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ARCHAEOLOGIA

AN EARLY BRONZE AGE LOG-COFFIN BURIAL FROM TETNEY, LINCOLNSHIRE

Edited by Hugh Willmott FSA

with contributions by Michael Bamforth FSA, Samuel Bromage, Tudur Davies FSA, Jane Evans, Francesca Gherardi, Katie Hemer FSA, Emma Hook, Angela Lamb, Mik Markham FSA, Peter Marshall, Amber Roy, Alison Sheridan FSA, Ellen Simmons and Ian Tyers

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AN EARLY BRONZE AGE LOG-COFFIN BURIAL FROM TETNEY, LINCOLNSHIRE

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Abstract

In July 2018, during groundworks at Tetney Golf Course, an unscheduled round barrow was flattened by a mechanical digger, which also scattered the remains of the primary burial consisting of a single individual interred in an oak log-coffin. As a response, the University of Sheffield undertook a rescue excavation to record the remains of the disturbed barrow and recover further artefactual remains and environmental samples from within the broken coffin. Analysis of the human remains shows that the individual buried in the coffin was a robust male in his 30s, and strontium and oxygen isotope analysis indicate that he did not grow up in the immediate vicinity. Very partial remains of a second individual were also recovered; these appear to have formed part of a later interment within the barrow which was entirely removed by the mechanical digger. The coffin is formed from a substantial split and hollowed oak log, which has chiselled grooves at either end, still retaining fragments of a securing rope. Dendrochronology and ^{14}C wiggle-matching reveal that the oak was felled in 2032BC and conforms to a well-established Early Bronze Age burial pattern. Plant macrofossils and pollen from within the coffin indicate that the individual was provided with organic bedding and pillow, possibly garlanded and accompanied by other plant offerings. The only surviving artefact from the coffin is a 'miniature' battle-axe with a head of fossiliferous limestone and a perfectly preserved wooden haft. Despite the unfortunate and destructive nature of the burial's initial discovery, its rapid excavation and excellent organic preservation allow for a remarkably detailed analysis and reconstruction of a funerary ritual at the end of the third millennium BC.

Keywords: Early Bronze Age; round barrow; log-coffin; battle-axe; organic residues; human remains; isotopes; dendrochronology; radiocarbon dating.

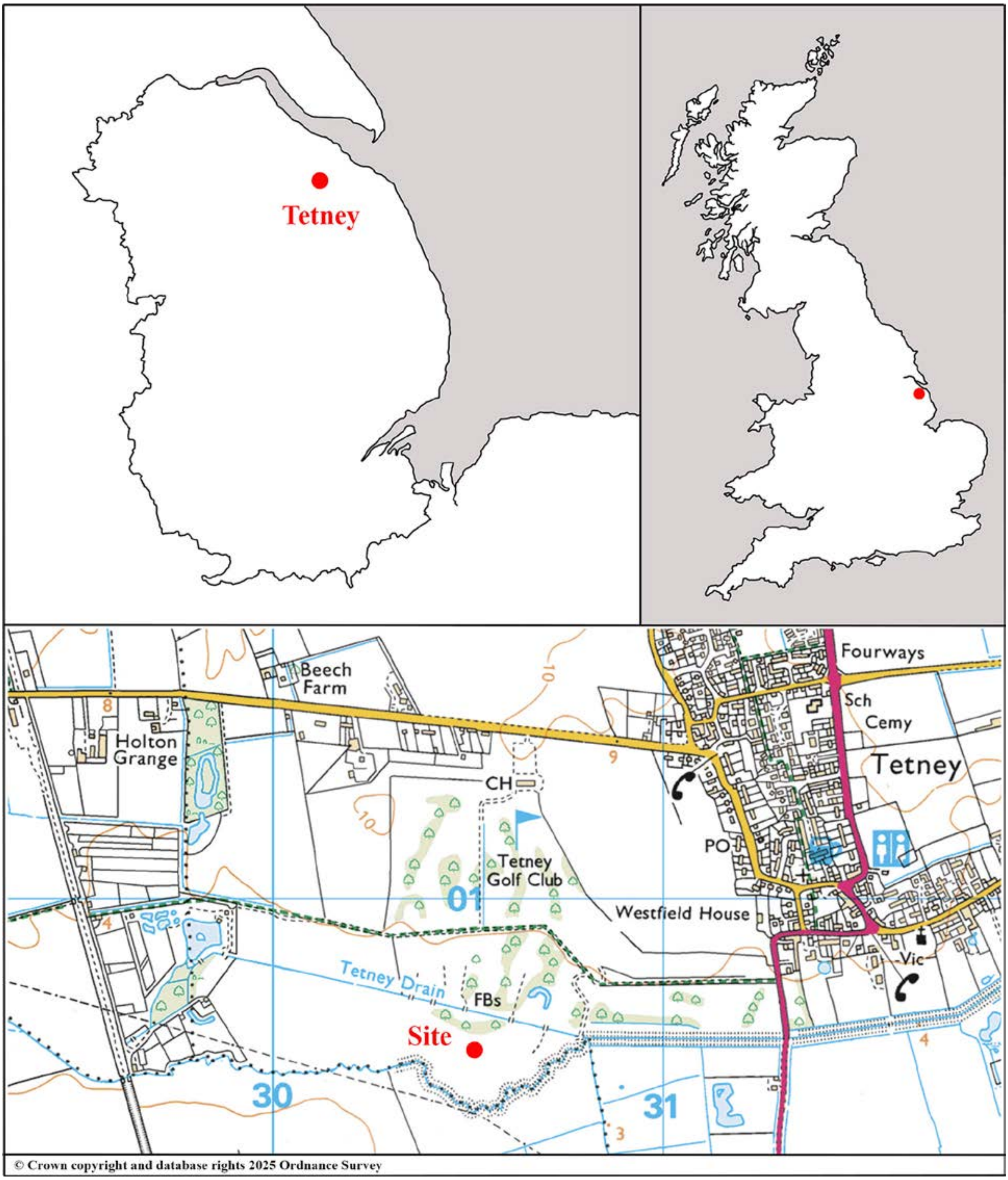

Fig 1.1. Site location (H Willmott)

CHAPTER 1

SITE DISCOVERY AND EXCAVATION

by Samuel Bromage and Hugh Willmott

Introduction

In July 2018, a previously identified but unscheduled burial mound (UID MLI82149) was accidentally disturbed by a mechanical excavator during groundworks at Tetney Golf Club, East Lindsey, Lincolnshire (Fig 1.1). The landowner was clearing and extending an existing pond, the area of which corresponded with the south-western part of the burial mound, and one of several likely associated barrows situated to the north of the Waithe Beck (Fig 1.2). Having excavated a large proportion of the mound's gravel matrix, the driver continued to extend the groundwork into the underlying alluvial clay. At the intervention's deepest point, the machine encountered a substantial log-coffin. The coffin appears to have been sealed and was voided internally when disturbed, as the skeletal remains and a small hafted stone battle-axe were loose, and so displaced during the coffin's unsupervised extraction. Once removed from the ground, the coffin was set upside down on the grass nearby.

Following the find's reporting to Adam Daubney – the Finds Liaison Officer for Lincolnshire at the time – and a visit by Tim Allen, Inspector of Ancient Monuments, the coffin pieces were relocated and secured away from the edge of the now substantial intervention. An initial walkover survey of the spoil recovered more human bone. The following day, Hugh Willmott and a small team from the University of Sheffield carried out a rapid excavation of what remained of the coffin's depositional context, establishing the coffin's original placement and the burial mound's makeup. At this point, twelve environmental samples were taken on a systematic grid pattern from the base of the coffin, which also resulted in a small amount of additional human bone being recovered. After the excavation, approximately two tonnes of spoil closely associated with the coffin were wet-sieved to retrieve any remaining finds.

Site location, soils and geology

The site is situated at the southeast corner of Tetney Golf Course, Tetney, Lincolnshire (NGR TA 30643 00616). It lies approximately 60m south of a drainage ditch and 130m west of the eastern limit of the property (see Fig 1.1). The surrounding area is former marshland, lying at 3–5m above sea level. Unfortunately, it is impossible

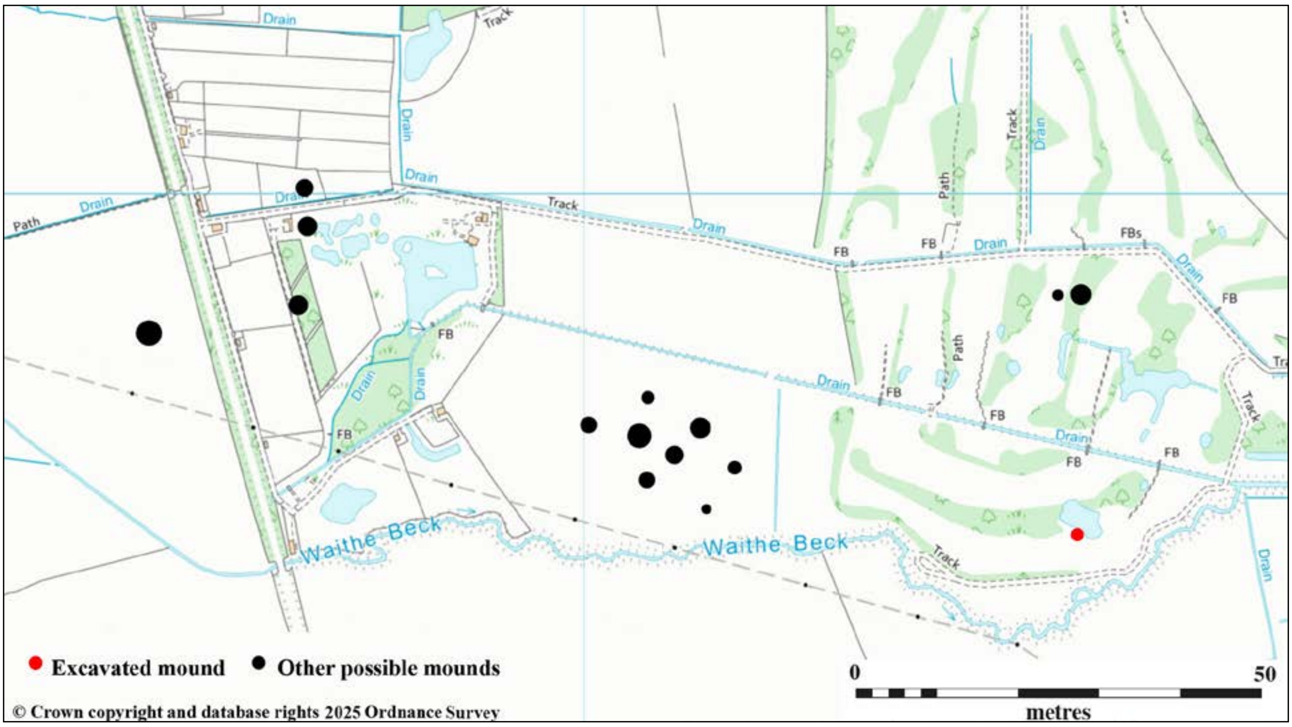

Fig 1.2. Identified features to the north of the Waithe Beck, after Trevarthen 2018 (H Willmott)

to determine the barrow's exact height prior to the initial intervention, but it was likely to have been approximately 1–2m above the surrounding ground surface.

The site is situated on an area of concealed higher-purity Upper Cretaceous chalk bedrock, overlain by Skipsea Till drift geology (Catt 1990, 21–3; Harrison *et al* 2002). The location occupies a broad interface between two differing soil types; the one to the north can be described as slowly permeable, seasonally wet, acidic loamy clay, while that to the south is characterised as loamy and clayey coastal flats with a naturally very high water table (Cranfield University 2019).

The archaeological context

There is growing evidence for significant prehistoric occupation in the area, although the lack of targeted excavation has meant that more specific characterisation remains difficult. Several potential prehistoric sites have been identified within 2km or so of Tetney Golf Course. These have primarily been identified through the National Mapping Programme by the Royal Commission on the Historic Monuments of England (RCHME 1992–1996). Furthermore, some isolated artefacts have also been recovered.

Approximately 2km to the northwest of the site, just south of Holton-le-Clay, a series of cropmarks has been interpreted as the remains of a prehistoric farmstead, though no more precise date has been attributed (UID MLI87945). These are possibly associated with an enclosure and trackway identified 0.8km to the south (UID MLI88083). A third grouping of cropmarks, indicating a likely Iron Age farmstead and associated field system, is located 1.8km south of the site, just outside the village of North Thoresby (UID MLI87670).

A Neolithic polished stone axe-head was found near Grainsby Holme, 1.1km south of the site (UID MLI41218), while fragments of a Bronze Age axe-head were recorded 3km to the west of the site in the village of Grainsby (UID MLI41212). A perforated and unfinished stone hammer was recovered from a garden rockery in North Thoresby in the 1960s (UID MLI41203). None of these was found in a secure context.

Of relevance are the numerous round barrows in the surrounding landscape. The furthest removed of these is a single, likely Bronze Age, round barrow, 25m in diameter and defined by a single ditch, recorded just west of Holton-le-Clay (UID MLI88745). Aside from the mound disturbed at Tetney (UID MLI82149), fourteen further round barrows have been recorded on, or bordering, Tetney Golf Course (see Fig 1.2). Several of these are still visible as earthworks, namely the four more prominent barrows of the eight described as making up a 'Bronze Age round barrow cemetery' 500m to the west of the site (UID MLI87666). Two further potential Bronze Age round barrows were recorded 250m to the north of the site (UID MLI82138) on the opposite side of an extinct watercourse which currently borders the golf course to the south. Aerial reconnaissance undertaken on behalf of Historic England following the Tetney coffin's recovery identified a group of four previously unknown round barrows immediately to the west of the golf course (Trevarthen 2018; see Fig 1.2). These were noted as being similar in both form and size to the barrows already described.

Excavation aims and objectives

The rapid speed and nature of the excavation reflected the reactionary nature of the project. The primary aim was to preserve by record the burial environment and recover any cultural and environmental remains before they degraded through exposure. The first objective was to stabilise the coffin and its remaining contents, as well as recover any additional wood fragments, human remains or associated artefacts. This included both *in situ* remains and any material dispersed as a result of the unsupervised intervention by the mechanical excavator. Following this, the excavation sought to recover and make a permanent record of the coffin's depositional context, including an assessment of the surviving mound fabric and structure, to determine its dimensions and form as far as possible. Finally, the fieldwork undertook to provide a contextual framework into which the individual specialist analyses of the recovered remains could be set and allow a holistic reconstruction of the original burial environment and the funerary rituals that had taken place.

Methodology

The situation prior to archaeological involvement

The area opened by the landowner encompassed most of the visible earthwork, although a slight rise was evident around the northern and eastern limits of the intervention. However, the southern and western limits of the mound had been removed entirely. This work was carried out using a tracked mechanical excavator equipped with a 1.6m toothed trenching bucket. No thought had been given to the possibility of encountering archaeological remains, so it was not until the log-coffin was removed and Adam Daubney and Tim Allen contacted that any archaeological method was applied. At this point, the coffin was moved to a secure location and some scattered archaeological material recovered from the already excavated spoil. The coffin and associated fragments were then temporarily covered with plastic sheeting, and the human remains, along with the only recovered artefact – a hafted miniature battle-axe – given into the keeping of the excavation team.

Archaeological excavation

The machine had already excavated the trench to a substantial depth, approximately 3m below ground level, levelling off most of the open area at approximately 2.2m below ground level prior to archaeological investigation. Therefore, the original stratigraphy of the coffin was truncated and thoroughly waterlogged. The trench was initially bailed out by hand and cleaned as far as possible, but as its base was below the natural groundwater level, excavation was frequently interrupted by the need to remove water manually from the trench.

Archaeological extension of the trench was guided by the excavator driver and his recollections of recovering the coffin. This led to the location of several small coffin fragments and the identification of the eastern end of the original grave cut, which had been significantly truncated (Fig 1.3). The grave cut itself was then recorded, the width and lengthwise sections drawn, and the trench planned (Figs 1.4–1.5).

Recording of the mound

Given that the mechanical excavator had almost completely removed the mound (Fig 1.6), accurate recording was difficult. Nonetheless, two sections were drawn. The first (Fig 1.7, top) documented the profile of the mound so far as it survived, although because of its sloped and curving nature the drawing is, at best, a record of what was extant and does not represent the genuine profile of the original mound. The second section (Fig 1.7, bottom) was recorded to illustrate the profile of the intervention and the slight rise surviving at its northern limit.

Fig 1.3. View of exposed *in situ* coffin fragments from the northwest (H Willmott)

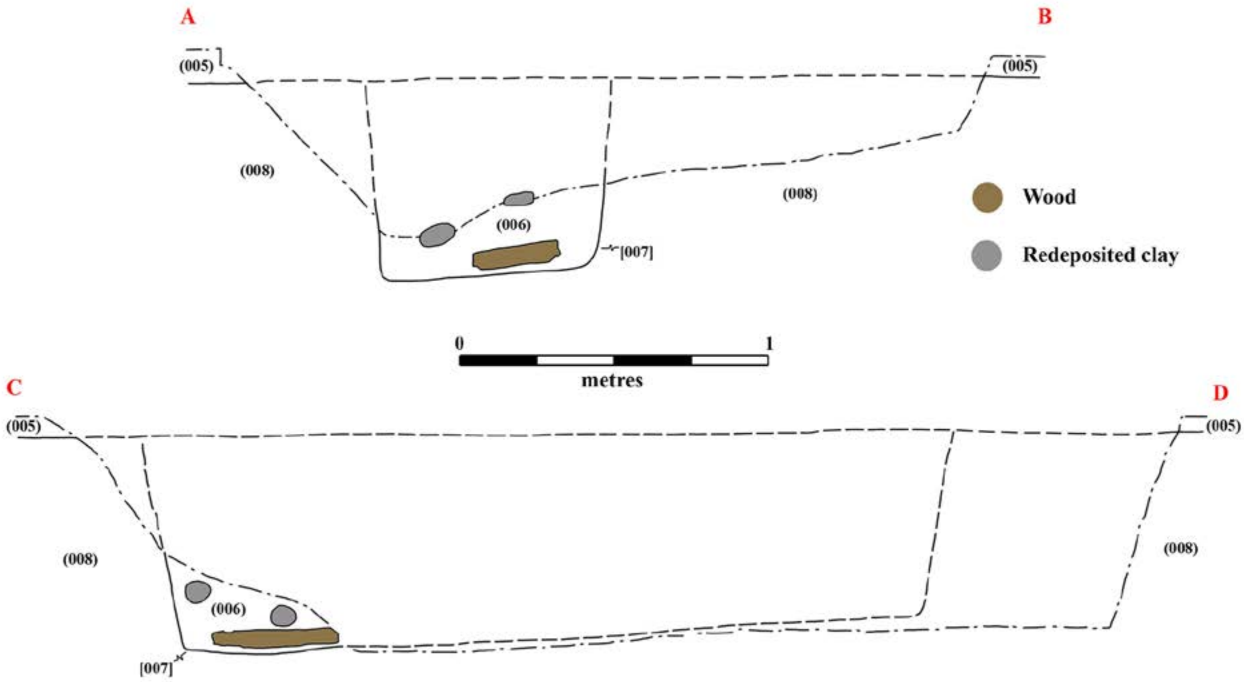

Fig 1.4. West-facing section (top) and north-facing section (bottom) through coffin cut [007] (H Willmott)

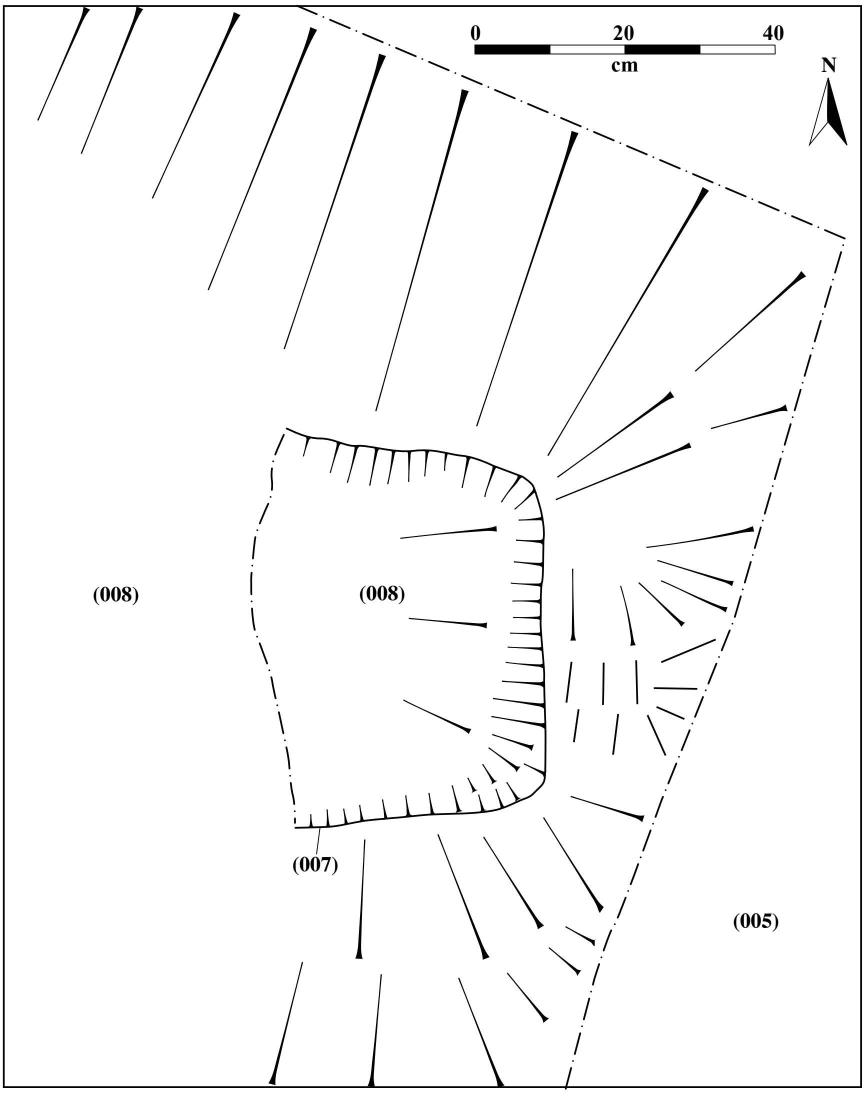

Fig 1.5. Plan of surviving coffin cut [007] (H Willmott)

Fig 1.6. Aerial view of the intervention prior to archaeological excavation; the burial is immediately to the left of the mechanical excavator (H Willmott)

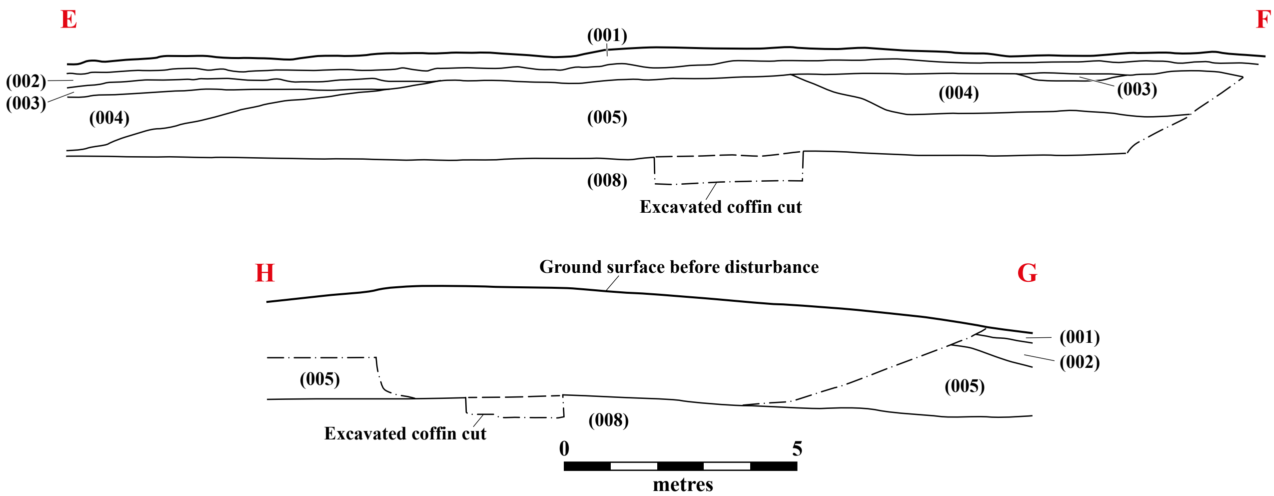

Fig 1.7. South-facing section (top) and west-facing section (bottom) through the mound (H Willmott)

Because of pressing time constraints, a result of the hot July weather causing the exposed sections to rapidly decay and exfoliate, what remained of the mound and the intervention were planned retrospectively using geo-referenced photographs (Fig 1.8). The fabric of the mound, or at least the fabric still *in situ*, was described and recorded to aid with any subsequent reconstruction of the mound's structure. This is expanded on below.

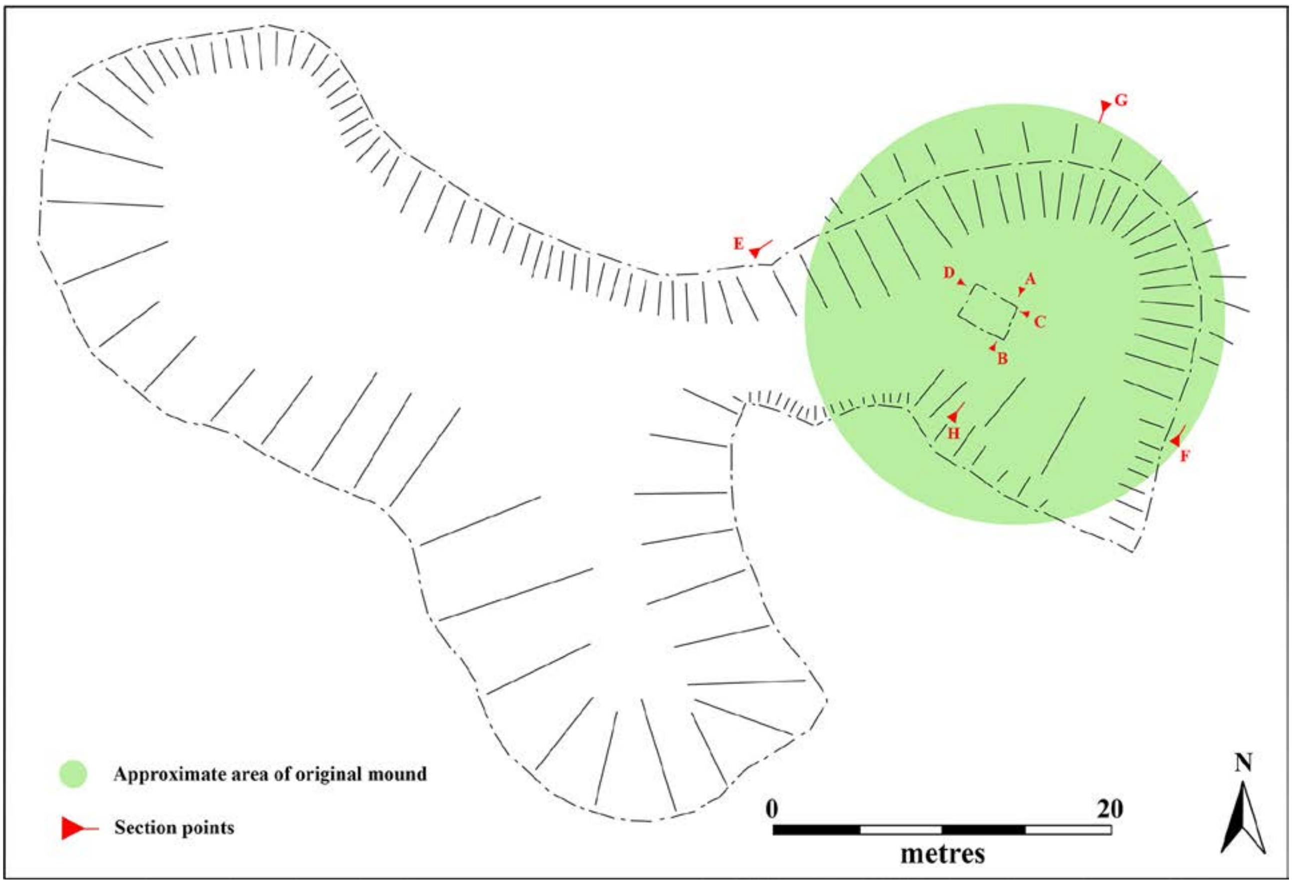

Fig 1.8. Plan of surviving mound and interventions (H Willmott)

Recording of the log-coffin

The coffin was measured, and an initial profile drawing made in the field. Numerous photographs were taken as the continued good state of preservation could not be assured. Upon completion, Historic England transported the coffin and other organic remains to the Mary Rose Trust in Portsmouth for stabilisation, where more detailed recording and analysis were undertaken (see Chapter 4).

Sampling

The base of the coffin still contained elements of a residue that was systematically sampled. Twelve samples were taken on a grid pattern across the coffin (Fig 1.9), and the few remaining fragments of human bone were recorded and recovered. Representative samples of the soil and groundwater from where the coffin had been sitting before its disturbance were recovered. This was to aid the coffin's stabilisation and the subsequent conservation of the associated organic materials.

The depositional context of the coffin

At the time of excavation, the northern and eastern edges of the mound were evident, and its diameter would likely have been approximately 25m (see Fig 1.8). No evidence for a surrounding ring ditch was identified and such a feature would have lain outside of the excavated area. Likewise, no direct association between the primary mound fabric (005) and the still *in situ* coffin fragments survived the initial unsupervised intervention. What did remain was a distinct cut [007], visible on three sides and approximately 0.6–0.75m in width. Given that this is considerably narrower than the width of the coffin at its greatest extent (1.2m, see section 4.5), it was surmised that this represented just the very base of the cut, which was originally tapered. Furthermore, given the reconstructed height of the coffin, 1.145m, most of it would have sat proud of the clay (008), so this feature probably

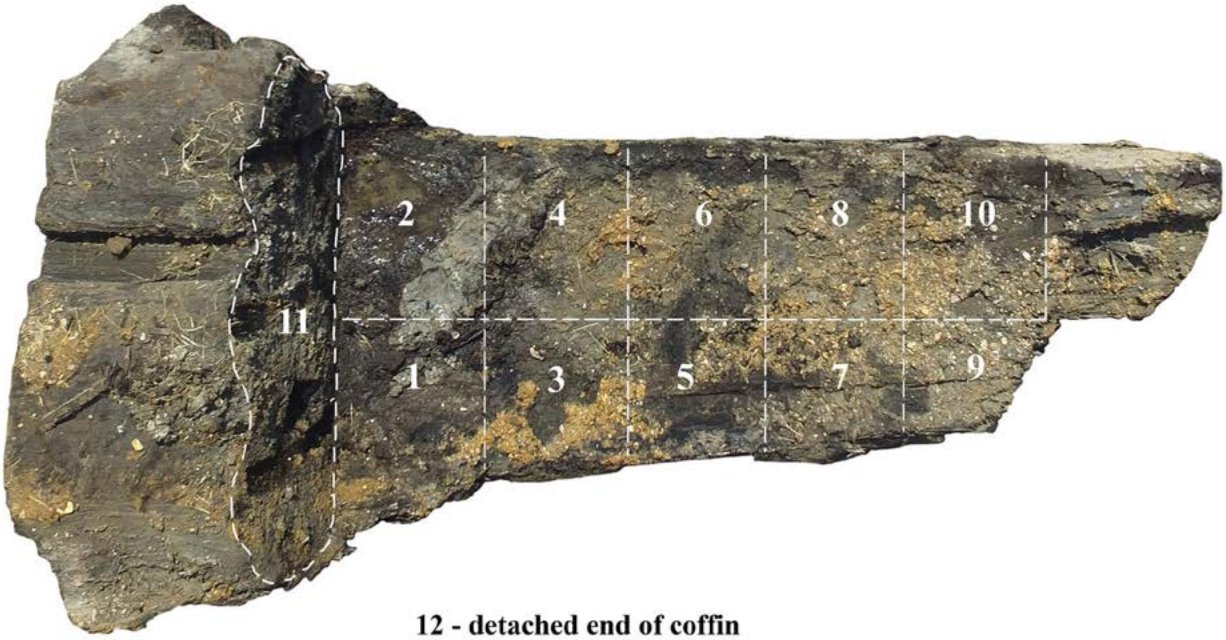

Fig 1.9. Location of environmental samples taken from the log-coffin (H Willmott)

was intended to act as a stable base for the large log rather than something to contain it entirely. The cut was orientated west–east, and once emptied survived to a depth of 0.27m. This was approximately 3m below the modern ground level, although its depth below the top of the original mound is unknown because of its removal by the mechanical digger.

Cut [007] was filled by a poorly sorted mid-greyish-brown sandy silt (006), which included significant patches of redeposited natural clay and was formed around the coffin fragments on three sides. The redeposited clay resulted from deliberate backfilling following the insertion of the coffin, which lay directly on the base of the cut. The cut [007] appeared to be expanding in width towards the west, as well as towards the surface. However, as only its extreme eastern basal limit survived truncation by the mechanical excavator, it is difficult to estimate its full extent. It can, however, be assumed that cut [007] continued to the west for at least 2.4m (the approximate length of the coffin).

Cut [007] extended into the mid-brownish grey alluvial clay natural (008). The similarity of the fill (006) to the barrow fabric (005) could either imply that cut [007] was dug through both (005) and (008) or more likely that the backfilling of the grave cut (006) and the deposition of the barrow fabric (005) were contemporary events. The significant depth of the burial, if cut through (005), would have required a shaft approximately 3–4m in depth, making its insertion through the mound unlikely. Because of the extent of disturbance, no soils underlying the made mound (005) could confidently be identified, and it appeared to lie directly over the natural clay (008), which could be seen in the limits of the trench dug by the mechanical excavator. Immediately overlying the mound fabric (005) was a substantial alluvial clay deposit (004), consistent with the regularly flooded marshland that covered the area prior to systematic draining. A second, thinner alluvial clay layer (003) overlaid (004), with a thickness of only approximately 200mm. Sealing these were a mid-greyish-brown silty clay subsoil (002) and a similar but darker and more humic topsoil (001).

No artefacts were recovered during the excavations except for a few dislocated fragments of coffin wood. Several large stones were found near some of the larger coffin fragments and intermixed with the disturbed mound fabric. While most consisted of locally derived chalk bedrock, one was granitic in formation. This was either a glacial erratic or more likely intentionally brought to the site from elsewhere (Fig 1.10). Indeed, this stone bore several abraded lines that did not appear natural in origin. While these are not thought to be identifiable as 'rock art' (Joana Valdez-Tullett, pers comm, 27 September 2023), they were not a result of the modern disturbance. The lack of other similar stones in the wider surviving mound makeup, coupled with the association of those that were recovered with the fragmented coffin, leads to the intriguing possibility that they were intentionally placed on top of the lid, possibly to keep it weighted and securely in place once it had been lowered into the grave cut, but prior to the erecting of the covering mound.

Fig 1.10. Flat stone, one of several possibly placed on top of the coffin lid (H Willmott)

No further grave cuts or other evidence for additional associated burials were identified archaeologically. However, this is not to say that inserted or more peripheral associated burials were not present, as severe truncation and incomplete exposure would have prevented their identification. Indeed, the analysis of the recovered disarticulated human remains identified the metatarsals from a second adult, the character of which suggests they did not come from the main burial deposit (see Chapter 2).

Excavation summary

In light of the excavations, the following depositional context can be suggested for the prehistoric burial recovered from Tetney Golf Course. Before constructing the round barrow, a grave cut [007] was dug into the clay natural and a substantial log-coffin inserted into its base. This was probably packed around in the cut with some of the redeposited clay (006) and the still-protruding lid weighted down with several large stones. The coffin and its contents were then buried beneath the mound fabric (005), formed from the local surrounding gravels. The stratigraphic profile of the barrow and its associated deposits suggest that it was constructed in one single phase.

The potential significance of placing the barrow alongside a now relict watercourse is unknown and maybe coincidental. However, such a relationship also has been observed elsewhere in Lincolnshire at Deeping St Nicholas, although the nature of the primary interment there differed substantially from that seen at Tetney (see French 1994).

Typologically, and following Garwood's (2007) chronological framework for Late Neolithic and Early Bronze Age funerary monuments, the Tetney mound potentially can be classed as a relatively modest, single-phase round barrow, with a single central primary inhumation, although given the disturbed nature of the archaeology any such positioning must be treated with caution. However, this broad chronology is far more tightly refined by the specialist analyses presented later in this report (see Chapters 4, 5, and 8).

CHAPTER 2

THE HUMAN SKELETAL REMAINS

by Emma Hook

Introduction

During the intervention, a single partial human skeleton was uncovered, SK001, originally contained within the log-coffin, and a portion of a second individual consisting of five left metatarsals and two unidentifiable bone fragments, SK002. Both sets of remains were examined using standard anthropological methods following the guidelines for recording human remains set out by the British Association for Biological Anthropology and Osteoarchaeology (BABAO) and the Chartered Institute for Archaeologists (CIfA) (Brickley and McKinley 2004; Mitchell and Brickley 2017).

Methods

Examination of the material

The skeletal elements were identified and laid out in standard anatomical position on a workbench. A macroscopic osteological examination was then undertaken, and an inventory of the presence and preservation of all surviving elements produced. Coding systems, where possible, were based on the guidelines in Mitchell and Brickley (2017), Brickley and McKinley (2004), and Buikstra and Ubelaker (1994).

Assessment of preservation and completeness

The preservation of each element was recorded using the coding system of Brickley and McKinley (2004) based on the integrity of the cortices and joint surfaces. Overall preservation was assigned to each skeleton, where good (grades 0–1) indicated that the majority of cortices and joint surfaces were free from any erosion, and poor (grades 4–5+) indicated the majority of surfaces were affected by erosion and/or many elements were fragile or crumbling. Completeness was unrelated to preservation and was recorded based on the percentage of the skeleton present.

Determination of sex

The methods used to determine the sex of skeletal remains include observation of the morphological differences in the skull and pelvis, which are only applicable if the skeleton is fully mature (Cox and Mays 2000). The pelvis is considered the most reliable element for sex determination (Buikstra and Ubelaker 1994), with an accuracy level of up to 96 per cent compared to up to 90 per cent for the skull alone (White and Folkens 2005).

The methods commonly used to examine the pelvis are set out by Buikstra and Ubelaker (1994). Greater weight is given to the pelvic traits, as outlined by the method of Phenice (1969). For SK001, only a few fragments of the pelvis were available for determining sex. Similarly, none of the facial bones was recovered, so analysis of the skull came from cranial traits. Where possible, the general size and robusticity of elements were noted.

Estimation of age at death

Various methods that measure the skeleton's biological ageing are used to estimate the age at death of an adult skeleton. These methods fundamentally assess the degeneration of the skeleton that occurs with age; the skeleton is affected by genetic predispositions, environment, nutrition, sex (hormones), behaviour, and socioeconomic status (Rosen *et al* 1999).

Degenerative changes to the morphology of the following skeletal elements are usually assessed: the auricular surface of the ilium (Buckberry and Chamberlain 2002; Lovejoy *et al* 1985), the pubic symphysis (Brooks and Suchey 1990; Todd 1921), and wear to the occlusal surfaces of the teeth (Lovejoy *et al* 1985). However, in the case of SK001, only the auricular surface was present in the pelvis, and dental wear was not employed as a method of age estimation because of extensive abrasion and limited availability.

Given the restricted application of traditional methods to SK001, it was decided to also apply transitional age analysis, following Milner and Boldsen (2012). This method is still being introduced to the osteological analysis of archaeological remains, but it offers a more specific age estimate and eliminates the known issues with traditional methods (Milner and Boldsen 2012, 98).

Metric analysis
Stature can be estimated by measuring the maximum length of long bones and applying these measurements to the regression formulae developed by Trotter and Gleser (1952; 1958), derived from studies of skeletons of modern Americans of known living stature. Although this dataset is not an ideal control for earlier British skeletal populations, they are currently the standard used and allow for inter-population comparisons. Such inconsistencies can be tempered through the application of contemporary inter-site comparisons; this report compares the Tetney SK001 remains with 35 other examples of Bronze Age adult males. The postcranial measurements taken for this sample were those listed in the CIfA guidelines (Brickley and McKinley 2004); an osteometric board was used to take measurements and the standard regression formulae were used to estimate stature. The long bone used was complete and unaffected by pathology.

Non-metric traits
Analysis of non-metric traits was not carried out because of the extensive taphonomic degradation of the bone surfaces and epiphyses in SK001.

Dental status
Dental status has been recorded via a description of the macroscopic appearance of the dentition. This decision was made as just four teeth were recovered from SK001: the mandibular left central incisor, lateral incisor, canine, and the second mandibular premolar.

Palaeopathology

All skeletal elements were examined for signs of pathology. Any lesions noted were examined using a x10 magnifying glass and described using standard anatomical terminology. Where possible, a diagnosis was made with reference to standard texts (Ortner 2003; Waldron 2009). It should be noted that poor preservation, fragmentation and incompleteness of remains in this sample led to the loss of evidence for many potential disease processes.

Results
Preservation and completeness
Figure 2.1 shows the elements of SK001 that were present, which was less than 25 per cent complete, consisting of the cranium, elements of both arms and legs, two vertebrae, four teeth, and fragments of the right os coxae, ribs, metacarpals, metatarsals and tarsals. Preservation was poor, with patchy surface erosion and damage to cortices and joint surfaces. Most elements present were largely incomplete and fragmented. The bones that were present were assessed to be of grade 3 condition, after Brickley and McKinley (2004). The entire skeleton had been affected by a blackish-brown stain consistent with the colour of the organic material recovered from the base of the coffin.

SK002 was less than 25 per cent complete, consisting of just five metatarsals of the left foot.

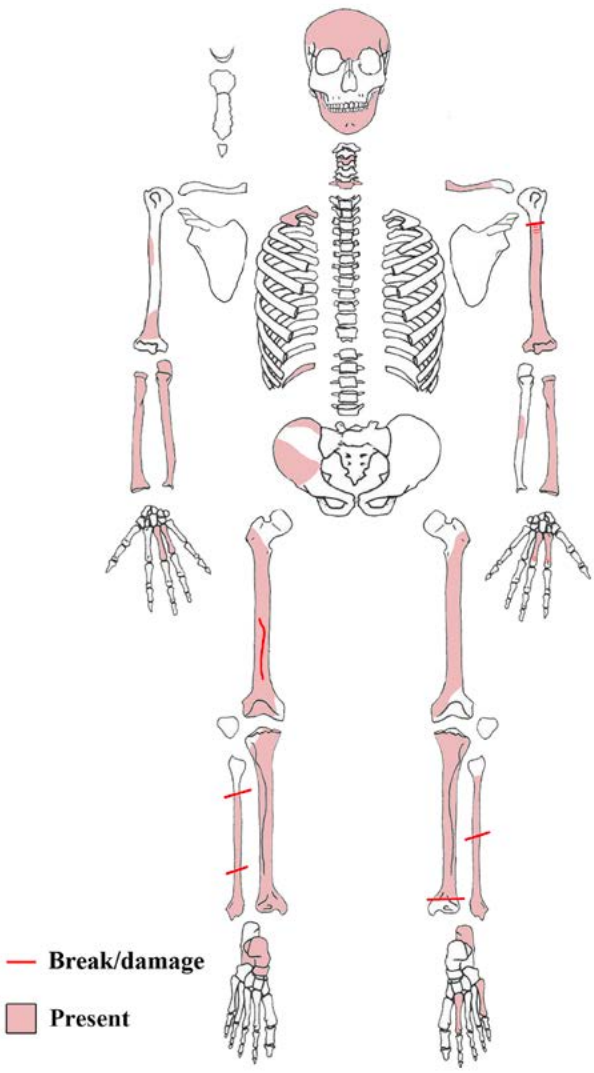

Fig 2.1 Skeletal elements present, SK001 (E Hook)

Biological sex
The biological sex of SK001 was determined from the examination of 25 non-metric sex indicators of the pelvis and skull (cranium and mandible), listed in Table 2.1. Considering the incomplete nature of the pelvis, only four traits could be examined, and only

for the right os coxae. Therefore, biological sex was determined mainly from traits of the skull. It was concluded that, with little doubt, the skeleton was male.

Table 2.1 Sexually dimorphic traits of the skull and pelvis

Traits of the skull			Traits of the pelvis	
1	The overall shape of the cranium	M	Overall structure	/
2	Glabellar profile	M	Overall shape	/
3	Frontal Slope	M	Pelvic inlet	/
4	Frontal and parietal tuberosities	M	Iliac crest	/
5	Zygomatic process of frontal	/	Iliac blade	/
6	Supraorbital ridges	M	Iliac tuberosity	/
7	Orbital outline	/	Greater sciatic notch	M
8	Nasal bones	/	Auricular surface	M
9	Zygomatic bones	/	Preauricular sulcus	M
10	Temporal ridges	M	Postauricular space	M
11	Suprameatal crests	?	Acetabulum	/
12	Mastoid process	/	Pubic symphysis height	/
13	Nuchal area	M	Pubic rami	/
14	External occipital protuberance	M	Sub-pubic angle	/
15	Occipital and mandibular condyles	M	Pubic tubercle	/
16	Pterygoid plates	/	Inferior pubic ramus	/
17	Canine eminence	/	Ventral arc	/
18	Palate	/	Sub-pubic concavity	/
19	Mandibular ramus (ant-post)	M	Medial ischio-pubic ridge	/
20	Mandibular ramus	M	Obturator foramen	/
21	Depth from incisors to mentum	?	Ischial tuberosity	/
22	Mental protuberance	M	Ischial spine	/
23	Lower margin of mandibular corpus	M	Width of sacral ala	/
24	Angle of mandible	M	Anterior sacral curvature	/
25	Lower first molar	/	Sacral auricular surface	/

Key: M – Masculine; F – Feminine; ? – Indeterminate; / – Not present for observation

Age-at-death determination

Due to SK001's incompleteness, age-at-death assessment methods were greatly restricted. Since there were just four teeth and no sternal rib ends recovered from the skeleton, attempts to determine age at death from dental wear and sternal rib ends were not undertaken. Only a single portion of the right os coxae survived from the pelvis, meaning that only the right auricular surface could be used in morphological analysis of the skeleton's age. Applied to this were established methods of age estimation following Buckberry and Chamberlain (2002) and Lovejoy *et al* (1985), which resulted in estimations of between 29 and 88 years with a mean age of 59.94 and 35–39 years, respectively. In addition, the method of transitional age analysis following Milner and Boldsen was applied, giving a more specific age estimate by eliminating known issues with traditional methods of estimation (Milner and Boldsen 2012, 98). This transitional analysis indicated an age of 33 years at death, with an upper limit of 67.8 years.

The suggestion that this individual was around 30–39 years old at death is supported by all the long bones present, which show complete fusion of the epiphyses and obliteration of the 'suture' margins. There are no signs of advanced cartilaginous ossification, which is often associated with an ageing skeleton.

Metric analysis

Stature

Stature estimates for SK001 were restricted to calculation from the right ulna and radius and the left radius, as these were the only long bones that were complete and suitable for analysis (Table 2.2). Stature regression equations following Trotter and Gleser (1958) and Trotter (1970) were applied. This methodology was chosen to compare directly with the data calculated from Gristhorpe Man, a Bronze Age log-coffin burial from North Yorkshire (Knüsel *et al* 2013). It was not possible to apply a diverse methodology, again because of the incompleteness of the skeleton, but the stature estimates placed the individual at 1.7906m (5'10½") tall, an evaluation that must be treated with some caution.

Table 2.2 Long bone measurements and estimated stature

Skeletal element	Length (cm)	Stature estimate (cm)
Right ulna	27.7	176.54 (± 4.32)
Right radius	26.8	180.314 (± 4.32)
Left radius	26.9	180.692 (± 4.32)
Average	–	179.056 (± 4.32)

Table 2.3 Stature estimates of Bronze Age males recovered from Britain (after Knüsel *et al* 2013, 99, table 8.1)

Location	Metric (cm)	Imperial*
Kinaldie, Aberdeenshire	173.25	5'8"
Ballidon Moor, Derbyshire	173.84	5'8"
Bostern, Derbyshire	164.18	5'4½"
End Lowe Derbyshire	175.05	5'9"
Galley Lowe, Derbyshire	179.29	5'10½"
Gotham, Derbyshire	173.25	5'8"
Green Lowe, Derbyshire	177.48	5'10"
Haddon Field, Derbyshire	173.25	5'8"
Hay Top, Derbyshire	174.46	5'8½"
Hitter Hill, Derbyshire	176.27	5'9"
Monsal Dale, Derbyshire	170.22	5'7"
Monsal Dale, Derbyshire	173.84	5'8"
Monsal Dale, Derbyshire	168.41	5'6½"
New Inns, Derbyshire	170.22	5'7"
Parsley Hill, Derbyshire	172.03	5'7½"
Rolley Lowe, Derbyshire	180.50	5'11"
Shuttlestone, Derbyshire	174.46	5'8½"
Wagon Lowe, Derbyshire	170.22	5'7"
Chilbolton, Hampshire	170.00	5'7"
Castern, Staffordshire	177.48	5'10"
Gratton Hill Staffordshire	177.48	5'10"
Ramscrost, Staffordshire	180.50	5'11"
Wetton Hill, Staffordshire	170.22	5'7"
Amesbury, Wiltshire	161.57	5'3½"
Amesbury, Wiltshire	173.53	5'8"
Amesbury, Wiltshire	174.00	5'8½"
Amesbury, Wiltshire	178.00	5'10"
Boscombe, Wiltshire	176.00	5'9"
Kennet Hill, Wiltshire	185.34	6'1"
Morgan's Hill, Wiltshire	179.29	5'10½"
Normanton, Wiltshire	182.30	6'
Roundway Hill, Wiltshire	185.34	6'1"
Stonehenge, Wiltshire	175.62	5'9"
Arras, East Yorkshire	176.27	5'9"
Gristhorpe, North Yorkshire	180.34	5'11"

*to the nearest ½ inch

Based on comparisons of stature with other Bronze Age males interred in barrows or cists (see Knüsel *et al* 2013, 99, table 8.1), it is evident that the Tetney individual is in line with the expected stature for the time (Table 2.3). The mean height of the comparative samples is 1.748m (5'9").

Body mass and asymmetry

Body mass can be estimated from dimensions of the femoral head breadth and a technique that combines bi-iliac breadth with estimated stature (Auerbach and Ruff 2006; Ruff *et al* 2005). If body mass cannot be estimated in either way because of the fragmentary nature of the surviving skeletal remains, it is possible to configure cross-sectional dimensions by measurement of bone length to calculate 'size' standards (Katzenberg and Saunders 2008, 188–98). However, in the case of SK001, no methodology was applicable as neither femoral head breadth, bi-iliac breadth, nor bone length were attainable because of fragmentation and damage to the skeleton. Similarly, it was impossible to assess the potential of bilateral asymmetry, which has been utilised in past studies to establish any bias in mechanical loading due to behaviour and/or pathology (Auerbach and Ruff 2006, 204). The skeletal elements typically used in such investigations are the humeri, radii, femora and tibiae. None of these bones was present on both the right and left sides of SK001, so consequently, body mass and bilateral asymmetry could not be analysed in the case of this skeleton.

Craniometric analysis

Previous research has highlighted changes in cranial shape during the Neolithic and Early Bronze Age. These changes manifest in a transference from a dolichocranic 'long-headed' shape in Neolithic specimens to a brachycranic 'broad-headed' shape in the Bronze Age (Mays 2000). Given that this changing cranial morphology has been recorded in past analyses, ideally a comparative cranial index analysis would be undertaken for SK001, following the method set out in White *et al* (2012, 97). While it was possible to obtain the skull's cranial length (194.5mm), it was not possible to measure the cranial breadth because of its incompleteness and the presence of just one temporal bone.

Dental health

Neither the maxilla (upper jaw) nor any maxillary dentition was recovered from SK001. Over 75 per cent of the mandible (lower jaw) was present, but only four teeth were found. It is apparent from the presence of dental alveoli (tooth sockets) that these teeth were lost in the retrieval process as opposed to being absent due to ante mortem tooth loss. The only recovered teeth were the left mandibular lateral incisor, lateral incisor, canine, and the second mandibular premolar.

Dental wear tends to be more common and severe in archaeological populations than in modern teeth. The severity of the dental wear was assessed using a chart developed by Smith (1984). Each tooth was scored using a grading system ranging from 1 (no wear) to 8 (severe attrition). The lateral incisor was scored a 6 (large dentin area with enamel rim lost on one side or very thin enamel only) on Smith's scale, and the canine a 5 (large dentin area with enamel rim complete). While calculus, cavities and dental enamel hypoplasia are frequently observed in archaeological populations, no such conditions were present in SK001, arguably due to the poor condition of the few recovered teeth.

Palaeopathology

Observation of pathological markers was limited because of the fragmentary nature of SK001. However, it was possible to identify evidence of bone degeneration in the vertebral column and the lower limb.

Just one vertebral bone survived from the individual; this was either a lower cervical or upper thoracic vertebra but was unidentifiable because of a lack of distinguishing features. Extensive porosity was present on the bone; lipping occurred around the superior and inferior borders; the vertebrae appeared shortened and splayed outwards; and osteophyte formation had taken place along the right-hand side. This leads to the conclusion that extensive degenerative changes to the spine had taken place and that new bone formation occurred as a response. Because of the limited presence of the vertebral column, it was impossible to determine further the aetiology or condition that the individual might have experienced.

Further degenerative changes were evident in the knee joint of the left leg. The distal femur and proximal tibia presented with eburnation of the joint surface, pitting of the joint surface, alterations in joint contour and marginal osteophyte formation. These characteristics are all part of the operational definition for osteoarthritis outlined in Waldron (2009, 34). There was no evidence suggestive of similarly advanced osteoarthritis in the right knee.

Osteoarthritis in the knee can occur as the result of numerous aetiologies. For example, the tibial and femoral bone morphology, limb alignment, and joint loading can significantly influence the development and progression of the disease (Glyn-Jones *et al* 2015, 376). In this case, it is evident that limb alignment or joint loading was compromised; osteoarthritis was only present in one knee, and within that knee the medial aspect of the joint surface was heavily affected by eburnation, while the lateral was not. Furthermore, leg-length inequality might have contributed to osteoarthritis in the shorter limb, as the discrepancy was over 10mm (Harvey *et al* 2010, 287). Alternatively, osteoarthritis can occur as a complication of trauma to the bone or cartilage of the joints, which consequently alters the biomechanics of the joint. In particular, knee trauma could increase the risk of osteoarthritis by more than four times (Muthuri *et al* 2011, 1287). The biomechanics of the knee are also altered by excess weight bearing on the joint; for example, in obese patients it has been recorded that the knee is substantially more burdened than the hip joint (Mork *et al* 2012, 682).

While it is impossible to determine which of these factors was responsible for the formation of osteoarthritis in this individual, it can be inferred that deviations in joint loading and uneven limb use impacted their stance. This would have affected daily activities by impacting joint mobility and causing long-term joint pain.

Summary

The skeleton SK001 recovered from Tetney was only partially complete because of the accidental nature of its exposure. As a result, this analysis comprises only a description of the fractured and incomplete remains. SK001 was an adult male aged approximately 30–39 years at death. In addition to the coffined skeleton, a secondary skeleton SK002 was disturbed by the mechanical digger, the recovered remains consisting of just five metatarsals from the left foot. Significantly, they do not exhibit the same staining as the primary burial and are somewhat later in date (see Chapter 5).

CHAPTER 3

ISOTOPE ANALYSIS OF THE HUMAN SKELETAL REMAINS

by Katie Hemer, Jane Evans and Angela Lamb

The human remains (SK001) interred in the log-coffin presented an opportunity for further scientific analyses that would complement the osteological data and contribute towards creating a more comprehensive osteo-biography for this individual. Strontium and oxygen isotope analysis was undertaken on sampled dental material to reconstruct this man's early life history and establish whether he was local to the Tetney region as a child.

Strontium and oxygen isotope analysis

Strontium and oxygen isotope analysis is routinely undertaken on human tooth enamel to investigate whether an individual was local to their place of burial as a child, or whether they migrated at some point prior to death. During tooth enamel formation, strontium and oxygen isotopes derived from food and water are incorporated into the tooth enamel matrix, remaining unchanged throughout the individual's life. Depending on which tooth is analysed and the age at which the crown enamel forms, the strontium and oxygen isotope signature will indicate the geological and climatic conditions in the region where food and water were sourced. Comparison between the isotopic fingerprint of the tooth enamel compared to the expected isotope values for the underlying geology and climate of the individual's place of burial allows us to consider whether or not the individual grew up and was buried in the same area; discrepancies between the expected and obtained isotopic values suggest the individual moved at some point between tooth formation and their time of death (see an overview of the method's principles in Britton 2020).

The area around Tetney has a bedrock geology that consists of the Burnham Chalk Formation (Sumbler 1999; Whitham 1991). Strontium biosphere data suggests that individuals sourcing their food (eg, arable crops, grazing animals) and drinking water in areas underlain by Cretaceous chalk are expected to have $^{87}Sr/^{86}Sr$ values between 0.7079 and 0.7087 (Evans *et al* (2022). In coastal regions, however, seawater and sea spray can also contribute marine-derived strontium – which has an isotope value of *c* 0.7092 – to the local biosphere. Plant sulfur isotope data from Evans *et al*'s (2022) Biosphere Isotope Domains map shows that Tetney, which is approximately 8km from the Lincolnshire coast, falls within a 'coastal zone', meaning seawater may contribute strontium to the local biosphere. As such, individuals sourcing their food and water in a coastal area underlain by chalk may yield strontium values between *c* 0.7079 and 0.7092. Tooth enamel oxygen values for individuals sourcing locally available drinking water near the east coast of England should broadly fall within the δ18Op range of 16.6–17.9‰ (mean 17.2‰ ± 1.3), which equates to oxygen drinking-water values (δ 18Odw VSMOW) between -8 to -7.5‰ (Evans *et al* 2012; 2022). This combination of oxygen and strontium values provides a useful para-meter against which to consider the values obtained from the analysis of tooth enamel belonging to SK001.

Materials and methods

The small amount of dental material available for SK001 means it was only possible to analyse strontium and oxygen isotopes from a single tooth, specifically the second permanent mandibular premolar (pm2). The enamel of the second permanent mandibular premolar crown forms between 2.5 and 7.5 years of age (AlQhatani *et al*, 2010; Hillson 1996, 123) and, therefore, the composition of the tooth's enamel will reflect where the individual sourced their food and water during early childhood.

Following the osteological analysis of the skeleton (see Chapter 2), a second permanent mandibular premolar was cleaned using a diamond dental burr to remove any dirt and surface contaminants from the tooth's surface. The tooth was transferred to the NERC National Environmental Isotope Facility Laboratory (NEIF) at the British Geological Survey, Nottingham. Sample preparation for strontium and oxygen isotope analysis followed standard laboratory protocols. For strontium analysis, *c* 30mg of clean enamel was transferred to a clean (class 100, laminar flow) working area for further preparation. In the clean laboratory, the sample was first cleaned ultrasonically in high-purity water to remove dust, rinsed twice, then soaked for an hour at 60 degrees celsius, rinsed twice, then dried and weighed into pre-cleaned Teflon beakers. The sample was mixed with ^{84}Sr tracer solution, dissolved in Teflon distilled 8M nitric acid (HNO_3), and converted to chloride form using 6M hydrochloric acid (HCl). Strontium was collected using Eichrom AG50 X8 resin columns. Strontium was loaded onto a single Re filament following the method of Birck (1986), and the isotope composition and strontium concentrations were determined by Thermal Ionisation Mass spectroscopy (TIMS) using a Thermo Triton multi-collector mass spectrometer. The international standard for $^{87}Sr/^{86}Sr$, NBS987, gave a value of 0.710259 ± 0.000010 (2SD, n=11) during the analysis of these samples. Data are corrected to an accepted value for this standard of 0.710250.

Oxygen carbonate analysis was also undertaken on a sample of clean enamel from the same tooth. Approximately 1mg of carbonate material was used for isotope analysis using an IsoPrime 100 dual inlet mass spectrometer plus multiprep device. Samples are loaded into glass vials and sealed with septa. The automated system evacuates vials and delivers anhydrous phosphoric acid to the carbonate at 90 degrees celsius (McCrea 1950). The evolved CO_2 is collected for 15 minutes, cryogenically cleaned and passed to the mass spectrometer. Isotope values ($\delta^{13}C$, $\delta^{18}O$) are reported as per mille (‰) deviations of the isotopic ratios ($^{13}C/^{12}C$, $^{18}O/^{16}O$) calculated to the VPDB scale using a within-run laboratory standard calibrated against NBS-19 (Coplen 1994). $\delta^{18}O$ values are then converted to the VSMOW scale using the following formula: $\delta^{18}O_{VSMOW} = 1.03091 \times \delta^{18}O_{VPDB} + 30.92$ ‰. The calcite–acid fractionation factor applied to the gas values is 1.00798 (Sharma and Clayton 1965). Because of the long run time of 21 hours, a drift correction is applied across the run calculated using the standards that bracket the samples. The Craig (1957) correction is also applied to account for $\delta^{17}O$. The average analytical reproducibility of the standard calcite (KCM) is <0.1‰ for $\delta^{13}C$ and $\delta^{18}O$.

Results and discussion

The analysis of the pm2 enamel from SK001 yielded results for both strontium and oxygen isotopes (Table 3.1). SK001 produced a $^{87}Sr/^{86}Sr$ value of 0.7091 and a concentration of 143 ppm (which reflects the abundance of strontium in the substrate). While this concentration is higher than the mean concentration recorded for human tooth enamel analysed from archaeological populations in Britain (105 ppm), it is still within the range of reported values (Evans *et al* 2012). It is, however, worth noting that this concentration is higher than strontium concentrations reported for other Early Bronze Age populations from Yorkshire and Lincolnshire (Evans *et al* 2012) (Table 3.1). The $^{87}Sr/^{86}Sr$ value of SK001 (0.7091) indicates that the individual sourced his food/water in an area that was not underlain by chalk and instead reflects a more radiogenic geology such as Jurassic clay formations, the nearest of which can be found to the north and west of Tetney (Evans *et al* 2022). Alternatively, the $^{87}Sr/^{86}Sr$ value may simply indicate that the individual inhabited a coastal area underlain by chalk and where marine-derived strontium made a notable contribution to the local biosphere. On that basis, SK001 may have been local to the Tetney chalk at the time of tooth formation. The $\delta^{18}O_p$ for SK001 (16.6‰) falls within the broader range of expected oxygen values for eastern England; however, it is offset towards the lower end of that accepted range, being 0.6‰ less than the mean oxygen value (17.2‰) for that region. The value also falls in the two-sigma range of oxygen isotope values obtained for archaeological populations (n=615) from Britain (Evans *et al* 2012), making SK001 an outlier within the broader dataset.

Table 3.1 Strontium and oxygen isotope data for SK001 from Tetney

Skeleton	Sample	$^{86}Sr/^{87}Sr$	Ppm	$\delta^{18}O_{carb}$‰ (VSMOW)	$\delta^{18}O_p$‰ (VSMOW)*	$\delta^{18}O_{dw}$‰ (VSMOW)*
SK001	Mand. PM2	0.7091	143	25.5 ±0.13	16.64 ±0.14	-8.08 ±0.21

*Values calculated using the equations of Chenery *et al* (2012)

Considering the Tetney SK001 data alongside published data for other Neolithic and Bronze Age skeletons from Britain provides a helpful comparison for interpreting these findings. Comparison is made between the data for the 'Amesbury Archer' from Wiltshire, who received a highly furnished burial (Evans *et al* 2012; Fitzpatrick 2013); an adult male buried in a log-coffin from Gristhorpe, North Yorkshire (Melton *et al* 2010; Montgomery and Gledhill 2013); three individuals from West Heslerton, North Yorkshire (Montgomery *et al* 2005); and 24 Iron Age burials from Wetwang Slack, East Yorkshire (Jay *et al* 2013). In addition, six early Anglo-Saxon individuals from Scremby, Lincolnshire, are also included since they were considered 'local' to the area where they were buried, which lies not too far from Tetney on the south-east border with the Lincolnshire Wolds (Fig 3.1).

Figure 3.1 illustrates the distinctiveness of SK001's oxygen value when compared to the selected archaeological populations from Britain. The $\delta^{18}O_p$‰ value for SK001 is at least 0.5‰ lower compared to the values for the Yorkshire Bronze Age populations and the 'local' Anglo-Saxon population from Lincolnshire. Oxygen data reported for Bronze Age populations from mainland Britain by Pellegrini *et al* (2016, 5) highlighted a notable degree of inter-regional variability, with both enhanced $\delta^{18}O_p$ and depleted $\delta^{18}O_p$ values occurring in the same

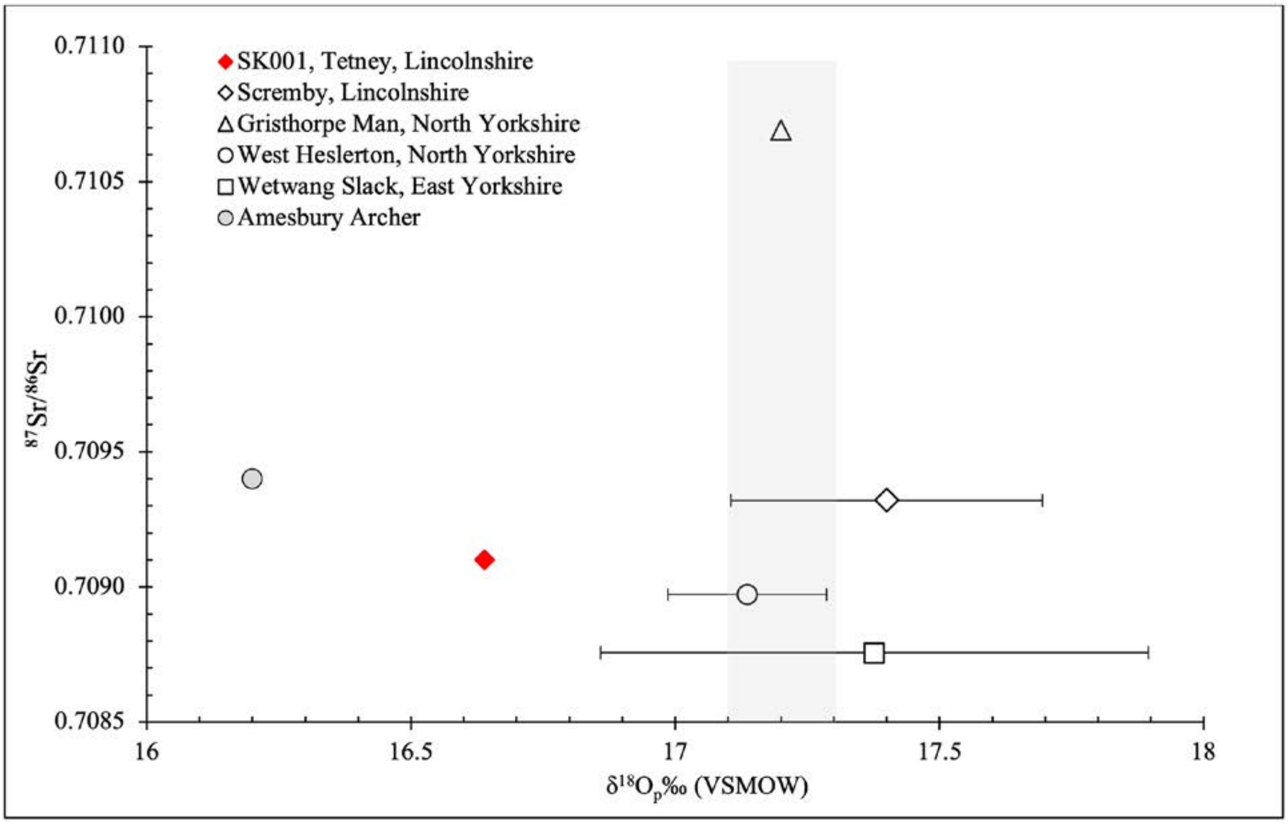

Fig 3.1 Strontium and oxygen data for SK001 from Tetney alongside published data for other archaeological populations, either from a similar time period or region. The grey bar represents the 95% confidence interval for oxygen isotope ratios from archaeological populations from eastern England (Evans *et al* 2012) (K Hemer *et al*)

areas. The authors proposed several possible factors to explain such anomalous values, including the effect of short-term climatic episodes during tooth enamel formation (eg, warmer/colder periods) or the consumption of other sources of water rather than local groundwaters, including river water originating from higher latitudes, or pond or lake waters (Pellegrini *et al* 2016, 2). There is also the possibility that individuals with outlying values might have been non-local to their place of burial, and/or non-local to the British Isles. For example, there was only 2.5% probability that the Amesbury Archer – who had an oxygen value of 16.2‰ – was local to Britain. Indeed, his isotopic values were more consistent with those reported for populations from Germany, Austria, Hungary and Czechia (Evans *et al* 2012). While SK001's $\delta^{18}O_p$ value may not be as low as the Amesbury Archer's, it is more centrally placed among oxygen values obtained for populations from more easterly Continental regions such as Belgium and Austria when compared to data from Lightfoot and O'Connell (2016, table S4).

Summary

Strontium and oxygen isotope analysis was undertaken on tooth enamel from SK001 to identify whether this adult male was local to his place of burial from childhood. Based on the data, it is possible he was local to the British Isles but not specifically the Tetney region. For example, potential places of childhood origin include regions underlain by Jurassic clay formations where other log-coffins dating from 3000–1600 BC have been found, such as parts of North Yorkshire and the East of England (Parker Pearson *et al* 2013, 30). SK001's oxygen value, however, is an outlier when compared to other contemporaneous populations from Yorkshire and Lincolnshire. Therefore, we cannot rule out that he may have come from outside the British Isles. Whether from elsewhere in England or further afield, the evidence suggests that SK001 spent his formative years some distance away from his final resting place.

CHAPTER 4

THE LOG-COFFIN

by Michael Bamforth

Introduction

The log-coffin recovered from the barrow, where it formed the primary burial, was highly fragmented upon archaeological analysis. Physical refitting of the coffin fragments was carried out at the York Archaeological Trust (YAT) during the recording process, with further digital refitting subsequently taking place. The coffin assemblage consists of sixteen physically or digitally refitted fragments (Table 4.1), a further eleven individually recorded un-refitted fragments (Table 4.2), and around 30 smaller smashed fragments that have been retained but not individually recorded.

Table 4.1 Refitted coffin fragments

Fragment	Section	Part of coffin	Position	Refit
B01	Lower	End and base	Proximal and distal	Physical and digital
B02	Lower	End	Distal	Physical and digital
B11	Lower	End, side and lug	Distal, right	Digital
B15	Lower	End, side and lug	Distal, left	Digital
B17	Lower	End	Distal	Physical and digital
B18	Lower	End	Proximal	Physical and digital
B20	Lower	End	Proximal	Physical and digital
Y01	Lower	Side	Distal, left	Physical and digital
Y04	Lower	Side	Distal, left	Physical and digital
B03	Upper	End	Proximal	Physical and digital
B13	Upper	End	Distal	Physical and digital
B14	Upper	End and top	Distal	Digital
B16	Upper	End	Proximal	Physical and digital
B19	Upper	End	Distal	Physical and digital
B21	Upper	Top	Central	Digital
Y02	Upper	End and top	Distal	Digital

Methodology

This report has been produced following Historic England guidelines for the treatment of waterlogged wood (Brunning and Watson 2010). The system of categorisation and interrogation developed by Taylor (1998; 2001) has been adopted within this analysis. Metric data were collected with hand tools, including callipers, rulers and tapes, and tool marks were recorded with a profile gauge. The coffin wood was identified as oak (*Quercus* sp.), based on macroscopic characteristics, following anatomical guides (Schoch *et al* 2004; Wheeler *et al* 1989) and modern reference material.

The initial coffin reconstruction was achieved through physical refitting of the fragments after cleaning and before conservation. The digital refitting was led by Jon Bedford (Historic England) alongside the author using the Blender software application (www.blender.org), based on 3D digital models of the coffin fragments produced by Jon Bedford.

Fragments numbered during excavation were assigned a 'B' prefix, those subsequently identified during post-excavation cleaning were assigned a 'Y' prefix.

Condition and damage

The wood is highly fragmented, with sixteen fragments currently refitted to form a *c* 65 per cent complete log-coffin (Table 4.1 and Fig 4.1). Both the quantity of un-refitted material and the presence of several refitted pieces forming the top of the coffin suggest the artefact was largely or wholly complete in the ground before being

Table 4.2 Individually recorded, un-refitted coffin fragments

Fragment	Bark/ sapwood/ heartwood	Ends	Description	Probable part of coffin	Dimensions (mm)
B01.a	H	Both ends broken	Sub-rectangular cross section, inner face worked, outer face degraded	Side / top?	720 x 220 x 90
B06	H	Both ends trimmed	Wedge shaped	End, proximal?	350 x 200 x 35
B07/B10	H	Both ends trimmed	B7 refits to end of B10. Sub-rectangular cross-section, inner face worked, outer face degraded. Possible outer part of slot / hole at both ends	Side, with part of hole / slot at each end and probable end of coffin at both ends	2160 x 300 x 120
B09	H	One end trimmed, one end broken	Sub-rectangular cross-section, inner face worked, outer face degraded. Possible outer part of slot / hole at intact end	Side, with part of hole / slot and probable coffin end	1950 x 200 x 145
B27	H	Both ends broken	Sub-rectangular cross-section, inner face worked, outer face degraded	Side / top?	240 x 230 x 90
B28	H	Both ends broken	Sub-rectangular cross-section, inner face worked, outer face degraded	Side / top?	470 x 45 x 80
Y03	SH	One end trimmed, one end broken	Sub-rectangular cross-section, sapwood on outside, worked on inside with 75 mm wide, 20 mm deep transverse slot present	Side, with part of lug / slot, and probable end	630 x 220 x 90
Y05	H	Both ends broken	Sub-rectangular cross-section, inner face worked, outer face degraded	Side	750 x 100 x 75
Y06	SH	Both ends broken	Sub-rectangular cross-section, sapwood on outside, worked on inside	Side	520 x 110 x 80
Y07	H	Both ends broken	Sub-rectangular cross-section, inner face worked, outer face degraded	Side	1000 x 105 x 60

severely damaged by a mechanical excavator during discovery. There are clear ‘tooth marks’ and other significant areas of damage visible from contact with the machine bucket, and many of the fragments display modern breaks to edges, ends, or both. However, the morphology of several of the breaks suggests these may have occurred in the burial environment sometime before discovery.

The condition scale developed by the Humber Wetlands Project (Van de Noort *et al* 1995, table 15.1) is used throughout this report (Table 4.3). The condition scale is based primarily on the clarity of surface data. Material is allocated a score dependent on the types of analyses that can be carried out, given the state of preservation. The condition score reflects the possibility of a given type of analysis but does not consider the suitability of the item for a given process. If preservation varies within a discrete item, the best-preserved section is considered when assigning the item a condition score. Under this system, the best-preserved section of the coffin, the inside of the base, scores a 4 (good). The upper parts of the coffin are notably more degraded. Sapwood has survived on the

Table 4.3 Condition scoring system (after Van de Noort *et al* 1995, table 15.1)

Condition score		Museum conservation	Technological analysis	Woodland management	Dendrochronology	Taxonomic identification
5	excellent	yes	yes	yes	yes	yes
4	good	no	yes	yes	yes	yes
3	moderate	no	yes / no	yes	yes	yes
2	poor	no	yes / no	yes / no	yes / no	yes
1	very poor	no	no	no	no	yes / no
0	non-viable	no	no	no	no	no

base but seems to have degraded on the side walls. The top surfaces of the coffin have notable surface degradation in the form of pitting and longitudinal troughs.

Refitting the fragments

The coffin is formed of a single large oak trunk, and the coffin fragments refit to form what appears to be a complete cylinder. For reasons discussed in more detail below, it is believed that the trunk was split in half to form an upper and a lower section of the coffin in a 'clamshell' or 'all-round tree-trunk' design. The ends are interpreted as the proximal (end closest to the ground when the tree was growing) and distal (end furthest from the ground when the tree was growing). Left and right are assigned as viewed from the proximal end, looking along

Fig 4.1 Physically refitted coffin viewed from the right side, proximal end to the left and distal end to the right with red line denoting join between upper and lower halves (M Bamforth)

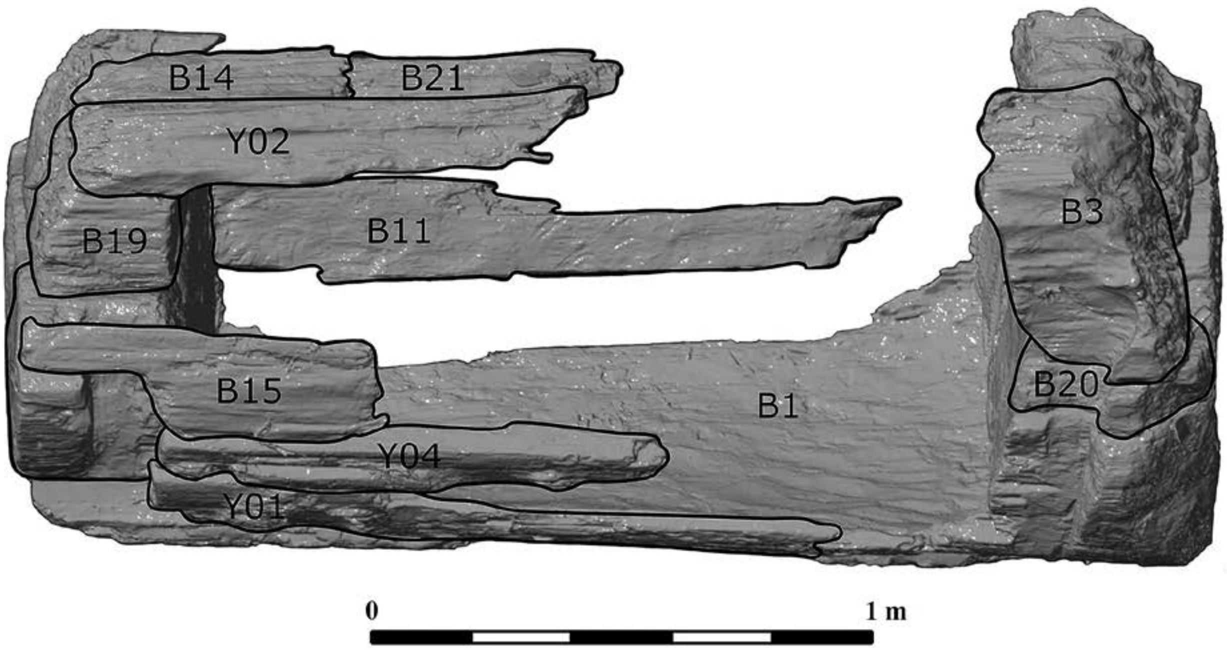

Fig 4.2 Graphic produced in Blender, viewing coffin (and portion of lid) from the left, with distal end to the left of the image (M Bamforth/J Bedford)

the coffin's length towards the distal end. As noted, physical or digital refits have been achieved for sixteen fragments (Table 4.1; Figs 4.1–4.2).

The lower half of the coffin

The largest fragment (B1) forms much of the base and most of the proximal end of the lower half of the coffin, with a small, worked section at the end forming the very bottom of the lower, distal end (Figs 4.3–4.4). Two smaller, wedge-shaped pieces (B18, right and B20, left) refit well onto the top of B1 at the proximal end, above which there is something of a disconnect which is believed to represent the boundary between the upper and lower half of the coffin. The lower, distal end of the coffin is formed of B2, which sits above B1 on the left side and B17 on the right. Several parts of the side have been refitted at the distal end to one side. Y01 adjoins base B1, above which sits Y04 and B15, which also forms part of the distal end and closes the slot in the end into a closed, sub-square hole. B11 sits in a similar position, forming part of the side and end closing the slot into a sub-square hole on the right side of the distal end.

The upper half of the coffin

The proximal upper end is formed from B3 (left, above B20) and B16 (right, above B18) (Fig 4.3). These two larger pieces have a moderate refit with each other. However, there is not a strong refit with the two smaller wedge-shaped pieces beneath them, leading to the interpretation that this represents the boundary between the upper and lower halves of the coffin. The distal end is formed of B19 (left, above B2) and B13 (right, above B17) (Fig 4.4). B14 sits on top of B19, forming part of the end and the top of the coffin. Y02 also sits on top of B19, adjoining B14 to the left. B21 probably joins the end of B14 and the right of Y02, forming another small part of the top of the coffin.

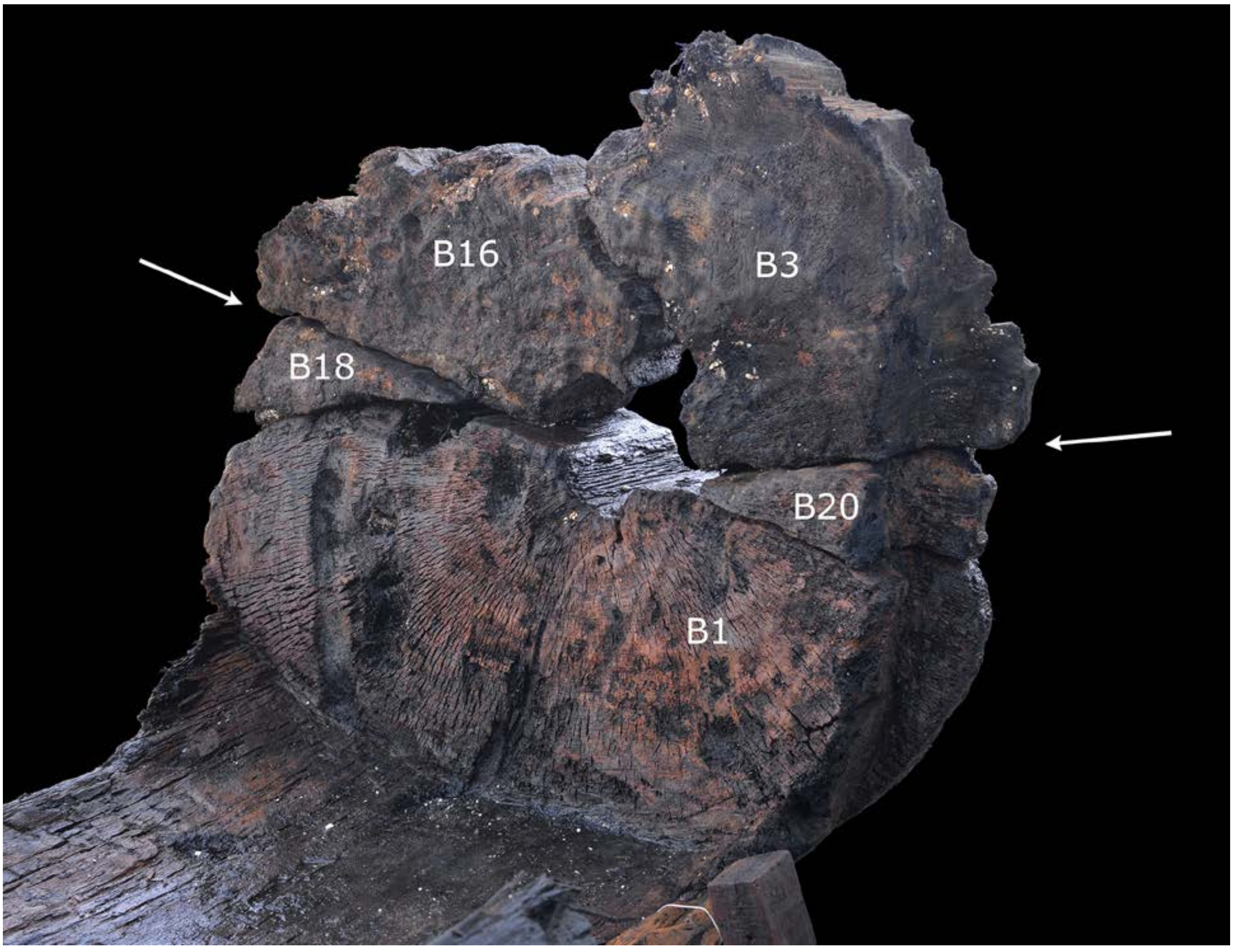

Fig 4.3 Proximal end physical refits, viewed from inside coffin with arrows denoting join between upper and lower halves (M Bamforth)

Fig 4.4 Distal end physical refits with arrows denoting join between upper and lower halves (M Bamforth)

Refitting discussion and reflections

In addition to the join between the upper and lower halves of the coffin, both ends are fragmented along the radial structure of the trunk. For the most part, these seem to represent ancient breaks. The edges of the pieces and the inner faces do not have the 'sharp' edges of freshly broken waterlogged wood; they are somewhat rounded and smoothed. This is supported by the presence of traces of roots growing in between many of the joins of the end pieces (Fig 4.5). It is suggested that the radial breaks in the end sections occurred in the burial environment some time ago. However, many of the side sections, including refitted and un-refitted pieces, clearly display modern breaks associated with the recent recovery of the coffin.

The physical and digital refitting were two very different procedures. The initial physical refitting of large, heavy pieces of wood required several people and the use of hand pallet trucks and a manually operated mobile lifting gantry; this task was complicated and risked damage to the wood. However, it was adequate for items that could be sat atop one another and worked well for the ends and lower sides. A particular strength of the physical refitting was the visibility of fine surface detail of physical characteristics of the tree (growth rings and rays), traces of the original working (such as the cut slots present on side pieces Y01 and Y04), and the surface degradation. However, it was not a practical method for refitting much of the sides and top of the coffin, which could not be physically supported. This is where the digital refitting was more appropriate, allowing pieces of the coffin that were large, heavy and delicate to be manipulated in digital space and left 'in place' in ways that are not possible physically. However, the level of visible surface detail, much of which is particularly small and fine, is simply not as detailed in the digital model. The two methods were complementary and worked well together.

However, despite these efforts, several pieces cannot be refitted to the coffin, but most probably form part of the sides or the top (Table 4.2). Perhaps the most notable are three fragments, B01a, B27 and B28, two of which refit each other, that were initially interpreted as a separate lid. However, digital refitting showed that they did not match each other in the way initially envisaged; they do not fit into the 'top' of the coffin, a space now filled by other refitted fragments (B7/B10 and B9, Table 4.2). As no refit space can currently be identified for these substantial pieces, the slim possibility that these might form part of another wooden object must be entertained. Although the dendrochronology suggests that B10 is probably from the same tree as the coffin (Ian Tyers, pers comm, 2022), it could be from a section of the trunk higher than that from which the coffin itself is formed.

The log-coffin

The log-coffin is constructed from the butt end of the trunk of a large oak tree and is estimated to have measured *c* 2.45m long, 1.15m high by 1.20m wide at the proximal end, and 1.05m high by 1.05m wide at the distal end. The underside of the coffin has sapwood and bark edge present, and it appears that the tree-trunk was debarked with no evidence for further shaping, as is sometimes the case with similar examples, although it is also common for the bark to remain in place (Parker Pearson *et al* 2013, 33). Although the sapwood has decayed away from much of the fragmented sides of the coffin, it seems likely that the outer edges of the sides of the coffin were also formed from the outside of the debarked tree. Both external ends of the coffin are relatively flat, having been cross-cut in the transverse plane with an axe. The proximal end has some angular, faceted, trimmed surfaces towards the outer edges, probably related to felling. The entire coffin is large and of a robust, 'heavy' design. Nowhere is this more apparent than the massive, flanged ends of the coffin that vary between a maximum thickness of 350mm (distal end) and 400mm (proximal end).

When the two halves of the coffin are placed together, the carved-out portions leave a sub-cylindrical void measuring *c* 1.70m long at the centre, where it is largest, and *c* 1.54m at the base of the internal space. The void is *c* 0.8m high by 0.9m wide at the proximal end and *c* 0.7m high by 0.8m wide at the distal end.

Fig 4.5 Evidence of roots growing on the broken face of B13 where it refits with B19. The fibrous break at the top of the piece represents the contrasting form of modern damage which occurred during excavation (M Bamforth)

Fig 4.6 Slot in B17 showing cut marks in base of slot (M Bamforth)

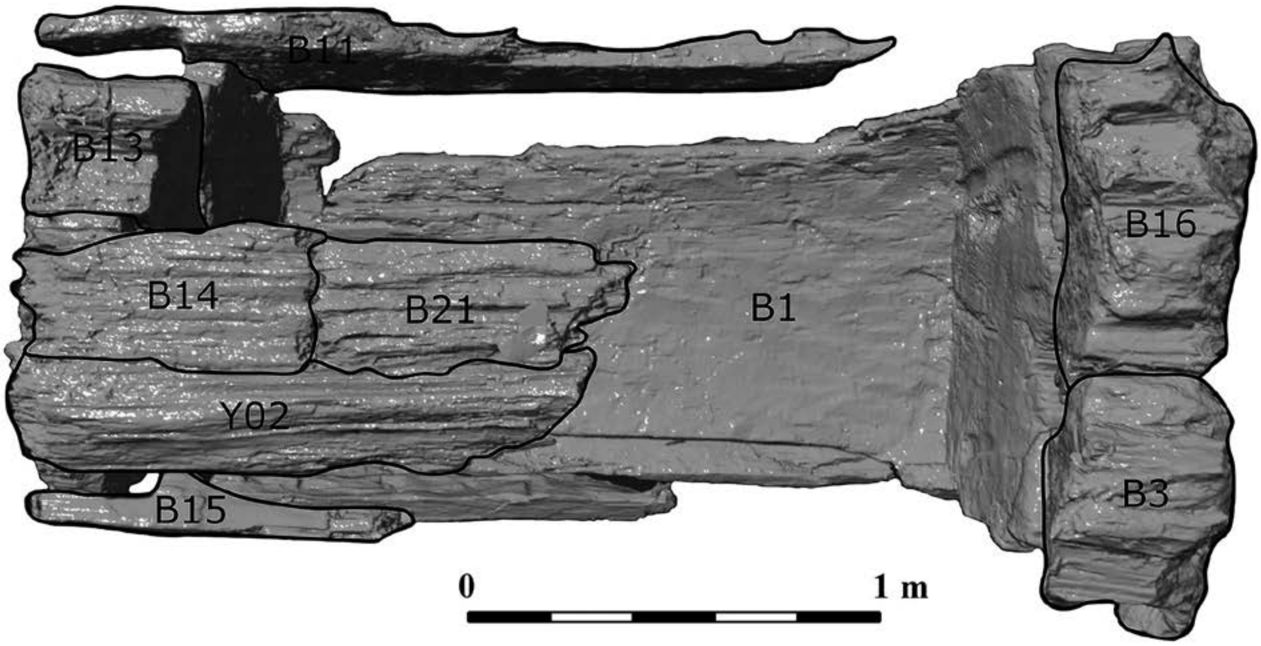

Fig 4.7 Graphic produced in Blender, viewing the coffin from above with the distal end to the left of the image; note B11 and B15 closing slots into holes (M Bamforth/J Bedford)

The lower half of the coffin has a U-shaped profile with an almost flat base which is *c* 100mm thick, while the sides are *c* 70mm thick. The inner ends have been worked almost vertically in a relatively flat, transverse cut sloping slightly towards the base. There is a relatively sharp transition between the internal end walls and the base. The coffin's upper half seems to mirror the lower half, although it is slightly less robust. This is most apparent where the two ends meet, with the end walls of the upper half being slightly thinner than the lower end walls.

There are four broad, vertical slots present, cut into both sides of each end, running up the outside of the coffin, around the circumference of the tree, and continuing between the upper and lower halves. At their largest, these slots are 100mm wide with a maximum depth of 650mm, with near-straight sides and a sharp 90-degree break into a flat base (Fig 4.6).

Fig 4.8 Possible rope fragment in slot of B17 (M Bamforth)

Digital refitting has shown that these slots formed closed holes (similar to a mortise) at the top of the lower half, at the distal end, for *c* 130mm on the right and *c* 100mm on the left side (Fig 4.7). In plan, the closed, sub-square holes measure *c* 120mm long and 90mm wide on the left and *c* 95 x 95mm on the right. The morphology of several other un-refitted parts (B9, B7/B10 and Y03) suggests that the slots were probably closed into holes at the proximal end of the lower half and at both ends of the upper half, in a mirror image of the lower half.

A small fragment of possible roundwood measuring 92 x 14mm, running along the base of the slot in B17, was present during initial recording but decayed prior to the commencement of conservation (Fig 4.8). This piece is of a suitable size to have formed part of a multi-strand twisted withy rope, similar to the three-ply honeysuckle example recovered from the central timber of the Early Bronze Age monument at Holme-next-the-Sea (Brennand and Taylor 2003). It is unclear whether the slot features were used for moving the coffin, for securing the two halves together, or perhaps for both functions.

The tree

The large trunk selected to produce the coffin is derived from a tree that is slightly faster grown than might be expected, which was *c* 170 years old when felled, with average annual growth rates of 3.5–5.5mm respectively at the distal and proximal ends of the coffin. Results from the dendrochronological analysis suggest that the tree was felled in late summer to early winter (Chapter 5).

The flaring at the larger end (B1, B3, B16, B18, B20) probably mirrors the shape of the parent tree at the proximal end, representing the widest point of the trunk, towards the base of the tree. This suggests that the builders were prioritising the selection of the largest-diameter timber that they could source. This is supported by what appears to be a star-shaped void, probably representing heartwood rot at the base of the tree. This is a feature that is common in large, mature oaks, and it is one of the reasons why separate transom boards are often used at the stern (generally also the proximal end) of large log-boats (Goodburn 2019, 15).

The trunk selected is relatively straight-grained and knot free. The proximal end has a pith-to-bark edge radius of 640mm, indicating an original diameter of *c* 1.28m. Allowing perhaps a metre at the base between the felled end and the ground, this describes at least the first 3.5m of the parent tree being free of large side branches. Such large, straight-grown oak trees are often slow grown (with annual ring growth in the region of 1–2mm). They are usually interpreted as being derived from tall, dense, ancient woodland that has been little disturbed by human activity, sometimes referred to as 'wildwood'. The tree selected has grown slightly faster than might be expected, suggesting it may have been situated in a relatively more open environment. The significance of large oak trees in later prehistory and their association with death and burial in the Early Bronze Age is discussed further below.

The woodworking

After felling, a process which may have taken several people one or two days for such a substantial tree (Goodburn 2019), the shaping of the coffin could commence. The two ends have been worked relatively flat in a transverse cross-cut with an axe. This would have been a fairly time-consuming process, and the marks left are somewhat different from those of a felling scar or those resulting from the action of trimming such a large timber to length, which would leave angled surfaces. The trunk was then split longitudinally, using wooden wedges, to form the upper and lower halves of the coffin, the latter being slightly larger than the former. Although no bark was present, suggesting this had been deliberately removed, the outside of the body of the coffin seems to have been minimally worked and was most probably left at the bark edge.

The hollowing of the two halves of the log-coffin is analogous to that of the initial stages of construction of a log-boat and, as such, it seems likely that the same techniques were used. As green oak burns very poorly, the hollowing is likely to have been achieved by cutting grooves across the timber and then splitting out the intermediate bulks (Goodburn 2019, 23). Three shallow, transverse, axe-cut grooves are visible in the base (B1) and two refitting side fragments of the coffin (Y1 and Y4), towards the distal end, which support this method of hollowing being utilised. The remaining traces of the grooves are 25–30mm wide, *c* 10mm deep, and are spaced 280–290mm apart (Figs 4.9–4.10).

While the external slots would not have been particularly complex to cut, there is a limit to how deep a closed hole can be cut with an axe, and this is perhaps why the features seem to appear as slots for much of their length, only being closed into holes at the join between the two halves (Figs 4.2 and 4.7).

Faint tool facets (the scar left when a tool passes through the wood, detaching a woodchip) and occasional partial stop marks (an impression of the cutting edge of the tool) are visible on several worked surfaces, particularly the inside and outside faces of the two ends. In all cases, the morphology of the facets and stop marks are suggestive of the use of metal as opposed to stone tools (Sands 1997). Both the partial nature and small number of stop marks recorded precludes any inferences regarding the design of the axe(s) used (cf Taylor 2001). Although there is evidence for palstaves being hafted as adzes in the Middle Bronze Age (Goodburn 2004, 129), the numerous vertical 'chop' marks in the base of the coffin suggest that, in this case, the tools were probably hafted as axes. Several stop marks were recorded, describing the cutting edges of the axes used. There are numerous partial chop marks in the base of the coffin on B1, the most complete of which was recorded as a stop mark measuring 52 x 5.5mm (Fig 4.11). There are several chop marks in the base of the B17 slot, the most complete of which was recorded as a stop mark measuring 57 x 10mm (Fig 4.11). Very faint traces of unmeasurable stop marks

Fig 4.9 Transverse grooves in base/side of coffin (M Bamforth)

Fig 4.10 Detail of transverse groove in base of coffin B1 (M Bamforth)

and faceting on the inner face of B17 demonstrate the wood being worked from the pith towards the outside of the tree/the base of the coffin. Several stop marks are present on the outer face of the distal end of B17, the unusual shape of which perhaps records the corner of the tool being used. The most complete was recorded and measured 39 x 10mm (Fig 4.11). These describe working from the pith towards the outside of the tree and are therefore related to the dressing of the end as opposed to the tree's felling. Given the nature of the bronze tools, which are likely to have been used to shape the coffin, and the qualities of oak as a timber, the work would have been carried out while the wood was green and unseasoned (Goodburn 2019; Tabor 2000).

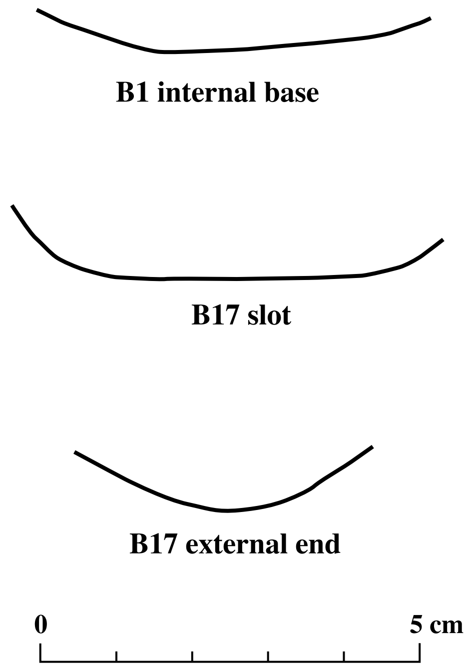

Fig 4.11 Stop marks recorded from the coffin (M Bamforth)

Log-coffins in the archaeological record

Although there is some evidence for the use of split timber coffins from the Bronze Age, most wooden coffins from this era are of the hollowed-out log construction of the coffin considered here (Cressey and Sheridan 2004). These artefacts are variously referred to as tree-trunk-, log- or monoxylous coffins.

There is a limited occurrence of post-Bronze Age log-coffins in Britain, including early medieval and Anglo-Scandinavian examples (Parker Pearson *et al* 2013, 29). However, except for two Late Bronze Age examples from North Yorkshire – at Rylstone (Melton *et al* 2016) and Melton (Parker Pearson *et al* 2013, 35) – all the prehistoric examples (around 65) date to the Early Bronze Age (Jones *et al* 2023; Parker Pearson *et al* 2013, 35). There is no unequivocal evidence for pre-Early Bronze Age log-coffins (Parker Pearson *et al* 2013, 29–42).

All the Early Bronze Age log-coffins have been recovered in association with a barrow or cairn (Parker Pearson *et al* 2013, 29–42). Although they have a broad distribution within Britain, Parker Pearson *et al* (2013, 31) identify three regional groupings:

- Yorkshire
- Wessex and south English coast as far as Sussex
- The Welland and lower Nene valleys of Leicestershire and East Anglia

The Tetney coffin falls between the Yorkshire group (to which it is closer) and the Welland/Nene Valley group. The closest known log-coffins are some 33km to the south, an isolated pair of heavily degraded examples recovered from a barrow in West Ashby (Field 1985). An alternative regional grouping is proposed by Jones *et al* (2023, 54) which places the Tetney coffin into the Midlands group, comprising 'a dispersed band of log-coffin burials, spread across the eastern portion of central England between the major concentrations in Northern and Southern England and to the west of the eastern England groups' (Jones *et al* 2023, 70).

While there is some evidence for log-coffins that are fashioned from, or that resemble, log-boats (Cressey and Sheridan 2004), this is not the case for the example from Tetney. In terms of design, both halves, with their substantial, robust ends, are strikingly similar to face-carved Bronze Age domestic troughs (Bamforth 2024, 562–76).

When Early Bronze Age log-coffins are identified they are almost always of oak, vary in length from 0.35m to 3.66m, generally have a U-shaped transverse profile and, except for the ends, often have limited external working (Parker Pearson *et al* 2013, 33–5). The worked ends, which can be matching or mixed, are most commonly both cross-cut and can also be pointed or curved (Parker Pearson *et al* 2013, 33). There is relatively plentiful evidence for log-coffins formed from two parts of a trunk split in half longitudinally, in a 'clamshell' or 'all-round tree-trunk' design. Parker Pearson *et al* (2013, 33) cite eight definite and probable examples, noting that more likely once existed but have not survived intact. Other lid forms include split timbers, stitched bark, stones, and perhaps roundwood or logs (Parker Pearson *et al* 2013, 33). The Tetney coffin can therefore be considered to fall well within the norms for the wider corpus of Early Bronze Age log-coffins. The exceptions to this are the vertical slots and sub-square holes seen on the external surface at either end of the coffin, for which no direct parallel can be found. The Gristhorpe coffin had a hole in the base (perhaps to allow the products of decomposition to escape), and a hole in the corner of the Cartington coffin was perhaps cut to facilitate haulage (Parker Pearson *et al* 2013, 34). The central timber of the Early Bronze Age monument at Holme-next-the-Sea ('Seahenge'), Norfolk, had similar-sized towing holes cut through the end of the timber which, complete with honeysuckle rope, had been used to drag and then lower the trunk into position (Brennand and Taylor 2003).

Big trees in the Bronze Age

The relationship between trees, death and funerary practice dates back to at least the Neolithic and is particularly strong in the Early Bronze Age. Within these periods, there is strong evidence that large oak trees, in particular, had a ritual and social significance beyond their potential practical merits (Evans *et al* 1999; Taylor 2010). From the enormous single oak tree used to construct the mortuary chamber within the Neolithic long barrow at Haddenham, near Cambridge, to the Early Bronze Age Holme-next-the-Sea, Norfolk, timber circle and the large assemblage of log-coffins, there are many examples of people being interred 'within' large oak trees (Brennand and Taylor 2003; Evans and Hodder 2006, 135–40; Parker Pearson *et al* 2013). Whether this represents a symbolic return to the womb, a way to emphasise the special nature of the deceased or was a more literal attempt to be interred within a tree is unclear (Brennand and Taylor 2003; Harding 2000; Parker Pearson *et al* 2013, 44–6). It has been suggested that the considerable size of some large oak trees, alongside their often-lengthy life cycles, may have led to a resonance with the transgenerational ancestral cycles of human life and death (Evans *et al* 1999; Taylor 2010).

Discussion

Felling, hollowing out and transporting the large tree used for this, and other, log-coffins would have been a time-consuming and difficult task that would not have been entered into lightly. The felling of such a large tree may have taken one to two days and the shaping some considerable time more (Goodburn 2019). Given the difficulty of transporting such a large object any distance, it seems likely that the location and setting of the tree relative to the place of burial were significant factors when selecting the raw material. There may also have been intangible factors such as proscribed access to resources and the potential ritual significance of the tree selected (Goodburn 2019, 20). The use of such a large tree would have required a level of community involvement, probably in the felling of the tree and shaping of the coffin – given the volume of work involved – and certainly in the moving of the coffin, given the weight of the artefact.

The nearest parallel in terms of the size of tree and the volume of work required is to be found in the form of hollowed log-boats. However, the form of this 'clamshell' log-coffin is most similar to a pair of extremely large domestic troughs. Indeed, there are two examples of log-coffins from Cairngall, Aberdeenshire, that even have what appear to be 'handles' carved into the outer ends, perhaps echoing smaller domestic vessels (Parker Pearson *et al* 2013, 34 and fig 4.5).

The results from the dendrochronological analysis (see Chapter 5) suggest that the tree was felled in late summer to early winter. In terms of where the work was carried out, given the extreme size and weight of timber involved, it seems likely that, as with log-boats, the shaping and hollowing would have been carried out where the parent tree was felled, leaving the lightest possible object to transport (Goodburn 2019, 20). Based on a weight of *c* 1.073 tonnes per cubic metre for fresh-cut oak (Goodburn 2019, 20), the section of trunk that was reduced down into the log-coffin would have weighed in the region of 3.5 tonnes. The finished coffin would have weighed in the region of 2.5 tonnes if the wood was still green and around 2 tonnes if it had been seasoned, a process that would take several years – based on a value of 800kg/m^3 for oak at 27 per cent moisture content, provided by Tanner (2019, 35).

Who carried out the work is a matter of conjecture, but a brief consideration of the nearest parallels provides some clues. Log-boats often display particularly fine craftsmanship, with evidence for a high level of precision and technological knowledge often present, and this has led to the hypothesis that boat builders may have been specialist woodworkers (Bamforth 2024, 653–4; Goodburn 2004; 2019; McGrail 1978). The level of precision, symmetry, design and technical expertise often evident in the construction of log-boats is not displayed by the woodworking of the Tetney log-coffin. However, as others have pointed out, a log-coffin does not have the same practical constraints of a log-boat, which has to be designed and constructed in a suitable form to float and move within water (Mowat 1996). Although the woodworkers were clearly competent, the woodworking is relatively imprecise and the coffin is not well finished – perhaps a reflection of the skill of those involved. While it certainly was the case for some log-coffins of the period to have been made to resemble a log-boat, perhaps associated with the journey to the next life (Cressey and Sheridan 2004; Parker Pearson *et al* 2013, 47–8), neither the form nor the execution of the Tetney log-coffin fit that particular hypothesis.

Although the void in the centre of the proximal end is most likely to be a natural feature, it is interesting to note that this created a hole through which it would have been possible to view the body interred within before the coffin was covered over by the barrow. This has some interesting possible implications given that visibility and proscribed space are common themes in prehistoric ritual practices. It has a possible direct parallel in the hidden space within the Early Bronze Age timber circle at Holme-next-the-Sea, which may have been associated with funerary rituals (Brennand and Taylor 2003).

The coffin is largely in keeping with the broader published corpus of log-coffins in terms of the use of the butt end of a large oak tree, the relatively basic woodworking, the clamshell design, and the overall robustness and form. The coffin is likely to have been fashioned by competent yet not highly specialised woodworkers, probably members of the same community as the deceased was a member of. The selection of the parent tree is likely to have been a function of both expedience – a large enough tree close enough to the burial site – and of intangible factors, including the significance of burial within a large oak tree. The vertical slots and closed holes in the ends of the coffin are without known parallel, and it seems likely these were used both to move and manoeuvre the coffin and to secure the upper and lower halves together. It is the rich evidence for manufacture, the unique slots/holes and the dating by dendrochronology which make the Tetney log-coffin of particular interest.

CHAPTER 5

THE CHRONOLOGY OF THE COFFIN AND HUMAN REMAINS

by Ian Tyers and Peter Marshall

Introduction

A review of the typological and scientific dating evidence from *c* 60 log-coffin burials within the Gristhorpe monograph suggests they are from a tradition that began during the last two centuries of the third millennium BC and continued to *c* 1600 BC (Parker Pearson *et al* 2013, 48). Although a more recent revaluation of the evidence has highlighted that at least two isolated examples of log-coffins can be dated to the Late Bronze Age, these are likely to represent a reintroduction of the practice from Continental Europe where the tradition persisted into the first millennium BC (Jones *et al* 2023, 74–5). A map of the known examples (Parker Pearson *et al* 2013, 30, fig 4.1) suggests there are geographic clusters of them around north Yorkshire and the eastern Midlands. As many were excavated long ago few of the timbers have survived, but the chances appear to be quite high that dendrochronological analysis of any extant examples could add to the available tree-ring network for these areas over this period. Places mentioned in this chapter are shown in Figure 5.1.

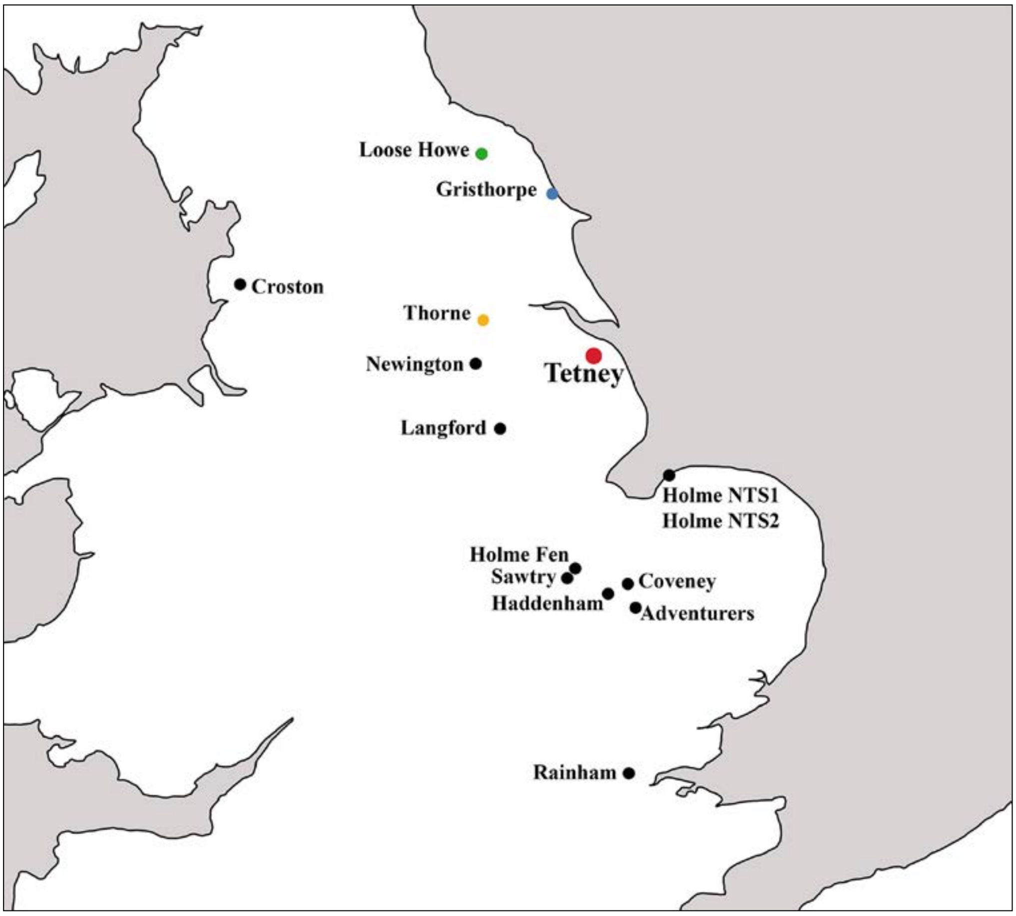

Fig 5.1 Places mentioned in the text. Tetney, red dot. The black dots represent all the dated oak tree-ring sites known to the author that cover a significant proportion of the period 2250–2000 BC. Willow Hall and Cracknell are bog oaks recovered from adjacent farms near Haddenham and are represented by a single dot. Thorne, yellow dot, is a contemporary pine series; Gristhorpe, blue dot, is an oak log-coffin tree-ring data set with a radiocarbon wiggle-match date suggesting it is a contemporary of Tetney. Loose Howe, green dot, is a pair of unsampled log-coffins with reasonable tree-ring potential, and likely to be broadly contemporaneous. For chronology references see text and Table 5.4. For their chronological distribution see Figure 5.3. It is difficult to illustrate their very different replication levels; Rainham, both Haddenham sites, Tetney and Gristhorpe are single timbers, Adventurer's Fen comprises a single timber for this part of its sequence; Coveney, Sawtry, Holme NTS2, Langford and Newington comprise between four and ten samples, Croston Moss and Holme Fen comprise more than a dozen samples each through this period, and Holme NTS1 contains more than 50. In most cases the number of distinct trees is less than the number of samples (I Tyers)

Log-coffins by their nature tend to be single, quite large, timbers; to have high chances of dendrochronological success they need to be long lived and slow grown, be relatively near to other extant data sets, or preferably both. This chapter documents the current state of knowledge regarding the Tetney coffin, and discusses two other examples, one of which has also been dendrochronologically analysed and radiocarbon wiggle-matched, and the other of which has dendrochronologically suitable timbers that have survived but which have not thus far been analysed.

Tree-ring analysis of the Tetney log-coffin
by Ian Tyers

The Tetney coffin is formed from a single hollowed-out and split oak tree-trunk (see Chapter 4). There are convincing separate lid parts, apparently lapped over the baulk ends, and vertical slots, either rebates or holes on either side within the baulk ends of the main coffin pieces. It is possible these contained ropes that linked the item together, and thus that the coffin part was in two halves, clamped together by this method.

Table 5.1 Tetney coffin sample series

Sample	Origin	Rings	Sap/bark	AGR	Relative dating
B1sap	underside	11	11+Bw	3.24	-10-0
B6	end	55	–	3.06	-163 to -109
B10	lid?	42	–	3.17	-61 to-20
B13	end	144	–	3.72	-170 to-27
B15	lid?	35	–	3.19	-47 to-13
B17	end	47	13+Bw	3.78	-46-0
B18	end	67	–	5.46	-112 to -46
Y06	side	24	14+Bw	3.50	-23-0

Key: AGR = average growth rate mm/year; Bw = complete final ring late summer/ winter felled

Table 5.2 Tetney coffin intra-correlation *t*-values

	B10	B13	B15	B17	B18	Y06
B6	\	12.21	\	\	\	\
B10	–	5.34	4.80	5.95	2.98	\
B13	–	–	4.88	2.93	6.62	\
B15	–	–	–	3.19	\	\
B17	–	–	–	–	\	6.65
B18	–	–	–	–	–	\

Key: \ = no overlap or short overlaps where no correlation can be calculated; – = sub 3.0 correlation.
Note: B1 is too short for *t*-value calculations and was matched visually. Y06 is also short and was matched visually, though we can calculate a *t*-value from this to B17

Subsamples are listed in Table 5.1. Some of the numerous individual fragments were given site labels in a B series, with Y labels added to unlabelled items at York Archaeological Trust (YAT). One fragment of detached sapwood, (B1sap), was collected during a visit in April 2019 when the coffin was at the Mary Rose Trust, Portsmouth, since it retained bark edge, and it was not clear at that time whether this would survive until sampling could take place. A further six pieces were sampled during a visit in June 2021, by which time the coffin pieces had been moved to YAT's conservation facility. The coffin pieces had at this stage been physically refitted where possible. The collected material comprised a combination of complete pieces for sectioning (B6, B13, B18), and sections cut out of other pieces (B10, B15, both potentially lid fragments, and Y06, a coffin wall fragment with sapwood). Analysis of these seven samples identified it was not possible to link convincingly the long inner sequences, present in the ends (from B6, B13, B18) and the outer heartwood sections (present in B10 and B15); in combination these were difficult to combine with the much shorter outer parts of the heartwood and sapwood present in the thinned walls of the coffin (B1sap, Y06). A further sample was cut during a second visit to YAT in July 2021 (from B17), and the majority of the previously sampled material was returned to the conservation tanks. B17 provided a convincing link between both parts of the tree-ring sequence (Table 5.2), where the key links are B13 > *t*-value 5.34 > B10 > *t*-value 5.95 > B17. These three create the full sequence present in all eight samples from the coffin. Synchronising all eight samples yielded a composite tree-ring sequence of 171 years, including full sapwood (Fig 5.2; Table 5.3). The felling occurred in later summer or winter of the last ring, which is present at the outermost edge of B1sap, B17 and Y06. The relative dating has been subsequently reorganised so that the felling occurred at relative year 0, and all the other annual rings have negative numbers, to facilitate conversion to *cal BC* dates in the radiocarbon modelling.

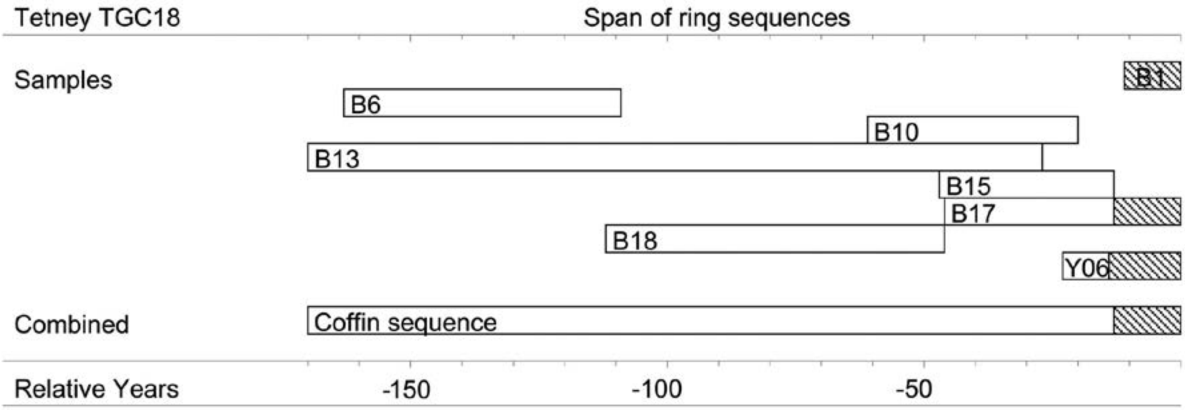

Fig 5.2 Relative construction of the full Tetney coffin sequence – plain bars heartwood, hatched bars sapwood (I Tyers)

The Tetney coffin timber was notable for being younger, i.e. having fewer rings, than one might have expected for such a large timber. This also meant that some of the individual tree-rings were unusually large for oak. One ring in B18 was 10mm in width, and anything over 5mm is normally considered very big for an oak tree-ring. Visual inspection of the pieces suggests that one end of the coffin is likely to be very near the root (or crown) of the tree, since the woodgrain in the coffin appears to flare at one end, and B18 has a notably more distorted and faster grown sequence than B13. B18 is definitely from the opposite end to B13, even though they are less than 2.4m apart and from the same quadrant of the trunk. It is possible that B6 and B15 are also from the B18 end. It would be reasonable to expect to obtain better and poorer tree-ring sequences from different locations within a single large, distorted tree-trunk.

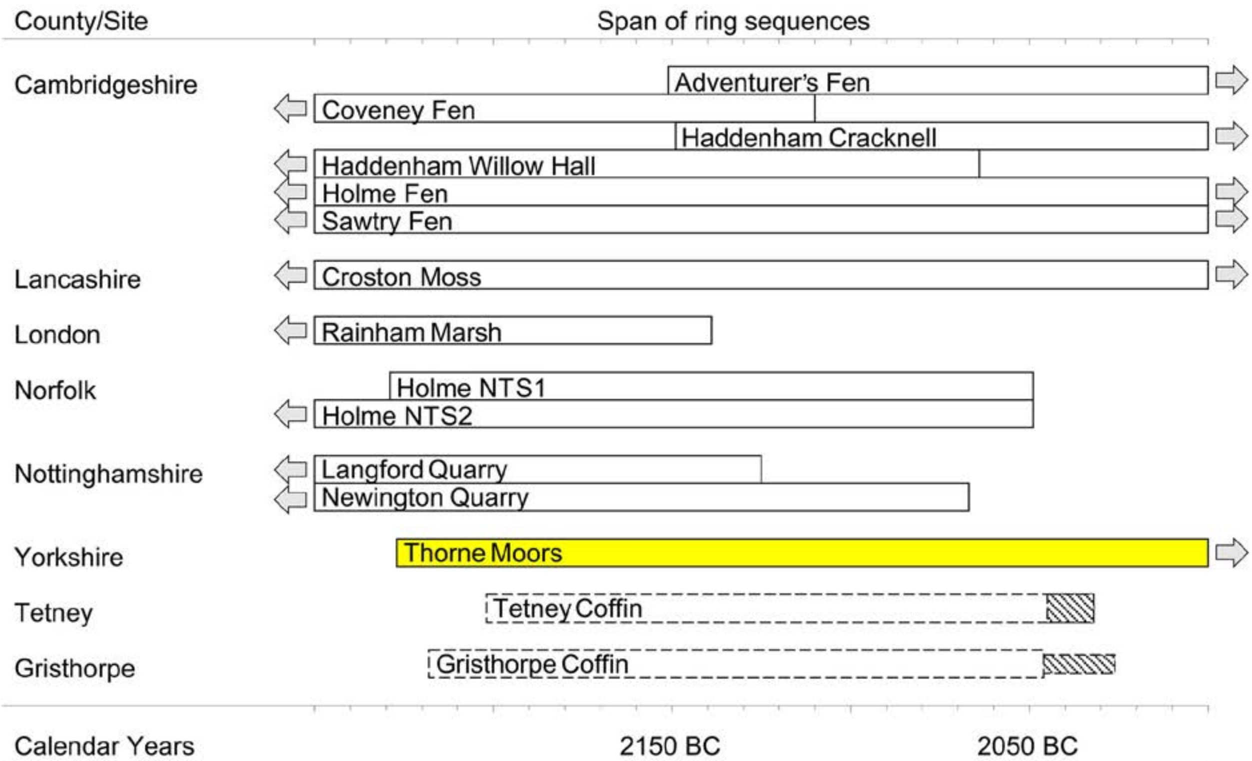

Fig 5.3 English oak and pine tree-ring chronologies covering the period 2250–2000 BC. Arrows left and right indicate which series extend beyond 2250 BC and/or 2000 BC. White bars are oak – these are a mixture of naturally deposited sub-fossil material and archaeological finds; the yellow bar is a sub-fossil pine series; dotted lines for Tetney and Gristhorpe indicate their possible calendar positions, sapwood hatched. For chronology references see text and Table 5.4; for geographic distribution see Figure 5.1 (I Tyers)

However, as yet there has not been any systematic attempt to verify this by slicing a landscape veteran tree at different heights and compass points and comparing their correlations to contemporary data. Most living tree data are derived from around 1.3m height, as the living tree corers are usually used standing up on level ground. In contrast, most sub-fossil, archaeological and building timbers are sliced or cored from their most suitable locations for both undistorted and most complete sequences. In effect, when given equally practical access these can come from anywhere up a trunk. However, one of the visual selection criteria for locating these is to be as far as possible from knots and clearly distorted areas. In normal day-to-day dendrochronological work, the amount of data obtained from close to either the root or the crown is very limited.

Two separate composite series were made: TGC_S8 using all the series, and TGC_S5 using five series, excluding B6, B15 and B18, which are, or appear to be, from the more distorted end. If uniformly circular, these composites would suggest a tree at least 1.24m in diameter, although it should be noted that the two with the oldest rings, B13 and B6, do not include the central rings (Fig 5.2; Table 5.3), so it was potentially slightly larger than that.

Table 5.3 Two versions of the Tetney coffin composite sequence

Name	Combination of	Rings	Sap/bark	AGR	Relative dating
TGC_S8	All 8 sample series	171	13+Bw	3.80	-170 to 0
TGC_S5	B1sap B10 B13 B17 Y06	171	13+Bw	3.62	-170 to 0

Key: AGR = average growth rate mm/year; Bw = complete final ring late summer/winter felled.
Note: TGC_S5 uses material from the less distorted end of the coffin

Table 5.4 Tree-ring correlations where Tetney relative year 0 = 2032BC

TGC_S5 2202–2032BC?	
Norfolk, Holme-next-the-Sea 'Circle 2' (Tyers 2014) 2376–2049 BC	5.89
Norfolk, Holme-next-the-Sea 'Seahenge' (Groves 2002) 2229–2049 BC	5.25
Cambridgeshire, Sawtry Fen (Brown and Baillie 1992) 2585–1745 BC	4.57
Cambridgeshire, Willow Hall, Haddenham (Tyers 2019) 2293–2064 BC	3.78
Nottinghamshire, Langford nr Newark (Hillam 1998) 2637–2125 BC	3.36
Cambridgeshire, Holme Fen (Brown and Baillie 1992) 3141–1868 BC	3.33

There are promising matches from Tetney to both the Holme-next-the-Sea series and there is a series of supporting matches to four other independent data sets (Table 5.4), although not to a high enough level to be confident that this is correct. To avoid the potential confusion of the Tetney sequence matching to Holme Fen bog oaks from Cambridgeshire and to both the Holme-next-the-Sea timber circles from Norfolk, the former are referred to as Holme Fen and the latter as Holme NTS1 and NTS2. If this is the correct dating position, then as expected TGC_S8 incorporating the more distorted data is weaker than TGC_S5. For example, TGC_S8 matches to Holme NTS2 with *t*-value 5.12 compared to TGC_S5's *t*-value of 5.89. Consequently, the TGC_S5 version is used for the rest of this discussion. Holme NTS1 and NTS2 are *c* 70km from Tetney and they comprise the contemporary tree-ring data sets that have the best combination of closeness to the Tetney site and reasonable internal replication. Langford is slightly closer but is both less-well replicated and only partially overlaps the Tetney sequence.

Between 2250 and 2000 BC the English tree-ring sequence appears to be geographically weak. It is, as usual, dominated by the Cambridgeshire Fen series and Lancashire Moss series produced by Brown and Baillie (1992), but relatively unusually the two other main contributor areas to the network, the Somerset Levels and Trent Gravels, provide only a single data set between them, Langford Quarry (see Figs 5.1 and 5.3). It is important to note that there are no *t*-values greater than 3.0 for this date to any of the other overlapping oak tree-ring series currently known from England. These comprise, in addition to those in Table 5.4, bog oaks from Cambridgeshire, Adventurer's Fen and Coveney Fen, and from Lancashire, Croston Moss (Brown and Baillie 1992). There are fewer replicated datasets from Newington bog oaks, Nottinghamshire (Tyers 2017), another Cambridgeshire Haddenham site at Cracknell Farm, (Hurford, pers comm, 2022), and a single timber from Rainham Marsh, London (Tyers, unpubl). Most of these series are relatively poorly replicated (Adventurer's, Rainham, Cracknell, Newington), some distance away (Rainham, Cracknell, Croston) or only partially overlap this sequence (Coveney, Rainham, also note Langford has a very short overlap). Several of these sites have two of these negative characteristics, and Rainham has all three. Furthermore, and as expected, a contemporary bog pine sequence from Thorne Moors, Yorkshire (Boswijk 1998) does not crossmatch to a single oak series. Perhaps the most concerning of these non-matches are the bog oak data from Croston Moss, which is strongly replicated at this period. They are from a similar latitude, but located *c* 80km due west of Tetney, so probably too far to expect a single tree sequence to correlate. There are no other contemporary dated tree-ring data sets from England. Likewise, there are no Scottish or Welsh data sets to compare it with, and there are no supporting matches from contemporary Irish bog oak material. There is a match to a German series (*t*-value 3.38 with BeckerBC, a long composite series of unknown composition, geographic coverage, and strength. BeckerBC also gives a *t*- value 4.58 to Holme NTS2, from which we may deduce it does match into eastern England at this period). However, we currently have no contemporary datasets from elsewhere in western Europe, though they undoubtedly exist. Despite this, it is highly unlikely that these will not add to our matches, unless they are strongly replicated. The lack of matching to Ireland and Lancashire and the matching to the Fens and Germany is fairly typical of low-lying/eastern English tree-ring data, and this meta-pattern gives some, admittedly subjective, additional support that this is the correct dating position. As a result of this inconclusive outcome, the Tetney tree-ring series was sampled for a radiocarbon wiggle-match.

Radiocarbon dating of the log-coffin
by Peter Marshall

In order to provide independent validation of the calendar dating for TGC_S5 suggested by the tree-ring analysis, a series of samples was selected for radiocarbon dating and wiggle-matching. Radiocarbon dating is based on the radioactive decay of ^{14}C, which trees absorb from the atmosphere during photosynthesis and store in their growth rings. The radiocarbon from each year is stored in a separate annual ring. Once a ring has formed, no more ^{14}C is added to it, so the proportion of ^{14}C versus other carbon isotopes reduces in the ring through time as the radiocarbon decays. Radiocarbon ages, like those in Table 5.5, measure the proportion of ^{14}C in a sample and are expressed in radiocarbon years BP (before present, 'present' being a constant, conventional date of AD 1950).

Table 5.5 Radiocarbon measurements and associated $\delta^{13}C$ values from the Tetney tree-ring sequence. Replicate measurements have been tested for statistical consistency and combined by taking a weighted mean before calibration as described by Ward and Wilson (1978; T'(5%)=3.8, v=1)

Laboratory number	Sample	Radiocarbon age (BP)	$\delta^{13}C_{IRMS}$ (‰)	$\delta^{13}C_{CAMS}$ (‰)
ETH-121101	Waterlogged wood, *Quercus* sp. heartwood, ring −169 of 171 ring tree-ring sequence	3757±22		−28.3
GrM-29166	Waterlogged wood, *Quercus* sp. heartwood, ring −149 of 171 ring tree-ring sequence	3746±26	−26.2±0.15	
ETH-121100	Replicate of GrM-29166	3708±22		−26.5
Ring149; ^{14}C: 3724±17 BP, T'=1.2				
GrM-29165	Waterlogged wood, *Quercus* sp. heartwood, ring −128 of 171 ring tree-ring sequence	3797±26	−25.5±0.15	
ETH-121099	Waterlogged wood, *Quercus* sp. heartwood, ring −107 of 171 ring tree-ring sequence	3738±15		−24.4
GrM-29164	Waterlogged wood, *Quercus* sp. heartwood, ring −86 of 171 ring tree-ring sequence	3689±26	−23.4±0.15	
ETH-121098	Replicate of GrM-29164	3657±22		−23.8
Ring86; ^{14}C: 3670±17 BP, T'=0.9				
GrM-29163	Waterlogged wood, *Quercus* sp. heartwood, ring −65 of 171 ring tree-ring sequence	3712±35	−25.0±0.15	
ETH-121097	Waterlogged wood, *Quercus* sp. heartwood, ring −44 of 171 ring tree-ring sequence	3691±15		−25.7
GrM-29162	Waterlogged wood, *Quercus* sp. heartwood, ring −23 of 171 ring tree-ring sequence	3734±24	−23.5±0.15	
ETH-121096	Replicate of GrM-29162	3685±22		−24.3
Ring23; ^{14}C: 3707±17 BP, T'=2.3				
GrM-29161	Waterlogged wood, *Quercus* sp. sapwood, ring −1 of 171 ring tree-ring sequence	3713±24	−26.0±0.15	
ETH-121095	Replicate of GrM-29161	3692±22		−24.3
Ring1; ^{14}C: 3702±17 BP, T'=0.4				

Radiocarbon measurements were obtained from nine single annual tree-rings from the TGC_S5 sequence (Table 5.5). Prior to subsampling, the slice was checked against the tree-ring width data. Then each annual growth ring was split from the rest of the tree-ring sample using a chisel or scalpel blade. Each radiocarbon sample consisted of a complete annual growth ring, including both earlywood and latewood, and every annual ring was then weighed and placed in a labelled bag. A complete series of rings from the 171-year sequence has been archived by Historic England.

Radiocarbon dating was undertaken at the Centre for Isotope Research, University of Groningen, the Netherlands, and the Laboratory of Ion Beam Physics, ETH Zürich, Switzerland, in 2022. At ETH Zürich cellulose was extracted from each ring using the base-acid-base-acid-bleaching (BABAB) method described by Němec *et al* (2010), combusted and graphitised as outlined in Wacker *et al* (2010c) and dated by Accelerator Mass Spectrometry (Synal *et al* 2007; Wacker *et al* 2010a).

At the Centre for Isotope Research each ring was converted to α-cellulose using an intensified aqueous pretreatment (Dee *et al* 2020) and combusted in an elemental analyser (IsotopeCube NCS), coupled to an Isotope Ratio Mass Spectrometer (Isoprime 100). The resultant CO_2 was graphitised by hydrogen reduction in the presence of an iron catalyst. The graphite was then pressed into aluminium cathodes and dated by AMS (Synal *et al* 2007; Salehpour *et al* 2016).

Data reduction was undertaken at both laboratories as described by Wacker *et al* (2010b). Both facilities maintain continual programmes of quality assurance procedures, in addition to participation in international inter-comparison exercises (Scott *et al* 2017). Details of quality assurance data and error calculation at Groningen are provided by Aerts-Bijma *et al* (2021), and similar details for ETH are provided in Sookdeo *et al* (2020).

Replicate radiocarbon measurements are available on four single rings, all of which are statistically consistent at the 5% significance level (Table 5.5) and a weighted mean has been taken as providing the best estimate for the ages of these rings. The results are conventional radiocarbon ages, corrected for fractionation using $\delta^{13}C$ values measured by Accelerator Mass Spectrometry (Stuiver and Polach 1977; table 5). The quoted $\delta^{13}C$ values were measured by Isotope Ratio Mass Spectrometry, and more accurately reflect the natural isotopic composition of the sampled wood.

Wiggle-matching

Radiocarbon ages are not the same as calendar dates because the concentration of ^{14}C in the atmosphere has fluctuated over time. A radiocarbon measurement has thus to be calibrated against an independent scale to arrive at the corresponding calendar date. That independent scale is the IntCal20 calibration curve (Reimer *et al* 2020). For the period covered by this study, this is constructed from radiocarbon measurements on tree-ring samples dated absolutely by dendrochronology. The probability distributions of the calibrated radiocarbon dates from TGC_S5, derived from the probability method (Stuiver and Reimer 1993), are shown in outline in Figure 5.4.

Wiggle-matching is the process of matching a series of calibrated radiocarbon dates which are separated by a known number of years to the shape of the radiocarbon calibration curve. At its simplest, this can be done visually, although statistical methods are usually employed. Floating tree-ring sequences are particularly suited to this approach as the calendar age separation of tree-rings submitted for dating is known precisely by counting the rings in the timber. A review of the method is presented by Galimberti *et al* (2004).

The approach to wiggle-matching adopted here employs Bayesian chronological modelling to combine the relative dating information provided by the tree-ring analysis with the calibrated radiocarbon dates (Christen and Litton 1995). It has been implemented using the programme OxCal v4.4 (http://c14.arch.ox.ac.uk/oxcal.html; Bronk Ramsey 2009; Bronk Ramsey *et al* 2001). The modelled dates are shown in black in Figure 5.4 and quoted in italics in the text. The Acomb statistic shows how closely the assemblage of calibrated radiocarbon dates as a whole agree with the relative dating provided by the tree-ring analysis that has been incorporated in the model; an acceptable threshold is reached when it is equal to or greater than An (a value based on the number of dates in the model). The A statistic shows how closely an individual calibrated radiocarbon date agrees its position in the sequence (most values in a model should be equal to or greater than 60).

Fig 5.4 illustrates the chronological model for TGC_S5. This model incorporates the gaps between each dated annual ring known from tree-ring counting; eg, that the carbon in ring 128 of the measured tree-ring series (GrM-29165) was laid down 21 years before the carbon in ring 107 of the series (ETH-121099), with the

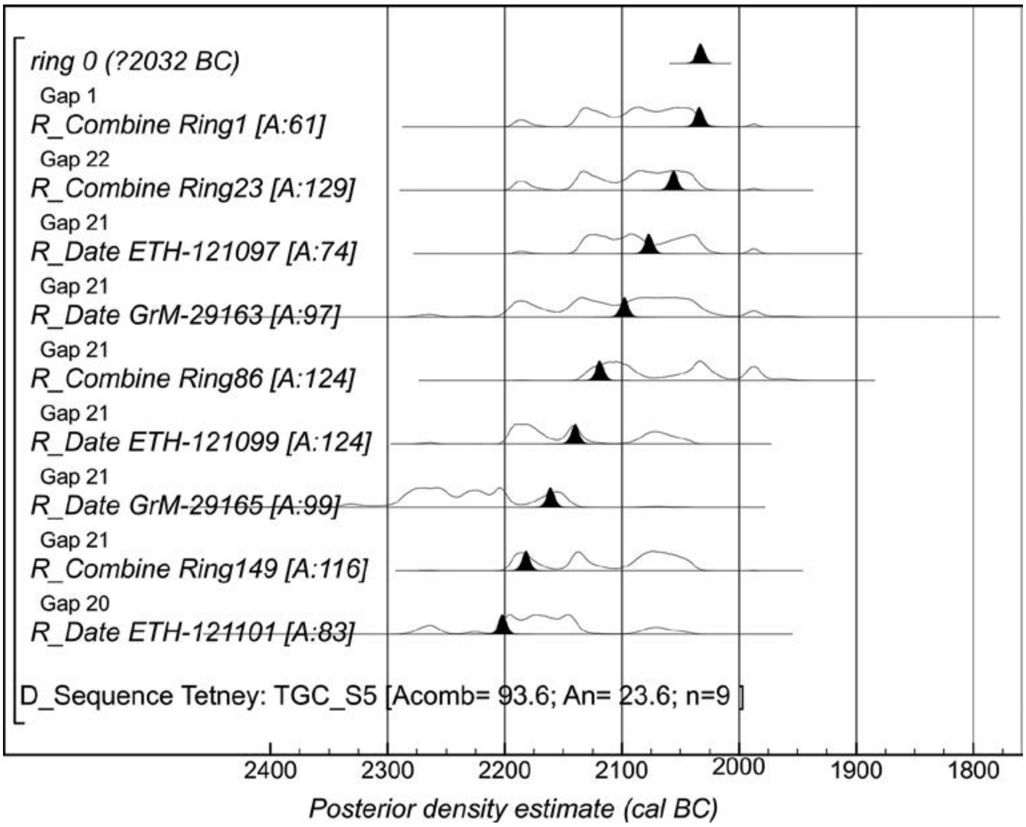

Fig 5.4 Probability distributions of dates from the site sequence TGC_S5. Each distribution represents the relative probability that an event occurs at a particular time. For each of the dates two distributions have been plotted: one in outline, which is the simple radiocarbon calibration, and a solid one, based on the wiggle-match sequence. The large square brackets down the left-hand side along with the OxCal keywords define the overall model exactly

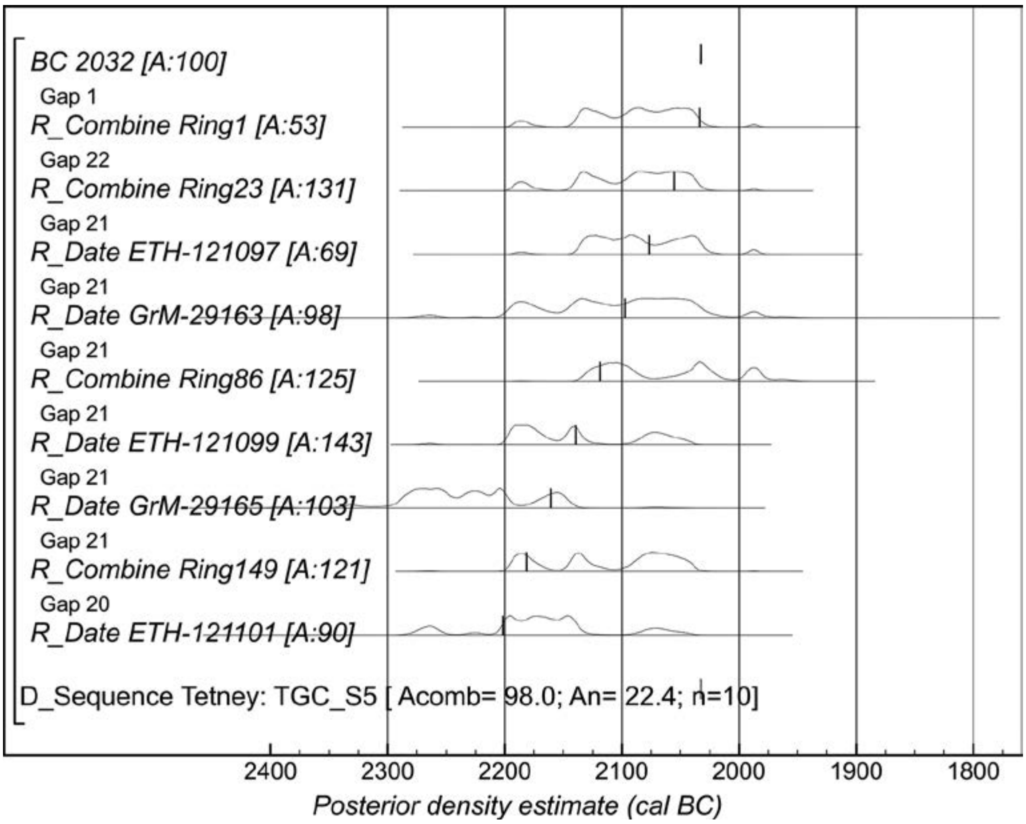

Fig 5.5 Probability distributions of dates from site sequence TGC_S5, including the tree-ring date of 2032 BC for the outer ring of the tree (ring 0). The format is identical to Figure 5.4

radicarbon measurements (Table 5.5) calibrated using the internationally agreed radiocarbon calibration data for the northern hemisphere, IntCal20 (Reimer *et al* 2020).

The model has good overall agreement (Acomb: 93.6, An: 23.6, n: 9; Fig 5.4), with all the radiocarbon dates having good individual agreement (A > 60). It suggests that the final ring of the tree-ring sequence formed in *2040–2025 cal BC* (*95% probability*; Ring0 (?2032 BC); Fig 5.4), probably in *2045–2025 cal BC* (*68% probability*), compatible with the last measured ring being formed in 2032 BC (Table 5.5). When the last ring of the wiggle-match is constrained to be 2032 BC, the model again has good overall agreement (Acomb: 98.0, An: 22.4, n: 10; Fig 5.5), with only one radiocarbon date having poor individual agreement (A < 60): Ring1 (A:53). This allows confirmation of the ring-width dendrochronology and the dating of the sequence to be considered as a radiocarbon-supported dendrochronological date, which spans 2202–2032_{DR} BC, with the final ring having been formed in 2032_{DR} BC. The subscript $_{DR}$ indicates that this is not a date determined independently by ring-width dendrochronology.

Radiocarbon dating of the human skeletal remains

Two samples of human bone from the single partial human skeleton (SK001) originally contained within the Tetney log-coffin were dated at the Laboratory of Ion Beam Physics, ETH Zürich, Switzerland, and the Centre for Isotope Research, University of Groningen, the Netherlands, in 2022 and a single sample from the second individual (SK002) at the Centre for Isotope Research.

At ETH Zürich the sample underwent ultrasonic cleaning in distilled water before gelatinisation and ultrafiltration as described by Hajdas *et al* (2007; 2009). The sample was then combusted in an elemental analyser and graphitised using the fully automated system described by Wacker *et al* (2010c). The graphite target was then dated using a 200kV, MICADAS AMS (Synal *et al* 2007, Wacker *et al* 2010a).

Carbon and nitrogen stable isotopic ratios were obtained on a subsample of the ultrafiltered gelatin at the Department of Geology, ETH Zürich, using a ThermoFischer Flash-EA 1112 elemental analyser coupled through a Conflo IV interface to a ThermoFisher Delta V Isotope Ratio Mass Spectrometer.

At the Centre for Isotope Research the samples were pretreated using an acid-base-acid protocol (4% HCl, 1% NaOH, <1% HCl), gelatinised, and filtered (50μm) (Dee *et al* 2020). Both samples were then combusted in an elemental analyser (IsotopeCube NCS), coupled to an Isotope Ratio Mass Spectrometer (Isoprime 100) for measurement of %C, %N, C/N, δ^{13}C and δ^{15}N. The resultant CO_2 was graphitised by hydrogen reduction in the presence of an iron catalyst. The graphite was then pressed into aluminium cathodes and dated by AMS (Synal *et al* 2007; Salehpour *et al* 2016). Data reduction was undertaken at both laboratories as described by Wacker *et al* (2010b).

Quality assurance

Both facilities maintain continual programmes of quality assurance procedures, in addition to participation in international inter-comparison exercises (Scott *et al* 2017). Details of quality assurance data and error calculation at Groningen are provided by Aerts-Bijma *et al* (2021), and similar details for ETH are provided in Sookdeo *et al* (2020).

Table 5.6 Radiocarbon and stable isotope measurements from the Tetney human remains. Replicate measurements have been tested for statistical consistency and combined by taking a weighted mean before calibration as described by Ward and Wilson (1978; T'(5%)=3.8, ν=1)

Laboratory number	Sample	Radiocarbon age (BP)	$\delta^{13}C_{IRMS}$ (‰)	$\delta^{15}N_{IRMS}$ (‰)	C:N
GrM-27781	SK001. Human bone, adult male, 30–39 years, left femur, from primary inhumation	3722±27	−21.0±0.15	10.7±0.3	3.2
ETH-117592	Replicate of GrM-27781	3711±27	−21.0±0.1	10.9±0.1	3.2
SK001: ^{14}C: 3717±20 BP, T'=0.1; δ^{13}C: −21.0±0.1‰, T'=0.0; δ^{15}N: 10.9±0.1‰, T'=0.4					
GrM-27782	SK002. Human bone, left metatarsal from ?secondary interment (five metatarsals and two unidentified bone fragments)	3588±24	−21.3±0.15	10.6±0.3	3.1

Both radiocarbon measurements on samples from SK001 are statistically consistent at the 5% significance level ($T'=0.1$; $T'(5\%)=3.8$; $\nu=1$; Ward and Wilson 1978) and a weighted mean (3717±20 BP) has been taken as providing the best estimate for its age.

The replicate $\delta^{13}C$ and $\delta^{15}N$ values measured by Isotope Ratio Mass Spectrometry (IRMS), are statistically consistent at the 5% significance level (Table 5.6). The quoted errors derive from the uncertainty in the IRMS combustion and measurement, and the observed reproducibility on repeat sample preparations. Given that the stable isotope results (Table 5.6) indicate that the dated individuals consumed a diet predominantly based on terrestrial C^3 foods (Bayliss and Marshall 2022, fig 22), the radiocarbon results are unlikely to be affected by any significant reservoir effects, so a fully terrestrial calibration curve can be employed.

Calibration

Calibration of the radiocarbon ages on the human bone has been undertaken using the probability method (Stuiver and Reimer 1993) and they are quoted with end points rounded outwards to five years. They have been calculated using OxCal v4.4 (Bronk Ramsey 2009) and the current internationally agreed atmospheric calibration dataset for the northern hemisphere, IntCal20 (Reimer *et al* 2020).

The primary interment within the oak log-coffin, SK001, is estimated to have died in *2195–2035 cal BC* (*95% probability*; GrM-27781, 3722±27 BP; Fig 5.6) and probably in *2175–2050 cal BC* (*68% probability*). Although falling just outside the 95% probability range, the 99% range, *2265–1985 cal BC*, does include the radiocarbon-supported dendrochronological date for the felling of the oak tree-trunk used for the coffin of 2032^{DR} BC.

Given that the primary interment, SK001, can be assumed to have died in the same year the tree for the coffin was felled, 2032^{DR} BC, the bones should yield a radiocarbon age of ≈3671±15 BP (Reimer *et al* 2020). The differences between the measurements provided by Groningen and ETH on SK001 and the expected radiocarbon age are statistically indistinguishable (Table 5.7), but despite this statistical consistency, there is an observable bias (Fig 5.7) with the measurements being older than the age derived from IntCal20. However, this may partly be a function of the lack of understanding of atmospheric radiocarbon in the late third millennium BC, as demonstrated by the paucity of data points and their bandwidth (Fig 5.8); ie, they are not derived from single-year tree-rings.

SK002 is estimated to have died in *2020–1875 cal BC* (*95% probability*; Fig 5.6) and probably in *1995–1900 cal BC* (*68% probability*; GrM-27782, 3588±24 BP) and therefore appears to be later than the oak log-coffin.

Table 5.7 Statistical consistency (Ward and Wilson 1978) between radiocarbon ages from SK001 and from 2032 BC (IntCal20)

Laboratory number	Radiocarbon age (BP)	IntCal20	Radiocarbon age (BP)	Ward and Wilson (1978; T'(5%)=3.8, v=1)
GrM-27781	3722±27	2032 BC	3671±15	2.7
ETH-117592	3711±27	2032 BC	3671±15	2.7
SK001	3717±20	2032 BC	3671±15	3.4

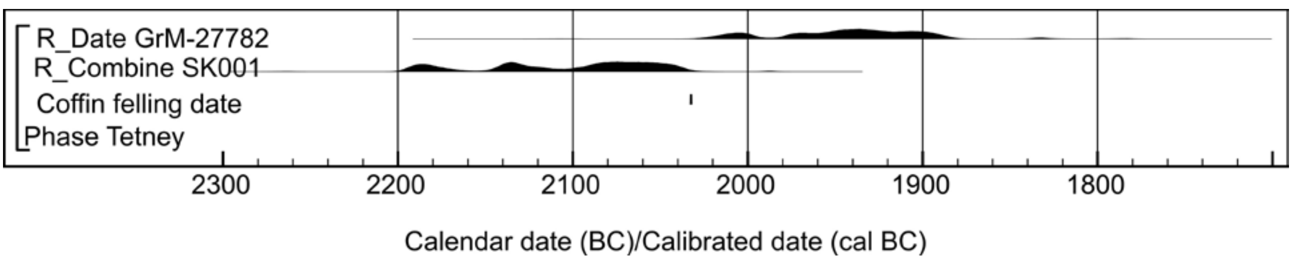

Fig 5.6 Probability distributions of the dates on human bone. The distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993) and the felling date for the oak tree-trunk for the coffin

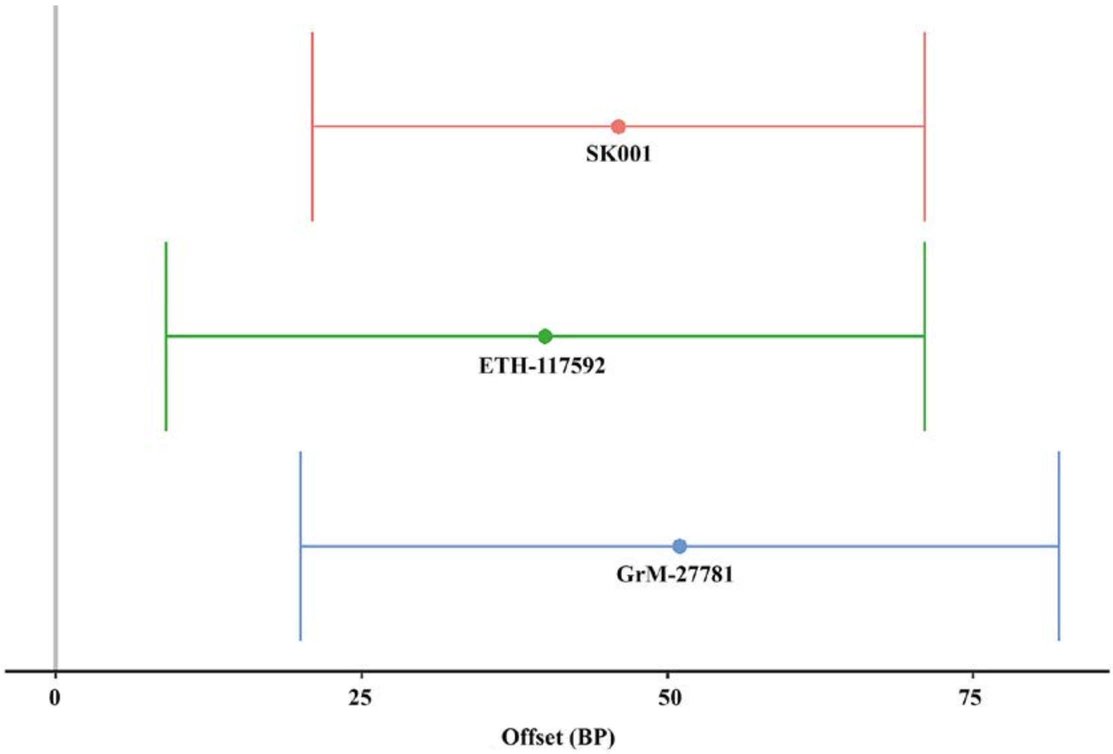

Fig 5.7 Offsets between radiocarbon measurements on human SK001 and the radiocarbon age for 2032 BC (error bars are at 1σ)

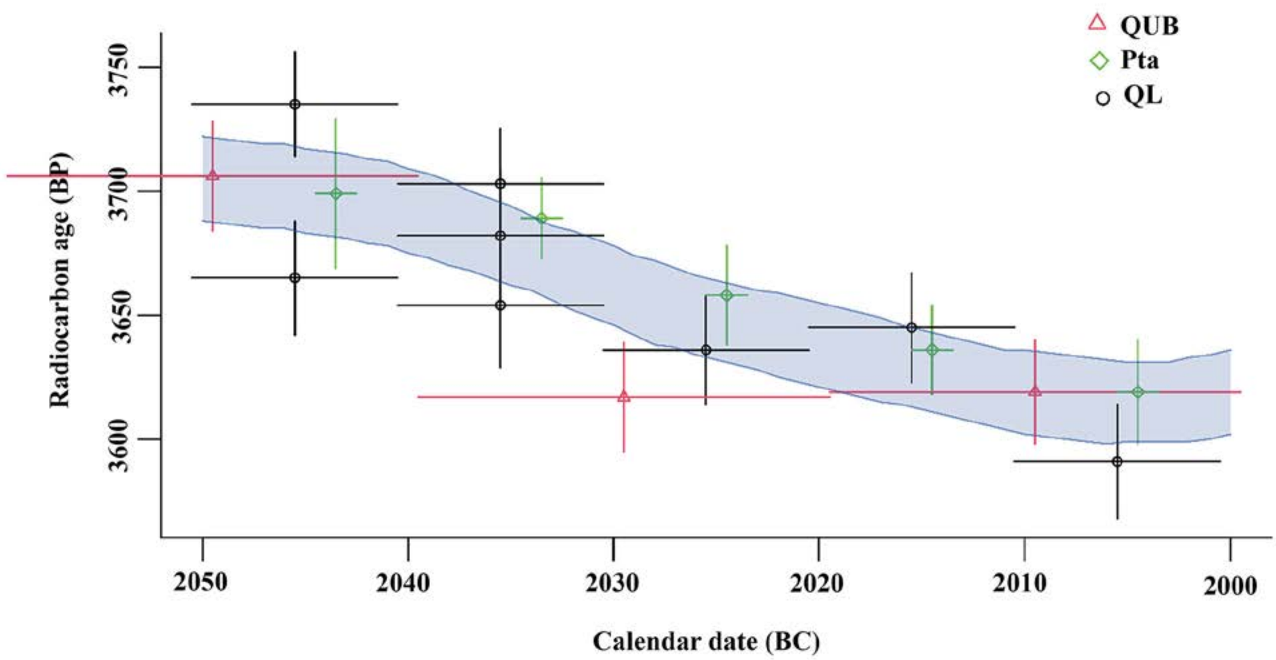

Fig 5.8 IntCal20 (2050–2000 BC) calibration curve (Reimer *et al* 2020) and data points (https://pure.qub.ac.uk/en/datasets/intcal13-radiocarbon-calibration-databases/)

CHAPTER 6

THE PLANT MACROFOSSILS

by Ellen Simmons

Introduction

Following the recovery of the log-coffin, a layer of organic material was found adhering to its base, which was sampled in the field using a grid pattern (see Chapter 1; Fig 1.9). Twelve samples were submitted to the Sheffield Archaeobotanical Consultancy for an assessment of palaeoenvironmental potential, after which four were selected for full sorting, identification and analysis of plant macrofossils. Eight samples were also selected for pollen analysis (see Chapter 7).

Methodology

The samples were processed by wash over to recover plant remains preserved by anoxic waterlogging, broadly following the techniques outlined in Kenward *et al* (1980). The samples were soaked in water overnight before being processed by gently washing material through a stack of sieves of mesh sizes 4mm, 2mm, 1mm, 500μm and 250μm. Material from each size sieve fraction was initially stored in distilled water in sealable plastic bags and kept refrigerated. To prevent deterioration of the material while awaiting further analysis, approximately 100ml of 70% ethanol was later added to each size fraction. All the identified plant material was stored in 70% ethanol in glass tubes with plastic stoppers and refrigerated in an airtight plastic container.

All twelve samples were initially assessed by scanning using a stereo-binocular microscope (x10–x65 magnification) and recording of the main classes of material present using an abundance scale (- = < 10 items, + = 10–29 items, ++ = 30–49 items, +++ = 50–99 items, ++++ = 100–499 items, +++++ = > 500 items). Samples 1–4, which were taken from the most complete end of the coffin, produced the highest concentrations of waterlogged plant macrofossils. Samples 5–12 produced very similar assemblages of material to that found in samples 1–4, but at lower concentrations. It was therefore recommended that complete sorting, identification, and analysis of plant macrofossils should be focused on the material in samples 1–4.

The >1mm fractions of samples 1–4 were fully sorted for identifiable plant macrofossils using a stereo-binocular microscope (x10–x80). The <1mm fractions were subsampled, and 25 per cent of each was fully sorted. No seeds or quantifiable fragments of plant material were found in the <1mm fractions; therefore, the plant material recorded in Table 6.1 is all from the >1mm fractions of the samples. Wood charcoal was examined using high-power binocular reflected light (episcopic) microscopy (x50, x100 and x400), and identifications were made based on the anatomic features observed in transverse, radial and tangential planes. The charcoal identifications are recorded in Table 6.2. The identification of plant material, wood and charcoal was carried out by comparison with material in the reference collections at the Department of Archaeology, University of Sheffield, and various reference works (Atherton *et al* 2010; Cappers *et al* 2006; Schulz 2018; Schweingruber 1990; Tomlinson 1985). Where possible, a record was also made of the ring curvature of the wood charcoal fragments and various aspects of wood anatomy, such as the presence of tyloses or fungal hyphae (cf Marguerie and Hunot 2007). Plant nomenclature follows Stace (2010).

Results

Plant macrofossils and wood have been preserved primarily by anoxic waterlogging. A small quantity of wood preserved by charring as charcoal was also present. Preservation of plant material, wood and wood charcoal was good. The plant macrofossil assemblage included twigs, leaves, leaf buds, flower buds, mosses and grass stems. Delicate diagnostic features, such as hairs on leaf bud scales, were present, indicative of the very good level of preservation. Fragmentation of dicotyledonous leaf fragments hampered identification, although a small proportion of the fragments with leaf margins were of sufficient size to allow the leaf margin shape to be determined.

The organic material in the base of the Tetney coffin was composed primarily of several layers of leaves (Fig 6.1a). Most of this leaf material was fragmented and, therefore, difficult to identify, but occasional fragments with rounded, lobed leaf margins were tentatively identified as oak (cf *Quercus* sp.) (Fig 6.1b). Most of the unidentified dicotyledonous leaf material in the samples was similar in appearance to the fragments suggested to be oak. No leaf fragments with leaf margins identifiable as other species were found, despite carefully sorting and examining

Table 6.1 Plant macrofossils from grid squares 1–4

Sample number		**1**	**2**	**3**	**4**
Sample volume		1000ml	1000ml	1000ml	1000ml
Volume of wash over		550ml	550ml	400ml	600ml
Plant macrofossils	**Common name**				
Bryophyta stem fragments	mosses	–	3	1	–
Taxus baccata L. leaves	yew	121	362	75	409
Taxus baccata L. twig/shoot fragments		9	71	8	78
Taxus baccata L. male flower buds		13	32	6	31
Quercus sp. leaf buds	oak	59	171	39	121
Quercus sp. leaf bud scales		116	313	23	188
Quercus sp. >4mm round wood fragments		–	5	–	–
Quercus sp. 2-4mm round wood fragments		33	157	20	103
Quercus sp. >2mm wood fragments		51	130	363	41
Quercus sp. leaf fragments		12	10	6	8
Corylus avellana L. nutshell halves	hazel	–	–	2	–
Corylus avellana L. whole nut		–	–	–	1
Stellaria media (L.) Vill. seed	chickweed	–	1	–	–
cf. Poaceae stem fragments	grass family	1	1	3	4
Indeterminate bud scales		5	20	10	7
Indeterminate twig fragments		3	38	20	39
Indeterminate dicotyledonous leaf fragment with a tentatively identified kidney gall of the oak gall wasp *Trigonaspis meg-aptera*		–	–	1	–
Indeterminate dicotyledonous leaf fragments (>2mm)		+++++	+++++	+++++	+++++
Indeterminate rootlets		++++	++++	++++	+++

Table 6.2 Wood charcoal from grid squares 1–4

Sample no.	**Species**	**Ring curvature**[a]	**Fungal hyphae**[b]	**Tyloses**[b]
1	*Alnus glutinosa* (L.) Gaertn	1 (nr)	–	–
2	*Quercus* sp.	1 (nr)	1	1
2	*Quercus* sp.	2	–	–
2	*Corylus avellana* L.	1	–	–
2	*Quercus* sp.	1 (nr)	1	1
2	*Alnus glutinosa* (L.) Gaertn	–	–	–
2	*Quercus* sp.	–	–	–
4	*Alnus glutinosa* (L.) Gaertn	1 (nr)	–	–
4	*Corylus avellana* L.	–	–	–

Key: [a]1 = low curve rings; 2 = intermediate curved rings; nr = narrow rings (<1mm wide); [b]1 = yes

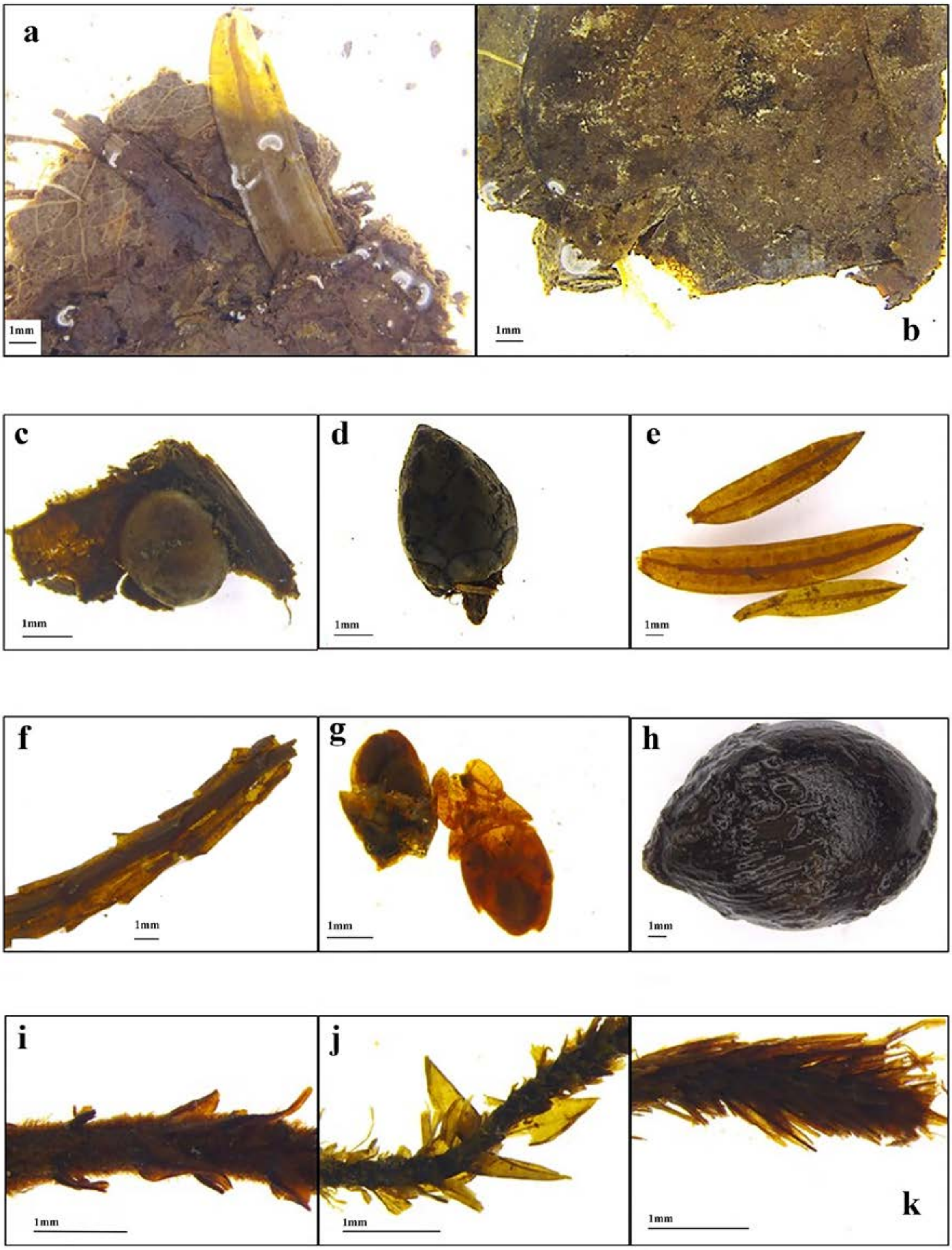

Fig 6.1 a) *Taxus baccata* leaves interleaved between layers of dicotyledonous leaves; b) lobed rounded leaf margin of cf *Quercus* sp.; c) cf kidney gall of the oak gall wasp *Trigonaspis megaptera*; d) *Quercus* sp. leaf bud; e) *Taxus baccata* leaves; f) *Taxus baccata* twig; g) *Taxus baccata* male flower buds; h) *Corylus avellana* nut; i) cf *Thuidium tamariscinum* moss fragment; j–k) unidentified moss types (E Simmons)

the >2mm leaf material. A possible kidney gall of the oak gall wasp *Trigonaspis megaptera* was found in sample 4 (Fig 6.1c). Small-diameter (≤4mm) twigs or roundwood fragments, whole leaf buds (Fig 6.1d), and detached bud scales were also present in the samples, with most of these identified as oak. Taken together, the evidence strongly suggests that most of the dicotyledonous leaf material is oak, along with some twigs or branchlets and leaf buds of oak.

However, the presence of large leaves from other dicotyledonous species cannot be discounted. Also present among the matrix of probable oak leaf fragments, often found in clusters, were abundant leaves of yew (*Taxus baccata*) (Fig 6.1e). Small-diameter (<1mm) twigs (Fig 6.1f) and unopened male flower buds (Fig 6.1g), both of yew, were also found. Large (>10mm) fragments of oak wood, assumed to be broken pieces of the coffin, were present with leaves pressed tightly against them. This suggests that the layers of oak and yew leaves were placed at the bottom of the coffin, beneath the body.

A greater concentration of plant material was present in samples 2 and 4 than in samples 1 and 3. This is likely because samples 1 and 3 came from the more damaged coffin side, which resulted in more material being lost, while samples 2 and 4 were more sheltered by the greater surviving height of the coffin. There was a similar relative abundance of yew twigs and flower buds in all four samples. However, the relative abundance of oak leaf buds and twigs was greater in sample 1 than in sample 3, and in sample 2 than in sample 4. This suggests that more oak twigs or branchlets were placed at the end of the coffin than towards the centre.

One whole hazelnut (*Corylus avellana*) was found in sample 4 (Fig 6.1h), two halves of hazel nutshell were found in sample 3, and hazel nutshell fragments were found in sample 8. Other plant remains found in samples 1–4 included nine grass family (Poaceae) stem fragments, five fragments of moss (Bryophyta), and a seed of chickweed (*Stellaria media*). It was possible to distinguish three types of moss, with one of the moss fragments tentatively identified as a stem of common tamarisk moss (cf *Thuidium tamariscinum*) (Fig 6.1i). It was not possible to identify the two other moss types further (Fig 6.1j–k).

In addition to the plant remains preserved by anoxic waterlogging, a small quantity of wood charcoal was found in samples 1–4. The taxa present were oak, hazel and alder (*Alnus glutinosa*). Two of the oak charcoal fragments had weak ring curvature, closely spaced (<1mm) annual growth rings, and tyloses in the vessel cavities, indicating slow-grown mature heartwood from larger branches or trunk material (cf Marguerie and Hunot 2007). Two of the alder charcoal fragments also had weak ring curvature and closely spaced annual growth rings. One of the hazel charcoal fragments had weak ring curvature, suggesting these are also likely to have come from larger branches or mature trunkwood. An oak charcoal fragment had intermediate ring curvature, which suggests the use of intermediate-calibre wood.

Discussion

The waterlogged plant remains suggest that a layer of plant material was placed in the base of the coffin beneath the body. This layer of plant material is composed primarily of dicotyledonous leaves, most of which are likely to be oak. Small-diameter oak roundwood fragments and leaf buds were also relatively abundant, which suggests the presence of oak twigs or branchlets. Some of these twigs or branchlets may have had leaves attached to them, although the abundance of oak leaves in comparison to twigs suggests that most of the leaf material was in the form of detached leaves. Yew leaves were also abundant, with occasional twigs and male flower buds of yew, which suggests that yew shoots or branchlets were also placed in the coffin, interleaved between the oak leaves. The plant macrofossil assemblage also suggests that a greater quantity of oak twigs or branchlets were placed in samples 1 and 2 at the end of the coffin. The body's orientation in the coffin is unknown due to the circumstances of the coffin's discovery, so samples 1 and 2 may have been located at the head or the foot end. However, the placement of oak twigs or branchlets at the head end is perhaps more likely. Sample 2 also produced the most significant volume of organic material, which may indicate the presence of a 'pillow'.

Both yew and oak are long-lived trees with many functional uses and a rich history of symbolism (Bevan-Jones 2016; Grigson 1975; Mabey 2007). Yew was used in the Bronze Age for making bows and as withies in constructing oak plank boats. Yew wood was also carved to make the Roos Carr Assemblage, a group of Bronze Age wooden figures with quartz eyes found in a tributary of the river Humber near Holderness (Bevan-Jones 2016). All parts of the yew can cause death if consumed, apart from the fleshy red aril surrounding the seeds (Bevan-Jones 2009). Oak is an excellent timber tree used in tanning and provides pannage for pigs (Rackham 2003). Oak is also a high-quality fuel wood that burns slowly but provides good heat (Bishop *et al* 2015). There are a number of examples of Bronze Age log-coffins made of oak (see discussion in Chapter 4), and oak is often the dominant taxon used as pyre fuel in Early Bronze Age cremations (O'Donnell 2016).

The whole hazelnut and hazel nutshell fragments are also likely to have been deliberately placed in the coffin as food offerings or grave goods. It is unlikely that hazelnuts attached to branches were unintentionally included with the plant material placed in the coffin, as most of the roundwood and dicotyledonous leaves in the samples have been identified as oak or probable oak. The position of the hazelnuts in the coffin also corresponds to pollen evidence for the presence of possible food plants (see discussion in Chapter 7). Hazelnuts are a nutritious high-calorie food (Mabey 2007), and charred hazel nutshells are often found at Early Bronze Age archaeological sites, which suggests that hazelnuts were an important food source at this time.

The minimal quantity of moss fragments and grass stems found in the samples is most likely to have been collected by accident along with the woodland leaf material. The chickweed seed may have come from a plant growing at the site at the time of the burial or may have been introduced through contamination. Chickweed is a common wild plant associated with fertile disturbed soils, such as in arable fields or areas of occupation (Stace 2010).

The small charcoal assemblage from the Tetney coffin included oak, hazel and alder. Weak ring curvatures on the oak, hazel and alder charcoal fragments suggest the use of large-calibre wood from mature trees, while a fragment of oak with intermediate ring curvature indicates some use of intermediate-calibre wood. The wood charcoal fragments may have originated from fires associated with funerary rites, such as feasting, and might have been deliberately deposited in the coffin; deposits of charcoal and/or evidence of burning are often found beneath Early Bronze Age barrows (Owoc 2000; 2001; Woodward 2002). As mentioned previously, both oak and hazel were present in the plant macrofossil assemblage, and high levels of all three woodland taxa were found in the pollen assemblage (see discussion in Chapter 7). Unlike oak and hazel, alder is, however, a low-quality fuel wood as it burns quickly and produces little heat (Bishop *et al* 2015), although it does produce a bright flame which may have been significant if it was burnt as part of funerary rites.

In addition to providing evidence for the potential role of plants in Bronze Age burial rites, the plant remains from the Tetney coffin also provide evidence for the time of year during which the burial is likely to have occurred. For example, the presence of oak leaf buds indicates the burial is likely to have occurred between late summer and early spring. The formation of leaf buds in deciduous trees occurs two months or more before leaf fall (Perry 1971), and leaf fall in oak is usually between October and November (Jones 1959). This suggests the Tetney burial took place in August or September at the earliest, which overlaps with evidence from dendrochronology for when the oak tree was felled (see Chapter 5). Hazelnuts also ripen in mid-September (Mabey 2007, 45). However, they can also be stored in their shells, so could have been placed in the coffin at any time of the year. Tree leaf buds remain dormant throughout the winter, so it is also possible that fallen oak leaves and twigs with leaf buds could have been collected and placed in the coffin in the winter rather than the autumn. Yew flower buds form in the second half of summer and open in February or March (Thomas and Polwart 2003), so the presence of unopened yew flower buds indicates that the burial took place no later than January. The tentatively identified gall of the oak gall wasp attached to a leaf in the Tetney coffin also points to late summer or early autumn rather than winter (Chinery 2011, 28–9). The flowering season of the insect-pollinated plant taxa found in the pollen assemblage from the coffin also suggests that the burial occurred in August or September (see discussion in Chapter 7).

Plant macrofossils have occasionally been preserved in other Bronze Age log-coffin burials. Although the plant taxa that have been found are quite variable, the use of a layer of leaves beneath the body is a consistent feature. A layer of 'rotted rushes, reeds or straw, which seemed to have formed a bed' and 'fragments of a pillow made of grass or straw' were found in the base of a log-coffin at Loose Howe, North Yorkshire, along with hazel branches and hazel nutshells (Elgee and Elgee 1949, 90; Jones *et al* 2019). A layer of plant material found in the base of a log-coffin excavated at Gristhorpe, near Scarborough, North Yorkshire, in 1834, was initially identified as dried rushes and included a 'long lanceolate leaf resembling that of mistletoe' (Sheridan *et al* 2013, 151). Bracken fronds were found in a log-coffin burial at Cartington, Northumberland (Dixon 1913; A M Jones 2016, 221), while a layer of dark material that resembled decayed and compressed leaves was found in a log-coffin burial at Towthorpe, Yorkshire (Mortimer 1905, 3–6; A M Jones 2016, 221).

Plant macrofossils have also been found in Bronze Age cist burials. They include similar types of plant material to that used at Tetney, such as dicotyledonous leaves, yew leaves, woody twigs and charcoal. 'A mass of vegetable matter mostly brown dust but containing plant remains' was found 'both above and below' a Bronze Age knife and a flint end scraper in a cist burial beneath Barrow 85 at Amesbury, Wiltshire (Newall 1930, 435). This vegetable matter consisted of abundant remains of yew, including leaves and wood, as well as abundant remains of sphagnum moss and a small quantity of *Mnium undulatum* and *Hypnum* leaves, which are both types of woodland mosses (Newall 1930, 440). A layer of plant material found on the skeleton's chest in a Bronze Age cist burial at Ashgrove, Methilhill, Fife, included 'abundant dicotyledonous leaf fragments, bark, twigs, wood charcoal (two tiny fragments), plant tissue with crystalline copper salts adhering to it and fairly abundant sphagnum moss' (Henshall 1966, 178). A matted layer of plant material, identified as purple moor grass (*Molinia caerulea*) was found in the base of an Early Bronze Age cremation burial in a cist on Whitehorse Hill, Dartmoor (J. Jones 2016). Organic material retrieved from the cist burial at Forteviot, Perth and Kinross, consisted of compressed 'lumps' made up almost entirely from the stems, leaves, flowers and seeds of meadowsweet (*Filipendula ulmaria*), which were interpreted as a floral tribute to accompany the body (Ramsay and Miller 2020, 186). As A M Jones (2016, 220) points out, these examples provide evidence for plant materials' importance and widespread use in Early Bronze Age funerary rituals. The plant assemblages from the Tetney burial add to the growing evidence for the apparent routine practice of lining graves and cists with plant material during this period.

Conclusion

Analysis of the plant macrofossils found in the base of the Tetney log-coffin suggests the use of a layer of mostly oak and some yew leaves to line the coffin. The presence of oak twigs with attached leaf buds and some yew twigs with unopened male flower buds attached is significant. These remains, together with the oak leaves, hazelnuts and a tentatively identified oak leaf kidney gall attached to a leaf fragment, suggest that the burial occurred in late summer or early autumn. There is also potential evidence for other deliberate inclusions based on the presence of hazelnuts and wood charcoal. Hazelnuts were likely placed in the coffin as food offerings or grave goods, while charcoal, possibly from fires associated with the burial rites, may be an accidental inclusion. The occasional fragments of moss and grass stems are most likely to have been accidentally collected with the woodland leaf material rather than derived from material deliberately placed in the log-coffin. Other examples of Bronze Age burials where plant macrofossils have been found indicate that using a layer of plant material placed beneath or around the body is likely to have been a frequent component of Bronze Age burial practice. The archaeobotanical evidence from the Tetney log-coffin not only provides further evidence for the importance of plant materials in Early Bronze Age funerary rituals, but a strong indication of the time of year the burial took place.

CHAPTER 7

THE POLLEN

by Tudur Davies

Introduction

The base of the coffin contained a dark residue that was systematically sampled in a grid pattern to collect twelve bulk samples (see Chapter 1; Fig 1.9). The initial palaeoenvironmental assessment of this deposit also observed frequent pollen grains from a diverse range of taxa, which resulted in the commissioning of a specialist palynology study. This chapter provides detailed analysis of eight of the twelve samples, looking at the spatial variation of pollen assemblages within the burial context. A discussion is also provided on the significance of these samples for improving our understanding of both Bronze Age burial practices and the wider environment surrounding the site.

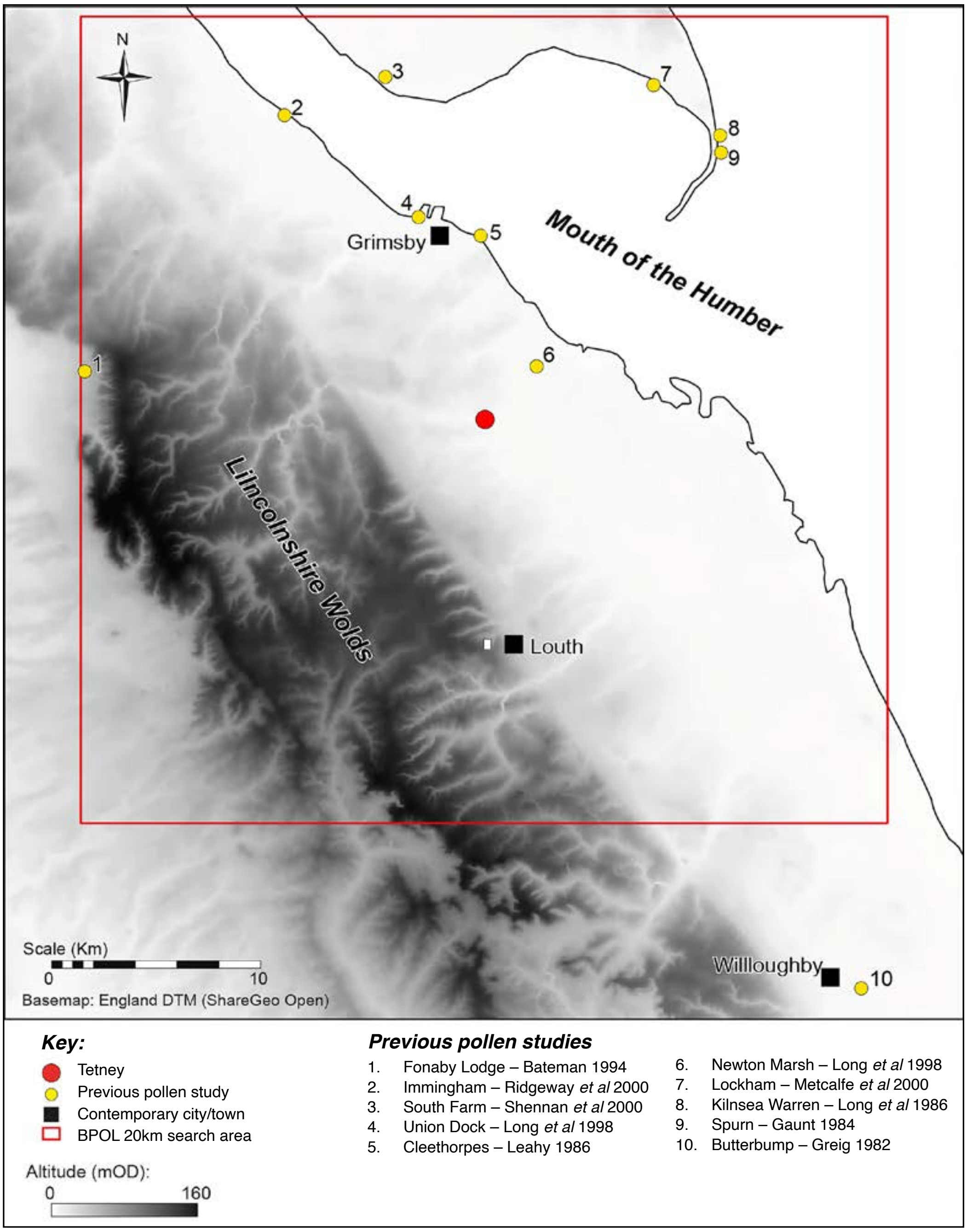

Fig 7.1 Site location in relation to previous pollen studies in the region

Methodology

Bulk samples collected during the excavation were subsampled for pollen analysis by Ellen Simmons (see Chapter 6). Considering the disturbance to the coffin caused by the poor conditions during discovery, extreme care was taken when selecting material for pollen analysis to reduce the possibility of contamination. Before processing, descriptions of the subsamples were made to provide a rough indication of contamination potential. These descriptions noted colour (Munsell value), texture and inclusions. These results are provided in Table 7.1.

Table 7.1 Sample descriptions

Sample no.	Description
1	Black (7.5YR 2.5/1) peat-like deposit
2	Black (7.5YR 2.5/1) peat-like deposit
3	Black (7.5YR 2.5/1) peat-like deposit with a few small (<3mm) mollusc shells
4	Black (7.5YR 2.5/1) peat-like deposit
5	Black (7.5YR 2.5/1) peat-like deposit with some small (<3mm) mollusc shells
6	Black (7.5YR 2.5/1) peat-like deposit with some small (<3mm) mollusc shells and a few streaks of brown (7.5YR 4/2) silty sand
7	Black (7.5YR 2.5/1) peat-like deposit with frequent small (<3mm) greenish-grey (Gley 1 6/10GY) sandstone fragments and one larger water-rolled sandstone fragment (c10mm)
8	Black (7.5YR 2.5/1) peat-like deposit and many small (<3mm) mollusc shells
9	Black (7.5YR 2.5/1) peat-like deposit with some small (<3mm) mollusc shells and many streaks of brown (7.5YR 4/2) silty sand
10	Black (7.5YR 2.5/1) peat-like deposit with a few small (<3mm) mollusc shells
11	Black (7.5YR 2.5/1) peat-like deposit with a few small (<3mm) mollusc shells
12	Black (7.5YR 2.5/1) peat-like deposit with a few small (<3mm) mollusc shells

Owing to the higher likelihood of contamination of samples next to the broken ends of the coffin, pollen analysis was restricted to samples 1–8. These were processed according to standard techniques described by Moore and Webb (1978), Moore *et al* (1991) and Faegri and Iversen (1989). Lycopodium spore tablets were added during sample processing to calculate relative pollen and charcoal concentrations (Stockmarr 1971). Micro-charcoal was quantified during pollen counting, with fragments tallied according to size using a graticule grid as described by Swain (1978). A minimum of 300 identifiable land pollen grains was counted from each sample using a light microscope at x400 and x1000 magnification. Pollen identification was undertaken using the keys of Moore and Webb (1978), Moore *et al* (1991) and Faegri and Iversen (1989). Identification of cereal-type and Apiaceae (Carrot family) pollen was undertaken according to the criteria of Andersen (1979) and Punt (1984), respectively. Records were also made of pollen clusters that might signify the presence of decayed anthers belonging to complete flowers within the coffin (cf Leroi-Gourhan 1975). Pollen nomenclature follows the classifications of Bennett (1994), and pollen diagrams showing variations in the percentages and concentrations of pollen types include the proportion and type of damaged grains for individual taxa (Figs 7.2–7.3). The tabulated pollen data were also imported into a GIS to enable spatial variation analysis of pollen types within the coffin (Figs 7.4–7.5).

Results and discussion

Sample descriptions

The samples selected for pollen analysis are relatively uniform in nature; they all comprise a black deposit similar to peat in its consistency, with the only slight variation between samples being the type of inclusions. Eight of the twelve samples contain small mollusc shells; these appear to occur with more regularity in the samples towards the broken end of the coffin, but there is no other reason to suggest that these are intrusive and related to the disturbance of the grave upon its discovery. There are also streaks of brown silty sand in samples 6 and 9, and fragments of water-rolled sandstone gravel in sample 7. These inclusions are similar to the materials used to construct the barrow mound. However, given the lack of sandy or gravelly material in other samples close to the broken end of the coffin, it is possible these inclusions made their way into the coffin during the burial and barrow construction rather than during the more recent disturbance. Nevertheless, in case the inclusions stemmed from contamination, an effort was made to avoid these portions of the sample while subsampling for pollen processing, to minimise their potential impact on the results of pollen analysis (detailed below).

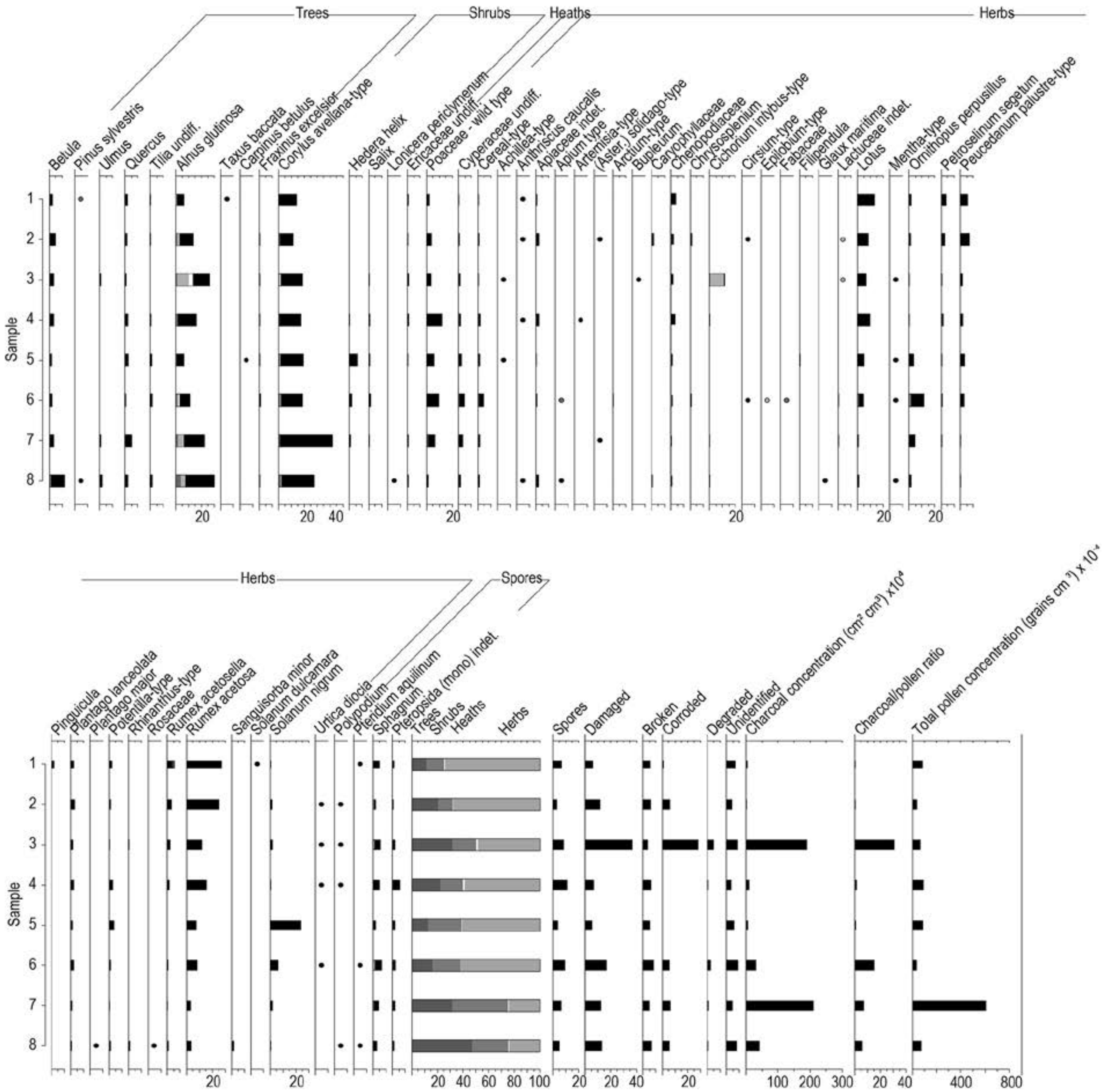

Fig 7.2 Pollen percentage diagram; broken grains shown in dark grey, corroded grains shown in light grey, degraded grains shown in white (T Davies)

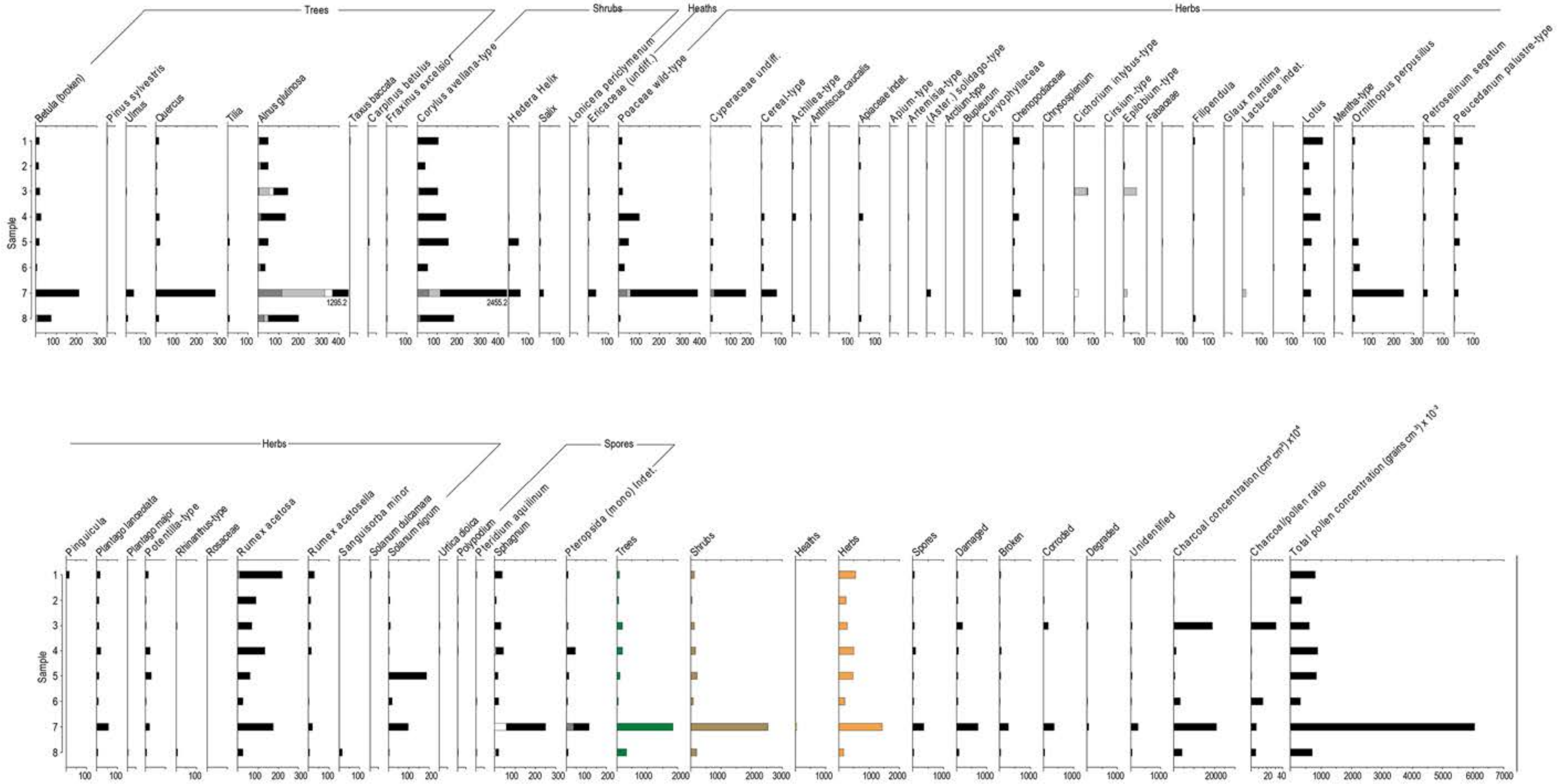

Fig 7.3 Tetney burial pollen concentration diagram; broken grains shown in dark grey, corroded grains shown in light grey, degraded grains shown in white (T Davies)

Pollen analysis

All samples examined from the grave contained a high concentration of pollen with a diverse range of taxa represented. Comparative analysis of the data also shows apparent differences in the composition of the pollen assemblage of each sample, with unusually high percentages of insect- or self-pollinated taxa concentrated within different portions of the coffin (see Figs 7.4–7.5). Small clusters of pollen grains, perhaps representing anthers, were also present within some samples (see Table 7.2). The reasons for these spatial variations are explored below through a discussion of the mechanisms that could have led to the pollen's deposition in individual samples. These include:

- modern contamination
- incidental inclusions at the time of burial
- natural/accidental dispersal from local and regional sources
- deliberate/ceremonial deposition within the coffin.

All references to habitat types and anthropogenic indicators are based on Behre (1981), Clapham *et al* (1987), Grime *et al* (2007), Stace (2010) and Turner (1962).

Table 7.2 Pollen clusters identified within samples

Sample	Taxa	No. of clusters	Grains within clusters	Total pollen of taxa in the sample
2	*Alnus glutinosa*	1	3	42 (13.9%)
5	*Peucedanum palustre*-type	1	2	10 (3.3%)
8	*Corylus avellana*-type	1	4	83 (27.5%)
8	Apiaceae indet.	1	5	5 (2.0%)1

Note: Three additional Apiaceae grains identifiable to their specific type were also present within this sample

Modern contamination. Although the grave was disrupted severely by the circumstances of its discovery, contamination from modern sources of pollen is not believed to have had much impact on the analytical results. Wrapping the coffin in plastic, together with the care taken in excavating and sampling the deposit, is likely to have reduced the possibility of contemporary pollen contamination of the samples. Post-depositional contamination from burrowing animals and insects is not believed to have influenced the pollen assemblage, given that the coffin would have been protected by at least 3m of deposit used in the barrow's construction (see Chapter 1). The fact that the coffin is believed to have been voided before its discovery also implies relatively little disturbance to the coffin prior to its discovery. However, the disturbance caused to the grave on discovery could have contaminated it with the deposits used to construct the barrow, especially in samples close to the broken edges of the coffin.

The potential effects of sample contamination may be variable, depending on the concentration of pollen and the composition of the assemblage of the contaminating deposit. However, there is little to indicate the presence of intrusive material in most samples. Indeed, the high counts of insect- and self-pollinated taxa, ivy (*Hedera helix*), bird's-foot (*Ornithopus perpusillus*), black nightshade (*Solanum nigrum*), corn parsley (*Petroselinum segetum*), milk parsley-type (*Peucedanum palustre*) and the small number of clusters of some pollen grains (Table 7.2), interpreted as anthers, would be difficult to explain as modern contaminants unless those taxa were growing in exceptionally large numbers on or in very close proximity to the site during excavation. The high levels of specific taxa within the coffin are thus thought to result from deliberate deposition rather than contamination (this activity will be explored further below).

Incidental inclusions at the time of burial. However, two samples – 3 and 7 – do contain evidence for a potential degree of contamination. Sample 3 has a particularly high number of corroded pollen grains and very high charcoal concentrations. Sample 7 has similarly high microcharcoal concentrations and a much higher pollen concentration than any other sample. The increased pollen concentration within sample 7 could indicate the presence of intrusive material with higher pollen concentrations than the vegetation mat that was targeted for analysis. The contamination of sample 7 is perhaps supported by the presence of sandstone inclusions absent from other samples (Table 7.1). The sample has a markedly high proportion of woodland taxa compared to the others from the coffin, especially oak (*Quercus*) and hazel-type (*Corylus avellana*) pollen. This could be because woodland plants were more common in that part of the vegetation mat or as a result of contamination. However, it should be noted that some of the *Corylus avellana*-type pollen could belong to the wetland shrub bog-myrtle (*Myrica gale*) rather than hazel (*Corylus avellana*). Nevertheless, there is also a higher-than-average quantity of woodland pollen in sample 8, especially birch (*Betula*) and alder (*Alnus glutinosa*), which lies adjacent to sample 7 and had limited evidence for contamination.

Corroded pollen grains are believed to represent deterioration from microbial activity when grains are exposed to oxygen (Moore *et al* 1991, 170) or fire damage (Andersen 1993, 159–60). Given the likely source of any intrusive material and the high microcharcoal concentrations in both samples 3 and 7, the corroded pollen might be linked to activity pre-dating the construction of the mound, such as burning vegetation to clear the site prior to burial or other aspects connected to the funerary rite. Furthermore, microbially corroded pollen may have been eroded from the upper horizons of nearby soils disturbed by burning or mound construction. The high microcharcoal concentration certainly implies that more significant quantities of burnt material are present within these samples. Both scenarios imply a relatively local origin for the corroded pollen grains. It should also be noted that the corroded grains in sample 3 do not entirely dominate the assemblage, and several undamaged grains of insect-pollinated taxa commonly occurring in other samples were identified within both samples 3 and 7. These include common bird's-foot-trefoils (*Lotus*), little white bird's-foot (*Ornithopus perpusillus*), corn parsley (*Petroselinum segetum*), milk parsley-type (*Peucedanum palustre*) and black nightshade (*Solanum nigrum*).

It is important to note that the incorporation of intrusive material into the vegetation mat within samples 3 and 7 may not be the result of recent disturbance. The funerary process for the individual interred in the log-coffin may well have involved laying materials on recently disturbed and/or burnt ground before they were placed into the burial. Other samples containing corroded grains may reflect limited contamination with intrusive material, with varying degrees of contamination reflected by the relative quantities of corroded pollen grains. Despite this, it should be noted that the proportions of corroded grains in other samples are minimal (less than 7%), suggesting a very low degree of contamination. Furthermore, finding some damaged grains in a pollen sample is not unusual, even when well-preserved and seemingly uncontaminated.

Natural/accidental dispersal from local and regional sources. If, as suggested above, corroded pollen grains were incorporated into the deposit at the time of the burial, either from burnt vegetation or disturbed soils, damaged pollen was probably roughly contemporary with the burial; thus, it could provide insight into the natural – or managed – environment around the site. This is in contrast to pollen within material deliberately brought to the site for the burial, potentially from a much wider region. However, care should be taken to directly correlate the corroded pollen grains with the composition of the local or regional environment because of the varying susceptibility of different taxa to oxidation. For example, corroded alder (*Alnus glutinosa*) and chicory-type (*Cichorium intybus*/Lactuceae, the tribe that includes dandelion as its most common type), have particularly high pollen numbers in sample 3. However, these are two pollen types least susceptible to oxidation (Havinga 1967, 86) and more easily identifiable because of their strongly attributable features. Less robust pollen types are more likely to have been destroyed or damaged beyond recognition, so the resulting biased pollen assemblage does not necessarily represent the most common plants growing near the site before the construction of the burial mound. The types included among the corroded pollen are, therefore, merely indicative of part of the range of resources available locally rather than a quantifiable representation of local vegetation communities and land use (Table 7.3).

Nevertheless, the assemblage suggests the presence of various available resources, from woodland, wetland and pasture. There is a slight possibility that there was arable land in the vicinity. However, the only pollen types indicating this are corroded grains from the goosefoot family (Chenopodiaceae) and willowherb-type (*Epilobium*) pollen. Although these pollen taxa may represent arable weeds, plants within these pollen types are also found in wetland or salt marsh areas. Such wetland habitats are likely to have existed near the site given its proximity to large tracts of coastal wetland *c* 2km to the northeast.

Most of the undamaged pollen is presumed to originate from material added to the grave rather than local vegetation. However, it is also possible that some of the undamaged pollen grains noted in the burial context represent pollen from local vegetation communities in areas from which resources were gathered to furnish the grave. Based on the pollen record alone, judging the full proportion of undamaged pollen grains from different source types is impossible. However, comparison with the results of archaeobotanical analysis can indicate which plants were deliberately brought to the grave. At least some portions of the plants represented in the pollen record are likely to have been imported, especially taxa that are self- or insect-pollinated and present in higher percentages/concentrations, or present as clusters of pollen grains (discussed in detail below). However, undamaged pollen better represents both arable and pastoral habitats than the corroded grains (Table 7.3).

Relating this information to northeast Lincolnshire's local and regional environmental contexts is difficult. A search of the British Palynological database (BPOL – Grant, pers comm, 2022) and a literature review of relevant studies indicate that this region's previous palynological research is comparatively scarce (Fig 7.1). Furthermore, most studies are in very different landscape contexts from Tetney's. The nearest, most relevant study consists of a poorly dated sequence near a cluster of Bronze Age barrows from Butterbump, *c* 34km to the southeast of

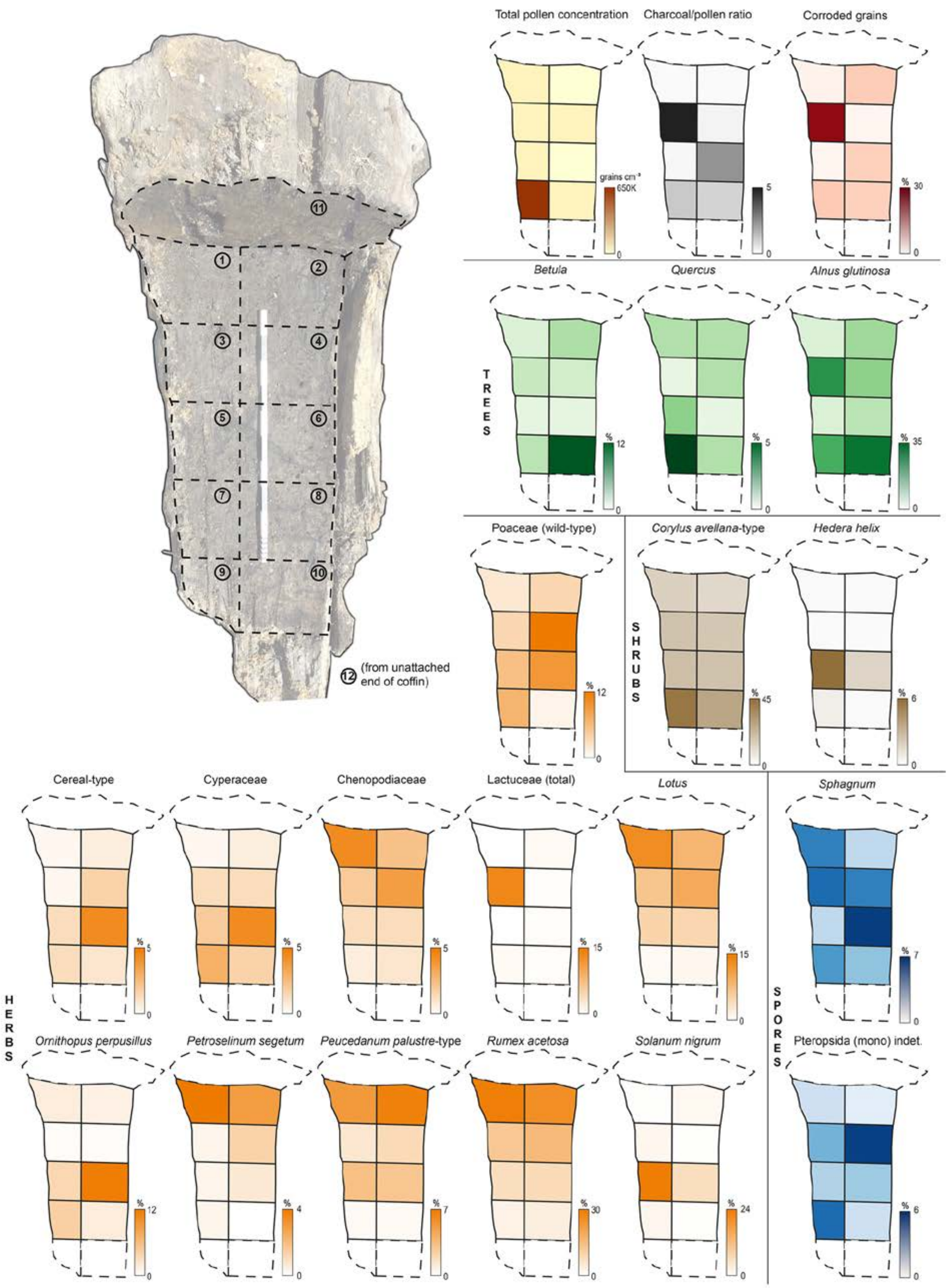

Fig 7.4 Pollen percentage distribution plots (% of TLP) for selected taxa ≥4% of TLP; dashed boxes in pollen plots indicate where samples have not been analysed (T Davies)

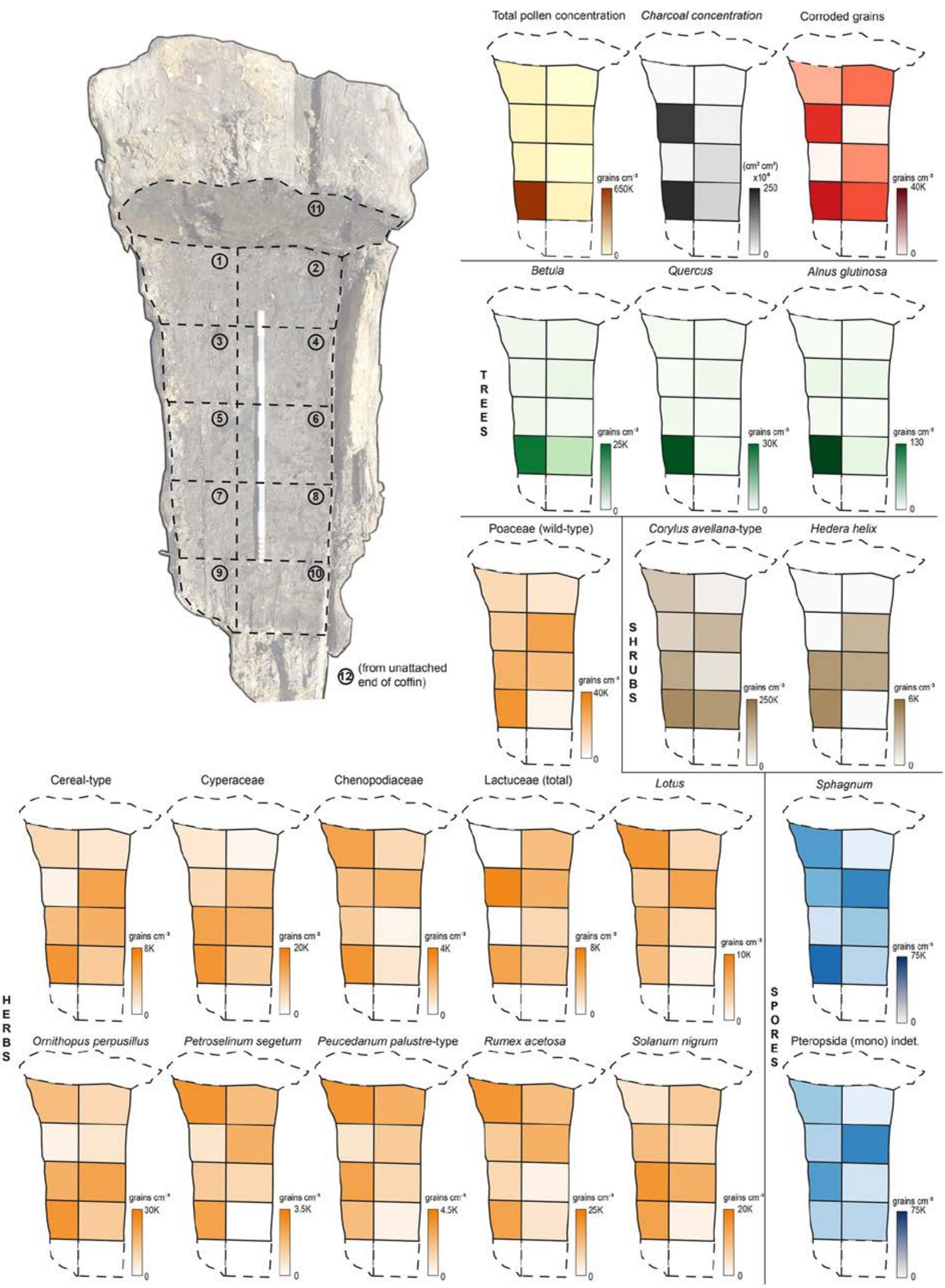

Fig 7.5 Pollen concentration distribution plots (% of TLP) for selected taxa ≥4% of TLP; dashed boxes in pollen plots indicate where samples have not been analysed (T Davies)

Tetney (Greig 1982). The relevant section of the Butterbump core, thought to date to the Bronze Age, indicates a relatively open landscape with evidence for both arable and pastoral land use. Woodland taxa are similar to those identified at Tetney, with higher levels of oak (*Quercus*) and alder (*Alnus glutinosa*) and lower percentages of hazel-type (*Corylus avellana*), Scots pine (*Pinus sylvestris*) and lime (*Tilia*). Most other studies closer to Tetney are located in coastal wetland settings on either side of the Humber, with a single study located on the opposite side of the Lincolnshire Wolds. Of the studies that are well dated, none falls into the expected chronological range of the Tetney burial. Nonetheless, relatively well-dated studies that pre- and post-date the Early Bronze Age are located at Lockham *c* 18km to the northwest (Metcalfe *et al* 2000), and at Newton Marsh *c* 4km to the northwest (Long *et al* 1998). Both sequences are located on coastal wetlands and suggest that the environment was relatively similar before and after the period of the Tetney burial. Their pollen records both show very open landscapes dominated by saltmarsh vegetation communities, including those in the goosefoot family (Chenopodiaceae) and sea plantain (*Plantago maritima*), with woodland likely to be located on the edges of the wetland, including relatively high levels of oak (*Quercus*), hazel (*Corylus avellana*-type) and alder (*Alnus glutinosa*), and lower values for birch (*Betula*) and Scots pine (*Pinus sylvestris*).

The plant macrofossil assemblage identified the remains of some plants that are missing or rare in the pollen record. A prime example of this is yew (*Taxus baccata*); only one pollen grain of this type was found, yet leaves and flowers of *Taxus*/Cupressaceae (juniper family) were identified in the grave's vegetation mat (see Chapter 6). Given the known distributions of yew and juniper families, the leaves are more likely to be from yew (Stace 2010, 50–5), and the marl among the till deposits located *c* 200m north of the site should have provided a suitable habitat for this tree (BGS 2020; Stace 2010, 50). The poor representation of *Taxus baccata* in the pollen record may be the result of preservation bias, given that it is a type that is highly susceptible to oxidation (Havinga 1967, 86). Alternatively, it may have been less abundant locally than other taxa (as suggested by its absence from other regional pollen studies). It is also possible that the season in which the burial took place has affected the relative proportion of *Taxus baccata* pollen; if out of season, there may consequently be less pollen of this taxon within the coffin. The unopened state of yew flower buds within the vegetation mat (see Chapter 6) may also indicate that the grave was furnished outside the flowering season for yew. This also suggests the flowers present within the grave were too immature to produce pollen grains. However, the unusually high percentages of insect- and self-pollinated taxa suggest the former presence of those plants in bloom as recently cut flowers within the grave. By comparing their flowering season, estimating when the burial took place should be possible. This data has been tabulated in Tables 7.4 and 7.5 and shows considerable overlap in the flowering seasons of the more prominent insect- and self-pollinated taxa identified in the grave, suggesting the burial occurred during August or September.

However, several of the wind-pollinated taxa present in the grave, including yew (*Taxus baccata*), have much earlier flowering seasons ranging from January to May. The disparity between the two sets of flowering seasons is possibly related to the higher pollen productivity of wind-pollinated taxa (Broström *et al* 2008). As a result, their pollen grains are more likely to be contained within other materials used to construct the vegetation mat of the grave – eg, the moss and leaf litter. It should also be noted that flowering seasons can vary by region and contemporary climatic conditions (Stace 2010, xi–xii). Considering this, it is important to be conservative in assigning a time of year to the burial, but the suggestion that it took place during the late summer or early autumn can still be made, a proposition supported by the plant macrofossils and dendrochroonology (see discussions in Chapters 5–6).

Estimating pollen catchment size from palynological data is a complex equation. This is especially the case for the Tetney samples, as the taxa present derive from a mixture of natural processes and anthropogenic activity. As noted above, some are likely to come from more localised contexts, either directly from the vegetation burnt to clear the site or from the surface of soils disturbed by that process. Others represent a mixture of the resources purposefully gathered from various habitats and pollen inadvertently incorporated within those materials that furnished the grave. The plants deliberately gathered are of particular archaeological interest; their distribution within the grave and potential significance in a funerary context are discussed below.

Deliberate and ceremonial deposition within the coffin. Although palynological examinations of graves in Britain are relatively rare, some previous studies in Britain and further afield have shown the value of such work, demonstrating the deliberate furnishing of prehistoric graves with plant material (eg, Clarke 1999; Dickson 1978; Dineley 1996; Fyfe and Perez 2016; Leroi-Gourhan 1975; Mora *et al* 2018; Tipping 1994; Whittington 1994; 1997). Furthermore, studies by Whittington (1997), Clarke (1999), and Mora *et al* (2018) have demonstrated that it is possible to determine the locations of specific plants within Bronze Age burials by examining multiple samples from within the grave. It is argued here that similar conclusions can be made from the burial at Tetney, distinguishing between plants that may have formed the vegetation mat and those provided as offerings, which may have been used to decorate the body or furnish the grave.

Table 7.3 Habitats suggested by corroded and undamaged pollen and spores

Habitats	Corroded grains	Undamaged grains
Woodland	*Betula, Ulmus, Alnus glutinosa, Corylus avellana*-type	*Betula, Pinus sylvestris, Ulmus, Quercus, Tilia, Alnus glutinosa, Taxus baccata, Carpinus betulus, Fraxinus excelsior, Corylus avellana*-type, *Hedera helix, Salix, Lonicera periclymenum, Polypodium*
Wetland/saltmarsh	*Alnus glutinosa, Corylus avellana*-type (?), Cyperaceae undiff., Chenopodiaceae (?), *Epilobium*-type (?), *Peucedanum palustre*-type (?), *Sphagnum*	*Alnus glutinosa, Corylus avellana*-type (?), *Salix,* Cyperaceae undiff., Chenopodiaceae (?), *Epilobium*-type (?), *Sphagnum, Peucedanum palustre*-type (?)
Heath	Ericaceae, Cyperaceae undiff. (?)	Ericaceae, Cyperaceae undiff. (?)
Grassland/pasture	Poaceae wild-type (?), *Cichorium intybus*-type, Lactuceae indet., *Lotus, Plantago lanceolata, Rumex acetosa*	Poaceae wild-type (?), *Cichorium intybus*-type, *Cirsium*-type, Lactuceae indet., *Lotus, Plantago lanceolata, Rumex acetosa, Rumex acetosella, Urtica dioica*
Disturbed ground	Chenopodiaceae (?), *Cichorium intybus*-type, *Epilobium*-type (?), *Plantago lanceolata, Rumex acetosa,* Pteropsida (mono) Indet.	Chenopodiaceae (?), *Cichorium intybus*-type, *Epilobium*-type (?), *Plantago lanceolata, Rumex acetosa, Rumex acetosella,* Pteropsida (mono) Indet.
Arable land	Chenopodiaceae (?), *Epilobium*-type (?)	Cereal-type, *Achillea*-type, Chenopodiaceae (?), *Epilobium*-type (?), *Plantago major, Solanum nigrum*

(?) indicates where a pollen taxon can represent multiple habitats

Table 7.4 Properties of selected pollen taxa: trees and shrubs

	Pollen type[1]	Pollination method(s)[2]	Flowering season[2]												Flower/ anther colour[3]	Known uses[4]
			January	February	March	April	May	June	July	August	September	October	November	December		
TREES	*Betula*	Wind				■	■								n.d.	Timber
	Quercus	Wind				■	■								n.d.	Timber, tanning leather, fodder
	Alnus glutinosa	Wind			■	■									n.d.	Timber
	Taxus baccata	Wind			■	■									n.d.	Ornamental, medicine
SHRUBS	*Corylus avellana*-type: *Corylus avellana*	Wind	■	■	■	■									bright yellow	Timber, food
	Myrica gale	n.d.					■	■							red	
	Hedera helix	Insect									■	■	■		n.d.	Ornamental, medicine

1. Includes most common pollen taxa present at the site (>4% TLP within any given sample); taxa identified from archaeobotanical analysis and pollen types prevalent at comparative sites
2. Clapham *et al* (1987)
3. Clapham *et al* (1987), Stace (2010)
4. Royal Botanic Gardens (2022)
n.d. = no data

Table 7.5 Properties of selected pollen taxa: herbs

	Pollen type[1]	Pollination method(s)[2]	Flowering season[2]												Flower/ anther colour[3]	Known uses[4]
			January	February	March	April	May	June	July	August	September	October	November	December		
HERBS	Poaceae wild-type	Wind	(Considerable variation)												n.d.	
	Cereal-type - *Avena-Triticum* group	Wind						■	■	■	■				n.d.	Food
	- *Hordeum*-group	Wind					■	■	■	■	■				n.d.	Food
	Cyperaceae undiff.	Wind			■	■	■	■	■	■	■				n.d.	
	Brassicaceae[5]	Insect/self	(Considerable variation)												various	Food (some)
	Cichorium intybus-type	Wind/ insect/ self						■	■	■	■	■			blue, yellow, pink or white	Food, drink, medicine
	Chenopodiaceae	Wind						■	■	■	■				n.d.	Food (some)
	Filipendula[6]	Insect/self					■	■	■	■	■				cream-white	
	Lotus	Insect						■	■	■	■				yellow or reddish	Food, drink, medicine
	Ornithopus perpusillus	Self					■	■	■	■					white veined with red	Food
	Petroselinum segetum	Insect								■	■				white	
	Peucedanum palustre-type - *Selinum carvifolia*[7]	Insect							■	■	■	■			white	
	- *Angelica sylvestris*[7]	Insect							■	■	■				white or pink	Food
	Plantago lanceolata[6]	Wind				■	■	■	■	■					n.d.	Food, fodder, medicine
	Rumex acetosa	Wind					■	■							white to pinkish white	Food, medicine
	Solanum nigrum	Insect							■	■	■				white petals with yellow anther	Food, medicine

1. Includes most common pollen taxa present at the site (>4% TLP within any given sample), taxa identified from archaeobotanical analysis and pollen types prevalent at comparative sites
2. Clapham *et al* (1987)
3. Clapham *et al* (1987), Stace (2010)
4. Royal Botanic Gardens (2022)
5. Not identified by the current study
6. Occurs in low numbers (<4%) in the current study
7. Only known types within the geographical zone of the site (Stace 2010).
n.d. = no data

Previous cases where high quantities of pollen were found within grave contexts have been interpreted as possible vegetation mats on which bodies were placed (Clarke 1999; Mora *et al* 2018; Tipping 1994; Whittington 1994). The presence of such a mat at Tetney has been confirmed by its actual preservation (see Chapter 6). The spatial distributions of some taxa within the Tetney grave, such as birch (*Betula*), oak (*Quercus*), alder (*Alnus glutinosa*), hazel (*Corylus avellana*), moss (*Sphagnum*), fern (Pteropsida), grasses (Poaceae) and possibly goosefoot (Chenopodiaceae), are consistent, in terms of pollen concentrations/percentages, throughout the grave (see Figs 7.4–7.5). This suggests that these types might have been part of the vegetation mat. However, as discussed above, the spatial distributions of some of these pollen and spore types may also be explained by their coincidental presence within materials used to create the vegetation mat; for example, as pollen naturally accumulating on moss or leaf litter before being laid in the grave. Alternatively, the high percentages of woodland taxa in samples 7 and 8 might indicate the presence of moss or leaf litter from woodland contexts or the anthers of woodland taxa incorporated into the vegetation mat, as indeed suggested by the *Corylus avellana*-type cluster in sample 8.

In addition to vegetation mats, the presence of a concentration of plant material, around skulls within graves, which may have acted rather like a 'pillow', has been suggested based on high concentrations of bracken (*Pteridium aquilinum*) at Dalgety Bay cist 3 (Whittington 1997) and of meadowsweet (*Filipendula*) at Whitsome (Clarke 1999). Unfortunately, as the skeletal remains at Tetney were already displaced from the coffin when it was excavated, it has not been possible to establish the body's orientation within it. However, examining the volume of archaeobotanical remains in the samples retrieved from the base of the coffin, it is apparent there was a greater volume of material in samples 1 and 2 (see Chapter 6), which would be consistent with the presence of a pillow. If this interpretation is correct, it provides a frame of reference for the orientation of the skeleton and distribution of pollen types within the log-coffin at Tetney. Furthermore, it implies that the head of the individual interred would have been located in grid squares 1 and 2, with the body flexed and its feet located in grid squares 9 and 10.

As previously noted, many of the insect- and self-pollinated taxa within the samples show a distinct peak in percentages in specific parts of the grave; this can also be observed in the distribution of common sorrel (*Rumex acetosa*), which is wind-pollinated. These taxa are present in other grid squares but appear to reduce in number in correlation with their distance from samples with the highest concentrations. This pattern is more acute in the percentage pollen plots (Fig 7.4) but can also be distinguished in the pollen concentration data (Fig 7.5). This suggests elements of these plants were specifically located in the grid squares with higher recorded values of the corresponding pollen types, with diminishing values representing the increasing distance from the plant remains. Several taxa have higher percentages/concentrations in grid squares 1 and 2, which may have corresponded with the position of the head in the coffin. These include sorrel (*Rumex acetosa*), bird's-foot (*Lotus*), and two taxa that are members of the Apiaceae family: corn parsley (*Petroselinum segetum*) and milk parsley-type (*Peucedanum palustre*).

As already noted, concentrations of pollen and spores around the head area have previously been interpreted as possible pillows (Clarke 1999; Whittington 1997). However, an alternative explanation is that they formed part of a headdress or 'flowers woven through the hair' (Clarke 1999, 559). Consequently, in the case of Tetney, higher pollen concentrations near the head may represent a garland around the neck or shoulders. This was suggested as an explanation for the high concentration of cabbage family (Brassicaceae) pollen in the thoracic area in burials at Cova des Pas (Mora *et al* 2018). In that case, a combination of excellent preservation conditions and the fact that bodies had been wrapped in shrouds that held the plant material in place enabled the authors to reach more robust conclusions about the placement of certain plants and the differences in taxa associated with particular individuals. Although a shroud may have been present at Tetney, this cannot be discerned based on the evidence of the preserved pollen alone. However, it is possible to explore the likelihood of different burial scenarios (eg, the presence of a pillow, placement of floral tributes/plants on or around the body) in more detail through comparison with the results of plant macrofossil analysis from the coffin (see discussion in Chapter 9).

Other notable concentrations of pollen grains in the Tetney samples include high levels of ivy (*Hedera helix*) and black nightshade (*Solanum nigrum*) in grid square 5, and little white bird's-foot (*Ornithopus perpusillus*), cereal-type pollen and possibly sedge family (Cyperaceae) in grid square 6. These grid squares are located midway along the coffin, presumably adjacent to the pelvis of its occupant and perhaps their hands, if their arms were extended. When considering the various known uses of the plants represented by pollen seen in the Tetney burial (Tables 7.4 and 7.5), it is possible to observe that the taxa in grid square 5 have some medicinal properties. In contrast, those in grid square 6 are cultivated and foraged food plants. Previous pollen studies have also noted the presence of cereal-type pollen within grave contexts, though the quantities have not been seen as significant compared to background pollen signatures (Clarke 1999; Mora *et al* 2018). Although the percentages of cereal-type pollen at Tetney are not outside what would be expected in the 'background signature', the percentages of cereal-type pollen in grid square 6 are much higher than those observed elsewhere in the coffin. Such concentration might suggest the deliberate placement of cereal plants or a product containing cereal pollen in this part of the grave. It is also significant that other food items identified by the archaeobotanical analysis (see Chapter 6) were found in grid squares 4 and 8, on the same side of the coffin as the higher concentrations of little white bird's-foot (*Ornithopus perpusillus*) and cereal-type pollen.

Previous work has considered the medicinal and nutritional value of plants represented by grave pollen assemblages (Brophy and Noble 2020; Clarke 1999; Dickson 1978; Mora *et al* 2018; Tipping 1994; Whittington 1994), including their possible presence within tributes of honey or mead (Clarke 1999; Dickson 1978; Tipping 1994; Whittington 1994). Such interpretations are problematic, especially when a container is missing from the grave. However, as Dickson (1978) notes, it is entirely possible that a leather or fibre container may not have survived in such cases. There are higher concentrations of sedges (Cyperaceae) corresponding with the elevated number of cereal-type grains in grid square 6, which could relate to a fibre container of some kind. However, no traces of such a vessel have been identified. Irrespective of this, the pollen evidence from Tetney strongly suggests the deposition of plant-based offerings in a specific spatial pattern.

Despite the similarities between the pollen records at Tetney and other funerary sites discussed above, there are also significant differences in the range and types of taxa present. *Filipendula* and Brassicaceae pollen are invariably two of the more common taxa identified, yet they were almost entirely absent from the Tetney samples. *Filipendula* pollen was present in samples 1, 4, 5 and 8 but only reached a maximum of 1.66 per cent of the TLP, in contrast to values ranging between *c* 15 and 82.5 per cent in other case studies (Clarke 1999; Fyfe and Perez 2016; Tipping 1994; Whittington 1994; 1997). However, Tetney has a far greater range of species present than these other examples, potentially due to them having been deliberately introduced into the coffin. Therefore, the differences in the pollen proportion from these flowering plants may be misleading. Combined, the plants identified as a possible offering at Tetney vary between *c* 36 and 68 per cent of the total, which is more consistent with other sites where there is often only one taxon identifiable as a deliberate inclusion.

Therefore, the competing number of plants at Tetney may reduce the overall percentages of any given plant within each sample in the grave. Other studies also had the advantage of undertaking targeted sampling for pollen analysis according to the placement of specific skeletal elements within the grave, which may have influenced their results. A further possible reason for the difference relates to the flowering season of the plants; if, as suggested above, the Tetney burial took place in the late summer/autumn, some taxa found in other graves may not have been flowering, such as Brassicaceae for example. Consequently, these plants may have been omitted owing to a lack of flowers, or were present but left no pollen signature. This does not apply, however, in the case of *Filipendula*; its flowering season overlaps with the other plants identified in the Tetney burial. Moreover, the fact that *Filipendula* is present in low numbers in half of the samples analysed demonstrates its availability in the landscape, so it seems that other species were deliberately chosen for the burial instead. These differences could also be related to the 'high' status of the individual buried at Tetney, which may have influenced the choice of plants and the depositional patterns within the coffin as part of the deliberate placement of funerary offerings. There may also have been symbolic or ceremonial significance behind the choice of specific plants. One example where this might be the case is the choice of yew leaves to be incorporated within the vegetation mat. Its significance relating to early Christian beliefs and association with medieval burial grounds is well recognised, and it has been argued that its ritual significance may have had earlier, pre-Christian origins (Bevan-Jones 2016; Cusack 2013).

The potential symbolic significance of the various plants selected is admittedly difficult to determine. However, the rationale for choosing plants may also have more straightforward explanations that may partly relate to their aesthetic properties. Apiaceae pollen (a family of aromatic plants) is present at both Tetney and Cove des Pas. In the latter case, the authors note the importance of their 'eye-catching' flowers (Mora *et al* 2018, 37). Tipping (1994, 138) suggests that the presence of *Filipendula* within many grave contexts in Scotland may relate to the appealing nature of its clumps of white flowers. Indeed, the colour choice may actually be a significant common denominator more generally in Bronze Age burials; many of the plants identified at Tetney, as well as at other sites such as Forteviot (see Brophy and Nobel 2020, 196–8), as potential funerary offerings, have white flowers (see Tables 7.4 and 7.5). These white flowers would have appeared very striking and would have stood out against the backdrop of the vegetation mat and log-coffin.

Conclusions

Despite the potential contamination of samples caused by the disturbance of the coffin on its discovery, the results of the pollen analysis suggest that this was minimal, and it is still possible to reach meaningful conclusions based on the pollen types and their distribution within the grave. Furthermore, any intrusive material within the samples analysed may be related to the construction of the barrow or even the funerary ritual itself rather than the more recent disturbance. The pollen within the few samples that could be contaminated may, therefore, provide information relating to the site's natural environment and the range of habitats within the local area. These potentially contaminated samples suggest the presence of woodland, wetland and land for pastoral activity within the local area. Although the potential for arable activity in the immediate locality is uncertain, the complete pollen assemblage from uncontaminated samples indicates that cultivation activities occurred in the wider region from where resources had been gathered to furnish the burial.

Comparing the range of taxa present in the samples indicates that some of the most common types would have flowered in late summer or early autumn, strongly indicating the time of year the burial took place. Spatial analysis of the variation between pollen samples also suggests deliberate placement of floral offerings, food items and possibly medicinal plants within the coffin. Although the potential motivations behind the choice of plants present in the grave is uncertain, this analysis provides invaluable insight into Early Bronze Age funerary practices.

CHAPTER 8

THE BATTLE-AXE

by Alison Sheridan, Mik Markham, Amber Roy, Michael Bamforth and Francesca Gherardi

Introduction

by Alison Sheridan

A remarkably well-preserved complete 'battle-axe' with a stone head that is notable for its small size was recovered following the initial disturbance of the grave by the mechanical excavator. (See the discussion below regarding the use of the term 'battle-axe'.) Although recovered out of context, its condition and association with the burial strongly suggest it was originally included within the coffin. The finely made battle-axe measures 338mm overall, with a diminutive stone head 69mm long fitted snugly onto a slender wooden haft (Fig 8.1). The lower side of the head was held in place by a narrow ledge in the haft, and the haft narrowed to a tenon-end to accommodate the head. The haft gently broadens towards its butt end to prevent the battle-axe from slipping out of the hand when held in a non-upright position. While undergoing freeze-drying during conservation, the stone head unavoidably developed a crack through its weakest plane, at the perforation (Panter and Creed 2023); although this is almost indistinguishable with the naked eye, even though it can be seen on the X-ray computed tomography image (Fig 8.2).

In plan, the head is roughly and asymmetrically elliptical, or slender tear-shaped, with a reasonably blunt blade, a narrow, rounded butt, and a perforation whose mid-point lies around three-fifths of the way along the body, towards the butt end. In profile, the blade and butt are modestly expanded, the blade more so than the butt; the blade is slightly convex and the butt a little more so (Fig 8.1). The head measures 69.2mm in length, 22.3mm in maximum breadth (beside the perforation) and 26.5mm in maximum height (at the blade). The height at the butt is 23.4mm, and at the perforation 18.8mm. The perforation diameter is 11.7mm, making for a very thin wall of *c* 5mm and *c* 5.6mm on each side at this point. One index of overall slenderness, as used by Fiona Roe's (1966) study of British battle-axe heads, is the ratio of breadth to length; in the case of Tetney, it is 0.32, placing this near the slenderest end of an overall range of 0.28–0.61 (based on the measurement of 101 battle-axe heads). According to Roe's index of thickness, calculated by the height at the perforation divided by length, the figure of 0.27 falls towards the thinner end of the overall 0.16–0.46 range (Roe 1966, 200). The shape of the perforation cannot be determined by external examination as the haft is snugly in place. However, X-ray computed tomography (Fig 8.2) shows that the perforation has a slight hour-glass shape.

The stone used to make the Tetney battle-axe head is a visually distinctive, light grey fossiliferous limestone (discussed by Mik Markham below), with the remains of the fossils occurring as various curvilinear shapes, some whitish, others represented as sockets where the fossils have leached out. The artefact's long immersion in tannin-rich water has degraded the stone's surface (Fig 8.3). When new, it would have been smoother than now, and a detailed microscopic examination (described by Amber Roy below) has identified small areas of surviving polish, so its original appearance would have been significantly different from its current state.

As for how the Tetney example fits within the broader corpus of battle-axe heads in Britain, two typochronological models exist. The first was established by Roe in 1966, building on previous work by Ashbee (Roe 1966). This model initially featured five developmental stages, cross-cut by nine morphological groups. The variations were the degree of blade and butt expansion, the distance between the expanded ends (as compared with overall length), and the butt shape in profile. Roe subsequently simplified her classification system into 'Early', 'Intermediate' and 'Developed' types (Roe 1979). According to Roe's 1966 system, the Tetney battle-axe head falls within her 'Stage III, Calais Wold group'; according to her simplified system, 'Intermediate'. More recently, in his comprehensive review of Chalcolithic and Early Bronze Age material culture, Stuart Needham has proposed an elegant typochronological model informed by radiocarbon dating (Stuart Needham, pers comm, 16 April 2024). This features eight morphological classes, the earliest, Class 1, corresponding to Roe's Stage I and part of Stage II (dating to *c* 2200 cal BC), and the latest, Class 8, corresponding to some of Roe's Stage V examples (dating to *c* 1600 cal BC or slightly before). The Tetney battle-axe head falls within Needham's 'Class 2', which dates to *c* 2000 cal BC.

A 3D photogrammetric model of the Tetney battle-axe can be found online at Sketchfab: Tetney Axe - 3D model by Historic England (last accessed November 2025).

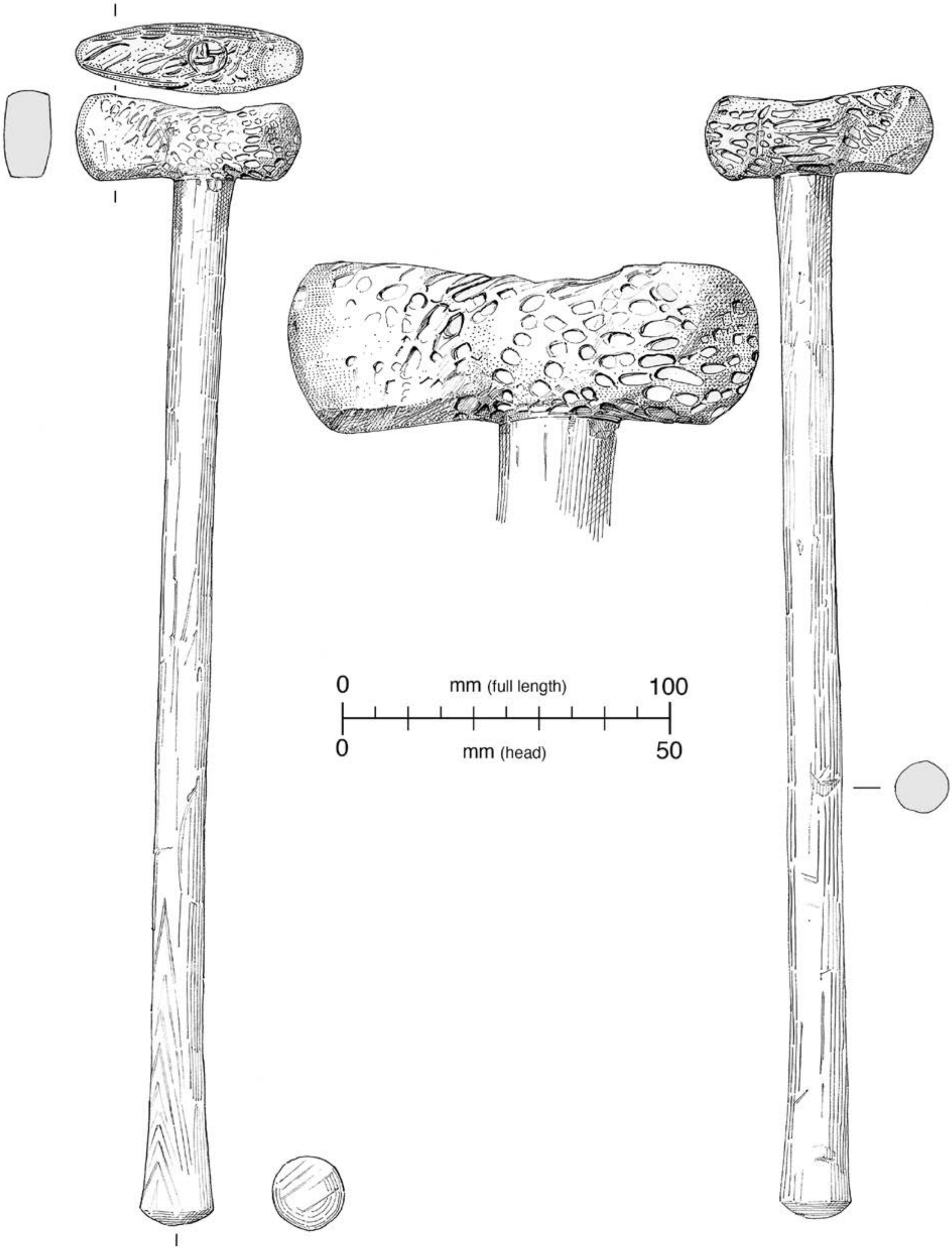

Fig 8.1 Plan, profile, basal and cross-section views of the battle-axe. (J. Dobie/Historic England). For a more detailed view of the tree-ring pattern on the base of the haft, see Figure 8.13

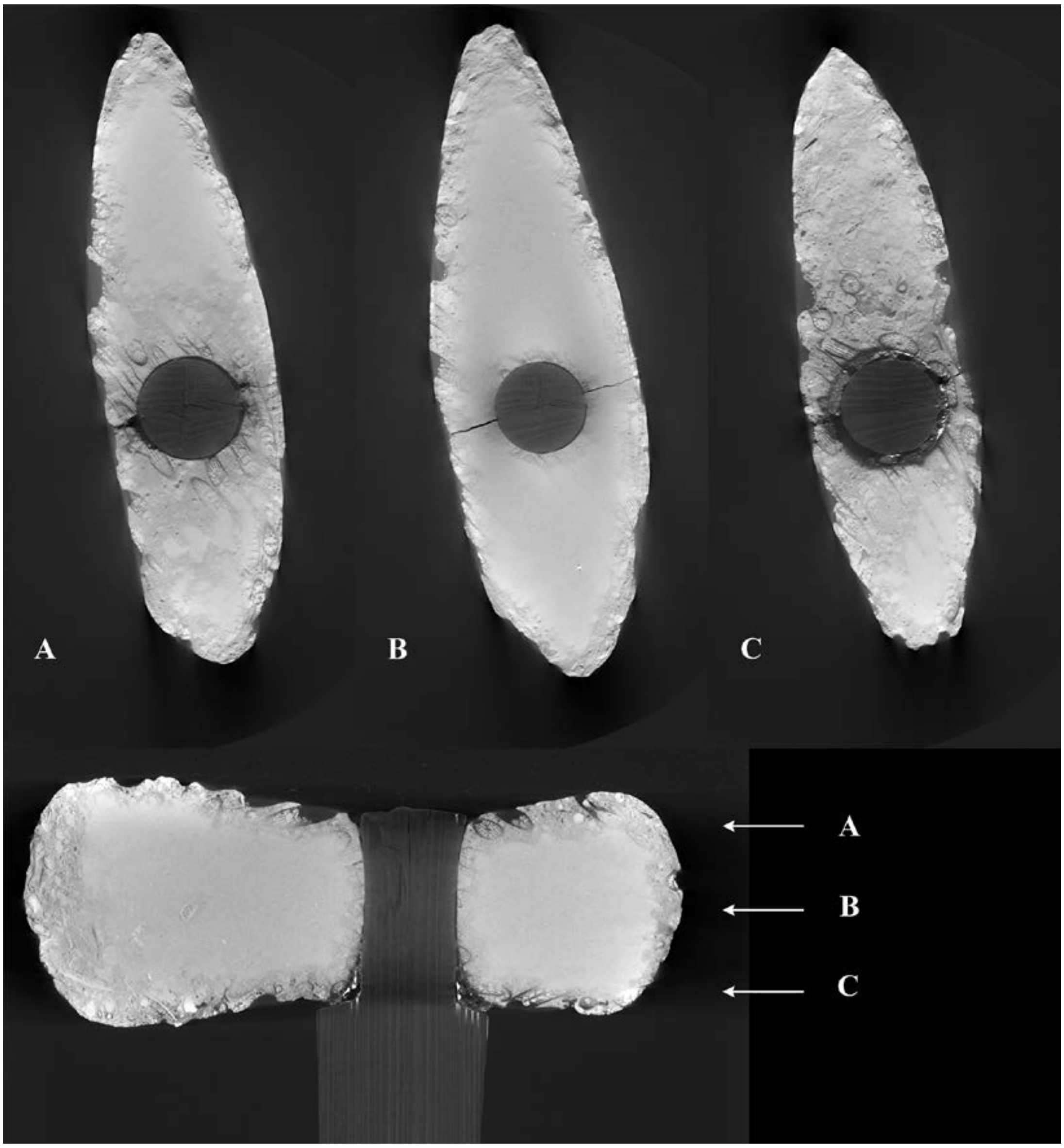

Fig 8.2 X-ray computed tomography of the battle-axe, created after the stone head had cracked (B Harding *et al*/Historic England)

Identification and source of the stone

by Mik Markham

The stone is a Lower Carboniferous fossiliferous limestone. The macrofossils are *Siphonodendron irregulare* (Bevans and Nudd, pers comm, 2022; Phillips 1836), solitary corals originally placed in the *Lithostrotion* genus of cnidarian solitary fossils but revised to be included in the *Siphonodendron* genus. *Siphonodendron irregulare* occur in rocks of 336–326.4 million years ago, the Middle Visean to Middle Asbian stages of the Lower Carboniferous. In this battle-axe head the fossils are less resistant to erosion than the matrix; many have concave surfaces or exist only as casts, having been leached out. The matrix appears to be micritic, a well-cemented limestone mud or a lime-rich fine sandstone, which contains sub-0.1mm small black flecks taken to be of organic matter, probably originally plant material.

Lower Carboniferous rocks outcrop extensively in the UK, especially in North Yorkshire where the Yoredale Group of shales-limestones-sandstones-coals/seatearth (protocoal/land emergent soil surface) have been extensively mapped. Consequently, it is strongly suspected that the stone used to make the Tetney battle-axe head had come from a source in the North Yorkshire Yoredale Group, the nearest potential source area, although other sources further afield are still possible. Nonetheless, such rock does not outcrop in or around Lincolnshire, nor is it likely that it had been transported to Lincolnshire by glacial action.

The type-fossil location for *Siphonodendron irregulare* is the disused limestone quarries at Ash Fell, Northumberland. However, the area is heavily overgrown, and obtaining good samples during a field visit was impossible. During a subsequent visit to Brownsey Moor, northwest of Feetham in Swaledale, North Yorkshire (around 165km to the NNW of Tetney), limestone was found with *in situ* bands of *Siphonodendron irregulare*. The age of the rocks in this area is at the upper range of the coral's age range (Visean–Namurian boundary), and these deposits offer a reasonably close parallel for the stone of the Tetney battle-axe head.

On closer examination and cutting of the samples from Brownsey Moor, however, it was discovered that the fossil corals were primarily restricted to the surface of the rock specimens and that the overall limestone matrix was soft, crumbling readily when worked. It became clear that the fossils in the Brownsey Moor samples were much harder than the matrix, whereas in the Tetney axe-head the opposite was the case.

Therefore, it is highly likely that the rock used for the Tetney battle-axe head came from the Yorkshire Dales. The outcrops sampled at Brownsey Moor, however, are too soft to be the exact source, implying that the material was obtained from another location within the region.

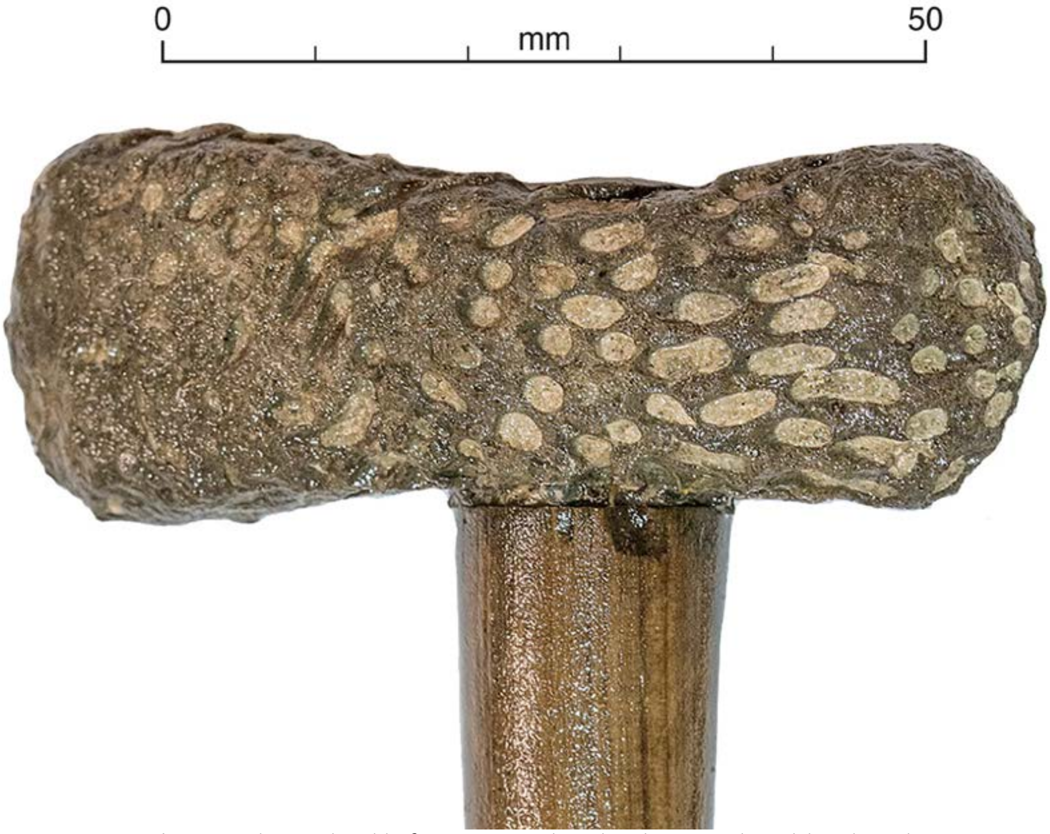

Fig 8.3 The axe-head before conservation showing post-depositional erosion (York Archaeological Trust)

Microwear examination

by Amber Roy

Method

A combined low- and high-power microscopy approach was used to analyse the wear traces on the Tetney battle-axe head and its haft (Figs 8.4–8.9). The stone head was initially analysed at low power using a Huvitz HSZ stereomicroscope with a GXCAM-U3-18 camera, followed by a high-power investigation with a Leica DM2700 MH RL metallographic microscope with MC170 HD camera.

Analysis at low magnifications allows evaluation of use-wear attributes from the implement's manufacture, use and treatment. This includes identifying linear patterns such as striations, pits and grain extraction, levelling, residue and the presence of polish or sheen on the blade edge and blade tip. In addition, analysis of edge modification or damage, such as fractures, crushed grains, micro-fractures from impact, edge rounding and abrasion can be identified (Adams 1993, 2002, 2003, 2010, 2014; Adams *et al* 2009; Dubreuil 2004; Dubreuil and Savage 2014; Hamon 2008; Hamon and Plisson 2008; Liu *et al* 2010; Plisson 1991). Analysis at high magnifications enables identification of the type of use polish and, therefore, the contact materials.

Recorded features of the polish included the form of the polished grains, texture, location, directionality, linkage, brightness, distribution, and the presence and type of striations (Borel *et al* 2014, 273; Dubreuil 2002, 2004; Dubreuil and Savage 2014; Fullagar and Field 1997; Gijn and Houkes 2006, 168; Plisson 1985). Using the multi-scale approach of low- and high-power microscopy enables a broader range and accuracy of results (Dubreuil *et al* 2015, 124).

Results

Analysis of the stone head revealed it had undergone changes due to weathering, such as rounding of stone grains across the whole implement and loss of stone grains (Fig 8.4). Despite this, some signs of the manufacturing process are visible on its body, butt and blade. The wear traces across the entire head are very similar, suggesting the manufacture traces may not have been altered by use. However, because of weathering, any signs of alteration to the manufacturing traces could be lost. At low power, the wear traces from manufacture indicated that mechanical action with a hard contact material, such as grinding stone on stone, had levelled the tops of the stone grains, but not enough to remove peaks and troughs within the microtopography. On a few areas of the body, grinding striations have survived the weathering process (Fig 8.5a). This small group of striations, numbering under ten, have U-shaped profiles and are in a parallel arrangement. These groups of striations also overlap (Fig 8.5b), with potential singular striations that may have been caused by the inclusion of grit or sand when grinding or polishing the surface with a hard material, such as stone.

The blade of the battle-axe head has several wide pits associated with the removal of large stone inclusions through manufacture and subsequent weathering. Despite this weathering, some striations survive, running parallel with the blade edge and similar to those on the body of the axe-head, suggestive of manufacturing traces (fig 8.5c). A small group of shallow, U-shaped pits is also visible in the centre of the blade tip (fig 8.5d). These

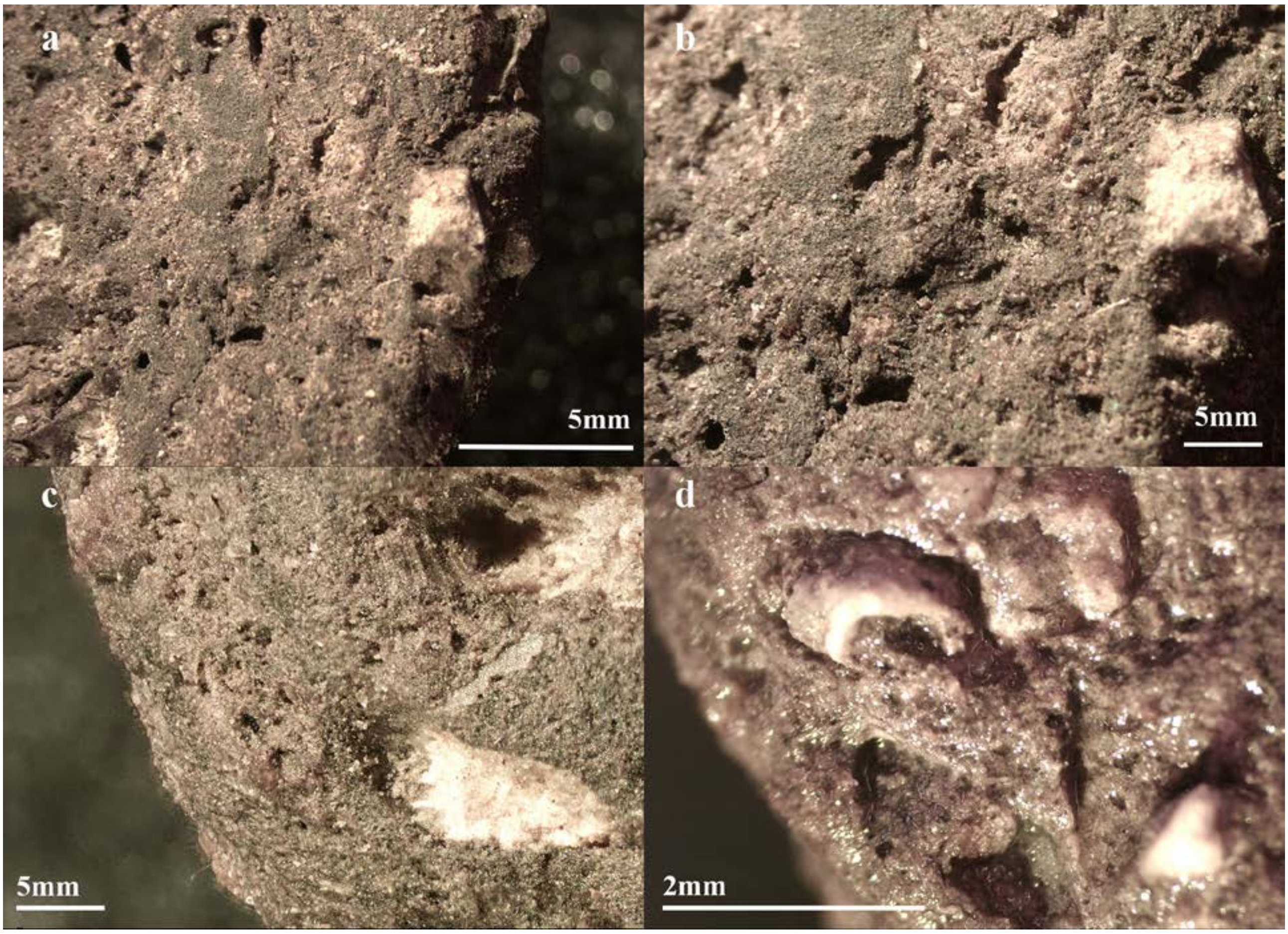

Fig 8.4 The stone head: a) blade edge; b) blade edge (higher magnification); c) butt edge; d) blade tip (A Roy)

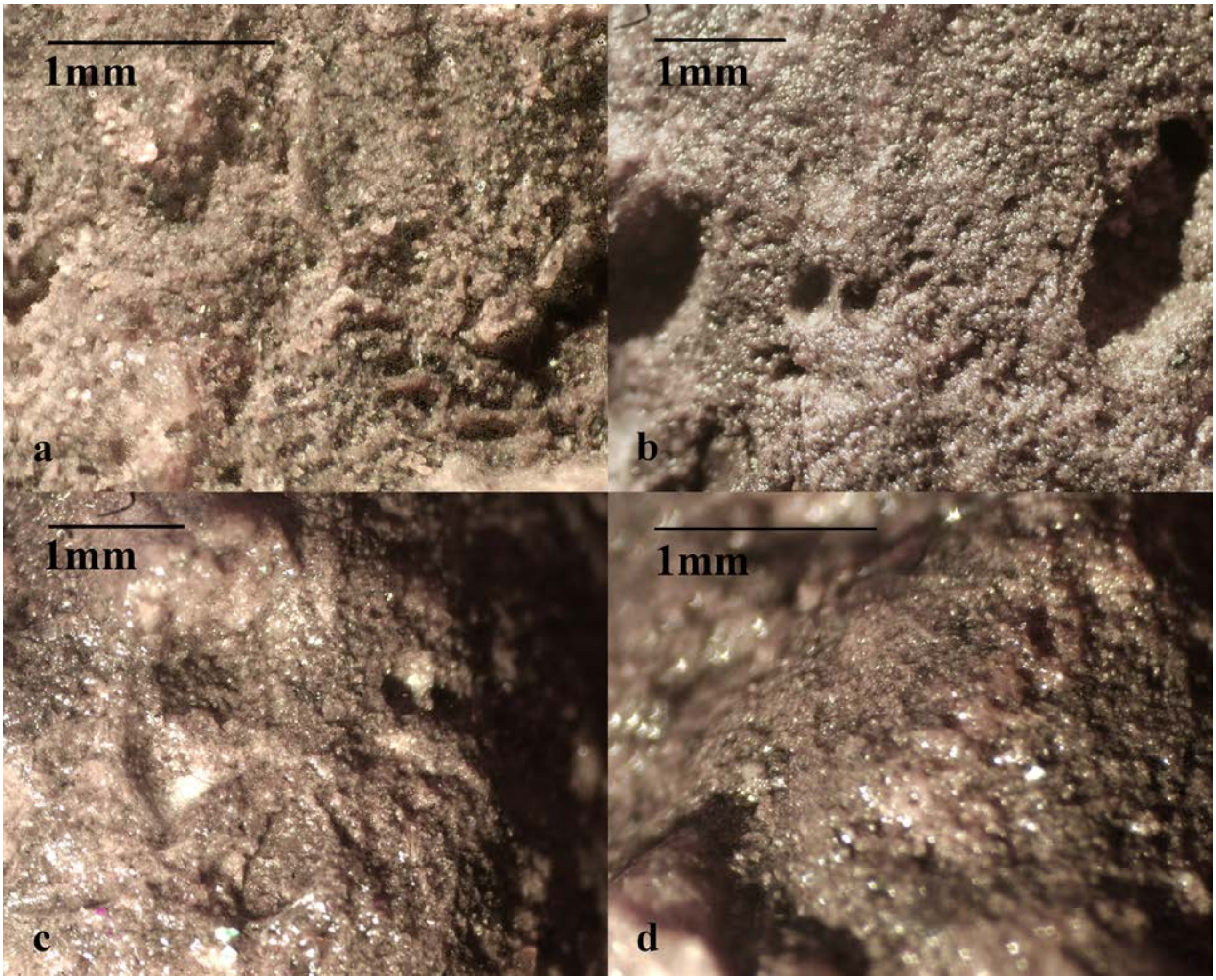

Fig 8.5 a) The stone head's blade edge; b) blade edge striations with U-shaped profiles, in parallel arrangement and overlapping; c) blade tip; removal of large inclusions on blade tip due to weathering, with some possible striations surviving on the blade edge; d) blade tip; shallow, U-shaped pits visible in the centre of the blade tip and parallel, overlapping striations (A Roy)

are associated with short parallel and overlapping, multi-directional striations that are most likely to be related to manufacture. However, the weathered state of the artefact means that it cannot be ruled out that some pits resulted from grain loss during weathering.

At high power, the manufacture traces are unclear and are limited to the harder inclusions. This is because the removal of stone grains across the entire artefact has disrupted wear formation so that the polish traces which survived the weathering are singular and sparse (Fig 8.6a). It is possible that areas of polish from manufacture, and possibly use, are also hidden from view because of the presence of water on the axe-head (Fig 8.6b): in order to preserve the wooden haft in its condition when found, the entire object was submerged in water during storage and frequently sprayed with water during analysis.

One of the fossil inclusions in the blade's centre has wear somewhat unaltered by weathering processes (Fig 8.6c). Short parallel and very thin striations are visible on this inclusion at low power, running almost parallel with the blade edge. At high power, short, parallel striations are also visible on the inclusion among a polish with a flat morphology, a corrugated appearance, and an intermediate density (Fig 8.7a–b). This wear is comparable to polish with a corrugated appearance created from an experiment involving rubbing dolomite against sandstone for eight hours (Fullagar *et al* 2012), thus suggesting it was produced during the manufacturing process, when the battle-axe head was finished by rubbing it against another stone.

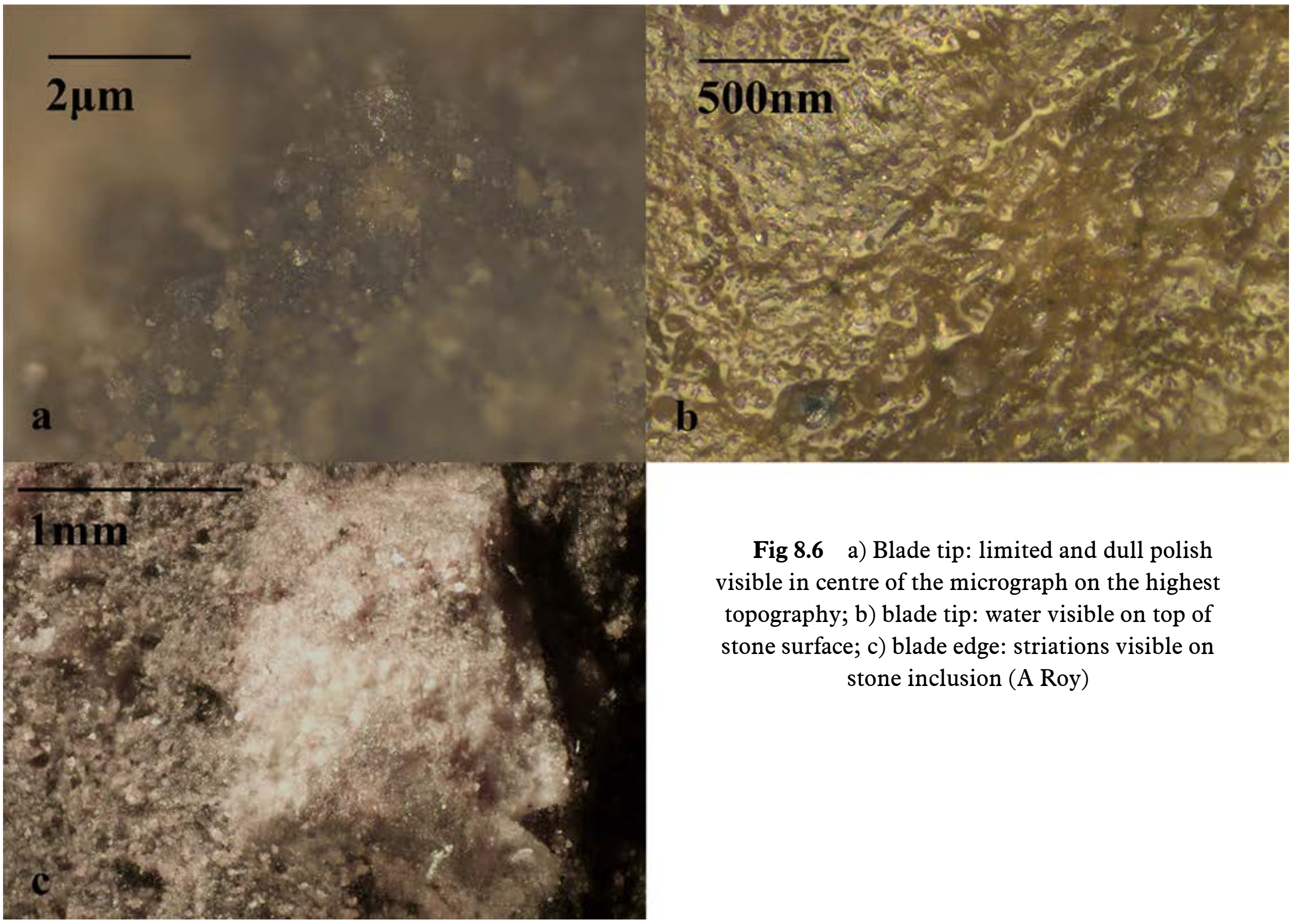

Fig 8.6 a) Blade tip: limited and dull polish visible in centre of the micrograph on the highest topography; b) blade tip: water visible on top of stone surface; c) blade edge: striations visible on stone inclusion (A Roy)

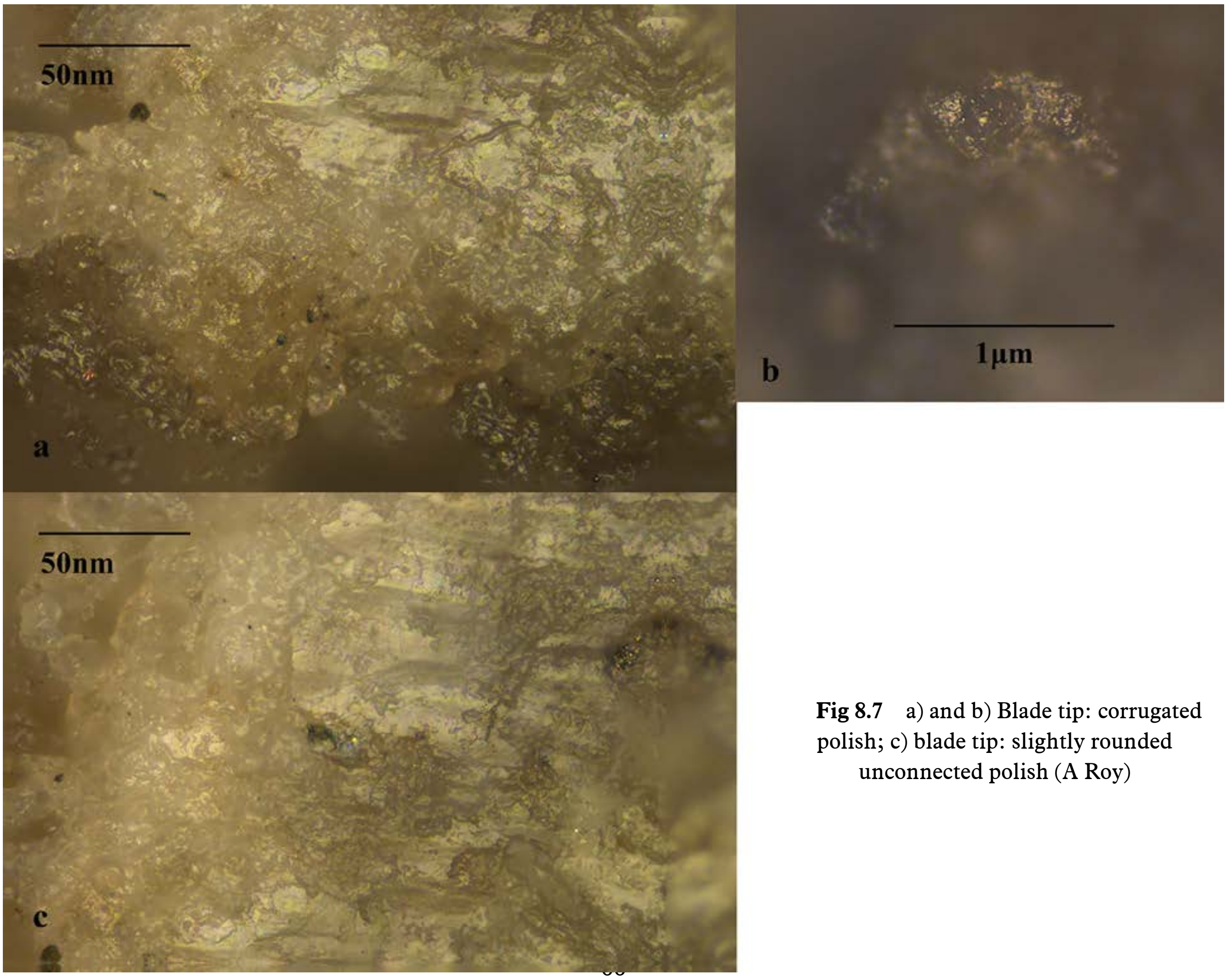

Fig 8.7 a) and b) Blade tip: corrugated polish; c) blade tip: slightly rounded unconnected polish (A Roy)

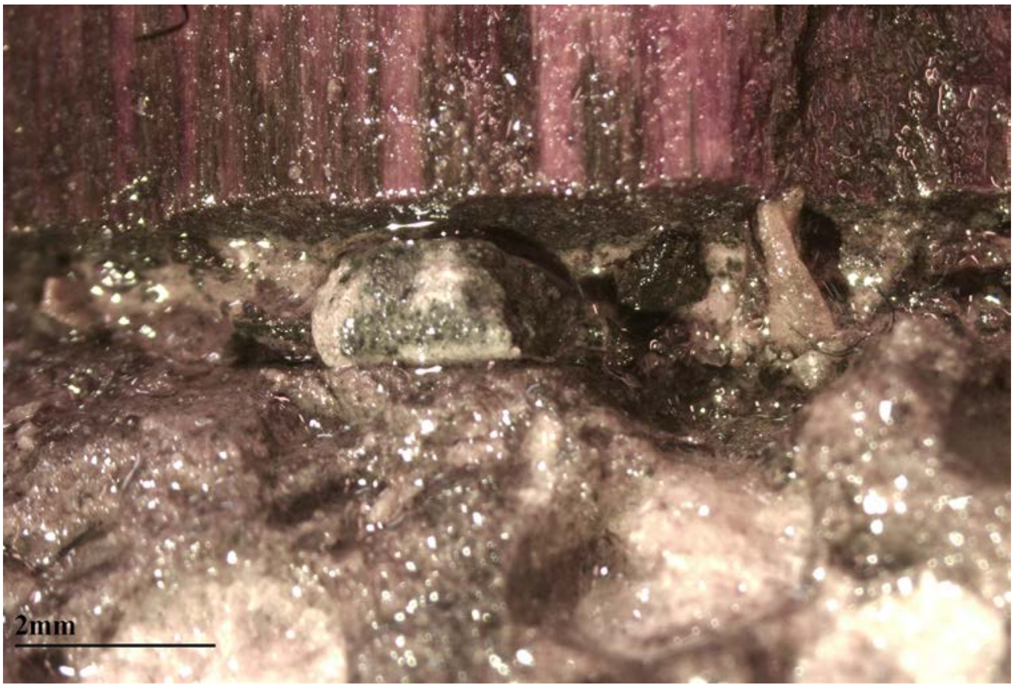

Fig 8.8 Hafted head at perforation with grit and other tiny stones lodged between the haft and the head (A Roy)

One other small area of polish also stands out on the blade tip under high magnifications (Fig 8.7c). This unconnected polish existed on the higher parts of the surface. It has a slightly rounded appearance and possible directionality and has similarities with polish caused by contact with wood. However, striations were not visible, and since manufacturing traces are abundant in comparison and the axe-head was weathered, it is also possible that the rounding was an effect of weathering.

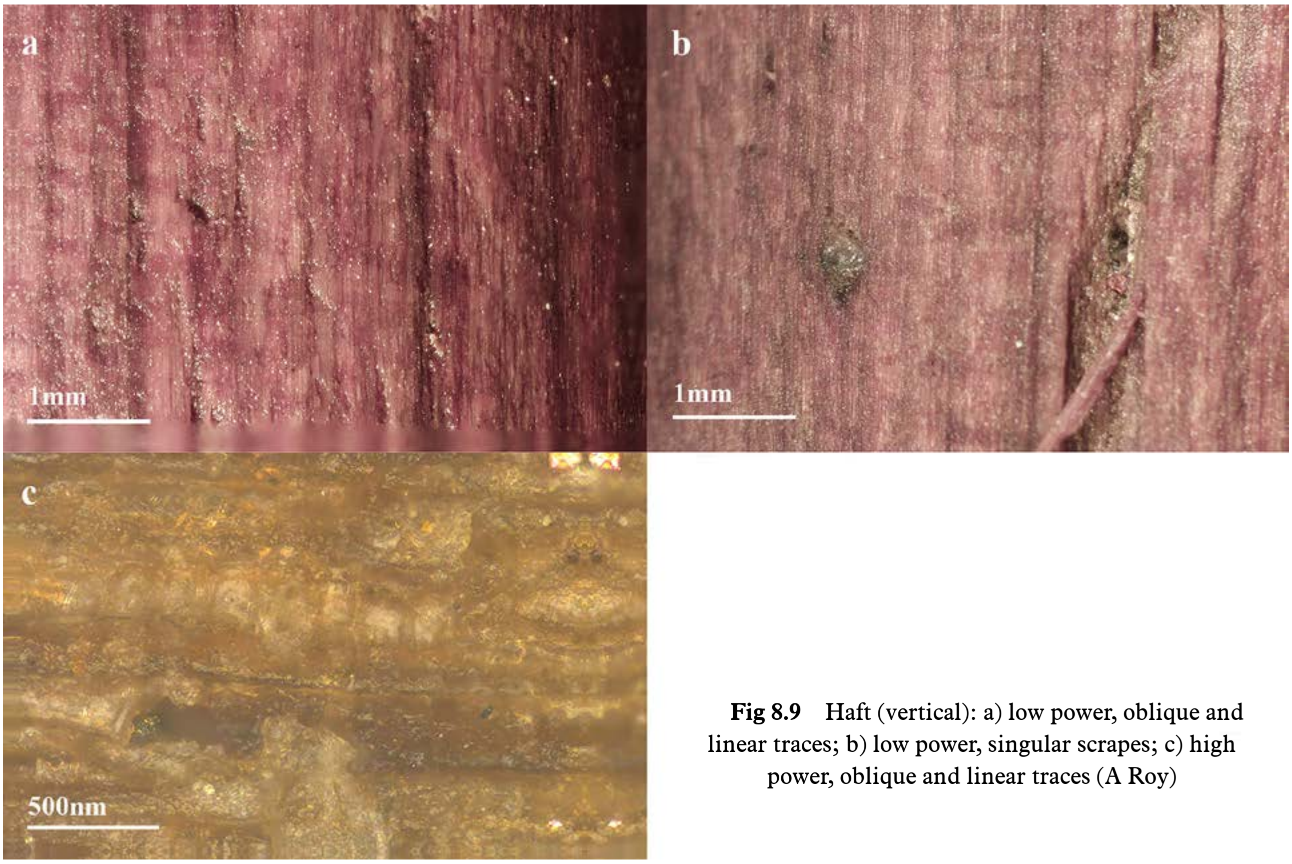

Fig 8.9 Haft (vertical): a) low power, oblique and linear traces; b) low power, singular scrapes; c) high power, oblique and linear traces (A Roy)

The perforation could not be analysed since the haft is securely fitted within it. Loose stone grains and sediments were trapped between the wooden haft and the edge of the perforation at both the upper and lower entrances to the perforation (Fig 8.8). These were probably a post-depositional accumulation, although it cannot be ruled out that sediment was used during the hafting process to create friction to enhance the secure fit of the haft in the perforation.

As noted below, the wooden haft is in almost perfect condition and has little evidence of damage. Microscopically, the haft shows obvious signs of manufacture, including linear longitudinal and oblique traces visible at both low and high power, and singular and sparse scrapes, which are macroscopically visible (Fig 8.9). The oblique traces may have been caused by thinning or planing of the wood. The longitudinal linear traces, which cover the haft, are parallel with its length and were probably produced by a debarking action, while the scrapes were caused by wear to the surface after manufacture (Caruso Fermé and Aschero 2020; Caruso Fermé *et al* 2015).

The haft
by Michael Bamforth

The haft is formed of a single wooden cylinder 338mm long. One end has been worked into a cylindrical tenon, 20mm long with a diameter of 12mm, to allow the haft to pass through a circular perforation in the stone head (Fig 8.10). Occasional slight facets are visible around the top of the tenon at the junction with the haft (Fig 8.11). The haft is cut flush in line with the top of the stone head. The haft measures 17mm by 18mm adjacent to the head and is waisted along its length, being thinnest in the middle, with a minimum diameter of 15mm by 16mm. The haft then flares towards the butt end, which has a diameter of 22mm. As previously discussed, use-wear analysis suggests the axe-head was not used for utilitarian purposes between manufacture and deposition, and this is in keeping with the condition of the wooden haft, which does not appear damaged or worn from use.

The haft is a heartwood dowel, worked down from a parent branch with an un-reconstructable diameter. Fashioned from a close-grained wood, the character of the grain has been displayed with a pleasing aesthetic by the waisting of the handle, providing an interesting display of the truncated growth rings, of which *c* 13 are visible, varying from 1.5mm to 2mm wide. The wooden handle is currently of an unknown wood type; both XCT and

Fig 8.10 The hafted miniature battle-axe head (M Bamforth)

Fig 8.11 Slight facets around top of haft at junction with tenon (M Bamforth)

3D microscopy were used to try to determine the wood species but these failed to identify it with any certainty. What can be said is the that the haft is made from a branch that comprises 33 annual rings (Harding *et al* 2024). A very slight twist to the grain is evident towards the lower (butt) end. In keeping with the Tetney haft, prehistoric axe hafts are almost always formed of dowels, as opposed to roundwood, to take advantage of the increased strength of such a form (Allen 2006; Bamforth 2024; Taylor 2001, 2004).

The haft is well finished and smoothed, removing almost all macroscopic traces describing the working of the object. The lower end of the haft appears slightly darker, and while one cannot rule out the possibility that this was due to the treating of the haft with some form of fat, wax or oil, it is equally or more likely that it is due to a post-depositional taphonomic factor. A small quantity of resin is visible within the darker area as blob-like accretions, including one particularly noticeable example (Fig 8.12). Given the high level of finish to the haft, it would seem unusual to have left a relatively large piece of some form of surface treatment visible. Instead, this appears to be a residue of animal/pitch glue, possibly used to affix the head to the shaft (as discussed by Francesca Gherardi below).

The butt end is hemispherical and smooth, with traces of the original working present in the form of two stop marks caused by a sharp-edged tool, the largest measuring 7mm wide and 1mm deep (Fig 8.13). A sub-circular flat area is present in the centre of the butt end, perhaps where the haft originally extended during the working process but has now been trimmed away. In keeping with the Early Bronze Age wooden studs from Whitehorse Hill, Dartmoor (Sheridan *et al* 2016), discussed further below, it seems likely that the butt end was abraded into shape following the primary working.

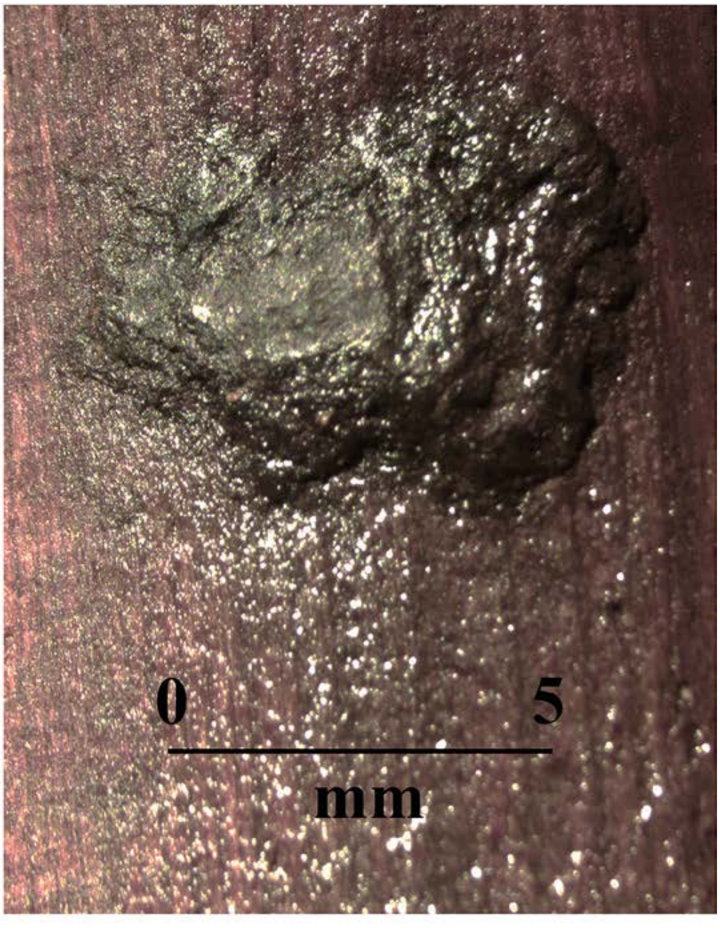

Fig 8.12 Substance present on handle (M Bamforth and A Roy)

Fig 8.13 Butt end of haft with stop marks present (M Bamforth)

The regular, uniform nature of the Tetney haft and the high degree of rotational symmetry raises the possibility that it was turned as opposed to carved. If turned, then the orientation of the haft with the grain running along the length would be described as spindle turned. The high level of finish has removed any traces of macroscopic evidence for primary working along the length of the shaft, leaving the method of conversion open to conjecture. The uniformity of the object does not necessitate turning, however, as a skilled woodworker could carve such objects (Diederik Pomstra, pers comm, 2021). If the handle is turned, it represents one of the earliest pieces of evidence for this technology in Britain, as it predates the earliest evidence for pole lathes and the use of a separate mandrel by a significant margin; see, however, the dating of the Whitehorse Hill studs and the turning technique thought to have been used to manufacture them (Sheridan *et al* 2016; and see below). If manufactured this way, it is likely that a strap lathe had been used, with the strap applied directly to the workpiece to provide reciprocal rotation (Morris 2000; Pugsley 2005; Woodbury 1963).

In terms of traces left by turning, it is interesting to note that Earwood, when discussing turned bowls, states that 'Even where vessels have been highly polished after turning, some of these fine marks can often be seen' (1993, 184). Indeed, brief microscopic examination of the haft during the use-wear analysis of the stone head revealed possible working traces around the circumference of the haft (as described above, and Fig 8.8). If this is indeed the case, then it would join the Whitehorse Hill studs as a very early example of the practice. However, it should be noted that such traces may also have been produced by working the haft with hand tools, without a lathe.

In Continental Western Europe, turning may have emerged as early as the Late Bronze Age, becoming more frequent in the Iron Age, although a relatively limited number of turned objects have been recovered (Earwood 1993, 184; Pugsley 2005, 3–4, 9). In Britain, there is virtually no definite evidence for the use of lathes, turned artefacts, or turning waste before the Iron Age (Earwood 1993, 184; Pugsley 2005). Until recently, the earliest undisputed evidence for turning in Britain was associated with the Mid- to Late Iron Age site of Glastonbury Lake Village, Somerset, and includes both wood and shale objects (Bulleid and Gray 1911; Pugsley 2005, 3, 9). There is a disputed Early Iron Age turned bowl base/spindle whorl recovered from Oakbank Crannog in Perth and Kinross (Pugsley 2005, 2; Sands 1997, 41–2, 58) and a limited number of earlier, possibly turned vessels from other sites (Earwood 1993; Pugsley 2005). The craft becomes more common, although certainly not ubiquitous, in the Romano-British period (Morris 2000, 21; Pugsley 2005, 3).

The earliest evidence for turning in Britain has recently been pushed back to the Early Bronze Age with a Bayesian model of 1730–1600 cal BC, 95% probability (Marshall *et al* 2016, 188), following the discovery of two pairs of studs – one pair probably ear studs, the other probably labrets – recovered from a cist grave at Whitehorse Hill (Sheridan *et al* 2016, 118). These were identified as turned on the basis not only of the regularity of their circular cross-section but also of the clear presence of parallel incisions around the waist of the studs (Sheridan *et al* 2016, 121–2). It is suggested the outer domes were ground against an abrasive surface to finish them and that the studs may then have been treated with oil. Experimental replication of the studs was carried out on a reciprocal strap lathe, with one person turning the lathe and the other controlling the cutting tool. The authors suggest that turning may have started in Britain with such relatively small, simple items, and the relatively plain, waisted haft considered here would undoubtedly be a natural progression of this origin theory (Sheridan *et al* 2016, 123). However, Pugsley (2005) cautions against the identification of turning based purely on the presence of linear striations around a circumference, warning that such marks can also be created by carving. In the author's opinion, however, it is considered to be a distinct possibility that the Tetney haft had been shaped by turning.

Whether considering prehistoric, historic or modern examples, tools that require rotational control of the working head, such as axes, almost always have handles with elliptical or ovoid cross-sections to enhance handling of the tool (Allen 2006; Bamforth 2024; Taylor 2001, 2004). The use of a circular cross-section haft for the Tetney battle-axe therefore describes a turned object, or else a carved object fashioned to mimic a turned object, or the outcome of a highly unusual aesthetic choice. The haft of the miniature battle-axe could represent some of the earliest evidence for wood turning in Britain. It is undoubtedly a rare and unusual object in terms of its aesthetic nature, high level of finish, and apparent precision and skill used in its manufacture. It is possible that the haft was fashioned by a highly specialised woodworker who was not part of the community that constructed the coffin, and that the artefact may have been acquired through long-distance trade.

Analysis by Fourier transform infrared (FTIR) spectroscopy of residues on the haft

by Francesca Gherardi

Materials and methods

To characterise the chemical composition of the residue traces on the haft, the battle-axe was sent to Historic England's Fort Cumberland laboratories, where it was subjected to Fourier transform infrared (FTIR) spectroscopy. The object had previously been conserved, and the intervention had included impregnation with polyethylene glycol (PEG) followed by freeze-drying. The residue on the haft was observed by 3D digital microscopy, using a Keyence VHX7000 3D digital microscope at different magnifications. Small samples were collected using a needle and analysed by FTIR spectroscopy to obtain qualitative chemical information. The FTIR spectra were acquired by a Spectrum 100 spectrometer (Perkin Elmer) equipped with a DTGS detector, fitted with an Attenuated Total Reflection (ATR) diamond-ZnSe crystal accessory. Spectra were recorded over the range 650–4000 $^{cm-1}$, with a resolution of 4.00 $^{cm-1}$, and were averaged over 32 accumulations.

3D digital microscopy

The residue on the haft has a diameter of about 6mm (Fig 8.12). It is dark brown and matte, except in the central part where it is light brown and reflective, most probably due to residues of PEG used during the conservation treatment. It is well adhered to the haft, but some micro-cracks are visible, resulting from the freeze-drying conservation process (Panter and Creed 2023).

ATR-FTIR spectroscopy

FTIR spectroscopy was used to gain preliminary qualitative chemical information for the residue. However, in the analysis of archaeological organic materials, it is important to highlight that the chemical composition of the materials may have been changed by treatment before use and by ageing.

Different spectra were collected from the samples, but only two are reported here as they show the same results (Fig 8.14). The spectra are characterised by peaks at about 2890 $^{cm-1}$ (CH stretching), 1468 $^{cm-1}$ (CH scissoring), 1340 $^{cm-1}$ (CH bending), 1100 $^{cm-1}$ (CO stretching) and 960 $^{cm-1}$ (CH rocking), which are related to the PEG (Panter and Creed 2023). Despite the presence of bands related to PEG, other vibrational bands can be observed at about 3290 (NH stretching), 1640 $^{cm-1}$ (Amide I (C=O) stretching), and at 1545 $^{cm-1}$ (Amide II (N-H) bending), which are ascribed to an aged proteinaceous material, such as an animal glue/adhesive. The spectra of the residue show a very slight peak at about 1735 $^{cm-1}$ (C=O stretching of ester), which could be related to the presence of another other organic material, such as pitch (solid or semi-solid portion of tar). This cannot be fully determined as

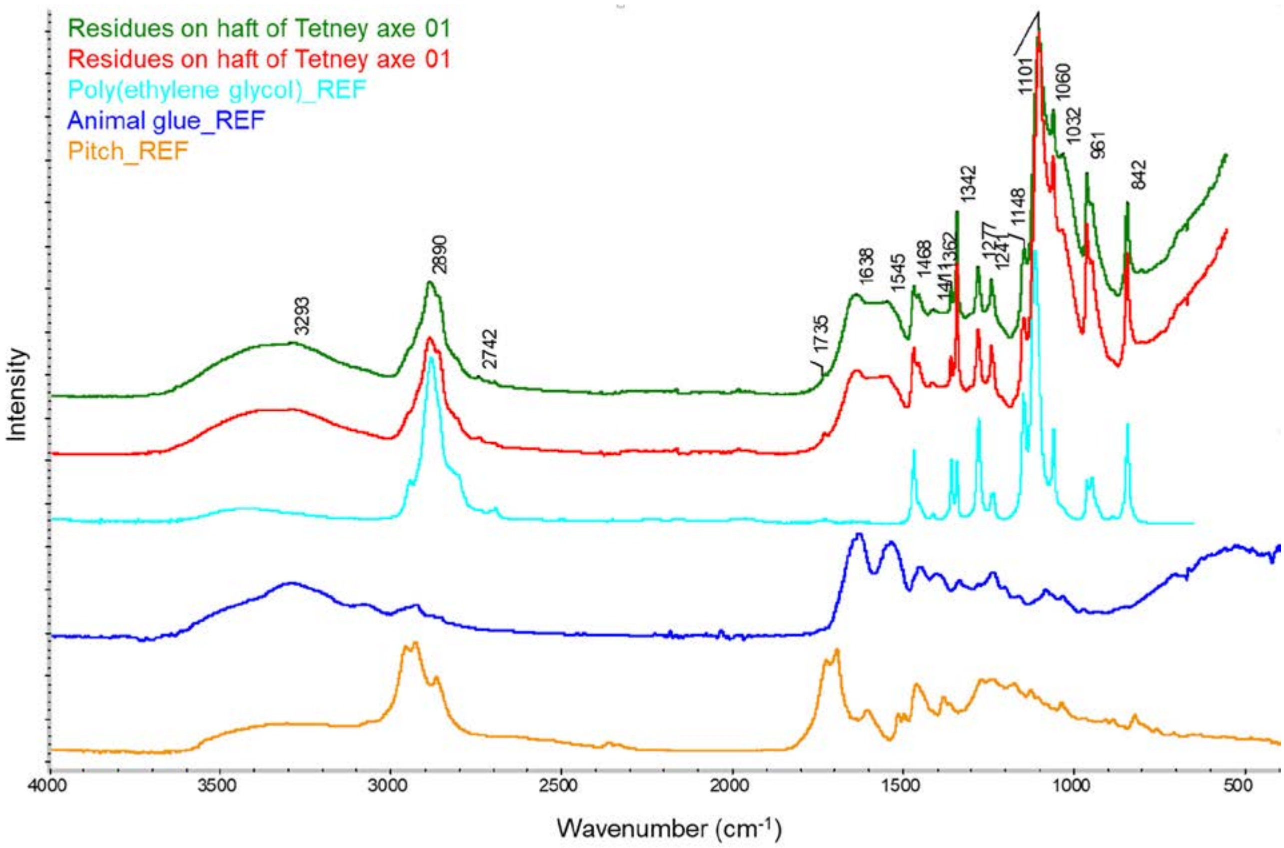

Fig 8.14 FTIR spectra of samples collected from the residues on the haft of the Tetney axe (green and red spectra) and the FTIR spectra of reference samples of PEG (light blue spectrum), animal glue (blue spectrum) and pitch (orange spectrum)

the main peaks related to this compound overlap with the absorption bands of PEG. The spectra display a high peak at about 1030 $^{cm-1}$ (Si-O bond), which is associated to the presence of silicates/clay materials. It is difficult to determine whether silicates were added intentionally as fillers to the proteinaceous adhesive or whether they are contaminants from the burial environment.

The results indicate that the residue on the haft contains a proteinaceous compound, such as an animal glue, which might have been mixed with another organic compound such as pitch. Collagen proteins in animal glues are obtained from animal hides, bones and connective tissues (Langejans *et al* 2022). Protein-based glues are prone to microbial decay, are water-sensitive and they do not preserve well, so are rarely found in the archaeological record (Kozowyk *et al* 2020). Grey-white adhesive residues were found on a Neolithic ornament from Kowal, Poland, which was made from two pieces of deer antler. This proteinaceous material, possibly an animal glue mixed with lime plaster, was apparently used to secure together the different pieces of the artefact (Rumiński and Osipowicz 2014). Hide glue was used to attach bark strips as decoration to a Neolithic yew bow found at the Parkhaus Opéra site in Zurich, Switzerland (Bleicher *et al* 2015), while tar and pitch were widely used to haft arrowheads, repair broken pottery and caulk ships (Kozowyk *et al* 2020).

Conclusions from the FTIR spectroscopy analysis

FTIR spectroscopy was used to provide a preliminary characterisation of the dark residue on the haft. The results indicate that it contains a proteinaceous material, possibly mixed with other organic compounds such as pitch. The identification of the compounds could not be fully assessed because of the overlapping of the absorption bands of PEG, which was used for the conservation of the haft. In the future, and in order to distinguish better these complex compounds and identify molecular biomarkers indicative of specific species, gas chromatography mass spectrometry analysis should be undertaken, being a more precise method to characterise organic compounds.

Discussion

by Alison Sheridan

The Tetney battle-axe is of international significance and extremely rare due to its completeness. In other examples where elements of the haft are preserved, they survive only as fragments within the perforation of the stone axehead. Such is the case at Groß Sarau in northern Germany (Schultrich 2018, 496), and the much earlier, double-bladed 'battle axe/sceptre' from Cham-Eslen, Switzerland, with its *c* 1200mm-long haft (Gross-Klee and Hochuli 2002; Gross and Huber 2016). This later Late Neolithic object has a weighted mean radiocarbon date of *4320–4000 cal BC (95% probability*; ETH-20508, Ua-14882, 5290±60 BP). The only other example of a complete Early Bronze Age battle-axe from Europe known to the author is the one found in a bog at Emmer-Compascuum in the Netherlands (Fig. 8.15), with a haft of rowan some 700mm long and a stone head *c* 108 mm long (Butler and Fokkens 2005, 391 and fig 17.17). Its haft has been radiocarbon-dated to 2310–2050 cal BC (95% probability; GrA-17284, 3770±35 BP; Brinkkemper and Drenth 2002). A final example of note is an axe-hammer found in Cleethorpes, Lincolnshire (Leahy 1986). It has a weighted mean radiocarbon date of *1870–1490 cal BC (95% probability*; OxA-130, OxA-131, 3360±71 BP). However, the Cleethorpes axe-hammer is significantly different from the other examples discussed here, having a large, heavy (2.73kg) stone head measuring 232mm by 101mm by 65mm and a haft that is slightly longer than that of the Emmer-Compascuum battle-axe.

The Tetney battle-axe is significant in several other respects as well: for having a precise deposition date of 2032 BC (see Chapter 5); for its context – a prestigious log-coffin – and its association with an adult male; for the choice of stone for its head; for its diminutive size; and for the absence of use-wear traces.

The 2032 BC deposition date – assuming that the battle-axe was not old when deposited – is the most precise date yet obtained for a British battle-axe head and is well in line with the radiocarbon dates for this particular type, Needham's 'Class 2', which he places around 2000 cal BC. Table 8.1 presents all the available radiocarbon and dendro-dating evidence for battle-axe heads in Britain known to the author. 'Class 2' examples fall within the early part of the overall 2200–1600 cal BC currency for British battle-axe heads.

The discovery of the Tetney battle-axe in a log-coffin under a barrow, a type of funerary monument that would have required considerable effort to create, underlines the special status accorded to the man buried in that coffin. The distribution, associations, date and significance of Early Bronze Age log-coffin graves have already been discussed in Chapter 4, as well as in detail elsewhere (Jones *et al* 2023; Parker Pearson *et al* 2013), so need not be repeated here. Suffice it to note that the Tetney coffin was constructed during the peak period of use of this type of funerary monument (Jones *et al* 2023), and that precious artefacts that will have constituted symbols of power are sometimes found in log-coffins. Battle-axe heads have been found in two log-coffins as well as at Tetney: at Hanging Grimston Barrow 90, North Yorkshire, and Hove, East Sussex (Parker Pearson *et al* 2013, table 4.1). At the latter site, the Class 8 battle-axe head was accompanied by a bronze-bladed dagger, a whetstone and an amber cup (*ibid*, 44.2). There is one further, possible, example: Phillips *et al* (1988, 58) refer to an 'axe-hammer' of micaceous sub-greywacke stone, allegedly found in a 'canoe' – possibly a log-coffin – under a barrow at Cononley, West Yorkshire (Clough and Cummins 1988, 216, Y698), but no further details are provided

Fig 8.15 The Tetney battle-axe compared to the larger example from Emmer-Compascuum, the Netherlands (M Bamforth and © Drents Museum, Assen)

and it is unclear whether the item in question was actually a battle-axe head, rather than an axe-hammer, which is a larger kind of artefact.

The association of the Tetney battle-axe with an adult male is consistent with the evidence both from log-coffins, which are overwhelmingly male-associated (as discussed in Parker Pearson *et al* 2013, 36), and from graves where battle-axe heads have been found. While the reliable sexing of the human remains associated with this artefact type has only been undertaken in a small proportion of the 116 funerary finds from Britain and the Isle of Man (Stuart Needham, pers comm, 16 April 2024), the evidence points unequivocally to a male association: of the 18 sexed individuals, 16 are definitely or probably male and two (from Stanton Moor T36, Derbyshire and Church Lawton, Cheshire) are only possibly female.

The choice of a distinctive-looking stone for the head of the Tetney battle-axe is also significant, as this pertains to a current debate as to what informed the choice of stone used for battle-axe heads and whether, or how, considerations other than a purely practical assessment of the durability and workability of the stone were sometimes involved in the choice. In a study of Scottish battle-axe heads and axe-hammers, Malcolm Fenton (1984) concluded that glacial, alluvial or beach cobbles were, in most cases, the preferred raw material for making both types of object. Amber Roy, whose research featuring use-wear analysis has demonstrated that some battle-axe heads fulfilled utilitarian roles such as chopping wood (Roy 2019; 2020), has interpreted the petrological diversity of battle-axe heads in terms of 'a haphazard exploitation of cobbles and glacial erratics' (Roy 2020, 242). This author, however, suspects that the situation was more complex than that, with social and prestige value probably informing the choice of raw materials in some cases. The Tetney battle-axe head, which would have been visually striking and aesthetically pleasing when new and polished, fits into a pattern of the use (albeit not invariable) of distinctive-looking, often variegated-colour stones for certain finely made battle-axe heads such as the ones shown in Figures 8.16–8.17. Such stones would have been deliberately sought out, and their appearance may have enhanced their value. While Roy's use-wear study of 62 British battle-axe heads found that at least one example made from speckled stone had been used, for chopping wood (Portpatrick, Dumfries and Galloway: Roy 2019, 247–8, ID 190), her analysis of the Tetney example has demonstrated that it shows no signs of utilitarian use. Further use-wear analysis, targeting the most finely made battle-axe heads, would be needed to determine what proportion of those had similarly not been used for 'everyday' purposes.

The use of a fossiliferous limestone for the Tetney battle-axe head, then, could well have been informed by the desire to make a visually striking object (and perhaps by a belief that the stone possessed supernatural properties); the stone was certainly not chosen for durability, as fossiliferous limestone is relatively soft and would probably break easily. There is one other example known to the author of the use of fossiliferous limestone (although not necessarily from the same source) for a battle-axe head, namely a 'full-sized' example from an unknown location in Scotland (Fig 8.16), now in the National Museums Scotland collection (NMS X.AH 66). Moreover, it should be noted that the Early Bronze Age mace-head from the richly equipped grave at Bush Barrow, Wiltshire – only slightly later than the Tetney battle-axe – is also of fossiliferous (corallian/coralline) limestone, from the south coast of England (Needham *et al* 2010, fig 5; 2015, 248–9 and fig 6.2.6). Other parallels exist for the use of not particularly hard stone for making battle-axe heads: one example found with cremated remains in a Cordoned Urn at McKelvie Hospital, Oban, is described as being of kaolinite, a particularly soft stone (Anon. 1898, 59). The associated cremated remains of an adult male have been radiocarbon dated to 1870–1560 cal BC (95% probability; GrA-24017, 3400±40 BP; Sheridan 2007a).

The diminutive size of the Tetney battle-axe is remarkable. The shortness of its haft compared to that of the Emmer-Compactuum battle-axe is clear from Figure 8.15, although it is not known whether the latter was a 'normal'-length haft, as no comparanda survive. The head joins a small set of British battle-axe heads that are shorter than 90mm, which are usually described as 'miniature'; examples are shown in Figure 8.17. In her publications on British battle-axe heads, Roe (1966; 1979) did not list examples that fall into this category, but the Welsh and Scottish 'miniature' battle-axe heads have been reviewed by Dawn McLaren (2004); her listing is reproduced, with additional examples, in Table 8.2. These data are revealing, showing that in some cases, as at Doune in Stirling, miniature battle-axe heads were associated with children – although clearly that was not the case at Tetney, so there must have been more than one reason for manufacturing such small battle-axe heads. Moreover, the fact that unfinished examples have been found in Shetland, Orkney and Wales demonstrates that these items were being manufactured in different parts of Britain.

The diminutive size of the Tetney battle-axe, the use of a relatively soft stone, and the absence of use-wear traces on its head are all pertinent to the debate about the function/s and significance of battle-axes. This debate has been long-running, with the use of the term 'battle-axe' reflecting the view, widely held during the 19th

Table 8.1 Radiocarbon-dated battle-axe heads in Britain, ordered according to Needham's classification. 'Miniature' examples indicated by italics

Findspot	Needham Class	Roe Stage	Context and associations	Dated material and date cal BC, 95.4% probability, calibrated using OxCal v.4.4.4, results not rounded out	References and comments
Barns Farm Grave 1, Fife	1	I	Associated with remains of unburnt contracted skeleton of adult of indeterminate sex, on right side, accompanied by tripartite Vase Food Vessel (FV), in a possible coracle in a pit under round barrow. Stain representing battle-axe haft present. Also present, and deposited at same time, were three deposits of cremated human remains, one with a burnt bone bead	Calcined human bone (3 deposits in grave): GrA-24001 = 2120–1780 cal BC GrA-23993 = 2130–1880 cal BC GrA-23995 = 2190–1900 cal BC	Sheridan 2003; 2007a; Watkins 1983, 70–4, 106–8, fig 19.61, pl 10 The dated deposits of cremated bone were deposited at the same time as the unburnt individual, the Food Vessel and the battle-axe; they may have been curated, but not necessarily for a long time
Tetney, Lincolnshire	**2**	**III**	**In log-coffin, with unburnt remains of adult male**	**Unburnt human bone: 3722±27 BP (GrM-27781), 2195–2035; dated by a combination of dendrochronology and radiocarbon to 2032 cal BC**	**This publication**
Wetwang Slack 12, burial iii, East Yorkshire	2	III	Associated with unburnt contracted remains of young adult male on L side, head to E, in large plank-built chamber in grave, accompanied by pig bones from joint of meat	Oak 'charcoal' from mature timbers: 3700±70 BP (HAR-4427), *2292–1895*	Dent 1983, 10, fig 2.3; Manby 2017, 121, table 5.2 The date, on oak, was determined a long time ago and there may be an 'old wood' effect
Ness of Gruting (House 1), Shetland	i) 2, unfinished (unperforat-ed); ii) 2?, broken, probably unfinished; [iii) not a battle-axe head]	i) II, unfinished (unperforated; Roe no. 435); ii) I (broken; Roe no. 436); iii) I ('blunt battle axe'; Roe no. 437)	From an Early Bronze Age house. i) and ii) found in the interior of the house, one near the hearth, the other on paving leading to the entrance; iii) – not a battle-axe head – found within the house wall. Other artefacts from the house (including within the wall filling): pottery (probably a Shetland version of 'domestic Beaker' pottery) and a large lithic assemblage including fragments of riebeckite felsite knives and axe-heads; see Henshall 1958 for details. Also present, inside the wall, was a cache of 12.7kg of carbonised barley grains, found beside a broken trough quern	Carbonised barley grain (terminus post quem for the battle-axe heads): AAR-15646 = 3736±35 BP AAR-15647 = 3668±35 BP GrN-6168 = 3710±55 BP BM-441 = 3514±120 and a weighted mean 3697± 23 BP provides the best estimate for the age of the deposit, that calibrates to 2190–1985 cal BC (95% probability).	Calder 1958, 354; Henshall 1958, 392–3, fig 19A to C; Roe 1966, 205, 220, 222, 223, 243 (nos 435–7) The largest of these three objects (Henshall 1958, fig 19A; Roe 1979, no. 437, NMS X.HD 1026, item 'iii' in this table) is described by Roe as a 'blunt battle axe' but arguably it is not a battle-axe head at all. The cache of carbonised barley grains is believed to date the construction of the house and provides a *terminus post quem* for the battle-axe heads; their deposition need not post-date the house construction by very long
Doune (Round Hill sand quarry), Stirling	3	III	In short stone cist with no obvious covering mound, associated with unburnt remains of child, 5–9, sex identified (through aDNA) as male; two Food Vessels, on small, one normal-sized; battle-axe head and small FV found close to where head would have lain	Unburnt human bone: SUERC-2869 = 1860–1570 cal BC	Fenton 1988, 128, fig 37 (PER 41); Hamilton 1959, 233, fig 9; McLaren 2004, 292, fig 100; Olalde *et al* 2018; Sheridan 2007a; Sheridan *et al* 2018
Cairnderry, Dumfries and Galloway	3	Prob. III (not IV as stated in Sheridan 2007b, 108)	In pit next to the entrance to a Bargrennan-type passage tomb, beside small inverted Collared Urn with calcined remains of adult of indeterminate sex in and around the urn; also present: accessory vessel. B-a has hairline crack but had not necessarily passed through the pyre	Calcined human bone: GrA-26605 = 1880–1630 cal BC	Cummings and Fowler 2007; Sheridan 2007a; 2007b
Oban, McKelvie Hospital, Argyll and Bute	3	IV	Found beside large upright Cordoned Urn containing cremated human remains of adult, indeterminate sex, resting on a rock ledge; two smaller urns found nearby. Battle-axe head lost; cast in National Museum of Scotland	Calcined human bone: GrA-24017 = 1870–1560 cal BC	Anon 1898, 58–9; Medina-Pettersson 2013, 282–4; Roe 1966, 221, 225, 241 (no. 364); Sheridan 2003; 2007a; Smith 1925, 92 fig 26, 96

Findspot	Needham Class	Roe Stage	Context and associations	Dated material and date cal BC, 95.4% probability, calibrated using OxCal v.4.4.4, results not rounded out	References and comments
Cross Farm, Stanbury, West Yorkshire	4	III	With calcined remains of young adult male in inverted Collared Urn in pit; accessory vessel, bone skewer pin, bone belt hook, two bronze basket-shaped ornaments, all burnt (as was the battle-axe head). Two further Collared Urns in same pit, upright	Calcined human bone: (OxA-18362) 3554±31 BP (SUERC-16360) 3555±35 BP and a weighted mean 3554± 24 BP provides the best estimate for the age of the cremation, that calibrates to 2000–1780 cal BC (95% probability).	Richardson and Vyner 2011
City Farm Site 3, Hanborough, Oxfordshire	4(?)	III or IV	With cremated human remains (age or sex not identified) in pit in ring-ditch	Charcoal (from a different pit within ring ditch; species not specified): GrA-1686 = 1610–1560 cal BC	Case *et al* 1965, 68, fig 26; S Needham, pers comm, 2024
Glasgow, Victoria Park ('Fossil grove'), City of Glasgow	5	IV	With cremated human remains in Collared Urn; no mound noted, nor is it specified whether the urn had been inverted or not	Calcined human bone: GrA-24866 1880–1630 cal BC	Fenton 1988, 121, fig 30 (LNK 32); Longworth 1984, 310, no. 1959, pl 141f; Mann 1923, 105, fig 5; Roe 1966, 242 (no. 396); 1979 61–2, fig 2 (no. 129); Sheridan 2007a
Carwinning Hill, Dalry, North Ayrshire	5	III	With calcined human remains (age and sex not identified) in inverted Collared Urn, buried in pit; bronze chisel	Calcined human bone: GrA-19421 = 1880–1620 cal BC	Fenton 1988, 119, fig 28 (Ayr 24); Longworth 1984, 309; Sheridan 2002; 2007a, 182
Low Caythorpe, Boynton, East Yorkshire	5	IV	With cremated human remains (age and sex not identified) in upright(?) Collared Urn, with flint knife, three flint flakes and snail shells; battle-axe head burnt. In pit inside ring ditch	Calcined human bone: SUERC-52003 3455±30 BP SUERC-52004 3516±27 BP and a weighted mean 3489± 21 BP provides the best estimate for the age of the cremation, that calibrates to 1885–1740 cal BC (95% probability).	Manby 2017, 121, table 5.2; S Needham, pers comm, 2024
Wilsford G58 (Hoare's no. 18), Amesbury, Wiltshire	5	IV	With unburnt remains of 'very tall and stout' male, on R side, head to SE, under centre of round barrow, accompanied by bronze axe-chisel; bronze double-pronged instrument; grooved stone block; bone spacer-plate; perforated antler handle; disarticulated human femoral fragment made into ?musical instrument; boar's tusk	Disarticulated human femoral fragment made into ?musical instrument: BRAMS-1426 = 1750–1550 cal BC	Annable and Simpson 1964, 47–8 (nos 211–8), 102 (fig); Booth and Brück 2020, supplementary table 3; Hoare 1812, 209, pl XXIX; Thurnam 1871, 411 fig 97; Woodward and Needham 2012; S Needham, pers comm, 2024
Church Lawton North barrow (monument B), F20, Cheshire	6	III	Found beside un-urned deposit of calcined bones of mature adult, possibly female, associated with calcined flint, bone pin and animal bone, in pit under round barrow	Calcined human bone: OxA-26841 = 1900–1700 cal BC	Needham in Reid 2014. The assemblage may well have been deposited in an organic bag
Bargrennan (pit 2), Dumfries and Galloway	6	IV (not III, as stated in Sheridan 2007b, 108)	With cremated remains of youth, possibly male, aged 15–16, in inverted Collared Urn within cairn of Bargrennan-type passage tomb; associated with burnt bone belt-hook. Battle-axe head burnt	Calcined bone: GU-13906 = 1890–1690 cal BC	Cummings and Fowler 2007, 44, 45, fig 3.32, 167; Sheridan 2007a; 2007b
High Lawfield, nr Kilmacolm, Renfrewshire	7	IV	With un-urned cremated remains (age or sex not identified) in pit under remains of cairn	Calcined human bone: GrA-24864 =1880–1630 cal BC	Fenton 1988, 123, fig 32 (REN 10); Mann 1923, 104, fig 4; Roe 1966, 207, 243 (no. 427); 1979, 60–1, fig 2 (no. 136); Sheridan 2007a, 185
Low Paradise Wood (Murton Common), Boltby, North Yorkshire	7	III	Associated with cremated remains of young adult male aged 15–25 plus pyre charcoal and a few flint flakes in upright Collared Urn in pit; burnt stone, prob. pyre debris, in pit	Oak charcoal: Beta-112235 = 2010–1700 cal BC	Boughey 2019; 2023; Heys and Taylor 1998 As the date is from oak charcoal, the possibility of an 'old wood' effect must be borne in mind

Findspot	Needham Class	Roe Stage	Context and associations	Dated material and date cal BC, 95.4% probability, calibrated using OxCal v.4.4.4, results not rounded out	References and comments
Eweford West, East Lothian (pit 025, context 043)	8	V	In pit beside Early Neolithic long cairn, associated with a secondary deposit of cremated human remains (of two adults, sex indeterminable) overlying and underlying further deposits of cremated human remains. Battle-axe head had been placed on top of deposit of cremated remains and a fire had been lit in the pit, possibly scorching the battle-axe head, before the final deposit of cremated remains was inserted	Calcined human bone: SUERC-5324 = 1880–1620 cal BC	Lelong and MacGregor 2007, 108–9 fig 5.8; Sheridan 2007a, 185; 2007c
Palmeira Square, Hove, (Sussex), Brighton and Hove	8	V	In oak log-coffin under large round barrow, with (probably) unburnt human remains, and amber cup, bronze dagger, perforated whetstone	Oak coffin: BM-682 = 1550–1320 cal BC	Evans 1897, 186, fig 119; Needham *et al* 2006, 97–9; Phillips 1857; Roe 1966, 221, 225, 226 (no. 207); Smith 1925, 81, fig. 2 Date determined long ago, on oak, and its reliability is questionable
Snail Down site XIV, Collingbourne Kingston, Wiltshire	Unclassified	'Early type'	Unassociated, found in ditchless barrow, in layer sealing inner mound	*Terminus post quem* date from pit under inner mound of barrow: ash charcoal: OxA-4178 = 2130–1690 cal BC	Roe 1966, 219, 238 (no. 223); Thomas 2005, 75, fig 24, 80, 213, fig 53 (J2)

Note: At Wilsford barrow G54, Wiltshire, a battle-axe head of Needham's Class 1 type, along with a bronze-bladed dagger of Needham's Type 2F1, was inserted into a pre-existing grave along with (presumably) unburnt human remains; the primary occupant of the grave had been associated with three early-style Beakers, and a set of barbed-and-tanged arrowheads found in the disturbed grave had also probably been associated with that primary occupant. A date of 3855±30 BP (SUERC-38159, *2470–2200 cal BC*) from an unburnt mandible (Booth and Brück 2020) must relate to the primary occupant of the grave (Stuart Needham, pers comm, 2024).

Fig 8.16 Battle-axe head of fossiliferous limestone, NMS X.AH 66, from an unknown findspot in Scotland. Photograph by Hugo Anderson-Whymark; © National Museums Scotland

and 20th centuries, that these were weapons used in inter-personal combat. The idea that they are also prestigious possessions, symbols of power of important individuals (for which the gender has been assumed to be male – a suggestion confirmed by the sexing evidence mentioned above), is also a long-established interpretation (as presented, for example, by Clarke *et al* 1985). Welcome new evidence pertaining to the debate has recently been provided by the use-wear analysis of 62 British specimens undertaken by Roy (2019; 2020), following similar analysis of Dutch examples by Karsten Wentink (2020). This has shown that many battle-axe heads have traces comparable to those produced experimentally by chopping wood, clearing roots and butchering – and, by extension, slaughtering an animal (although the 'contact-with-bone' traces could equally relate to use in inter-personal combat). Moreover, Roy's work has shown that several examples found in funerary contexts – such as one from Sandmill Farm, Dumfries and Galloway (Roy 2020, 243 and fig 7) – had been reground following use, as if to ready them for further use by the deceased in the afterlife. In discussing her results, Roy – like others in the 'new materialist' school of thought – plays down the 'prestige/symbols of power' interpretation of battle-axe heads. However, in this author's opinion, a false dichotomy is being drawn between 'utilitarian' and 'prestige/symbols of power' interpretations: an object could be *both* a symbol of power *and* one that was used for a variety of everyday purposes. This is illustrated convincingly in the aforementioned, much earlier double-bladed 'battle-axe/sceptre' from a lake settlement at Cham-Eslen, Switzerland: the head of this object is of rare and exotic serpentinite

Fig 8.17 Examples of 'miniature' battle-axe heads: 1. Unfinished example from near Skara Brae, Orkney; 2. Doune, Stirling; 3. Near Trevose Head (Cataclews), Cornwall. Photos: 1 and 2, © National Museums Scotland; 3: © Mik Markham

and the haft embellished by a decorative binding of pierced birch bark, stuck on with birch-bark tar (Gross and Huber 2016), suggesting this had been a precious possession of a high-ranking individual, and yet use-wear revealed that it had been used, possibly for a variety of tasks associated with one who spent long periods in a boat.

In this author's opinion, there was probably a spectrum of uses, and of attributed values, for Early Bronze Age battle-axes. Some were probably made and used for exclusively utilitarian purposes; some could indeed have been used as weapons; the possible use of some miniature versions as toys or amulets has been suggested with regard to the finds from a settlement at Sumburgh, Shetland (as discussed in McLaren 2004); and Roy's use-wear analysis has revealed that some had seen various uses. Others could have been used both for utilitarian purposes and as status symbols. Some, including the Tetney example, could have been made purely as status symbols (and the miniature example that was found in a boy's grave at Doune could have been both status symbol and toy). This could well account for the marked disparity in haft length between the Tetney example and the 'utilitarian' 'battle-axe' from Emmer-Compascuum, shown in Figure 8.15. The fact that some battle-axe heads – including the Tetney example – have evidently been made with great care and skill (as shown in Figures 8.16–17), and sometimes using carefully selected, distinctive-looking stone, suggests that the signalling of social status was indeed a factor – or *the* factor – in some cases. With the Tetney battle-axe, which was wholly unsuited for utili-

Table 8.2 'Miniature' British battle-axeheads <90mm long. From McLaren 2004, with additions

Findspot	Length (mm)	Context and associated material	Scientific Date	Reference	Comment
Tetney, Lincolnshire	69.15	Funerary: log-coffin; unburnt remains of adult male, 30–39 years	2032 BC (dendro date; see also Tyers and Marshall, Chapter 5 this publication, for ^{14}C dates)	This publication	
Doune, Perth and Kinross	66	Funerary: cist containing unburnt remains of child aged 5–9 (probably 6–7), sex determined as male through aDNA analysis; small Food Vessel and fragment of a larger Food Vessel	3400±35 BP (SUERC-2869), 1872–1547	Hamilton 1959; McLaren 2004; Olalde *et al* 2018; Sheridan *et al* 2018	Use-wear analysis by Roy (2019, 258) concluded that the battle-axe head showed no use-wear traces. Stone identified as quartz-rich sandstone (McLaren 2004, 291) A nearby cist at Glenhead, Doune, contained a miniature macehead, associated with the unburnt remains of a female aged 15–21, inside a Food Vessel
Kirkcolm, Low Glengyre, Dumfries and Galloway	73 (68, according to Mann 1923)	Funerary?: found 31 feet (9.45m) from upright Collared Urn, containing cremated remains of child aged 8–12, that was buried in a small, stone-lined pit under cairn. Accessory Vessel containing cremated remains beside the urn. Fire-damaged thumbnail scraper and 2 flakes of flint also present. Battle-axe head may have been deposited below cairn		Mann 1923; McLaren 2004	McLaren notes that Ian Longworth (1984, 297) did not accept the claimed association between the battle-axe head and the grave, and this seems reasonable – although its position, probably under a cairn, suggests association with funerary practice
Llanrhian, Pembrokeshire	74	Funerary: found among debris thrown out from a large cist under a round barrow. Cist contained unburnt human remains		McLaren 2004, with further references	
Near Trevose Head (Cataclews, Harlyn Bay), Cornwall	87	Funerary: from a barrow, associated with a Food Vessel. No further details		Crawford 1921	Length described in the Crawford 1921 report as '3.8"' (98mm), but photograph by Mik Markham suggests it is actually 87mm
Shrewton barrow G27, Wiltshire	82	Funerary: from primary grave under bowl barrow, with unburnt human remains		Annable and Simpson 1964, 49, 103, no. 237	
Rolston, Wiltshire	90	Funerary: from primary grave under round barrow, with contracted skeleton; battle-axe head found on the right of the skull		Smith 1925, 87 and fig. 16	
Ness of Gruting, Shetland	i) 57 ii) 72 (est.)	Domestic: inside house	TPQ (from cache of barley in house wall): a weighted mean 3704± 23 BP that calibrates to 2190–2005 cal BC (95% probability)	Calder 1956; McLaren 2004; Sheridan 2014	i) Unfinished (unperforated); ii) broken across middle; original length extrapolated. See Table 8.1 for further information on the dates
Sumburgh, Shetland	34	Domestic: found in LBA context in a settlement but assumed to be residual from EBA activity		McLaren 2004, with further reference	Interpreted as a toy or amulet
Wrexham, formerly Denbighshire	72	In River Clywedog		McLaren 2004	Unfinished (incomplete perforation)
Skaill, near Skara Brae, Orkney	80	Stray find		McLaren 2004	Unfinished (unperforated)
Skooan, Georth, Evie, Orkney	Est. not > 80	Stray find		McLaren 2004, with further reference	Broken; highly polished. Mis-spelled as 'Skoonan' in McLaren 2004
Poltalloch Estate, Argyll and Bute	86	Stray find		McLaren 2004	
Teifiside, Ceredigion	81	Stray find		McLaren 2004	
Venton Vedna, Sithney, Cornwall	73	Stray find(?)		Evens *et al* 1962, 259 no 854	

Notes: 1. Falling just outside the size range considered here is an example, 99mm long, associated with the cremated remains of a child aged around 9 in a cist under a cairn at Foel Cairn, Caeerwyd, Garthbeibio (McLaren 2004, 296)
2. This excludes the bead in the form of a miniature battle-axe head from a grave at Wilsford G8 barrow, Wiltshire (Woodward and Hunter 2015, 195 and fig. 5.9.3) although this is indeed an example of miniaturisation
3. Several small battle-axe heads, only a little above the 90mm threshold, are known, eg. from a barrow on Windmill Hill, Wiltshire (Annable and Simpson 1964, 49, 103 no. 234)

tarian use because of its size and the relative softness of the stone, and which shows no signs of having been used to strike anything, it seems that the signalling of social status was its *raison d'être*. In this respect, the object is analogous to the maces that have been found elsewhere, and especially the Bush Barrow mace, with its head of fossiliferous limestone and its *c* 470mm-long haft embellished with bone and gold mounts (Needham *et al* 2010; 2015, esp. fig 6.2.5). It is hard to interpret that object as anything other than a symbol of power of a high-ranking individual: something that looks like a weapon (and may have symbolised prowess and the potential to enforce authority with force), but was for ceremonial use. That some battle-axes (and also halberds) were regarded as symbols of power is suggested by the fact that miniature versions have been found as beads or pendants in richly equipped graves in Wiltshire at Wilsford barrow G8 (miniature Continental-style halberd and miniature battle-axe head) and at Preshute barrow G1a – the 'Manton' barrow (miniature Continental-style halberd) (Woodward and Hunter 2015, 194, 195, figs 5.9.1 and 5.9.3). Evoking such artefacts in the form of this unequivocally high-status jewellery, in an extreme form of miniaturisation, points strongly towards the fact that they possessed high social value.

As for the question of why it was deemed appropriate to mark the status of the deceased man in the log-coffin at Tetney using such a small battle-axe, it may well be that, with the battle-axes that were purely symbols of power, size really did not matter – as is suggested by the similarly diminutive size of some other examples from funerary contexts (eg, Shrewton barrow G27, Wiltshire; Rolston, Wiltshire; or one of the 'Cataclews' barrows, Cornwall) (Table 8.2 and Fig 8.17). The deposition of the Tetney battle-axe – perhaps an inalienable personal possession, a kind of 'badge of office' – with the adult male in the log-coffin sent out a powerful statement to the mourners about the importance accorded to this individual, and the connection he had both with the living and with the dead (cf Brück 2006).

CHAPTER 9

CONCLUDING REMARKS

by Hugh Willmott

Unexpected and destructive as the circumstances of the Tetney burial's discovery may have been, the rescue excavation and subsequent analyses have provided an almost unparalleled opportunity to study a funerary rite performed at the end of the third millennium BC. Although the burial mound was severely disturbed, the coffin fragmented and its contents scattered, the preserved remains have allowed unique insight into a complex ritual enacted nearly 4,000 years ago. The authors of this volume have provided detailed discussions on individual aspects of the burial, which enable a complex and intriguing narrative to be constructed.

In the late summer to early autumn of 2032 BC, a man in his 30s died. Although what caused this is unknown, he was between 1.75m and 1.83m tall, robust and in comparatively good health, apart from the onset of osteo-arthritis in his left knee (Chapter 2). Despite being buried in northern Lincolnshire, the strontium and oxygen isotope values in his teeth suggest that he had spent his childhood elsewhere in England or even in Continental Europe (see Chapter 3).

The first act undertaken after his death was the preparation of the coffin for his burial (Chapter 4). A fast-growing oak around 170 years old was felled, and the lower trunk selected for working. It was roughly debarked, split in two and hollowed out to create the container. While the work was competent, it was executed quite roughly, and the log was not finely finished, suggesting that those who undertook the task were not experienced specialists but ordinary craftspeople, and the scale of the undertaking implies it required considerable input from a number of individuals. Upon completion, the coffin, weighing around two and a half tonnes, was taken to the burial site where other members of the community were already interred under large low mounds nearby. A shallow grave cut was made into the natural clay on a west–east orientation (Chapter 1). While this positioning might reflect the continuation of an earlier Beaker burial tradition (Parker Pearson *et al* 2019), given that the burial took place close to the autumn equinox, its alignment with the rising sun on the eastern horizon could have been significant.

The main shell of the coffin was then placed into the prepared grave, and its open rim would have protruded above the surrounding ground surface. A mat formed from interleaved oak and yew twigs was laid in the bottom of the coffin, and a rough pillow of oak twigs was placed at the western end (Chapter 6). The body was laid out flexed, as the man's height was greater than the internal length of the coffin, and a possible garland of sorrel, bird's-foot and corn parsley placed around his head (Chapter 7). A possible food or plant-based offering, consisting of cereal grains, black nightshade and white bird's-foot was placed in the coffin close to the man's abdomen, along with some whole hazelnuts that had just come into season.

The only artefact in the coffin was a miniature battle-axe with a polished head formed from distinctive and highly decorative fossiliferous limestone (Chapter 8). This choice of material may have been deliberate, as the closest significant outcrop of this stone to Tetney is in North Yorkshire, one of the possible places the strontium and oxygen isotope ratios in the man's teeth suggest he could have spent some time when a child. Whether this particular stone was intended to signify the man's origins or was purely chosen for its aesthetic appeal, the miniature battle-axe was highly polished and seemingly unused, conveying important messages about his status and position within his community.

With this stage of the interment complete, the lid was placed on the coffin and probably secured with twine ropes secured in vertical slots cut into each end of the log. Large stones were placed on top to weigh it down, at least one of which was not of the local chalk (Chapter 1) and possibly brought from the beach some five kilometres away specifically for this purpose. This implies that the coffin remained exposed and uncovered in the grave for at least some time, and a natural opening in the centre of the heartwood of the log at its proximal end could have afforded some limited view and access to the body.

Finally, a low mound, around 25m in diameter, was formed over the burial by scraping up and redepositing the surrounding silt and gravel. With the final funerary rituals completed, the log-coffin and its contents rapidly became waterlogged because of its insertion into the thick alluvial clay, resulting in the preservation of the organic materials and the dark staining of the bones caused by the waterborne tannins. However, Tetney remained a place of commemoration and interment long after this particular burial (Chapter 2). Further barrows in the cemetery may have been constructed afterwards, and approximately 150 years after the coffined burial, between 2020 and 1875 cal BC (Chapter 5), the still-prominent mound was the focus for a secondary interment. The precise nature of this later burial is uncertain. However, it appears to have been inserted into the top or side of the silt and gravel mound at a level above the natural waterlogging, thus preventing its bones from becoming stained in a similar way to the original burial.

Given the nature of its initial discovery, some significant evidence from the Tetney burial will inevitably have been lost. We cannot be sure that other, particularly fragile organic, itedo you mean ms were not initially present in the coffin. The skeleton is unfortunately incomplete, so questions regarding the man's lifestyle and manner of death remain unanswered. Likewise, while the presence of a secondary inhumation can be inferred, all other details are irrevocably lost. Nonetheless, the accidental discovery and subsequent study of the log-coffin burial have still provided surprising results. The precision of the burial's dating, not just to a year but a precise season, is nothing short of remarkable (Chapters 5–7).

That said, the burial from Tetney is not unique; it joins a corpus of over 60 other known examples from Early Bronze Age Britain (Parker Pearson *et al* 2013, 29). Its dating to 2032 BC fits comfortably within Jones, Griffiths and Brunning's recently defined 'Northern England' and 'Midlands' phases of log-coffined burial (Jones *et al* 2023, 56), which is perhaps unsurprising given its geographical location between the two regions. Indeed, most aspects of the burial and its assemblage find parallels at other sites, especially where conditions for organic preservation have been more favourable. The deceased individual buried at Tetney conforms to a rite reserved almost exclusively for males, often of mature age (Jones *et al* 2023, 75), and the flexed or crouched body position within the coffin is typical for such a burial (Melton *et al* 2016, 383; Parker Pearson *et al* 2013, 36–7). Parallels for the coffin itself have already been discussed extensively in Chapter 4, and its split-log form is the most common type found (Cressey and Sheridan 2004). Where Tetney is more unusual is in the chiselled vertical slots cut at the ends of the coffin made for a range of possible uses, including aiding the transport of the coffin or securing the lid (or indeed both), although a hole in the corner of the log-coffin from Cartington, Northumberland was suggested by the excavator as having served a similar function (Dixon 1913, 81).

More delicate organic remains have sometimes also been observed within log-coffins, although burial conditions and early antiquarian excavations have undoubtedly impeded our full appreciation of what was originally present. Plant material, including possible mistletoe leaves, was reported in 1834 as forming bedding material for the log-coffin at Gristhorpe, North Yorkshire (Sheridan *et al* 2013, 151). Likewise, a bed and pillow made from reeds or straw were found lining the log-coffin at Loose Howe, North Yorkshire (Elgee and Elgee 1949, 90), and perhaps significantly, this burial also included hazel nutshells indicative of a similar food offering and elements of a shared rite with that at Tetney. The survival of a miniature battle-axe, complete with its haft, is perhaps the most spectacular element of the burial assemblage (Chapter 8). Nonetheless, parallels are known, albeit in less diminutive form, such as a battle-axe head from a log-coffin at Hanging Grimston, North Yorkshire (Mortimer 1905, 97). Even surviving hafts are not unknown; a stone mace with an ash haft 450mm long was reportedly found at Towthorpe, North Yorkshire (Mortimer 1905, 3–5, figs 5, 9–10), and there is a depiction of what seems to be a hafted axe-hammer from Chalk Common, Hampshire (Needham and King 2022, 21).

The overall form of the funerary monument erected at Tetney fits well with an established pattern for this mode of burial. The insertion of the coffin into a shallow cut in the ground surface and the construction of a large mound approximately 25m in diameter are well-recognised characteristics observed at many sites (Parker Pearson *et al* 2013, 35–6). Even the possible use of stones to hold down the lid of the coffin at Tetney has clear parallels with the placement of earth and a 'cairn' over the log-coffin at Pant-y-Dulaith, Denbighshire, prior to its covering by a mound (Hayes 1996, 23–6). Furthermore, the insertion of a secondary inhumation is not particularly unexpected, given the concentration of other burials in the vicinity. However, whether this insertion was in such proximity as the crouched burial found immediately on top of the log-coffin at Bishop's Waltham, Hampshire, will never be known (Ashbee 1957, 149–50, fig 8).

What makes Tetney special has been the opportunity to explore the rich and complex funerary rite of an exceptionally well-preserved log-coffined burial, through a combination of modern excavation, sampling and scientific analysis. With so many similar burials being investigated by antiquarians or archaeologists who lacked many of these investigative techniques, and thus the ensuing loss of data from these sites, Tetney must stand as one of the most important studied to date, despite its fragmented nature.

Finally, it is important to consider that this was just a single burial in a complex mortuary landscape. At least fourteen other barrows have been identified in close proximity to the excavated burial, either as upstanding monuments or from aerial photographs (Trevarthen 2018), and these probably represent only a proportion of those constructed originally. The funerary rite involved in these other burials is unknown beyond the final construction of a barrow, which was likely a ritual afforded to only a select few. So, while the present study provides exceptional detail of how an individual was treated after death, it was only one man and cannot be taken as indicative of established community practice, even among the apparent elite. Only with further fieldwork will the broader funerary context of Tetney be appreciated, but in the meantime, we are still afforded a unique insight into a moment of commemoration during the Early Bronze Age.

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The physical archive and finds are held at The Collection, Lincoln, and deposited digitally with the Archaeology Data Service (https://archaeologydataservice.ac.uk).

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Links to HER and PastScape records of monuments referred to in the text

UID MLI87945
https://heritage-explorer.lincolnshire.gov.uk/Monument/MLI87945

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