Gristhorpe Man: an Early Bronze Age log-coffin burial scientifically defined

Nigel Melton[1*], Janet Montgomery[1], Christopher J. Knüsel[2], Cathy Batt[1], Stuart Needham[3], Mike Parker Pearson[4], Alison Sheridan[5], Carl Heron[1], Tim Horsley[6], Armin Schmidt[1], Adrian Evans[1], Elizabeth Carter[7], Howell Edwards[8], Michael Hargreaves[8], Rob Janaway[1], Niels Lynnerup[9], Peter Northover[10], Sonia O'Connor[1], Alan Ogden[1], Timothy Taylor[1], Vaughan Wastling[1] & Andrew Wilson[1]

A log-coffin excavated in the early nineteenth century proved to be well enough preserved in the early twenty-first century for the full armoury of modern scientific investigation to give its occupants and contents new identity, new origins and a new date. In many ways the interpretation is much the same as before: a local big man buried looking out to sea. Modern analytical techniques can create a person more real, more human and more securely anchored in history. This research team shows how.

Keywords: Gristhorpe, Early Bronze Age, log-coffin burials, élite status, radiocarbon dating, stable isotope, metallurgy

[1] *Archaeological, Geographical and Environmental Sciences, School of Life Sciences, University of Bradford, Bradford, West Yorkshire BD7 1DP, UK*
[2] *Department of Archaeology, University of Exeter, Laver Building, North Park Road, Exeter, Devon EX4 4QE, UK*
[3] *Honorary Research Fellow, Archaeology & Numismatics, National Museum Wales, Cathays Park, Cardiff, UK*
[4] *Department of Archaeology, University of Sheffield, Northgate House, West Street, Sheffield S1 4ET, UK*
[5] *National Museums Scotland, Chambers Street, Edinburgh EH1 1JF, UK*
[6] *University of Michigan, Museum of Anthropology, 1109 Geddes Avenue, Ann Arbor, Michigan 48109-1079, USA*
[7] *Vibrational Spectroscopy Facility, School of Chemistry, The University of Sydney, Sydney 2006, NSW, Australia*
[8] *Centre for Astrobiology & Extremophile Research, Division of Chemical & Forensic Science, University of Bradford, Bradford, West Yorkshire BD7 1DP, UK*
[9] *Laboratory of Biological Anthropology, Institute of Forensic Medicine, University of Copenhagen, Blegdamsvej 3, DK-2200, Copenhagen, Denmark*
[10] *Department of Materials, University of Oxford, Begbroke Science Park, Sandy Lane, Yarnton, Oxford OX5 1PF, UK*
[*] *Author for correspondence (Email: N.D.Melton1@bradford.ac.uk)*

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This paper is dedicated to the late Dr Paul Ashbee, author of the classic 1960 volume 'The Bronze Age Round Barrow in Britain', who took an active interest in this project. His attendance and support at the Gristhorpe Man session at the BA Festival of Science in Norwich in 2006 were greatly appreciated.

The Gristhorpe discovery and Early Bronze Age log-coffin burials in Britain

In July 1834 William Beswick, the local landowner, and a group of friends opened a barrow at Gristhorpe, just north of Filey, North Yorkshire (Williamson 1896: 44). The barrow was the central and most prominent in a group of three on the clifftop (Figure 1). They recovered an intact log-coffin containing a flexed skeleton laid on its right side, with the head to the south and facing east. Organic and inorganic grave goods were recovered too and the complete skeleton, which was stained black in the manner of a bog body, was conserved by simmering it in a solution of glue. The skeleton was subsequently articulated and wired together for display by local doctors William Harland and Thomas Weddell (Scarborough Philosophical Society Minute Book for 1834; Harland 1932; K. Snowden *pers. comm.*). The finds were donated to the Scarborough Museum where, except for a brief period in storage during the Second World War, they have remained on display ever since (Figure 2).

William Crawford Williamson, the 17-year-old son of Scarborough Museum curator John Williamson, swiftly published a report: Gristhorpe Man was powerfully built, over 6ft tall and of advanced age, and a Brigantian chief (Williamson 1834). The technique of phrenology, then in vogue, was used to identify his personal qualities: combativeness, destructiveness, firmness, perseverance and self-esteem, traits necessary to fit him for *'high and important office'* and to *'overawe a wild and uncivilized people'* (Williamson 1834: 16). The skull subsequently featured in *Crania Britannica* (Davis & Thurman 1865).

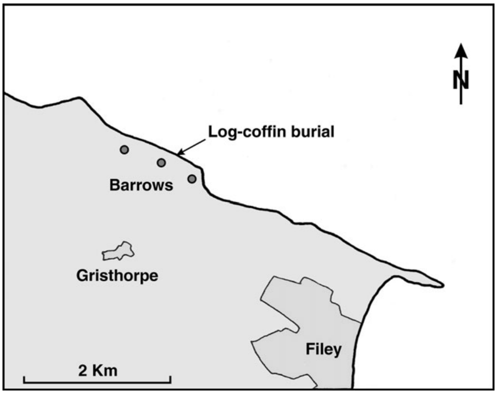

Figure 1. Plan showing the location of the Gristhorpe log-coffin burial.

Parallels between the Gristhorpe coffin and Danish log-coffins were noted at the time of its discovery, and in 1836 the Gristhorpe coffin was compared to the log-coffin found at Toppehoj, Bjolderup (Rowley-Conwy 2007: 118), and illustrated alongside the Danish example in *Antiqvarisk Tidsskrift* (reproduced in Jensen 1998: 40). The perceived close connection with the Danish finds meant that when Thoms published his English translation of Worsaae's *The primeval antiquities of Denmark* in 1849, he did so in Worsaae's stated belief that the *'close connection which in old time existed between Denmark and the British islands, renders it natural that British antiquaries should turn to the antiquities of Denmark, and compare them with those of their own countries'* (Worsaae trans. 1849: iv). Thoms' translation of Worsaae's

Figure 2. The Gristhorpe finds on display (centre, back) in the Rotunda Museum in the late nineteenth century (courtesy of Scarborough Museums Trust).

1843 work, which helped to make Thomsen's 'Three Age System' readily available in Britain, used as the prime example of such comparisons the Gristhorpe coffin and its contents, quoting Williamson's 1834 report in detail (Thoms, Preface to Worsaae trans. 1849: xi–xix). The Three Age System itself was developed in 1819, published in Danish in 1836 and translated into English in 1848. This fundamental advance in understanding enabled Williamson to revise his report 38 years later, assigning the coffin and its contents to the Early Bronze Age and distinguishing them from similar finds made in Denmark which he correctly identified as being of later Bronze Age date (Williamson 1872).

The Gristhorpe log-coffin burial is one of 75 recorded in Britain that range in date from the twenty-third to seventeenth centuries cal BC (Parker Pearson *et al*. forthcoming). Although no certain example is known from Ireland, they are found throughout Britain from Scotland to the south coast and from East Anglia to Wales. Log-coffin burial was also practised during the Early Bronze Age in The Netherlands, Germany and Central Europe (Harding 2000: 105–107; Drenth & Lohof 2005: 439–40). Within Britain, three particular concentrations occur, in Wessex, Yorkshire and eastern England (the East Midlands and East Anglia). Intriguingly, large expanses within two if not all three of these regions were substantially lacking in mature woodland by the Early Bronze Age (French 2003; French *et al.* 2007), so the distribution of log-coffin burials does not necessarily reflect availability of supplies of suitable timber.

Gristhorpe is one of three Bronze Age log-coffins in Britain to have survived intact to the present day, the two others being from Disgwylfa Fawr, near Ponterwyd, Ceredigion

(Savory 1980: 22). Many log-coffins were found intact upon discovery but have subsequently perished or survive just as fragments. These include the coffins from Hove, Sussex (Phillips 1856); Stoborough, Dorset (Hutchins 1767); Cairngall, Dalrigh and Dumglow, Scotland (Mowat 1996: 83, 85, 102-3; D. Bertie *pers. comm.*); Loose Howe (Elgee & Elgee 1949) and Rylstone (Greenwell 1877: 375-7), North Yorkshire; and two from Winterbourne Stoke, Wiltshire (Colt Hoare 1812: 122-4). One of the latter two was reported to be of elm, but the others appear to have been of oak.

Most log-coffins have been recorded as soil stains recognisable only through careful excavation. It can be difficult to differentiate between plank-built coffins and log-coffins in such circumstances (Petersen 1969). The former are known from the fourth millennium BC onwards, whereas the earliest log-coffins for single graves appear as an innovation in the climax Beaker period (Period 2, Needham 2005), although the predominant ceramic associations are Food Vessels. Log-coffins were clearly in their heyday after 2000 cal BC.

A good case can be made that even those log-coffins without observable grave goods were probably the gaves of individuals of some distinction. Symbolic associations with woodland and occasionally with boats can be identified on the basis of material, shape and, in cases such as Gristhorpe, the grave's location overlooking the sea. Some individuals may have had specialist ties to woodland with status roles connected to forestry and hunting, while others may have had associations with the maritime interaction networks that were becoming such a major social force during the Early Bronze Age (Frank 1993; Kristiansen & Larsson 2005; Needham 2009).

Our re-examination of Gristhorpe Man reported here included the analysis of the skeleton and grave goods, using modern techniques for dating, diet and provenance. The original barrow and its nineteenth-century excavation were also located using geophysical methods and confirmed by test excavation. The results suggest a new context for the burial and the use of log-coffins on the British side of the North Sea.

'Gristhorpe Man': an osteobiography

Gristhorpe Man was a physically active male who had attained the prime of life, being at least 36 to 45 years and probably much older at the time of his death (following the methods of Brothwell 1981; Meindl & Lovejoy 1985; Iscan & Loth 1986). This is an assessment strengthened by the extent of age-related infra-cranial enthesial modification and the presence of ossified tracheal cartilage rings that Williamson had misidentified (as a broken horn ring possibly used for '*fastening a light scarf*' [Williamson 1834: 9]). Standing between 178.27cm (5′ 10″) and 181.2cm (6′) (using the equations of Trotter [1970] and Fully [1956], respectively), he was of above average height for the Early Bronze Age compared with the statures of other individuals from Early Bronze Age barrows (mean height = 174.5 ± 5.0cm 1sd). Taking the more accurate Fully (cf. Raxter *et al.* 2006) result of 178.27cm, Gristhorpe Man is at the top end of the stature range (161.6-185.3cm) and nearly a standard deviation from the mean for the group (Wastling 2006). A body mass estimate, ranging between 69.8kg and 74.6kg (using the methods of Ruff *et al.* 1991; McHenry 1992; Grine *et al.* 1995), suggests a body mass index of roughly 22, which is in the heart of the

Table 1. The measurements and values used to assess humeral bilateral asymmetry.

Humeral measurement	Right (mm)	Left (mm)	% asymmetry
Maximum transverse head diameter	49	48	2.62 %
Maximum breadth of the greater tubercle	34	34	0 %
Minimum circumference of the humeral shaft	65	60	8 %
Epicondylar breadth	67	63	6.2 %
Articular breadth	49	47	4.1 %
Maximum length	336	330	1.8 %

Table 2. The measurements and values obtained to assess clavicular asymmetry.

Clavicle	Right (mm)	Left (mm)	% asymmetry
Maximum length	155	159	– 2.55 %
Sagittal diameter at midshaft	14	13	7.41 %
Vertical diameter at midshaft	10	9.5	6.67%

normal range of 19 to 25 of modern standards (Frisancho 1993: 428). The maximum bi-iliac breadth method (Ruff 2000) suggests a body mass index of between about 24 and 25, which falls towards the upper end of the normal range of 19 to 25 of modern standards (Frisancho 1993: 428). The estimates of body mass are based on articular surface measurements that are set at physiological maturity (Ruff *et al.* 1991), when growth ceases. This means that in his prime, Gristhorpe Man possessed a lithe, muscular build that would be considered healthy by modern standards. Some form of strenuous physical activity involving extension, abduction and lateral rotation of the hip resulted in bilateral third trochanters and marked hypotrochanteric fossae on the posterior surfaces of the femora, a combination of physical changes indicative of strenuous activity of the hips and lower limbs. Comparing favourably with the previously analysed and very robust Towton medieval combatants (Knüsel 2000), Gristhorpe Man appears to have been right-handed and strongly lateralised, indicating that he engaged in activities requiring strenuous use of his dominant right upper limb (Tables 1 & 2). This could have been from weapon use, although other activities requiring the use of a single hand, technological or subsistence-linked, could also have contributed to this asymmetry.

Gristhorpe Man's origins and diet were investigated using a combination of stable isotope measurements. Strontium, lead and phosphate oxygen isotope ratios from the mandibular second molar tooth enamel, which mineralises between the ages of two and a half and eight (Gustafson & Koch 1974), are all consistent with origins on the Jurassic silicate rocks of the Scarborough region but not Jurassic limestones or the Cretaceous Chalk of the Wolds (Montgomery 2002; Darling *et al.* 2003; Montgomery *et al.* 2005; Evans *et al.* 2010) (Table 3). The results cannot rule out origins in other regions of Europe where a similar combination of values might be found, but the most parsimonious explanation for such results is that he spent his childhood in north-east Yorkshire.Childhood (second molar

Table 3. Lead, strontium and oxygen isotope data.

Sample	Material	Pb ppm	$^{206}Pb/^{204}Pb$[1]	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$	$^{207}Pb/^{206}Pb$	$^{208}Pb/^{206}Pb$	Sr ppm	$^{87}Sr/^{86}Sr$[2]	$^{18}O_{bp}$‰[3]	$^{18}O_{dw}$‰[4]
Dagger	Bronze		18.2428	15.6308	38.2600	0.85684	2.09736				
Second molar	enamel	0.003	18.45	15.63	38.44	0.847	2.083	66.3	0.710689	17.2 $\pm$0.18	–7.8 $\pm$0.4
	dentine							173.9	0.710619		

[1]External reproducibility for the dagger measured by MC-ICP-MS at NIGL, Keyworth: $\pm$0.0124% for $^{208}Pb/^{204}Pb$; $\pm$0.0108% for $^{207}Pb/^{204}Pb$; $\pm$0.0078% for $^{206}Pb/^{204}Pb$; $\pm$0.0043% for $^{207}Pb/^{206}Pb$; $\pm$0.0068% for $^{208}Pb/^{206}Pb$ 2σ and data are normalised and errors propagated to within run measurements of NBS 981. For the tooth measured by TIMS: $\pm$0.15% for $^{208}Pb/^{204}Pb$; $\pm$0.11% for $^{207}Pb/^{204}Pb$; $\pm$0.07% for $^{206}Pb/^{204}Pb$; $\pm$0.04% for $^{207}Pb/^{206}Pb$ and $\pm$0.08% for $^{208}Pb/^{206}Pb$ (2σ, n=19).

[2]External reproducibility was estimated at $\pm$0.004% (2σ).

[3]External and sample reproducibility for phosphate oxygen measurements was estimated at $\pm$0.18 (1σ).

[4]Calculated using Levinson's equation (Levinson *et al.* 1987) after correction for the difference between the average published values for NBS120C and NBS120B used by Levinson (Chenery *et al.* 2010).

Table 4. Carbon and nitrogen isotope data. Carbon and nitrogen stable isotope measurements were undertaken by continuous-flow isotope ratio mass spectrometry at the Stable Light Isotope Facility, University of Bradford. 'Small fraction' refers to the collagenous proteins that go through the ultrafilter and hence have a molecular weight less than 30 000. Analytical error determined from repeat measurements of internal and international standards was 0.2 per mil or better.

Sample	d^{13}C	d^{15}N	%C	%N	C/N	n
Femur – surface removed	−21.2	10.7	44.7	16.4	3.2	2
Femur – surface removed repeat	−21.2	10.8	43.6	16.1	3.2	2
Femur – surface removed small fraction	−21.3	10.6	42.3	15.2	3.2	2
Femur – surface removed small fraction repeat	−21.4	10.7	42.3	15.1	3.2	2
Femur surface – small fraction	−21.4	10.5	40.3	13.5	3.4	2
Femur surface – small fraction repeat	−21.7	10.5	40.0	13.1	3.6	1
Bone 'dust'	−21.6	10.5	45.0	15.6	3.4	1
Bone 'dust' – small fraction	−21.1	10.7	40.6	14.3	3.3	2
Bone 'dust' – small fraction repeat	−21.2	10.7	41.4	14.4	3.2	1
Mean of bone	−21.3	10.6	42.2	14.8	3.3	
1 sd	0.2	0.1	1.9	1.1	0.1	
Tooth dentine from second molar	−21.0	11.3	45.0	16.9	3.1	2
'Brain'	−23.6	11.7	54.9	8.1	7.9	2
Beeswax from inside the cranium	−26.8	n/a	81.8	0.1	n/a	2

root dentine) and later life (cortical femur) diet were investigated using carbon and nitrogen isotope analysis of collagen (Table 4). Both provide a similar result: $\delta^{15}N = 11.3‰$ (dentine) and 10.7‰ (femur); $\delta^{13}C = -21.0‰$ (dentine) and –21.1‰ (femur). This indicates that his diet contained a substantial amount of protein of terrestrial origin from an early age, placing him at the upper end of the range for other East Yorkshire and British Late Neolithic and Bronze Age individuals (Jay & Richards 2007; Jay *et al.* in press). Relatively reduced dental wear and lack of enamel hypoplastic lines (the presence of which would indicate a stressed growth period) and robust skeletal development testify to an individual who benefited from good nutrition and a diet that contained cariogenic foodstuffs from birth (as suggested by the presence of dental caries).

Three small, spherical objects, *c*. 5mm in diameter, originally thought to have been 'mistletoe berries', were found in the coffin (Williamson 1834, 1872). The chemical composition of one of these was investigated by Raman Spectroscopy. The Raman spectra from the outer surface and inner core revealed the presence of peaks typically associated with phosphate and degraded protein (Edwards *et al.* in press). Their composition is similar to modern kidney or gallstone calculus, a result that is consistent with his age-at-death and also high nitrogen values associated with a meat-based diet that would have predisposed him to suffer these abdominal stones during his advanced years (cf. Blackman *et al.* 1991).

Brachycrany (cranial index of 82.7), typical for the Bronze Age, as well as his height and strong build, with isotope evidence for a high-protein diet, support the hypothesis that Gristhorpe Man was probably a member of an elite from birth. The presence of traumatic injuries – two healed fractures of left ribs six and nine (Figure 3), and damage to

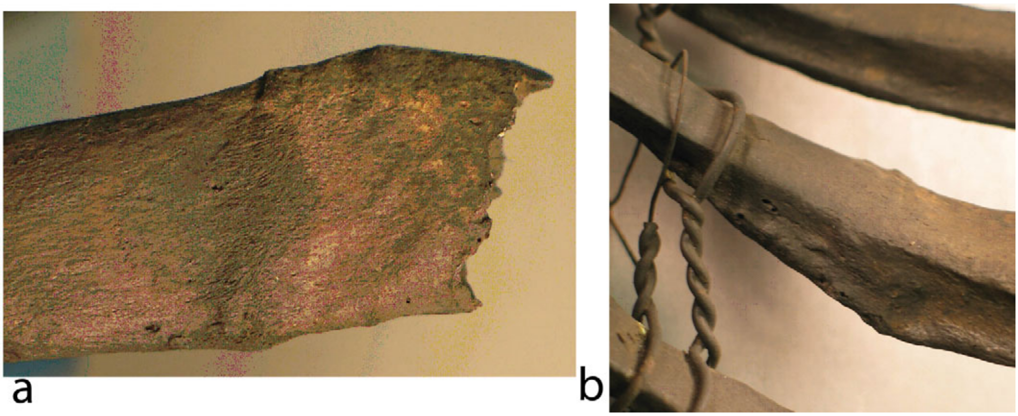

Figure 3. Healed fractures of the sixth (a) and ninth (b) ribs (photograph: V. Wastling).

cervical vertebrae two and three that resulted in left apophyseal joint fusion (Figure 4) – in addition to vertebral degenerative osteophytes of vertebral bodies and a large syndesmophyte extending from the right side of the first sacral vertebra, attests to the effects of physical rigours and advanced age. In addition to dental disease (caries), he had suffered further episodes of trauma to the lower central incisors resulting in dead tooth roots and cyst formation. Furthermore, a large cyst had formed above the left maxillary molars and into the maxillary antrum.

Figure 4. Fused left apophyseal joints of cervical vertebrae 3 and 4 (photograph: V. Wastling).

Since the nineteenth-century wiring could not be interfered with, the skeleton was submitted for CT scanning to obtain 3D visualisation and virtual dissection. This enabled articular surfaces to be examined and revealed that, despite his healthy physique and physical evidence for social advantage for much of his life, Gristhorpe Man suffered from a slowly developing intra-osseous, benign intra-cranial tumour in the left anterior parieto-temporal region (Figure 5), the increased intra-cranial pressure from which probably had an impact on cerebral function. A lesion in this location may have had behavioural consequences prior to death, ranging from intermittent headaches, vomiting, aphasia (i.e. impaired speech and speech comprehension) and hemiparesis (i.e. muscle weakness) to impaired consciousness and seizure (Aufderheide & Rodríguez-Martín 1998: 250–51; De Angelis *et al.* 2002: 68).

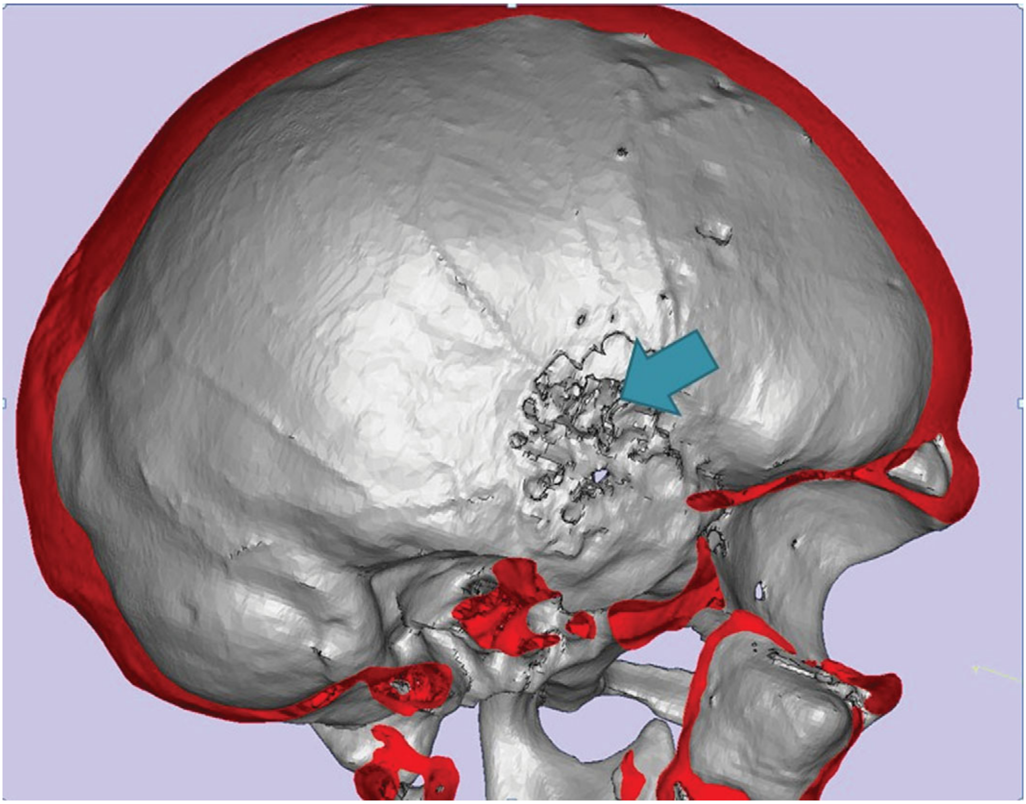

Figure 5. Sagittal CT slice revealing the extent of the osteolytic area, measuring 25–30mm in extent, once occupied by the intra-cranial tumour.

Gas chromatography-mass spectrometry (GC-MS) was undertaken on a small (1–2mg) sample of black material contained in a vial labelled 'brain'. Although lipid analysis of degraded brain tissue from archaeological contexts is uncommon (Gülacara *et al.* 1990), analysis revealed the presence of stanols and stanones in high abundance including coprostanol (5β–cholestanol), epicoprostanol and coprostanone (5β–cholestan–3–one). These are microbial alteration products of cholesterol. The brain is the most cholesterol-rich organ in the human body. Cholesterol is the only sterol present in the adult human brain and accounts for 25 per cent of total lipid of the tissue (Norton 1981). Although no cholesterol was present in the Gristhorpe sample, the abundance of cholesterol alteration products suggests that the sample could indeed be remnant brain tissue. Stable isotope analysis supports this interpretation: the nitrogen isotope ratio obtained from the black material ($\delta^{15}N = 11.7‰$) is very similar to that obtained from the tooth dentine ($\delta^{15}N = 11.3‰$), whilst the carbon isotope ratio ($\delta^{13}C = –23.6‰$) is 2.6‰ more negative than that for the dentine ($\delta^{13}C = –21.0‰$). This situation would be consistent with the expected carbon isotope ratio offset between collagen and a fatty, lipid rich tissue such as the brain (Jim *et al.* 2004).

The coffin and grave goods

On discovery, the 2.29 × 0.99m coffin was aligned north-south and in an excellent state of preservation. It was roughly square cut at the foot (i.e. northern) end, but the base and lid had been rounded off at the head (i.e. southern) end to give it a 'canoe' shape. More explicitly canoe-shaped examples have been found at Loose Howe (Elgee & Elgee 1949) (for example, see Grinsell 1941). Only the coffin lid, which now measures 2.26 × 0.79m, survives.

In 1834 the excavators identified '*a rude figure of a human face*' carved into the foot end of the lid, i.e. at the opposite end to the head of the body inside (Williamson 1834: 5–6). This carving, now much degraded, is surrounded by a cut which flares, possibly to indicate shoulders (Maron 2007), and which distinguishes it from the surrounding wood (Figure 6). There is no bark present on the carved 'face' and an area of flattened sapwood and a slightly curving gash may be the results of damage during the lifting of the coffin in 1834 (Williamson 1834: 5–6, 1872: 6).

Figure 6. The carved 'face' on the coffin lid (photograph: N. Melton).

The artefacts accompanying the burial are characteristic of other Early Bronze Age adult males in Yorkshire and elsewhere in Britain, except that they include organic materials that do not normally survive. According to Williamson's account (1834: 10, 1872: 15), the body lay on '*vegetable substance*' described as rushes, and was wrapped in animal hide fixed at the chest with a polished bone pin, 72mm long, which has been fashioned from a pig fibula (T. O'Connor *pers. comm.*)

On the lower chest was '*a double rose of a ribband, with two loose ends*' decorated with raised lines made of a brittle material that disintegrated on exposure to air (Williamson 1834: 10, 1872: 15). No other garments or human hair, nails and skin were reported. The animal skin may have survived because it had been treated, perhaps tanned, before burial.

Several other objects accompanied the corpse; unfortunately, their original positions were mostly not recorded. These comprise: 1) a dagger blade and pommel; 2) a knife and two flint flakes; 3) a bark container, found beside the body; 4) a small wooden object, probably a fastener; and 5) fox metatarsal and pine marten phalanges, originally identified by William Buckland as from a weasel. The '*horn ring*', and '*mistletoe berries*' (Williamson 1834) or '*seeds of a leguminous plant*' (Williamson 1872) have, as already discussed, now been identified as ossified tracheal cartilage rings and kidney stones (see above).

Method

The dagger has a short, slender flat bronze blade (Figure 7), classified by Gerloff within her *Type Merthyr Mawr, Variant Parwich* (Gerloff 1975: 51). A revised classification (Needham forthcoming) confirms that it can be grouped with early flat bronze daggers (series 2) despite being one of the shortest examples; this may in part be due to sharpening. It is placed in type F3 (*Merthyr Mawr*) which seems to be specifically late within the overall currency of series 2 weapons, dating close to the turn of the millennium. The cutting-edge was cold-worked and annealed through several cycles at a temperature high enough to ensure a homogeneous bronze. The organic hilt, of which no trace survives, was riveted to the blade with two metal peg rivets. The original 1834 illustration of the blade appears to depict a scabbard, which would have been made from wooden plates lined and/or covered with hide (Henshall 1968; Cameron 2003; Gabra-Sanders *et al.* 2003). This no longer survives except perhaps in the form of traces of animal collagen on the blade which were visible on scanning electron micrographs.

Figure 7. The dagger blade (photograph: S. O'Connor).

Metallurgical analysis of the blade shows it to have been of an unleaded medium tin-bronze with 12.00% tin, which is within the 9–12% range characteristic of Early Bronze Age alloys (Northover 2007). The principal impurities are 0.38% arsenic, 0.09% antimony, 0.14% silver and 0.07% lead, with traces of nickel, zinc, and bismuth (Northover 2007). The arsenic/antimony/silver impurity pattern and the negligible nickel are consistent with Northover's Group A3, long attributed to Ireland (Rohl & Needham 1998; O'Brien *et al.* 2004). Detailed typological studies suggest that the Gristhorpe dagger, like most contemporary British objects, would have been manufactured in Britain using recycled Irish metal (Needham 2004). The lead isotope ratios (Table 3) are also consistent with the presence of Irish copper ore, as they overlap with those of Chalcolithic 'A' metal from Ireland and Wales.

Perhaps the most extraordinary item in the assemblage is the perfectly preserved pommel, the sides of which splay out to a flat oval top *c*. 52mm wide (Figure 8) dwarfing the blade, whose maximum width is about 38mm. The top and sides are polished to a high sheen, but it is unclear whether or not this is partly due to use-wear. Originally identified as whalebone, reappraisal confirms it as a cetacean jawbone. Its form is intermediate between two clearly defined classes of socketed pommels; broadly speaking, pre-2000 BC examples (class 2) are oval in plan and

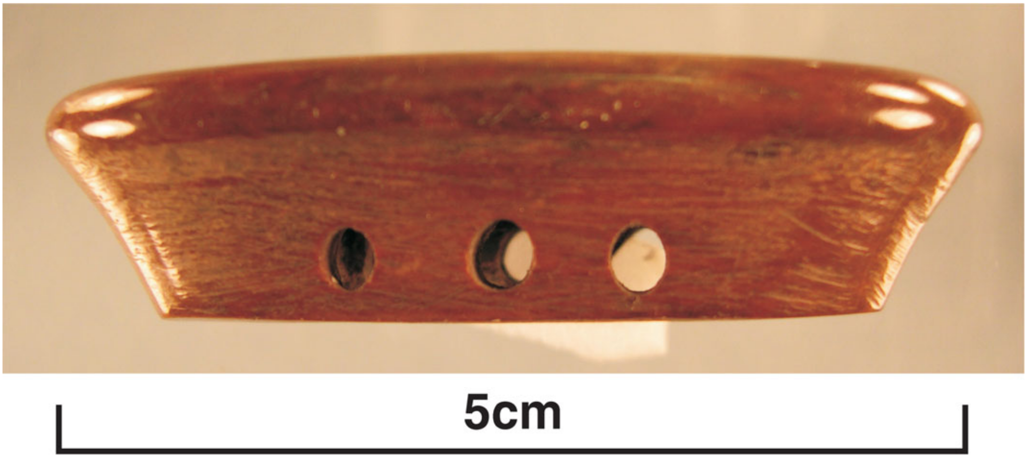

Figure 8. The whalebone dagger pommel (photograph: S. O'Connor).

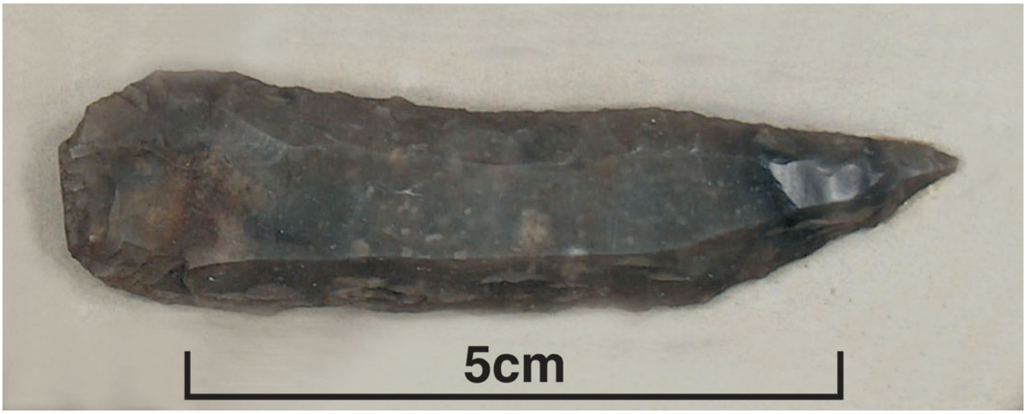

Figure 9. The flint knife (photograph: A.S. Wilson).

rectangular/gently trapezoidal in face view, whereas post-2000 BC (class 3) pommels are elliptical or lenticular in plan and more strongly expanded, usually with a 'lip' at the top (Needham forthcoming). The Gristhorpe pommel is unusual in combining characteristics of both classes.

Three lithic artefacts recovered from the log-coffin comprise a finely retouched blade (Figure 9) described in the original report as the head of a small javelin (Williamson 1834: 8) but identifiable as a knife, and two unmodified flakes, described originally as *'rude heads of arrows'* (Williamson 1834: 9). In the 1872 report the retouched blade is described as an *'implement of flint*. . . [these were]. . . *probably used as knives, or occasionally as scrapers for cleaning skins'* (Williamson 1872: 14). The other two pieces were correctly described as flint flakes. These artefacts are readily paralleled in Early Bronze Age graves from Yorkshire and elsewhere in Britain, with numerous examples from the East Riding of Yorkshire as illustrated by Mortimer (1905).

The bark container, now a quantity of warped and degraded pieces of wood and bark, had a flat wooden base to which bark sides had been attached. It was first described as

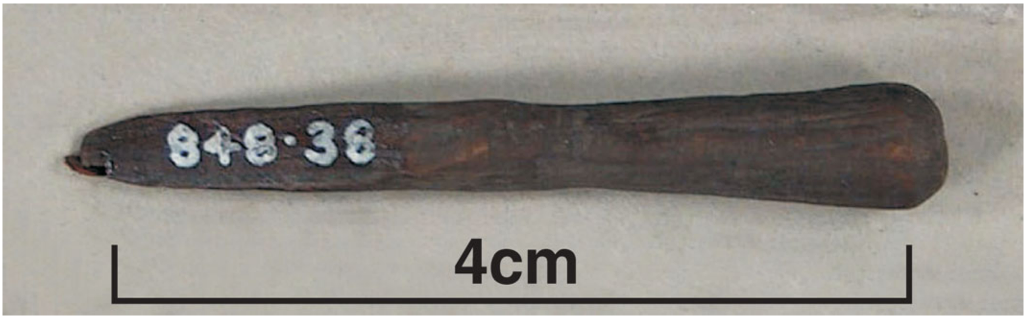

Figure 10. The small wooden object, probably a toggle (photograph: A.S. Wilson).

'a kind of dish, or shallow basket of wicker work' (Williamson 1834: 9) and later as *'a kind of dish composed of pieces of bark stitched together with strips of skin or of animal sinews'* (Williamson 1872: 15). Williamson (1834: 9) described a deposit of organic material found inside the container as *'a quantity of decomposed matter, which has not yet been analysed'*. At some stage it was labelled as *'food residue'* and a hand-written note in the museum archive records that it was investigated by Stuart Piggott in the 1950s, but the analysis proved indeterminate.

GC-MS analysis of solvent extracts of this deposit suggests a plant origin. However, there appears to be contamination of the sample from lignin-derived molecules that may have leached from the oak coffin. Analysis of a tiny fragment of the coffin supported such a view. Although further work is required, it may be that the deposit is not a food residue but a plant-based product used to make the interior waterproof. Whether the fibrous material, hair and sinew traces found embedded in it represent accidental inclusions or the last traces of some foodstuff is unclear.

A small wooden object, 44 × 6.4mm, rounded at one end and slightly waisted, tapers to a spatulate shape at the other end (Figure 10). It is manufactured from a small piece of roundwood not identifiable to species. A slight notch across the waist on one side, created through use, makes it likely that this was a fastener, shaped so that the tapered surface would lie flat when fastened. A possible use is as a pouch fastener (analogous to the V-perforated buttons probably used in this way at Rudston, barrow 68a and at Acklam Wold barrow 124, Yorkshire [Greenwell 1877: 265; Mortimer 1905: 91; Shepherd 1973, 2009]) or else as a fastener for the bark container.

The black-stained fox metatarsal and pine marten phalanges found among the vegetable matter in the coffin may be the remnants of fox and pine marten furs, as paws are often retained with the pelt when an animal is skinned. Alternatively, the bones may simply attest to the presence of animal remains, perhaps as amulets.

The date of the burial

A combination of AMS radiocarbon and dendrochronological dating of the Gristhorpe assemblage provides insight into the sequence of events related to burial and permits comparison with similar finds. All radiocarbon dates are quoted at 95% confidence and full details are given in Melton *et al.* (forthcoming). Dagger blade and pommel typologies suggest a date of around 2000 BC, and a conventional radiocarbon date obtained in the 1980s on the branches overlying the coffin provided a date of 2300–1650 cal BC (HAR-4424).

The longest possible dendrochronological sequence was obtained from two sections from the oak coffin lid. A section from the 'foot' end, near the carving, including the bark and outer rings, produced 126 rings, and one from the 'head' end, 108 rings. Together these provide a 173 year composite ring sequence. The relatively small number of rings for the size of section suggests fast growth in a favourable environment (Tyers *pers. comm.*). Unfortunately, it was not possible to match this floating ring sequence with others from the region to obtain a calendar date because the sequence was relatively short and there are few dated dendrochronological records for this Early Bronze Age period (Tyers *pers. comm.*).

AMS radiocarbon dating was carried out on tooth root dentine, on femoral samples and on the branches overlying the coffin. In addition, a sequence of six evenly spaced tree-ring samples was obtained from the dendrochronology section from the coffin lid to allow a more precise wiggle-matched radiocarbon date for felling. Two factors had to be borne in mind when dating the skeleton: first, whether the attempt in 1834 to consolidate the *'very rotten'* bones by simmering them for eight hours in a *'thin solution of glue'* (Williamson 1872: 7) had introduced animal collagen; and, second, whether the skeleton is a nineteenth-century composite or replacement, with Indian ink (J. Ambers *pers. comm.*) used to 'touch up' substitute bones. The survival of so much bone mineral from an oak coffin burial is highly unusual, as conditions are not normally conducive to bone mineral preservation (Glob trans. 1983; Randsborg & Christensen 2006: 35–6).

The tooth root dentine provided a date of 2140–1940 cal BC (OxA-16844), while the femur gave a date of 2280–2030 cal BC (OxA-19219). These combine to give a date for the skeleton of 2200–2020 cal BC at 95% confidence. In addition, the level of lead in the tooth enamel (three ppb) is extremely low even compared to other Bronze Age or pre-metallurgical Neolithic populations (Montgomery *et al.* 2000, 2005; Montgomery 2002). Such a low level of lead indicates Gristhorpe Man inhabited a remarkably unpolluted environment which was not the case for people living in nineteenth-century England (Montgomery *et al.* forthcoming). This finding thus supports the dating evidence that shows the skeleton is of Early Bronze Age date and not that of a nineteenth-century individual.

The stable carbon and nitrogen isotope ratios of the dated collagen are inconsistent with terrestrial herbivores, marine fish or marine mammal collagen, so the skeleton seems to have been unaffected by nineteenth-century attempts at conservation with glue. The same is true for the surface and sub-surface femur samples, and for the separated, ultra-filtered and small fraction samples where degraded animal collagen might be detected if present. All of these samples provided very similar carbon and nitrogen stable isotope results (Table 4), which leaves open the question of why the skeleton survived so well and, furthermore, how the unusual nineteenth-century conservation method worked. There is no apparent evidence for any protein that does not come from an Early Bronze Age human. The section of femur used for dating, although stained, was greasy and dense, with a high collagen yield. This strongly suggests that original collagen preservation was very good. Moreover, any mineral loss was not so extensive as to render the bones soft; there is no evidence for bone warping and deformation. Unfortunately, although a chemical analysis of the coffin water was made in 1834, the pH is unknown, but it is likely that any acid in the burial environment was buffered by the presence in the water of *'much sulphate of lime'*, (Williamson 1872: 8) and this, coupled with anaerobic conditions, led to the preservation of both mineral and organic materials.

The branches over the coffin dated to 1750–1530 cal BC (OxA-16812). Wiggle-matching of the radiocarbon dates for the coffin lid (Bronk Ramsey *et al.* 2001) confirmed a date of 2115–2035 cal BC for the date of felling.

The combined dating evidence indicates that the tree for the coffin was felled between 2115 cal BC and 2035 cal BC and that Gristhorpe Man died between 2200 cal BC and 2020 cal BC, indicating that these could have been contemporary events. The branches over the coffin were cut between 1750 cal BC and 1530 cal BC, meaning that this cannot have occurred at the same time, and that the branches were laid over the coffin at least 270 years after the death of Gristhorpe Man. The tree-ring sequence from the coffin can now be incorporated into the dated master records for the region.

Discussion

The unusual preservation circumstances of Gristhorpe Man provide a rare insight into Early Bronze Age funerary practices and the social networks that supported them. Parallels can be found for most, if not all, of the burial goods. In particular, the hide wrapping and the dagger with its pommel of rare cetacean bone represent items of conspicuous display that, along with the coffin and the structure and location of the funerary monument, emphasise a pre-eminent social status that is perhaps closely paralleled by the log-coffin grave unearthed at Stoborough, Dorset (Hutchins 1767).

Among these distinctive interments, where individual social identities appear to be emphasised (cf. Treherne 1995; Stig Sørensen 1997; Whitley 2002), is a group of males accompanied by metal weapons. These weapons, along with the conspicuous consumption usually involved in the construction of the funerary monuments, would have served to justify and legitimate a pre-eminent social position in life and in death.

Well-excavated burial sites frequently show complex histories of construction and successive burial deposits. The oak branches were described as *'...carelessly thrown over the coffin; they are from five to eight inches in diameter, and, like the coffin, are still covered with their rough bark'* (Williamson 1872: 16). If these are the axe-trimmed logs curated in the museum today, there is at least a 270-year difference between them and the oak coffin. It may be that Gristhorpe is an example of an interment that remained accessible for a time before the barrow was completed over it, or — more likely, given the coffin's state of preservation — the subject of a later intrusion or interment unrecognised by the nineteenth-century excavators.

The choice of grave goods may well have had special symbolic significance. The cetacean bone pommel indicates a connection with the sea that might also be echoed in the boat-like shape of the coffin. It is also curious that this senior dagger-accompanied male, a class of individual almost invariably laid on the left side at this time, is here laid on his right side looking out to sea. It is clear that travel, and the long-distance movement of materials and objects, was important to the operation of Early Bronze Age society (e.g. Needham 2009).

Gristhorpe Man appears to be a paramount chief born locally, as indicated by his local isotope ratios, but linked into a wide network by the sea, with his burial accoutrements being part of a regional tradition of interment. The bark container with its probable internal coating of sealant appears to be a vessel or container paralleled by the characteristic Beaker or Food Vessel found with other near-contemporary single burials (see Ashbee 1960; Needham 2005; Woodward *et al.* 2005).

The ostentation of the Gristhorpe grave appears to have been matched by the physical attributes of the man himself. His prominent stature and body mass suggest that he benefited from good nutrition and living conditions from birth. The high nitrogen isotope ratio for the period indicates a substantial meat component to his diet that predisposed him to develop renal stones or gallstones, a condition associated with older, well-fed males of higher socio-economic status today. The skeletal and isotope evidence for good nutrition from early childhood would be consistent with inherited rather than acquired status. It is likely that this pre-eminent social standing was built upon an active lifestyle that included strong lateralised use of his right upper limb, perhaps in martial exploits that exposed him to several traumatic injuries in the form of healed fractures. In later life, he developed an intra-cranial tumour that may have caused physical and behavioural impairment, particularly of his dominant limb and those qualities that aided his rise to social prominence, such as the use and comprehension of speech, physical strength and co-ordinated movement.

Conclusion

The early discovery and publication of the Gristhorpe burial in 1834 and its re-working by the same author nearly half a century later in 1872 afford a rare opportunity to appraise changes in nineteenth-century archaeological thought. The interpretation of the find in 1834 is very much in the antiquarian manner, with heavy emphasis on classical sources, mainly that of Julius Caesar, which we now know describes societies at a 2000-year remove from the Gristhorpe burial. By 1872 Williamson was able to employ Thomsen's/Worsaae's 'Three Age System', both Thomsen and Worsaae having previously compared the Gristhorpe remains with similar Danish log-coffins in the formulation of this bedrock of archaeological interpretation (Rowley-Conwy 2007: 118; Worsaae trans. 1849: fn. 96). Our new programme of dating on the Gristhorpe skeleton and coffin, along with recent dendrochronological dating of the Danish examples (Randsborg & Christensen 2006), shows conclusively that Gristhorpe Man is the earlier by some 700 years.

This type of chronological resolution epitomises the advances made in the discipline over the years since 1872. Other noteworthy developments include residue analyses of proteins and chemical constituents of both artefacts and human remains that clarify the identification, preservation, manufacture and use of material and biological remains found in funerary contexts. Major advances have been made in analyses of human remains. This subject has been entirely re-invented from its origin as part of medicine and reliant upon now-defunct methods, such as phrenology, the latter being present in the 1834 analysis of Gristhorpe Man but reproduced with due scepticism in 1872. New methods include standards for determining age at death, sex, body proportions, and health status, enhanced most recently by the application of medical imaging techniques. Isotopic analyses now provide means to examine the diet, provenance and movement of people to explore the origin and social relationships implicit in funerary contexts. The use of these studies, in conjunction with continued scholarly synthesis of archaeological discoveries, highlights the value of the retention and curation of finds. The Gristhorpe remains have resided in the Rotunda Museum since 1834, and their new display ensures public dissemination of research findings, as well as their availability for future study in light of even newer techniques and ideas.

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