

# From corpse to skeleton: dealing with the dead in prehistory

## Du cadavre au squelette : gérer les morts dans la Préhistoire

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**Abstract** The shortcomings of the archaeological record raise many challenges for the interpretation of prehistoric funerary practices, particularly because the remains of most people in prehistory have left no trace at all. Throughout prehistory, most human remains were treated in ways that are archaeologically invisible. A brief review of the sequence of funerary practices in British prehistory reveals major gaps and deficiencies in the burial record. It may well be that the normative rites for much of British prehistory were those that left little or no archaeological trace, such as excarnation through exposure of corpses or scattering of cremated ashes.

One form of mortuary practice only recently demonstrated for British prehistory is that of mummification. Scientific analysis of Late Bronze Age skeletons from Cladh Hallan, in the Outer Hebrides of Scotland, has revealed that they were not only composites of multiple individuals but were also mummified prior to burial. In particular, histological analysis of bioerosion in the bone microstructure reveals that putrefaction was arrested soon after death. This method of histological analysis has been applied to a large sample of prehistoric and historical human remains, and reveals that patterns of arrested decay are particularly a feature of the British Bronze Age from the Bell Beaker period onwards.

**Keywords** Prehistory · Funerary rites · Mortuary practices · Mummification · Histological analysis

**Résumé** Les sépultures mises au jour par l'archéologie constituent seulement une faible proportion des restes humains laissés par les populations préhistoriques. Même en tenant compte des phénomènes post-dépositionnels, de l'érosion et des limitations propres à l'archéologie, le nombre de sépultures fouillées est sans comparaison avec le total attendu, si la sépulture avait été le traitement normal durant la Préhistoire.

Un tel problème est bien illustré par des exemples issus de la préhistoire britannique. De manière peu surprenante, les restes humains sont rares pour le Paléolithique supérieur et le Mésolithique. Les sépultures néolithiques (c. 4000-2400 av. J.-C.) sont beaucoup plus nombreuses, mais les progrès récents enregistrés par les datations radiocarbone ont montré que de nombreux monuments funéraires néolithiques n'avaient été utilisés que durant de courtes périodes ; au sein du Néolithique, les intervalles chronologiques marqués par une absence totale ou relative de témoignages mortuaires sont fréquents, quels que soient les contextes : monuments, grottes, rivières ou tombes. À l'image de périodes plus tardives de la Préhistoire, les dépouilles de la majorité des individus du Néolithique britannique ont connu un destin qui n'a pas laissé de traces.

La crémation a été pratiquée durant le Néolithique ancien (c.4000-3400 av. J.-C.), mais n'a connu pas de réel succès qu'au Néolithique récent (c.3000-2400 av. J.-C.) ; ceci a pu être mis en évidence grâce à la récente possibilité de dater les os humains brûlés par la méthode du radiocarbone, dans la mesure où la majorité des sépultures à crémation de cette période n'est accompagnée d'aucun mobilier. Les données attestent de la continuité de la pratique de la crémation parallèlement à l'arrivée vers 2400 av. J.-C. des inhumations associées au Campaniforme. La fin de cet épisode, vers 1850 av. J.-C., est aussi celle de l'inhumation. À partir de ce moment, les restes incinérés sont surtout placés dans des urnes en céramique de styles variés jusqu'à l'âge du Bronze final. Un petit nombre d'inhumations est cependant daté de l'âge du Bronze moyen, de même que des dépôts secondaires en habitats.

L'inhumation et la crémation ne sont finalement que deux traitements du cadavre parmi tout ceux pratiqués en Grande Bretagne entre le Néolithique et l'âge du Fer. Les dépôts en rivière ont laissés quelques traces, particulièrement au Néolithique ancien et de la fin de l'âge du Bronze à l'âge du Fer. En revanche, de nombreux autres traitements ont pu exister qui n'ont pas laissés de traces archéologiques. Il est très probable que durant une large part de la Préhistoire britannique les restes humains furent dispersés soit après crémation soit après exposition du corps.

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Cependant, une pratique n'a jusqu'à présent pas reçu une attention suffisante dans la Préhistoire britannique : la momification. Sa mise en œuvre a été détectée dans un habitat localisé sur une butte de l'île de South Uist dans les Hébrides extérieures, près de la côte ouest de l'Écosse. Deux tombes en apparence individuelles implantées dans un espace domestique ont finalement été identifiées comme composites. L'une avait le crâne d'un vieil homme, la mandibule d'une jeune femme et le torse d'un troisième sujet. La seconde comprenait la tête d'un homme, le torse d'une femme et le bras droit d'une troisième personne. L'analyse histologique microscopique et l'analyse de la porosimétrie par intrusion de mercure ont révélé une attaque microbienne intense mais très localisée sous la surface de l'os, indiquant que la décomposition avait été interrompue très peu de temps après la mort. Ces divers indices montrent que les individus ont été momifiés avant d'être inhumés.

L'application d'analyses histologiques à un large éventail de squelettes aussi bien préhistoriques qu'historiques a montré que ces attaques biologiques limitées sont spécifiques des squelettes de l'âge du Bronze, indiquant que la préservation des tissus mous était un objectif du traitement du corps durant cette période, par opposition au Néolithique ou à l'âge du Fer. Les squelettes identifiées comme d'anciennes momies viennent de toute la Grande Bretagne et sont datés du Campaniforme (c.2400-1850 av. J.-C.) jusqu'à l'âge du Bronze final (c.1200-750 av. J.-C.).

La reconnaissance de la pratique de la momification durant l'âge du Bronze britannique a plusieurs implications. De telles pratiques ont pu être répandues non seulement en Grande Bretagne mais aussi dans d'autres parties de l'Europe. L'utilisation de la momification est également intéressante sur le plan social car les corps préservés sont régulièrement utilisés par les vivants comme un instrument de pouvoir pour des manœuvres généalogique ou politique. Des exemples d'une telle utilisation de corps préservés sont attestés aussi bien dans l'Empire inca qu'à l'University College of London, où le philosophe Jeremy Bentham décréta que sa propre dépouille devait être exposée et mise en place lors des réunions du conseil de l'Université.

**Mots clés** Préhistoire · Rites funéraires · Pratiques mortuaires · Momification · Analyse histologique

One of the greatest problems for archaeologists working with prehistory is to establish why so few human remains are recovered, given that millions of people lived and died in prehistoric times. Recent attempts at estimating population numbers in European prehistory [1] reveal that there would be many millions of burials to be located from the 5,000-year period between the Neolithic and the Iron Age in Europe.

As David L. Clarke declared, we only ever recover a sample of a sample of the traces of the initial activities that have survived [2]. Many of the problems are therefore the result of post-depositional transformations – bones and teeth destroyed by the acidity of certain soils – or retrieval problems due to archaeological remains not being detected because of inadequate recovery strategies applied when an archaeological resource is to be destroyed.

But there is also a problem with our attitudes and expectations that *burial* of the dead might be considered a normative rite in prehistory, in the same way as it has been, for certain, for the world's religions over the last two millennia. In fact, it now seems that inhumation burial and burial of cremated remains – the two forms of post-mortem treatment most likely to appear in the archaeological record – may only ever have been minority rites in European prehistory from the Palaeolithic onwards.

An example from British prehistory illustrates these problems of representativity. Until the development of high-precision radiocarbon dating in the 1990s, it was generally considered that there were characteristic styles of burial for each of the main chronological periods. Only in recent years has it become apparent that those human remains recovered from burial deposits represent only a tiny fraction of the entire population, most of whom have left no material traces in the archaeological record.

## Where are the dead of British prehistory?

A single Upper Palaeolithic burial is known from Britain, from Paviland in Wales, dating to 28000-29000 BP [3]. With the exception of a lost group of over 50 individuals from Aveline's Hole and a single inhumation from Gough's Cave in the Mendip hills, Mesolithic human remains (c.8000-4000cal BC) are partial, disarticulated and sparse, consisting mostly of stray finds from caves, shell middens, palaeochannels and other deposits [4,5]. It is not until the Neolithic in Britain that human burial is well represented and, even then, it is nowhere near close to accounting for all those who lived at the time.

Until recently, the Neolithic (c. 4000-2400cal BC) was thought to be characterised by relatively plentiful numbers of burials – often disarticulated or occasionally cremated – in chambered tombs, long barrows and round barrows, and a variety of other monuments. The Bell Beaker period (2400-1850cal BC) was considered as restricted to inhumation burial, initially in simple graves but later under round burial mounds. This inhumation rite was then seen to overlap with, and be ultimately replaced by, Bronze Age (2200-750cal BC) cremation rites in urns of various shapes. Finally, the Iron Age saw the disappearance of a single widespread rite, replaced either by regional traditions of inhumation,

cremation or disarticulation, or by nothing at all – many areas of Britain by this time were left with no evidence of funerary practices.

In recent years, this simple characterization has been replaced by a growing understanding of the gaps in space and time left by the missing dead, as well as by the recognition of a more complex sequence. Dating of Neolithic burials in monuments reveals that they were not a long-term, continuous tradition but episodic events during the 4<sup>th</sup> millennium BC [6]. Instead of being long-term repositories for human remains, tombs were in fact only used for burial for brief periods of a generation or two. Many of them were in use for just a century or so during the 3800-3400cal BC period. Burial in the Early Neolithic (4000-3400cal BC) was a relatively uncommon funerary rite; occasional instances of flat-grave inhumation [7] and cremation burial [8] are known but these are rare. Some people were buried in caves and rock-shelters [9] during the 3800-3400cal BC period but only rarely after that. A less commonly found practice is that of river burials (3800-3000cal BC) [10]. None of these, even taken together, bear any kind of comparison with the many thousands of human lives that were lived in the Early Neolithic in Britain.

The Middle Neolithic (3400-3000cal BC) is a particularly problematical period in terms of recovered human remains. There are monuments that contain the buried and cremated remains of the dead, such as the round barrows of East Yorkshire [11] and the Peak District [12] in particular. New kinds of monuments in this period, such as cursuses (long rectangular enclosures, the longest being just over 10km in length) [13,14], stone circles and timber circles [15], are sometimes associated with the remains of the dead. One such circle, at Ferrybridge in West Yorkshire, has a cremation burial in its centre; although interpreted by its excavators as a timber circle [16], the evidence of its ‘postholes’ shows that these were probably holes for a circle of standing stones. Yet the overall picture is of fewer recovered burials than from the Early Neolithic. This matches the evidence for woodland regeneration at the time [17] and a decline in the numbers of radiocarbon dates, interpreted as evidence for a drop in population [18]. Even allowing for a much-reduced population in the Middle Neolithic, there are far too known few burials for below-ground deposition to have ever been a normative rite.

The Late Neolithic (3000-2400cal BC) is characterised by cremation, with inhumations being not only rare but also mostly restricted to the remains of children [19]. A number of circular enclosures, some known as ‘formative’ henges, contain cremation burials, stoneholes and ditches. Once known as the ‘Dorchester culture’ after the cremation enclosures at Dorchester-on-Thames in Oxfordshire [20], this is a rite found from Cairnpapple in Scotland [21,22] to Llandy-

gai in North Wales [23] and Stonehenge in southern England (Fig. 1) [24,25].

Cremation continued into and through the Bell Beaker period, as is clear from the dates of unaccompanied cremation burials at Boscombe Down near Stonehenge [26], and Ferrybridge and Ferry Fryston, both in West Yorkshire [16,27]. Outshone by the highly visible inhumation graves of the European continental Bell Beaker phenomenon, their invisibility up to now is almost certainly due to the fact that this type of cremation burial without any grave goods was entirely overlooked until the recent development of radiocarbon dating of cremated remains [28]. The homogenous nature of Bell Beaker funerary practices, focused on single-body inhumation, has also been exposed as an oversimplification of the diversity of body treatments [29].

Beakers were rarely included in cremation burials except in southwest England and Ireland [30], but the indigenous ceramic styles that followed – mainly food vessels, collared urns, cordoned urns and Deverel-Rimbury urns [31] – were frequent accompaniments and especially used as containers of cremated remains until the Middle Bronze Age (1600-1200cal BC). Cremation burial continued into the Late Bronze Age but increasingly without urns or other grave goods.

Inhumation continued to the end of the Beaker period, with new variations; more of these later graves contained either no vessel at all or a food vessel. Others were associated with the graves furnished with gold ornaments of the Wessex I period, dating to *c.*2000-1800cal BC [32,33]. Thereafter, the burial record is dominated by urned cremations. Only sporadically are inhumations found from the Middle and Late Bronze Age [13,34,35]. River burial appears to have returned by the Late Bronze Age [36,37] and continued into the Iron Age [38]. Similarly, disarticulated human remains are frequently found in settlements from the Middle Bronze Age onwards [39]. There is evidence of developing regionality in funerary practices from at least the Late Bronze Age into the Iron Age, with, for example, cremation popular in southeast England and disarticulated remains and whole bodies buried in central southern England [40]. The cremation practices of the Late Iron Age and Early Roman period in southern Britain could be said to be the culmination of a potentially uninterrupted tradition of cremation stretching back to the Late Neolithic at the time of Stonehenge.

## Detecting the ‘archaeologically invisible’

Identifying the archaeologically invisible funerary rites of the mass of the population at any one time in British prehistory is difficult, to put it mildly. Recent advances in wetland and riverine archaeology have led to the discovery that





**Fig. 1** Excavation at Stonehenge in 2008. Stonehenge is the largest identified cemetery in Britain from the third millennium BC, with sixty-three cremation burials and one inhumation dated to the period from c.3000 to 2200 cal BC, which probably account for less than half of all those originally buried at this monument. The 59 burials excavated at Stonehenge in 1919-1926 were deposited in a pit in 1935 that was not re-opened until 2008 / *Fouilles à Stonehenge en 2008. Stonehenge est le plus grand cimetière de Grande Bretagne pour le III<sup>e</sup> millénaire av. J.-C., avec 63 sépultures à incinération et une inhumation datées entre 3000 et 2200 av. J.-C. Elles représentent sans doute moins de la moitié des tombes initialement associées à ce monument. Les 59 sépultures fouillées à Stonehenge entre 1919 et 1926 furent réenfouies en 1935 dans une fosse, seulement rouverte en 2008.*

bodies went into water, particularly in the Early Neolithic and in the Late Bronze Age-Iron Age. Yet there were probably many forms of treatment that ensured that human bones never entered contexts that might survive for future archaeologists. If cremation was widespread between 3000 BC and AD 200, then perhaps ashes were more likely to be scattered than buried. The existence of a scattering rite could account for the fact that Bronze Age cremations contain on average less than a third of the ashes produced in the pyre [41]. Corpses exposed on the ground, on wooden platforms or in trees – so-called ‘sky burials’ – will also leave no long-term archaeological trace unless the bones enter a depositional context in which they are protected from further weathering and erosion [42].

We might envisage a series of *chaînes opératoires* that can be employed between death and disposal, and consider their likely archaeological manifestations. Thus, the exposure of corpses will result in the occasional survival of disarticulated bones and fragments in settlement debris. The same can be said of the scattering of cremated ashes. Cannibalism similarly results in discards of human bones and fragments as food waste [43], although the crushing and eating of cremated ashes or unburnt bones – the former practiced, for example, among the Yanomamö of the Amazonian rain

forest [44] – would rarely come to light. Placing corpses in water may result in archaeological recovery of human bones, especially skulls and long bones, although much depends on hydrological processes of deposition and sedimentation. In contrast, scattering ashes in water is unlikely to leave much trace except when sought out with care.

Most of these different kinds of mortuary treatment have been considered for prehistoric Europe but perhaps the one method that has not is mummification, both in its artificial and controlled natural forms. In arid and anaerobic conditions, the results of artificial mummification are easy to recognise because of the long-term preservation of soft tissue and wrappings [45,46]. In temperate environments such as Europe, mummies are only very occasionally preserved in specific contexts; one such example is a naturally mummified burial (Sepultura 121) of the Early Bronze Age Argaric culture from Castellón Alto, Galera, in southern Spain [47]. Natural mummies have been preserved in the anaerobic conditions of peat bogs in western and northern Europe [48], although it is uncertain to what extent these corpses were intended for long-term preservation below ground and out of sight.

Identifying above-ground, artificial mummification in temperate environments is, obviously, extremely difficult

because the corpse will either be reduced to a skeleton, if buried, or to disarticulated bones, if left to decay amongst other settlement debris. Recently an opportunity arose to learn to recognise human skeletal remains that had formerly been covered by mummified human soft tissue. This led to the development of a scientific suite of methods for identifying formerly mummified skeletal remains.

## The Cladh Hallan mummies

The Outer Hebrides (or Western Isles), off the west coast of Scotland, are not the first place one might think of to search for evidence of mummification in prehistory. Their maritime climate is damp and windy and their gneiss bedrock supports acidic soils that are hostile to organic preservation. In archaeological terms, the most specific feature of these islands is a deep and extensive accumulation of alkaline shell-sand along the west coast. This supports grassy vegetation known as 'machair' [49]. The shell-sand formed a dune-filled coastal plain during the fourth millennium BC and was a favoured location for settlement from the Beaker period until medieval times and even later [50]. These machair settlements survive as mounds of deeply stratified deposits with well-preserved house floors and other remains of daily life.

One of these settlement mounds is Cladh Hallan, excavated between 1992 and 2003 to reveal a deep sequence of 16 phases of settlement remains and burials from the Beaker period to the Middle Iron Age (*c.* 2000-500cal BC). The main constructional event was the building of a row of three roundhouses (phase 8) shortly before 1050cal BC (Fig. 2) [51]. Whilst disarticulated human remains were found in these houses, especially in the wall cores, there were also four graves of people (and a fifth burial of a sheep) beneath the floors. The main house was built on top of the grave of a 10-14 year-old child, probably a girl, whose death in 1190-1015cal BC was broadly contemporary with the roundhouses built on top of her body. Under the southernmost house were the semi-articulated remains of a younger child. But the most unusual burials were the two beneath the northernmost house. The one in the northeastern part of the northern house dates to 1440-1260cal BC (95% probability) and the one in the southern part to 1310-1130cal BC (95% probability).

Both skeletons are composites, each formed from several different individuals and reassembled without much outward sign that they were made up of more than one person. The one under the northeast part of the roundhouse was buried at some point between 1440 and 1260cal BC, and was made up of the torso of one man, the head of another and the mandible of a third (Fig. 3). The spine was at a 90° angle to the neck vertebrae. Also indicative of the presence of multiple indi-

viduals was the fact that the mandible had a full set of teeth while the maxilla had none; many of the teeth in the maxilla had fallen out long before death, causing the tooth sockets to become reabsorbed. Whereas the maxilla and skull were those of an old man, the lower jaw was that of an individual in his or her 20s.

The other skeleton, which was buried below the southern part of the roundhouse, was also made up of parts of three separate individuals (Fig. 4). The torso belonged to a woman who died in the period from 1310 to 1130cal BC and the skull was that of a man who probably died 70-200 years earlier (68% probability). Analysis of the ancient DNA not only confirmed that they were two separate individuals, but also revealed that the woman's right arm actually belonged to a third individual [52]. Two teeth were found to be missing from the man's maxilla – the left and right lateral incisors. These were found in the skeleton's hands, the left in the left hand and the right in the right hand. Just why this was done remains a mystery but perhaps it was a further way of linking the male head with the female body.

Evidence that these composite burials were also mummies – or at least collections of mummified body parts – comes from scientific analysis of the bones. Microscopic histological analysis and mercury intrusion porosimetry (HgIP) analysis revealed that, whilst bodily decay had begun after death, it was abruptly arrested [53]. The analysis of the Cladh Hallan skeletons revealed an unusual pattern of microbial alteration, with evidence of dense microbial attack just below the bone surface but not elsewhere (Fig. 5). This intense but limited pattern of attack indicates that there was some initial decay which was then interrupted.

Further confirmation that the soft tissues of the corpses had been preserved long after death came from matching up bones from different parts of the Cladh Hallan site [54]. The woman's left knee (upper tibia and fibula, patella and lower femur) had been broken off prior to burial and buried in another pit, five metres to the west of the grave. Not only was the knee found fully articulated, indicating that it was broken off while the soft tissues were still in place, but the nature of the fractures indicated that these bones were, in contrast, those of someone already long dead. The bone had lost its elasticity, due to collagen decay, and yet must have still been connected by soft tissue, something that could only happen if the corpse had been mummified.

The tightly crouched posture of the two bodies can now be considered to be not simply the result of tightly wrapping or tying the body after death but of wrapping their already mummified remains. But how had the corpses been mummified? In many different parts of the world, simple mummification can be achieved by drying corpses over a slow fire, normally after evisceration of the internal organs [45]. In the case of the Cladh Hallan mummies, Fourier transform infrared spectroscopy (FTIR spectroscopy) showed that the





**Fig. 2** A row of Late Bronze Age roundhouses at Cladh Hallan on South Uist in the Outer Hebrides, lying on top of a group of burials, two of which were shown to have been mummified before interment / *Une rangée de maisons rondes à Cladh Hallan, South Uist, Hébrides extérieures, recouvre un groupe de sépultures, dont deux contenaient des sujets momifiés avant la mise en terre.*





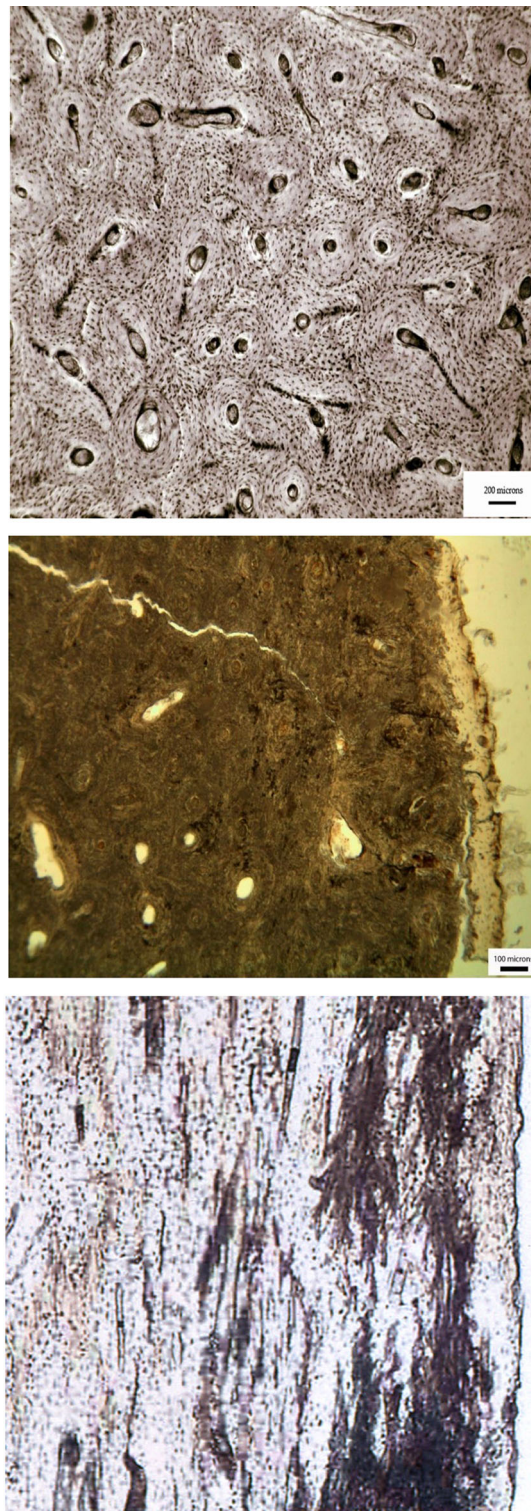
**Fig. 3** The composite burial at Cladh Hallan of a skeleton assembled from three separate male individuals. A variety of scientific analyses demonstrated that the remains had formerly been mummified, with biological decay being arrested soon after death. Preservation of soft tissue long after death may have been achieved by placing the fleshed bodies in a peat bog / *Une tombe composite à Cladh Hallan, comprenant un squelette formé par trois sujets masculins différents. Diverses analyses scientifiques ont montré que les restes avaient d'abord été momifiés, avec un arrêt de la décomposition peu de temps après la mort. La préservation des tissus mous longtemps après la mort a pu être obtenue en plaçant le cadavre dans une tourbière.*





**Fig. 4** The mixed-sex composite skeleton at Cladh Hallan. Two teeth from the man's maxilla were found in the hands of the woman. Her articulated but snapped-off knee was found in a nearby pit. The orange staining of the bones is thought to have been caused by the method used to preserve the soft tissue after death but before burial / *La tombe composite mêlant les deux sexes de Cladh Hallan. Deux dents supérieures d'un homme furent retrouvées dans les mains d'une femme. Son genou, articulé mais brisé, fut mis au jour dans une fosse à proximité. La coloration orange des ossements est interprétée comme une conséquence des méthodes de conservation mises en œuvre avant l'inhumation.*





**Fig. 5** Different conditions of human femoral bone in transverse microscopic histological thin sections, showing the preserved periosteal surface to the right of the image: top: well-preserved bone with no indication of bioerosional decay; middle: bone with an internal microstructure extensively altered by bacteria, a diagenetic signature typical of archaeological human bones; bottom: bone from the composite male skeleton from Cladh Hallan, showing accumulations of bacterial tunnelling (black areas) towards the periosteal surface, indicating arrested decay / *Coupes histologiques de fémurs humains montrant à la droite de l'image : en haut, la surface périostée bien conservée ; au milieu, une microstructure interne altérée par des bactéries – typique des ossements humains archéologiques ; en bas, un os de l'homme composite de Cladh Hallan, avec de multiples galeries (zones noires) dues aux bactéries traversant la surface périostée, et indiquant que la décomposition fut interrompue.*

mineral content of the outer three millimetres of the bone surfaces had altered, whilst small-angle X-ray scattering (SAXS) showed an unusual thickening of bone mineral crystallites in these areas. These analyses indicate that the bone surface had lost its calcium mineral content, a process that could not have occurred in the alkaline machair sand in which the bodies were buried. However, such a change could have been effected by soaking the corpses in the acidic waters of a Scottish peat bog. Visual evidence of this method of mummification – effectively tanning the corpses – was provided by the orange and dark brown staining of the skeletons' bones, caused by immersion in the peat bog.

It is likely that the Cladh Hallan corpses were immersed in a peat bog for perhaps a few weeks or months, enough to 'tan' the soft tissues but not too long for the bones to become completely demineralised. People at this time were already digging peat to use as fuel for their fires; the earliest evidence of peat-digging in Scotland comes coincidentally from the neighbouring island of Barra in the Outer Hebrides and dates to 1690-1490cal BC [55]. Once the corpses had been retrieved from the peat bog, they must have been allowed to dry. This could have been achieved in a separate 'mummy house' or, perhaps more likely on the basis of ethnographic evidence, in a dwelling where they could be suspended from the rafters above the fireplace.

### Detecting prehistoric mummification from skeletal remains

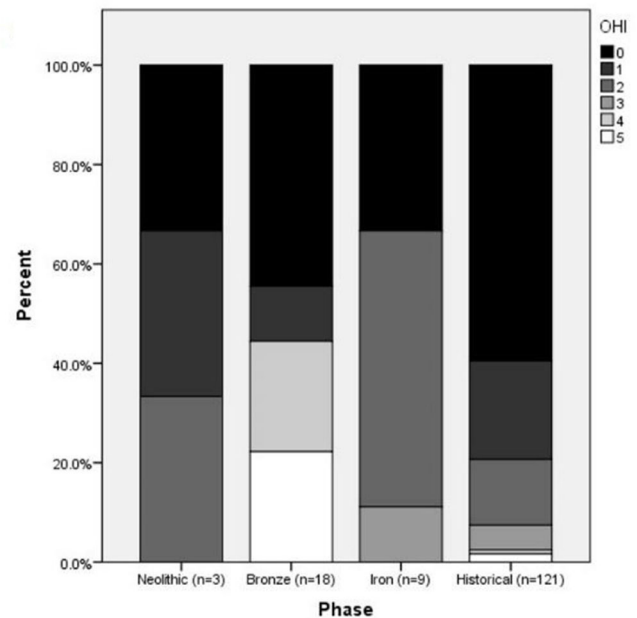
Whilst these discoveries were published some years ago, it is only recently that the scientific methods developed at Cladh Hallan have been applied to human remains from other parts of Britain to explore whether mummification was widespread beyond these remote Scottish islands. Tom Booth has carried out microscopic histological analysis of human bones from many different periods, from the Neolithic to the Mediaeval, to establish whether any show evidence of arrested decay after death [56].

Booth's analysis has confirmed that bone from mummified bodies shows near-perfect preservation from bacterial attack, in contrast to the bones of archaeologically recovered skeletons. Similarly, waterlogged human remains such as bog bodies can be well preserved with only limited bacterial bioerosion. The key marker on skeletons thought to have been formerly mummified is a thin layer of bacterial bioerosion beneath the periosteal layer, showing that decay had begun but that bacterial attack was then prevented from spreading through the entire bone structure.

In addition, the extent of remaining intact bone microstructure could be measured in each individual by using the Oxford Histological Index (OHI) to score preservation on a scale of 1-5 [57,58]. The results indicate that scores of

4-5 are found only in a small proportion of all the 214 specimens from aerobic non-waterlogged environments (Fig. 6). Nine of these were from disarticulated and partially articulated Neolithic remains that had gone through post-mortem processes in which soft tissue may well have been removed soon after death, thereby leaving the bone microstructure in good condition. When disarticulated and partially articulated specimens were removed from the sample, eight of the 18 Bronze Age articulated individuals scored 4 or 5, in contrast to none from other prehistoric periods and less than 5% from historical periods.

This analysis shows that post-mortem soft tissue preservation appears to have been a prominent feature of burials from the British Bronze Age but not the Neolithic or the Iron Age. The burials come from different parts of Britain, from the south coast to the north of Scotland, indicating that the practice was widespread across the country. Whilst peat bogs occur only in the north and west of Britain, there may well have been many different ways of preserving corpses, such as those involving smoking of the body. One particular burial from an Early Bronze Age round barrow at Neat's Court, Sheppey, Essex, exhibits not only an arrested pattern of bacterial attack but also discolouration of the cranium, teeth and articular ends of long bones. These traces suggest



**Fig. 6** Distribution by period of Oxford Histological Index (OHI) scores among articulated post-neonatal bones from aerobic environments in Britain. A significant proportion of Bronze Age samples have high OHI scores / *Répartition des Oxford Histological Index (OHI) relevés sur des individus post période néonatale, issus de contextes aérobies de Grande-Bretagne. Une proportion significative d'individus de l'âge du Bronze a des valeurs OHI élevées.*





**Fig. 7** Canada Farm Bell Beaker burial with (inset) the Wessex-Middle Rhine Beaker that was found at the adult male's feet. Microscopic histological thin section analysis indicates that this individual was probably mummified after death. Two radiocarbon dates on his bones are significantly earlier than the date of this style of Beaker, suggesting that death had occurred a long time before the body was buried / *Inhumation campaniforme de Canada Farm avec le gobelet Wessex-Rhin moyen (cartouche) mis au jour près des pieds de l'adulte masculin. Les coupes histologiques indiquent que cet individu fut probablement momifié après la mort. Deux dates radiocarbone sur les ossements sont significativement plus récentes que la période de ce style de gobelet, suggérant que c'est un vieux cadavre qui a été inhumé.*

that the corpse was exposed to low-level burning consistent with smoking for preservation.

Mummified bodies may have been kept above ground for some time, as suggested by the discrepancy in radiocarbon ages between the male head and female torso of the Cladh Hallan mixed-sex burial. A Bell Beaker burial from a round barrow at Canada Farm, Dorset, with signs of arrested bacterial attack, has two radiocarbon dates of 2620-2470 cal BC and 2470-2290 cal BC and yet is buried with a Bell Beaker of Wessex/Middle Rhine style that can be dated typologically to c.2300-1900cal BC (Fig. 7) [59]. The mummified corpse appears to have been eventually interred with a much more recent Beaker than the body itself.

The Canada Farm round barrow was used as the focus for burials for many centuries afterwards. Interestingly, some of these were the graves of Middle Bronze Age sub-adults, several of which had post-mortem cut marks and drill holes in the bones [60]. The most unusual of these was the skeleton of an adolescent (F3), which had drill holes in the ends of both femurs. It seems most likely that these were made when the body was in an advanced state of decomposition prior to the bones being re-assembled in their anatomical position. This raises the question of whether the drill holes held wooden pegs that served to keep the skeleton connected.

## Conclusion

The transition from corpse to skeleton can be long and complex. Whilst it is easy to assume that prehistoric skeletal remains, especially those with articulations preserved, were the end product of relatively swift and simple mortuary practices, the Cladh Hallan burials indicate otherwise. The ability to recognize evidence of mummification in the British Bronze Age is a methodological advance allowing the identification of a particular funerary quirk, possibly limited to Britain or – as future research will be able to establish – maybe more widespread, perhaps even across the Bell Beaker regions of Europe. It is also an indication of hitherto unrecognized attitudes to the body in death, especially the potential for the dead to be represented ‘in the flesh’ amongst the living as tangible representations of ancestry and genealogy.

From ethnographic and ethnohistorical cases in different parts of the world, it is clear that mummies can be afforded a level of agency akin to that of living beings. As in the case of royal Inca mummies of Peru, they might have been consulted by the living for advice and counsel. They might also have been significant contributors to ceremonies and meetings: at my own university of UCL, the ‘auto icon’ of philosopher Jeremy Bentham (1748-1832) is occasionally wheeled into meetings of the senate council. If mummification was a significant aspect of Bronze Age mortuary prac-

tices, the social implications for growing concerns over genealogy are likely to have been considerable. Such aspects may have related to concerns over access to and ownership of land as well as to lineage and authority. Perhaps the European Bronze Age was not simply a world of chiefs, farmers and slaves but also of mummies with their own particular forms of agency amongst a complex constellation of beings both alive and dead.

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