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The Late Roman Field Army in Northern Britain? Mobility, Material Culture and Multi-Isotope Analysis at Scorton (N. Yorks.)

By HELLA ECKARDT, GUNDULA MÜLDNER and GREG SPEED

ABSTRACT

At Hollow Banks Quarry, Brompton-upon-Swale/Scorton, located just north of Catterick (N. Yorks.), a highly unusual group of 15 late Roman burials was excavated between 1998 and 2000. The small cemetery consists of almost exclusively male burials, dated to the fourth century. An unusually large proportion of these individuals was buried with crossbow brooches and belt fittings, suggesting that they may have been serving in the late Roman army or administration and may have come to Scorton from the continent. Multi-isotope analyses (carbon, nitrogen, oxygen and strontium) of nine sufficiently well-preserved individuals indicates that seven males, all equipped with crossbow brooches and/or belt fittings, were not local to the Catterick area and that at least six of them probably came from the European mainland. Dietary (carbon and nitrogen isotope) analysis only of a tenth individual also suggests a non-local origin. At Scorton it appears that the presence of crossbow brooches and belts in the grave was more important for suggesting non-British origins than whether or not they were worn. This paper argues that cultural and social factors played a crucial part in the creation of funerary identities and highlights the need for both multi-proxy analyses and the careful contextual study of artefacts.

Keywords: Scorton, late Roman cemetery, isotope anlysis, mobility, crossbow brooches

INTRODUCTION

Excavations at the Hollow Banks Quarry, Scorton (N. Yorks.) 1998–2000 revealed 15 late Roman inhumation graves, preliminarily dated to the fourth century (FIGS 1–3). These late burials are separated from the Roman fort and town of Catterick to the south only by the river Swale,[1] making a connection between the two likely. Immediately to the north-west, but set spatially apart from the Roman burials, lies a much larger (105 burials) Anglian cemetery. A number of the burials from Scorton were equipped with crossbow brooches and/or belt sets, suggesting a military association and possibly a continental origin for the individuals.[2] With a grant from the Roman Research Trust, multi-isotope analyses (carbon, nitrogen, oxygen and strontium) of nine individuals (and carbon and nitrogen isotope analysis only of a tenth) were carried out in order to investigate this possibility and to explore differences or similarities to burials from nearby Catterick.[3]

Isotope analysis has now been applied to a considerable number of Romano-British burials.[4] The isotopic systems traditionally employed to reconstruct past mobility are oxygen and strontium; however, dietary (carbon and nitrogen) isotopes have also been shown to be extremely useful in the identification of incomers to Roman Britain.[5] Since the isotopic range of the Romano-British diet can by now be relatively well defined, it is likely that individuals with extremely different, 'exotic' diets in early life moved to Britain from abroad.[6] Previous work on Roman burials from Britain has demonstrated that many later Roman towns had very diverse populations, although there is no simplistic relationship between unusual grave goods and the origin of the individuals buried with them. Immigrants came both from warmer/more coastal and cooler, more continental areas, and it was not only men that travelled in their roles as soldiers, administrators or traders but also women and children. These findings support and enhance epigraphic and historical research which has long posited that the Roman Empire as a whole was characterised by high levels of mobility.[7] Previous isotope studies have also highlighted the current limitations of the method for studying migration to Roman Britain, namely that the isotopic 'profiles' of individuals growing up in Britain can also be expected to match other parts of the Empire, especially areas in Western Europe and the Northern Mediterranean, and migrants from these areas may be invisible to the isotopic methods which are currently conventionally employed.[8] Multi-isotopic studies, which employ various different isotopic systems, are therefore the best way to achieve conclusive results.[9]

It is within this context that the current study was conceived. This paper will discuss the isotope data from Scorton in the context of archaeological analyses of the artefacts and burial rites in order to explore the complex relationships between biological and social identity in late Roman Britain.

THE LATE ROMAN BURIALS AT HOLLOW BANKS QUARRY

The excavations at Hollow Banks Farm were undertaken in 1998–2000 by Northern Archaeological Associates Ltd on behalf of Tilcon (North) Ltd in advance of sand and gravel extraction. Initial post-excavation analysis was funded by Tarmac Northern Ltd, with additional funding for the analysis of the cemetery assemblage provided by English Heritage from the Aggregate Sustainability Levy Fund.

The excavated area at Hollow Banks Farm, Scorton lies immediately across the parish boundary within Brompton-upon-Swale, North Yorkshire, and only 200 m north-east of Catterick Bridge, with the Roman cemetery centred at SE 22850 99660 (FIGS 1–2). The burials lay within a multi-period palimpsest of archaeological features including Neolithic 'ritual' monuments, a Beaker barrow and Iron Age settlement. However, during the Roman period the area seems to been under agricultural use, laid out in large rectangular fields, and there is no evidence to suggest that any of the earlier features were still recognisable. Later use of the site included the large Anglian cemetery located 30 m to the north-west, which is further discussed below; otherwise, the area has subsequently remained in agricultural usage.

The solid geology of the area is complex. Although the site itself overlies Carboniferous Millstone Grit,[10] this is covered by deposits of fluvio-glacial sands and gravels accumulated during early deglaciation.[11] The soils across the site are mapped as Wick 1 Association, which comprises deep, well-drained, coarse loamy earth.[12] Work by Taylor and Macklin[13] has shown that until *c.* 2000 BP the Swale floodplain had been occupied by shallow channels characteristic of a 'braided' river system and accumulating alluvial deposits. These were subsequently incised by a single-thread meandering channel which has produced a series of lower-level terraces and resulted in substantial lowering of the floodplain surface. To the south, the river has been constrained by a limestone outcrop forming the hill on which the Roman fort and town were located.

The Hollow Banks Farm Roman cemetery was located on a slight promontory (65.5 m AOD) at the edge of the upper terrace gravels, which was created by former river channels approaching successively from the north-west and south-west. From finds recovered at Hollow Banks[14] and successive phases of riverside revetment excavated at Catterick Bridge[15], these channels were active throughout much of the Roman period. The burials were thus originally near the riverbank (despite now lying over 200 m from the river) and visible from the raised vantage points of the Roman town wall and fort on their hill, which lay respectively only 400 m and 650 m to the south-west. Roman Dere Street, the main road linking York with Hadrian's Wall passes 400 m to the west.

The remains of the late Roman cemetery occupied an area measuring 24 m from north-east to south-west and 10 m wide from north to south (FIG. 3). Ten of the 15 features lay in a fairly dense cluster at the north-eastern end of the cemetery, while the other five formed a more dispersed scatter to the south-west. The graves ranged in size from 1.75 to 2.65 m in length and 0.80 to 1.0 m wide and had surviving depths of 0.20 to 0.72 m. Bone preservation varied considerably, from good to non-existent, between (and even within) graves. In two cases (Nos 3 and 8) only grave-shaped cuts survived, with or without grave goods, but with no preserved skeletal remains. In another (No. 4), a shallow feature containing two bangles and three iron nails may have been part of a disturbed grave or, alternatively, a votive offering.

The cemetery population is almost exclusively male, with four individuals sexed as male, three as probably male and only one as female; a further three are likely to be male on the basis of their grave goods. There are no children or adolescents and most individuals fall either within an age range of 17–25 years (x3) or 25–35 years (x9). Apart from a few incidences of caries (Graves 1 and 2) and mild enamel hypoplasia (Graves 1, 6, 10, 13 and 15), the only significant pathological lesion observed was a healed but misaligned fracture of the tibia and fibula (Grave 13).[16] Overall, this small Roman cemetery is characterised by a number of features, notably an unusual gender distribution, the presence of a high number of crossbow brooches and belts and the overall homogeneity of the individuals themselves, in terms of their age-distribution and (skeletal) health status, as well as their grave goods.

All bodies were found in an extended supine position, usually with the arms folded across the abdomen; in a few cases the arms were extended along the side of the body. Most if not all of the individuals were placed in wooden coffins, of which substantial iron nails survive in many graves. In two cases (Nos 11 and 14) rounded stones were also placed inside the grave cut. While similar in these ways, the graves were not arranged in a consistent pattern or orientation; heads were aligned to the north (x5), west (x3) and south-east, east or south (x4). The excavators note that female No. 11 and male No. 12 were buried in parallel graves, sharing a unique orientation within the cemetery and suggesting a possible connection; their heads, however, were at opposite ends (11 to the east and 12 to the west). A connection between the two individuals may be supported by the fact that these are the only two graves within this small cemetery that contained bronze bracelets. Late Roman parallel burials with opposing head alignments occur at nearby Catterick Bridge (Graves 163/191 and 1001/1003)[17], perhaps suggesting that this is a local custom.

Of the 15 burials, only nine had skeletal elements with suitable preservation to allow isotope analysis. These nine individuals were sampled for strontium, oxygen, carbon and nitrogen isotope analysis, and a tenth was sampled for carbon and nitrogen isotope analysis only. Summary information on these individuals can be found in Table 1 and it is these graves that the present paper is mainly concerned with.

ARCHAEOLOGICAL ANALYSIS OF CROSSBOW BROOCHES AND BELT FITTINGS

A striking feature of the Hollow Banks late Roman cemetery is the frequency with which crossbow brooches and belt buckles occur. No less than four graves (Nos 1, 5, 7 and 14) have crossbow brooches and six have belt fittings (Nos 1, 5, 6, 7, 12 and 14: see FIGS 4–8). Crossbow brooches appear to have been worn by males in positions of authority and in the later Roman period may have been associated specifically with administrators rather than just military men.[18] Archaeological evidence, for example from Lankhills (Winchester), confirms the overwhelming association with male burials and adults.[19] The relative proportion of burials with crossbow brooches at Scorton (4/15) is highly unusual for Roman Britain. In general, and relative to the continent, Britain has few of these types of furnished inhumations. Lankhills is the only other Romano-British cemetery for which high numbers of crossbow brooches have been reported, but there the equivalent numbers is 6/306 from the recent and 8/444 from the old, 1970s, excavations.[20] For the classification of crossbow brooches, continental typologies are usually followed; however, Swift's [21] analysis provides an excellent summary of the Romano-British material and makes some interesting suggestions about the production of these striking brooches.[22] Crossbow brooches in the northern British 'frontier zone' broadly follow the typological patterns established by Swift[23] for Roman Britain, but sites on Hadrian's Wall display a distinctive profile, which may be due to 'decreasing levels of contact between the frontier and central imperial authorities'.[24]

The Scorton crossbow brooches are broadly of Keller/Pröttel Type 3/4,[25] but one (541AB from Grave 14) has elements of Keller Type 2, while another (571AV from Grave 7) may have elements of his Type 5.[26] Crossbow brooches of Keller Type 3/4 are usually dated to the last two thirds of the fourth century and into the fifth century (A.D. 350–410)[27]. However, crossbow brooches may have had long 'lives' and biographies; thus we may note the broken example in a young individual's grave at Lankhills and general evidence for repairs.[28] A recent example of a very worn crossbow brooch deposited in an unusual context comes from the villa at Ingleby Barwick (Stockton-on-Tees), where a gilt example was uncovered in a pit with Anglo-Saxon pottery and an articulated dog burial.[29] Without examining the Scorton brooches directly it is difficult to identify wear, but the crossbow brooch from Grave 5 lacks the central knob, so may have been old when buried. This is especially interesting as the grave also contained an assemblage of coins thought to have been deposited shortly after A.D. 353–6.[30] While it is difficult to distinguish possible local products from certain imports, it is possible that the brooch from Grave 5 (528AAY) was from the continent due to its similarities to common continental frontier zone examples (see below). However, this brooch also has a close parallel from Chorley in Lancashire.[31] Brooch 502AA from Grave 1 on the other hand, with its atypical decoration, may have been produced away from the main production areas, perhaps in Britain or Gaul.[32]

Of the crossbow brooches in graves across the Empire, 48 per cent were found *in situ* on the right shoulder, 10 per cent on the left shoulder and 5 per cent on the breast, while 37 per cent were evidently not worn but placed in the grave.[33] At Scorton, two were on the right shoulder (Graves 1 and 7), one (Grave 14) was on the left chest and another (Grave 5) was found with the coins at the feet of the skeleton.[34]

Crossbow brooch 502AA from Grave 1 (FIG. 4) has a foot which is longer than the bow; the knobs are onion shaped with ribbed mouldings at the base; the arms have two longitudinal perforations each and are ridged at the top. The bow is decorated with a row of circle and dots, a decoration that is not paralleled in Swift[35]. The side of the bow has a pair of circle-and-dot designs, which again is unusual. The foot is decorated by 20 circle-and-dot motifs arranged in facing pairs with a horizontal line between each set of four. This foot decoration is not listed in Swift[36] (but cf. fig. 48) but crossbow brooches where the entire foot is decorated with circle-and-dot motifs are known from continental sites.[37]

Crossbow brooch 528AY from Grave 5 (FIG. 5) has a foot which is longer than the bow; the knobs are rounded rather than fully onion shaped. These knobs may have been onion shaped originally but damaged or modified; the central knob is missing. The knobs have ribbed mouldings at the base and the arms have one longitudinal perforation each (sometimes described as a facetted cross arm with openwork decoration). The foot is decorated with circle-and-dot design (Swift b2 foot decoration)[38] and the bow with stamped triangles (Swift A2 bow decoration). The b2 foot design has a wide distribution, with numerous examples known at Augst, Lauriacum, Dunapentele and Ságvár.[39] A number of examples from Britain and the continent share the b2 foot design but have onion-shaped knobs and bow design Swift I9;[40] see also Grave 27 from Oudenburg.[41] Of the latter sub-type, dated Romano-British parallels are the brooch from a Richborough ditch fill dated to A.D. 400+ and from Grave 81 in Lankhills dated to A.D. 350–70.[42] A good parallel, unfortunately a metal-detected find without context, is from Chorley in Lancashire.[43] Also in Grave 5 was a purse hoard containing coins thought to have been removed from circulation (and probably deposited) shortly after A.D. 353–6.[44]

Crossbow brooch 571AV from Grave 7 (FIG. 6) has a foot which is longer than the bow and onion-shaped knobs with ribbed mouldings at the base. It is of a solid shape with a wide bow and foot. There are diagonal lines on the bow and a herringbone design on the centre of the foot, which is also decorated with neat facetting (two pairs at the top and two at the base). We are not aware of very close parallels, but there are some similar examples, for example from Alem and Tongeren in the Netherlands.[45]

Crossbow brooch 541AB from Grave 14 (FIG. 7) has elements of Keller Type 2/3, with a slight design and a longer bow. There are three onion- to poppy-headed knobs, with plain mouldings at the base. The brooch has a facetted but otherwise undecorated bow and the foot is decorated with neat facets. This brooch may be slightly earlier than the others from Scorton. Similar brooches are known from, for example, Krefeld Gellep.[46]

As noted above, when compared with the continent, late Roman belt equipment is not very common in Romano-British cemeteries, with the exception of Lankhills and Scorton, where belts are associated mainly with adult males.[47] Belts were important symbols of power in the later Roman world[48] At Scorton there are six graves with belt fittings (Nos 1, 5, 6, 7 (see Fig. 6), 12 and 14 (see FIG. 7)). With the exception of the belt in Grave 5, which was placed with a brooch and a coin hoard near the foot, they appear to have been worn in death. In graves 1, 12 and 14 the belt buckle was on the right hip or waist, with the pin facing right, while in Graves 6 and 7 it was on the left thigh.[49] In terms of typology, the belt fittings in Graves 6, 7, 12 and 14 all have an oval belt plate with two, or more usually, three rivets and a D-shaped buckle. These buckles are of a common type which, in Britain, appears to date to the mid to late fourth century.[50] In Grave 1 (FIG. 4) only a D-shaped buckle and its pin were found, in a position on the right hip suggesting that it was worn. The belt fitting from Grave 5 (FIG. 5) lacks both the buckle loop and the pin and the plate is unusual in having an oval top plate and an angular plate on the underside, fixed by three rivets and still containing traces of mineralised leather. This plate design is similar to the example found in Grave 1925 at Lankhills.[51] The absence of the loop and pin may suggest that this belt was no longer fully functional, but was placed into the grave as an old and treasured possession. Interestingly, the associated crossbow brooch also shows signs of wear.

Previous isotopic studies have found no clear-cut relationship between the presence of a crossbow brooch or belt, and whether or not equipment was worn, and the geographical origin of its wearer. For example, of individuals with belt-fittings at Lankhills, 1175 has a British-made belt but is, according to the isotopic evidence, certainly not from Britain, but from a cooler, probably more continental climate.[52] On the other hand, the two individuals from Lankhills with the combination of buckles with an oval plate and a heart-shaped strap-end (Graves 81 and 426) are both isotopically foreign,[53] which suggests that such an ensemble may therefore be an indication of foreign origin. It is regrettable that Grave 14 from Scorton, which also has such a combination (FIG. 7), was not available in time for full multi-isotopic analysis; however, the results of the dietary reconstruction still lend some support to Cool's hypothesis (see below). Heart-shaped strap-ends are dated to A.D. 340–70 by Clarke[54] and on the basis of the example from Lankhills Grave 745, from the new excavations, their use may extend into the late fourth century[55]. The strap-end from Scorton Grave 14 is decorated with a pair of stamped circle-and-dot designs divided by a line of incised herringbone[56] and was found at the middle of the left femur.[57] Overall, belt fittings were clearly an important part of high-status male costume but more research is required to untangle their social implications.

Other grave goods at Scorton include copper-alloy and bone bracelets. Grave 11, the only burial identified as that of a woman, contained two fragmentary bracelets (FIG. 8). A plain bronze strip bracelet appears to have been placed above the right forearm while a curved, fragmentary bone object with an iron rivet and some copper-alloy staining was found near the right elbow. The latter is a bone bracelet of Clarke's Type B, with bone strips ending in butt terminals with a metal sleeve held by a rivet. Clarke dates these to *c.* A.D. 350–70 but more recent finds may suggest a bias towards the later fourth and even into the fifth century.[58]

In Grave 12 a fragmentary copper-alloy bracelet was found at the left side of the skull of an adult male, together with a purse hoard (FIG. 9). This appears to be a strip bracelet with one hooked terminal surviving; it is decorated with an s-shape or herringbone design. Swift has a number of bracelets with similar designs (cf. her decoration d5 and d6, although the Scorton example lacks the central line found on those parallels).[59] The example belongs to Cool's Bracelet Group XX, sub-group B.[60] Published examples include a bracelet with s-shaped decoration from a late fourth-century grave at Butt Road, Colchester[61] and two examples from Gadebridge Park.[62]

The original interpretation of two iron objects in Grave 5 as styli is unlikely on grounds of their shape, so the function of these two objects remains unknown. Two graves (Nos 5 and 12) contained hoards of 44 and 24 coins respectively; both were in organic containers or purses with one placed near the feet and the other beside the right shoulder. Coins do occur in graves in other late Roman cemeteries such as at Lankhills, but there the largest number of coins in a single grave was seven.[63] In general, coins in graves are thought to become more common from the mid-fourth century, as is the deposition of multiple (but usually <12) coins.[64] By contrast, large coin groups as found at Scorton are rare, although a good parallel is provided in Grave 2 at Frilford, where 34 coins (ending with the House of Theodosius) were found placed *c*. 30 cm above the head of a young adult male buried without other grave goods.[65]

A number of graves (Nos 3, 5, 7, 14 and 15) contained pottery vessels, either a Nene Valley beaker on its own or combined with a dish or bowl. A drink offering thus seems to have been important, while food may only have been included occasionally. Grave 7 contained a poorly preserved animal jaw bone and in Grave 5 the mineralised organic remains included hazelnuts and legume seed pods. Grave 7 is the only one to contain a glass vessel, an ovoid flask of a form apparently unique in Britain but paralleled in northern France.[66]

After examining both their grave goods and burial rite, we may be tempted to speculate as to the geographical origin of the people buried at Hollow Banks. In particular, we may consider the criteria first employed by Clarke for the late Roman cemetery at Lankhills, Winchester to distinguish between 'local' and 'intrusive' burials, which focused in particular on whether brooches, belts and bangles were worn in death or placed into the grave.[67] While the wearing of personal ornaments in death can no longer be taken as a reliable indicator of an immigrant burial,[68] their application at Hollow Banks would still suggest that five individuals (Nos 1, 6, 7, 12 and 14) may be described as 'intrusive' archaeologically in that they appear to have been buried dressed and, in particular, wearing a belt and/or crossbow brooch. The male No. 7 also has an unusual, clearly imported glass flask. The female No. 11 and male No. 5 on the other hand had objects placed into the grave in a rite which has been viewed as indicative of local traditions,[69] although it should be noted that No. 5 has both a belt and a crossbow brooch, just like the males Nos 1 and 7. Individuals Nos 2, 10 and 13 had no grave goods.

Whatever the meaning of worn or placed grave goods, the small Hollow Banks cemetery is clearly very different from nearby late Roman burials. The Hollow Banks site at Scorton is located only about 650 m from the fort and associated small town of Catterick (*Cataractonium*) in North Yorkshire.[70] Military occupation begins here around A.D. 80 and forts were re-established twice between the second and early fourth centuries. The adjacent civilian settlement eventually developed into a walled small town and settlement activity at *Cataractonium* is thought to have continued until at least the fifth century.[71] Recently, isotope analysis of 26 individuals from sites around Catterick fort and town and from the roadside settlement at Bainesse, including the famous 'eunuch'[72] was carried out.[73] In contrast with the mainly urban sites also examined as part of the 'Diasporas in Roman Britain' project,[74] the population at Catterick appears to have been much less heterogeneous. Most of the Catterick population has isotope signatures compatible with a UK origin; indeed significant numbers probably had a local upbringing. Only two individuals, including the possible eunuch, may have had foreign origins. Chenery *et al.* note an interesting difference between the somewhat earlier Bainesse burials, where individuals displayed greater variation in oxygen and strontium values, and the more homogeneous later (fourth-century) burials from the town and fort.[75] These may be related to changes in the recruitment policy of the Roman army and/or a significant downturn in traffic along Dere Street.

Below, isotope signatures from the newly analysed burials from Scorton will be compared to those from Catterick, and to other isotope data which have recently become available. Of particular interest are burials of males buried with similar belt fittings and crossbow brooches, such as those from Lankhills.[76] There are also men buried with crossbow brooches and very distinctive chip-carved belts, often interpreted as 'Germanic' *foederati* and dated to the later fourth–early fifth century and thus slightly later than the men at Scorton. One such individual is known from Grave 538 in the eastern London cemetery and a small group from Dyke Hills, Dorchester.[77] At the latter site, in addition to antiquarian finds of burials with chip-carved metalwork[78] a recently discovered burial has a chip-carved belt fitting and an iron axe.[79] Parallels for both suggest a continental origin for this 30–40 year-old male. The isotope analysis suggests that this individual's oxygen isotope ratio is outside the British range and consistent with a continental origin.[80] Finally, there is the so-called Gloucester Goth, an adult male buried with a silver belt buckle, silver shoe buckle, two silver strap-ends and a knife; his grave goods are paralleled in south-eastern Europe and south Russia, leading to the suggestion that this man was a Gothic immigrant, probably buried in the later fourth and early fifth century.[81] The results of recent isotope analysis are broadly consistent with such an origin.[82]

ISOTOPE ANALYSYS OF SKELETEL REMAINS FOR DIET AND MOBILITY RECONSTRUCTION

Isotopes are atoms of the same element but of slightly different mass. Their relative abundance in nature varies systematically and predictably between different environments, so that individual substances can be traced back to the environments they came from based on their isotopic composition. Isotope analysis of skeletal remains is based on the principle that all body tissues, including the skeleton, are formed from the basic molecular components of the food and drink ingested by the individual. They therefore contain the 'isotopic signatures' of the types of food consumed and also of the environments they were grown in, allowing for the reconstruction of diet and mobility of individuals.[83]

Carbon and nitrogen stable isotopes of skeletal collagen are well established as reflecting the main sources of dietary protein consumed by an individual.[84] Measured in bone, they reflect diet over the last ten to 30+ years prior to death, while dentine preserves the dietary signal at the time of tooth formation in childhood or early adolescence.[85] Meaningful differences between bone and dentine isotope values therefore indicate a significant change in diet in the life-time of an individual, which could be explained by a change in location.[86] Carbon stable isotope ratios ($^{13}C/^{12}C$ or $\delta^{13}C$) vary substantially between plants using the C_3 and C_4 photosynthetic pathways as well as their consumers in a food-web; most plants in temperate environments belong to the C_3 group while C_4 plants are mostly tropical grasses as well as the cultigens maize, millet, sorghum and sugarcane. $\delta^{13}C$ values also distinguish between terrestrial (C_3) and marine foods. Nitrogen isotope values ($^{15}N/^{14}N$ or $\delta^{15}N$) provide information about trophic level and therefore the relative importance of animal protein in a person's diet, although this relationship can be obscured by various environmental and metabolic factors.[87]

Strontium and oxygen form two independent isotopic systems which vary systematically according to local geology and climate respectively.[88] Both elements are incorporated in dental enamel at the time of crown formation. Enamel undergoes little remodelling thereafter and therefore retains an isotopic 'signature' of a person's place of residence in childhood, allowing archaeologists to reconstruct patterns of mobility in the past.[89]

Oxygen in human skeletal tissues is derived primarily from ingested fluids, with smaller contributions from food and atmospheric oxygen. Most drinking water is ultimately derived from rainwater and, provided that water was not transported over long distances, its oxygen isotope composition ($^{18}O/^{16}O$ or $\delta^{18}O$) should therefore indirectly reflect the isotopic value of local meteoric water.[90] Like other light stable isotopes, oxygen isotope ratios are subject to change through various metabolic processes between ingested oxygen and its incorporation in skeletal tissues.[91] This so-called ‘fractionation’ is fairly well understood and therefore allows estimating the isotopic composition of the drinking water ($\delta^{18}O_w$) from the isotope ratios measured in enamel phosphate ($\delta^{18}O_p$) by applying a water-to-phosphate conversion equation. The computed $\delta^{18}O_w$ can then be used to constrain an individual’s place of origin, assuming that documented modern drinking water values are not significantly different from past values.[92] The signficant uncertainty (i.e. statistical error) attached to such conversions is often understated[93] and the isotopic composition of ingested oxygen can also be modified by cultural practices, such as methods of food and drink preparation, and may therefore be population-dependent,[94] although we are only just beginning to understand the significance of this for bioarchaeological interpretations. Because of these complications, many researchers prefer to estimate the ‘local range’ of oxygen isotope ratios directly from the $\delta^{18}O_p$ of a group of humans who are assumed to be local, without a conversion to drinking water values and this method is also employed below.[95]

Strontium in skeletal tissues is derived from both solid and liquid foods and the strontium isotope composition ($^{87}Sr/^{86}Sr$) of bone and teeth directly relates to that of bioavailable strontium in the soils where the food was produced, without metabolic fractionation. While most strontium isotope variation is dependent on age and type of the bedrock, differential weathering, sediment formation and drift as well as strontium transferred through dust or rainwater can have a marked effect on biosphere $^{87}Sr/^{86}Sr$ and consequently on local values. Wherever possible, strontium isotope studies for human mobility should therefore undertake an assessment of the local range using biosphere samples, such as plants or animal remains.[96]

MATERIALS AND METHODS

Of the 15 burials from the Scorton Roman cemetery, only nine had skeletal remains which were well enough preserved for isotope analyses and/or were available for sampling. Of each of these, a tooth (preferentially a second molar or second premolar) and a bone sample (preferentially rib or, if not available, long bone) were obtained and prepared for strontium and oxygen isotope analysis of tooth enamel for the reconstruction of mobility and carbon and nitrogen isotope analysis of root dentine and bone collagen for the reconstruction of childhood and adult diet, respectively. Samples of a tenth individual (No. 14) became available later and were processed for carbon and nitrogen isotope analysis of dentine and bone only.

Sample preparation and analysis were carried out at the NERC Isotope Geoscience Laboratory at the British Geological Service in Keyworth (for strontium and oxygen isotopes) and at the University of Reading (for carbon and nitrogen isotopes) following the protocols described in Evans *et al*. and Müldner *et al*.[97] Analytical errors were as follows. For oxygen, the reproducibility of the internal phosphate standard (NBS120C) during the set of analyses was ± 0.16‰ (1 s.d.). $\delta^{18}O_p$ analyses were done in triplicate and the average standard deviation of the triplicates was ± 0.09‰. For strontium, the international standard for $^{87}Sr/^{86}Sr$, NBS987, gave a value of 0.710250 ± .000006 (n=8, 2 s.d.) during the analysis of these samples. Blank values were in the region of 100 pg. For carbon and nitrogen, repeat analysis of internal collagen standards calibrated to internationally certified reference material over the period of analysis gave an error of ±0.2‰ (1 s.d.) for both elements.

RESULTS

Individual data are shown in Table 1. $\delta^{18}O_p$ values range from 15.0‰ to 19.9‰ (range 4.9‰), with a mean of 16.7 ± 1.5‰ (all 1 s.d.). $^{87}Sr/^{86}Sr$ gave a narrow range between 0.7088 and 0.7104 (range 0.0016) with a mean of 0.7096 ± 0.0007. Strontium isotope analysis of one of the samples (No. 2) failed on grounds of poorly preserved enamel. Carbon isotope ratios of dentinal collagen extend from -16.9‰ to -19.5‰ (range 2.6‰), with a mean of -18.3 ± 0.9‰, while $\delta^{15}N$ of the same samples range from 9.3‰ to 13.2‰ (range 3.9‰), with a mean of 10.9 ± 1.3‰. $\delta^{13}C$ of bone collagen extend from -18.5‰ to -19.5‰ (range 1.0‰), with a mean of -19.0 ± 0.4‰, and nitrogen isotope ratios range from 8.4‰ to 12.3‰ (range 3.9‰), with a mean of 10.4 ± 1.0‰.

DISCUSSION

Strontium and oxygen isotopes

FIG. 10 depicts strontium and oxygen isotope data from Scorton in comparison with human isotope values from Catterick and strontium biosphere data from modern plants from the Vale of York and surrounding areas.[98] Also shown is the 2 standard deviations range of phosphate oxygen isotope ratios for 615 archaeological individuals from Britain,[99] which is taken as an estimate for $\delta^{18}O_p$ values consistent with British origins. This range is wider and therefore more conservative than the estimate used in Chenery *et al.*,[100] but it can be regarded as more robust as it is based on a much larger number of samples than were previously available.[101]

The strontium isotope ratios for eight individuals from Scorton ($^{87}Sr/^{86}Sr$ for No. 2 could not be determined) are all well within the estimated local range for the Catterick area (0.7076–0.7108).[102] The strontium isotope values from Scorton are therefore all consistent with a local upbringing. It should be noted, however, that $^{87}Sr/^{86}Sr$ like those observed here are relatively generic and fit a range of mostly Mesozoic terrains which are very commonly encountered in Britain and on the European mainland.[103] While a local origin of the Scorton individuals would therefore be the simplest explanation based on the strontium isotope data, they could equally have moved from areas of similar geology in Britain or abroad. The oxygen isotope values indeed indicate the latter.

When the oxygen isotope data are examined, there are only three individuals (Nos 1, 12 and 13) with $\delta^{18}O_p$ within the estimated British range and for whom a local upbringing therefore seems easily possible. (Note that for at least one of these, No. 1, a British origin is nevertheless unlikely on grounds of his carbon isotope values, see below). No. 11, the only female in the group, has a significantly elevated $\delta^{18}O_p$ of 19.9‰; however, since the sample was taken from a first molar, a tooth whose crown formation is complete in the first years of life;[104] this value is probably artificially elevated by the consumption of breast milk.[105] A local or at least British origin, possibly in Southern or Western England, where oxygen isotope ratios of drinking water are higher than in the north-east,[106] is therefore quite possible for this individual.

Five individuals from Scorton (Nos 2, 5, 6, 7 and 10) have $\delta^{18}O_p$ outside and lower than the estimated British range, making origins in a cooler, more continental climate likely. Conversion of the skeletal data into drinking water values using the equation by Longinelli give $\delta^{18}O_w$ between -10.0‰ and -11.5‰[107] (± ~1‰ typical 95% CI)[108]. These values would be consistent with an origin in Central/Eastern Europe or with access to drinking water from higher altitudes.[109]

Carbon and nitrogen isotopes

FIG. 11 shows carbon and nitrogen isotope values for the Scorton humans (dentinal and bone collagen, reflecting childhood diet and long-term dietary average, respectively) compared to human and faunal data from nearby Catterick. It is easily evident that there is very little overlap between the two sites and the Scorton humans display significantly higher carbon isotope ratios than those from Catterick in both their bone and dentine[110] These differences demonstrate that the Scorton individuals, as a group, consumed diets which were isotopically different from the average.

Further detail is gleaned when dentine and bone isotope ratios from the same individuals are compared: at Catterick where most individuals are thought to have been local, differences between the two tissues are typically small and in any case no greater than 0.5‰ for $\delta^{13}C$ and 1.0‰ for $\delta^{15}N$.[111] If these values are taken as indicative of the variation expected between bone and dentine of individuals on homogenous diets, then more than half of the Scorton males (Nos 1, 2, 5, 7, 12, 14) appear to have undergone measurable dietary change between the time when their tooth roots formed in their early teens and their time of death (FIG. 11).[112] In each case the shift (0.8–1.8‰ for carbon and 1.2–2.3‰ for nitrogen) is towards more negative $\delta^{13}C$ in later life, and therefore towards the C_3-ecosystem dominated isotope values observed for the Catterick humans. These results suggest that the isotopic composition of the bone collagen, which is replaced only slowly after the end of adolescence was,[113] at the time of death, still in transition between their variably ^{13}C-enriched childhood diets and local values.

While the early diets of the Scorton males indicated by these data are also primarily based on C_3-plant derived protein, they contain varying but sufficiently large contributions from high $\delta^{13}C$- (C_4-plant or marine) foods to make them stand out in the Catterick context. Compared to isotope data from some larger Romano-British towns, e.g. the provincial capital of York, where diets were predictably more diverse and included a greater proportion of aquatic and marine protein (FIG. 12), they are less unusual. Nevertheless, a number of the Scorton individuals still plot on the very margins of the distribution in terms of $\delta^{13}C$ even then (close to or even outside the 2 standard deviations range) and two of the Scorton males (Nos 1 and 2) are even more than 3 standard deviations from the York average, and therefore en par with other extreme outliers for whom it has been argued that a British origin is very unlikely on account of their 'exotic' diets.[114] The isotope values of these two, unusually high carbon isotope values combined with no observable rise in δ15N, could result from a mixture of C_3-terrestrial foods and low-trophic level marine resources.[115] However, given the 'continental' oxygen isotope signature of Scorton 2, at least his dietary signal may be best explained by the consumption of C_4-plants or C_4-derived protein. This was most likely from millet which was the only C_4-cultigen grown on the European continent (but not in Britain) at the time.[116] In the Roman period combinations of carbon and nitrogen isotope values such as in Scorton Nos 1 and 2 have so far only been reported in isolated individuals, most likely also migrants, but not in whole populations.[117] The exception is a second-century cemetery of the Wielbark culture in Rogowo, Central Poland where mean $\delta^{13}C$ and $\delta^{15}N$ values of -17.7±0.7‰ and 9.7±0.5‰ (1 s.d., n=30) were measured (maximum $\delta^{13}C$ was -16.4‰).[118] It is important to emphasise that this comparison is not meant to suggest any direct connection between Scorton and the area of modern-day Poland. It is merely meant to demonstrate that dietary values like those observed at Scorton existed in Roman-period Central Europe, a region which is also consistent with the oxygen and strontium isotope values of several of the Scorton individuals (although not easily No. 1). Since there is some evidence from Germany, France and the Low Countries that cultivation of millet declined on their integration into the Roman Empire,[119] it would be tempting to suggest that isotopic evidence for millet consumption could, in this particular context, indicate origins outside the *Imperium Romanum*; however, as we are only just beginning to understand dietary variation in the Roman world, this would be little more than speculation at this point.[120]

In summary, the results of the isotope analysis confirm that the Scorton group is highly unusual, not only in the context of Roman Catterick, but most of them also in Roman Britain as a whole. Oxygen isotope data suggests a continental origin for five of the eight Scorton males tested (Nos 2, 5, 6, 7 and 10) and for another (No. 1), a childhood in Britain is extremely unlikely on account of his highly unusual diet. The childhood dietary (carbon and nitrogen isotope) values of Nos 12 and 14 are not as 'exotic' in a wider Romano-British context as those of No. 1 and 2. They are most similar to individuals from the high-status group at Poundbury, whose origins have unfortunately never been tested.[121] Nevertheless, they also plot sufficiently on the margins of even larger, urban data-sets (i.e. only just in- or outside 2 standard deviations from the mean $\delta^{13}C$ of York (see FIG. 12) and Lankhills/Winchester (n=124)[122], to allow us to at least question a British origin. In any case, these two have childhood diets which are distinct enough from the Catterick population (i.e. more than 3 standard deviations from the mean, see FIG. 11) to render at least a local origin very unlikely.

Of ten individuals, there remain therefore only two, a male without grave-goods (No. 13) and the only woman in the group (No. 11) for whom the isotope data are easily consistent with upbringings in the Catterick area. Even for these it must be remembered that isotope analysis can only ever exclude but not confirm local origins.

Isotopes and archaeology

It is now widely accepted that the relationship between socially and culturally constructed identities as expressed through artefacts and burial rite on the one hand and biological identities such as sex and geographic origin on the other is highly complex.[123] A detailed discussion is beyond the scope of this paper, but it is clear that while ethnicity was initially seen as biologically determined and fixed, it is now usually viewed as dynamic and historically contingent.[124] Increasingly, ethnicity is seen as an ideological construct, often negotiated through strategies of distinction such as the wearing of particular kinds of objects that can be created, reinforced and challenged by groups and individuals.[125] How diverse populations were and whether or how differences were experienced and expressed is a question of particular importance to the Roman world, a society probably characterised by unprecedented levels of mobility.[126] While initially lagging behind, for example, early medieval archaeology, these issues are now being addressed for the Roman period, not just through the exceptionally rich epigraphic material[127] but also through careful analysis of later Roman material culture.[128] Recent isotope work on several Romano-British sites has now highlighted that burials identified on archaeological grounds as intrusive sometimes indeed appear to be the graves of people who spent their childhoods in significantly warmer or colder, continental climates, or who consumed unusual diets that suggest origins outside of Britain.[129] Equally, there are individuals whose burial rites appear to follow local traditions and whose isotope signatures match the local ones. On the other hand, we are also confronted with individuals who appear local archaeologically but are clearly intrusive isotopically, while others look 'foreign' archaeologically but appear to be local isotopically. We have argued previously that these complexities should be expected as identities involve multiple aspects of a person and evolve over time, while burial goods were, of course, chosen by the mourners, adding another layer of mediacy.[130] In some cases we may also see the effect of intermarriage or may even be able to identify second-generation migrants such as the girl from Winchester who was buried according to what appears to be a continental rite and with some unusual grave goods but whose isotopic signature is fully consistent with a childhood in Winchester.[131]

The new data from Scorton further illuminate the complex ways in which individuals expressed aspects of their identities in life and death. Using archaeological criteria such as grave goods and burial rite, five individuals (Nos 1, 6, 7, 12 and 14) were thought to have been 'incomers' in that they were buried wearing belted tunics and/or cloaks fastened by crossbow brooches. One of these (No. 7) also had an unusual glass flask of a type that is currently unique in Britain, but can be paralleled in northern France.[132] The female No. 11 and male No. 5 had grave goods placed into the grave rather than worn, following a rite that has been seen as indicative of local traditions, although No. 5's grave goods (belt and crossbow brooch) are just like those of males Nos 1 and 7. Individuals 2, 10 and 13 had no grave goods. What can be deduced once we contrast these archaeological indicators with the results of the isotope analysis?

Three of the individuals actually wearing belts and brooches (1, 6 and 7) are indeed isotopically not local (in the case of No. 1, this was determined on the basis of an unusual dietary signature, not oxygen/strontium, with the latter indicating that he is from a climate and geology that is similar to that of Scorton/Catterick). Interestingly, this incoming male (No. 1) is thus from a different region to the other intrusive men, but judging by his grave goods and burial rite he served in a similar role within the late Roman military and administration. His crossbow brooch has unusual decoration, and may have been made in Britain or Gaul. While the unusual glass vessel may hint at an origin in northern France for No. 7, there is currently not enough isotope data available from that region to verify this suggestion and in any case the differences between northern France or Germany and southern or Eastern Britain would probably not be marked enough to make such an identification possible.[133]

The probable male No. 5, who is buried with what may well be an imported crossbow brooch and a belt, is also foreign isotopically, even though these objects were placed into the grave (not worn), in a rite that is often thought to be British. We could speculate that we see here the impact of those responsible for the actual funeral, for example a local wife burying her husband undressed in a shroud (or dressed but not wearing the brooch and belt) and placing these important objects by his feet. Alternatively of course, we may simply see variation within burial rites related to factors that we cannot now determine. Grave No. 5 is also distinguished by the presence of a large purse hoard, as is Grave No. 12.

Female No. 11 again is thought by the excavators to have been buried in a shroud and had bracelets placed above the right arm and elbow; such a rite might again be thought to indicate local British origin. While the oxygen isotope value for this individual initially appears to be too high to be local or even British, the analyses were conducted on a first molar and the isotope ratio is therefore likely artificially elevated by the consumption of breast milk;[134] this woman may thus well be one of the few native Romano-Britons in the group.

Male No. 12 has a worn brooch and belt that make him look foreign archaeologically. The deposition of a bracelet in this grave is also unusual, but together with the alignment might point to a personal relationship with the woman buried in Grave 11. Isotopically, his profile is not clear-cut; while an upbringing in and around Catterick appears unlikely on account of his diet, an origin elsewhere in Britain cannot be excluded (although areas with a similar climate and geology abroad are equally possible). Like the intrusive male No. 5 he was also buried with a large purse hoard. This may be an individual who joined the administration or army and followed the traditions he may have observed for his fellow officers or administrators who had originated from other parts of the Empire, but who was in fact British. In other words, we may see an example here where status in the sense of a professional identity and as expressed through objects which are almost like insignia of office was more important than geographical origin or ethnicity.[135] It is often necessary to look very closely at the type of crossbow brooch and belt fitting, with some representing imports and others British products. At Lankhills, both imported and possibly British-made ‘hybrid’ crossbow brooches were associated with isotopically foreign individuals, illustrating that it was the symbol of office and status itself that was important and not necessarily the origin of the brooch or indeed the individual.[136] The chip-carved belt set and axe at Dorchester and the silver buckles at Gloucester may be even more distinctive archaeological indicators of immigrant males, as in both cases the men are not from Britain isotopically.[137]

The isotopic profile for Scorton 14 is unfortunately incomplete and although the palaeodietary data are sufficient to raise question about a British origin, they are ultimately inconclusive. The grave goods, in particular the combination of a buckle with an oval plate and a heart-shaped strap-end, have been taken as indicators of foreign origin at Lankhills[138] and given the dietary data, this seems likely for this individual from Scorton, too, although we are in danger of a circular argument here. Ultimately, we can only hope to resolve this question by future oxygen and strontium analysis, which was not possible within the timeframe of this project.

Of the three individuals buried without any (surviving) grave goods, two (Nos 2 and 10) are isotopically foreign while one (No. 13) was probably local. Again, this illustrates that aspects of identity other than origin were highlighted in death; for example, the absence of surviving grave goods might indicate a lower professional status.

Another aspect to consider is the question of change over time. While this small cemetery is strikingly homogeneous and all graves can be broadly dated to the mid–late fourth century, the burials clearly did all not occur at exactly the same time. The two burials with coin hoards give the most precise dates: Grave 12 is the earlier, with a possible deposition date in the early A.D. 340s (341/2?), while Grave 5 is perhaps ten or so years later, with a suggested deposition date of A.D. 354–6.[139] The artefacts are more difficult to sequence. Generally, the crossbow brooches date to the last two thirds of the fourth century and possibly into the fifth century; the belt fittings are of mid- to late fourth-century date and the bracelets probably belong to the mid- to later fourth and into the fifth century. The eight pottery vessels from the cemetery have a date range of the very late third to the fourth century, but are thought most likely to date to the middle of the fourth century.[140] The latest vessel is a simple-rimmed Nene-Valley colour-coated dish from Grave 7 thought to post-date A.D. 350. Price suggests that a date after A.D. 360 is appropriate for the unusual glass vessel from the same grave and the crossbow brooch may be the latest of the Scorton examples typologically; this may suggest that Grave 7 is amongst the latest in this small cemetery.[141] The issue of dating is complicated by the deposition of objects that may have been quite old when placed in the grave; this is especially noticeable for Grave 5. Interestingly, the later Graves 5 and 7 are on roughly the same alignment, while the early Grave 12 is aligned with

Grave 11; unfortunately there are no stratigraphic relationships that would allow us to recreate the burial sequence further.

Overall, the Scorton isotope data are very different from those from nearby Catterick. There, isotope analysis revealed a relatively homogenous population who, with the exception of the so-called eunuch, were not buried with unusual grave goods and are characterised by isotope signatures that are on the whole compatible with British, or indeed local Yorkshire, origins.[142] Chenery *et al*. detect a difference between the burials from the roadside settlement at Bainesse and those more closely associated with the fort and town, which they attribute to possible political and economic factors leading to a decline in migration into the area.[143] The new data from Scorton demonstrate that such migration, probably from colder and more continental parts of Europe, did occur in the later fourth century and, judging from the grave goods, that this movement of young men was closely associated with the late Roman administration and army. It is tempting to see the Scorton men as members of the late Roman field army (*comitatenses*), as has been suggested for individuals buried with chip-carved belts.[144] The *comitatenses* included regiments of barbarians, sometimes described as *foederati* or allies, who are thought to have been equipped by the government; they 'may have differed visually from regular Roman regiments but if so, we do not know how'.[145] In other words, it may simply not be possible to distinguish between the types of army personnel attested historically in the archaeological record; indeed the same may apply to the visual distinctions between administrators and officials and the army. We may note that the late Roman military activity at Catterick is not exceptional in the region and is indeed paralleled at Piercebridge and Binchester, both also located on Dere Street. Interestingly, neither Piercebridge nor Catterick are listed in the *Notitia Dignitatum*, though this may well be due to the nature of this complex document.[146]

In general, the Scorton data, like those from Winchester and York, highlight that late Roman populations (and the army in particular) were isotopically very diverse and that the Roman period was characterised by high levels of mobility. Of course, the skeletons studied from Roman Britain so far are not a representative sample, as they were largely chosen because they are archaeologically unusual and there is now an urgent need to sample rural and 'unremarkable' individuals.[147]

Another interesting question to explore in future work is whether the presence of male incomers from the continent in the very late Roman period also has implications for our understanding of the Anglian period in the Catterick area. It is now clear that the area of the town was certainly occupied beyond A.D. 400 and it has been suggested that, as at other sites such as Birdoswald, members of the late Roman army may have taken control of strongholds and local food supply systems once central pay stopped.[148] At Catterick, the presence of Anglian immigrants is attested by material culture, Grubenhäuser and funerary evidence possibly from A.D. 500 and certainly from A.D. 600.[149] Catterick has also been equated with Catraeth, the place of the famous battle in *c.* A.D. 600 between Britons and Anglians described in Y Gododdin, a poem dating to between the seventh and eleventh centuries and surviving in one later thirteenth-century manuscript.[150] The dating of the Anglian burials at Scorton remains debated[151] but our work shows that already in the later Roman period significant numbers of the Catterick population may have arrived from the European continent and conversely, not all individuals buried with Anglian grave goods are likely to have been incomers, as demonstrated at West Heslerton.[152] In addition to the full publication of the Anglian phase at Scorton, isotope analysis of the Anglian burials is thus highly desirable.

Returning to the late Roman burials, once again there is no clear-cut relationship between cultural and biological identities; in some cases the archaeological indicators such as grave goods and burial rite 'match' the geographic origin reflected in the isotopic signatures but in others they do not. This is not surprising and in fact is what makes the analysis of late Romano-British burials so interesting. At Scorton and other sites there is a suggestion that geographical origin probably was not the most important aspect of identity for people, perhaps both in life and death. What seems to have been particularly emphasised through dress accessories is status and, in this case, an official role specifically.[153] It may be that such conspicuous consumption in burials is a sign of competition and 'insecure' elites within a local context.[154] Gender and age are clearly also important, as reflected in the strong association of worn bead strings and bracelets with young girls at Lankhills[155] and in the strikingly homogeneous association of crossbow brooches and belts with adult men at Scorton.

CONCLUSION

Multi-isotope analysis at Scorton suggests that at least six of the nine individuals tested were indeed immigrants, probably from the European continent. As in other recent studies which have compared artefactual evidence to isotopic signatures, the relationship between geographical origin and burial rite is not straightforward; several individuals that look archaeologically foreign display non-local isotope signatures, yet there is also an individual buried in what may be described as an intrusive style who may have spent his childhood in Britain, if not in Catterick itself. Other factors such as age, gender and status clearly played an important part, as did the cultural identity of the partners, parents, children and friends who were presumably responsible for the burials. The study demonstrates that it is crucial for all aspects of identity to be examined in a contextual, multi-proxy analysis as only critical comparison of a combination of factors can begin to disentangle the relationships between personal identity and archaeological remains in what was clearly a complex and highly mobile society.

Department of Archaeology, University of Reading (HE/GM)
h.eckardt@reading.ac.uk
g.h.mueldner@reading.ac.uk
Northern Archaeological Associates (GS)
gs@naa.gb.com

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BIBLIOGRAPHY

Adler, H. (ed.) 1989: ‘Römische Kaiserzeit’, *Fundberichte aus Österreich* 28, 203–57

Alcock, L. 1983: ‘Gwŷr Y Gogledd: an archaeological appraisal’, *Archaeologia Cambrensis* 132, 1–18

Atanasov, G. 2007: ‘Late antique tomb in Durostorum-Silistra and its master’, *Revista Pontica* 40, 447–68

Barber, B., and Bowsher, D. 2000: *The Eastern Cemetery of Roman London. Excavations 1983–1990*, London

Barth, F. 1969: *Ethnic Groups and Boundaries*, Boston

Bayley, J., and Butcher, S. 2004: *Roman Brooches in Britain: a Technological and Typological Study based on the Richborough Collection*, London

Bentley, R.A. 2006: ‘Strontium isotopes from the earth to the archaeological skeleton: a review’, *Journal of Archaeological Method and Theory* 13, 135–87

Birley, A. 1979: *The People of Roman Britain*, London

Booth, P. 2014: ‘A late Roman military burial from the Dyke Hills, Dorchester on Thames, Oxfordshire’, *Britannia* 45, 243–73

Booth, P., Simmonds, A., Clough, S., Cool, H., and Poore, D. 2010: *The Late Roman Cemetery at Lankhills, Winchester, Excavations 2000–2005*, Oxford

Bradford, J.S.P., and Goodchild, R.G. 1939: ‘Excavations at Frilford, Berks’, *Oxoniensia* 4, 1–70

Brettell, R., Evans, J.,Marzinzik, S., Lamb, A., and Montgomery, J. 2012a: “Impious Easterners’: can oxygen and strontium isotopes serve as indicators of provenance in Early Medieval European cemetery populations?’, *European Journal of Archaeology* 15, 117–45

Brettell, R., Montgomery, J., and Evans, J. 2012b: ‘Brewing and stewing: the effect of culturally mediated behaviour on the oxygen isotope composition of ingested fluids and the implications for human provenance studies’, *Journal of Analytical Atomic Spectrometry* 27, 778–85

Brickstock, R.J. 2002: ‘Coins in the Roman burials’, in Speed 2002, 3747

Bridgeland, D., Innes, J., Long, A., and Mitchell, W. 2011: *Late Quaternary Landscape Evolution of the Swale-Ure Washlands, North Yorkshire*, Oxford

Burger, A.S. 1966: ‘The late Roman cemetery at Ságvár’, *Acta Archaeologica Academiae Scientiarum Hungaricae* 18, 99–234

Chenery, C., Eckardt, H., and Müldner, G. 2011: ‘Cosmopolitan Catterick? Isotopic evidence for population mobility on Rome’s Northern frontier’, *Journal of Archaeological Science* 38, 1525–36

Chenery, C., Müldner, G., Evans, J., Eckardt, H., and Lewis, M. 2010: ‘Strontium and stable isotope evidence for diet and mobility in Roman Gloucester, UK’, *Journal of Archaeological Science* 37, 150–63

Clarke, G. 1979: *Pre-Roman and Roman Winchester. Part 2: The Roman Cemetery at Lankhills*, Oxford

Collins, R. 2010: ‘Brooch use in the fourth to fifth century frontier’, in Collins and Allason-Jones 2010, 64–77

Collins, R. 2012: *Hadrian’s Wall and the End of Empire. The Roman Frontier in the Fourth and Fifth Centuries*, London

Collins, R., and Allason-Jones, L. (eds) 2010: *Finds from the Frontier: Material Culture in the Fourth–Fifth Centuries*, CBA Research Report 162, York

Cool, H.E.M. 1983: *A Study of the Roman Personal Ornaments made of Metal, excluding Brooches from Southern Britain*, unpublished PhD thesis, University of Wales

Cool, H.E.M. 2002: ‘An overview of the small finds from Catterick’, in Wilson 2002, 24–43

Cool, H.E.M. 2010a: ‘Objects of glass, shale, bone and metal’, in Booth *et al*. 2010, 267–308

Cool, H.E.M. 2010b: ‘Finding the foreigners’, in Eckardt 2010b, 27–44

Coulston, J.C.N. 2010: ‘Military equipment of the “long” fourth century on Hadrian’s Wall’, in Collins and Allason-Jones 2010, 50–63

Crummy, N. 1983: *The Roman Small Finds from Excavations in Colchester 1971–9*, Colchester

Cummings, C., and Hedges, R. 2010: ‘Carbon and nitrogen stable isotope analyses’, in Booth *et al*. 2010, 411–21

Dansgaard, W. 1964: ‘Stable isotopes in precipitation’, *Tellus* 16, 436–67

Darling, W.G., and Talbot, J.C. 2003: ‘The O & H stable isotopic composition of fresh waters in the British Isles. 1. Rainfall’, *Hydrology And Earth System Sciences* 7, 163–81

Daux, V., Lécuyer, C., Héran, M.–A., Amiot, R.L. Simon, L., Fourel, F., Martineau, F., Lynnerup, N., Reychler, H., and Escarguel, G. 2008: ‘Oxygen isotope fractionation between human phosphate and water revisited’, *Journal of Human Evolution* 55, 1138–47

Derks, T., and Roymans, N. (eds) 2009: *Ethnic Constructs in Antiquity: The Role of Power and Tradition*, Amsterdam

Eckardt, H. 2010a: ‘A long way from home: diaspora communities in Roman Britain’, in Eckardt 2010b, 99–130

Eckardt, H. (ed.) 2010b: *Roman Diasporas: Archaeological Approaches to Mobility and Diversity in the Roman Empire*, Portsmouth, RI

Eckardt, H., and Müldner, G. 2014: ‘Mobility, migration and diasporas in Roman Britain’, in M. Millett, A. Moore and L. Revell (eds) *Handbook of Roman Britain*, Oxford, page nos needed

Eckardt, H., Müldner, G., and Lewis, M. 2014: ‘People on the move in Roman Britain’, *World Archaeology* 46.4, 534-550.

Eckardt, H., Chenery, C., Booth, P., Evans, J.A., Lamb, A., and Müldner, G. 2009: ‘Oxygen and strontium isotope evidence for mobility in Roman Winchester’, *Journal of Archaeological Science* 36, 2816–25

Elton, H. 1996: *Warfare in Roman Europe, AD 350–425*, Oxford

Evans, J. 2014: ‘Isotope analysis’, in Booth 2014, online Appendix 2.

Evans, J. 2002: ‘Pottery from the Roman cemetery’, in Speed 2002, 49

Evans, J., Stoodley, N., and Chenery, C. 2006: ‘A strontium and oxygen isotope assessment of a possible fourth century immigrant population in a Hampshire cemetery, southern England’, *Journal of Archaeological Science* 33, 265–72

Evans, J.A., Montgomery, J., Wildman, G., and Boulton, N. 2010: ‘Spatial variations in biosphere $^{87}Sr/^{86}Sr$’, *Journal Of The Geological Society, London* 167, 1–4

Evans, J.A., Chenery, C.A., and Montgomery, J. 2012: ‘A summary of strontium and oxygen isotope variation in archaeological human tooth enamel excavated from Britain’, *Journal of Analytical Atomic Spectrometry* 27, 754–64

Faure, G., and Powell, J.L. 1972: *Strontium Isotope Geology*, Berlin, Heidelberg & New York

Gardner, A. 2007: *An Archaeology of Identity. Soldiers and Society in Late Roman Britain*, Walnut Creek

Gerrard, J. 2013: *The Ruin of Roman Britain: An Archaeological Perspective*, Cambridge

Hakenbeck, S., McManus, E., Geisler, H., Grupe, G., and O'Connell, T. 2010: 'Diet and mobility in early medieval Bavaria: a study of carbon and nitrogen stable isotopes', *American Journal of Physical Anthropology* 143, 235–49

Handley, M. 2011: *Dying on Foreign Shores: Travel and Mobility in the Late-Antique West*, Portsmouth, RI

Hawkes, S.C., and Dunning, G.C. 1961: 'Soldiers and settlers in Britain, fourth to fifth century', *Medieval Archaeology* 5, 1–70

Hedges, R.E.M., and Reynard, L.M. 2007: 'Nitrogen isotopes and the trophic level of humans in archaeology', *Journal of Archaeological Science* 34, 1240–51

Hedges, R.E.M., Clement, J.G., Thomas, C.D.L., and O'Connell, T. C. 2007: 'Collagen turnover in the adult femoral mid-shaft: modeled from anthropogenic radiocarbon tracer measurements', *American Journal of Physical Anthropology* 133, 808–16

Hills, C.M., and Hurst, H.R. 1989: 'A Goth at Gloucester', *Antiquaries Journal* 69, 154–8

Hillson, S. 2005: *Teeth*, Cambridge

IAEA/WMO 2013. Global Network of Isotopes in Precipitation. The GNIP Database. Accessible at: http://www.iaea.org/water

Institute of Geological Sciences 1970: *Richmond, Sheet 41: Solid Edition*, London

Jarvis, R.A., Bendelow, V.C., Bradley, R.I., Carroll, D.M., Furness, R.R., Kilgour, I.N.L., and King, S.J. 1984: *Soils and their Use in Northern England*, Soil Survey of England and Wales Bulletin No. 10, Harpenden

Keenleyside, A., Schwarcz, H., and Panayotova, K. 2006: 'Stable isotopic evidence of diet in a Greek colonial population from the Black Sea', *Journal of Archaeological Science* 33, 1205–15

Keller, E. 1971: *Die spätrömischen Grabfunde in Südbayern*, München

Killgrove, K., and Tykot, R.H. 2013: 'Food for Rome: a stable isotope investigation of diet in the Imperial period (first–third centuries AD)', *Journal of Anthropological Archaeology* 32, 28–38

Kohn, M.J. 1996: ‘Predicting animal $\delta^{18}O$: accounting for diet and physiological adaptation’, *Geochimica et Cosmochimica Acta* 60, 4811–29

Leach, S., Lewis, M., Chenery, C., Müldner, G., and Eckardt, H. 2009: ‘Migration and diversity in Roman Britain: a multidisciplinary approach to the identification of immigrants in Roman York, England’, *American Journal of Physical Anthropology* 140, 546–61

Leach, S., Eckardt, H., Chenery, C., Müldner, G., and Lewis, M. 2010: ‘A “lady” of York: migration, ethnicity and identity in Roman York’, *Antiquity* 84, 131–45

Lee-Thorp, J.A. 2008: ‘On isotopes and old bones’, *Archaeometry* 50, 925–50

Longinelli, A. 1984: ‘Oxygen isotopes in mammal bone phosphate: a new tool for palaeohydrological and palaeoclimatological research’, *Geochimica et Cosmochimica Acta* 48, 385–90

Mays, S. 2010: *The Archaeology of Human Bones*, London and New York

Mertens, J., and Van Impe, L. 1971. *Het Laat-Romeins Grafveld van Oudenburg*, Archaoelogia Belgica 135, Brussels

Meskell, L., 2001: ‘Archaeologies of identity’, in I. Hodder (ed.) *Archaeological Theory Today*, Cambridge, 187–213

Montgomery, J. 2010: ‘Passports from the past: investigating human dispersals using strontium isotope analysis of tooth enamel’, *Annals of Human Biology* 37, 325–46

Montgomery, J., Evans, J.A., Powlesland, D., and Roberts, C.A. 2005: ‘Continuity or colonization in Anglo-Saxon England? Isotope evidence for mobility, subsistence practice and status at West Heslerton’, *American Journal of Physical Anthropology* 126 (2), 123–38

Montgomery, J., Evans, J., Chenery, C., Pashley, V., and Killgrove, K. 2010: “Gleaming, white and deadly’: using lead to track human exposure and geographic origins in the Roman period in Britain’, in Eckardt 2010b, Portsmouth, RI, 199–226

Müldner, G. 2013: ‘Stable isotopes and diet: their contribution to Romano-British research’, *Antiquity* 87, 137–49

Müldner, G., Chenery, C., and Eckardt, H. 2011: ‘The “Headless Romans”: multi-isotope investigations of an unusual burial ground from Roman Britain’, *Journal of Archaeological Science* 38, 280–90

Neal, D.S. 1974: *The Excavation of the Roman Villa in Gadebridge Park Hemel Hempstead 1963–8*, London

Noy, D. 2000: *Foreigners at Rome: Citizens and Strangers*, London

Noy, D. 2010: ‘Epigraphic evidence for immigrants at Rome and in Roman Britain’, in Eckardt 2010b, 13–26

Oelze, V.M., Koch, J.K., Kupke, K., Nehlich, O., Zaeuner, S., Wahl, J., Weise, S.M., Rieckhoff, S., and Richards, M.P. 2012: ‘Multi-isotopic analysis reveals individual mobility and diet at the early iron age monumental tumulus of Magdalenenberg, Germany’, *American Journal of Physical Anthropology* 148, 406–21

Pearce, J. 2010: ‘Burial, identity and migration in the Roman world’, in Eckardt 2010b, 79–98

Philpott, R. 1991: *Burial Practices in Roman Britain*, BAR British Series 219, Oxford

Pirling, R. 1966: *Das römisch-fränkische Gräberfeld von Krefeld-Gellep*, Berlin

Pirling, R. 1989: *Das römisch-fränkische Gräberfeld von Krefeld-Gellep 1966–1974,* Stuttgart

Pohl, W. 1998: ‘Telling the difference: signs of ethnic identity’, in W. Pohl and H. Reimitz (eds)*, Strategies of Distinction: The Construction of Ethnic Communities, 300–800,* Leiden, 1–69

Pollard, A.M., Ditchfield, P., McCullagh, J.S.O., Allen, T.G., Gibson, M., Boston, C., Clough, S., Marquez-Grant, N., and Nicholson, R.A. 2011a: “These Boots Were Made For Walking’: the isotopic analysis of a C_4 Roman inhumation from Gravesend, Kent, UK’, *American Journal of Physical Anthropology* 146, 446–56

Pollard, A.M., Pellegrini, M., and Lee-Thorp, J.A. 2011b: ‘Technical note: some observations on the conversion of dental enamel $\delta^{18}O_p$ values to $\delta^{18}O_w$ to determine human mobility’, *American Journal of Physical Anthropology* 145, 499–504

Powlesland, D. 2003: ‘The early-middle Anglo-Saxon period (AD 400–AD 850)’, in R. Butlin (ed.), *Historical Atlas of North Yorkshire*, Otley, 62–7

Price, J. 2002. *The Glass flask [571AE] from Roman Grave 7, Hollow Banks Quarry, Scorton, North Yorkshire*, unpublished report for Northern Archaeological Associates, in Speed 2002, 48

Price, J. 2010: ‘Late Roman glass vessels in the Hadrian’s Wall frontier region’, in Collins and Allason-Jones 2010, 37–49

Price, T.D., Burton, J.H., and Bentley, R.A. 2002: ‘The characterization of biologically available strontium isotope ratios for the study of prehistoric migration’, *Archaeometry* 44, 117–35

Pröttel, P.M. 1988: ‘Zur Chronologie der Zwiebelknopffibeln’, *Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz* 35.1, 347–72

Reitsema, L.J., and Kosłowski, T. 2013: ‘Diet and society in Poland before the state: stable isotope evidence from a Wielbark population (second century AD)’, *Anthropological Review* 76, 1–22

Richards, M.P., Hedges, R.E.M., Molleson, T.I., and Vogel, J.C. 1998: ‘Stable isotope analysis reveals variations in human diet at the Poundbury Camp cemetery site’, *Journal of Archaeological Science* 25, 1247–52

Roymans, N. 2004: *Ethnic Identity and Imperial Power: The Batavians in the Early Roman Empire*, Amsterdam

Scheidel, W. 2004: ‘Human mobility in Roman Italy, I: the free population’, *Journal of Roman Studies* 94, 1–26

Schwarcz, H.P., and Schoeninger, M.J. 1991: ‘Stable isotope analyses in human nutritional ecology’, *Yearbook of Physical Anthropology* 34, 283–321

Sealy, J.R., Armstrong, R., and Schrire, C. 1995: ‘Beyond lifetime averages – tracing life-histories through isotopic analysis of different calcified tissues from archaeological human skeletons’, *Antiquity* 69, 290–300

Simpson, C.J. 1976: ‘Belt-buckles and strap-ends of the Later Roman Empire’, *Britannia* 7, 192–223

Soil Survey of England and Wales. 1983: *Soils of England and Wales Sheet 1: Northern England*, Southampton

Sommer, M. 1984: *Die Gürtel und Gürtelbeschläge des 4. Und 5. Jahrhunderts im römischen Reich*, Bonn

Speed, G. 2002: *Excavations at Hollow Banks Quarry Scorton, North Yorkshire, Vol. 2: the Romano-British and Anglian Cemeteries*, unpublished report for Northern Archaeological Associates

Stout, A.M. 1994: ‘Jewelry as a symbol of status in the Roman Empire’, in J.L. Sebesta and L. Bonfante (eds), *The World of Roman Costume*, Wisconsin, 77–100

Swift, E. 2000: *Regionality in Dress Accessories in the Late Roman West*, Montagnac

Swift, E. 2010: ‘Identifying migrant communities: a contextual analysis of grave assemblages from continental late Roman cemeteries’, *Britannia* 41, 237–82

Taylor, M.P., and Macklin, M.G. 1997: ‘Holocene alluvial sedimentation and valley floor development: the River Swale, Catterick, North Yorkshire’, *Proceedings of the Yorkshire Geological Society* 51, 317–27

Voerkelius, S., Lorenz, G.D., Rummer, S., Quétel, C.R., Heiss, G., Baxter, M., Brach-Papa, C., Deters-Itzelsberger, P., Hoelzl, S., Hoogewerff, J., Ponzevera, E., van Bocxstaele, M., and Ueckermann, H. 2010: ‘Strontium isotopic signatures of natural mineral waters, the reference to a simple geological map and its potential for authentication of food’, *Food Chemistry* 118, 933–40

Walton-Rogers, P. 2002: ‘The Roman burials: clothed and shrouded bodies’, in Speed 2002, 35–6

White, C.D., Spence, M.W., Stuart-Williams, H.L.Q., and Schwarcz, H.P. 1998: ‘Oxygen isotopes and the identification of geographical origins: the Valley of Oaxaca versus the Valley of Mexico’, *Journal of Archaeological Science* 25, 643–55

Wierschowski, L. 1995: *Die regionale Mobilität in Gallien nach den Inschriften des 1. bis 3. Jahrhunderts n. Chr.*, Stuttgart

Wierschowski, L. 2001: *Fremde in Gallien – "Gallier" in der Fremde : die epigraphisch bezeugte Mobilität in, von und nach Gallien vom 1. bis 3. Jh. n. Chr*., Stuttgart

Willis, S., and Carne, P. 2013: *A Roman Villa at the Edge of Empire. Excavations at Ingleby Barwick, Stockton-on-Tees, 2003–04*, York

Wilmott, T. 1997: *Birdoswald: Excavation of a Roman Fort on Hadrian's Wall and its Successor Settlements: 1987–92*, London

Wilson, P.R., Cardwell, P, Cramp, R.J., Evans, J., Taylor-Wilson, R.H., Thompson, A., and Wacher, J.S. 1996: 'Early Anglian Catterick and *Catraeth*', *Medieval Archaeology* 40, 1–61

Wilson, P.R. 2002: *Cataractonium: Roman Catterick and its Hinterland. Excavations and Research, 1958–1997*, York

Wright, L.E., and Schwarcz, H.P. 1998: 'Stable carbon and oxygen isotopes in human tooth enamel: identifying breastfeeding and weaning in prehistory', *American Journal of Physical Anthropology* 106, 1–18

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[1] Wilson 2002.
[2] Speed 2002; a full publication of the site is planned.
[3] Chenery *et a*l. 2011.
[4] Eckardt 2010a for summary.
[5] e.g. Müldner *et al.* 2011; Pollard *et al*. 2011a.
[6] Müldner 2013.
[7] e.g. Birley 1979; Handley 2011; Noy 2000; Scheidel 2004; Eckardt 2010b.
[8] Chenery *et al.* 2011; see also Evans *et al.* 2012.
[9] Müldner *et al*. 2011; Montgomery *et al.* 2010.
[10] Institute of Geological Sciences 1970.
[11] Bridgland *et al*. 2011, 53.
[12] Soil Survey of England and Wales 1983; Jarvis *et al.* 1984, 302–5.
[13] Taylor and Macklin 1997, 326 and fig. 7.
[14] Speed 2002.
[15] Site 240 Wilson 2002, 185–205.
[16] Speed 2002, 32
[17] Site 240, Wilson 2002, 195, fig. 103, pl. 86.
[18] Stout 1994, 85
[19] Swift 2000, 3–4; Cool 2010a, 283.
[20] Booth *et al*. 2010; Clarke 1979; cf. Cool 2010a, 278.
[21] Swift 2000, 13–88.
[22] See also Cool 2010a, 278–84.

[23] Swift 2000.
[24] Collins 2010, 73.
[25] Keller 1971, 26–55; Pröttel 1988.
[26] Ellen Swift, *pers. comm*.
[27] Swift 2000, 15.
[28] Cool 2010a, 284; Cool 2010b, 39–41.
[29] Willis and Carne 2013, 101.
[30] Brickstock 2002.
[31] Collins 2010, 74, fig. 7.1, No. 20.
[32] cf. Swift 2000, 73–8; pers. comm.
[33] Swift 2000, 4.
[34] Walton Rogers 2002.
[35] Swift 2000.
[36] ibid.
[37] e.g. Adler 1989, 237, fig. 1265; Burger 1966, pl. 101, Grave 112; Pirling 1966, 142, pl. 98, grave 1216.
[38] Swift 2000, figs. 44, 48.
[39] ibid., 280–2.
[40] ibid., 2000, 62, fig. 67.
[41] Mertens and Van Impe 1971, 68–9, pl. IX.
[42] Bayley and Butcher 2004, 118, fig. 91, No. 320; Clarke 1979, 260, fig. 32, No. 74.
[43] Collins 2010, 74, fig. 7.1, No. 20.
[44] Brickstock 2002.
[45] Vince Van Thienen, pers. comm.: Rijksmuseum van Oudheden Leiden 32; Tongeren Gallo-Romeins Museum Tongeren 1377
[46] Pirling 1966, 142–3, pl. 104, grave 1218, dated to the first half of the fourth century; Pirling 1989, 50, pl. 7, grave 2938, coin dated to after A.D. 350.
[47] Cool 2010a, 285–90.
[48] Atanasov 2007, 454–5.
[49] Walton Rogers 2002.
[50] Sommer 1984, 18, pl. 1.1 Sorte 1, Form A; Swift 2000, 186–90, figs. 231–2; Cool 2010a, 286; Clarke 1979, 270–2.
[51] Booth *et al*. 2010, 230, fig. 3.261.
[52] Eckardt *et al*. 2009; Cool 2010a, 289.
[53] Evans *et al*. 2006; Cool 2010a, 289.
[54] Clarke 1979, 282–3.
[55] Cool 2010a, 287–8.
[56] cf. Simpson 1976, 201–2, fig 5.
[57] Speed 2002.
[58] Clarke 1979, 313–4; Cool 2010a, 300–3.
[59] Swift 2000, 304, fig. 206.
[60] Cool 1983, 839–42, figs. 63–4.
[61] Crummy 1983, 41, fig. 44, 1700.
[62] Neal 1974, 138, fig. 60.140.
[63] Booth *et al.* 2010, 261; cf. Clarke 1979, 114.
[64] Philpott 1991, 213.
[65] ibid., footnote 22; Bradford and Goodchild 1939, 57, 62.
[66] Price 2010, 47.
[67] Clarke 1979.
[68] Cool 2010a, 308–9.
[69] e.g. Clarke 1979.
[70] Wilson 2002.
[71] ibid., 473–5.
[72] Cool 2002, 41–2.
[73] Chenery *et al.* 2011.
[74] York, Gloucester and Lankhills, Winchester: cf. Eckardt 2010a for summary.
[75] Chenery *et al.* 2011.
[76] Clarke 1979; Booth *et al*. 2010; note discussion of parallels above.
[77] Barber and Bowsher 2000, 206–8.

[78] Hawkes and Dunning 1961.
[79] Booth 2014.
[80] Booth 2014, 259-260; Evans 2014.
[81] Hills and Hurst 1989.
[82] Evans *et al*. 2012.
[83] Mays 2010, 265.
[84] Schwarcz and Schoeninger 1991; Lee-Thorp 2008.
[85] Hedges *et al*. 2007; Hillson 2005.
[86] Sealy *et al*. 1995.
[87] Schwarcz and Schoeninger 1991; Mays 2010; see Hedges and Reynard 2007.
[88] Faure and Powell 1972; Dansgaard 1964.
[89] Hillson 2005; Bentley 2006; White *et al.* 1998.
[90] Longinelli 1984.
[91] Kohn 1996.
[92] Longinelli 1984, Daux *et al*. 2008; see Chenery *et al*. 2010.
[93] Pollard *et al*. 2011b.
[94] Daux *et al.* 2008, Brettell *et al*. 2012b.
[95] White *et al*. 1998; Chenery *et al.* 2010; Müldner *et al*. 2011.
[96] Price *et al.* 2002; Bentley 2006; Montgomery 2010.
[97] Evans *et a*l. 2006; Müldner *et al.* 2011.
[98] After Chenery *et al*. 2011.
[99] Evans *et al*. 2012.
[100] Chenery *et al.* 2011
[101] Chenery *et al*. 2010.
[102] Chenery *et al*. 2011.
[103] Evans *et al*. 2012; Evans *et al*. 2010; Voerkelius *et al.* 2010.
[104] Hillson 2005.
[105] Wright and Schwarcz 1998; Evans *et al*. 2012.
[106] Darling and Talbot 2003; Evans *et al*. 2012.
[107] Longinelli 1984.
[108] Pollard *et al.* 2011b.
[109] IAEA/WMO 2013; Oelze *et al.* 2012.
[110] As demonstrated by inferential statistics:independent samples Kruskal-Wallis test $H_{(2)}=34.7$, $p<0.001$ for $\delta^{13}C$; $H_{(2)}=1.9$, notsignificant for $\delta^{15}N$; Dunn-Bonferroni post-hoc tests for $\delta^{13}C$ compute significant differences between Catterick and Scorton for bone and dentine samples (Bonferroni-adjusted $p<0.001$ for both group comparisons). Differences between Scorton bone and dentine are not significant.
[111] Chenery *et al*. 2011.
[112] Hillson 2005.
[113] Hedges *et al*. 2007.
[114] Müldner 2013.
[115] Keenleyside *et al.* 2006.
[116] Müldner *et al.* 2011.
[117] Hakenbeck *et al.* 2010; Müldner *et al*. 2011; Pollard *et al*. 2011a; Killgrove and Tykot 2013.
[118] Reitsema and Kosłowski 2013.
[119] Müldner *et al.* 2011.
[120] Müldner 2013.
[121] Richards *et al*. 1998.
[122] Cummings and Hedges 2010.
[123] e.g. Meskell 2001.
[124] Derks and Roymans 2009, 1–10; Gardner 2007, 197–203.
[125] Pohl 1998, 21–2; Barth 1969.
[126] Scheidel 2004.
[127] e.g. Handley 2011; Noy 2000, 2010; Wierschowski 1995; 2001.
[128] e.g. Cool 2010b; Derks and Roymans 2009; Roymans 2004; Swift 2010.
[129] Eckardt 2010a; for individual sites: Chenery *et al*. 2010; Chenery *et al.* 2011; Evans *et al*. 2012; Leach *et al.* 2009; Leach *et al*. 2010; Müldner *et al.* 2011; Eckardt *et al.* 2009; Booth 2014.

[130] cf. Pearce 2010.
[131] Evans *et al.* 2006, 271; Eckardt *et al*. 2014, 540–2.
[132] Price 2010, 47.
[133] Brettell *et al.* 2012a.
[134] Wright and Schwarcz 1998.
[135] cf. Cool 2010b, 41.
[136] cf. Cool 2010a, 283; Cool 2010b, Table 3.7.
[137] Evans 2014; Evans *et al*. 2012.
[138] Cool 2010a, 289.
[139] Brickstock 2002.
[140] Evans 2002
[141] Price 2002.
[142] Chenery *et al*. 2011.
[143] ibid., 1533.
[144] e.g. Coulston 2010, 60.
[145] Elton 1996, 92.
[146] Collins 2012, 47–48.
[147] Eckardt and Müldner 2014, **page nos needed**.; Eckardt 2010a, 122.
[148] Wilmott 1997, 203–31; Wilson 2002, 473–5.
[149] Wilson *et al*. 1996, 54.
[150] Alcock 1983
[151] Speed 2002; Powlesland 2003, 62; Wilson 2002, 475.
[152] Montgomery *et al*. 2005.
[153] cf. Gerrard 2013, 151–5.
[154] Collins 2012, 133.
[155] Cool 2010b, 31–4.