly assisting such high levels of skeletal preservation.

Minimum number of individuals

The number of articulated burials uncovered was twenty-nine. A quantity of disarticulated human bone was uncovered during excavation. In general, however, disarticulated human bone is of limited scientific value (English Heritage 2004); such material is difficult to date, age and sex. These criteria cannot be determined for the majority of single bones and therefore the distribution of

Site	Date (century)	Type	No of skeletons	Reference
St Mary Merton Priory, London	12–16th	Augustinian Priory - monastic and lay people	738	MOLAS centre for Human Bioarchaeology
St Benet Sherehog, London	11th–16th	Late Medieval population	39	MOLAS centre for Human Bioarchaeology
St Mary's Abbey, Bordesley, Worcestershire	12th–16th	Cistercian Abbey	38	Gilchrist and Sloane 2005
St Mary's Abbey, Cirencester, Gloucester	11th–16th	Augustinian Abbey	46	Gilchrist and Sloane 2005
St Oswald Priory, Gloucester	12th-16th	Augustinian priory	214	Gilchrist and Sloane 2005
St Guthlac's Priory, Hereford	12th-16th	Monastic community	36	Crooks 2000

Table A1.1

Comparative sites

Completeness	<25%	26–50%	51–75%	76–100%
Number	10	4	11	4
%	34.5	13.8	37.9	13.8

Table A1.2

Completeness of skeletons

pathological lesions throughout the skeleton cannot be assessed. Due to time constraints and the lack of information that can be obtained the disarticulated remains were not assessed.

Any disarticulated human bone uncovered was returned to church officials for later reburial.

Demography

The presence and preservation of the pelvis is vital 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). In non-adults, consideration of primary and secondary ossification centres (Scheuer and Black, 2000a, 2000b), dental formation and eruption timings (Ubelaker, 1989) as well as long bone length (Fazekas and Kosa 1987, Maresh 1970) are used to calculate age.

Sex was determined using standard osteological techniques; morphological differences in the skull and pelvis (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.

Age at death is divided into a number of adult and non-adult categories. For a breakdown of adult categories see *Table A1.3*. Three non-adults were found on site, one younger child (1–6 yrs) and two adolescents (13–17 yrs).

Due to the small number of individuals assessed and the small extent of the burial ground excavated it is likely that this sample is not an accurate representation of the buried population.

The skeletons assessed consisted of 3 non-adults (10.3%) and 26 adult (89.7%) individuals. The small percentage of non-adults at Pershore is comparable to other contemporaneous sites, such as St Mary's Abbey, Bordesley, Worcestershire where non-adults consisted of 8% of those excavated.

Of the three non-adults, one was a younger child and two were adolescents. The low occurrence of non-adult burials within medieval contexts may be because children were buried elsewhere or the shallowness of child graves may make them more susceptible to disturbance. Furthermore, children's under-calcified bones are in general less resistant to degradation than adults' bones (White 1988:52).

The adult age and sex distribution is shown in *Table A1.3*. There is a higher prevalence of older-middle adults and older adults from Pershore Abbey. Comparisons can be seen at St Guthlac's Priory (both categories together 28.6%), St Benet Sherehog (29.2% and 8.3%) and Merton Priory (38.4% and 12.1%) which all have a predominately high prevalence of individuals from these categories. There was a higher prevalence of males compared to females uncovered from Pershore Abbey, plus five individuals who could not be sexed.

Age category*	M – %	F – %	Unsexed -	All Adults
AD	1 (7.7%)	1 (12.5%)	5(19.2%)	7 (26.9%)
Y AD	4 (30.8%)	0 (0%)	–	4 (15.4%)
Y-M AD	2 (15.4%)	1 (12.5%)	–	3 (11.5%)
O-M AD	4 (30.8%)	2 (25%)	–	6 (23.1%)
O AD	2 (15.4%)	4 (50%)	–	6 (23.1%)
Total	**13 (44.8%)**	**8 (27.6%)**	**5(19.2%)**	**26(100%)**

AD = Adult; Y AD = Younger adult; Y-M AD =Younger-middle adult; O-M AD =Older-middle adult; O AD =Older adult

Table A1.3

Adult age and sex distribution

Stature

Stature could be estimated for 15 of the 26 adults; the majority had both a complete femur and tibia to measure and Trotter's regression formulae (1970) was used.

The mean male stature at Pershore Abbey of 169.7 cm falls within, albeit at a lower extent, of the range of means given for late medieval sites in Britain by Roberts and Cox (2003, 248). The female mean stature of 163.05cm also falls within the range of means given for late medieval period, albeit to a slightly higher extent.

Both males and females from Pershore Abbey church were closest in height to, but still shorter than, those buried at Merton Priory and St Benet Sherehog, however males were noticeably shorter than the average height of individuals from St Guthlac's priory, whereas female stature was noticeably taller.

Sex	Number		Mean	Range	
	(n)	(%)		Min	Max
Male	9	69%	169.70	162.11	176.52
Female	6	62%	163.05	158.76	162.53

Table A1.4

Adult statures (cm)

Illus A1.1

Charcoal lined burial [SK084]

Illus A1.2

SK067 Healed misaligned fracture to left radius compared to normal right radius

Non-metric traits

Non-metric traits are believed to suggest hereditary affiliation between skeletons, although some can be produced by factors such as mechanical stress (Kennedy, 1989) or environmental factors (Trinkaus, 1978). Generally the comparative analysis of these traits requires a large sample size.

It is interesting to note the presence of squatting facets within this population. Squatting facets can be observed on the lower part of the tibia where it articulates with the ankle. These facets are an extension of the articular surface of the tibia due to the hyperflexion of the foot associated with activities such as kneeling or adopting a squatting posture eg. grinding wheat on a quern stone (Capasso *et al.* 1999, 127) or habitual kneeling associated with monastic activities. Five individuals in total exhibited squatting facets. Of the ten adult individuals with the lower end of the right tibiae present, five exhibited squatting facets, while four out of ten individuals had squatting facets on the left tibiae.

Paleopathology

The skeleton can be affected by a variety of pathological conditions which can be identified by characteristic lesions and the distribution of these lesions across the skeleton. Understanding the expression of such changes and the clinical impact that they had on the individual is of vital importance in understanding morbidity and life histories in past societies. It must be remembered that this is a small sample size, excavated from a small part of the site, however some prevalences are given to indicate possible patterns of disease and trauma within the population buried at Pershore Abbey. All pathological manifestations were described in detail (Ortner, 2003) and where possible a differential diagnosis was stated.

Trauma

Twelve of twenty nine individuals assessed from Pershore Abbey were affected by some form of trauma. Both fractures and muscle trauma were observed on the skeletons; the latter can be seen in the form of myositis ossificans traumatica (MOT), an exuberant ossification in muscle tissue at the site of attachment, which is more likely to occur in response to trauma in younger individuals (Resnick and Niwayama 1995).

Eight adult individuals suffered from a fracture in one or more of their bones during life and in all cases were well healed by the time of death. The total crude prevalence rate for fractures is 27.6% with four males, three females and one unsexed individual affected. All, except one younger middle adult female, one younger middle adult male and the unsexed adult skeleton, were within the older middle adult age category or older. The comparative sites also displayed evidence for trauma such as St Benet Sherehog which displayed an 8% prevalence rate and St Guthlac's Priory 27.7%, the latter reflecting a similar percentage of trauma to Pershore Abbey.

One individual exhibited severe trauma to the right elbow joint. SK 071, an older-middle adult male, exhibited complete fusion of the right elbow joint involving the humerus, radius and ulna (See *Illus A1.1*). It seems to have been caused by a fracture to the proximal part of the ulna just below the joint area and probable subluxation of the radius. The severity of this trauma caused muscle and ligament tissue within and around the joint to ossify (or turn to bone) leaving the elbow joint fixed at a 120 degree angle. Such a fracture can be caused by blunt force trauma to the back of the forearm (nightstick fracture) or falling on an outstretched pronated (palm facing down) hand.

◄ **Illus A1.3**

SK074, Spondylolysis

Schmorl's nodes are associated with degeneration of the intervertebral discs, as discs may rupture due to trauma, such as frequent lifting or carrying heavy loads, or other pathological processes may weaken them. The subsequent pressure of the herniated vertebral discs manifest as indentations in the vertebral body surfaces termed Schmorl's nodes (Aufderheide and Rodriguez-Martin 1998). Seven individuals exhibited Schmorl's nodes (29.2%), including five males, one female and one unsexed adult individual. In total 14.5% (38/262) of vertebrae had Schmorl's nodes; in the thoracic region of the spine 25 of 129 vertebrae (19.4%) were affected and in the lumbar 13 of 81 vertebrae (16.0%).

SK 067, a younger-middle adult male, had a well healed misaligned fracture to the right proximal radius or forearm bone (See *Illus A1.2*). The continued use of the misaligned radius caused the ulna to bend to compensate for the misalignment which is clearly visible on the shaft. Such fractures are caused by a direct blow to the forearm.

Vertebral and rib fractures are also present within the assemblage. Four individuals suffered from vertebral compression fractures. All fractures were mild in form, with approximately 25% of vertebral body height lost, and wedged on either the left or anterior side of the vertebrae. Two females (one older adult, one adult) were affected at the L3 position (2/69 lumbar bodies) and one male (older-middle adult) and one unsexed adult individuals were affected in the thoracic region (5/112 thoracic bodies).

One older-middle adult male individual exhibited a single rib fracture on the left side (0.6% of ribs).

SK 058 displayed evidence for eburnation, a polished surface caused by two bones coming into contact with one another, on the site of a muscle attachment of the right radius. This indicates that the radius must have been dislocated at some point during life and remained that way for a period of time before it was put back in place. No evidence of corresponding eburnation could be seen on other elements of the elbow region as preservation in the area was poor. This individual also displayed a healed fracture to the styloid process of the third metacarpal of the left hand.

One older-middle adult female (SK074) exhibited spondylolysis which is a separation (lysis) of the body and arch of the vertebrae through the pars interarticularis (between the superior and inferior articular processes) (See *Illus A1.3*). This condition usually exhibits bilateral or unilateral separation of the arch. Spondylolysis is generally produced by fatigue or stress fracturing (Hutton *et al.* 1977, Cyron & Hutton 1978); however rare cases have been attributed to acute trauma (Smith *et al.* 1977, Cope 1988). The same individual displayed an exostosis (caused by MOT) or bony spur on the lower end of the left fibula 'frequently the cause of the origin of such new bone structures is excessive physical stress or trauma' (Schultz 2001).

SK034, an older adult female, displayed unusual lesions on her vertebrae from T10 to L3. The lesions represent a more severe form of Schmorl's nodes, as mentioned above. These are Cystic Schmorl's nodes which develop in the same way as Schmorl's nodes, however the exact cause is unknown, 'One possibility is that the occurrence of trauma leads to trabecular fracture with secondary haemorrhage and cystic degeneration' (Hauger et. al. 2001). The material extruded as a result of the ruptured disc is pushed into the vertebral body and does not heal in the same manner as a Schmorl's node, therefore creating a large circular scooped out lesion which extends into the vertebral body. This individual also suffered from severe degenerative disc disease and osteoarthritis of the vertebral facets (see below).

SK 058, who also displayed a fracture to the styloid process and possible dislocation of the right radius, suffered from rotator cuff disease (RCD). The rotator cuff muscles act as rotators of the humerus and also stabilise the shoulder joint. RCD is a degenerative disease, the prevalence of which increases with age and is associated with injuries linked with the over-use of the shoulder joint i.e. pushing, lifting, pulling or throwing, and can occur in some occupational groups (Waldron 2009).

Infectious disease

Seven individuals (24.1%) showed signs of non-specific infection. Four individuals exhibited bilateral healed periostitis on the tibial shafts and two exhibited unilateral infection in the tibia; in total 5 of 13 left and 5 of 11 right tibial shafts exhibited healed periostitis. One individual displayed bilateral active periostitis on the tibiae. The tibia is a common area affected by such infection as it lies close to the skin and so can be subject to minor injury more frequently (Roberts and Manchester 1993). Furthermore, one individual had a small area of healed periostitis on the spine of the left acromion process of the scapula. A low percentage of non-specific infection was seen at St Benet Sherehog (13%).

SK012 was the only individual that exhibited healed periostitis on the visceral (inner) surfaces of four left and two right ribs. These rib lesions are linked to infection of the pleural lining and may be related to poor air quality and conditions such as tuberculosis (Roberts *et al* 1994).

Metabolic disease

SK 091 displayed lateral bowing of the proximal tibial shafts which may represent residual bending deformities associated with childhood rickets caused by a vitamin D deficiency. Vitamin D deficiency can be caused due to the lack of exposure to sunlight, which is used to synthesise vitamin D in the body. Vitamin D is only found in very limited amounts within food. (Mays *et al.* 2009).

Joint 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). Degenerative disc disease of the vertebral bodies is characterised by osteophyte development around the margins of, or on, the body surfaces, as well as porosity of the body surfaces (Rogers 2000).

In the adult skeletons from Pershore Abbey church 10 individuals of 24 with one or more vertebrae preserved were affected by degenerative disc disease (41.6%). In total 13.4% (35/262) of vertebrae were affected; 8.3% (3/36) of cervical vertebrae, 15.5% (20/129) of thoracic, 12.3% (10/81) of lumbar and 12.5% (2/16) of sacral vertebrae.

Osteoarthritis (OA) was present in the spine and extra-spinal joints of several individuals from Pershore Abbey. The clearest diagnostic feature of OA is eburnation; when a polished surface is created from bone-to-bone contact once deterioration of the joint cartilage has taken place. Further features of OA include osteophytes on or around the joint margin, porosity on the surfaces, and subchondral cysts. OA is characterised by the presence of at least two of these latter features, or eburnation even if it occurs alone (Rogers 2000). Studies have shown no correlation between severity of pain experience by the individual and the expression of OA (Cockburn *et al.* 1979).

Four out of the twenty one individuals with one or more vertebral facets observable, were affected by OA; these individuals also had degenerative disc disease (see above). One individual had the cervical vertebrae affected, one had the thoracic vertebrae affected and one individual had the lumbar vertebrae affected, while OA could be seen in both lumbar and sacral vertebra in one individual.

Five individuals had extra-spinal OA. SK058, an older adult male, had extra-spinal OA which involved the left acromioclavicular joint, left sternoclavicular joint, the glenohumeral joint (or shoulder joint), the right hand, bilateral rib heads, bilateral hip joints (acetabuli) and the proximal right tibia. In this case OA may have been a result of old age or may also have been as a result of occupational activities, involving heavy labour during life. SK058 also exhibited possible dislocation of the radius, a healed fracture to the left third metacarpal and rotator cuff disease (see above) all indicating an active lifestyle.

The size of the assemblage is too small to attempt to discern any pattern of OA in differing areas of the spine or rest of the body, by age or sex.

Illus A1.4

SK065, Osteochondritis dissecans lesion on the left MT3

Circulatory disorders

Two individuals one male (SK058) and one female (SK065), both older adults, displayed a condition known as osteochondritis dissecans (OD). It is a circulatory disorder caused by defective blood flow within a joint or by low-grade chronic or micro trauma resulting in focal areas of destruction. The fragment of bone removed as a result can remain loose within the joint. The resulting lesion is a depressed, usually smooth walled area (See *Illus A1.4*). This is a common condition that causes no symptoms therefore it can remain unnoticed within the joint (Aufderheide and Rodriguez-Martin 1998).

Congenital abnormalities

Spina bifida occulta (SBO) is the most common of all spinal congenital defects in which incomplete midline bony closure is present in one or more neural arches of the sacrum (Aufderheide and Rodriguez-Martin 1998).Nine out of fourteen individuals with one or more sacral arches present exhibited SBO, with one individual having all of the arches open. SK034 had a supernumerary or an extra lumbar vertebra. These are developmental anomalies (Barnes 1994), but the individual would have suffered no adverse affects (Ortner 2003).

Dental pathology

Of the twenty-nine skeletons analysed seven adults had teeth present.

Calculus is a build up of mineralised plaque and is associated with carbohydrate consumption and a lack of oral hygiene (Roberts and Manchester 1995). All deposits consisted of slight to moderate patches on the enamel surfaces of the teeth and affected 100% (7/7) of those individuals with teeth. Due to the small size of the sample comparisons must be made with caution. This sample seems to be higher than the average for later medieval sites (54%), (Roberts and Cox 2003) and similar to that of St Benet Sherehog (100%, 7/7) and Merton Priory (96.5%, 437/453).

◄ Illus A1.5

SK078, Severe dental attrition

Over half of the individuals (57.1% 4/7) had caries (tooth decay) which is similar to the mean percentage range of late medieval sites at 53% (Roberts and Cox 2003). The two males and two females affected had the majority of lesions located on the posterior teeth, likely to be due to the fact that they are the hardest teeth to clean. Caries are multi-factorial in origin; however the main cause is the presence of sucrose and fermented carbohydrates in the diet.

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). One older adult female, suffered an abscess at the left maxillary first molar, and one adult male suffered two abscesses at the root of the left maxillary premolars. Abscesses are extremely painful and sometimes debilitating. 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 teeth affected 7.1% (5/70) exhibit slight periodontal disease, 7.1% (5/70) had a moderate expression and 5.7% (4/70) had a severe form. All ages exhibited slight to moderate expressions however, only older-middle and older adults (and two un-aged adults) had teeth with severe periodontal disease. The prevalence at Pershore Abbey appears greater due to the small size of the population and is significantly higher than the average rate of periodontal disease of later medieval Britain at 37% (Roberts and Cox, 2003). However a high prevalence was observed at Merton Priory of 80.1% (363/453).

	No of teeth affected	% of total teeth*	No individuals affected	% of total Individuals*
Calculus	132	86.8	7	100
Caries	9	5.9	4	57.1
Abscess	3	1.5	2	28.6
Periodontitis	70	46.1	6	85.7
AMTL	3	2.0	3	42.9
DEH	37	24.3	6	85.7

Table A1.5

The prevalence of dental disease in the skeletons from Pershore Abbey

Ante-mortem tooth loss was seen in three individuals (42.9%), two adults (one male, one female), and one older middle adult male. Ante-mortem tooth loss can be the result of a variety of factors including dental caries, abscess, and heavy wear exposing the tooth pulp, periodontal disease and trauma (Hillson 1996).

Dental enamel hypoplasias (DEH) are important indicators of general health during childhood in a population as they represent a disruption in development of the enamel, resulting from stress such as malnutrition or disease (Hillson 1996). In total, 85.7% of individuals were affected (6/7) and 24.3% (37/152) of total teeth; the prevalence of teeth affected was similar to St Benet Sherehog (85.7%) though higher than St Guthlac's (58.3%).

Dental attrition or tooth wear is caused by grinding of teeth against one another and contact with food, cheeks and tongue (Hillson 1996). One adult male individual (SK078) displayed severe dental attrition (See illus. 10). The enamel surfaces were worn down and displayed distinct grooves and notches on the teeth. The Benedictine order is known for their roles as farmers within their own community (Butler 2010) and therefore the attrition may be related to some associated occupational activity. There is evidence for deliberate tooth mutilation and use of teeth as 'tools' in manufacturing processes and other activities (Milner & Larsen, 1991) which may be the case in this instance.

Overall there was high prevalence of dental calculus and periodontitis. 'For this period the high calculus rate is more likely to reflect a lack of effective oral hygiene' (Roberts and Cox 2003), which in turn contributed to the high prevalence of periodontitis. Carbohydrates, a major contributor to calculus and caries, were a major part of diet during the later medieval period; however with regards to monasteries certain foodstuffs were generally favoured. Wheat was the most desired grain and before the fifteenth century, Benedictine monks, who were established at Pershore, were only allowed to eat fowl or fish (Roberts and Cox 2003). Over half of individuals were affected by dental caries and this combined with the high prevalence of calculus and periodontitis may also reflect a high carbohydrate based diet.

Conclusion

Skeletal preservation was excellent, meaning that a range of pathological conditions could be observed. The presence of females and non-adults within an ecclesiastical context may indicate burials of members of the laity. The assemblage of skeletons assessed from the excavation, although small, shows some interesting features; notably similar levels of trauma prevalence in comparison to other assemblages of this period. There was a high prevalence of upper limb fractures, specifically to the radius and ulna, which is quite common within the late medieval period (Roberts and Cox 2003, 279) and may be associated with accidental trauma or occupational activities. Individuals from Pershore suffered low levels of infectious disease and vitamin D deficiencies indicating a general healthy lifestyle reflecting reasonable living conditions and low levels of air pollution. Moderate prevalences of degenerative disc disease, Schmorl's nodes and OA suggest an active lifestyle.

Bibliography

Aufderheide, AC & Rodriguez-Martin, C 1998 *The Cambridge Encyclopaedia of Human Paleopathology*, Cambridge.

Barnes, E 1994 *Developmental Defects of the Axial Skeletal in Paleopathology*, Niwot, Colorado, United States.

Brickley, M and McKinley, J I 2004 *Guidelines to the Standard for Recording Human Remains*, BABAO and IfA paper no. 7.

Brickley, M, Berry, H, and Western, G 2006The people: physical anthropology, in *St Martin's Uncovered: Investigations in the churchyard of St Martin's-in-the-Bull Ring, Birmingham, 2001*, (eds Brickley, M, Buteux, S, Adams, J & Cherrington, R), Oxford, 90–151.

Brothwell, D R 1981 *Digging up Bones*, New York.

Butler, C 2010 *Benedictine Monachism: Studies in Benedictine Life and Rule*, Kessinger Publishing, London.

Capasso, L, Kennedy, KAR & Wilczak, C A 1999 *Atlas of Occupational Markers on Human Remains*, Italy, Edigrafital S.P.A.

Cockburn, A, Duncan, H & Riddle, JM 1979 Arthritis, ancient and modern: guidelines for field workers, in *Henry Ford Medical Journal 27: 1: 74–7.*

Cope, R 1988 Acute traumatic spondylolysis. *Clinical Orthopaedics* 230: 162–165.

Corbett, ME and Moore, WJ 1976 'Distribution of caries in ancient British populations IV: The 19th century' in **Caries Research** 10: 401–414

Gyron, BM & Hutton, W C 1978 The fatigue strength of the lumbar neural arch in spondylolysis, *Journal of Bone and Joint Surgery*, 60-B: 234–238.

English Heritage 2004 *Human Bones from Archaeological Sites: Guidelines for producing assessment documents and analytical reports*, English Heritage, Centre for Archaeology Guidelines.

Fazekas, I Gy & Kosa, F 1978 *Forensic Foetal Osteology*, Budapest.

Hauger, O, Cotton, A, Chateil, J-F Borg, O Moinard, M. & Diard, F Giant Cystic Schmorl's Nodes: Imaging Findings in *Six Patients The American Journal of Roentgenology*, 176, 969–972 April 2001.

Hawkey, DE & Merbs, CF 1995 Activity induced musculoskeletal stress markers (MSM) and subsistence strategy changes among ancient Hudson Bay Eskimos, in *International Journal of Osteoarchaeology* 5: 324–338.

Hillson, S 1996 *Dental Anthropology*, Cambridge, Cambridge University Press.

Hillson, S 2005 *Teeth*, Cambridge; Cambridge University Press.

Hutton, WC, Stott, JRR & Cyron, BM 1977 Is spondylolysisa fatigue fracture? *Spine* 2: 202–209.

Iscan, MY & Loth, SR 1985 'Determination of age from the sternal rib in white males: A test of the phase method' Journal of Forensic Sciences 31: 990–999.

Iscan, MY, Loth, SR & Scheuermann EH 1985 'Determination of age from the sternal rib in white females: A test of the phase method' Journal of Forensic Sciences 31: 990–999.

Jurmain, R 1999 *Stories from the Skeleton: Behavioural Reconstruction in Human Osteology*, Taylor and Francis, London and New York.

Kennedy, K 1989 Skeletal Markers of Occupational Stress, in *Reconstruction of Life from the Skeleton* (eds Iscan, M & Kennedy, K), New York, 129–160.

Lawrence, JS 1969 Disc Degeneration Its frequency and relationship to symptoms, in *Ann. Rheum. Dis.* 28: 121–138.

Lovejoy, CO, Meindl, RS, Pryzbeck, TR & Mensforth, RP 1985 Chronological metamorphosis of the auricular surface of the ilium: a new method for the determination of adult skeletal age at death, in *American Journal of Physical Anthropology*, 68:15–28.

Maresh, MM 1970 Measurements from roentgenograms, in *Human Growth and Development* (ed McCammon, RW), Springfield, Illinois, 157–200.

Mays, S and Cox, M 2000 *Human Osteology in Archaeology and Forensic Science*, Cambridge University Press. New York.

Mays, S, Brickley, M & Ives, R 2009 'Growth and Vitamin D Deficiency in a Population from 19th century Birmingham, England' in *International Journal of Osteoarchaeology*, 19: 406–415.

McKinley, JI 2004 Compiling a skeletal inventory: cremated human bone, in Brickley and McKinley, 9–13.

Milner, GR & Larsen, CS 1991 Teeth as artefacts of human behaviour: intentional mutilation and accidental modification. In Kelley, M. A. & Larsen, C. S. (eds.), *Advances in Dental Anthropology*, New York: Wiley-Liss, pp. 357–78.

Ortner, DJ 2003 *Identification of Pathological Conditions in Human Skeletal Remains*, Amsterdam.

Resnick, D and Niwayama, G 1995 'Soft Tissues' in D Resnick (ed.) *Diagnosis of bone and joint disorders*, 3rd edition, Saunders, Philadelphia, pp. 4333–4352.

Roberts, C & Cornell, B 2004 Guidance on recording paleopathology, in Brickley & McKinley, 34–39.

Roberts, C & Cox, M 2003 *Health and Disease in Britain: from prehistory to the present day*, England.

Roberts, C & Manchester, K 1995 *The Archaeology of Disease*, Stroud.

Rogers, J 2000 The paleopathology of joint disease, in Mays and Cox, 163–182.

Scheuer, L & Black, S 2000 *Developmental Juvenile Osteology*, London.

Scheuer, L & Black, S 2004 *The Juvenile Skeleton*, Great Britain.

Schultz, M 2001 Mikroskopische Identifikation von Krankenheiten an mazerierten Skelettfunden, in M Oehmichen & G Geserick (eds): Osteologische Identifikation und Altersschatzung, Research in Legal Medicine, Vol 26. Lubeck: Schmidt-Romhild, pp. 197–220.

Smith GR, Northrop CN and Loop JW 1977 Jumpers' fractures: Patterns of thoracolumbar spine injuries associated with vertical plunges, *Diagnostic Radiology*, 122: 657–663.

Suchey, JM and Brooks, ST 1990 Skeletal age distribution based on the Os pubis: a comparison of the Acsadi-Nemeskeri and Suchey-Brooks Methods, in *Human Evolution*, 5: 227–238.

Trinkhaus, E 1978 Bilateral asymmetry of human skeletal non-metric traits, in *American Journal of Physical Anthropology*, 49:315-318.

Trotter, M 1970 Estimation of stature from intact long bones, in Stewart, T D (ed.) *Personal Identification in Mass Disaster*, Washington, pp. 71–83.

Ubelaker, DH 1989 *Human Skeletal Remains: Excavation, Analysis, Interpretation*, Washington, DC.

Waldron, T 2009 *Paleopathology*, Cambridge University Press. United States.

Walker, PL, Dean, G and Shapiro, P 1991 Estimating age from tooth wear in archaeological populations, in *Advances in Dental Anthropology* (eds. Kelly & Larsen), Amsterdam, 145–179.

White, WJ 1998 Skeletal Remains from the Cemetery of St Nicholas Shambles, City of London. London: London and Middlesex Archaeological Society.

11. APPENDIX 2 – OSTEOLOGICAL CATALOGUE

SK	%	Frag	SP	Age est.	Sex	Stature (cm)	Skeletal pathology notes	Dental pathology notes
7	<25%	Low	G1	Adult	U	–	Bilateral healed non-specific periostitis on the medial shaft of the distal tibiae.	No dentition.
10	51–75%	Low	G1	YMA (30–34)	M	170.108	Intervertebral osteochondrosis on the superior of T12. Kissing spine – articular facets visible on the anterior and posterior faces of the spinous processes of T7–8. T6 is absent though there is a facet on T7 for articulation with it and T8 has a facet on its posterior edge of spinous process for articulation with T9 (spinous process broken PM). Schmorl's nodes T7–10 and T12–L4. SBO 4-5.	No dentition.
12	>75%	Low	G1	OA (45–49)	M	172.43	Bilateral mild and healed porotic hyperostosis of the parietals and occipital. Bilateral non-specific periostitis (compact irregular new bone formation) on the medial aspect of the distal shafts of both fibulae, also remodelled periostitis (compact irregular striated porotic) on the medial aspect of the left tibial proximal shaft. Four left and two right ribs have irregular elongated nodules of compact bone indicative of healed infection on the visceral rib surfaces. One left rib has a circular compact neoformation (similar to an osteoma) on its visceral surface different from those caused by infection as seen on other ribs. Healed rib fracture with enlarged callus at the posterior angle, lateral to the neck, of the left eleventh rib. Bilateral bony spurs on the posterior calcanei. Ossification of costal cartilage. OA – left acromioclavicular joint (acromion and clavicle), bilateral medial clavicles and the right acromion process. Degenerative disc disease L4–S1. Sacralisation of the first coccygeal segment. SBO open to 5.	32 tooth positions; 28 teeth; 28 PO; 4/32 lost PM. 28/28 with slight-severe calculus; 2/28 with caries; 8/28 with linear type DEH; 24/28 with slight-severe periodontal disease.
17	<25%	Low	G1	ADOL (12–16)	U	–	No pathology.	No dentition.
20	51–75%	Mod	G0	YA (18–24)	M	162.11	No pathology.	No dentition.
25	26–50%	Mod	G0	YMA (25–29)	F?	174.852	Intervertabral osteochondrosis on the anterior superior margin of the vertebral body. Vertebral compression fracture in the form of mild left lateral wedging of L3.	No dentition.
28	<25%	Mod	G1	OA (45–49)	F	–	OA – left hip (acetabulum) and vertebral facets L5 and S1. Degenerative disc disease T10–11. Marginal osteophytes of vertebral bodies T12, L2–3. Schmorl's node T11–L4.	No dentition.
32	<25%	Mod	G1	OMA (40–44)	M	–	No pathology.	No dentition.
34	51–75%	Mod	G0	OA (50–60)	F	162.533	Vertebral compression fracture in the from of a mild left lateral wedge of L3. Intervertebral osteochondrosis on the superior body of T10. Supernumerary lumbar vertebra. Vertebral lesions???? OA – Right MC1 carpometacarpal joint (trapezium and proximal MC1) and vertebral facets L3-5. Degenerative disc disease T10, T12 and L4–6. Marginal osteophytes of vertebral bodies T11, L2–3 and S1.	No dentition.
38	51–75%	Mod	G1	YC (3.5–4)	U	–	No pathology.	No dentition.
40	<25%	Low	G1	AD	F	–	Bilateral moderate porotic hyperostosis of the parietals and occipital.	29 tooth positions; 6 teeth: 6 PO; 1/29 lost PM; 22/29 lost AM. 5/6 with slight moderate calculus; 1/6 with caries; 1/6 with linear type DEH; 5/6 with periodontal disease. Severe ante-mortem tooth loss indicates an older individual.

SK	%	Frag	SP	Age est.	Sex	Stature (cm)	Skeletal pathology notes	Dental pathology notes
44	<25%	Mod	G2	YA (17–25)	M	–	No pathology.	32 tooth positions; 32 teeth; 32 PO. 24/32 with slight-moderate calculus; 15/32 with linear type DEH; 9/32 with periodontal disease. (Due to the unclean nature of this skeleton the full extent of calculus was unclear).
47	26–50%	Low	G1	OMA (40–44)	M	–	Schmorl's nodes L3 and L5.	No dentition.
50	26–50%	Low	G0	OA (45–49)	F	161.298	Bilateral healing non-specific periostitis (lamellar) on the lateral surface of the proximal tibial shaft surfaces. Accessory sacral facets on both ilia. Degenerative disc disease L5. Marginal osteophytes of vertebral bodies L3.	No dentition.
52	51–75%	Low	G2	YA (17–25)	M	176.52	Healed non-specific periostitis (striated lamellar) on the right tibial medial and lateral shaft surfaces, on the anterior shaft surface of the distal half of the right femur and on the lateral surface of the proximal shaft of the right fibula. Degenerative disc disease C5–7. Schmorl's nodes T3–4, 6–11, L2 and L4.	14 tooth positions; 14 teeth; 14 PO. 12/14 with slight-moderate calculus; 3/14 with DEH.
56	<25%	Mod	G1	OMA (45–49)	F?	160.804	No pathology.	No dentition.
58	>75%	Low	G1	OA (60+)	M	168.98	Rotator Cuff Disease of the left humerus; greater and lesser tubercles are irregular showing a change in the contour, with lytic lesions and enthesopathy – moderate stress lesion. Dislocation of the right radius (and realignment) as there is eburnation, ops and porosity on the radial tuberosity suggesting it articulated with another bone; no evidence of OA on humerus or ulna. Incomplete fracture of the styloid process of the left MC3 (healed with fracture line visible). Osteochondritis dissecans lesion on the proximal joint surface of the proximal phalange of the right MT1 and on the proximal joint surface of MT1. OA – left acromioclavicular joint(lateral clavicle and acromion), left shoulder (glenoid) and the left medial clavicle, the distal joint surface of right MC3 and proximal phalange, bilateral hips (acetabuli), right proximal tibiofibular articulation (tibia and fibula), four left and right ribs (vertebral ends) and vertebral facets T1–6. Degenerative disc disease T1–2 and L4–5. Marginal osteophytes of vertebral bodies T3–4 and T7–9. Schmorl's nodes T7–11 and L4. SBO 4–5.	No dentition.
61	<25%	Mod	G2	AD	U	–	No pathology.	No dentition.
65	>75%	Mod	G1	OA (45+)	F	160.082	Bilateral porotic hyperostosis on parietals and occipital. Ostechondritis dissecans on the proximal articular surface of left MT3. Bilateral healed non-specific periostitis (striated lamellar) on medial and lateral surfaces tibiae and on the proximal half, lateral surface of the left fibula. OA – left elbow (proximal radius) and the proximal phalanx of left MC1. Marginal vertebral lipping T5–6. Degenerative disc disease T7–11. SBO 1–5.	No dentition.

SK	%	Frag	SP	Age est.	Sex	Stature (cm)	Skeletal pathology notes	Dental pathology notes
67	51–75%	Low	G2	YMA 30–34	M	173.014	Bilateral mild porotic hyperostosis on the parietals and moderate on the occipital. Well healed misaligned fracture to the proximal half of the left radial shaft; proximal half is misaligned posteriorly as a result of the fracture; two small foramina at site of fracture (non-osteomyelitic) and the callus has been obliterated; the left proximal ulnar shaft is bowed posteriorly in the same region as the radius; the ulna may have been subjected to a green-stick type fracture and did not break all the way through or due to the continued use of the misaligned forearm the ulna also developed a bow as a result. Large osteophyte emerging from the left body of L3 (not the margin) and extends anteriorly where it meets with a smaller osteophyte also extending from the left body of L2; may be trauma related/ossified ligaments. Marginal osteophytes of vertebral bodies T5 and L2–4. SBO open to S5.	No dentition.
71	51–75%	Low	G1	OMA (35+)	M	–	Fusions of the right distal humerus, proximal radius and ulna; fusion of the entire joint; caused by fracture of ulna at the proximal shaft just below the joint surface with partial dislocation of the ulna postero-laterally; partial dislocation of radius, the proximal joint surface, faces in a posterolateral direction and only partially articulates with the capitulum of the humerus; healing has caused the anterior ligament to ossify forming a bridge from the superior edge of the trochlea on the humerus, to the coronoid process of the ulna; the area between the radial tuberosity and the ulna has fused; this reulted in the fusion of the arm in a 120 degree flexed position. Vertebral compression fracture in the form of a mild anterior wedge T5–7. OA – bilateral acromioclavicular joint(left lateral clavicle, right acromion and lateral clavicle) and one right rib head. Marginal vertebral lipping T9. Degenerative disc disease T3–8. Schmorl's nodes T7–9 and T11.	24 tooth positions; 23 teeth; 23 PO; 1/24 lost AM. 19/23 with slight-moderate calculus; 7/23 with slight-moderate periodontal disease. Heavy attrition on lower right molars; distinct grooves in enamel which may be associated with occupational usage.
74	>75%	Low	G3(skull) G1 (post cranial sk)	OMA (40–44)	F	158.757	Small patch of woven bone on the anterior surface of the left mandible in the region of tooth apex of the first molar; a large carie is present in the tooth and there is severe periodontal disease; therefore the woven bone may indicate the presence of an abscess at the tooth apex which has not yet perforated the alveolar bone. Exostosis or bony spur on the distal half of the right fibula, medial surface at the attachment site for the interosseous ligament. Ossification of costal cartilage. Spondylolysis of L5 – complete bilateral separation. SBO 4–5.	32 tooth positions; 27 teeth; 27 PO; 4/32 lost PM. 27/27 with slight-moderate calculus; 6/27 with caries; 1/32 with a dental abscess; 7/27 with linear type DEH; 15/27 with slight-severe periodontal disease.
78	51–75%	Mod	G1	AD (35–45)	M	174.32	Bilateral mild porotic hyperostosis of parietals and occipital. Button osteomata, two on the right parietal and three on the right frontal. Marginal osteophytes of vertebral bodies T4 and T7.	31 tooth positions; 22 teeth; 22 PO; 2/31 lost PM; 7/31 lost AM. 12/22 with slight-moderate calculus; 1/22 with a carie; 2/31 with a dental abscess; 4/22 with linear type DEH; 14/22 with periodontal disease. Heavy dental attrition on the upper and lower dentition which may be associated with occupational usage (some notches are similar to pipe smoking facets, teeth 43,44 and 33,34).
82	26–50%	Mod	G1	AD	U	–	Vertebral compression fracture – mild anterior wedge to T10 and mild left lateral wedge to T8. Schmorl's node T10.	No dentition.

SK	%	Frag	SP	Age est.	Sex	Stature (cm)	Skeletal pathology notes	Dental pathology notes
84	51–75%	Low	G2	OMA (35–44)	M	163.98	Active non-specific periostitis (woven) on the medial distal shaft surface of the right tibia and on the proximal lateral shaft surface of the left tibia. Degenerative disc disease L4–5. Sacralisation of L5 vertebra. SBO 3–5.	No dentition.
89	51–75%	Low	G2	ADOL (15–18)	U	–	Healed non-specific periostitis (remodelling lamellar bone) on the medial and lateral shaft surfaces of both tibiae, there is also smooth compact bone remodelling on the posterior of the spine of the left acromial process. Femoral cortical excavation on the medial side of the distal posterior right femur (gastrocnemeus muscle attachment site). Enlarged nutrient foramen located centrally on the popliteal surface of the left femur; it is smooth edged and angled upwards.	No dentition.
91	<25%	Low	G1	AD	U	–	Healed rickets – moderate lateral bowing of the proximal half of both tibiae. Striated lamellar (healing) on the medial and lateral shaft surfaces of both tibiae, distal posterior shaft and around the fibular notch; medial surface of distal left fibula (proximal half damaged) and medial and lateral surfaces of the right fibula.	No dentition.
95	51–75%	Low	G2	YA (18–20)	M	165.86	No pathology.	No dentition.
97	<25%	Low	G1	AD	U	–	No pathology.	No dentition.

12. APPENDIX 3 – FINDS ASSESSMENT

Julie Franklin

Introduction

The finds assemblage amounted to four iron nails, a sherd of pottery and the remains of a lead or pewter chalice.

The chalice was fragmentary, the only large piece being part of the solid stem. The bowl and foot are represented by many small sherds. The condition of the metal is such that no surface detail is visible and little evidence of form is discernible. A thickening of the stem suggests that it is knopped, a typical form for medieval chalices. The burial of lead or pewter plate in graves was common for the internment of member of the clergy (Glenn 2009).

The nails were all found in graves, though not in large enough numbers that they must necessarily relate to coffins within those graves. The three nails associated with SK025 do appear to be coffin nails, featuring as they do mineralised wood adhering to the shaft, a feature common to coffin nails where the nails have corroded *in situ*.

The nail associated with SK020 has no mineralised wood. It may be a residual coffin nails, or equally may relate to building work in the vicinity. The sherd of pottery is of post-medieval date but is unlikely to relate to activity in the graveyard.

Finds catalogue

The pottery fabrics codes are taken from those published in Hurst and Rees 1992.

References

Glenn, V 2009 'The Later Medieval Ecclesiastical Metalwork and Related Items' in Lowe, C *'Clothing for the Soul Divine': Burials at the Tomb of St Ninian. Excavations at Whithorn Priory, 1957–67*, Historic Scotland Archaeology Report no.3, 82–97.

Hurst, D & Rees, H 1992 'Pottery fabrics; a multi-period series for the county of Hereford and Worcester' in S Woodiwiss (ed) Iron Age and Roman Salt production and the Medieval Town of Droitwich, CBA Research Report 1981, 200–209.

Context	SK	SF	Quantity	Weight (g)	Material	Object	Description	Spot date
20	SK020	–	1	17	Iron	Nail	Hand wrought nail, medium sized, no mineralised wood, possible coffin nail	–
25	SK025	–	3	27	Iron	Nails	hand wrought nails, medium sized, from minimum of two nails, mineralised wood on shafts, probable coffin nails	–
77	–	–	1	69	Pottery (PM)	Fabric 78	Post-Medieval Redware. Large heavy jar rim sherd, dark brown lead glaze on interior	18th/19th
78	SK078	1	1	240	Lead	Chalice	Fragmentary remains of lead or pewter mortuary chalice. Large stem sherd and a number of bowl sherds, with many small fragments. Excavated in soil block, which was then fine sieved and sorted to retrieve all pieces. Very poor condition. Stem sherd is solid and appears to increase in diameter, probably knopped. Another curving sherd implies a hollow part of stem or base. No reconstruction possible of bowl or foot. Remains equate to approx a quarter of the whole.	medi

Table A3.1

Finds catalogue

13. APPENDIX 4 – CHARCOAL IDENTIFICATION AND ANALYSIS

Laura Bailey

Introduction

A total of twenty five charcoal fragments were identified from a sample taken during excavation at Abbey Church, Pershore, Worcestershire. The sample was taken from a charcoal rich deposit (087) lining a grave. Charcoal analysis was undertaken in order to identify the taxa used for the grave lining and to provide information on the regional tradition of lining graves with charcoal, a relatively rare category of medieval (possibly Saxon) burial.

Methodology

Charcoal was randomly selected from a sample (001) from a charcoal rich deposit (087) lining a grave. The charcoal was broken or fractured to view three sectional surfaces (transverse (TS), tangential (TLS) and radial (RLS)) necessary for microscopic wood identification. The charcoal fragments were then mounted onto a slide and examined using an incident light microscope at magnifications of 100x, 200x and 400x, where applicable. Identifications were made using wood keys by Schweingruber (1978, 1990) and IAWA (1989).

As part of the identification process the morphology of the charcoal fragments was also noted as to whether they could be identified as roundwoods. The number of rings was counted for each fragment and the presence of very narrow or extremely wide rings was noted. Due to the fragmentary nature of charcoal and the shrinkage it undergoes during the burning process it is unlikely that all fragments can be associated exactly with the type of wood being used for fuel (eg. branch wood as opposed to large timbers). However, through looking at the rings and their curvature we may be able to give an estimate of the size of timbers used. Ring curvature has been measured using the keys by Marguerie and Hunot (2007), where weak curvature is thought to denote large timbers, medium curvature, medium sized timbers and strong curvature represent small timbers. Where curvature could not be viewed they are noted as indeterminate.

The charcoal was also examined for evidence of biological degradation in the form fungal hyphae. The presence of fungal hyphae in wood is revealed by colour changes, of physical-mechanical characteristics and of the hyphae themselves (Schweingruber, 1978).

Results

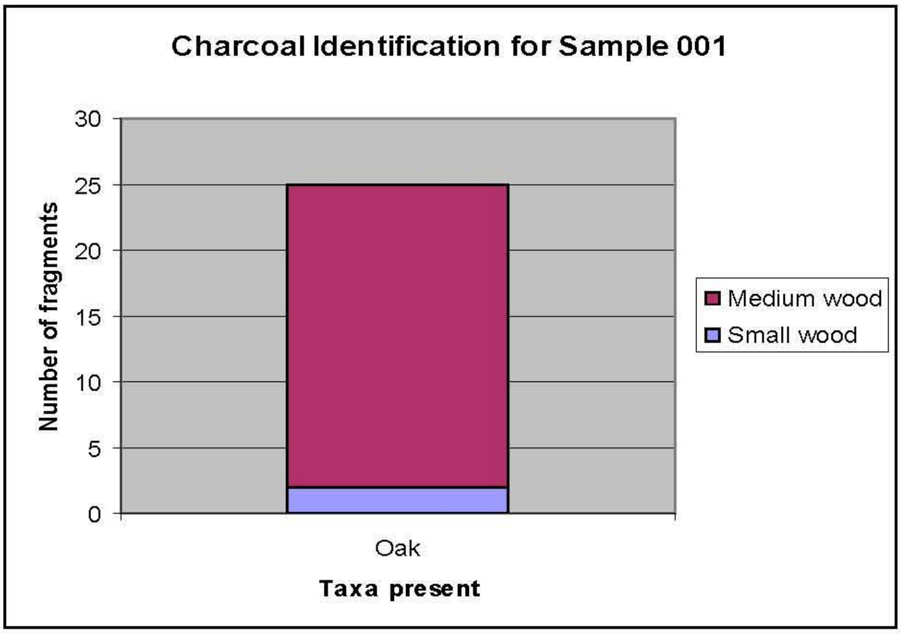
Charcoal analysis showed that all of the charcoal derived from oak (*Quercus* sp) wood (*Illus A3.1*). Analysis of growth ring curvature indicated that the majority of fragments were from medium to large timbers. However two of the fragments derived from small branch wood, one of which was a twig, complete with bark. The majority of growth rings represented average growth (1–2 mm). Growth ring patterns contained evidence of narrow growth ring sequences, preceding relatively wide growth rings, spaced 2.23mm apart, which indicates that environmental stresses were placed on some trees during growth and may also provide tentative evidence for woodland management in the form of pollarding or coppicing (Wheeler, 2011). The absence of fungal hyphae and insect channels within the fragments suggests that the wood was relatively fresh when burnt and is unlikely to have been stockpiled or gathered from the forest floor.

Discussion

Graves lined with charcoal ash have been identified in more that thirty-five cemeteries, including those in churchyards as well as those unknown to be connected with a particular church (Holloway, 2010)

Charcoal burials were first documented in the fourth century by Sulpicius Severus in a letter about the burial of St Martin of Tours and became common from the ninth to the twelfth century (Daniell, 1997). They have been found in a number of Saxon Cathedral or Abbey cemeteries including Exeter, Hereford, Gloucester, Lincoln, Oxford, Repton, Worcester and York. Almost no examples of the custom have been found in East Anglia, the south-east or the north-west of England (Holloway, 2010).

The purpose of charcoal burials is unknown, however, several hypotheses, both ritual and functional, have been advanced to explain their purpose. It has been suggested that they may have an important symbolic character, perhaps representing penance or the



Illus A4.1

Charcoal Identifications for Sample 001 state of the soul, symbolic purification of the grave cut or perhaps used to define the space of the body in the same way that a coffin would. Functional explanations include the suggestion that charcoal was used to absorb bodily fluids from decomposing bodies (Daniell, 1997) or perhaps to mark burial locations in order to prevent future re-use of the site (Holloway, 2010).

Charcoal analysis has shown that the majority of charcoal fragments derived from medium and large oak timbers. This corresponds well with charcoal analysis undertaken at Castle Green, Hereford (Shoesmith, 1980), where oak fragments from several large timbers were recovered from the grave cuts in several burials.

Oak was the favoured tree for construction purposes in early Medieval England. When trees recorded in pre-Conquest charters and place-names are plotted, oak and ash dominate in the known regions of wood-pasture. Oak was well represented In Worcestershire, which was particularly well-wooded at the time of the Doomsday book and had the most extensive royal forests after 1086 (Hooke, 2011). Oak was therefore relatively abundant in the area at the time, and was therefore probably deliberately selected for use. Oak is an excellent fuel-wood and has been extensively exploited in the British Isles for artefactual and structural purposes (Austin 1995).

The mixture of twigs and large timbers suggests that the charcoal fragments did not all derive from large timbers or planks of wood.

Conclusion

- All charcoal fragments were oak.
- All fragments derive from medium and large oak branches although one twig was recovered, suggesting that the wood used wasn't all from large planks.
- The assemblage correlates with the charcoal assemblage from Castle Green, Hereford.
- No fungal hyphae were observed in the fragments, suggesting that fresh wood was used.

References

Austin, P. 2009 The wood charcoal macro-remains form Mesolithic midden deposits at Sand, Applecross. In K. Hardy and C. Wickham-Jones (eds.) ***Mesolithic and later sites around the Inner Sound, Scotland: the work of the Scotland's First Settlers project 1998–2004.*** http://www.sair.org.uk/sair31

IAWA committee, E.A. Wheeler, P. Bass and P.E. Gasson (eds.) 1989 IAWA List of Microscopic Features for Hardwood Identification, Published for the International Association of Wood Anatomists.

Daniell, C 1997 Death and Burial in Medieval England 1066-1550, Routledge

Holloway, J 2010 Material Symbolism and Death: Charcoal Burial in Later Anglo-Saxon England in Buckberry and Cherryson, A, 2010 Burial in later Anglo-Saxon England c. 650-1100 AD, Studies in Funerary Archaeology. Oxford: Oxbow books.

Hooke, D 2011 Woodland usage in Anglo-Saxon England, as illustrated by contemporary documents and place-names. Birmingham

Ludemann, T and Nelle, O 2002 Die Wälder am Schauinsland und ihre Nutzung durch Bergbau und Köhlerei. Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg, Abteilung Botanik und Standortskunde, 15, Freiburg

Marguerie, D and Hunout, J Y 2007 'Charcoal analysis and dendrochronology: data from archaeological sites in north-western France'. Journal of Archaeological Science 34, 1417-1433.

Prior, J and Alvin, K L 1983 'Structural changes on charring wood of Dichrostachys and Salix from southern Africa.' IAWA Bulletin n.s. 4: 197-206

Schweingruber, F H 1978 Microscopic wood anatomy, Birmensdorf: Swiss Federal Institute for Forest, Snow and Landscape Research.

Schweingruber, F H 1990 Microscopic Wood Anatomy (3rd edition) Paul Hupt Berne and Stuttgard Publishers, Stuttgard.

Shoesmith, R 1980 Hereford City Excavations Volume 1: Excavations at Castle Green, CBA Research Report 36.

Stuijts, I 2005 'Wood and charcoal identification'. In M. Gowen, J. O Neill and M. Philips (eds) The Lisheen Mine Archaeological Project 1996-8. Wordwell: Bray 137-186.

Wheeler, J 2011 'Charcoal analysis of industrial fuelwood from medieval and early modern iron-working sites in Bilsdale and Rievaulx, North Yorkshire, UK: evidence for species selection and woodland management'. Environmental Archaeology 16 (1) 15-35.

14. APPENDIX 5 – RADIOCARBON DATING CERTIFICATE AND ISOTOPIC ANALYSIS

Isotope analysis (δ15N and δ13C) – explanation

Humans that obtain the majority (>90%) of their protein from marine food typically have δ15N values between 12 and 22 per mil. While those that consume only terrestrial protein (C3 pathway plants) have δ15N values ranging from 5 to 12 per mil. Similarly, human bone collagen δ13C values of –11 or –12 per mil indicate a diet composed almost entirely (>95%) of marine protein, while a value of –20/-21 indicates a predominantly (>95%) terrestrial protein diet. (Please note: these values reflect the protein component of the diet that is routed to collagen, it does not reflect the total diet contribution).

The d15N values for your sample may indicate a small "aquatic" (freshwater) diet (i.e. a value of 8 per mille has been considered to be a 0% aquatic diet and 17 per mil a 100% aquatic diet), but it may also indicate a higher level of protein in this individuals diet. Unfortunately, we cannot correct accurately for a freshwater component to the diet without knowing a bit more about the reservoir age of the water in the area where these individuals lived. Similar values are quite common for UK samples.

More information on aquatic reservoirs can be found in an article by Cook, *et al.* 2002. Problems of dating human bones from the Iron Gates. Antiquity, 76:77-85.

If you have additional data that may affect this result, please contact the lab and we will recalibrate the result for you.

Quality control (%N, %C and C:N) – explanation

Modern collagen has about 43% carbon and 16% nitrogen, and should have a C:N value of about 3.2. Most well preserved archaeological bone averages 35wt%C with between 11 and 16 wt%N and a CN ratio of 3.1-3.5. The C/N ratio falls within acceptable parameters.

Sample ID	d15N vs Air*	Total N	d13C vs PDB*	Total C	C:N	%Marine
	‰	%N	‰	%C		–
Murphy 35600	13.08	15.43	-19.02	43.14	3.26	–

*precision = ± 0.2 ‰

Table A5.1

Isotope values measured on bone gelatin

The University of Waikato
Radiocarbon Dating Laboratory

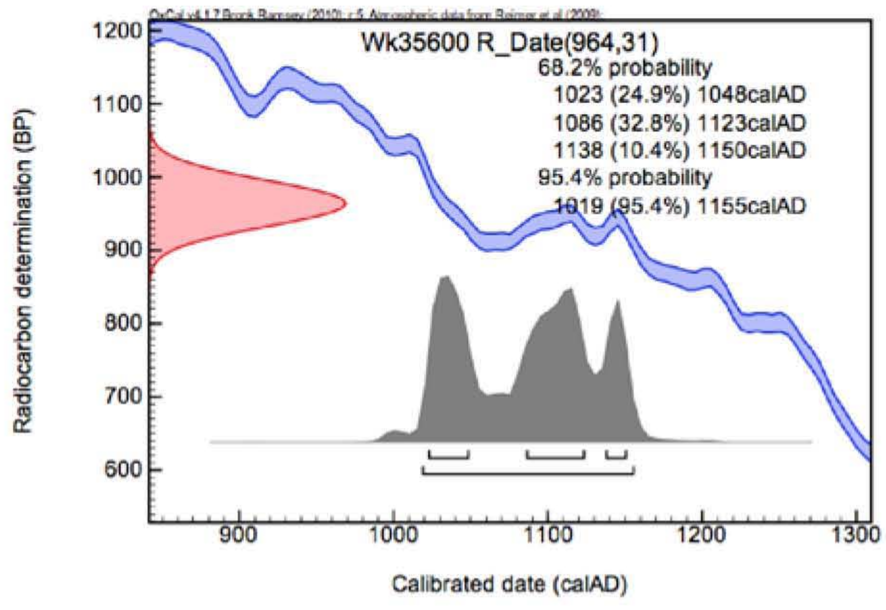
Private Bag 3105
Hamilton,
New Zealand.
Fax +64 7 838 4192
Ph +64 7 838 4278
email c14@waikato.ac.nz
Head: Dr Alan Hogg

Report on Radiocarbon Age Determination for Wk- 35600

Submitter	Jason Murphy
Submitter's Code	SK084
Site & Location	Pershore Abbey Church, Pershore, Worcestershire, England., United Kingdom
Sample Material	Human Bone
Physical Pretreatment	Sample was cleaned, ground and visible contaminants were removed.
Chemical Pretreatment	Sample was decalcified in 2% HCl, rinsed and dried. Then gelatinised at pH=3 with HCl at 90 degrees for 4 hours. Rinsed and dried.

$\delta^{13}C$	-21.8 ±	0.2 ‰
$D^{14}C$	-113.0 ±	3.4 ‰
$F^{14}C\%$	88.7 ±	0.3 %
Result	**964 ± 31 BP**	

Comments



7/01/13

- Result is *Conventional Age or Percent Modern Carbon (pMC)* following Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*

15. APPENDIX 6 – SITE REGISTERS

Context register

Context	Description	Levels mOD
001	Topsoil	21.17
002	Subsoil	
003	Natural	
004	Cut of modern backfilled trench	
005	Fill of [004]-modern backfill	
006	Cut for SK007 (not visible)	
007	Adult skeleton-legs only-in [006]	20.39
008	Fill of [006]	
009	Cut for SK010 (not visible)	
010	Adult skeleton c.50-60% complete	20.85
011	Fill of [009]	
012	Skeleton within cist [015]	20.52
013	Grave cut for SK012	
014	Fill of [013]	
015	Structure-mortared cist for SK012	20.73
016	Cut for SK017 (not visible)	
017	Sub-adult skeleton <25%	20.79
018	Fill of [016]	
019	Cut for SK020	
020	Adult Skeleton c.50%`	20.83
021	Fill of [019]	
022	Drain. North-south direction. Phase 1	
023	Coffin for SK020 in [019]	
024	Cut for SK025	
025	Adult Skeleton-c.25% complete in [024]	20.73
026	Fill of [024]	
027	Coffin for SK025, in [024]	
028	Skeleton	20.47
029	Grave cut for SK028	
030	Fill of [029]	
031	Cut for SK032	
032	Adult skeleton <25% complete	20.7
033	Fill of [031]	
034	Skeleton	20.36
035	Grave cut for SK034	
036	Fill of [035]	
037	Grave cut for SK038	

Context	Description	Levels mOD
038	Sub-adult skeleton in [037]	20.75
039	Fill of [037]	
040	Skeleton, within [041]	20.64
041	Grave cut for SK040	
042	Fill of [041]	
043	Grave cut for SK044	
044	Adult skeleton <25%	20.48
045	Fill of [043]	
046	Grave cut for SK047	
047	Adult Skeleton c.50% complete	20.37
048	Fill of [046]	
049	Grave cut for [050]	
050	Adult skeleton c.51% complete	30.37
051	Fill of [049]	
052	Skeleton	20.41
053	Grave cut for [054]	
054	Fill of [053]	
055	Grave cut for SK056	
056	Adult skeleton	20.21
057	Fill of [055]	
058	Skeleton	20.34
059	Grave cut for SK058	
060	Fill of [059]	
061	Skeleton <50%	20.33
062	Grave cut for SK061	
063	Fill of [062]	
064	Grave cut for SK065	
065	Adult skeleton >50%	20.49
066	Fill of [064]	
067	Adult skeleton c.50% complete	20.52
068	Grave cut for SK067	
069	Fill of [068]	
070	Grave cut for SK071	
071	Adult skeleton <50%	20.65
072	Fill of [070]	
073	Grave cut for SK074	
074	Adult skeleton c.80%	20.50

Context	Description	Levels mOD
075	Fill of [073]	
076	Cut 18th/19th century disturbance	
077	Fill of [076]	
078	Adult skeleton with chalice	20.47
079	Grave cut for SK078	
080	Fill of [079]	
081	Grave cut for SK082	
082	Adult skeleton <50%	20.56
083	Fill of [081]	
084	Skeleton	20.34
085	Grave cut for SK084	
086	Fill of [085]	
087	Charcoal lining of grave SK084	
088	Grave cut for SK089	
089	Sub-adult skeleton >75%	20.14
090	Fill of [088]	
091	Adult skeleton	20.23
092	Grave cut for SK091	
093	Fill of [092]	
094	Cut for SK095	
095	Adult Skeleton c.75% complete	20.21
096	Fill of [094]	
097	Skeleton	20.11
098	Grave cut for SK097	
099	Fill of [098]	
100	Stone cist for SK097	20.08

Photographic register

Photo	Colour (649)	B/W (663)	Digital	Direction	Description
1	01	01	01	–	ID Shot
2	02	02	02	W	SK007 – <25% complete
3	03	03	03	W	SK010 – 50-60% complete
4	04	04	04	W	SK012 within cist 15
5	05	05	05	W	SK017 – c.25% complete sub-adult
6	06	06	06	W	SK020 – c.50% adult
7	07	07	07	W	Cist 015 – post-ex
8	08	08	08	W	Cist 015 facing north
9	09	09	09	W	SK025 – adult.c.26% complete-disturbed spine

Photo	Colour (649)	B/W (663)	Digital	Direction	Description
10	10	10	10	W	SK028 adult <25% complete
11	11	11	11	W	SK032 Adult <25%
12	12	12	12	W	SK034 Adult c.50%
13	13	13	13	W	SK038 subadult c.60%
14	14	14	14	W	SK040 adult <25% (skull only)
15	15	15	15	W	SK044 – adult <25% at edge of trench
16	16	16	16	W	SK047 – adult skeleton c.50%
17	17	17	17	W	SK050 adult skeleton c.51%
18	18	18	18	N	SK052 adult c.60%
19	19	19	19	W	SK056 adult c.51%
20	20	20	20	W	SK058 adult c.75%
21	21	21	21	W	SK065 – adult-c.75%
22	22	22	22	W	SK061 adult <50%
23	23	23	23	W	SK067 adult c.50%
24	24	24	24	W	SK071 adult <50%
25	25	25	25	W	SL074 adult c.80%
26	26	26	26	W	SK078
27	27	27	27	W	Close up of remains of mortuary chalice
28	28	28	28	W	SK082 Adult <50%
29	29	29	29	W	SK084 – charcoal lining [087]
30	30	30	30	W	SK089 subadult >75%
31	31	31	31	E	SK091 adult lower legs only
32	32	32	32	E	SK 095 adult c.75%
33	33	33	33	W	SK097; cist 100 (found in test pitting)
34	34	34	34	W	Cist 100
35	35	35	35	–	General post-ex site shot
36	36	36	36	–	General post-ex site shot

Drawing register

Drawing	Scale	Plan/Section	Description
1	1:20	Plan	Plan with cist 015 and edge of church
2	1:50	Plan	Trench plan with SK positions
3	1:10	Plan	SK020

Drawing	Scale	Plan/Section	Description
4	1:10	Plan	SK034
5	1:10	Plan	SK038
6	1:10	Plan	SK047
7	1:10	Plan	SK050
8	1:10	Plan	SK056
9	1:10	Plan	SK052
10	1:10	Plan	SK058
11	1:10	Plan	SK065
12	1:10	Plan	SK067
13	1:10	Plan	SK074
14	1:10	Plan	SK078
15	1:10	Plan	SK085
16	1:10	Plan	SK084
17	1:10	Plan	SK095
18	1:10	Plan	SK097

Sample register

Sample	Context no.	Description
1	087	Charcoal lining of grave containing SK084

Headland Archaeology (UK) Ltd

Midlands & West

Headland Archaeology
Unit 1, Premier Business Park, Faraday Road
Hereford HR4 9NZ
01432 364 901
hereford@headlandarchaeology.com

South & East

Headland Archaeology
Technology Centre, Stanbridge Road
Leighton Buzzard LU7 4QH
01525 850878
leighton.buzzard@headlandarchaeology.com

North East

Headland Archaeology
13 Jane Street
Edinburgh EH6 5HE
0131 467 7705
office@headlandarchaeology.com

North West

Headland Archaeology
10 Payne Street
Glasgow G4 0LF
0141 354 8100
glasgowoffice@headlandarchaeology.com

www.headlandarchaeology.com