

A NEOLITHIC CAIRN AT WHITWELL, DERBYSHIRE

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SUMMARY

A damaged Neolithic cairn was located during archaeological survey on the edge of a limestone quarry on the outskirts of Whitwell in Derbyshire in 1988. The remains of the monument were completely excavated in advance of further quarrying. The monument proved to be the rear portion of a trapezoidal long cairn with a complex structural sequence which included collective mortuary deposits and also encapsulated a single inhumation contained within an oval cairn. Post-excavation work has identified a sequence of seven phases of activity which extended over a period of between 120 and 270 years in the middle part of

the fourth millennium BC, with subsequent disturbance to the cairn some 1500 years later, in the Early Bronze Age. The Neolithic finds comprise remains of 17 individuals together with Carinated Bowl pottery and lithics which include a notable series of arrowheads found with the skeletal material.

INTRODUCTION

Location and topography

Whitwell cairn was discovered in 1988 during survey of karst features such as collapsed caves and fissures within the active face of Whitwell Quarry, between the villages of Creswell and Whitwell in Derbyshire, SK 53207482 (Fig. 1). The cairn was just beneath the summit of a north-south running limestone ridge at 90m OD, a location with good views to the west and south-west as the scarp slope drops down into Creswell Vale and the course of the River Wollen (Fig. 2). To the east the land dips more gradually, the limestone eventually running under the Bunter Sandstone beds.

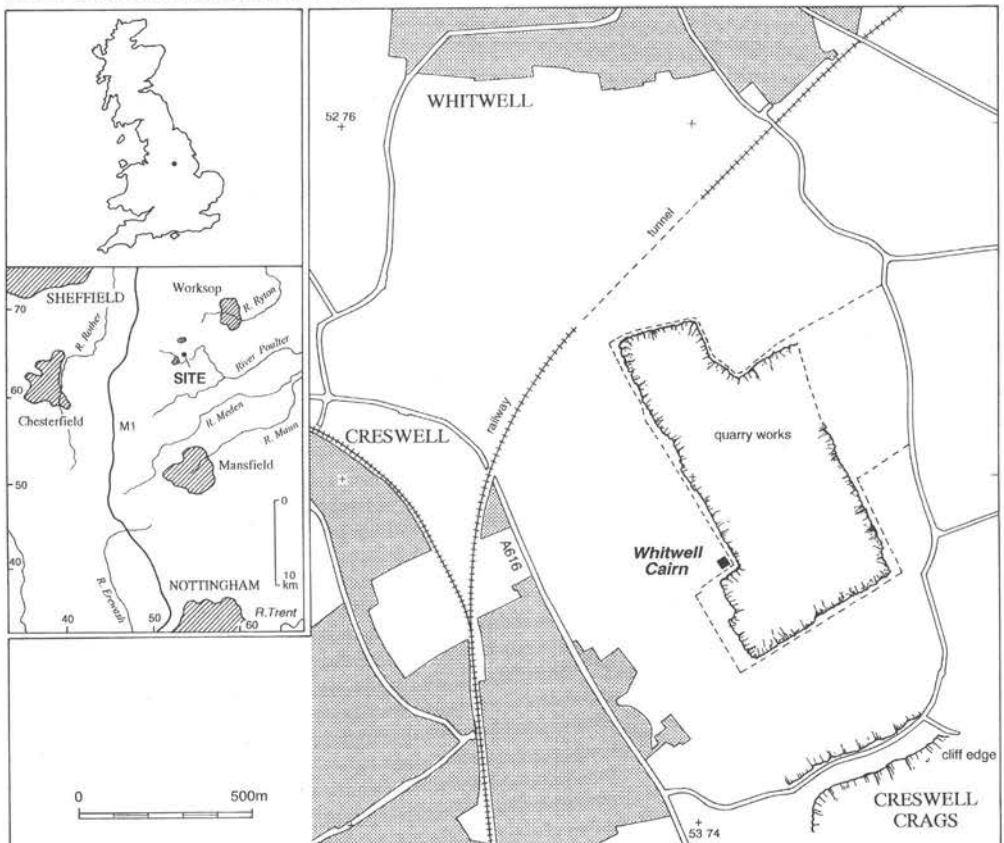


Fig. 1: Plan showing the general site location and relationship of the cairn to the limestone quarry.

The nature and subsequent weathering and tilting of the Magnesian limestone geology of the area, deposited as sea dunes during the Permian, has created a gently undulating landscape punctuated by shallow valleys and occasional gorges, best seen at Creswell Crags half a mile to the south. The limestone is overlain in places by calcareous loessic soils, once much more



Fig. 2: Whitwell cairn in relation to the local topography and geology.

extensive, providing freely draining and fertile land away from the occasional rocky outcrops in the valleys and high on the plateau. Arable farming now dominates the agricultural economy of the area, activity that has resulted in the generally poor survival of archaeological sites away from the relative protection of cave and rock shelter sites. Subsequent to the discovery and excavation of the Whitwell cairn, archaeological surveys and assessments demonstrated the limited extent of previous work beyond the gorges such as Creswell Crags, and identified a number of possible burial mounds in the area (Knight and Brown 1995) but subsequent excavation of an oval mound at Birchy Close, Whitwell, revealed it to be of natural origin, an interpretation now attributed to the other features (Knight and Priest 1996). Set apart from the Peak District cairns to the west (Barnatt 1996a; 1996b; Clay 2006, 75), the Whitwell cairn is an apparently isolated monument, with no near neighbours, a characteristic it shares with similar sites in northern England (Masters 1984). However, the Magnesian limestone ridge on which the Whitwell cairn sits extends northwards with cairns of probable Neolithic date at Dinnington and Sprotborough (Manby 1970, 24) and possibly High Melton in South Yorkshire

(Barnatt and Reader 1982), although nothing is known of their structural components. On the northern extension of the ridge two features in the Neolithic complex at Ferrybridge have been suggested as remains of damaged Neolithic structures (Roberts 2005, 197).

Methodology and history

Removal of overburden in the south-west extension to the quarry, prior to stone extraction, exposed a series of stony features which coincided with a slight rise of the ground surface. This gradual rise was also seen extending into the adjacent field to the north where the continuation of underlying stone features was confirmed by a geophysical and probe survey. Examination of the quarry section revealed three 0.50m high sections of drystone wall resting on a distinct silt horizon. A concentration of weathered limestone lay between the wall sections (Fig. 3; Plate 1).

A trial trench, 11m x 1m wide, was excavated parallel with the quarry section. This trench was later extended to the north with two open areas each 5.5 x 5.0m, separated by a 2m wide baulk. This initial phase of excavation clearly demonstrated continuation of the stone concentration into the field and revealed the presence of linear and curvilinear walls. Following an interruption to the excavation programme, a linear mortuary deposit was discovered beneath the baulk, suggesting for the first time a Neolithic date for the site. Excavation continued in 1990 and by 1991 the cairn had been completely excavated before the active quarry face was extended.

In the absence of stratigraphic information reliance has had to be placed on the sequence of radiocarbon dates available for the site. Attention, however, is drawn to the fact that a number of the initial determinations must now be discounted. They suggested that the single inhumation pre-dated the multiple funerary deposit, and that both, not wholly plausibly, belonged to the fifth millennium cal BC, and were cited as evidence for the early introduction of monumental aspects of the Neolithic (Schulting 2000, 30-31). The revised and extended series of determinations now places the sequence firmly within the earlier part of the fourth millennium cal BC, and, less certainly, allows for the multiple funerary deposit marginally to pre-date the single inhumation deposit (Marshall *et al.* below; Bronk Ramsey *et al.* 2004a).

Chance discovery of the cairn in its damaged state at the edge of an active quarry prompted its excavation between 1988 and 1989 initially utilising the resources of the Manpower Services Commissions' Bassetlaw Heritage Project. This was one of the last Manpower Services Commission Projects and its demise precluded the completion of post-excavation processing and analysis for Whitwell cairn. Additional support from Derbyshire County Council and latterly English Heritage provided resources to complete the excavation and post-excavation analysis and development of the site archive some years later. This included processing of the radiocarbon dates which suggested a fifth millennium BC chronology for the site. These unexpectedly early dates prompted a renewed programme of radiocarbon dating, reported upon below. While this process introduced an element of delay to the post-excavation programme, it has allowed the formation of a robust chronological framework for the construction and use of Whitwell cairn.

SITE DESCRIPTION

Summary

Considerable structural complexity was revealed by excavation of the remaining east end of the monument, where it had been truncated by removal of topsoil prior to the quarry extension. Some indication of this complexity became visible once the cairn had been cleared of topsoil

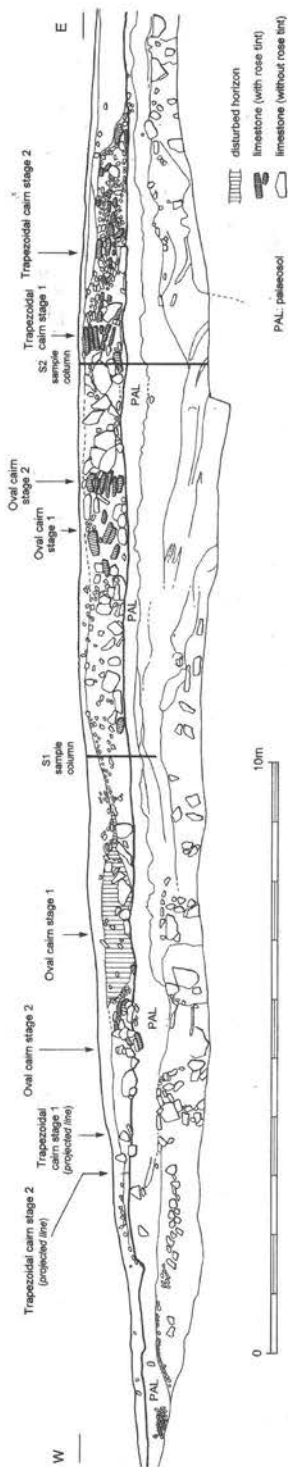


Fig. 3: West – east section through the monument, as revealed by quarry disturbance.

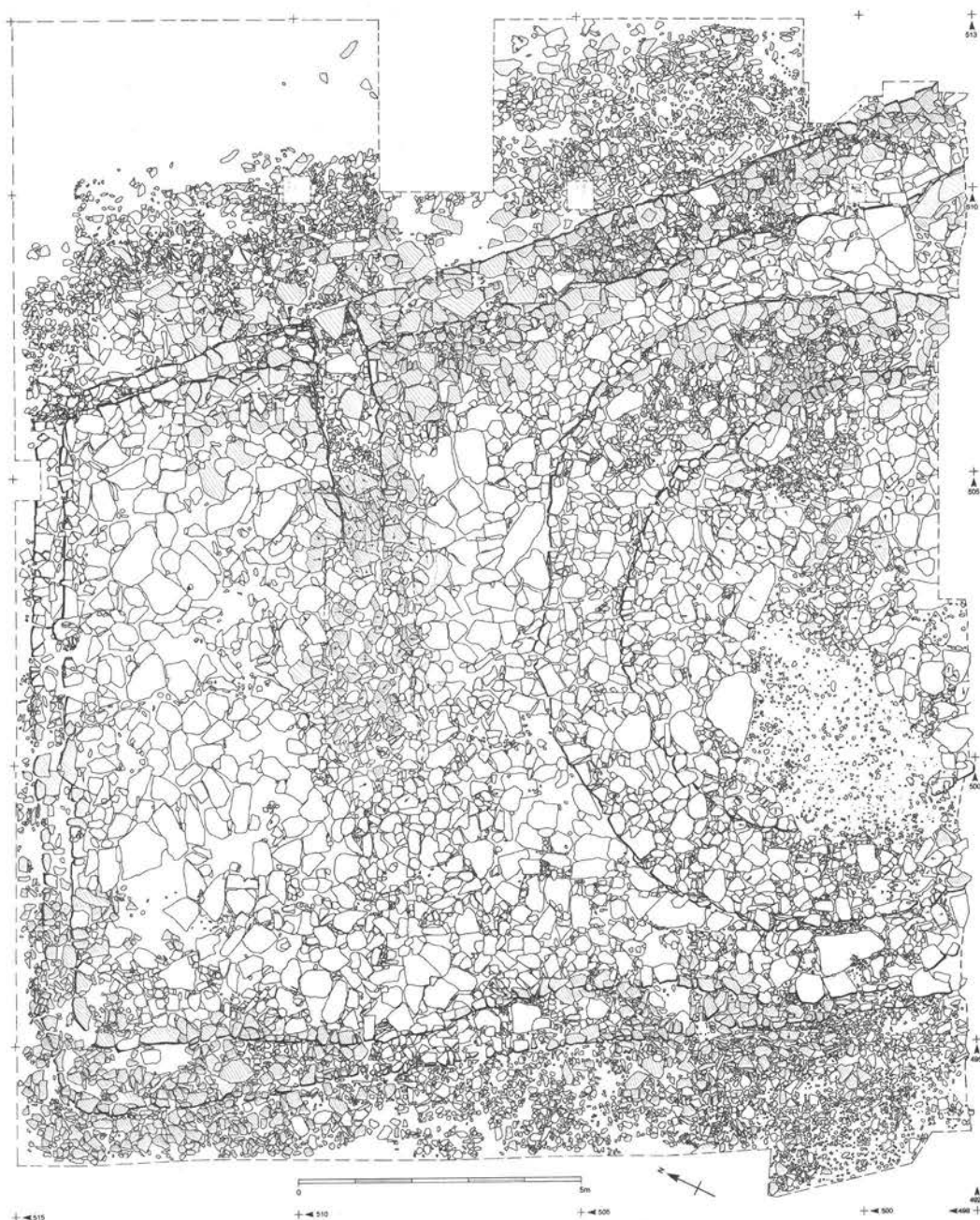


Fig. 4: Detailed plan of the Whitwell cairn, showing cairn construction.

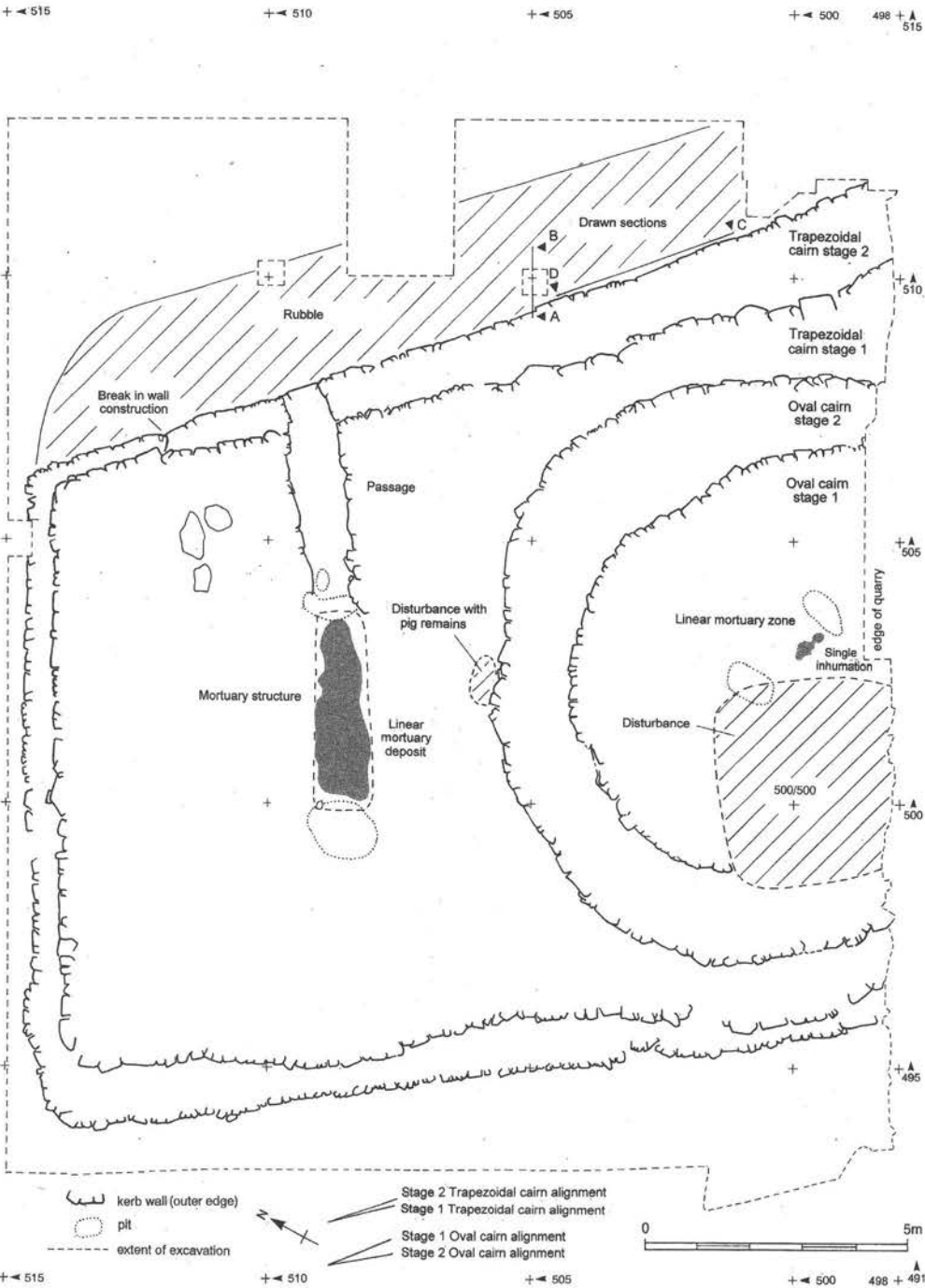
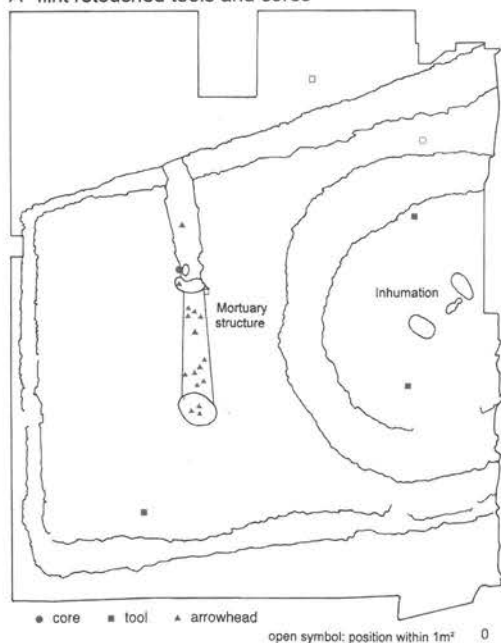
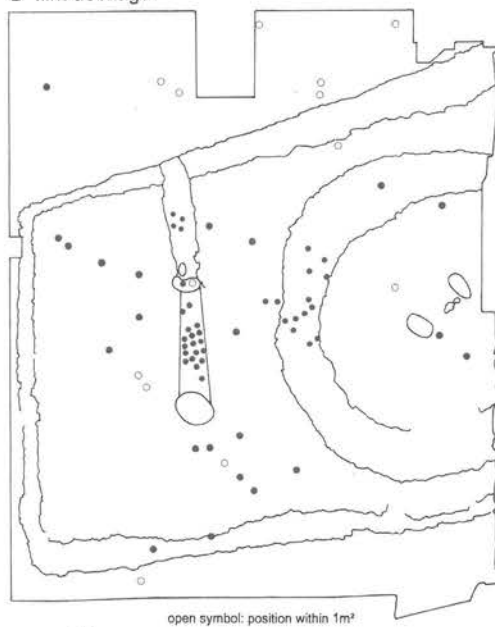


Fig. 5: Outline plan showing the principal components of the cairn.

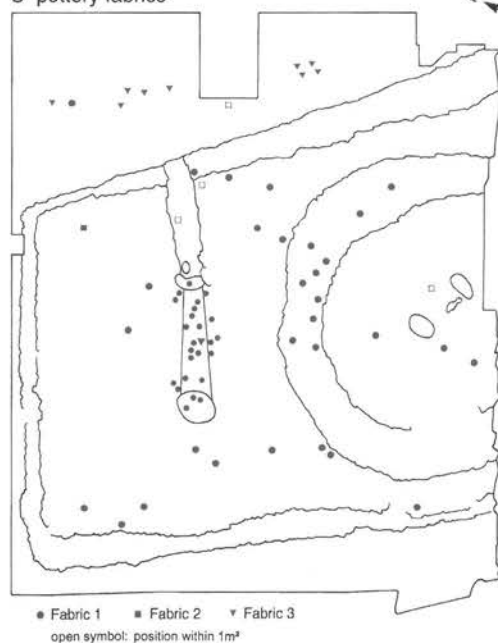
A flint retouched tools and cores



B flint debitage



C pottery fabrics



D fauna

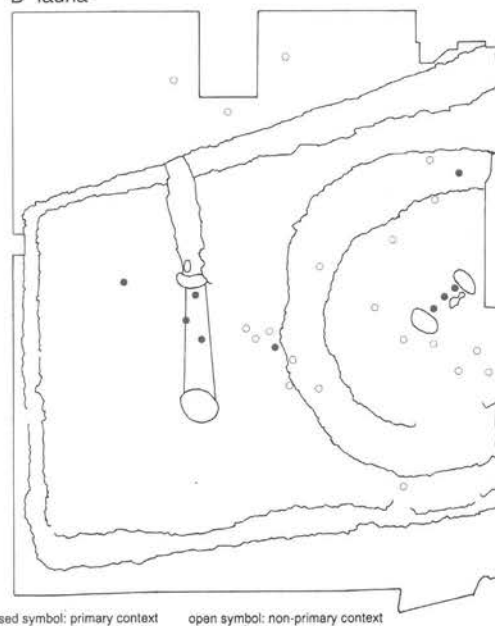


Fig. 6: Plan showing distribution of finds (all phases).

and disturbed stony deposits (Fig. 4; Plate 2). In its final form the rear portion of the cairn was trapezoidal in shape with a passage providing access to a linear mortuary deposit (Fig. 5). In common with linear mortuary deposits found elsewhere, the Whitwell example was bounded at either end by posts set in pits. There was evidence for two phases of mortuary deposition.

The enclosing trapezoidal cairn also encapsulated an oval cairn which covered a single inhumation placed between two pits, echoing the plan of the linear mortuary structure although there was no evidence for posts having been set into the pits. Both the oval and trapezoidal cairn incorporated double walls, suggesting a parallel sequence of re-modelling and re-alignment. Funerary activity ended with sealing of the entrance passage and placement of rubble against the cairn's outer wall. Early Bronze Age cairn disturbance was associated with the deposition of pig bones. The Neolithic finds assemblage comprises Carinated Bowl pottery and lithic material, including a notable series of flint arrowheads found with the skeletal material (Fig. 6).

Background

Although remains of the monument have a number of distinct components, not all of these articulate. The sequence of activity has been established through a combination of observation of direct relationships, inferences based on indirect relationships, and information provided by an extended set of radiocarbon determinations which have been subjected to rigorous review. Uncertainties persist, however, not least because of the incomplete state of the monument but also because of the relatively short period of time that the Neolithic activity endured, and because neither the structural nor the radiocarbon evidence allows complete certainty as to whether the two very distinctive funerary activities present took place consecutively or concurrently. The site narrative offered here is therefore based, where indicated, on probabilities rather than certainties.

The pre-monument surface

A yellow silt palaeosol was preserved beneath much of the cairn which in section reached a maximum depth of 0.2m. The surface and profile of this deposit was sampled for environmental information. Although not excavated completely, bulk samples obtained from this deposit when the upper surface was cleaned, recovered a small assemblage of pottery and flint believed to be for the most part contemporary with initial use of the monument. There was no visible trace of any buried soil sandwiched between the lowest stones of the cairn and the underlying silt and a single microlith and one or two other flint pieces were the only items that might pre-date the principal period of site use (Garton, below). The absence of artefacts from the pre-cairn surface tends to support the sedimentological and molluscan evidence in suggesting that at Whitwell the cairn site had been cleared of topsoil before mortuary activity was initiated (Frederick and Wagner respectively, below).

Phase 1 *Mortuary structure 1*

Established on an approximate east-west alignment, a linear mortuary deposit, 3.5m long by 1m wide, lay between two defining pits (Fig. 7). Both pits were approximately 0.50m deep, the pit at the east end [182] was D-shaped in plan and measured 1.0 x 0.40m, in contrast with the pit to the west [194] which was circular and 1.3m in diameter. Adjacent to both pits thin localised deposits of clay [200], no more than 0.05m deep, rested on the palaeosol. These deposits may be remains of material excavated from the pits, no other pits were present. The

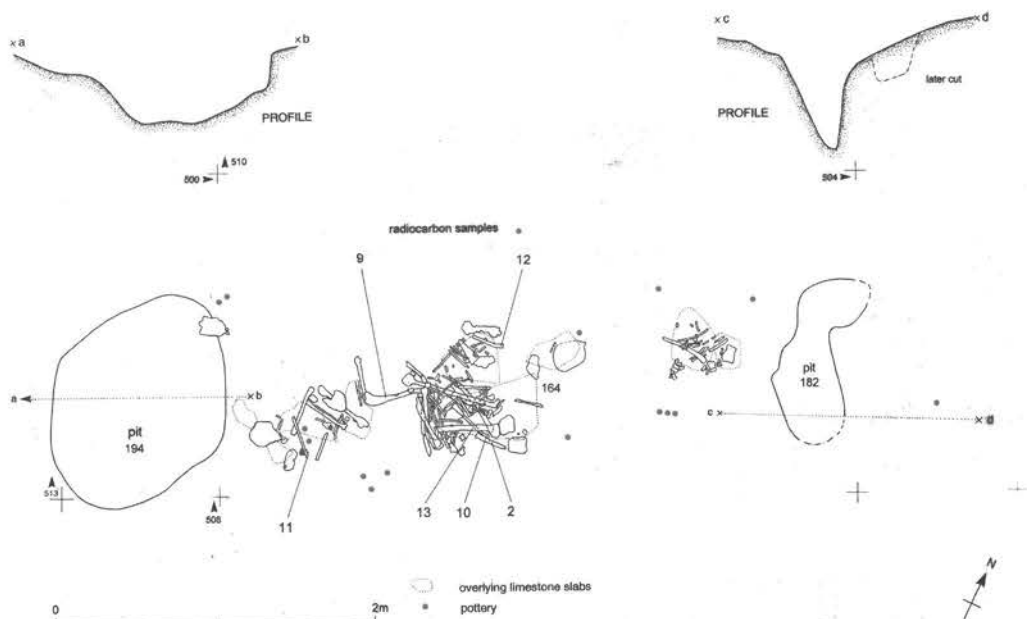


Fig. 7: Mortuary structure 1 features and first stage linear mortuary deposit, showing location of radiocarbon dated bones.

pits, and the disposition of the mortuary deposit, suggest the former existence of a structure in which the skeletal remains had been deposited.

Neither of the end pits contained any indication that timbers had been burnt or had rotted *in situ*. In the eastern pit [182] only low levels of charcoal were recovered and there was no evidence of a post-pipe. Two slabs set vertically against the east side of the pit may have retained their place as packing stones, but otherwise the fill [164b] comprised homogenous limestone rubble within a sandy matrix. The stone fill of the western pit [194], however, gave a stronger impression of material which had been packed around a post, perhaps circular in section and 0.5m in diameter. The pit had been backfilled with limestone rubble [164d].

The linear mortuary deposit comprised a spread of disarticulated human bone with well-defined edges which, together with the pits, suggests that the skeletal remains had been contained within a structure (Fig. 7; Plates 3 and 4). The skeletal remains were concentrated in the central and western area of the mortuary structure, with some sort of medial division of the deposit, if not the enclosing structure, suggested by the lack of bones at the eastern end of the deposit. The later insertion of a large limestone block appeared to reinforce a medial distinction which was maintained in later skeletal deposition in Phase 5 (described below). Thus this first phase of the mortuary structure would appear to have comprised proximal and distal pits containing upright timbers which acted as the ends of a narrow timber or composite timber and wattle box. The end-timbers would have predicated access to the box, requiring that deposition of human remains would have to have been made over the side of the structure, between the vertical posts. A total of 116 human skeletal fragments can be securely related to this earlier phase through their position sealed beneath limestone slabs within the mortuary deposit. A minimum number of people represented within this group is four adults and one child (Chamberlain, below), of a total 16 individuals represented in the whole deposit. Radiocarbon estimates obtained from this first burial horizon suggest that

deposition took place between 3790 and 3710 cal BC (Table 1: Marshall *et al.* below).

The deposition of human bone was concentrated centrally and to the western end of the mortuary structure. Part of the central deposit was overlain by limestone slabs [boundary between 164a1 and 164a2] from the later remodelling of the mortuary structure. Further bone deposits extended beyond the limestone slabs to the north and their relative position suggested they also belonged to the early phase of deposition. The extent of the bony deposit implies a width of 1m for a containing structure around 3.4m long between the proximal and distal pits. Also clear definition of the central deposit, and distinct smaller concentrations of bone to the east end, suggest the presence of a division within the structure which was not otherwise evidenced. The deposits appeared to lie directly on the ground surface, although the possible original presence of a timber floor should not be discounted, and, indeed, is likely. None of the human bone had been burnt. The deposit included a few fragments of unidentifiable animal bone and a cattle tooth (Witkin and Chamberlain, below). Intermixed with deposits of both this and later phases of skeletal deposition were 14 of the 15 leaf-shaped flint arrowheads found on the site (Garton, below). Almost all of these had been broken and joining fragments were found in varying parts of the deposit, as well as in the fill of the mortuary structure end pits, indicating some movement at least of the upper levels of the deposit.

To the north-east of the eastern end of the mortuary structure, within the area later defined by the north passage wall and the eastern wall of the Phase 4 monument, three flat slabs of limestone [165a] rested on the ground surface (Fig. 5). A total of 11 fragments of human bone were recovered from this area, the only concentration of bone outside the mortuary structure, while four flints and three potsherds were also present in this area (Fig. 6), as well as the tibia of a cow which has cut marks and one end seemingly pared to make a pointed tool (Collins, below). The presence of this material raises the possibility, discussed below, that this area was associated with specific ritual activities connected with use of the Phase 1 mortuary structure, the limestone slabs perhaps being surviving stones from a small paved area.

Phase 2 Linear mortuary zone and single inhumation

As discussed further below, the deposition of a single inhumation, that of a young woman, is suggested to have taken place some time after establishment of the stage 1 mortuary structure with its linear mortuary deposit and possibly close to, but before restructuring of this feature. The inhumation lay in a crouched position directly on the ground surface between two sub-circular pits which defined a rectangular area 1.5 by 1.0m, referred to here as the mortuary zone. This feature was 7m to the south of the mortuary structure and was aligned approximately south-east / north-west (Figs 5 and 8; Plate 5). The burial was not located centrally between the pits, but rested adjacent to the eastern pit. Radiocarbon dates obtained from the skeleton provide a date range of 3760 – 3650 cal BC (Table 1). Faunal remains associated with the inhumation comprised a cattle tooth and a hare/rabbit bone and neither showed signs of having been worked. Directly adjacent to, and surrounding, the inhumation a series of limestone slabs [part 183eI] lay on the ground surface. It is not clear whether these stones represent a deliberate attempt to create a surface within the mortuary zone, or were simply the primary stones laid down during the construction of the overlying cairn.

The pits [206, 207] defining the mortuary zone were of equal dimensions, 1.0 by 0.5m in plan, and both cut the palaeosol to a depth of 0.50m. Their fill [respectively 183b and 183c] comprised predominantly limestone rubble in a sandy matrix, much the same as the overlying cairn fill. No finds or charcoal were recovered from either pit. The lack of any indication of a post-pipe suggests that, if either pit had originally contained a post, each was

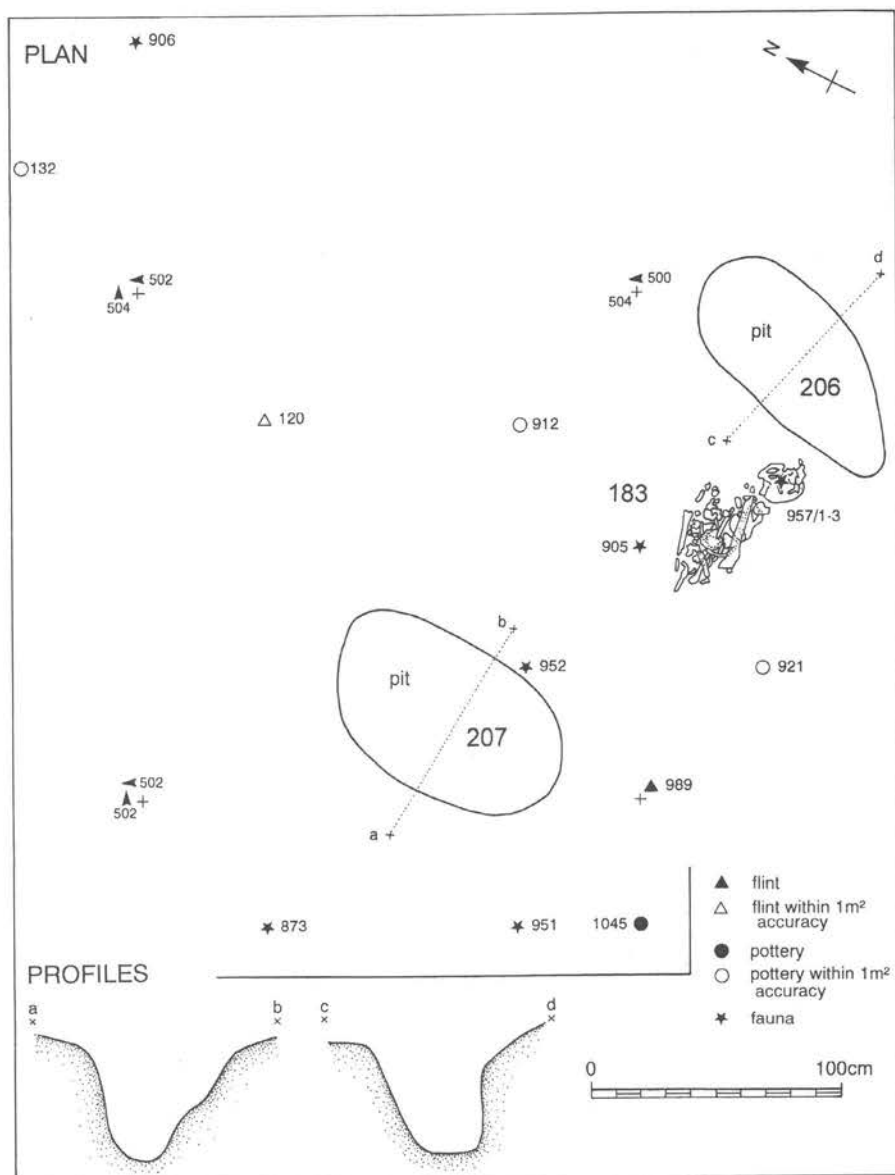


Fig. 8: The mortuary zone and single inhumation beneath oval cairn stage 1.

emptied and deliberately back-filled before the construction of the overlying cairn. There is no evidence to suggest that either pit had contributed to the support of a structure, although there is a suggestion from the overlying cairn material that some kind of box surrounded the inhumation. The possibility that the inhumation deposit and its container may not have been immediately enclosed within the oval cairn is raised by the presence of a breeding colony of snails contained within the skull (Wagner, below). In the immediate vicinity of the single inhumation there was a reduction in the concentration, size and character of the cairn stones [183d]. The stones here were more slab-like and their orientation was suggestive of collapse

into the space occupied by the inhumation deposit. Directly above the skull the cairn fill comprised predominantly sandy sediment with very little stone. The nature of the surrounding cairn and the intact and relative completeness of the burial suggested it had been placed within an organic structure, the subsequent decay of which resulted in the collapse of the surrounding stones. The extent of loose or slipped material suggests a structure around 0.90 by 0.90m in plan.

Phase 3 *Oval cairn stage 1*

A cairn was constructed over the single inhumation. This was oval in plan, 7.4m wide and with much the same surviving length, although extrapolation suggests that the original length was in the region of 9m or more. It was surrounded by a low wall, 0.50 to 0.60m high. The south-east / north-west orientation of the cairn appears to have had no regard for the underlying pits and inhumation, orientated east-south-east / west-south-west. Subsequent quarry disturbance had significantly damaged the southern end of the oval cairn, with perhaps as much as one third being removed and replaced with a mixed clay and stone fill [171] (Fig. 5). Away from the mortuary zone the cairn was constructed of massive stones [183ei], up to 1.2 by 0.80 by 0.30m in size, the long axes of the stones orientated towards and sloping down to the cairn perimeter and away from the inhumation and the mortuary zone. This pattern demonstrated that cairn construction had proceeded outwards from the mortuary zone. Between the stones was a sandy matrix which graded to clays and silts towards the base [164a1], lying directly above the palaeosol. This matrix is thought to be a natural deposit formed largely through subsequent weathering of the cairn stones.

The cairn wall was of dry stone construction, built of slab limestone and often averaging only one stone in width [173]. Nowhere did the wall exceed 0.20m in width. A feature of this wall was the fine finish on the outer edge in contrast to the ragged inner face. This suggests that the outer face of the wall was exposed and provided a neat outer edge to a cairn fill with which it was integral. The construction thus never existed as a free-standing wall, nor does it appear to have provided much in the way of structural support for the cairn it bounded.

A characteristic of this and the second constructional phase of the cairn is the use of pink coloured limestone which appears to have been deliberately selected to provide contrasting colours within the cairn body (Fig. 4). Concentrations of this pink material were observed along the north-east portion of the oval cairn wall from the quarry section approximately 5m along its length and in the cairn content in the vicinity of the mortuary area which, although comprising a predominantly cream-coloured stone matrix, exhibited a dozen or so pink stones.

A very limited number of artefacts – four pieces of flint debitage and four potsherds – were sealed beneath the cairn, a quantity consistent with increasing distance from the focus of artefact distribution within and around the linear mortuary structure, and which demonstrates that the first phase of the oval cairn succeeded the deposition of flint and pottery at the site. On the western side of the oval cairn much of the stone fill and a section of the enclosing wall were absent (Fig. 4), and the loose and mixed nature of the cairn in this area [185] clearly demonstrated this area had been disturbed.

Phase 4 *Oval cairn stage 2*

Some time after construction, the oval cairn was extended and its outline changed by construction of an additional outer wall [156] and infilling of the space between the two walls with stone. This created a cairn whose outline remained an oval, but whose axis had changed

by perhaps 10°, from 310° to 320°, still further at odds with the orientation of the underlying mortuary zone (Fig. 5; Plate 6). The external wall and infill material were placed on the same surface as the initial phase of the oval cairn and the lack of any deposits accumulated against the original cairn wall suggests that only a relatively short period of time elapsed before this extended constructional phase.

The height and neatness of the cairn wall was consistent with that of the enclosed inner cairn, the wall being typically 0.50m high and 0.20m wide. Similarities extended to the use of pink limestone, principally for the construction of the cairn wall in its eastern sector. A less well finished wall construction was recorded along the northern side of the extended oval cairn over a 2.5 m length, where weathered rounded stones were used for both wall and infill [parts of 156], in contrast to the slab limestone seen elsewhere (Pl. 7). There is no obvious reason for the change in building materials, although it should be noted that this sector of the oval cairn was nearest the adjacent mortuary structure and in this sector had a slightly flattened curve to the walled outline. Disturbance had taken place in this area at a considerably later date, as discussed below. The original overall size of this stage of the cairn is unknown on account of truncation by the quarry. However, the new width was around 11.5m, and the addition of between 1.3 and 2m to the original cairn suggests a new length of perhaps 13m, or possibly the alterations resulted in a more nearly circular cairn. Whatever the final dimensions, the structure suggests a remodelling and re-alignment which was careful to reflect the original construction of the monument.

The northern side of the extended cairn overlay the greatest concentration of potsherds and pieces of flint debitage found beyond the limits of the linear mortuary structure, suggesting either that construction of this phase of the oval cairn may have preserved some debris which might otherwise have been tided up, or that between the linear mortuary structure and the single inhumation there had been a second focus of activity involving artefact deposition before and/or during construction of the oval cairn. A few potsherds and flint fragments, as well as one human tooth, were recovered from among the cairn stones. Significantly these finds include a large and unabraded sherd from a carinated bowl, vessel 4 (Beswick, below), presumed to have been deposited at various locations at the time of construction of the enclosing trapezoidal cairn. The tooth was recovered approximately 1.5m to the south of the mortuary zone in the quarry overburden section, it does not derive from the single inhumation (*pers. com.* Andrew Chamberlain), nor is there any evidence that it originated in the linear mortuary deposit.

Phase 5 Trapezoidal cairn stage 1

Following the activities which resulted in deposition of potsherds and flint pieces, and probably prior to the completion of deposition of skeletal remains on the site, a low trapezoidal cairn was constructed in much the same style as the oval cairn. The wall [157a] was integral with the cairn it bounded and enclosed the oval cairn and the mortuary structure to its north, on an alignment approximately 5° more than south-east / north-west. A continuing interest in the mortuary structure is confirmed by construction of a narrow passage leading from the eastern side of the cairn, at its north-east end, directly to the east end of the mortuary deposit (Fig. 9).

Because of the loss of the front southern end the original dimensions of the trapezoidal cairn are impossible to establish with certainty, but in order to enclose the extrapolated dimensions of the stage 2 oval cairn a minimum length of 22m must be envisaged. The cairn was 11m wide at its northern end, while the extrapolated width at the southern end would be in the region



Plate 1: View of the cairn section at quarry edge, 1989.



Plate 2: View of the cairn after removal of topsoil and disturbed material.



Plate 3: The linear mortuary deposit, looking west, both stages.

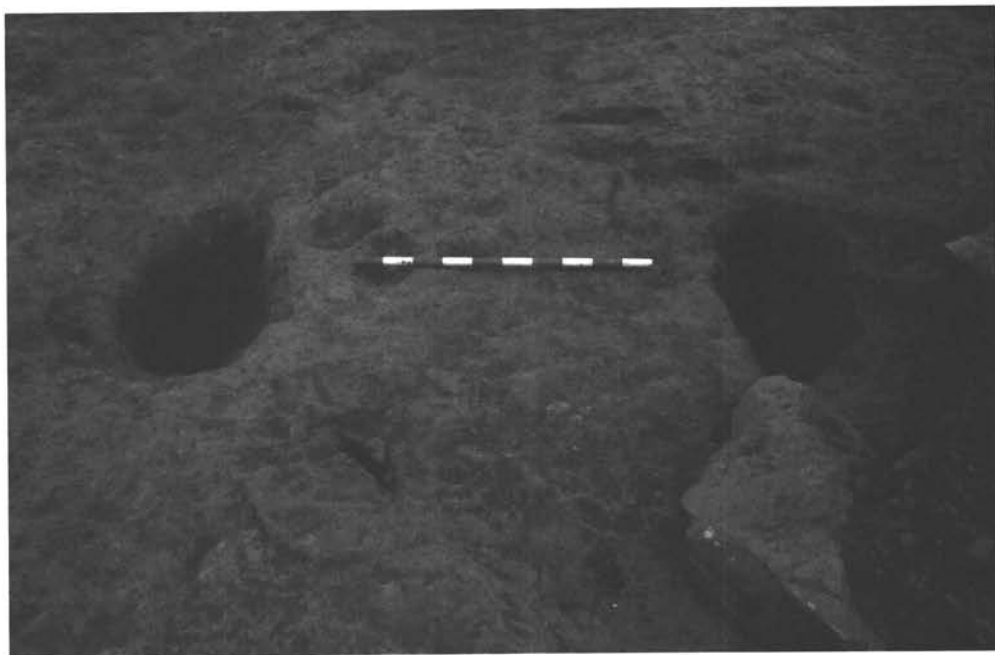


Plate 4: Linear mortuary zone pits.



Plate 5: Single inhumation and surrounding cairn material.



Plate 6: Walls of the two stages of the oval cairn, view from the east.



Plate 7: North-east portion of the trapezoidal cairn, showing two phases of walling. Large boulders at the cairn core give way to limestone slabs at the northern side of the passage.



Plate 8: Second phase linear mortuary deposit with flint arrowhead 6 (Fig. 16).



Plate 9: Eastern side of cairn showing variation in alignment between stage 1 and stage 2 of the trapezoidal cairn.



Plate 10: Detail of cairn wall of stage 2 trapezoidal cairn, eastern side.



Plate 11: Detail of passage blocking showing slabs at west end of passage in foreground of picture. Passage entrance blocking can be seen in the background.



Plate 12: Displaced cairn material against eastern side of stage 2 trapezoidal cairn.

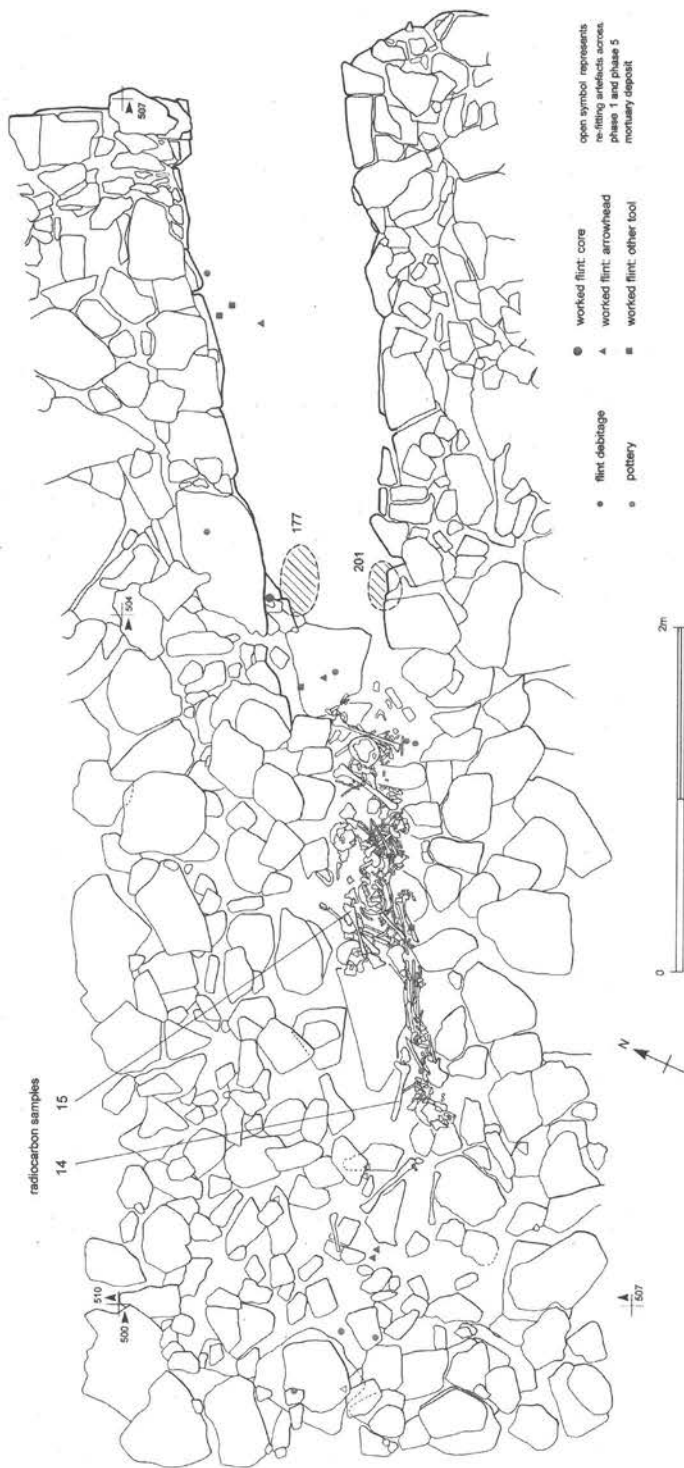


Fig. 9: Upper levels of linear mortuary deposit with adjacent trapezoidal cairn stage 1, approach passage and scoops.

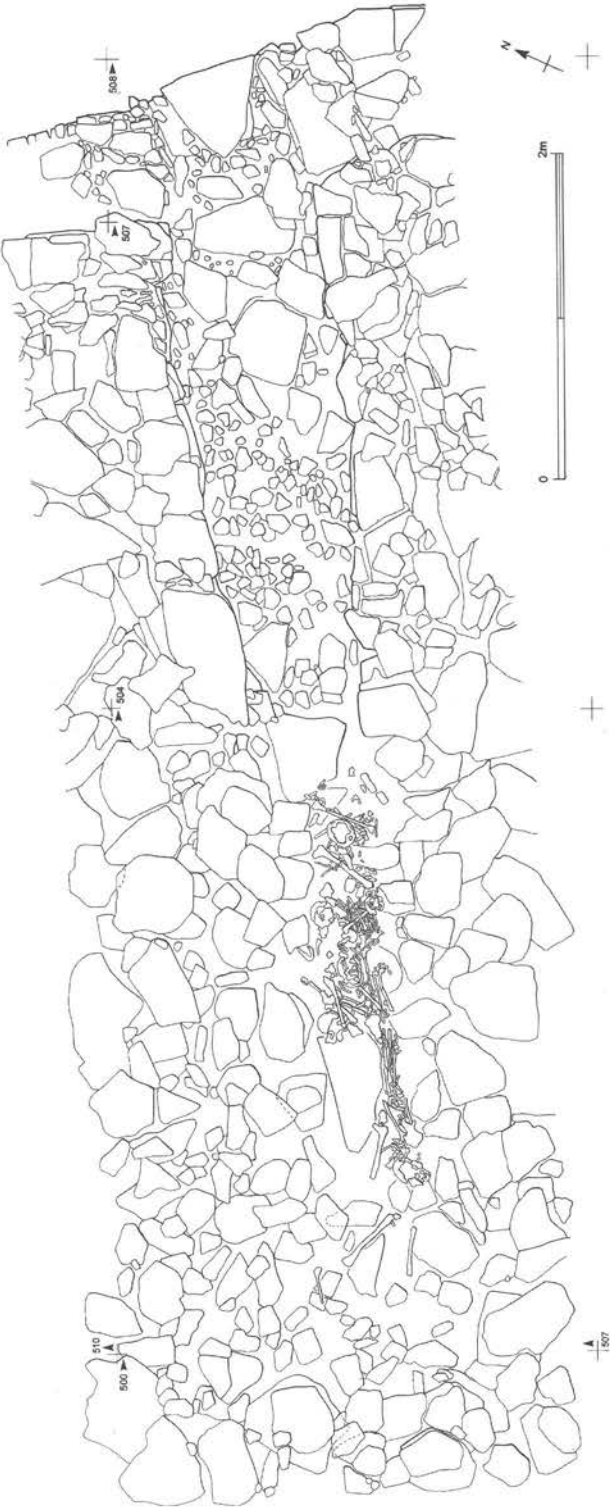


Fig. 10: Upper levels of linear mortuary deposit with adjacent trapezoidal cairn stage 1, outer cairn wall of trapezoidal cairn stage 2 and passage blocking material.

of 17.5m (Fig. 23). The cairn wall stood up to 0.50m high on the north-east side, decreasing to 0.20m towards the north. The cairn was best preserved along its eastern side, where the maximum surviving height was 0.60m (Fig. 10), along the west side it was more generally 0.20m high. The variable survival of the cairn was partly due to its being located on a slight west-facing slope, resulting in the accumulation of colluvial silts [30] and plough soil which protected the eastern side from plough damage. At the northern end the height diminished to 0.20m, an original low stature confirmed by the insubstantial nature of the wall in this area and the limited amount of displaced material outside to the north and west. Everywhere, the cairn survived to the height of the largest boulders, so the diminution in height towards the northern end, and its good survival on the eastern side was at least partly a reflection of the stone content. The cairn wall construction was consistent along its entire length, although the use of variably coloured dolomitic limestone was again noted. On the north-eastern side there was a preference for using pink dolomite which created a marked contrast with other portions of the wall, where the stone was cream in colour. This contrast was particularly evident in the section between the passage and the north-eastern corner, where there was a sudden change from pink to buff limestone which coincided with a break in the wall construction, adjacent to the possible paved ritual area (Figs 4 and 5).

The cairn's centre was infilled with large boulders within a sandy silt matrix [167a, 167b], but adjacent to the eastern wall these gave way to flat blocks of limestone (Plate 7). The cairn body consisted predominantly of large weathered limestone boulders up to 1m in size, generally of more massive proportions than those employed in the construction of the oval cairn. Perhaps because of the very varied sizes of the boulders, there was no obvious indication of pattern in the construction. The northern area of the cairn contained exceptionally large limestone blocks which had created shallow depressions in the palaeosol surface. The general orientation of slabs was similar to that observed within the oval cairn, with the long axis of stone slabs orientated down and out towards the cairn perimeter. Silts and sands had accumulated between the stone voids. Excavation beyond the cairn revealed no flanking quarry ditches or pits. A number of limestone outcrops exist nearby today and it would be safe to assume that limestone for the cairn and the walls, both cream and pink, would have been readily available locally.

Construction of the first stage of the trapezoidal cairn followed removal of the end posts of the mortuary structure, the sockets of which were then infilled with small blocks and rubble. Within the mortuary structure the initial skeletal deposits were partly covered with limestone slabs, primarily in the centre and western portion of the structure. At the eastern end the homogenous nature of the pit fill [164b], the absence of a post-pipe and the small amount of carbonised material suggests that a post had not rotted nor had it been burnt *in situ*, but had been deliberately removed, leaving a void which was infilled with limestone blocks, rubble and sand. Notably, the pit contained, at its base, the only complete flint arrowhead from the site. The uppermost part of the pit fill contained small pieces of bone. Backfilling [164d] of the western post-socket included in its upper levels fragments of bone from the adjacent mortuary deposit. Although the end posts of the mortuary structure had been removed, it is not clear that this entailed re-modelling of the chamber confining the mortuary deposit, since later phases of skeletal deposition maintained the outline of earlier deposits, as noted further below.

The outline of the passage at the north-east corner of the cairn was first marked by an appropriate gap in the boulder base of the cairn. This was then lined with a drystone wall [161] with up to eight surviving courses, the space between the facing stones and cairn boulders

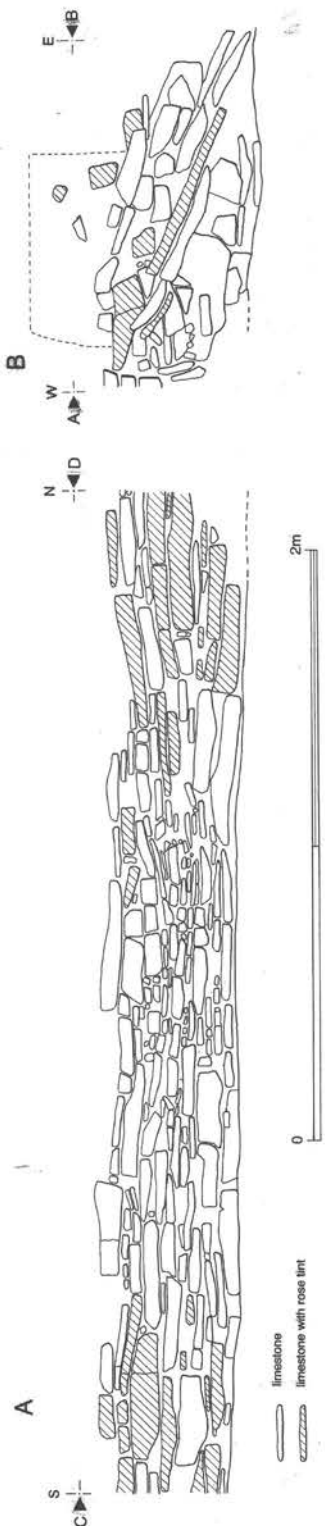


Fig. 11: A - detail of trapezoidal cairn stage 2 wall, east; B - section through trapezoidal cairn stage 2 external deposits.

filled with limestone blocks and rubble which eventually acquired a leaning angle into the passage. Overall, the passage was 4m long, with an average width of 0.80m. In this phase of activity access to the passage was obtained through a carefully-edged gap in the cairn wall, which was integral with that of the passage (Figs 9, 10 and 11). The location of the passage is highly significant, since it led from the cairn outer wall directly to the eastern end of the former mortuary structure. It may also have had some relationship with the area to the north-east of the passage, suggested to have had a function associated with ritual activity.

The passage floor at this time appears to have comprised the existing ground surface, into which two scoops had been cut immediately in front of (i.e. to the east) of the infilled eastern post-pit of the former mortuary structure [north 177, south 201] (Fig. 9). Each was oval, 0.20m in depth and 0.40 by 0.20m maximum dimensions, and so equally spaced between the passage walls as to suggest that they had been created after the passage had been set out. These pits were filled with a mixture of burnt limestone, charcoal and silt clays, deposits that were tightly contained within the features and found not to extend beneath either of the flanking passage walls. Their purpose is unclear. Their localised nature suggests that the process of burning took place as one isolated and short-lived activity, soon buried beneath small slabs of limestone. The deposits from the northernmost feature had become mixed with the primary deposits in the passage and, although charcoal-rich, did not contain any large fragments of charred wood but comprised small amounts of comminuted charcoal, including fragments of oak and hazelnuts which were recovered by sieving. The passage had clearly been built before any of the burning activity associated with its early use, for which a radiocarbon date, 3810-3650 cal BC, has been obtained (Table 1).

The enclosing cairn, surviving to a height of no more than 0.60m but doubtless reduced somewhat by ploughing and other attrition, may not have precluded physical access to the remains of the former mortuary structure. The fact that the newly-constructed passage led directly to the east end of the mortuary structure, its end-post now removed, suggests that access was now intended by this route. Renewal of skeletal deposition may not have taken place until after the episode of ritual activity associated with the scoops at the western end of the passage. No charcoal was present beyond the west of the end of the passage therefore it would appear that the scoops and their fills had been sealed before further access was gained to the mortuary deposit.

Bones deposited in the mortuary area in this later phase were concentrated towards the east of the central limestone slab and continued in a well-defined alignment along the southern edge of the area (Fig. 9). The alignment and high incidence of skeletal deposits on the south and eastern end of the mortuary structure suggests that access was either restricted to areas accessed from the passage, or that this was a preferred area of deposition, activity that led to the greatest depth of skeletal deposit of 0.15m. This second phase of skeletal deposition took place after the placement of the large limestone slab over the centre of the first phase skeletal deposits. Bones were butted up to this slab, but the straight edge to the skeletal deposits of this second phase suggests that a wooden chamber or container was still present. A total of 122 bone fragments could be securely related to this later burial phase, representing a minimum of five adults and one child. A number of the fragments of leaf-shaped flint arrowheads are likely to belong to this phase of skeletal deposition (Plate 8; Garton, below), and the presence of joining pieces suggests, as does the representation of the bone fragments (Chamberlain, below) and the included potsherd, a degree of movement of the deposits.

Radiocarbon dates obtained from this later funerary horizon suggest an extended use of the area into the mid-fourth millennium, 3630 – 3530 cal BC (Table 1). Among this later sequence of deposits was a large sherd of coarseware (Beswick, below). Away from the central area of the mortuary deposit smaller limestone slabs sealed further bones at the west end of the mortuary structure. It was unclear whether these deposits were contemporary with the central bone concentrations or represented later deposits.

Phase 6 Trapezoidal cairn stage 2

Alterations were made to the trapezoidal cairn in a manner reflecting the alterations to the oval cairn. During this phase the cairn was extended by construction of an additional cairn wall [153] and the infilling, with a smaller stone component, of the space between the initial wall and this later extension. The passage entrance was maintained and extended by 0.80m through this cairn material (Fig. 9). The effect of the alterations was to increase the cairn size to 12.3m wide at the north end and 16.2m wide at the quarry face. The overall surviving length was now 16.4m, and the extrapolated original length increased by a minimum of c.1m, to 23m. The intention appears to have been to amend the orientation of the cairn by 5°, so that its alignment was approximately SE – NW (Plate 9). The cairn's height was maintained, and in particular the sharp distinction, 2.4m to the north of the passage, between pink and buff limestone was preserved, as were concentrations of pink limestone in the north-west corner and the southern section of the cairn wall (Fig. 4).

No sign of weathering was observed on the original cairn wall, suggesting that the second phase of construction occurred soon afterwards. The outer wall of the extended cairn also maintained a similar well-crafted external finish, and where best preserved along the north-eastern side, south of the passage entrance, contained ten surviving courses of stonework (Fig. 11; Plate 10). To what extent the stony material against the cairn had been displaced by ploughing, or was the product of erosion, or had been placed deliberately, is discussed further below.

Reconstruction of the cairn appears to have been coincident with, or followed only shortly after, deposition of fresh sherds from a single carinated bowl, vessel 4 (Beswick, below). Excavation of the inner base of the outer cairn wall to the north of the passage recovered a fragment of this bowl which was the largest pottery sherd from the site. The unabraded nature of sherds of this vessel from both the second phase of the trapezoidal cairn, and from the oval cairn make up, emphasise the short timescale of this complex construction sequence.

Along the north-east side of the trapezoidal cairn a large, weathered, triangular sill stone now defined the passage entrance (Fig. 10). This sill, set upon an unweathered limestone slab, is thought to have been intended to bring the entrance level up to that of the primary sill and the existing passage deposits. From the sill stone the passage deposits contained a stone slab component which presented a discontinuous surface [176] which sealed earlier deposits, including the charcoal-rich features at the passage end described above. A small assemblage of flint and pottery was recovered from these later passage deposits (Fig. 12). It is not clear what element of the skeletal deposits may be associated with this phase of construction. Possibly those assigned to the first phase of the trapezoidal cairn were actually deposited at this time, in which case ritual activity associated with the first use of the cairn may have been limited to the excavation of the two scoops at the passage end and the burning which led to deposition of carbonised material there. Alternatively, the uppermost levels of the skeletal deposit may be of this phase. Extension of the passage certainly suggests that continued deposition of skeletal remains was intended.

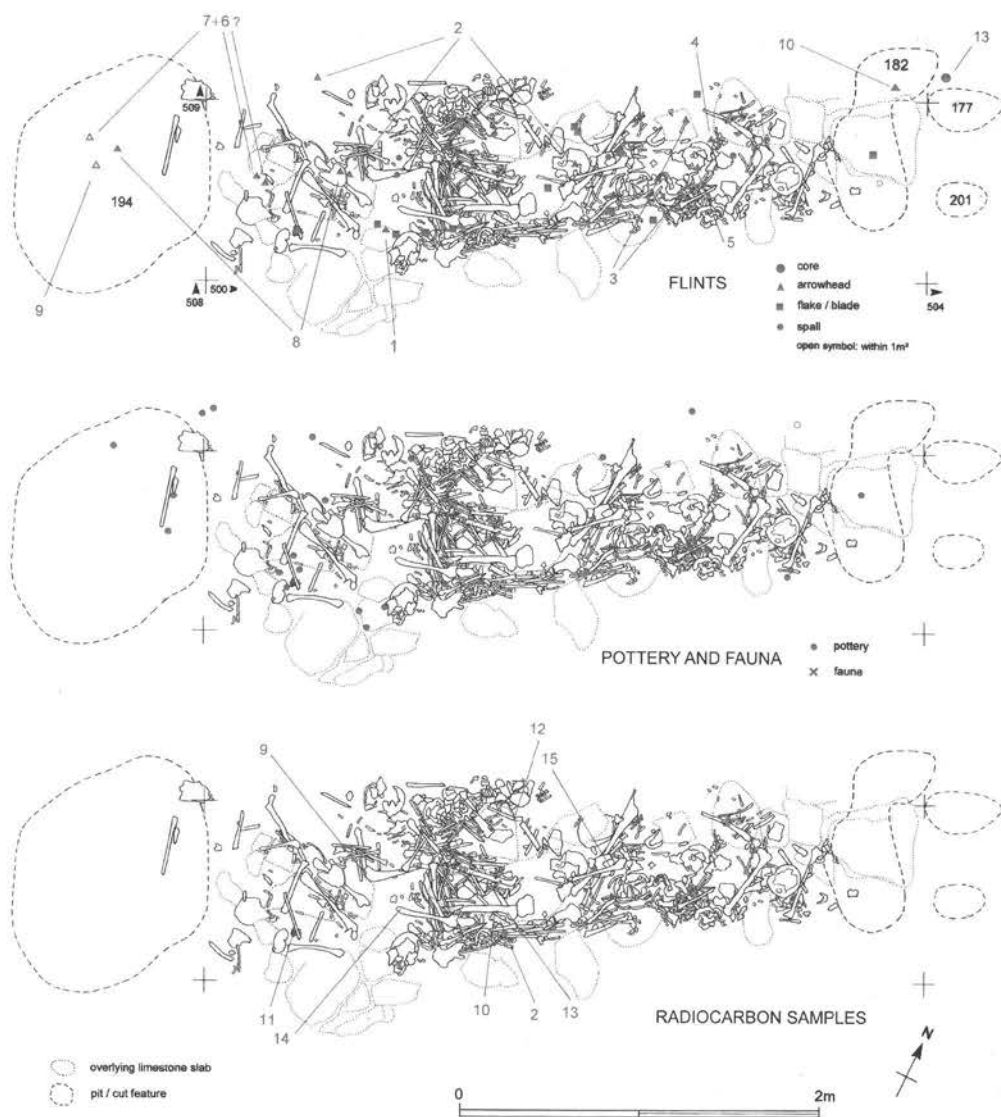


Fig. 12: Linear mortuary deposit, showing the distribution of flints, pottery, animal bones and location of radiocarbon-dated human bones.

Phase 7 Sealing of the monument

Directly overlying the slabs paving the floor of the passage and the infilled pit at the eastern end of the mortuary structure lay a number of thin pink limestone slabs [164eii]. The slabs at the eastern end were set at 45° to the ground surface and then gradually decreased in angle to an almost horizontal position towards the west (Fig. 4; Plate 11). The variation in angle suggests the slabs had been somewhat untidily piled on top of one another, the angle of lean increasing with each added stone, so as ultimately to block the end of the passage. Adjacent

and east of the slabs a concentration of smaller stones [164c], predominantly pink limestone, lay directly over the uppermost levels of the linear mortuary deposit. An absence of large slabs over the mortuary deposit suggests it never had a major stone component and that the small rubble which now overlay it infilled a formerly unroofed cavity or, as suggested below, rested on top of a timber capping.

A level of small limestone rubble [35, 36] appeared to complete the blocking process within the passage (Fig. 10). Along the eastern cairn edge was an accumulation of small weathered limestone boulders and large limestone slabs [31] and, adjacent to poorly preserved lengths of the outer wall, the base of this deposit consisted of displaced facing stones which had created depressions in the underlying land surface and were covered with a smaller sized stone fraction. Where preservation of the outer wall was favourable, in the south-eastern area, the outer deposit rose to the height of the wall and decreased in height at an angle of approximately 30°, extending between 1.5 and 3m eastwards from the cairn wall. The mixed nature of this deposit, with slab limestone and smaller stones orientated to the direction of slope of the deposit (Fig. 11; Plate 12), suggests that this was not totally haphazard collapse but was at least partially material which had been placed deliberately to mask the cairn wall. Buried beneath this deposit was a thin lens of clay silt.

Phase 8 *Early Bronze Age activity*

A variation in construction of a section of the northern wall of the stage 2 oval cairn was noted in the description of Phase 5. This coincided with a poorly defined area of disturbance to the body of the trapezoidal cairn [163] and a section of the oval cairn wall constructed of weathered rounded stones in contrast to the limestone slabs used elsewhere. Adjacent, outside the oval cairn but within the disturbance to the trapezoidal cairn, was a deposit of animal bones which included pig, sheep/goat, and dog/fox as well as fragments from a number of small mammals (Collins, below). That this relates to activity subsequent to construction of the trapezoidal cairn is suggested by a radiocarbon date of 2140 – 1970 cal BC derived from the pig remains (Table 1). Although the nature of this animal's diet appears to have been slightly unusual, the date is reliable and suggests disturbance of the cairn in the Early Bronze Age, a by no means unlikely event, since a number of Neolithic cairns within the region have Bronze Age mounds built on them (Barnatt 1996, 22). That the excavated pit remained open for some time, and that the location was relatively secluded, is indicated by the small mammal bones, suggested to have been deposited in the pellets of roosting owls (Collins, below). As discussed further below, the possibility that the ritual nature of the earlier cairn was recognised in the Early Bronze Age is a matter of debate.

Phase 9 *Later activity*

A further, undated disturbance is evidenced by the removal of cairn material on the southern part of oval cairns 1 and 2 and its replacement with clayey soil [178]. No artefacts were associated with this phase of activity, which may best be interpreted as stone robbing for construction of successive overlying enclosure boundaries discussed in more detail below. Recent plough disturbance of the cairn was indicated by a mixed deposit of fragmented stone, silts and soil directly beneath the ploughsoil, and the recovery of a fragment of an iron plough share from the cairn.

Phase summary

As discussed further by Marshall (below), the ranges quoted in *italics* are derived from mathematical modelling of archaeological problems, while the ranges in plain type have been calculated according to the maximum intercept method (Stuiver and Reimer 1986). All other ranges are derived from the probability method (Stuiver and Reimer 1993). As discussed elsewhere, the nature of the evidence requires that phasing is indicative and almost certainly simplifies a complex sequence.

Phase 1

- 1.1 Mortuary structure / mortuary deposit phase I, possible ritual platform, possible totemic posts. Radiocarbon dates suggest 3790-3710 cal BC (95% probability) and 3770-3720 cal BC (68% probability) – dates so close as not to matter.
- 1.2 Radiocarbon suggests the first body was deposited here in 3770-3650 cal BC – earlier in the period seems most likely. Radiocarbon dates suggest phase duration of deposition 10-100 years (95% probability) and 30-80 years (68% probability) – shorter phase probably to be preferred.
- 1.3 No direct evidence that flint arrowheads or potsherds were deposited at this stage, but they may have been.

Phase 2

- 2.1 Single inhumation deposited in a box adjacent to two pits. Radiocarbon suggests 3760-3650 cal BC (95% probability) and 3710-3660 cal BC (68% probability).
- 2.2 Analysis shows it is 98% probable that the first body was interred in the collective deposit before deposition of the single inhumation, but it is 63% probable that the single inhumation was deposited before construction of the slabs over the collective mortuary deposit. Safest to suggest that the single inhumation is made after initiation of the linear deposit.
- 2.3 This suggested phase may conflate two phases, the first part being the two pits and use of space between them, the second being the deposition of the inhumation within a box or basket structure.

Phase 3

- 3.1 Oval cairn stage 1 constructed over single inhumation after pottery and flint had been scattered on ground surface. No direct dating evidence.

Phase 4

- 4.1 Oval cairn stage 2 representing extension and remodelling of stage 1 oval cairn. No direct dating evidence but has to be before the construction of the stage 1 trapezoidal cairn and its wall, and might have followed closely on oval cairn stage 1.

Phase 5

- 5.1 Trapezoidal cairn stage 1 and passage with ritual burning to east end of mortuary

structure, demolition of mortuary structure, re-establishment probably as some kind of basket/box, radiocarbon date from hazelnut 3810-3650 (83%) cal BC. Resumed deposition of skeletal material. Radiocarbon dates on bone suggest 3720-3650 cal BC (95% probability) and 3700-3660 cal BC (68% probability).

- 5.2 The duration of use of the linear mortuary as a whole is estimated to be between 100-260 years (95% probability) and 130-210 years (68% probability) – the shorter period probably to be preferred.

Phase 6

- 6.1 Trapezoidal cairn stage 2, maintaining the passage and extending it. No dating evidence, but might be a short sequence, comparable with the oval cairn.
- 6.2 Ritual activity continuing, mortuary deposition probably continuing otherwise the passage would not have been extended?

Phase 7

- 7.1 Terminal phase with limestone slabs sealing the entrance to the mortuary structure. Coincides with the ending of deposition of skeletal remains, suggested by radiocarbon dates to be 3630-3540 cal BC (95% probability).
- 7.2 Probably coincides with the placement of rubble against the eastern side of the trapezoidal cairn, and followed soon after by the scattering of potsherds (Fabric 3) across the top of the cairn and beyond. With the exception of a single sherd in the upper level of the mortuary deposit, the sherds only survived in the area to the east of the 'extra-revetment' material.

Phase 8

- 8.1 Early Bronze Age disturbance/intrusive activity outside the northern edge of oval cairn 2, dated by pig bones to 2140-1970 cal BC (95% probability).

Phase 9

- 9.1 Disturbance at south end of cairn – undated.

RADIOCARBON DATING

By

Peter Marshall, Alex Bayliss, Ian Wall, Christopher Bronk Ramsey and
Johannes van der Plicht

Previous dating

Three human bone samples were dated at the Oxford Radiocarbon Accelerator Unit in 1993 (OxA-4176-77; OxA-4326). The dating of PVA treated (OxA-4177) and untreated (OxA-4176 and OxA-4326) samples acted as a pilot study to determine whether contamination by water-soluble PVA could be removed successfully by the dating process. They were processed and measured using the methods outlined in Law and Hedges (1989), Hedges *et al.* (1989;

1992) and Bronk and Hedges (1989). In the light of the re-dating of these samples we believe these determinations (OxA-4176-77; OxA-4326) should be considered unreliable (they are highlighted in Table 1 to distinguish them from those measurements considered to be reliable).

Recent dating

In 2000-2005 a further series of 17 samples was submitted for AMS radiocarbon dating, 15 to the Oxford Radiocarbon Accelerator Unit (ORAU) and two to the Centre for Isotope Research, Rijksuniversiteit Groningen, The Netherlands. The charcoal samples measured in 2000-2001 at ORAU (Bronk Ramsey and Hedges 1997) were pre-treated as outlined in Hedges *et al.* (1989). The bone samples measured in 2005 at ORAU were prepared and dated using methods outlined in Hedges *et al.* (1989), Bronk Ramsey *et al.* (2004a), and Bronk Ramsey *et al.* (2004b).

Following the identification of a problem with the ultrafiltration procedures undertaken as part of bone pre-treatment at Oxford in October 2002 (Bronk Ramsey *et al.* 2004a and below) two samples were also submitted to the Centre for Isotope Research, Rijksuniversiteit Groningen in 2003. Finally in 2004 the three samples originally submitted in 1993 were re-sampled and processed at both the ORAU and Rijksuniversiteit Groningen.

The samples processed at the Centre for Isotope Research, Rijksuniversiteit Groningen, were measured by Accelerator Mass Spectrometry (AMS), according to the procedures set out in Aerts-Bijma *et al.* (1997; 2001) and van der Plicht *et al.* (2000) following initial soxhlet extraction (Bruhn *et al.* 2001).

Objectives

The new dating programme was designed within a Bayesian framework:

- to establish the period of use of the linear mortuary deposit
- to establish the chronological relationship of the single inhumation and the linear mortuary deposit
- to establish the start and end date of funerary activity at the site.

Sample selection

The samples were chosen from material that was unlikely to be residual in the context from which it was recovered. As the mechanism by which a sample came to be in its context is a matter of interpretation rather than certain fact, this judgement is of necessity hazardous! For this reason an extremely rigorous scrutiny of every potential sample took place. Samples were selected where there was evidence that they had been put 'fresh' into their contexts or where an apparent functional relationship existed between the sample and the context.

The main categories of material that met these taphonomic criteria were:

- articulated bone – this must have been buried with tendons attached or it would not have remained in articulation, and was hence almost certainly less than six months old when buried (Mant 1987)
- inferred articulated human bone -spatial patterning of the skeletal remains and refitting of body elements within the linear mortuary deposit strongly suggests that the assemblage contains skeletal material that was originally deposited in the form of articulated whole or partial skeletons.
- charred hazelnut shells – from contexts in which they seemed to have been deposited as a single event.

Given the potential for dating the same individual more than once it was decided that only skeletal elements from distinct individuals would be submitted, so all the measurements are statistically independent. Right femurs from the collective inhumation deposit were preferentially chosen because they yielded the highest possible number of individuals (nine adults and two children) and because they showed some stratigraphic relationships, with clear horizontal distinction between bones lying above and below limestone slabs. Samples from this location were preferentially selected because stratigraphy provides relative dating information which can be combined with radiocarbon evidence using mathematical modelling to produce more precise dating. As there were no other certainly identified different people, further measurements to overcome the inevitable statistical scatter on the radiocarbon measurements have had to be undertaken by running replicate determinations on the same sample.

In addition to the taphonomic issues discussed above samples were also preferentially chosen if they had not been treated with PVA. As PVA adds geological-age carbon to the samples it must be demonstrated that this has been removed correctly so that we can have faith in the accuracy of the radiocarbon measurements.

Radiocarbon quality assurance

The Oxford Radiocarbon Accelerator Unit maintains a continual programme of quality assurance procedures, in addition to participation in international inter-comparisons exercises during the periods when the measurements were made (Rozanski *et al.*, 1992; Scott *et al.*, 1998; Scott 2003). These tests identified a problem with the graphitisation process at the laboratory (during 2001), resolution of which led to replication of a number of measurements (WQ-9 SP 187 (a); WQ-9 SP 187 (b); WQ-9 SP42, 58, 190, 179, 192(a), WQ-9 SP42, 58, 190, 179, 192(b)). Three of the four pairs of measurements are statistically consistent (Table 1) and demonstrate the validity of the precision quoted. Relevant quality assurance data for these samples are provided in Bronk Ramsey *et al.* (2002).

Following the discovery of a contamination problem in the ultrafiltration protocol used for the processing of bone at Oxford in 2002 (Bronk Ramsey *et al.* 2000) which resulted in some bone samples giving ages which were about 100-300 radiocarbon years (BP) too old (Bronk Ramsey *et al.* 2004a), a number of samples were re-dated at the Centre for Isotope Research Rijksuniversiteit Groningen in 2003 and 2005. The three replicate measurements (Burials 659 and 982; W92A 957, Table 1) are statistically consistent and demonstrate the validity of the precision quoted (Bayliss *et al.* 2007).

Results

The results are given in Table 1 and are quoted in accordance with the international standard known as the Trondheim convention (Stuiver and Kra 1986). They are expressed as conventional radiocarbon ages (Stuiver and Polach 1977).

Calibration

The calibrations of the results, relating the radiocarbon measurements directly to calendar dates, are given in Table 1 and Figure 13. All have been calculated using the calibration curve of Reimer *et al.* (2004) and the computer program OxCal (v3.10) (Bronk Ramsey 1995; 1998, 2001). The calibrated date ranges cited in the text are those for 95% confidence. They are quoted in the form recommended by Mook (1986), with the end points rounded outwards to

Lab No	New numbering	Sample Ref.	Material	Radiocarbon Age (BP)	$\delta^{13}\text{C}$ (‰)	$\delta^{15}\text{N}$ (‰)	C:N ratio	Weighted Mean	Calibrated date range (95% confidence)	Posterior density estimate (95% probability)
OxA-4177	1	W92A_957	human bone, femur, from central inhumation	5190 ± 100	-20.1				4310-3770 cal BC	-
OxA-14494		W92A_957	Repeat of OxA-4177	4961 ± 33	-20.1	11.0	3.3	4927 ± 21 BP T ⁺ =2.8; =2; T ⁻ (5%) =-6.0	3765-3650 cal BC	3760-3650 cal BC
GrA-27513		W92A_957	Repeat of OxA-4177	4875 ± 40	-21.1	10.0				
OxA-12763		WQ-9_957	human bone, undiagnostic fragments	4925 ± 38	-20.4					
OxA-4176	2	Burial 659	human bone, ribia, from linear mortuary deposit	5380 ± 90	-20.7				4370-3980 cal BC	-
OxA-14493		Burial 659	Repeat of OxA-4176	4946 ± 32	-20.7	9.8	3.3	4961 ± 25 BP T ⁺ =0.6; =1; T ⁻ (5%) =3.8	3795-3660 cal BC	3780-3680 cal BC
GrA-27519		Burial 659	Repeat of OxA-4176	4895 ± 40	-21.3	9.2				
OxA-4326		Burial 982	human bone, femur, from mortuary deposit	5115 ± 70	-20.4				4050-3710 cal BC	-
OxA-14495	3	Burial 982	Repeat of OxA-4326	4879 ± 32	-20.2	9.8	3.3	4858 ± 25 BP T ⁺ =1.1; =1; T ⁻ (5%) =3.8	3695-3635 cal BC	3700-3630 cal BC
GrA-27515		Burial 982	Repeat of OxA-4326	4825 ± 40	-21.4	8.9				
OxA-12133	4	WQ-9_270	human bone, right femur, from the centre of linear mortuary deposit	4770±27	-21.0	10.3	3.5		3650-3570 cal BC	3650-3560 cal BC
OxA-12762	5	WQ-9_430	human bone, right femur, from western end of linear mortuary deposit	4894 ± 33	-20.8	9.7	3.3		3720-3630 cal BC	3760-3740 (2%) or 3720-3630 (93%) cal BC
OxA-12760	6	WQ-9_214	human bone, right femur, from eastern end of linear mortuary deposit	4725 ± 33	-20.7	10.2	3.4		3640-3370 cal BC	3640-3570 cal BC
OxA-12761	7	WQ-9_374	human bone, right femur, from western end of linear mortuary deposit	4933 ± 33	-20.8	9.2	3.3		3790-3640 cal BC	3770-3640 cal BC
GrA-22551	8	WQ-9_363	human bone, right femur, from centre of linear mortuary deposit	4700 ± 45	-22.2				3640-3360 cal BC	3640-3570 cal BC

Lab No	New numbering	Sample Ref.	Material	Radiocarbon Age (BP)	$\delta^{13}\text{C}$ (‰)	$\delta^{15}\text{N}$ (‰)	C:N ratio	Weighted Mean	Calibrated date range (95% confidence)	Posterior density estimate (95% probability)
GrA-22564	9	WQ-9_456	human bone, right femur, from centre of linear mortuary deposit below slab 1	4905 ± 45	-21.6				3780-3630 cal BC	3770-3660 cal BC
OxA-12764	10	WQ-9_755	human bone, right femur, from centre of linear mortuary deposit below slab 1	4966 ± 30	-21.0	8.2	3.3		3900-3650 cal BC	3790-3670 cal BC
OxA-12134	11	WQ-9_394	human teeth (enamel and dentine) from the western end of linear mortuary deposit below slab 4	4931 ± 28	-21.1	10.1	3.3		3760-3660 cal BC	3770-3660 cal BC
OxA-12135	12	WQ-9_778	human bone, right femur, from centre of linear mortuary deposit below slab 2	4984 ± 28	-21.0	9.7	3.3		3760-3690 cal BC	3790-3690 cal BC
OxA-12765	13	WQ-9_701	human bone, right femur, from centre of linear mortuary deposit	4961 ± 31	-20.6	9.4	3.2		3800-3650 cal BC	3780-3670 cal BC
OxA-12765	13	WQ-9_701	human bone, right femur, from centre of linear mortuary deposit	4961 ± 31	-20.6	9.4	3.2		3800-3650 cal BC	3780-3670 cal BC
OxA-12767	14	WQ-9_330	human bone, right femur, from centre of linear mortuary deposit, above slab 1	4965 ± 32	-20.6	9.7	3.3		3900-3650 cal BC	3710-3640 cal BC
OxA-12766	15	WQ-9_229	human bone, right femur, from phase 2 linear mortuary deposit	4747 ± 34	-20.9	8.8	3.2		3640-3370 cal BC	3640-3570 cal BC
OxA-9646		WQ-9 SP187(a)	Corylus sp. shell fragments, from passage to linear mortuary deposit	4890 ± 55	-24.8			4986 ± 32 BP T ^w = 4.5; = 1; T ^w (5%) = 3.8	3940-3660 cal BC	3790-3660 cal BC
OxA-10214		WQ-9 SP187(a)	replicate of OxA-9646	5035 ± 40	-23.5					
OxA-9647		WQ-9 SP187(b)	Corylus sp. shell fragments, from passage to linear mortuary deposit	4960 ± 50	-24.1			4974 ± 42 BP T ^w = 0.2; = 1; T ^w (5%) = 3.8	3940-3650 cal BC	3780-3650 cal BC
OxA-10219		WQ-9 SP187(b)	replicate of OxA-9647	5005 ± 75	-24.1					

Lab No	New numbering	Sample Ref.	Material	Radiocarbon Age (BP)	$\delta^{13}\text{C}$ (‰)	$\delta^{15}\text{N}$ (‰)	C:N ratio	Weighted Mean	Calibrated date range (95% confidence)	Posterior density estimate (95% probability)
OxA-9648		WQ-9 SP42,58,190, 179,192 (a)	Corylus sp. nut shell, from base of east end of mortuary deposit	4950 ± 55	-26.0			4947 ± 32 BP T ^w =0.0; =1; T ^v (5%) =3.8	3940-3660 cal BC	3940-3870 (14%) or 3810-3660 (81%) cal BC
OxA-10215		WQ-9 SP42,58,190, 179,192 (a)	replicate of OxA-9649	4945 ± 40	-26.7					
OxA-9649		WQ-9 SP42,58,190, 179,192 (b)	Corylus sp. nut shell, from base of east end of linear mortuary deposit	4960 ± 55	-26.4			4984 ± 35 BP T ^w =0.3; =1; T ^v (5%) =3.8	3940-3660 cal BC	3940-3870 (14%) or 3810-3660 (81%) cal BC
OxA-10216		WQ-9 SP42,58,190, 179,192 (b)	Corylus sp. nut shell, from base of east end of linear mortuary deposit	5000 ± 45	-27.2					
OxA-12759		WQ-9 _865	Sus scrofa, left or right ulna, from matrix fill, post-dating funerary deposition. Repeat of OxA-9701	3673 ± 38	-19.4					
OxA-12758		WQ-9 _865	Sus scrofa, left or right ulna, repeat of OxA-9487	3677 ± 31	-20.9			3756 ± 29 BP T ^w =1.7; =1; T ^v (5%) =3.8	2140-1970 cal BC	2140-1970 cal BC

Table 1: Whitwell cairn radiocarbon results (shaded rows indicate the original 1993 results believed to be unreliable).

ten years if the error term is greater than or equal to 25 radiocarbon years or to five years if it is less. The ranges quoted in *italics* are *posterior density estimates* derived from mathematical modelling of archaeological problems (see below). The ranges in plain type in Table 1 have been calculated according to the maximum intercept method (Stuiver and Reimer 1986). All other ranges are derived from the probability method (Stuiver and Reimer 1993).

Analysis and interpretation

A Bayesian approach has been adopted for the interpretation of the chronology from this site (Buck *et al.* 1996). Although the simple calibrated dates are accurate estimates of the dates of the samples, this is usually not what archaeologists really wish to know. It is the dates of the archaeological events which are represented by those samples that are of interest. In the case of the Whitwell cairn, the most important archaeological events are the dates of the two funerary deposits. Absolute dating information in the form of radiocarbon measurements

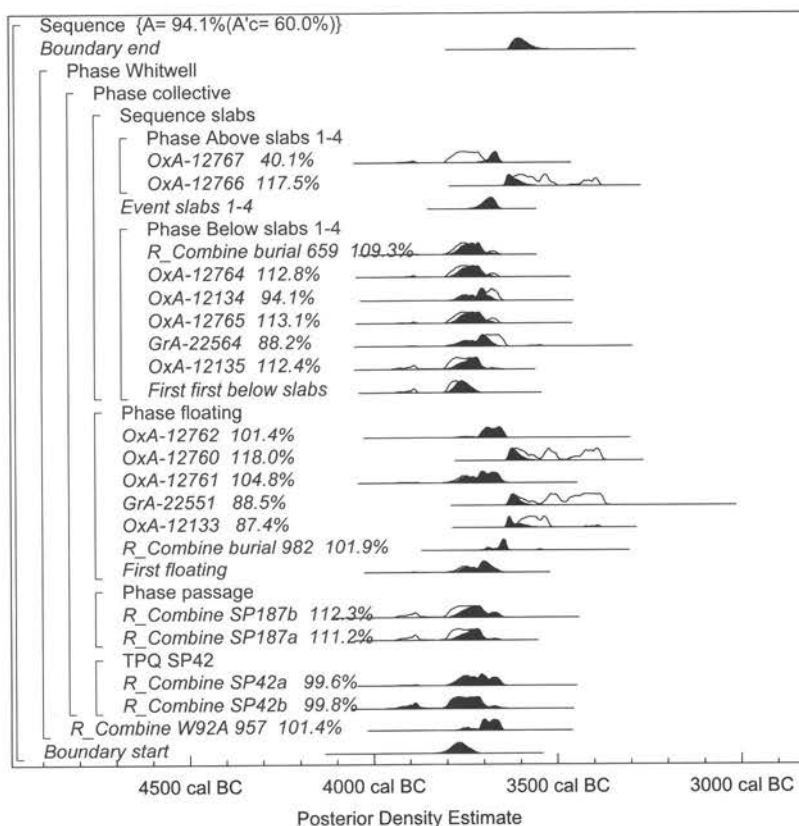


Fig. 13: Probability distributions of dates from Whitwell cairn: each distribution represents the relative probability that an event occurs at a particular time. For each of the radiocarbon dates two distributions have been plotted, one in outline, which is the result of simple radiocarbon calibration, and a solid one, which is based on the chronological model used. The other distributions correspond to aspects of the model. For example, the distribution 'boundary start' is the estimated date for the start of activity at Whitwell. The large square brackets down the left hand side along with the OxCal keywords define the model exactly.

on the skeletons and charred hazelnut shells can be combined with the relative information provided by stratigraphic relationships between samples to provide estimates of the dates of the funerary activities (Fig. 13).

Fortunately, methodology is now available which allows the combination of these different types of information explicitly to produce realistic estimates of the dates of archaeological interest. It should be emphasised that the *posterior density estimates* produced by this modelling are not absolute. They are interpretative *estimates*, which can and will change as further data become available and as other researchers choose to model the existing data from different perspectives.

The technique used is a form of Markov Chain Monte Carlo sampling and has been applied using the program OxCal v3.10 (<http://www.rlaha.ox.ac.uk/>), which uses a mixture of the Metropolis-Hastings algorithm and the more specific Gibbs sampler (Gilks *et al.* 1996; Gelfand and Smith 1990). Details of the algorithms employed by this program are available from the on-line manual or in Bronk Ramsey (1995; 1998; 2001). The algorithm used in the models described below can be derived from the structure shown in Figure 13.

Replicate measurements on the same sample have been combined before calibration by taking a weighted mean, and the consistency of groups of results which are, or may be, of the same actual age has been tested using the methods outlined in Ward and Wilson (1978).

Stable isotope measurements

The $\delta^{13}\text{C}$ values and $\delta^{15}\text{N}$ values (Table 1 and Fig. 14) do not show any evidence of a major marine or freshwater fish component in the diet that could affect the radiocarbon dating (Chisholm *et al.* 1982; Schoeninger *et al.* 1983). The human remains sampled for dating, in common with stable isotope measurements on other Neolithic human remains, show no evidence for the consumption of significant amounts of marine or riverine resources (Bayliss *et al.* 2007, Richards *et al.* 2003).

The C:N ratio of all the bone samples suggest that bone preservation was sufficiently good to have confidence in the radiocarbon determinations (Masters 1987; Tuross *et al.* 1988).

The samples and their stratigraphic relationships

Mortuary structure 1

Mortuary structure 1 contained a linear mortuary deposit comprising a spread of disarticulated bone. A total of 116 skeletal fragments can be related to this phase through their position beneath limestone slabs within the mortuary structure. Five distinct individuals from below slabs 1-4, represented by skeletons [394] (OxA-12134), [701] (OxA-12765), [778] (OxA-12135) and [755] (OxA-12764) and [456] (GrA-22564) were dated.

Oval cairn 1 and 2

The oval cairn and the associated single articulated inhumation of a woman (skeleton 957) was treated with PVA prior to lifting. In addition to a sample of femur from this individual (OxA-4177; OxA-14494; GrA-27513), a bone fragment from the soil surrounding the inhumation (OxA-12763) was also chosen because it had not been treated with PVA and should thus act as a check on the effectiveness of the PVA removal. The four measurements (OxA-4177 OxA-14494; GrA-27513 and OxA-12763) are not statistically consistent ($T^*=9.6$; $\nu=3$; $T^*(5\%)=7.8$; Ward and Wilson 1978) suggesting that PVA contamination has not been completely removed. The three measurements obtained in 2003 and 2005 (OxA-14494;

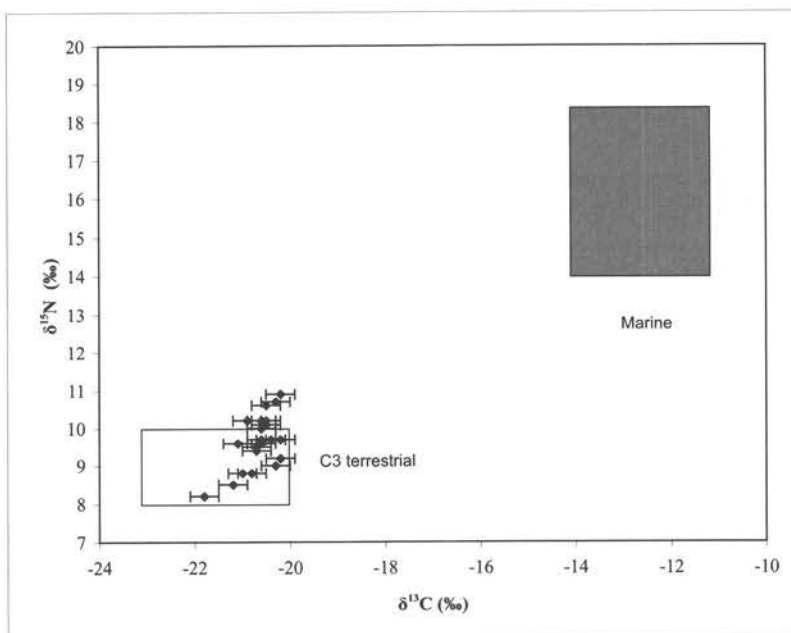


Fig. 14: Graph of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of bone collagen from Whitwell cairn related to the values expected for archaeological populations consuming pure terrestrial and marine diets (after Mays 1998).

GrA-27513; OxA-12763) are statistically consistent ($T'=2.8$; $v=2$; $T'(5\%)=6.0$; Ward and Wilson 1978) giving confidence in removal of all PVA contamination from OxA-14494 and GrA-27513. These results suggest that the original measurement (OxA-4177) from skeleton [957] is inaccurate because the pre-treatment failed to removal all the contamination (Bronk Ramsey *et al.* 2004).

The remains of a young pig were found in a disturbed area of the cairn. The two determinations from this sample (OxA-12758 and OxA-12759) are statistically consistent ($T'=1.7$; $v=1$; $T'(5\%)=3.8$ Ward and Wilson 1978). These measurements show that the pig skeleton was deposited some 1500 years after the main period of funerary activity on the site.

The $\delta^{15}\text{N}$ value for the sample was measured as $0.5 \pm 0.3\text{‰}$. This is unusually low for an omnivorous animal such as pig, especially a neonate, and is more typical of terrestrial herbivores such as cattle or horses. The preservation of bone collagen, however, was good and the C:N ratio suggests that a reliable date should be obtained from it.

Mortuary structure 2

Continued deposition of skeletal remains continued after the construction of the trapezoidal cairn. A total of 122 bone fragments can be securely related to this later funerary phase, samples from two distinct individuals were dated from above slabs 1-4; skeleton 229 (OxA-12766) and skeleton 330 (OxA-12767).

Within the passage leading to the linear mortuary deposit were two shallow oval cut features filled with a mixture of burnt limestone, charcoal, and silt clays. Replicate measurements on a fragment of carbonised *Corylus* sp. shell (OxA-9646 and OxA-10214) from sample SP187a

are not statistically consistent ($T'=4.5$; $v=1$; $T'(5\%)=3.8$; Ward and Wilson 1978) although those from SP187b are (OxA-9647 and OxA-10219; $T'=0.2$; $v=1$; $T'(5\%)=3.8$; Ward and Wilson 1978).

'Floating' people within the linear mortuary deposit

Deposition of human bone was concentrated centrally and in the western end of the mortuary structure. Adjacent and to the north of this concentration were further bone deposits whose relative position, although not sealed by slabs, suggested that they also belonged in mortuary structure 1. These provided the following samples: skeleton 659 (OxA-4176; OxA-14493; GrA-27519); skeleton 982 (OxA-4326; GrA-27515; OxA-14495); skeleton 214 (OxA-12760); skeleton 363 (GrA-22551), skeleton 374 (OxA-12761) and skeleton 430 (OxA-12762). The three measurements from skeleton 659 and skeleton 982 are not statistically consistent ($T'=21.6$; $v=2$; $T'(5\%)=6.0$; and $T'=13.6$; $v=2$; $T'(5\%)=6.0$; Ward and Wilson 1978). However, in both cases the two measurements obtained in 2005 (656 - GrA-27515; OxA-14495; and 982- GrA-27515; OxA-14495) are statistically consistent ($T'=0.6$; $v=1$; $T'(5\%)=3.8$; and $T'=1.1$; $v=1$; $T'(5\%)=3.8$ Ward and Wilson 1978). Skeletons 659 and 982 were not treated with PVA (as in the case of skeleton 957 see above), so failure to completely remove this contaminant cannot be the reason for the originally inaccurate results (OxA-4176, OxA-4326).

The three original results (OxA-4176; OxA-4177 and OxA-4326) were measurements made using the ion exchange method (Bronk Ramsey and Hedges 1989). This method was developed to remove contaminants present in the soil or due to conservation. However, Hedges and Pettitt (1998) showed that contamination could still be present at concentrations of up to 0.2% for samples with high collagen yield and even higher than this for samples with lower yields when the method was compared to the dating of extracted tri-peptides. The ion exchange method was subsequently dropped for routine work for all dates after OxA-7000 (Bronk Ramsey *et al.* 2000). The sample yields from the three original samples were low: 5.6mg (OxA-4176), 2.2mg (OxA-4177) and 10.7mg (OxA-4326). These can be compared to yields of 22.4, 20.9 and 47.0mg for the same samples pre-treated using the ultrafiltration method. Consequently, and in the light of the good agreement between the Oxford and Groningen results in all three cases, the new determinations should be considered more reliable than the original ones.

A pit sealed by slabs of limestone at the eastern end of the mortuary structure produced a small amount of charred plant remains. Replicate measurements on two samples from this feature (SP42a and SP42b) of *Corylus* sp. shell (SP42a; OxA-9648 and OxA-10215; SP42b; OxA-9649 and OxA-10216) are statistically consistent ($T'=0.0$; $v=1$; $T'(5\%)=3.8$; and $T'=0.3$; $v=1$; $T'(5\%)=3.8$; Ward and Wilson 1978).

Absolute chronology

The model in Figure 13 shows good agreement between the stratigraphic and radiocarbon evidence ($A_{\text{overall}}=94.1\%$). Deposition of human remains appears to have started in 3790-3710 cal BC (95% linear mortuary deposit; first below slabs: Fig. 13) and probably in 3780-3720 cal BC (68% probability). Human remains continued to be deposited until the limestone slabs were laid down, estimated to have taken place in 3720-3650 cal BC (95% probability; slabs 1-4: Fig. 13) and probably in 3700-3660 cal BC (68% probability). The initial use of mortuary structure 1 is estimated to have lasted for between 20-100 years (95% probability)

and probably 30-80 years (68% probability).

In line with the archaeological interpretation that the concentration of human bone in the northern part of the linear mortuary deposit was part of the early phase of activity, although it was not sealed by slabs, the dating evidence suggests the first body was deposited here in 3780-3730 cal BC (95% probability; first floating: Fig. 13).

The single inhumation is estimated to date to 3760-3650 cal BC (95% probability; R _Combine Oval Cairn (957): Fig. 13) and probably 3710-3660 cal BC (68% probability). Further analysis show that it is 98% probable that the first body was interred in mortuary structure 1 before the deposition of the single inhumation. But it is 58% probable that the single inhumation was deposited before the placement of the slabs over the first phase linear mortuary deposit.

The latest deposits were made in mortuary structure 2, above slabs 1-4 and in the 'floating' group, in the last quarter of the 37th century cal BC.

Use of the monument is estimated to have started in 3820-3720 cal BC (95% probability; boundary start: Fig. 13) and probably in 3790-3740 cal BC (68% probability) and ended in 3630-3540 cal BC (95% probability; boundary end: Fig. 13). These estimates allow for the possibility that the earliest and latest individuals deposited have not been sampled for dating. Also on this basis the duration of use is estimated to be between 100-260 years (95% probability) and probably 140-210 years (68% probability).

The juvenile pig remains from the disturbance in the oval cairn fill are considerably later than all other radiocarbon samples from the site. This activity is estimated to have taken place in 2140-1970 cal BC (95% probability; 865: Table 1).

THE POTTERY

By Pauline Beswick

The Neolithic pottery, a small but significant assemblage, comprises 130 sherds (583g, excluding fragments), and includes the remains of at least six bowls in the Carinated Bowl tradition of the primary Neolithic. Contextual evidence suggests that pottery deposition was intimately bound up with rituals of burial and tomb construction and possibly included symbolic single sherd deposition.

Methodology

Each sherd was examined macroscopically using a hand lens (x10), and each was weighed to the nearest half gramme. Fabrics were analysed using a system recommended by the Prehistoric Ceramics Research Group (1997), in which clay matrix, inclusions, form and surface finish are used to define fabric types and numbers of vessels. Visible burnt residues were noted and size and condition codes (details in archive) assigned to each sherd, to help determine the nature of the excavated contexts and to attempt to understand what the sherds might represent in terms of past activities (Orton *et al.* 1993, 168). Because much of the pottery had been treated with PVA residue analysis was not undertaken.

Fabrics

Three prehistoric fabrics were identified, principally on the basis of their distinctive inclusions. These were examined and identified by the late Dr Ron Firman of Nottingham University in hand specimens.

Fabric 1 - crushed vein quartz, rare to sparse (1-3%), poorly sorted, angular, and size 2-4 mm

Fabric 2 - crushed shell, common (20-25%), poorly sorted, and size 1-5 mm

Fabric 3 - sandstone fragments, moderate (10%), poorly sorted, angular, and size 2-5 mm

Dr Firman was of the opinion that clay and inclusion sources are likely to have been obtained locally and reported:

'Quartz could have been obtained in pebble form from nearby glacial tills (boulder clay), one possibility being patches mapped by the Geological Survey a mile east of Barlborough and about 3 miles west of Whitwell Quarry. Another possible source could have been Triassic pebble beds which outcrop a few miles east of Whitwell Quarry.

The shells are too small to determine whether they are fossil or Neolithic but the fact they are not calcined suggests that refractory Coal Measure clays have not been used and that a clay such as those in the Permian Edlington Formation (formerly Permian Middle Marls) was used. Tile Kiln Wood, about 2 miles south-east of Whitwell Quarry, would be the nearest of several possible sources.

The sandstone inclusions are made of well-cemented quartz grains with some tiny white mica flakes. This pottery could have been made from glacial till containing naturally crushed sediments or Coal Measures sandstone from the source near Barlborough featured above. An alternative source could have been *in situ* weathered Coal Measures from sites to the west of Whitwell (*cf.* Geological Survey Memoirs for Derbyshire Coalfield).'

Vessels

Many sherds were assigned to individual vessels on the basis of fabric and form. Fabric 1 includes three fine ware bowls (Vessels 1, 2, 3), two possibly carinated (Vessels 2 and 3), and two coarser ware bowls in the same fabric (Vessels 5, 6), vessel 6 having a slight shoulder ridge. Fabric 2 represents one S-profiled bowl (Vessel 4), and Fabric 3 an unidentified coarseware vessel (Vessel 7). Diagnostic sherds, where present, are illustrated for each vessel (Fig. 15), and fabric, form and contextual information are included in the vessel descriptions below.

Vessel 1 (Fabric 1)

Joining rim and body sherds of a bowl with out-curving rim, beaded in parts (Fig. 15.1: finds 216, 286). Hard, fine fabric, nearly black in colour, burnished and sherds unabraded. Joining sherds found at opposite ends of the multiple inhumation deposit [164a(1)/(2), 164a(2)], and along the southern edge. Phases 1, 5/6 and 6, respectively.

Vessel 2 (Fabric 1)

Rim sherd of a bowl with beaded rim and upright or closed neck (Fig. 15.2 top: find 1012). Fabric hard, fine, black, burnished and sherd unabraded. Found on surface below oval cairn

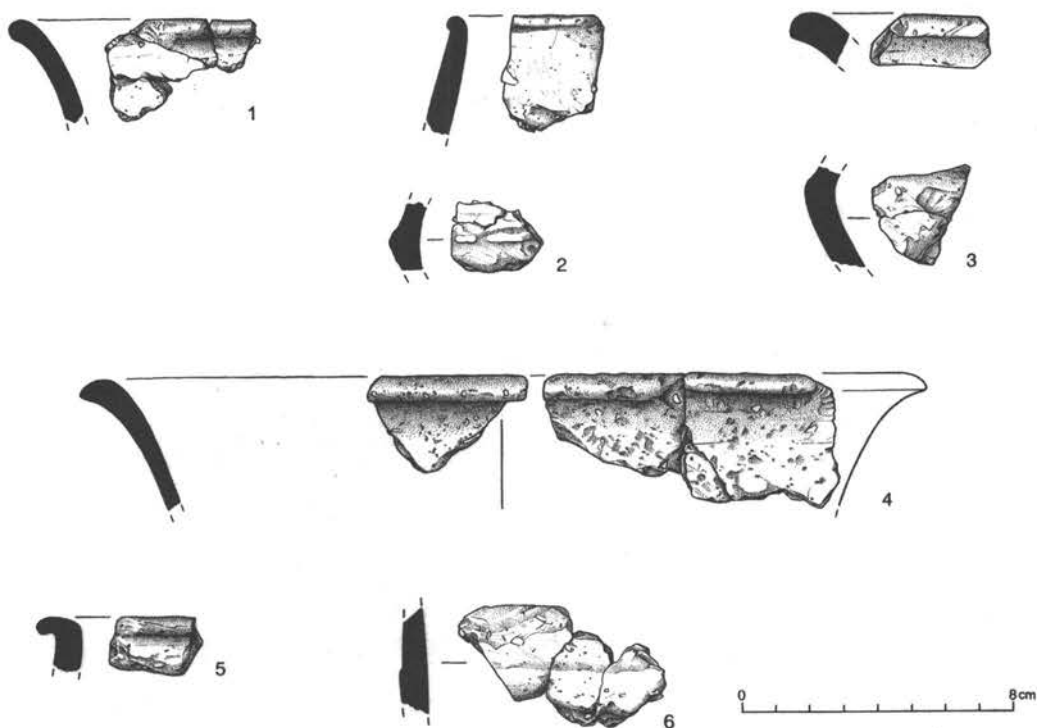


Fig. 15: Neolithic pottery, vessels 1 to 6.

[192], to north of central burial. On morphological grounds an abraded sherd with a stepped carination is probably from the same vessel (Fig. 15.2 lower: find 1030). Found at interface of surface and oval cairn matrix [188], Phase 3, in between the cairn and its perimeter wall at the northern end, where there is a variation in construction of the cairn wall (see site description above).

Twenty-four body sherds found in the multiple inhumation deposit, passage and pits, and on the surface under both the oval cairn and the trapezoidal cairn were assigned on grounds of similarity of fabric and thickness (5-7mm), generally to vessels 1 or 2 (Fig. 6). In the absence of conjoins more specific attribution was not possible.

Vessel 3 (Fabric 1)

Rim sherd of a bowl with a heavy, everted, 'squared' rim, angle uncertain (Fig. 15.3 top: find 1062). Abraded fabric hard, smooth and dark grey in colour but irregularly fired and traces of burnt residues or sooting on exterior. Found on surface beneath trapezoidal cairn [190], Phase 0, outside north-west sector of perimeter wall of the oval cairn. Carinated sherds, abraded and unabraded respectively, are likely to be from vessel 3 on the grounds of colour and body thickness, but this attribution is not absolutely certain and they could possibly be from otherwise unidentified bowl(s), (Fig. 15.3 lower: finds 745 and 1025b[not illustrated]). The illustrated piece was found in the multiple inhumation deposit [164a(1)], Phase 1, and the

small fragment was from the interface of the surface and the oval cairn matrix [188], Phase 3, in between the cairn and its perimeter wall, among the group of sherds at the northern end (Fig. 6).

Twenty-eight other body sherds, around 7 to 10mm thick and grey in colour, were also assigned to vessel 3 on the grounds of similarity of fabric and thickness. These were found in a similar distribution pattern to Fabric 1/2 sherds, described above.

Six sherds and numerous fragments in Fabric 1 could not be attributed to individual vessels, mainly because of their small size and poor condition, but their distribution mirrors that of vessels 1, 2 and 3 (Fig. 6).

Vessel 4 (Fabric 2)

Rim sherds, from a large, S-profiled, open bowl, about 250mm diameter, with out-curving, slightly pointed rim; soft fabric, reddish brown in colour and in varying states of preservation dependent on the acidity of the micro-environment of individual contexts. The shell inclusions occasionally survive but multiple voids are more common and original surfaces have largely been destroyed. A total of 43 rim and body sherds survive and all are probably from the same vessel. None was found in the multiple inhumation deposit but a single sherd was located at the centre of the oval cairn matrix (find 912 [183d]; Phase 4), while groups of sherds were found under the trapezoidal cairn walling, in the cairn matrix at the north-eastern end, and in the entrance passage, [165b and 158], Phases 5 and 7 (Fig. 15.4: finds 140, 1026a - joining; Fig. 6 ; Table 3).

Vessel 5 (Fabric 1)

Rim sherd with a flat out-turned profile and from a coarser ware bowl. Thick (7-10mm), hard, coarse fabric oxidised a light brown colour and abraded. Found among the sherd group within the perimeter wall at the north end of circular cairn, and at the interface of the old ground surface and cairn matrix [188], Phase 3 (Fig. 15.5: find 1015).

Three plain body sherds in the same fabric were found in the same vicinity and two others, one in the multiple inhumation deposit and one to the north of this deposit in the initial trapezoid cairn silts [166], Phase 1. Slight traces of burnt residues or sooting were found on the exterior of two of these sherds.

Vessel 6 (Fabric 1)

Joining body sherds, weakly carinated, from a coarse-ware bowl. Thick (6-8mm), hard, coarse, reddish-brown fabric and abraded, with traces of burnt residues on the interior. The larger piece joins along an old abraded break, and its inclusions and parts of the two adjoining pieces are discoloured by burning. Found on the surface [190], Phase 0, to the west of the multiple inhumation deposit. (Fig. 15.6: find 1008).

Four other sherds possibly of the same vessel occurred principally in and around the multiple inhumation deposit, Phases 0 and 1.

Vessel 7 (Fabric 3)

Seven plain, coarse and heavy body sherds (8-11mm thick) may all be from one vessel, on the basis of the fabric characteristics (see below), but there is no evidence for shape or decoration except for slight fingernail traces left on one sherd from shaping. The fabric is soft and the sherds have red oxidised external surfaces, dark grey cores, black internal surfaces and

a rough soapy texture. Apart from one large sherd found near the middle of the multiple inhumation deposit (find 354 [164a]: Phase 5/6), the rest were all found outside the eastern side of the trapezoid cairn, not far from the passage entrance (Not illustrated; Fig. 6; Table 3).

Forms, fabrics and chronologies

Bowls 1 to 6 were found associated with the construction of a cairn dated to the 38th century cal BC by radiocarbon, and represent one of only a few early 4th millennium BC assemblages from funerary contexts in Britain (Bayliss and Whittle 2007). Although small, the group is also notable for the variety of its bowl forms and fabrics.

In general the forms of Fabrics 1 and 2 are characteristic of the Grimston/Lyles Hill series (Piggott 1954, 114; Smith 1974, 108), now redefined in its earliest manifestation as the Carinated Bowl phase (Herne 1988). It is typified by very fine, plain, open bipartite bowls with distinctive hollow necks, sharp shoulder carinations, relatively low down on the profile, and simple rims. Herne argued that vessels with developed rims, S-profiles (*cf.* Vessel 4 from Whitwell) or high shoulders, present in the Grimston/Lyles Hill series, did not form part of the earliest pottery repertoire (1988, 15). Subsequently others have questioned the over-simplicity of this approach. Cleal (2004, 180-1) has shown it to be misleading as to the character and diversity of forms and fabrics found in the earliest pottery alongside carinated forms (*c.* 3850 cal. BC), for example in Wessex and the south-west. Barclay (Barclay and Case 2007, 280; table 15.1) has postulated at least two pottery groups within the Early Neolithic; one Herne's classic Carinated Bowl and a second which includes fine and coarse wares with heavier rims, occasionally rolled, shoulders less acute and necks relatively shorter. The first group he suggests is earlier (before *c.* 3800 cal. BC) than the second (*c.* 3800-3650 cal. BC), but admits it is unclear if the distinction is contextual or chronological. At Whitwell cairn the Fabric 1 group comprises both very fine carinated and coarse-ware bowls deposited early in the 38th century cal. BC, but the single S-profiled bowl, in Fabric 2, on contextual grounds was deposited later (see below).

Whitwell cairn bowl forms are paralleled in Early Neolithic bowls from sites in England, Wales, Scotland and Ireland. For instance Vessels 1 and 4, in the absence of any certain evidence for a carination, could have been S-profiled open bowls similar to one from Giants' Hills long barrow, Lincolnshire (Piggott 1954, 114, fig. 17.1). The stepped shoulder on Vessel 2 and its upright or closed neck compares with examples from east Yorkshire, e.g. Kilham long barrow (Manby 1976, fig. 17.1) and Rudston Wold Corner Field Site 6 (Manby 1975, fig. 3.11). An upright neck profile is also characteristic of vessels from the Sweet Track, Somerset, where uniquely a dendro date determined that wood for the track was felled in 3807/3806 cal BC (Coles and Coles 1990). The heavier rim and postulated angled carination of Vessel 3 could have resembled bowls from the type site of Hanging Grimston, east Yorkshire (Manby 1988, fig. 4.4.1, 2 and 4).

Regionally comparable fabrics are known for Fabrics 1 and 2. For example, quartz-tempered Early Neolithic plain bowls are recorded from sites in the Trent Valley to the south, such as Swarkestone Lowes (Greenfield 1960, 23), Willington (Manby 1979, 146), and Great Briggs, Holme Pierrepont (Guilbert 2009, 108). Sherds from the latter site are similar in colour and fabric to Vessels 1 and 2 (Fabric 1) from Whitwell cairn, but the clay matrix is coarser and more sandy. Nutshells associated with this pottery were dated to 3770-3650 cal. BC. Fabric 2 from Whitwell is comparable with the voided fabric of the carinated pottery from Lismore Fields, Buxton, with similar radiocarbon dates (Garton 1991, 14, 18; Beswick

in Garton in prep.), and from Mount Pleasant, Kenslow (Garton and Beswick 1983, 16), where all inclusions had leached out completely but, given the local geology, had probably consisted of crushed limestone. At Aston-on-Trent both quartz-gritted sherds and a carinated bowl in a voided fabric were present among the Grimston Ware (Reaney 1968, 81).

Two of the Whitwell cairn bowls (Vessels 1 and 2) are particularly finely made from clean clays with prepared crushed quartz added. There is clear evidence for ring or coil building, for careful body thinning (5 to 6mm common and occasionally 3mm), shaping, finishing and burnishing. Some knowledge and control over firing conditions was required to obtain the even black colour. Vessel 4 is equally evenly coloured, but the state of preservation is less good for determining finishing techniques, and Vessel 3 sherds are too abraded.

The coarser and thicker-walled Fabric 1 bowls from Whitwell cairn (Vessels 5 and 6) are representative of the coarse-ware component associated with Early Neolithic finely made bowls at sites ranging, for example, from Yorkshire (e.g. pit assemblages at Rudston Corner Field Site 6 - Manby 1975, 28, fig. 3.16 – mixed fine carinated and coarser bowls) to the Cotswolds (e.g. assemblage from midden below Ascott-Under-Wychwood cairn – Barclay and Close 2007, 277). The rim of Vessel 5 foreshadows the T-sectioned rims of Developed Neolithic pottery (Cleal 2004, 181), *c.* 3650 cal. BC and later.

Fabric 3 sherds of Vessel 7 lack any diagnostic features but their coarseness and evidence of poor firing is in complete contrast to the quality manufacturing technique used in Vessels 1 to 4. Given the late occurrence of the sherds in the cairn's phasing (Table 4: Phases 5/6, and 7; see below) and the radiocarbon end of use date for the site (Fig. 13: 3630-3540 cal. BC 95% probability), possible comparisons were sought among coarser wares from sites dated by radiocarbon to late in the first half of the 4th millennium BC. This was a time when a series of coarser, thicker-walled bowls often with heavier and decorated rims emerged and in which Peterborough Ware had its origins, although it was not fully developed until *c.* 3300 cal. BC (e.g. Gibson 2002, 75, 78). One possible attribution could be Towthorpe Ware (Manby 1988, 48), a limited range of simple, plain, open and closed non-carinated bowls with thickened and expanded rims in thick-walled, heavily tempered coarse-ware fabrics, found mainly in Yorkshire Neolithic contexts, and with radiocarbon dates, for example, from Marton-le-Moor (Manby *et al.* 2003, 51, 114), spanning Cleal's Developed Neolithic phase *c.* 3650-3350 cal. BC (2004, 181). A similar range of heavy bowls, Balfarg Class 2 Ware, identified in Scotland, have a comparable range of radiocarbon dates (Cowie 1993, 69, 75; 3710-3345 cal. BC). Both date ranges would allow an appearance at Whitwell before the estimated end use dates for Phases 6 and 7 when Vessel 7 sherds appear to have been deposited. The presence of a kite-shaped arrowhead at Whitwell cairn (Garton, below) is of some interest in this context because in Yorkshire this flint type has only Towthorpe Ware associations (Green 1980, 85; Manby 1988, 52). However, recent radiocarbon dating of associated skeletal material from Mortimer's nineteenth century excavations at Towthorpe 18 (Gibson and Bayliss 2010, 85, 90: primary deposit with Towthorpe Ware) and Duggleby Howe, Yorkshire (Gibson and Bayliss 2009, 68, 71, Table 1: Burials K with Towthorpe Ware and G with arrowhead), has given a date range *c.* 3500-3300 cal. BC for classic Towthorpe Ware and its associations. This suggests that the Whitwell material, albeit from a very different context, is comparatively early or alternatively that the pottery is an unidentified coarse-ware but that does not explain the arrowhead (for further discussion see Garton, below).

<i>Fabric</i>	<i>Sherd Total</i>	<i>Total Weight</i>	<i>Sherd Condition</i>			<i>Sherd Size</i>			<i>Vessels</i>
			Av	Ab	(Fg groups)	Lg	Med	Sm	
1	77	261g	28	49	(15)	3	34	40	5 (vessels 1,2,3,5,6)
2	43	240g	27	16	(2)	11	10	22	1 (vessel 4)
3	10	82g	4	6		3	4	3	1 (vessel 7)
Total	130	583g	59	71	(17)	17	48	68	7

Table 2: Whitwell cairn: quantity, condition and size of Neolithic pottery by fabric. Av (Average*), Ab (Abraded), Fg (Fragment*), Lg (Large >10g), Med (Medium 3-10g), Sm (Small<3g) (Please note: fragments are omitted from sherd and weight totals)

*Average = slight abrasion on surfaces and edges; likely to have been moved or disturbed at least once since breakage.

*Fragment group = none or very little of original surfaces remaining and more than one fragment found together; likely to have been moved and/or disturbed considerably and possibly damaged in situ e.g. by trampling and/or cairn building. It is also possible that some damage may have occurred during excavation and post-excavation because of the inherent fragility of Fabrics 1 and 2.

Distribution and contexts

The different distribution and physical condition of the three Neolithic fabric types suggests they have different depositional histories (Fig.6; Table 2).

Fabric 1 is the largest quantity and comprises at least five vessels - three fine-ware bowls (Vessels 1, 2 and 3) and two coarse-ware bowls (Vessels 5 and 6) (Fig. 15). The majority of sherds are abraded, small and fragmentary (Table 2). They occur mainly on the surface beneath the cairn, Phase 0 (Table 3: 41 sherds out of 77), and in Phases 1 and 3 in contexts particularly in and around the linear mortuary deposit and flanking pits, and to a lesser extent beneath the northern part of the oval cairn; a distribution which implies that this pottery was on site during the first phase of mortuary deposition and the placement of the single inhumation, and before construction of the oval cairn (Fig. 6).

The small quantity and poor condition of sherds suggests this pottery was not deposited as complete vessels but had been broken elsewhere, and may have derived from a midden. Some cairns were built over the site of earlier 'curated' middens (see below), but at Whitwell the original humic topsoil was absent from the soil profile (Frederick, below) and no evidence for a midden was present. The pottery, however, and possibly other material such as flint, may have been brought to the site as broken pieces from a midden close by, or perhaps

selected from a specifically ritual area. Pieces may have arrived with the first burials and then at intervals with successive burials. For example, there is evidence from Windmill Hill causewayed enclosure in the mid-4th millennium BC for ritually deposited material being stored on site or elsewhere before being selected for eventual structured deposition (Whittle *et al.* 1999, 354).

Vessels 1 and 2 very fine quality raises the question of whether or not they were made for special activities and it may be significant that rim sherds of each (Fig. 15.1 and 2) were found respectively in the multiple inhumation deposit and near to the single burial. On the other hand this deposition could be completely fortuitous, given the scattered and generally abraded character of Fabric 1 sherds. The only cross-joining sherds recognised from the site were the unabraded rim sherds of Vessel 1 found at opposite ends of the linear mortuary deposit, possibly broken and disturbed by some stage of burial activity in Phase 6. Evidence for old *in situ* breakage is demonstrated by joining pieces from Vessels 3 and 6, and by the large number of fragments retrieved (Table 2), suggestive of trampling and other damage during burial and building activities. The dispersed locations within different phases of two carinated sherds, possibly both from Vessel 3, are typical of the scattered distributions of many related pieces.

Residues and burning on Vessel 6 sherds in particular and the slight traces on Vessels 3 and 5, suggest domestic activity or possibly feasting, but there is no evidence for *in situ* burning on the site. Organic residue analysis on vessels from Ascott-under-Wychwood (Copley and Evershed 2007, 283-87) revealed evidence for milk and dairy fats and similar evidence was found on vessels from Lismore Fields, Buxton (Garton in prep.), indicating that vessels such as these were used in food preparation.

Fabric 2 probably represents one large bowl, Vessel 4 (Fig. 15.4), and the majority of sherds, although acid-leached, are unabraded, some join and half are medium to large in size (Table 2). None was found in the multiple inhumation deposit and only one in the oval cairn (Fig. 6). This came from the cairn matrix [183d], Phase 4, above the single inhumation, and is large (17g) and unabraded, suggesting it may have been placed deliberately either during construction of the cairn or afterwards (Vyner, below: suggests as part of the Early Bronze Age disturbance, Phase 8). The remainder of sherds of Vessel 4 were found mainly in deposits against and outside the outer trapezoid cairn wall, in between the boulders of the cairn, on the passage floor and adjacent to the passage (Table 3: Phases 0 and 4 to 7).

Vessel 4 is represented by the largest quantity of sherds of any one vessel, and compared with the weight of a similar vessel in a similar fabric from Lismore Fields, Buxton (vessel 12, c. two-thirds complete and c. 400g; Beswick in Garton in prep.), at least one-third or more (240g) has been retrieved by excavation. Clearly its depositional history is different from that of Fabric 1 vessels. It would appear likely that it was brought to the site during construction Phases 4 or 5 in a complete state and after accidental or deliberate breakage larger sherds were placed on the original ground surface before or during building of the trapezoid cairn walls, and on the oval cairn during or after its construction. Apart from the one sherd on the oval cairn and some small, probably residual, pieces in the entrance passage (sherds 1067), the distribution of the rest suggests preference for the area around the entrance to the linear mortuary deposit. However, their obvious absence from that deposit indicates the possibility of a different function and/or a different chronology for Vessel 4 compared with Fabric 1 sherds. Deposition of Vessel 4, given its contexts, preceded completion of the monument but occurred later than vessels in Fabric 1, and the contrasting pottery fabric would allow for the

<i>Phase</i>	<i>Feature</i>	<i>Contexts</i>	<i>Fabric 1</i>	<i>Fabric 2</i>	<i>Fabric 3</i>
Phase 0	Old ground surface	159		22	1
		170	18		
		190	19		
		208	3		
Phase 1	Linear mortuary deposit	164a1	3		
		164/170	2		
		166	3		
		169	3		
		200	3		
Phase 3	Oval cairn Stage 1	192	2		
		188	10		
Phase 4	Oval cairn Stage 2	183d		1	
Phases 1, 5/6	Trapezoidal cairn	164a1/2	3		
Phase 5	Trapez.cairn Stage 1	163b			
		165b		1	
		164b	1		
Phase 5/6		164d	3		
		164a			1
		164	1		
Phase 6	Trapez. cairn Stage 2	164a2	2		
		153b		2	
Phase 7	Trapez. cairn closed	35		3	
		175		2	
		158	1	12	7
Phases 8 etc	Disuse, collapse disturb.	150/159			1
		171			
		1			
Sherd totals			77	43	10

Table 3: Whitwell cairn: sherd totals in relation to phases, contexts and features by fabric.

Note: Fabric 1 – vessels 1,2,3,5 and 6

Fabric 2 – vessel 4

Fabric 3 – vessel 7

participation of another local group in these different activities.

Fabric 3 consists of only 10 sherds, likely all to be from Vessel 7, not diagnostic but possibly a Towthorpe Ware bowl. Six sherds are abraded and the majority are medium to small in size (Table 2). Nine sherds were scattered outside the east wall of the monument and the cairn's presence appears to have precluded activities associated with deposition of this vessel in Phase 7 (Fig. 6; Table 3). One sherd, however, was found in the linear mortuary deposit [164a], Phases 5/6, and its size (35g) and unabraded condition imply that it is unlikely to be residual and, like the Vessel 4 sherd in the oval cairn, may have been placed deliberately in this position before the passage was finally blocked around the mid 4th millennium BC. It is just possible that this took place in a burial context in association with a kite-shaped arrowhead but evidence to substantiate this is lacking and sherd and arrowhead were found nearly a metre apart (Garton, below).

Post-prehistoric pottery includes three Romano-British sherds found in topsoil outside the eastern wall of the monument together with seven of the post-medieval sherds, two others being on the cairn to the north of the passage and inhumation chamber. Medieval sherds occurred roughly in a north-south line to the east of the cairn and an east-west line across the trapezoid and oval cairns in contexts indicating some kind of intervention or disturbance at this period. All are likely to relate to agricultural activities in the area and the distribution of medieval sherds may indicate former boundaries. Post-prehistoric sherd details are held in the archive.

Discussion

Well-known long barrow and long cairn sites associated with the Early Neolithic Carinated Bowl phase are on the chalk wolds of Yorkshire and Lincolnshire, well to the north and east of Whitwell (Manby 1970, 16). Some nearer ceramic parallels in the Trent Valley have been referred to above, but none is from long cairns. In the Peak District, however, a number of sherds were found beneath the forecourt blocking at Green Low chambered tomb, Aldwark (Manby 1965, 11), and possible Grimston Ware (now lost) and Peterborough Ware sherds were found at Five Wells chambered tomb, Taddington (Piggott 1931). Local to Whitwell there are no confirmed finds. A number of shell-tempered sherds found in Whaley Rock Shelter 2, 1937-1948 (Radley 1967, 7-9), examined in Sheffield City Museum [now Museums Sheffield] (1996, 585), are more likely to be of first millennium BC date than Neolithic, and one shell-tempered sherd from Ash Tree Cave (Sheffield City Museum 1997.30) is probably medieval.

Nationally, Carinated Bowl pottery is the most commonly found type on long barrow and long cairn sites and either preceeds or is associated with their earliest phases. Rarely bowls appear to be associated with burials, as for example at Kilham, Yorkshire (Manby 1976, 137, 139, fig.17.1; Kinnes and Longworth 1985, 110, 234.1), but more normally the pottery occurs as sherds from several vessels in contexts associated with construction phases and general ritual use of the monument. For example at West Kennet, Wiltshire, sherds were in stone holes, on chamber floors and on the old ground surface (Piggott 1962, 32, 35-6) and at Street House, Loftus, Cleveland, sherds were found mainly in the facade trench fills (Vyner 1984, 169-70).

On occasions this type of pottery has been claimed to occur in connection with *in situ* pre-monument settlement or other activities, as for example at Gwernvale, Powys (Lynch 1984, 108) and Hazelton North, Gloucestershire, where interpretation also suggests a midden

(Saville 1990, 14). It has been suggested that cairns may have been placed deliberately at the location of earlier middens. In the case of a large midden found under the long cairn at Ascott-under-Wychwood, Oxfordshire (Benson and Whittle 2007), Barclay has argued (Barclay and Case 2007, 276) there is little to show that the pottery was broken *in situ* and that the assemblage appears to represent accumulations of fragmentary material perhaps with symbolic value and special meaning. The Fabric 1 assemblage from Whitwell is very similar in character and also suggestive of selective re-working and re-deposition, although the amount of material is considerably smaller (five vessels, compared with 48).

There are instances of fine carinated bowls being used as material symbols in ritual acts of complex and structured deposition practised particularly on burial sites (Herne 1988, 23). An example of ritual deposition are the sherds of four bowls, three carinated, placed deliberately in a pit in front of the earliest burial chamber at Dyffryn Ardudwy, Wales (Powell 1973, 12, 24-5). The only placed pottery at Ascott-under-Wychwood, however, was half of a later, coarser, heavy-rimmed bowl found in the southern passage which appeared to have been deliberately broken and deposited there towards the middle 4th millennium BC but not necessarily linked to burial (Barclay and Case 2007, 278, 281). It has been suggested this may represent increasing emphasis on material deposits around the 37th century BC (Bayliss and Whittle 2007, 131).

At Whitwell, although there is no evidence for structured deposits in ditches or pits, as in causewayed enclosures (Whittle *et al.* 1999), this type of practice could be in evidence. In particular, the single large, unabraded sherds of Vessels 4 and 7 found respectively on the oval cairn and in the linear mortuary deposit, could have been deposited carefully; the sherd of Vessel 7 perhaps as a token symbol in the last rites which sealed the burials in the mortuary deposit; and that of Vessel 4 in recognition of the single burial below the oval cairn, either in the Early Neolithic or during the time of Early Bronze Age disturbance (Vyner, below). The presence of neither sherd can be easily explained as a casual discard (*cf.* Vyner, below). It could also be argued that comparatively large quantities of Vessel 4 may have been placed deliberately in relation to construction of the trapezoid cairn and location of the entrance passage, and that diagnostic sherds, or 'characterising vessel segments' of Vessels 1 and 2 may have been selected and dropped deliberately in significant positions relative to burials, but with less formality to their deposition. However, in these instances speculation is lacking real contributory evidence.

THE FLINT

By Daryl Garton and Ian Brooks

Introduction (DG)

The flintwork (128 pieces) was laid out by phase and each piece recorded for a series of typological characteristics which forms the archive. The material was recorded on site by both context and coordinate data, no sieving was conducted, except for samples taken for palaeoenvironmental purposes. The residues from sieved deposits were examined for small lithic artefacts by J. Brown; this only produced five items from three contexts. The material is listed by phase, location and form in Tables 4 and 6, with selected retouched artefacts illustrated in Figures 16 and 17 (illustration numbers in brackets below).

	C	C phase 9	TC	T	T phase 9	M	M phase 9	P	O	O phase 9	Unstrat
Blades+blade-like	1	2	3	6		5		2	1		3
Flakes	11		4	14		9		2	4	1	10
Spalls	3 (17)		3	4		6		1			
Cores					1 (12)			1 (13)			
Natural + chunks				1				1		1	2
Arrowhead						15 (all in Fig. 16)		1 (11)			
Bifacial knife					1 (20)						
Edge-used + gloss											1
Microlith	1 (14)										1
Notched blade											1 (18)
Piercer									1		
Scraper	1 (15)										
Serrated blade							1 (16)				
Slug knife											1 (19)
Used flake/burin									1		
Total	17	2	10	25	2	35	1	8	7	2	19
of which number burnt	2			1		2		1			1

Table 4: The form of flintwork by location, all phases prior to 9 (disuse/collapse), which are listed separately.
Pieces illustrated in Fig. 17 are numbers in brackets.

C = within outer oval cairn (phases 0, 3 and 4)
T = within trapezoid cairn (phases 5, 6 and 7)
TC = within trapezoid cairn, but probably part of same scatter as beneath the outer circular cairn (phases 5, 6)
M = linear mortuary deposit group (phases 1, 5 and 6)

P = passage group (phase 5, 6, 7)
O = outside trapezoid cairn
Unstr = no coordinates (all pieces attributed to phase are 9)

Raw materials (DG)

All but one piece of unmodified chert was flint. Virtually all the flint was heavily corticated (as Shepherd 1972, 116), though pieces which are recently damaged or lightly corticated show the use of mottled grey, mottled brown and translucent flints. The presence of a rolled cortex on many of the struck flakes, even small ones, would usually suggest the use of predominantly small nodules from derived deposits (Brooks, below). However, the presence of large retouched tools, including both the curved bifacial knife (20) and leaf arrowheads (2 and 6) would require large flake blanks. Small rolled nodules are incorporated into the nearest source of raw materials, the Trent river gravel terrace deposits some 30km to the east (Henson 1985, 7; Brooks, below), but larger unflawed nodules would seem to be much rarer judged by the quality and size of the flintwork found locally (e.g. Knight *et al.* 1998, 73). Sources of the Whitwell raw materials were therefore investigated through thin-section analysis of the palynofacies (Table 5; Brooks, below) to assess whether they were likely to be derived from the same sources, and whether the larger flakes were consistent with those known from the Trent gravels. Since this technique is destructive, samples were taken from flakes, cores and broken tools, with all items investigated for microwear (Donahue, archive report), and drawn and photographed prior to making the thin-section. With two exceptions, samples were taken from the linear mortuary group as the secure context from the site. They include four of the leaf arrowheads (including the three largest *i.e.* size 1/2; Green 1980, 67) and five flakes (of which two retained cortex); and items attributed securely to both lower (flake 748, phase 1) and upper bone deposits (flakes 183, 500, phase 6). Flint of the two cores are macroscopically similar in character, and since flakes with their distinctive manner of working were found on site, they may be presumed to be the raw material actually worked there (13 from the phase 7 passage group). The bifacial knife (20) is the largest piece of raw material on the site.

Raw material analysis (IB)

The origins of the micropalaeontological investigation of flint and cherts is linked with the earliest development of palynology and micropalaeontology as a discipline. Archaeology, however, was relatively slow in recognising the potential for the study of flint resources and assemblages: Valensi (1955a; 1955b) applied the techniques to the lithic assemblage from the Magdalenian site at Saint Amand and followed this work up by a study of the cherts of Grand Presigny (Valensi 1957) and the lithic assemblage from the Abri Pataud (Valensi 1960). More recently micropalaeontological characterisation as part of an investigation of potential lithic resources has been adopted by a number of French and Italian workers (e.g. Masson 1981; 1984; 1985; 1986; Torti-Zannoli 1983; Demars 1983; 1984; 1985; Mauger 1984). Research by Brooks (1989a; 1989b) developed the techniques to suit the flint resources of England using a mixture of macroscopic appearance, microfacies form and micropalaeontological content to characterise potential flint resources.

Four arrowheads, five flakes, two cores and a bifacial knife as detailed above (Table 5) were sampled with the specific research questions:

- Could the tools all come from the same source deposits?
- Could the flakes and cores all come from the same source deposits?
- Which deposits might have been exploited?

There are no flint resources within the immediate area of the site, however, within the larger region a number of potential resources exist. The nearest primary flint source, directly from

chalk, is the Lincolnshire and Yorkshire Wolds which contain considerable flint reserves in two main forms. Of particular interest are the Welton and Burnham Formations (Wood and Smith 1978). The lower, Welton formation, is characterised by the presence of bands of thalassinidean burrow nodular flint, whereas the Burnham formation contains tabular and semi-tabular flint bands some of which are markedly carious. The general quality of both flint groups is not good. Wold flint is often opaque, grey in colour and of poor knapping quality, although the nodular Welton Formation flints are sometimes of better quality.

More importantly for prehistoric exploitation there are a number of derived sources also available. The Devensian tills of Lincolnshire and Yorkshire contain considerable flint resources (Kent *et al.* 1980). These vary in quality, but they include a number of translucent, high quality flint nodules of good knapping quality. Lincolnshire also contains a number of pre-Ipswichian tills (Perrin *et al.* 1979; Straw 1958) which also could serve as a potential flint resource. Flint within these till sheets is derived from both the local grey flints and flint from further afield including chalk resources no longer available. River and beach gravels of Lincolnshire and Yorkshire are also potential flint sources as they contain flints derived from both the chalk and till sources within the area.

Further afield, Irish Sea Till outcropping to the west and south-west of the Peak District, particularly on the Cheshire Plain, contains a low percentage of flint originally derived from Northern Ireland and the North Irish Sea (Mackintosh 1879). These resources were further derived into the river gravels of the Cheshire Plain and have been shown to be important in the Early Neolithic assemblages in the Derbyshire Peak District (Brooks and Garton in prep.).

Methods

The methods used follow those detailed in Brooks 1989a. Eleven thin sections were prepared by the Geology Department of the University of Leicester: unfortunately they varied in quality, with some being ground thinner than the ideal of 30 μm , others had air bubbles reducing the sample size and one of the samples (183) did not survive thin sectioning and could not be included. A single slide (from artefact 6) made by the Oxford Research Laboratory for Archaeology and the History of Art did not suffer the problems outlined above (the authors are grateful to Chris Doherty for arranging this).

The method is a multistage analysis with initial examination of the macroscopic characteristics, followed by a microfacies analysis (general appearance of the thin-section) and detailed microfossil analysis. Macroscopic analysis relies on both a written description of the sample and a direct comparison with raw material samples. Direct comparison is important as no written description can define the subtlety of colour and texture variations exhibited by flints and cherts. The first level of microscopic analysis is the general appearance of the thin-section allowing for the state of preservation and density of the fossil assemblage to be recorded. The second level is a detailed analysis of the microfossil content.

A range of microfossils is represented within flints, the largest group of which comprises the foraminifera. These are recorded as a series of 53 morphotypes (Brooks 1989b, fig. 3.3), representing not only variation in species but also in orientation and state of preservation. Other fossil groups represented include calcareous dinoflagellates, sponge spicules, calpinellids, radiolarians, dinoflagellate cysts, acritarchs, bryozoans, fish teeth, pollen and spores. Ideally counts of at least 500 microfossils are carried out under magnifications of X250 or greater. The results were compared to a database of 341 raw material samples from 42 locations largely in Yorkshire, Lincolnshire, Cheshire, Staffordshire, Merseyside, Warwickshire and

<i>Tool type</i>	<i>Context</i>	<i>Phase</i>	<i>Sample/ accession/ Fig. no.</i>	<i>Possible sources *</i>	<i>Best fit source+</i>	<i>Area of best fit source</i>	<i>Location</i>	<i>OS grid ref of best fit source</i>	<i>Source type</i>
<i>Arrowhead</i>	M	5/6	212 Fig. 16.6	FNL 7, 13, G, SKW 20, SWB 18, KIR 4, WR 6, TB 8, 13	FNL 7	Flamborough North Landing	East Yorkshire	TA 239721	Chalk
<i>Arrowhead</i>	M	5/6	215 Fig. 16.2	FNL 9, FSL 14, TB 19, FB 1, WR 6, TB 17, WIR 1	FSL 14	Flamborough South Landing	East Yorkshire	TA 233692	Till
<i>Arrowhead</i>	M	5/6	432.2 Fig. 16.3	FNL 6, 8, TUR 7, 9, SKW 23, KIR 7	TUR 7	Turnstall	East Yorkshire	TA 316315	Till
<i>Arrowhead</i>	M	5/6	618 Fig. 16.8	FNL 8a, A, FSL 15, WLW 13, 16, KIR 5, 17, TB 6	WLW 13	Welton le Wold	Lincolnshire	TF 282883	Till
<i>Flake</i>	M	5/6	429	TUR 3, 7, WLW 19	TUR 3	Turnstall	East Yorkshire	TA 316315	Till
<i>Flake</i>	M	6	500	WLW 12, TB 19	WLW 12	Welton le Wold	Lincolnshire	TF 282883	Till
<i>Flake</i>	M	3	685	WLW 19, KIR 11, 12, WR 2, 11	WLW 19	Welton le Wold	Lincolnshire	TF 282883	Till
<i>Flake</i>	M	3	748	FNL 10, A	FNL A	Flamborough North Landing	East Yorkshire	TA 239721	Chalk
<i>Core</i>	M	7	199 Fig. 17.13	FNL 10, A, WLW 3, 13, KIR 10	WLW 13	Welton le Wold	Lincolnshire	TF 282883	Till

Tool type	Context	Phase	Sample/ accession/ Fig. no.	Possible sources *	Best fit source+	Area of best fit source	Location	OS grid ref of best fit source	Source type
Core	T	9	884 Fig. 17.12	TUR 3, 7, WLW 8, 19, TB 19	WLW 19	Welton le Wold	Lincolnshire	TF 282883	Till
Bifacial knife	T	9	868 Fig. 17.20	WR 6, FNL 14, TUR 10, FSL 8, 20, WN 4, WR 1, 6	WR 6	West Ravendale	Lincolnshire	TA 227001	Chalk

Table 5: Samples showing the suggested source locations from analysis of the form and diversity of the microfossil assemblages.
* codes for possible sources, where they are not the 'best fit', are listed below. +The numbers are from Brook's database
of 341 raw materials sampled from 42 locations. M = linear mortuary deposit, T = within trapezoidal cairn

Site Code	Site Name	County	Grid Reference	Source Type
WN	Wold Newton	Lincolnshire	TF 245961	chalk
SKW	Skipsea/Withow	East Yorkshire	TA 184547	till
FB	Filey Bay	North Yorks.	TA 200799	till
SWB	Sewerby	East Yorkshire	TA 203687	till
KIR	Kirmington	Lincolnshire	TA 104116	till
TB	Thornwick Bay	East Yorkshire	TA 233723	till

Worcestershire (relevant sample locations summarized in Table 5). These represent the main resources available in the site's region. Photomicrographs in archive record the general microfacies of the samples and specific microfossils.

Samples

All samples were highly corticated (Shepherd 1972, 116) such that the original colour and texture of the flint could not be determined. Fragments remaining from production of the thin-sections were examined to identify raw material types, but these macroscopic groupings did not entirely match those determined from the microfossil assemblages. Finally the microfossil assemblages were compared with samples from the reference collection, results of which are shown in Table 5 (full analysis in archive).

These determinations are based on relatively low microfossil counts with the largest number counted being only 282 in artefact 2; in artefact 500 only 20 microfossils were identified. These low numbers were due, in part, to the small size of the samples and the quality of the thin-sections. In order to compensate for this problem all available characteristics were considered.

Discussion

A wide range of flint sources would appear to have been used and none of the samples investigated came from the same nodule, but some broad patterning was determined.

All the sources exploited were from eastern England, with no flint from the Cheshire Plain being found in the samples. This is not unexpected if one considers the distances and terrain between Whitwell and potential sources. Matches have been made to both possible primary and derived raw material sources. However, flint from primary chalk resources is also found in derived sources and it is considered most likely that derived sources were the source.

Also there is some suggestion that specific flint types were selected, with three macroscopic flint types identified. Both cores (12, 13) are from till sources in Lincolnshire. The raw material sample was taken from the Wolstonian till on the eastern side of the Lincolnshire Wolds but it is also found in the gravels of the River Trent. Two flakes sampled (500 and 685) were also from this potential source, but not from the actual cores sampled.

Two other flakes are from sources sampled in East Yorkshire. One from the Devensian till (429) and one from a primary chalk deposit (748). Once again it must be stressed that the chalk flint is also incorporated into tills and other derived deposits in the region. Devensian tills also extend south of the Humber and possibly these were the resources exploited.

The flint used for the bifacial knife (20) has a best match from the Burnham Formation chalk in Lincolnshire, although again it is most likely to be from a derived source.

Three of the four arrowheads are made of flints sampled in East Yorkshire, whilst the fourth is made of flint similar to that sampled from the Wolstonian till in Lincolnshire. It is noticeable that two of the arrowheads (2 and 6) match flint sources on Flamborough Head and the third (3) is from Devensian till in East Yorkshire, which also outcrops at Flamborough. It is tempting to suggest a link between these artefacts and the series of specialist knapping sites between Sewerby and Flamborough South Landing (Henson 1989, 11; Durden 1995, 431). Artefacts 2 and 6 were the largest arrowheads in the assemblage and the latter was ripple flaked, a feature which has been noted as part of the specialist assemblages from the Flamborough area (Durden 1995, 410). However, artefact 8 was not a similar flint type, even though it is also large. A link with Flamborough must remain tenuous with the real possibility

of alternative sources having been found closer to the site. The nature of derived sources in the region means that flint types are found in a number of dispersed and interrelated places and exact source locations are unlikely to be definable.

Chronology (DG)

Even in this small assemblage there are some indicators that the flintwork is multi-period. However, as will be explained below, the majority is consistent in form and condition, and, because the patterning varies with the phases/structures (Fig. 6), it is interpreted as predominantly contemporary with the construction and use of the cairns (Phases 1-7), with a small amount from the disuse and collapse (Phase 9) of the structure. The flints indicative of this multi-period chronology are described here (Table 4: Figs 16, 17).

A broad blade fragment (Phase 9) is heavily iron stained and is in a quite different condition from any of the other material; condition is not a wholly reliable indicator (Schmalz 1960, 49; Rottlander 1975, 109), but this artefact could be much older than the rest, or perhaps has come from another environment.

The earliest diagnostic piece is a microlith (14) with edge-damage and rounding probably indicating post-depositional erosion perhaps from trampling or having been on the surface for some time (as also noted by Donahue in archive report). The notched blade is also a type well known amongst Mesolithic industries. However, if this was intended as a microlith blank, it is unusual in retaining a strip of cortex along part of the dorsal face. A thin end-scraper (15), with its straight end, is reminiscent of some scrapers associated with Mesolithic scatters elsewhere (Healey 1976, 50; Garton *et al.* 1989, 135), although the character of the dorsal flaking could also belong with Neolithic industries. Both microlith and scraper were from the palaeosol beneath the Phase 3 oval cairn: these are the only items which must be from pre-monument activity.

The diagnostic Early Neolithic tool type from this site, all of which came from the linear mortuary deposit (Phases 1/5/6) or underlying palaeosol (Phase 0), or passage leading to it (Phases 5/6/7), is the leaf-shaped arrowhead (Fig. 16); these are discussed in detail below. The only other Early Neolithic tools, a serrated blade with edge-gloss (16) and a bifacially-flaked knife (20) are from the uppermost levels or disturbance after the monument had gone out of use (Phase 9). On the basis of their forms and distribution, the scatter of flakes, blades and spalls (debitage in Figs 6B and 12) could be contemporary with the mortuary and passage deposits (Phases 1/5/6), and/or after construction of the earliest oval cairn (Phase 3 – see below).

The typology of some of the unstratified pieces, for example a piercer (18) and a fragment of a prismatic tool/rod (19; Phase 9), are both items which would not be out of place in Later Neolithic/Early Bronze Age contexts; they may date to the Phase 8 disturbance of the cairn and its subsequent disuse and collapse (Phase 9). Similar items have been found during systematic fieldwalking within the adjacent parish of Elmtun, although not in the adjacent fields to the west of the cairn (Knight *et al.* 1998, fig. 4).

The lithic material from the Whitwell cairn is discussed further by location below, rather than by phasing of the excavated structural sequence (Table 4), because of widespread evidence for the vertical migration of flintwork and other artefacts where biological activity is high in such free-draining neutral-basic sediments (*cf.* Atkinson 1957; Collcutt in Barton 1992, 64-78; Bell 1996, 80).

Oval cairn and burial (Phases 2-4)

No flints were in direct association with the single inhumation deposit (Phase 2). The small cluster of flintwork (17 items), with the scatter of Earlier Neolithic pottery (vessels 3 and 5; Beswick, above) found outside, and to the north of, the Phase 3 oval cairn, may suggest that this material was deposited after its construction, but prior to the Phase 4 extension of the oval cairn. They included two spalls (17), which because they had faceted butts had been struck from either a bifacial implement (such as an arrowhead), or from a faceted platform core. In addition, seven of the pieces were struck from angles other than directly behind that of the previous flake, *i.e.* there is some evidence for either turning of cores when knapping, or shaping of implements. However, two flakes retain some cortex on their dorsal surface, and another two have cortical butts: this does not suggest final finishing of implements. One flake is from a core where the flakes have been removed in opposite directions from a single edge similarly to the core from the passage group (13). One fragment is burnt.

Linear mortuary group (Phases 1, 5 and 6)

The linear mortuary deposit (Phases 1/5/6) with its east and west bracketing pits (Phase 1), together with the material located within the palaeosol below them (Phase 0), are considered together and are hereafter termed the linear mortuary group: bones from these deposits are dated by radiocarbon to the early to mid 4th millennium cal BC radiocarbon (from 3810-3710 to 3630-3540 cal BC, Marshall *et al.*: Table 1).

Most of the stratified flintwork from the site comes from these contexts and notably all of the leaf-shaped arrowheads bar one from the passage (11; Table 6). Fifteen leaf-shaped arrowhead fragments from a minimum of eight arrowheads were found in the linear mortuary group (Table 6). The only other tool perhaps attributable to this group is a serrated blade with edge-gloss (16) recorded above the eastern end of the mortuary group (Phase 9). Flakes, blades and spalls were also recorded (Table 4: Fig. 6). One of the spalls has an acute angle between platform and dorsal surface strongly suggesting it is from retouching an implement. Two of the larger pieces, a blade and blade-like flake, are the only ones to retain some cortex in this group. Two flake fragments are burnt.

Even if the arrowhead fragments are ignored (they are discussed later), this area has the highest density of flintwork which is not mirrored in the adjacent construction of the trapezoid cairn or passage, or outside of the passage entrance (Fig. 6). Hence, the flintwork seems to be preferentially deposited within the Phase 1/5/6 mortuary deposit. Given the often small, and mostly unremarkable nature of the pieces, there seems no reason to suggest that they were individually selected for this purpose. However, they do complement a range of small abraded pottery sherds within the mortuary deposit, which Beswick suggests were brought in, perhaps with midden deposits, rather than as whole/substantial pots as offerings. Whatever their origin, the edges of the flint are fresh, with only one of the 21 (non-arrowhead) flints recorded as having ancient edge-damage, so they would not appear to have suffered substantial disturbance since their original deposition (many of these pieces are assessed as unused using microwear analysis, Donahue *pers. comm.*), though the broken, scattered, arrowheads do suggest some movement of these deposits.

The size and form of the arrowheads are diverse (Table 6). Only one is virtually complete (10), the rest are fragmentary, with the almost certainly joining, and possibly joining fragments itemised in Table 6. The arrowhead tip retrieved from sieving (9), could be from one of the illustrated arrowheads, but any matches cannot be demonstrated.

The two largest arrowheads are both broken, with only three non-joining pieces recovered from each. The tip, base, and mid-section of artefact 2 are linked through their morphology and distinct cortication (*sensu* Shepherd 1972, 116) which includes a darker patch of flint along one side (illustrated at half-scale in Fig. 16). Such surface patterning can reflect the original hafting (*cf.* Green 1980, 182, pl. II), but, in this instance, the patterning appears to represent variation within the raw material. None of the three fragments join from a large, ripple-flaked kite-shaped arrowhead, with edges that are almost serrated (6/7), but these characteristics, together with the similarity of outline, cross-section and condition strongly suggest that they were once one (discussed further below and in catalogue). The shorter, wider, tip (7) has a flute-like fracture and crack, perhaps damage from hafting if part of 6. There are also two joining fragments from a similar-sized arrowhead (8). These three larger arrowheads all come from the western end of the linear mortuary deposit (Fig. 12). Such large arrowheads are typically from burial deposits, particularly in areas like Whitwell where flint resources are generally small (Green 1980, 85).

Two of the smaller arrowheads (3 and 4) and a fragment (5), were found around skull 231 near the eastern end of the linear mortuary deposit. As far as one can judge from fragmentary items, both surfaces are completely flaked. The only other small arrowhead from the linear mortuary deposit (1) was also by a skull (222 - though the skull was recorded as Phase 6, *i.e.* the later phase of bone deposition, whereas the arrowhead is recorded from the palaeosol, Phase 0). It is thicker, and only one surface is completely flaked, but more crudely than the others, perhaps due to two cortical inclusions within the raw material (illustrated by stippling in the half-scale outline in Fig. 16.1).

Arrowhead fragments (7; the mid-fragment of 8 and 9), and the only virtually complete arrowhead (10), were located in pits defining both ends of the linear mortuary deposit (194, 182). The outline of arrowhead 10 is distinctly ogival at both ends: apparently a regional rarity (Green 1980, 74, 231).

The best evidence for re-arrangement of body parts within the mortuary will undoubtedly come from the bones themselves (Chamberlain, below), but the location of fragments from conjoining/ the same arrowheads (like the single conjoining sherd of pottery, Beswick, above) provides some additional evidence (Fig. 12). Two arrowhead fragments from pit 194 (the western pit of the mortuary structure) are part of arrowheads otherwise located within the mortuary deposit (the joining tip of 8 was located below sacrum 535 - see catalogue; 7 is probably the same arrowhead as 6 - see catalogue and discussion of kite-shaped arrowhead below). These broken arrowheads are amongst the closest to pit 194; this may suggest they became incorporated into it accidentally, perhaps when any post in pit 194 was removed or the mortuary structure collapsed. Similarly, arrowhead 10, from the basal fill of pit 182 (the eastern pit of the mortuary structure), may have become incorporated when this putative post was removed, though the virtual completeness of the arrowhead might lead to the alternative suggestion that it was a dedicatory item. Within the mortuary deposit, joining fragments of arrowhead 3 were found some 0.4m apart. In addition, the basal fragment of arrowhead 2 was located below pelvis 315 and therefore below the slab layer defining the end of Phase 1, yet its non-joining mid-fragment was found some 1.3m away below a skull lapping onto the slab layer. This evidence for the fragmentation of arrowheads suggests the movement of flint, and probably bone, since its original placement within the mortuary deposit.

Passage group (Phases 5, 6 and 7)

The palaeosol beneath the passage (0), its construction and deposits (Phase 6), and its blocking and collapse (Phase 7), are hereafter referred to as the passage group.

The passage contains only a small number of items, but these tend to be amongst the larger from the site. They include the only leaf-shaped arrowhead outside of the linear mortuary group (11), lodged within the discontinuous stone surface of the passage (context 176: Phase 5). The other items include a flake with a faceted butt, a large primary flake with smooth, rolled cortex, a bashed lump, and a core with flakes removed in opposite directions from a single edge *i.e.* keeled (13). The flake with the faceted butt could have come from a core worked in the same manner as that recovered, as could a flake from the linear mortuary deposit. The core was beneath the slabs sealing the linear mortuary deposit (Phase 7).

The pieces from outside the passage, beyond the cairn, are amongst the largest recovered. Two flakes, otherwise unmodified, both have flute-like fractures (see below), where the butt has been removed, like those on some of the arrowheads.

Disuse and collapse (Phase 9)

Virtually all the items from the final phase are larger than those from other phases: the lack of smaller items, comparable with those from other contexts, may be due to the more robust removal of these deposits. Since the earlier deposits were carefully removed by trowel, the absence of larger items is probably real. It is also noticeable that the items from the Phase 9 and unstratified deposits have more macroscopic edge-damage, both ancient and modern. This is typified by 20, a curved, bifacially worked knife (approximately half): its discovery near the surface of the cairn, and that it has two phases of cortication (illustrated at half scale in Fig. 17.20), suggests that its burial environment has changed in antiquity (Schmalz 1960, 47); it also has some uncorticated, and presumed recent, damage. It would appear that knife 20 was originally in another context, then moved to its recovered location sufficiently long ago for the surface of the artefact to become corticated again. Experimental evidence suggests that such cortication can happen quickly under basic conditions (Schmalz 1960, 49). Similar knives are described by Clark (1932) and appear most commonly on Early Neolithic sites (Healy 1980, 232; Healey and Robertson-Mackay 1987, 14, fig. 65, F145), so an original context from or beneath the cairn would not be surprising.

Discussion of arrowheads from the linear mortuary and passage groups (DG)

The recovery of a minimum of nine arrowheads from the linear mortuary and passage groups raises the question of why they were found here, but nowhere else within the excavated area. Arrowheads are well documented in mortuary contexts, and have often been interpreted, along with other artefacts, as grave goods (e.g. Kinnes 1992, 108). If they were grave goods, they were not accompanied by any other flint tools (though such associations in Early Neolithic mortuary deposits are rare: *ibid.*, 112), or by complete vessels. There is also some evidence of arrowheads within bodies from both formal mortuary and other contexts (listed by *ibid.*, 108-109), where the arrowhead has been interpreted as the reason for death, and this evidence for violence can be supported by cranial trauma in a range of contexts (Schulting and Wysocki 2005, 122) and the compelling evidence for attack with arrows on some Neolithic sites (Mercer 1981, 68; Kinnes 1992, 61). Such opposed interpretations as grave goods versus cause of death, might be thought to be simple to distinguish, but this is rarely the case (*cf.* Saville 1990, 167; Evans and Hodder 2006, 157, 174-76), and the widespread evidence for the movement of bones within mortuary

areas (e.g. Barber 1988, 60-61; Evans and Hodder 2006, 156-57; Whittle *et al.* 2007, 357-58), would confuse such evidence. Further, the robustness of arrowheads themselves means that the evidence from their location, breakage and wear will be difficult to interpret. Finally, the poor state of the bone recovered at Whitwell means that any impacted tips, and bone damage from such arrowheads, would not necessarily have been visible or interpretable (A. Chamberlain *pers. comm.*). However, such evidence as there is from the arrowheads is examined below.

If there is evidence that the arrowheads were made on site, this might suggest their manufacture for grave goods. The presence of spalls and flakes with faceted butts and multiple directions of flaking on their dorsal surfaces (like those from the scatter outside of the phase 3 oval cairn), could indicate bifacial tool manufacture such as the repair/shaping of leaf-shaped arrowheads, but they could also result from the flaking of keeled cores like 13. The small amount of flaking debris does count against manufacture, but if blanks were made elsewhere (see comments by Brooks above) with only the final finishing conducted, then such debris may only have been obvious after a very extensive programme of sieving (*cf.* Towner and Warburton 1990, 317-19) which was not conducted (two arrowhead tips and three spalls were recovered from wet-sieving of palaeoenvironmental samples). On balance, there could have been some tool finishing or modification on site, and since arrowheads are the only retouched tool from these contexts, the simplest explanation is that some could have been finished on site prior to placement as grave goods.

Alternatively, if the arrowheads were lodged within the bodies, rather than being deposited as grave goods, then their breakage might show patterns diagnostic of impact (Table 6). Experiments on flint projectile points (Bergman and Newcomer 1983, 243; Fischer *et al.* 1984, 19; Odell and Cowan 1986, 199) show broad agreement on the patterns of macroscopic damage on impact which produce burin-like spalls, flute and bending fractures (terminology following Barton and Bergman, 1982, 240; Bergman and Newcomer 1983, 241). Whereas it seems clear that projectile impact (*i.e.* pressure along the length of the implement), can be distinctive from breakage produced by other processes (e.g. trampling, where pressure is often perpendicular to the item), impact on substances other than bone e.g. mis-hits on timbers, may not be distinguishable (Fischer *et al.* 1984, 19, table 1), and bending-fractures can be indistinguishable from the snapping of flakes on manufacture (Barton and Bergman 1982, 240). In addition, of 148 experimental points fired into carcasses, only some 40% had diagnostic macroscopic wear traces (Fischer 1985, 30, table 1). Further, some of the experimental pieces shattered on impact (Bergman and Newcomer 1983, 243, fig. 2.8-10), producing fragments that would be difficult to recover and identify in the archaeological record. Finally, whereas impact with bone will often cause macroscopic damage, penetration into skin and soft body tissue may result in no observable macro or microscopic traces (Bergman and Newcomer 1983, 240; Barton and Bergman in Barton 1992, 222-24; Fischer *et al.* 1984, 34).

Using this experimental evidence, only those arrowheads with burin-like spalls and flute-fractures can be suggested as suffering impact damage if not found within bones. However, consideration of arrowheads in archaeological contexts which are clearly impacted into bones (rather than being within the body cavity), shows that they all exhibit bending fractures. At Ascott-under-Wychwood (Knusel 2007, 218-20) and Tulloch of Assery B (Corcoran 1964, 44, 52, 63, pl. XIV) the arrowheads are both impacted into vertebrae. To judge from the photograph (Corcoran 1964, pl. XIV), the tip from Tulloch of Assery B has a bending fracture: no further details are given by Henshall (1972, 310.21, 557) except that it is chert rather than flint. The arrowhead at Ascott-under-Wychwood 'lost a small part of its tip' with a 'bending fracture below

the point of entry' (Cramp 2007, 305); no burin-like spalls or flute fractures are visible on the observable face of this arrowhead (Cramp 2007, fig. 12.6, 7). The recently spotted flint tip in a rib from the chamber of Pen-y-wyrld, Talgarth, appears to be a bending fracture (Wysocki and Whittle 2000, fig. 5), as does that embedded in an arthritic male pelvis recovered from riverine gravels at Langford, Nottinghamshire (dated 3650-3510, 3430-3390 cal BC at 95% probability: Beta 158370 4780 \pm 40BP, spotted by L. Elliott with bone identified by D. Brothwell). Finally, these examples which are broadly contemporary with Whitwell are complemented by a burial in the ditch of Stonehenge (Evans *et al.* 1984, 14-21), where a barb-and-tang arrowhead was found separately from its broken tip impacted into a rib: the photographs and illustration suggest a bending fracture (*ibid.*, 20-1).

Phase/group	Illustration in Fig. 16	Accession number	Size	Shape	Tip fracture	Body fracture	Part of*
<i>Linear mortuary group</i>							
Phase 0	1	842	3	B	B	-	-
Phase 5/6	2	215	1	C	-	B	?400/521
	2	400	1	C	-	B	?215/521
	3	432.2	3	C	B	B	<u>237</u>
	4	209	3	B	F	B	-
	5	232	fragment	-	F	B	-
	6	212	1	C kite	-	B,S	213
	6	213	tip	-	B	B	212
	8	618	1/2	C	B	B	<u>1003</u>
Phase 6	2	521	fragment	-	-	B	?215/400
	3	237	3	C	-	B	<u>432.2</u>
<i>Pit backfills bracketing</i>							
<i>Linear mortuary group</i>							
Phase 5/6	7	1080	tip	-	F	B	?212/213
	8	1003	1/2	C	-	B	<u>618</u>
	9	1079	tip	-	B	B	
	10	936	3	B	-	-	virtually complete
<i>Passage</i>							
Phase 5	11	922	3	B	F	-	

Table 6: Arrowhead characteristics (size and shape after Green 1980, 69-72; fracture types after Bergman and Newcomer 1983, 241).
Arrowheads located in Fig. 12.

S = burin-like spall

F = flute-like fracture

B = bending fracture

all as defined by Bergman and Newcomer 1983, 241

*underlined pieces actually join; pieces with a question mark are almost certainly part of the same arrowhead, but there are no actual joins; pieces without either question mark or underlined are believed to be non-joining fragments of a single arrowhead.

Impact of some form can be identified on the tips of all but two of the Whitwell arrowheads (Table 6). Of these, 10 is virtually complete, and 2 is part of a fractured arrowhead, the distance apart of its pieces suggesting some re-arrangement within the mortuary (above). At first sight, the burin-like spall running from the bending fracture of the mid-fragment of 6 is good evidence of impact, but it was recovered immediately adjacent to its non-joining tip (Plate 8), suggestive of disruption within this area which might have resulted in this damage (similar comment by Donahue *pers. comm.*). Bending fractures occur at the tips of 1, 3, 8 and 9. Finally, flute-like fractures, leaving a shallow flake scar on one surface from a broken edge, found on 4, 5 and 11, are perhaps the clearest examples of impact.

The reasons for the presence of the leaf-shaped arrowheads from the Whitwell linear mortuary group are not clear-cut. The only virtually complete arrowhead was not strictly from the mortuary deposit (10: from the base of pit 182, perhaps being incorporated when the post was removed, so almost certainly contemporary), so cannot be claimed as a certain grave good. The inclusion of at least two large arrowheads (2 and 6), of a size which seems elsewhere to have been selected for burial purposes (Green 1980, 85, 89, 90; Pierpoint 1980, 182), could suggest their inclusion as grave goods, and it may be significant that neither tip has clear impact damage. The location of three arrowheads (3, 4 and 5) around skull 231 could be an indicator of placed grave goods (Fig. 12): but these include two of the arrowheads with flute-like fractures which are the strongest evidence for impact damage, and the clear re-arrangement of bones suggests that this positioning might not be original. Given the range of arrowhead sizes, shapes and evidence for impact, taken together with associations of kite-shaped arrowheads elsewhere (explored further below), it is possible that both modes of deposition, inclusion within bodies and as placed grave goods, are represented. What is not in doubt is the Early Neolithic attribution: these arrowheads are all clearly associated with bone dated by radiocarbon to the early to mid 4th millennium cal BC (using the end dates of Phases 1 and 5, between 3810-3710 and 3630-3540 cal BC, Marshall *et al.*: Table 1).

Local comparanda (DG)

A systematic fieldwalking survey of Elmtun parish, which lies immediately to the west of the Whitwell cairn (fields walked within 300m), was conducted in the mid 1980s (Knight *et al.* 1998). This recovered scattered evidence for Mesolithic and Earlier Neolithic lithics, with a wider spread of Later Neolithic tools (Knight *et al.* 1998, figs 3, 4), including a Group VI axe (Db248, Clough and Cummins 1988, 191). In addition, Mesolithic and Neolithic material is known from both fieldwalking and more recent test-pitting some 300-500m south of the cairn (Knight and Priest 1996) and in the caves in the gorge which are famous for their Middle and Upper Palaeolithic artefacts and fauna (Jenkinson 1984). Hence, there is a recorded background of activity, albeit not understood, for the communities constructing and using this cairn.

There are four leaf-shaped and three indeterminate arrowhead fragments from systematic fieldwalking in Elmtun which produced 927 lithic items, and another two arrowheads from the parish in various casual collections now housed at Sheffield City Museum. The complete arrowheads are small (Green size ranges 3-4), with only two incomplete fragments that could come from larger arrowheads, one with all-over ripple flaking, comparable with the larger arrowheads from the Whitwell cairn. They were found scattered across the parish with no obvious concentrations: only one indeterminate arrowhead was recorded from the fields immediately west of the cairn.

The nearest certain Neolithic burials are all in the Peak District, some 40km to the west, and although other possible Neolithic cairns on the limestone are noted to the north, e.g. Dinnington (Thurnam 1869, 171, note a); Melton Warren (Barnatt and Reader 1982), little is known about them. Of the 389 mounds in the Peak District recorded as having been excavated, mostly in the 19th century (Barnatt 1996, 7), only 16 have any leaf-shaped arrowheads, and of these, only eleven sites would appear to have arrowheads actually associated with burials, although the relationship of the arrowheads to the body/ies are not always clear. Whereas the character of the multiple burials within large cists or chambers at Ringham Low (Bateman 1861, 95; Barnatt 1996, 22-24, 201), and Long Low (Bateman 1861, 144-45; Barnatt 1996, 219), could provide broad analogies with Whitwell, that at Liffs Low is quite different in having a suite of artefacts, including kite-shaped arrowheads, deposited with a single inhumation (Bateman 1848, 42-43; Kinnes 1979, fig. 18.7).

Dating of kite-shaped arrowheads (DG)

There is at least one clear kite-shaped arrowhead at Whitwell (6/7) from the linear mortuary deposit (Phase 1/5/6), bones from which produced a series of Early Neolithic radiocarbon dates, in the early to mid 4th millennium cal BC (Table 1). Outside Yorkshire and Derbyshire, the kite-arrowheads documented by Green in Earlier Neolithic contexts (1980, 86, 93-4) are small and, bar the Cotswold-Severn chambered cairn at Ty-Isaf, do not have clear mortuary associations (*ibid.*, table IV.12): they include Lyles Hill, pit 8 (Evans 1953, 14), Carn Brea (Saville 1981b, 124, 149), and a single example at Hembury (Green 1980, table IV.11; though inspection of the published illustrations seems to show several probable examples – Lidell 1930, pl. XXXII, 129; 1932, pl. XXII, no. 846; 1935, pl. XXXIX, 1457). The kite-shaped arrowhead from Ty-Isaf, Brecknocks, is of size 3 (Green 1980, 328); it came from chamber 1 and was ‘contemporary with the use of the tomb’ (Grimes 1939, 126, 130), while the ‘despoilers of the chamber appear not to have interfered to any great extent with the deposits’, which included plain bowl pottery of Earlier Neolithic type (*ibid.*, fig. 6 nos 7, 8). Two large kite-shaped arrowheads (of four burnt) were also recovered from the chambered cairn at Unstan, Orkney (Clouston 1885, fig. 13). These seem to have been recovered from the chamber along with Unstan pottery (*ibid.*, 344); though hints of a complex sequence of activities/deposits (*ibid.*, 344) plus a broken barb-and-tang arrowhead from the passage (*ibid.*, 342, fig. 13) mean that the relationship of the kites to the bodies cannot be regarded as certain.

Before the Whitwell excavations, the evidence from Derbyshire and the adjacent county of Yorkshire seemed to suggest that *large* (i.e. Green 1980 size 1-2) kite-shaped arrowheads were part of a set of specialist items deposited as grave goods attributable to the Later Neolithic (Kinnes 1979, fig. 6.3a; Green 1980, 74, 85-6, 93-4; Pierpoint 1980, 182-83).

The earliest kite-shaped arrowheads recorded by Kinnes occurred in burial contexts transitional from communal to individual grave rites with accompanying artefacts (his Stage C 1979, fig. 3.2, 64; Harding 1997, 285). Two kites were found with six closely-grouped flexed inhumations at Towthorpe 18 (Kinnes 1979, fig. 18.3; Mortimer 1905, fig. 16). One of these arrowheads was said to have been ‘by pressure, affixed to a femoral bone’, and might have been brought in with the body (Mortimer 1905, 9: neither Mortimer’s, nor Kinnes’, drawings indicate any impact damage at either tip, while Gibson and Bayliss [2009, 73] note that none of the surviving thigh bones show any sign of trauma). The suite of artefacts from Towthorpe 18 include four ‘standard’ leaf-shaped arrowheads, two Towthorpe bowls and three stone rubbers, and these would usually be interpreted as grave goods accompanying the

burials. Within the mortuary deposit at Whitwell a single, undiagnostic, but large unabraded sherd, may be from a Towthorpe Ware bowl (Fabric 3: Beswick, above); if so, this would provide another link with associations such as those at Towthorpe 18.

Individual burials (Kinnes Stage D) with large, kite-shaped arrowheads have been found at Liffs Low, Derbyshire and Duggleby Howe, Yorkshire (Kinnes 1979, figs 3.2, 3.3, 18.7, 18.8; Kinnes *et al.* 1983, 97). Antiquarian records of excavations are not always reliable (*ibid.*, 94, 105-107; Barnatt 1996, 96-98), but those available suggest that these arrowheads were deposited as grave goods. Bateman's sketch plan of the Liffs Low cist shows the arrowheads as part of an artefact group positioned behind the head (*ibid.*, 98), which also includes an edge-polished knife, partially polished axes and an antler macehead (illustrated in Kinnes 1979, fig. 18.7). Mortimer's description of Duggleby burial G, a flexed male, states that a diamond-shaped arrowhead without its tip lay 'in front of the chest' together with a partially-polished flint adze and an antler mace-head (Mortimer 1905, 28). New radiocarbon determinations from these three sites suggest that the burials are of the later half of the 4th millennium BC (Table 7); there is no overlap with the determinations from Whitwell (Table 1).

<i>Site</i>	<i>Laboratory Id. and Radiocarbon Age BP</i>	<i>cal BC (95%)</i>	<i>Reference</i>
Duggleby G mandible, Yorkshire	Mean of GrA-33104 4470±35, OxA-17243 4485±31, SUERC-13939 4460±35	3345-3210 (or 3175-3160 1% probability)	Gibson and Bayliss 2009, 68 table 1
Liffs Low skull (zygomatic), Derbyshire	SUERC -26173 4510±30	3350-3100	Jay <i>et al.</i> 2010, 128
Towthorpe 18, burial 3 mandible*, Yorkshire	Mean of OxA-17240 4541±31, SUERC-13930 4535±35	3365-3105	Gibson and Bayliss 2010, table 5.1

(*Labelling of the bone had suffered since collection in the 19th century, but this radiocarbon determination is thought to represent the deposition of the primary multiple burial which also included older material [Gibson and Bayliss 2010, 99-100]).

Table 7: Radiocarbon dates from human bone associated with kite-shaped arrowheads in Derbyshire and Yorkshire.

Hence, it is important to examine the context of the large kite-shaped arrowhead at Whitwell: if clearly associated with communal burial, the type must have a long currency. Arrowhead 6, though fragmentary, is certainly kite-shaped; it was from one of the higher, and therefore later, spits excavated within the western end of the mortuary structure (Fig. 12). This deposit, and the second phase mortuary structure were covered with rubble, interpreted as a sealing layer, and there is no evidence that this area was disturbed after cessation of use (Phase 7, above). As explained above and in the catalogue below, the form and condition of 6 strongly suggests that it is from the same arrowhead as non-joining fragment 7: if so, this is additional evidence for its stratification within the mortuary deposit prior to the removal/collapse of the Phase 1 mortuary structure. Fragment 7 was retrieved by sieving the basal fill

of pit 194 and was therefore either in the post-packing (which seems unlikely since this post was related to the primary, Phase 1, structure, while matching fragment 6 came from the higher spits of the mortuary deposit), or more probably, was incorporated into the pit infill when the post collapsed or was removed (*i.e.* in Phase 5). The act of collapse/removal of the post of the mortuary structure may have caused the disturbance which broke, then scattered, this arrowhead, and could also have been the mechanism responsible for incorporating bone and a fragment of arrowhead 8 into the upper infill of pit 194. Hence, both arrowhead fragments 6 and 7 were stratified within the mortuary structure prior to its destruction, estimated by analysis of the radiocarbon dates to have occurred in the mid 4th millennium cal BC (3630-3540 - 95% probability: boundary end, Fig. 13). This is earlier than the Derbyshire and Yorkshire examples of kite-shaped arrowheads cited above (Table 7), although we should be mindful of the inclusion of demonstrably earlier materials with both of the Yorkshire burials. The antler macehead with Duggleby burial G was 'some decades, if not a century or so, old' (Gibson and Bayliss 2009, 68), and burials 4 and 6 at Towthorpe 18 were weathered and considerably older than burial 3 (Gibson and Bayliss 2010, 99-100, fig. 5.23). The possibility that those Yorkshire kite-shaped arrowheads were heirlooms or curated items, perhaps from a time appropriate to the context of the Whitwell arrowhead(s), cannot be discounted.

The fine workmanship of the 'specialist' Duggleby-type artefacts is commonly assumed to be from specialist craft workshops, using the flint from the Yorkshire Wolds and drift around and west of Flamborough Head (e.g. Manby 1974, 98-101; Pierpoint 1980, 184-85; Henson 1989, 10-17; Durden 1995, 410). Indeed some analysis of those flint assemblages has demonstrated specialist elements (Henson 1989, 14; Durden 1995, 427-31), but so far they have been related mostly to Late Neolithic products, even though the studied assemblages were clearly multi-period (Moore 1964, 194-95; Durden 1995, 429). It is therefore of considerable interest that, the two largest of the four arrowheads from Whitwell that have been tested for flint source, seem to match sources derived ultimately, if not directly, from Flamborough Head (Brooks, above) – including kite 6. If this arrowhead was from the Flamborough workshops, then its context and dating at Whitwell, together with the later 4th millennium cal BC radiocarbon dates from Duggleby and Towthorpe, might lead to the deduction that what has formerly been regarded as Later Neolithic focii of production had earlier origins.

Catalogue of drawn items (DG)

Figure 16

- 1 Leaf arrowhead made on a flake with two cortical inclusions - *i.e.* flake had two areas which would have flaked slightly differently and would always have been patterned – either deliberate choice or reflection of available quality of flintwork? Location: palaeosol within mortuary deposit. Context 164a(1)/170, Phase 0, Accession number 842.
- 2 The tip fragment of this arrowhead is linked to the base fragment by the similar patchy cortication. Any joining pieces not located, but the mid-fragment has a similar thickness and colouration (its edge is missing because of a burin-like spall). The tip is worked all over on one side, with working restricted to the margins on the other. The base fragment is worked along the margins only on both sides. With the flattest surface of the base fragment uppermost, the direction of flaking of the primary flake surface matches the partially flaked

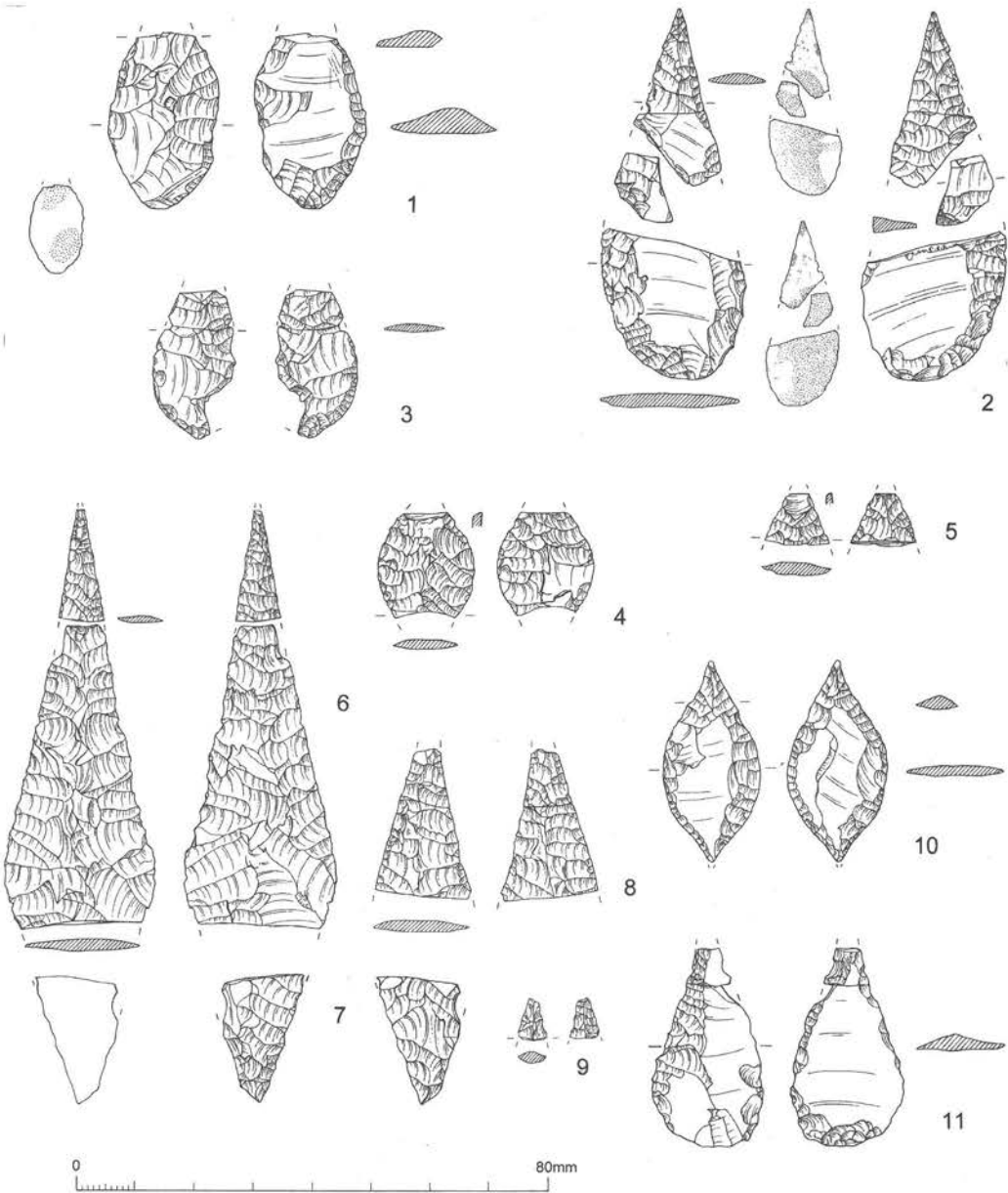


Fig. 16: Flint arrowheads.

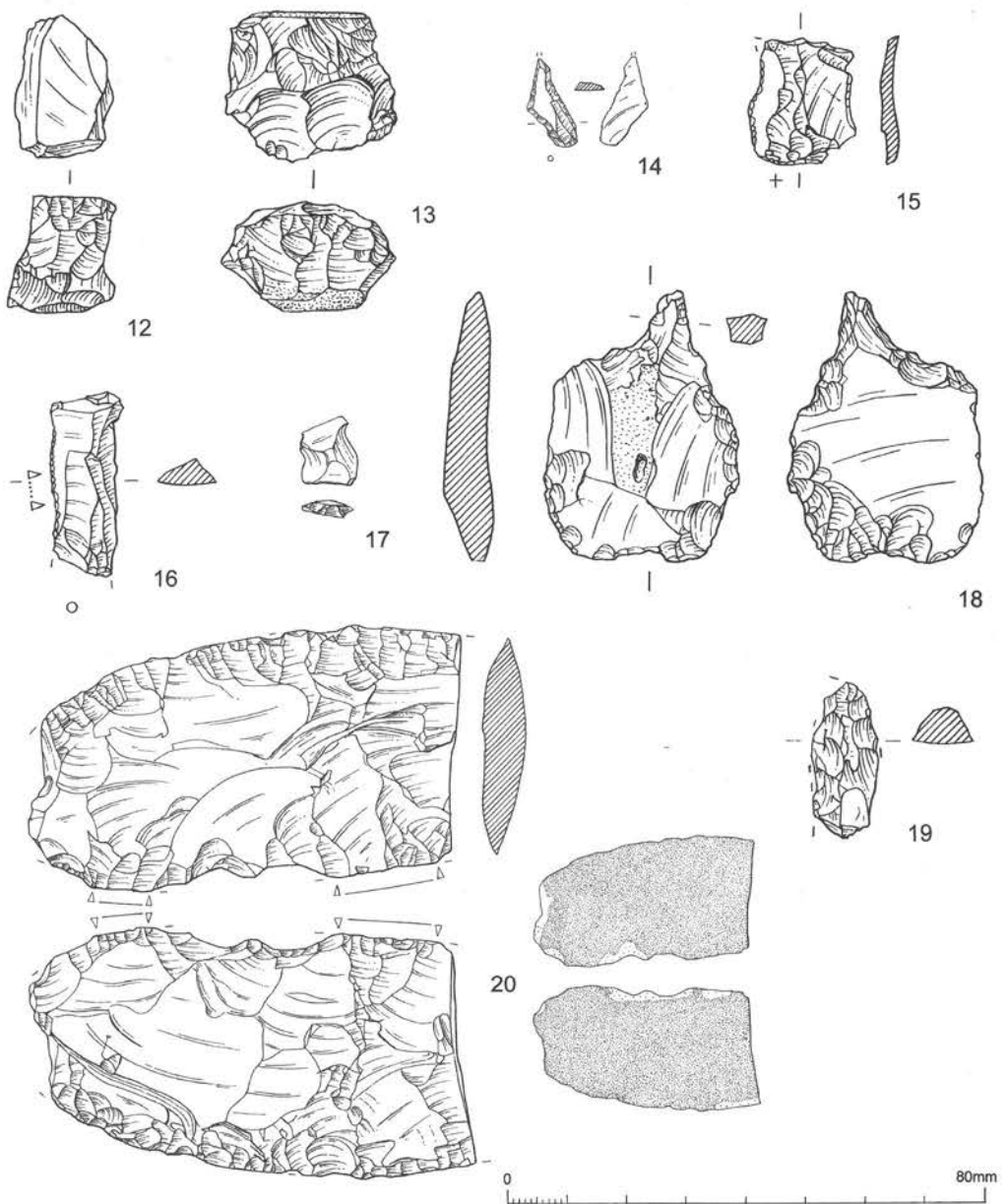


Fig. 17: Other illustrated flint.

side of the tip and a darker flint patch appears on both right-hand sides of the pieces. The primary flake on the other side is more undulating, perhaps it matches the more convex side of the tip? The tip has no sign of impact. Tip sampled for microfossil analysis. Location: linear mortuary deposit. Context 164a(1/2), 164a(2), 164(1/2), Phase 5/6, 6, 5/6, Accession numbers 215/521/400.

- 3 Two joining fragments which have just the basal angle intact. Thin with shallow ripple flaking. Bend-fracture on tip, no other obvious sign of impact. Ancient damage one side. Location: linear mortuary deposit. Context 164a(2), 164a(2), Phase 5/6, 6, Accession numbers 432.2/237.
- 4 Arrowhead body with a curved bending-fracture at one end (?base), and flute-fracture at probable tip. Surface is glossy. It does not join 5, but if they were part of one arrowhead there is a missing joining sliver across the full width of the arrowhead. However, their different surface conditions, the fact that the tip is nearly twice the width of the body at its base as drawn, but more crucially that the maximum breadth of the tip is slightly wider than the body, suggests that they are not actually part of the same arrowhead even though they were found in close proximity (Fig. 12). Location: linear mortuary deposit. Context 164a(1/2), Phase 5/6, Accession number 209.
- 5 The tip has a flute-like impact break at tip. Its surface is horny rather than glossy. See comments on arrowhead 4, above. Location: linear mortuary deposit. Context 164a(1/2), Phase 5/6, Accession number 232.
- 6 Two non-joining fragments, separated by a tiny sliver missing from between the tip and body, but found adjacent and in their relative positions to each other (Plate 8). The burin-like spall from the mid-fragment could be from damage, like crushing under foot, rather than impact. The ripple-flaking is regular, with an even, thin cross-section, and thin edges that are almost serrated; it is highly corticated with some spots of lighter cortication. The similarity in form and condition to 7 strongly suggest they are from the same arrowhead, but this cannot be proven since any joining fragments are missing. Location: linear mortuary deposit. Context 164a(1/2), 164a(1/2), Phase 5/6, Accession numbers 212, 213.
- 7 Ripple-flaked fragment with edges that are almost serrated and an even, thin cross-section. Both ends broken, the tip with a flute fracture and a crack, perhaps indicating impact. It is highly corticated with some spots of lighter cortication. The similarity to 6 suggests that this is a missing base fragment, but despite the near match in condition, size and flaking patterns, there is no join. Since 6 was analysed for its raw material by Brooks (Table 5), it would be possible to sample and analyse 7 to show if this was from the same flint nodule, though this would probably result in the destruction of the piece. Location: sieving of basal deposit of western pit (194) defining linear mortuary deposit. Context 194, Phase 5/6, Accession number 1080.
- 8 Two joining fragments with end of tip missing. Thin, regular ripple flaking with fine, regular edge. Bend fractures, no obvious impact. Virtually identical in size to tips 2 and 6, so was probably from an arrowhead of size 1 (Table 6). The tip lay close (0.1m distant) to the tip of

- 2, but the style of flaking and pattern of cortication makes the suggested matching of tip 2 with the more distant piece most likely. Location: linear mortuary deposit. Tip from context 164a(1/2); mid-fragment from 164d = uppermost fill of western pit (194) defining mortuary structure, both Phase 5/6, Accession numbers 618 and 1003.
- 9 Tip, probably of leaf-shaped arrowhead. No certain matches to other recovered pieces (not from 8 and 11, as 9 is too broad, or 5 as 9 is too wide). Location: sieving of basal deposit of western pit (194) defining mortuary structure. Context 194, Phase 5/6, Accession number 1079.
- 10 The only virtually complete example: it is double pointed, the longest tip being distinctly ogival. There is no significant ancient damage from impact. Location: basal fill of the eastern pit (182) defining the mortuary structure. Context 164b, Phase 5/6, Accession number 936.
- 11 Flake with edge retouch to form leaf shape with tip towards proximal end. Tip flute-fracture. Recent break near tip shows 'sugary' surface suggesting flint very highly corticated. Location: passage. Context 176, Phase 5, Accession number 922.

Figure 17

- 12 Small core with two platforms at right-angles. The flakes from one platform (main face illustrated) appear small and narrow, with much step fracturing, the two major flakes struck from the second platform are broad with no previous flake removals remaining. Rolled, stained, cortical part remaining to right of heavily step-fractured face. Location: trapezoid cairn. Context 1, Phase 9, Accession number 884.
- 13 Small core with single platform flaked from opposite directions *i.e.* keeled. The final flakes (upper face as drawn) have hinge fractures. There is one cortical surface on two surviving faces. Location: passage. Context 164e, Phase 7, Accession number 199.
- 14 Microlith, scalene in shape, but made on a small, squat flake, with a partially truncated proximal end to form one side of the triangle. It is therefore atypical in not being made on a small bladelet with the proximal end completely truncated. It has significant macroscopic edge-damage and rounding (Donahue *pers. comm.*) suggesting it has been weathered/trampled prior to burial. Location: below Phase 3 oval cairn. Context surface, Phase 0, Accession number 1050.
- 15 End-and-side scraper made on a thin, squat flake, with abrupt distal retouch forming an approximately straight end. Both side junctions with distal end has spalls removed perhaps indicating pressure in use. Location: Phase 3 oval cairn. Context 192, Phase 0/3, Accession number 992.
- 16 Blade with serrated edge, and narrow band of edge-gloss on ventral surface only (located between arrows). Edge-gloss is usually thought to result from use (Saville 1981b, 132), but not necessarily cereals (Curwen 1935). Proximal end missing. Location: uppermost level of mortuary structure. Context 1, Phase 9, Accession number 109.

- 17 Spall with faceted butt and dorsal surface with flakes struck from multiple directions, classically from retouching a bifacial implement. Location: Phase 4 oval cairn. Context 188, Phase 0/3, Accession number 1017.
- 18 Proximal end of a broad flake, perhaps struck from a keeled core, has been truncated by inverse retouch to form a stout point. The distal inverse face also has edge-damage, perhaps from pressure from hafting and/or use. The retouch/wear is all in a similar corticated condition to the rest of the flint. Location: outside cairn. Unstratified context, Phase unknown, Accession number 19.
- 19 Tip of a steeply retouched prismatic tool or rod (Saville 1981a, 63). The lack of wear/abrasion at the tip precludes classification as a fabricator: the regularity of the flaking suggests comparison with plano-convex knives (*cf.* Smith 1965, 108), though the steep angle of retouch falls outside that definition (Pierpoint 1980, 124). Saville (1981a, 63) suggests that rods are a Middle Bronze Age type at Grimes Graves, but notes their similarity to (unused) fabricators which are found in widely dated industries (Healy 1980, 255-57). Location ?NW corner of wall. Context 1, Phase 9, Accession number 852.
- 20 This finely made knife is biconvex in section, with extensive shallow flaking completely covering both surfaces, with a different character of flaking along the edges to form a sub-crescentic shape. It is a type often described as a sickle (Clark 1932), though no 'sickle gloss' (*ibid.* 70), is visible on this example. Neither is there any sign of macroscopic wear on the convex side, although the flake arêtes of the surviving edges of the concave side are slightly worn (indicated by lines between arrows in Fig. 17, as in the manner described by Saville 1977, 4), and presumably worn by use, rather than the deliberate grinding and polishing described by Evans (1897, 357). This implies use of the inside edge, though for contact with a malleable, resistant material like hide (as suggested by Saville 1977, 4), rather than its traditionally suggested use of cutting silica-rich grasses. No specific use-wear could be identified microscopically (Donahue *pers. comm.*). It has two phases of cortication (heavy stippled densely, light stippled lightly in half-scale outline), suggesting that its burial environment changed in antiquity (Schmalz 1960, 47); it also has recent damage (not stippled in half-scale outline). Location: trapezoid cairn. Context 1, Phase 9, Accession number 868.

THE HUMAN REMAINS

By Andrew T. Chamberlain and Annsophie V. Witkin

Introduction

This report presents the results of an osteological analysis of the entire human mortuary assemblage. The aims were threefold: to obtain demographic and life history information for the individuals represented, to investigate spatial patterning within the linear mortuary deposit, and to investigate post-mortem taphonomic processes that have affected the bone assemblage.

The material comprised the single complete articulated inhumation from within the oval cairn and more than 900 disarticulated skeletal elements and fragments nearly all of which were

from the area within and surrounding the linear mortuary structure. The bones recovered from the linear mortuary deposit ranged in size from complete skeletal elements to small fragments. Fragmentation was extensive and many bones had been damaged, perhaps due in part to the collapse of the mortuary structure but more likely from episodes of disturbance between phases of use of the mortuary structures. Some skeletal elements had also suffered from extensive cortical erosion. The smooth undulating surface of many bones with distinct oval depressions was likely to have been caused by an acidic soil matrix. On a few bones the loss of cortical integrity was so severe that the normal morphology of the bone surface had been largely lost.

On-site conservation using a polyvinylacetate (PVA) emulsion had been applied to all bones except for a few samples set aside for radiocarbon dating purposes. The application of the consolidant had made it possible to lift many skeletal elements intact which would otherwise have been extensively fragmented and very difficult to identify. Although the consolidant can be removed using organic solvents this is time-consuming and was not undertaken for this study. The use of consolidant has resulted in most of the cortical surfaces of the bones being obscured by adhering deposits of silt and clay. This caused some difficulties in observing bone surfaces for determining age at death, for recording pathology and for detecting possible evidence of cutmarks or other post-mortem activity that might leave traces on bone surfaces.

Skeletal element representation and minimum number of individuals (MNI)

Skeletal part representation in the disarticulated assemblage

All of the skeletal remains, apart from the largely complete skeleton 957, were in a disarticulated state when excavated. Material was identified to skeletal part and entered into a database: 83% of the skeletal remains were anatomically identifiable with the remaining 17% of specimens recorded as anatomically unidentifiable. The skeletal part representation was calculated from the total number of database entries of selected parts of the skeleton, following the procedure established by Mays (1998, 26-32) in his study of burial practices in the Neolithic of southern Britain. Mays calculated the relative proportions of skulls, vertebrae, long bones and hand and foot bones in skeletal assemblages from the Fussell's Lodge and Wayland's Smithy Neolithic long barrows in order to determine whether the pattern of disarticulation was due to post-mortem disturbance of intact inhumations or to secondary burial of excarnated bones. Mays compared the Neolithic assemblages to the skeletal part representation in a large series of intact inhumations from the medieval cemetery of Wharram Percy and to the expected proportions of skeletal parts in complete skeletons. Figure 18 illustrates Mays' data together with the relative frequency of skeletal parts in the Whitwell linear mortuary deposit.

All of the archaeological assemblages show some deficit of hand and foot bones when compared to the expected frequencies for complete skeletons. Mays attributed the reduced frequency of these small bones to the combined effects of preservational and recovery bias. The relative frequencies of skeletal parts in the Wayland's Smithy assemblage corresponded closely to the pattern observed at Wharram Percy, from which Mays inferred that Wayland's Smithy contained disturbed burials that were initially deposited in the long barrow in an intact state: this inference is consistent with the partially articulated state of some of the Wayland's Smithy remains (Whittle 1991). The assemblage from Whitwell cairn has a further deficit of hand and foot bones compared to the frequencies of these skeletal elements at Wayland's Smithy and at Wharram Percy, but this may be attributable to the less favourable conditions of preservation provided by the soils at Whitwell. The deficit of these small skeletal elements at Whitwell is not as marked as at Fussell's Lodge which was interpreted by Mays (1998) as an

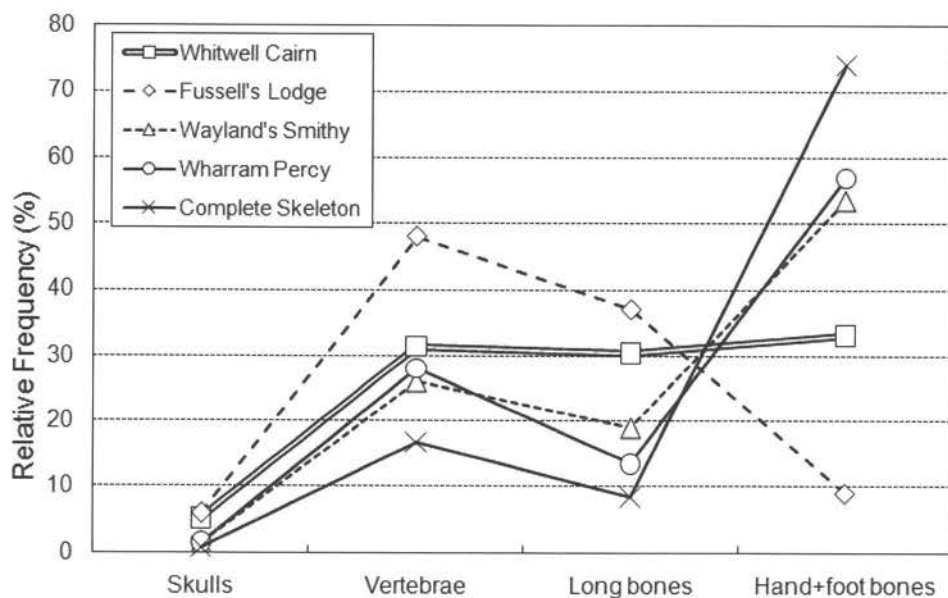


Fig. 18: Relative frequency of skulls, vertebrae, long bones and bones of the hands and feet at Whitwell compared to bone frequencies at other archaeological sites and in a complete skeleton.

assemblage of bones introduced to the monument when they were already in a defleshed and disarticulated state. The Whitwell remains show a pattern of skeletal part representation that is characteristic of an assemblage initially deposited as complete or partially articulated bodies, a conclusion that is supported by the results of the spatial analysis. The extent of under-representation of hand and foot bones in the articulated skeleton is similar to that observed in the disarticulated assemblage, thus the loss of these skeletal elements is unlikely to be attributable to a deliberate process of exhumation.

Minimum number of individuals (MNI) in the disarticulated assemblage

The poor state of preservation of many of the specimens from the linear mortuary deposit made it impossible to assign bones to specific skeletons, although it was possible to identify a limited number of antimeres (matching pairs of left and right side skeletal elements from the same individual). Overall counts of particular bones were made in order to establish the MNI of the assemblage (Table 8). Bones which had a high potential for survival and were easy to identify were used for the calculation. The highest estimates of MNI were obtained using the cranial elements and the teeth, these belonged to a minimum of eleven adults/juveniles and four children, a total of 15 individuals.

This estimate was corroborated by counting the numbers of teeth: there were 15 lower left permanent first molars and 16 upper left permanent first molars in the assemblage (some of these were isolated teeth, for which it was not possible to determine whether they were from adults or from older children). Separate consideration of the ageing data (see below) indicated the presence of 4 children in the assemblage. Thus our final estimate of the minimum number of individuals in the linear mortuary deposit comprised 12 adults and 4 children.

These individuals are distributed approximately equally between Phase 1 and Phase 5 of the mortuary deposit: a minimum of four adults and one child were deposited in Phase 1 and five adults and one child were deposited in Phase 5 (the remaining individuals cannot be assigned to a specific phase).

<i>Skeletal Elements</i>	<i>Adults & Juveniles</i>	<i>Children</i>	<i>Total</i>
Clavicle	4	3	7
Ulna	8	0	8
Tibia	7	2	9
Radius	8	2	10
Femur	9	2	11
Humerus	8	3	11
Ilium	9	3	12
Mandible	10	4	14
Cranium	11	4	15
Lower teeth	-	-	15
Upper teeth	-	-	16

Table 8: minimum number of individuals in the linear mortuary deposit, calculated from different skeletal elements.

The single inhumation (skeleton 957)

This skeleton was more than 75% complete and there were no duplicated anatomical parts, indicating that context 957 contained the remains of a single individual. The cranium had a few fragments missing from the left side and all but five of the teeth were present. The right ulna was missing together with all carpals, metacarpals and all but one of the phalanges. Of the lower limbs, the left hip bone was represented by a few fragments and both patellae and the right fibula were missing. Most of the tarsals and metatarsals and all except one of the foot phalanges were also missing.

Age at death

For immature skeletal remains age at death was assessed by determining the state of development of the dentition (Smith 1991), and the stage of skeletal growth and fusion of epiphyses and secondary ossification centres (Hoppa 1992; Scheuer and Black 2000). For adult individuals the degree of dental wear (Miles 1963) was the principal method used for estimating the age at death. Although the relationship between dental wear and age depends on the diet and cultural practices of any particular population, the wear gradients along the molar tooth rows in the Whitwell sample were broadly similar to those observed by Miles and therefore justified the application of this ageing method. It was not possible to estimate adult age at death from other conventional age indicators, such as the condition of the pubic symphyses or the auricular surfaces, as these regions were not sufficiently well preserved in this assemblage. Broad age categories were employed, with individuals being allocated to four sub-adult and three adult age categories (Table 9).

The single inhumation (articulated skeleton 957)

The half-formed root of the maxillary third molar of skeleton 957 indicated an age of about 16 years (Smith 1991, 161). The ossification of the postcranial growth plates was mixed.

Fusion had started in the proximal end of the right tibia, and at this location epiphyseal fusion is normally completed by 17 years in females (Scheuer and Black 2000, 408). The epiphyses of the distal radius, the head of the humerus and the distal femur were unfused: these epiphyses normally fuse between 16 years and 18 years in females. Taken together the estimates converge on an age of between 16 and 17 years.

Linear mortuary deposit

The ages at death were estimated for the children, the juveniles and for eight of the adults, while for a further three adults it was not possible to assign a more precise age estimate (Table 9). Although most age categories were represented in the assemblage there were no identifiable remains of infants and the numbers of children were fewer than expected on the basis of theoretical demographic models for early agricultural populations (Chamberlain 2006). The lack of infant remains might be expected as it is common for this age category to have received different mortuary rites from older individuals in a population (Finlay 2000, for discussion) and even if infants had been deposited in the cairn the preservation conditions at the site would have militated against the survival of their small and delicate bones.

<i>Age Category</i>	<i>Age Range</i>	<i>Number of Individuals</i>
Infant	Birth – 11 months	0
Young child	1 – 6 years	1
Older child	7 – 12 years	3
Juvenile	13 – 17 years	2
Young adult	18 – 25 years	2
Prime adult	26 – 45 years	5
Older adult	46+ years	1
Adult (not aged)	18+ years	2
Total:	All ages	16

Table 9: assessment of ages at death for the linear mortuary deposit.

Estimation of sex of the adult skeletal remains

The morphological characteristics of the hip bone and the cranium of the articulated skeleton 957 were consistent with the individual being female. The hip bone had a wide sciatic notch, a small acetabulum which faced anterolaterally and a small ischial tuberosity. The skull had small mastoid processes together with marked frontal and parietal bossing as well as slight supraorbital ridges and a smooth glabellar profile. The vertical diameter of the head of the humerus was also within the female range.

The crania and pelvises of the adult disarticulated remains were sexed by a visual assessment of sex diagnostic criteria and the resulting sex distribution was corroborated by examining the diameters of the heads of the femur, humerus and radius (Krogman and Isçan 1986). The crania and mandibles produced the largest number of sexed individuals, of which five were female, one probably female and five were male. The results from the pelvis and long bones confirmed that there was an approximately equal representation of adult males and females in the linear mortuary deposit.

A more or less equal representation of adult males and females is characteristic of some other multiple inhumation deposits in the British Neolithic, including Fussell's Lodge, West Kennet Long Barrow and Wayland's Smithy.

Estimation of adult stature

For the calculation of stature, the maximum lengths of all complete adult long bones were measured and converted to stature estimates using regression formulae for white females and males (Trotter 1970). Additional near-complete bones were also measured and their total length estimated by comparison with intact bones of similar size and shape. Since it was not possible to reassemble the skeletal elements into complete individuals, some of the bones measured may have been from the same individual. Moreover, it was only possible to estimate the sex of four of the disarticulated long bones. For the unsexed bones, the average of the female and male stature estimates is given. The bone lengths and stature estimates are presented in Table 10.

<i>Element</i>	<i>Number</i>	<i>Side</i>	<i>Sex</i>	<i>Maximum Length (mm)</i>	<i>Stature (mm)</i>
Femur	0214,0253 [#]	R,L	F	453	1660
Femur	0701/1	R	F	450	1650
Tibia	0398	R	?	344*	1680
Tibia	0475	R	?	395*	1770
Tibia	0957	L	F	355*	1680
Humerus	0957	R	F	324	1700
Humerus	0257	L	?	315*	1650
Humerus	0448, 0760 [#]	R,L	M	320*	1675
Radius	0443	R	?	240*	
Ulna	0366	L	?	268	1725
Ulna	0436	L	?	256*	1680

Table 10: stature estimates (*=estimated length, #=antimeres).

The three individuals sexed as females had an average stature of 1667mm. This is a relatively high value for a prehistoric population, but it is noticeable that both the average and the range of statures for the Whitwell female sample are close to those observed in the sample of females from Wayland's Smithy (Table 11). The Whitwell individual sexed as a male had an estimated stature of 1675mm, but this single estimate may be atypical of the average for this population as there are an additional two *unsexed* individuals whose statures of 1725mm and 1770mm are well above the maximum values for females found in other British Neolithic samples. If these additional individuals are regarded as males then the average stature for males in the Whitwell assemblage would be 1725mm.

Skeletal pathology

Degenerative joint disease

There were few signs of degenerative joint disease in the skeletal sample, but many long bones were missing their epiphyseal ends and the number of specimens sufficiently intact to allow recognition of joint disease was limited. Porosity of the joint surfaces, without eburnation and osteophyte formation, was observed on six non-spinal skeletal elements. One distal femur (0520/2) had a localised area of porosity as well as slight lipping of the lateral edge of the medial condyle at the bicondylar fossa. These changes may be diagnostic of early stage osteoarthritis.

The vertebrae available for examination were in many cases severely fragmented. Nevertheless, all were observed for any pathological lesions present. The results indicated a low incidence of spinal joint disease. Changes were present at the areas of the vertebral

<i>Site</i>	<i>Stature of Males in mm</i>	<i>Stature of Females in mm</i>
Whitwell	?1725 (1675-1770, n=3)	1667 (1650-1690, n=3)
Hazelton North ¹	1726 (1698-1774, n=4)	1595 (1595, n=1)
West Kennet Long Barrow ²	1687 (1565-1797, n=9)	1547 (1485-1643, n=8)
Wayland's Smithy ³	1705 (1660-1770, n=8)	1662 (1620-1690, n=5)
Fussell's Lodge ⁴	1711 (1634-1816, n=10)	1572 (1485-1620, n=10)

Table 11: average stature of males and females in British Neolithic skeletal samples (ranges of individual stature estimates and numbers of individuals in samples are given in parentheses).

Sources: 1: Rogers (1990); 2: Wells (1962); 3: Brothwell and Cullen (1991); 4: Brothwell and Blake (1966).

column where the greatest levels of mechanical stress are found; in the mid-cervical, mid-thoracic and lower lumbar vertebrae. Lesions consisted of mild porosity, either on the vertebral body or the articular processes (three cervical, five thoracic and two lumbar vertebrae). This porosity is caused by the normal degenerative changes which occur with ageing.

Schmorl's nodes, or indentations, were also present on six lumbar vertebrae. These are stress-related defects caused by herniations of material from the intervertebral disc (Rogers and Waldron 1995, 27). In addition to Schmorl's nodes one of the lumbar vertebrae also had slight osteophyte formation. A combination of the two are a normal degenerative change associated with ageing.

In their review of health and disease in British Neolithic human skeletal material Roberts and Cox (2003, 71) found low frequencies of degenerative joint disease with 2% of individuals exhibiting non-spinal joint changes and 7% showing spinal joint disease. The Whitwell sample corroborates this evidence.

Metabolic disease

Evidence for anaemia may appear on the roofs of the orbits (eye sockets) as the condition known as cribra orbitalia, and on the outer surface of the calvaria, especially on the parietals a condition is known as porotic hyperostosis. (Aufderheide and Rodríguez-Martín 1998). Orbits of the articulated skeleton 957 exhibited impressions and perforations consistent with cribra orbitalia. The lesions were graded using the system devised by Stuart-Macadam (1991). The right orbital roof had capillary impressions present (grade 1) and the left orbit had scattered fine foramina (grade 2). The lesions did not appear to be active at the time of death. Cribra orbitalia has a low frequency in British Neolithic populations (Roberts and Cox 2003, 67) and it is therefore unsurprising that only a single example was identified in the Whitwell sample.

Three crania had thickening of the diploe (the spongy bone between the inner and outer tables of the cranial vault: thickening of the diploe is one of the characteristics of porotic hyperostosis). This thickening was present on the occipital and parietals in one individual (0316/1, adult) and across the parietals on the other two (0265, adult and 0698/1, adult male). Diploic expansion has been noted amongst other British Neolithic crania, including two of the individuals from Fussell's Lodge Long Barrow (Brothwell and Blake 1966).

Neoplastic disorder

A solitary neoplasm was present at the proximal end of the right tibia of articulated skeleton 957. Macroscopically, the lesion consisted of a bony outgrowth arising from the region of the tibial tuberosity causing flaring of the cortex. The growth plate also remained unfused (Plate 13). The radiograph shows that the trabecular structure and medullary cavity within the exostosis is continuous with the surrounding normal bone. The appearance of the lesion is consistent with an osteochondroma, a benign bone tumour of cartilaginous origin. This specimen is the earliest known occurrence of the disease in a European skeleton (Chamberlain *et al.* 1992, 53). Osteochondroma arises from a faulty ossification of the growth plate during the growth period in childhood and the distal metaphysis of the femur and proximal metaphysis of the tibia are the most common locations of the disorder (Aufderheide and Rodríguez-Martín 1998, 381). The lesion is not likely to have caused discomfort or severe disability for this individual.

A possible trepanation

There was a subcircular perforation through the frontal bone immediately above the left orbit on 843/1, the cranium of a child aged around 12 years. The external circumference averaged 35mm and was substantially larger than the inner diameter where it averaged 20mm, so that the perforation had a markedly bevelled edge. There was no macroscopic evidence of tool marks and the edges were sharp with no sign of healing (Plate 14). The lesion is consistent with the scrape method of trepanation using a stone tool, and the position of the perforation is not unusual, with similar locations being present on Danish middle/ late Neolithic crania (Bennike 1985). The left side of the cranium is also a more common location than the right, perhaps reflecting a hand preference in the surgical operator.

However, a range of different processes can give rise to holes in the cranium (Kaufman *et al.* 1997). A glancing blow from a sharp-edged weapon can produce a similarly shaped bevelled hole, and natural processes such as continuous pressure from a sharp stone adjacent to the skull or from selective chemical erosion of a localised region of the cranium can sometimes mimic this type of defect (Brothwell 1981, 122). The lack of tool marks and any indications of healing, coupled with the incomplete nature of the cranium and evidence for post-mortem chemical erosion on other parts of the cranium imply that the perforation could have been produced by the burial environment rather than as a consequence of deliberate human activity (Schulting and Wysocki 2005, 114).

Dental pathology

A total of 325 teeth were recorded of which 116 were isolated teeth separated from the jaws. The majority of the loose teeth were identified anatomically and recorded. Only 11 teeth were not identifiable, largely as a result of obliteration of diagnostic features of the tooth crown through excessive wear.

Dental caries

Dental caries occur as a result of acids produced by bacterial fermentation of dietary carbohydrates causing demineralisation and cavitation of the dental tissues. The carious lesions were classified according to the grading system produced by Lukacs (1989, 267). Location of the lesion on the tooth was also recorded according to which surface of the crown or root was affected. Caries prevalence rates were calculated by considering the total number

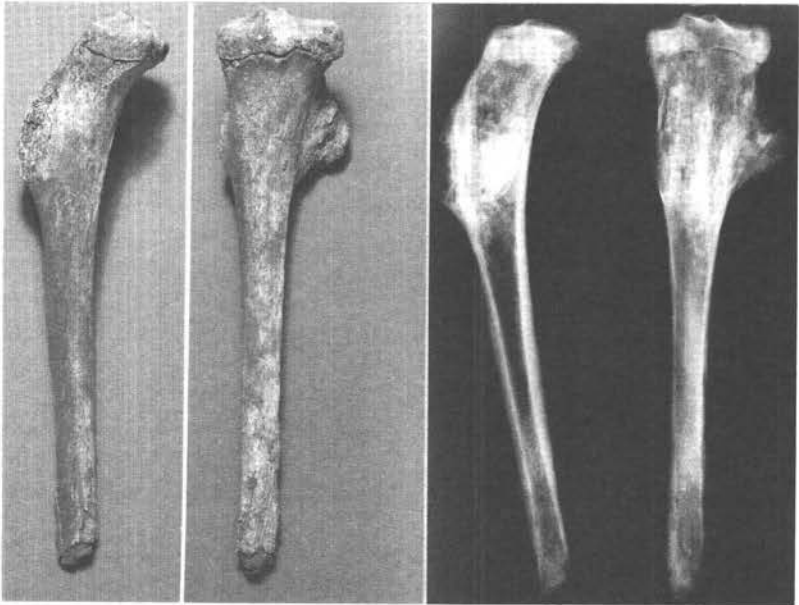


Plate 13: Medial and posterior photographs and radiographs of the osteochondroma on the right tibia of skeleton 957.

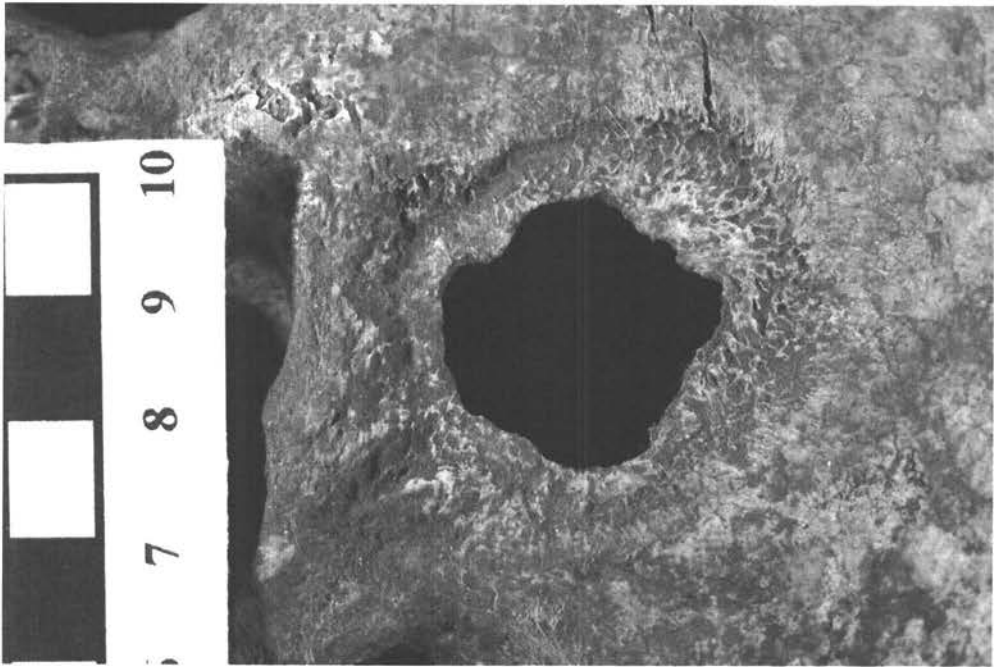


Plate 14: A possible trepanation on the left frontal bone of 834/1.

of carious teeth over the total number of identified teeth, including those *in situ* in the jaw (including partially erupted teeth that had emerged through the gum but excluding unerupted teeth) as well as the loose teeth. It cannot be known whether a tooth lost *ante-mortem* or *post-mortem* was carious: the calculation therefore provides an approximate measure of the prevalence of active lesions in the sample.

A total of ten carious lesions was recorded for the 296 identified and erupted permanent teeth and 18 deciduous teeth present. This gives a caries prevalence rate for the sample as a whole of 3.3% of all teeth (3.0% of permanent teeth and 5.6% of deciduous teeth). Three lesions were located on teeth *in situ* in the jaw. For both upper and lower dentition dental caries occurred most frequently in the molar teeth, with the most affected tooth being the first molar followed by the second and third molars. The caries rate for the anterior teeth (incisors, canines and premolars) was very low with only two teeth affected out of 157 (1.3%).

Of the nine lesions observed in the permanent dentition, five were recorded as stage 1 severity and four as stage 2 (after Lukacs 1989). The lesions were most commonly located at the cement-enamel junction (78%) and only one occlusal and one buccal lesion were present. The location of lesions is closely linked with the amount of dental wear in the population, which is in turn influenced by the diet (see below). Since dental attrition was heavy in all of the adults, any pits and fissures on the occlusal surfaces of the molars (a common site for the development of dental caries in modern populations) would have worn away rapidly, thus preventing the formation of caries on the occlusal surfaces.

Only one caries lesion was present out of 18 deciduous teeth and was situated on the occlusal surface in the form of a pit. Due to the low number of deciduous teeth it is not appropriate to draw any conclusions from a comparison with the permanent teeth.

Ante-mortem tooth loss

Loss of permanent teeth before death, or *ante-mortem* tooth loss, may be caused by dental caries, periodontal disease, severe attrition and trauma. Deliberate tooth avulsion may also have been practiced for clinical or aesthetic purposes. *Ante-mortem* tooth loss is usually correlated with advancing age, although other factors such as poor oral hygiene may play a part in its incidence.

The prevalence rate of *ante-mortem* tooth loss was calculated by dividing the total number of teeth lost *ante-mortem* by the sum of the total number of *in situ* teeth, tooth roots and empty sockets (Table 12). The overall prevalence of *ante-mortem* tooth loss was 15 out of 243 teeth (6.2%). Tooth loss was more common in the mandibular dentition than in the maxillary dentition, and the data fit the expected pattern of a greater *ante-mortem* loss of molars (9.6%) than of anterior teeth (4.0%).

Dental abscesses

Dental abscesses form when bacteria gain entry to the pulp cavity of the tooth, usually as a consequence of dental caries, severe attrition or fracture of the tooth, (Hillson 1996, 284). A dental abscess may also form as a result of periodontal disease and the formation of a periodontal pocket in which an accumulation of plaque initiates the abscess (Roberts and Manchester 1995, 50).

The prevalence rates for dental abscesses were calculated in the same way as the *ante-mortem* tooth loss rates. A total of 7 abscesses was recorded out of 251 teeth, which provides an overall prevalence rate of 2.8%.

Dental calculus

Dental calculus consists of mineralised plaque which accumulates either above (supra-gingival) or below (sub-gingival) the margin of the gum. Deposits of calculus are most often situated close to the salivary glands, since the mineral is ultimately derived from saliva (Hillson 1996, 255). The deposits of calculus may predispose the individual to develop gingivitis (inflammation of the gum), and subsequently periodontal disease (Lukacs 1989). Regular cleaning of the teeth removes plaque deposits and prevents the formation of calculus. Therefore calculus deposits are an indication of poor oral hygiene.

The degree of calculus formation was recorded according to standards set out by Brothwell (1981). Three grades were recorded: 'slight' (1), 'medium' (2) and 'considerable' (3). Prevalence rates were based on totals for affected teeth expressed as percentages of the total number of *in situ* fully erupted teeth and loose teeth. Of all permanent teeth 29.3% had calculus deposits present (85/290). The overall distribution of calculus deposits of the maxillary teeth corresponds very well with the locations of the salivary glands. The highest rates were on the molars and deposits were commonly located on the buccal sides of these teeth. The mandibular teeth showed a more equal spread of deposits, but with a high prevalence rate on the anterior teeth, again corresponding to the location of salivary glands.

Of the 18 deciduous teeth, only two had slight calculus deposits present and these were molars from the same individual.

Periodontal disease

Periodontal disease is caused by the accumulation of calculus and/or bacteria between the teeth and the gum line. This accumulation causes gingivitis, which in an advanced stage involves the bone and is then classified as periodontitis (Hillson 1996, 262). The disease is characterised by horizontal loss and/or porosity of the alveolar bone. As the bone is resorbed, the teeth loosen and are eventually lost. In present day populations periodontitis is very common in adults over 30 years of age, and there is a gradual increase in the proportion of the population affected up to 40 or 50 years. The disease is also more common in men than in women (Hillson 1996). Eight of the eleven adults in the Whitwell assemblage had periodontal disease (72.7%). Of those with the disease, five were male and three were female. Four of the individuals were in the age category Prime Adult (PA), one Older Adult (OA) and two Young Adult (YA).

Enamel hypoplasia

Pits, grooves and lines marking the surface of the enamel of a tooth crown are classified as enamel hypoplasia. These are developmental defects which arise during the formation of the enamel matrix. The defects occur when the teeth are developing during childhood (birth to about 13 years) and are caused by severe non-fatal systemic stresses such as acute nutritional deficiencies and infections (Aufderheide and Rodríguez-Martín 1998, 405). The prevalence rates for the teeth were calculated in the same way as for dental calculus.

Of the tooth crowns examined, 1.4% had enamel hypoplasia (4/290). The defects were expressed as faint single lines and were confined to three individuals. The teeth affected were the mandibular central incisor, lateral maxillary incisor and right and left maxillary canines.

Comparative data on dental pathology

Table 12 compares rates of dental pathology at Whitwell with rates at other Neolithic

mortuary sites in Britain. The prevalence rates for dental pathological lesions are based upon total numbers of teeth, counting both maxillae and mandibles together, while the rates for periodontal disease and enamel hypoplasia are calculated on a per individual basis. Samples from Whitwell, Hazelton North and West Kennet include only adults but the other two sites, Wayland's Smithy and Fussell's Lodge, may include children.

<i>Site</i>	% teeth with caries	% teeth with AMTL	% teeth with abscess	% inds. with periodontal	% inds. with hypoplasia
Whitwell	3.0% (9/296)	6.2% (15/243)	2.8% (7/251)	72.7% (8/11)	18.7% (3/16)
Hazelton North	0.6% (1/181)	22.5% (92/409)	8.1% (33/409)	63.6% (21/33)	6.00% (3/50)
West Kennet	0.5% (1/190)	7.4% (25/336)	2.8% (9/318)	23.8% (5/21)	- -
Wayland's Smithy	4.7% (6/129)	8.7% (11/127)	7.0% (9/129)	64.3% (9/14)	28.6% (4/14)
Fussell's Lodge	3.9% (7/179)	14.3% (37/259)	1.9% (5/259)	30.0% (6/20)	20.7% (6/29)

Table 12: dental pathological comparisons.

The caries prevalence rate at Whitwell is similar to the overall rate of 3.6% (35/961) previously determined for the British Neolithic (Brothwell 1962). The rate of *ante-mortem* (AMTL) tooth loss at Whitwell is lower than in the other Neolithic samples, and the abscess rate is average. On an individual basis, the prevalence of periodontal disease is high with most of the adults showing the disease, a pattern which is also common amongst the skeletal assemblages from the other sites. Similarly, the dental enamel hypoplasia rate is comparable with the other rates observed.

Dental wear and subsistence

Dental wear is caused primarily by the combination of attrition (tooth to tooth contact) and abrasion (tooth and food contact, including exogenous material such as grit in the diet) (Hillson 1996, 231). Severity of wear of the occlusal (biting) surfaces of teeth is determined by food consistency and texture which may be modified by food preparation (Larsen 1997, 249). The shift in subsistence from hunting and gathering to farming is thought to have produced a reduction in dental wear due to the change from fibrous plant material to the use of domesticated grain as well as changes in food preparation technology (Larsen 1997, 250).

Although the teeth of both Mesolithic and Early Neolithic populations may express a similar severity of wear, the detailed pattern of wear on the teeth is often different. The softer food consistency of agricultural diets produces a more oblique or cupped molar wear pattern than the flatter molar wear pattern typical of hunter-gatherer populations (Smith 1984; Chamberlain and Witkin, 2003). This difference is due to the mechanism of chewing. The initial phase of mastication is that of puncture-crushing, in which teeth in opposing jaws

do not contact each other while repeatedly chop the food stuff. In the second phase of the chewing cycle, teeth shear and grind across each other generating oblique wear facets on their occlusal surfaces. Consequently, diets with a high proportion of tough fibrous food have a longer phase of puncture-crushing than diets consisting of softer food, the former producing a flatter wear plane while the latter generate a more oblique plane.

An additional effect of high occlusal loads is interproximal wear facets between the crowns of teeth adjacent to each other in the jaw. These are distinctive, small, oval and highly polished facets which flatten the margins of tooth crowns. This polishing is produced by lateral movements of the teeth and the amount of interproximal wear depends on the magnitude of force exerted by loads on different teeth in the jaw. Hunter-gatherers typically practice vigorous mastication which generates relatively more interproximal wear at a given level of occlusal wear (Hinton 1982).

Molar wear patterns

The mandibular dentitions from Whitwell were scored for occlusal wear using the system devised by Smith (1984). Tooth wear was scored on a scale from one (no wear) to eight (complete loss of crown). In addition, the angle of wear on all *in situ* first left mandibular molars, which also had their right side, was measured using a duplication of the method outlined by Smith (1984).

Six mandibular first molars were available for measurement of the angle of wear plane. Although this is a small sample size, extremes of the wear stages were present thus allowing calculation of the trend of occlusal wear. The trend for the Whitwell individuals was compared with trends published by Smith (1984) for British and French Neolithic agriculturalists and a sample of French Late Mesolithic individuals (Fig. 19). The molar occlusal wear plane angles in the Whitwell individuals resemble those observed in the Mesolithic population, with a relatively flat angle of wear even when the occlusal wear had reached the maximum value of stage eight. This suggests that a diet with a high proportion of tough fibrous food was consumed by the Whitwell individuals (Chamberlain and Witkin 2003).

Interproximal facet widths were measured on ten Whitwell individuals at the contact between second premolar and first molar and on seven individuals at the contact between first molar and second molar. As with the variation in occlusal wear plane angles, the interproximal facet width was plotted against molar occlusal wear stage (Fig. 20) showing that the Whitwell sample has interproximal wear that falls between values established for North American hunter gatherers (Archaic and Woodland periods) and agriculturalists (Mississippian period).

Dental microwear

Microscopic wear on dental enamel can be used to investigate the effects of different diets and food preparation techniques, working on the principle that hard particles in the diet can generate a signature in the form of microscopic pits and scratches in the enamel on the occlusal surfaces of the teeth (Teaford 1991). Epoxy resin replicas were prepared from a sample of 15 maxillary and mandibular first molars from Whitwell and imaged using scanning electron microscopy (Nystrom and Cox 2003). The Whitwell teeth matched other prehistoric samples in having larger dimensioned pits and striations compared to material dating to historical periods, but the Whitwell sample did not exhibit either the density or scale of features that might be expected if the individuals were experiencing particularly high occlusal loads.

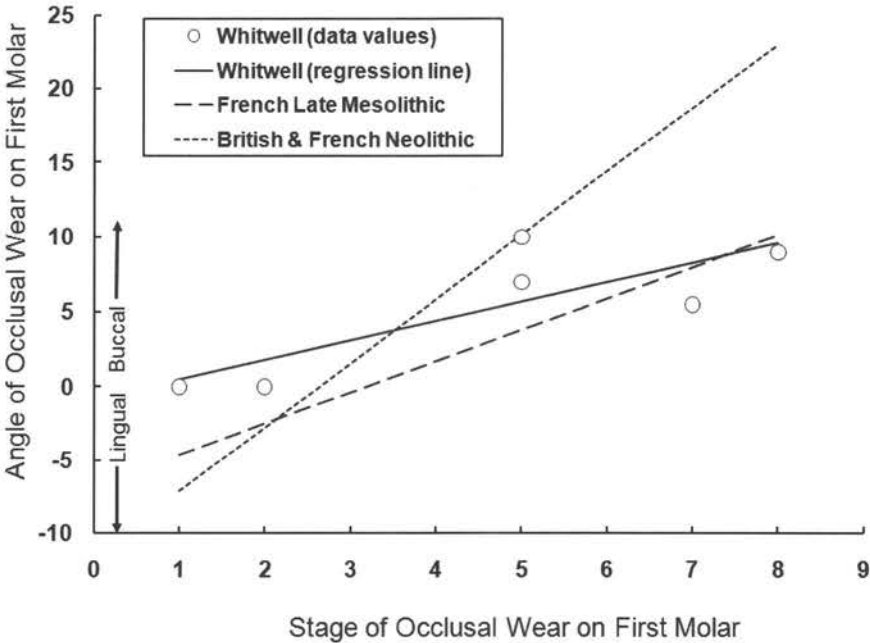


Fig. 19: The angle of occlusal wear on first molars plotted against the stage of occlusal wear for six individuals from Whitwell compared with samples of British and French early agriculturalists and a French Late Mesolithic sample.

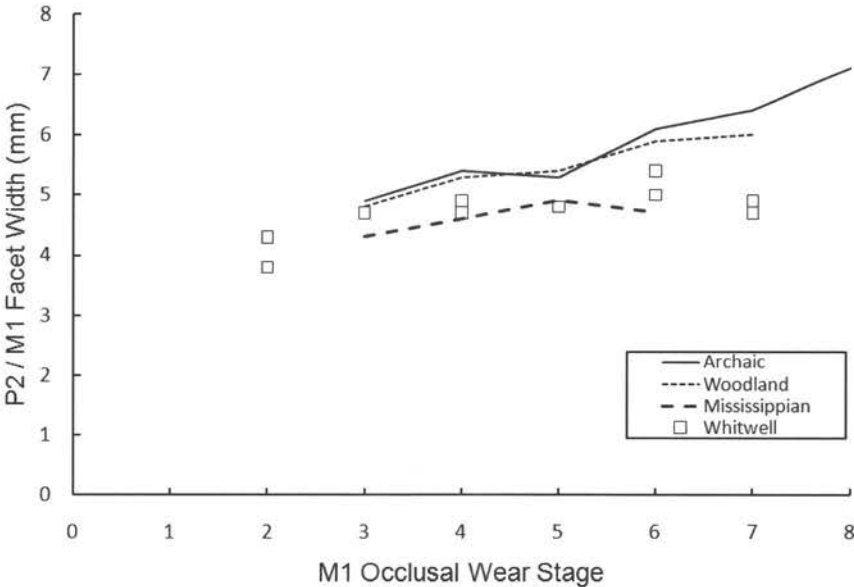


Fig. 20: Interproximal facet width on the first molars of Whitwell individuals compared to North American hunter gatherers (Archaic and Woodland periods) and agriculturalists (Mississippian period).

Extramasticatory wear

Non-dietary wear of the teeth has been recorded amongst a variety of human populations including Inuit, native North Americans and Mesolithic Northern European people (Larsen 1997, 258). The wear is produced by the teeth being used as tools, and it results in a distinctive pattern of abrasion, crown fractures and traumatic tooth loss (Milner and Larsen 1991).

In scoring both the loose and the *in situ* teeth for dental wear it became apparent that the wear pattern varied considerably depending on the sex of the individuals. The two complete maxillae from prime adult females displayed extremely heavy wear of the incisors and canines (Plate 15). The single male maxilla from a prime adult displayed no marked reduction of crown height of the anterior dentition (Plate 16). Though it is impossible to draw any firm conclusions from such a limited sample, the differences of wear suggests a gender-specific non-dietary use of the teeth. This pattern of wear has also been detected amongst the Mesolithic population of Skateholm, Sweden (Fraser 1988). Though one can only speculate regarding what activities produced the reduction of crown height amongst the females, historical evidence from North America indicates the use of the anterior dentition for the preparation of hides. Moreover, San foragers in South Africa used the teeth to prepare plant fibres for ropes. In both populations these were primarily female activities (Larsen 1997, 257).

Pre-mortem tooth damage in the form of slight chipping of the occlusal margins were evident from the anterior dentition of a young adult male. This type of trauma is archaeologically associated with excessive masticatory loads such as crushing of bones or non-dietary activities such as hide processing (Larsen 1997, 267).

Spatial patterning within the linear mortuary deposit*Methods of spatial investigation*

The database of identified skeletal parts and the coordinates of the centre of each skeletal element on the site grid were used to investigate the spatial patterning of human remains within the linear mortuary deposit. In this investigation the skeletal remains from the earlier (Phase 1) and later (Phase 5) periods of deposition were analysed separately. The spatial distributions of selected skeletal elements and age and sex classes within grid squares 499/507 to 503/510 are presented in Figures 21 and 22. These grid squares included the deposit containing the main concentration of disarticulated bone together with its flanking pit features at the western and eastern ends of the mortuary structure: outlines of the flanking pits and margins of the main bone concentrations are indicated on the figures by dashed lines. In our spatial analyses we did not distinguish between complete bones and bone fragments, and it should be borne in mind that some skeletal parts, such as cranial bones and ribs, may break into many fragments thereby giving an exaggerated impression of clustering in the spatial distribution maps.

Although it was not possible to assign bones to individual skeletons some of the specimens were matched to a common individual through cross-matching across joint surfaces and post-mortem breaks, and through the identification of antimeres. The most reliable methods of skeletal refitting are those that cross-match fragments of a single skeletal element across unabraded post-mortem fracture surfaces, and those that match adjoining skeletal elements across closely approximated joint surfaces. Examples of the latter are the refitting of multiple-rooted teeth into their corresponding tooth sockets, and the matching of adjacent cranial vault bones across complex interdigitating cranial sutures. Less reliable refitting methods are those which match adjacent parts of the skeleton at joints which permit a greater degree of

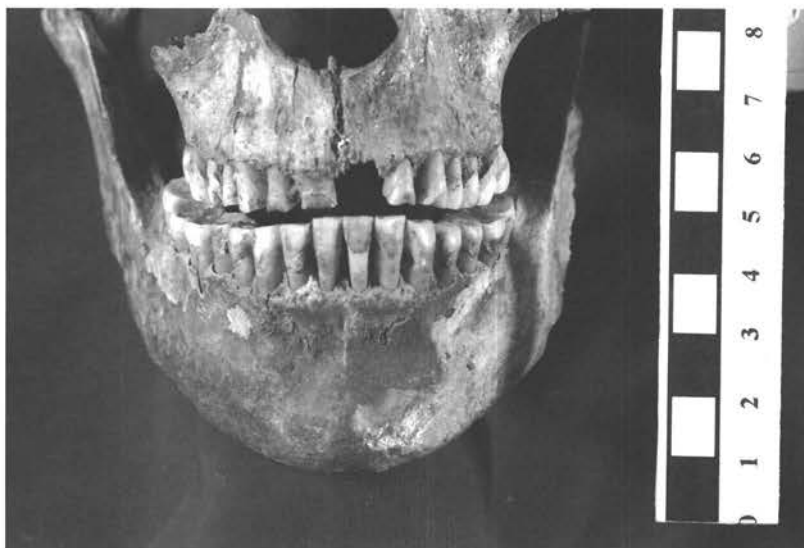


Plate 15: Strongly worn maxillary anterior dentition in an adult female (219/485).



Plate 16: Lightly worn maxillary anterior dentition in an adult male (334/395).

movement, for example matching the head of the femur to the acetabulum (socket on the hip bone), where a variable depth of soft tissue is interposed between the adjacent bone surfaces. Adjacent teeth originating from the same jaw can be matched by closely comparing the degree and orientation of occlusal wear and the presence of matching inter-proximal wear facets on the margins of the tooth crowns. Upper and lower jaws from the same individual can sometimes be matched by comparing corresponding wear facets and by examining the pattern of occlusion present in the individual. Antimeres were identified by establishing mirror-symmetry between the features of left and right side specimens.

Distribution of skeletal parts

The overall distribution of the 265 skeletal elements within the selected grid squares assigned to Phases 1 and 5 (these elements comprise 30% of the total skeletal assemblage: most of the remains were not assignable to a specific Phase) shows that the distribution of skeletal parts is not even, and distinct areas of bone concentration are visible in each phase (Figs. 21 and 22).

Phase 1

The skeletal elements assigned to Phase 1 formed three discrete and well-separated clusters in the centres of squares 500/508 and 501/508 and at the northeast corner of square 502/508. The cluster of remains in square 500/508 consisted mainly of limb bones, while the cluster at the northeast corner of 502/508 was dominated by vertebrae and ribs. The largest cluster of Phase 1 remains, in the centre of the mortuary deposit, included a mixture of all skeletal elements except for humerus and scapulae. Within the clusters of remains there was close grouping of elements that are anatomically adjacent to each other, such as vertebrae and ribs, radii and ulnas, femurs and hip bones and tibias and fibulas. This suggests that whole bodies or body segments were initially deposited in this phase, and that post-depositional disturbance has been relatively slight, especially for the larger skeletal elements.

This proposed lack of disturbance is confirmed by the results of cross-matching and comparison of antimeres. Elements that could be cross-matched were confined to the discrete clusters, and most of the cross-matched elements were separated by distances of 10cm or less (Fig. 23). Two elements in Phase 1 had antimeres that were not assignable to a phase, but like the cross-matches these antimeres were separated by only small distances (Fig. 24). Most importantly, there were no skeletal elements in Phase 1 that cross-matched or had an antimeres in Phase 5 or *vice versa*.

Phase 5

In Phase 5 a more diffuse distribution of skeletal remains occupied squares 501/508, 502/508 and the western half of 503/508 (Fig. 22). This distribution had the appearance of being banked up against the southern boundary of the mortuary deposit. The evidence from cross-matching and antimeres suggested there may have been substantial movement of remains along the axis of the mortuary deposit. Elements anatomically adjacent to each other such as the humerus and scapula, radius and ulna and femur and hip bone were nonetheless closely associated with each other in this phase of the deposit. As with Phase 1, this suggests that whole bodies or body segments were initially deposited in Phase 5 and that this association had not been completely obscured by subsequent disturbance of the remains. Some clustering of the remains of sub-adults, adult males and adult females was also evident: for example, remains of adult females were concentrated in square 502/508. The cross-matching data (Fig. 25) showed separation of fragments of the same bone by distances up to or exceeding one metre, most of these movements being along the east-west axis of the deposit. An identical pattern of dispersal was seen in the comparison of antimeres in Phase 5 (Fig. 26) suggesting that post-depositional disturbance also caused the dispersal of formerly adjacent parts of the same bodies.

Discussion of spatial patterning

The spatial patterning of the human skeletal remains within the linear mortuary deposit at

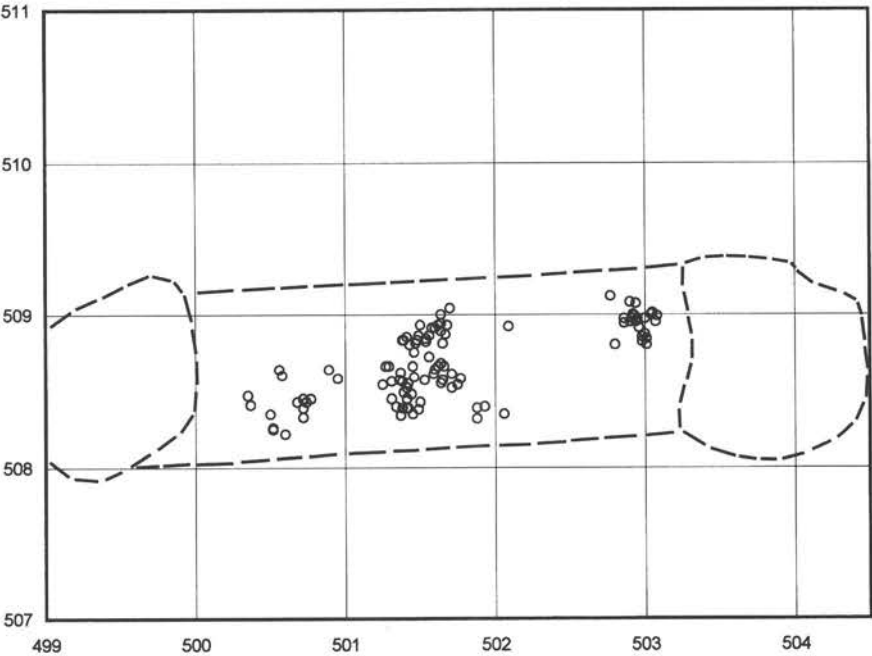


Fig. 21: Spatial distribution of skeletal elements assigned to Phase 1.

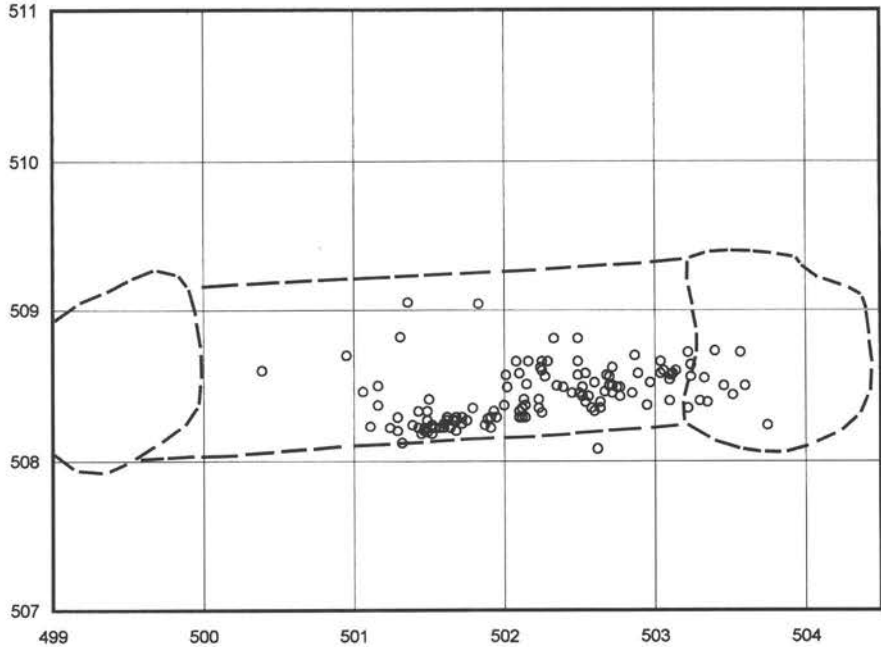


Fig. 22: Spatial distribution of skeletal elements assigned to Phase 5.

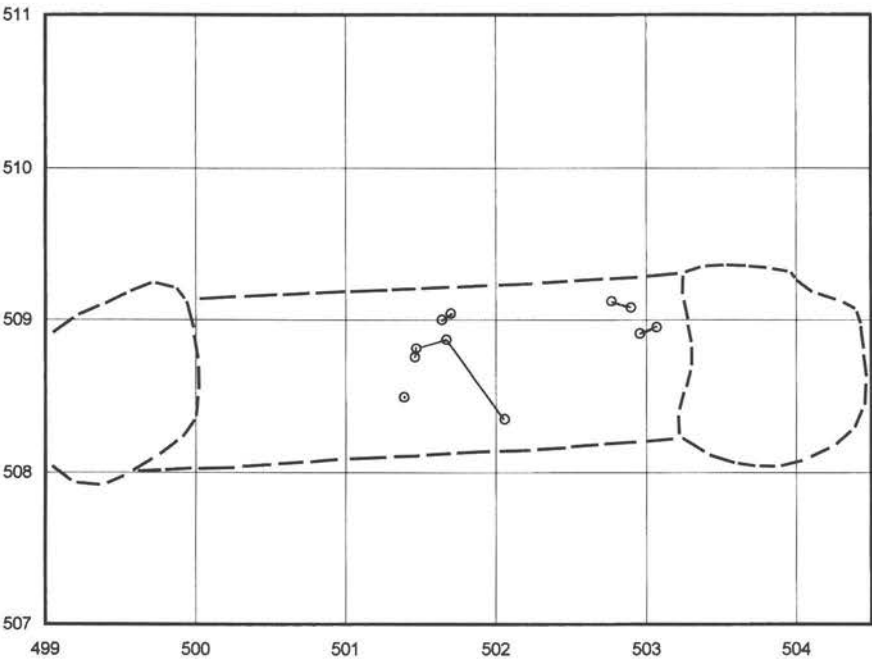


Fig. 23: Spatial distribution of cross-matched bones assigned to Phase 1.

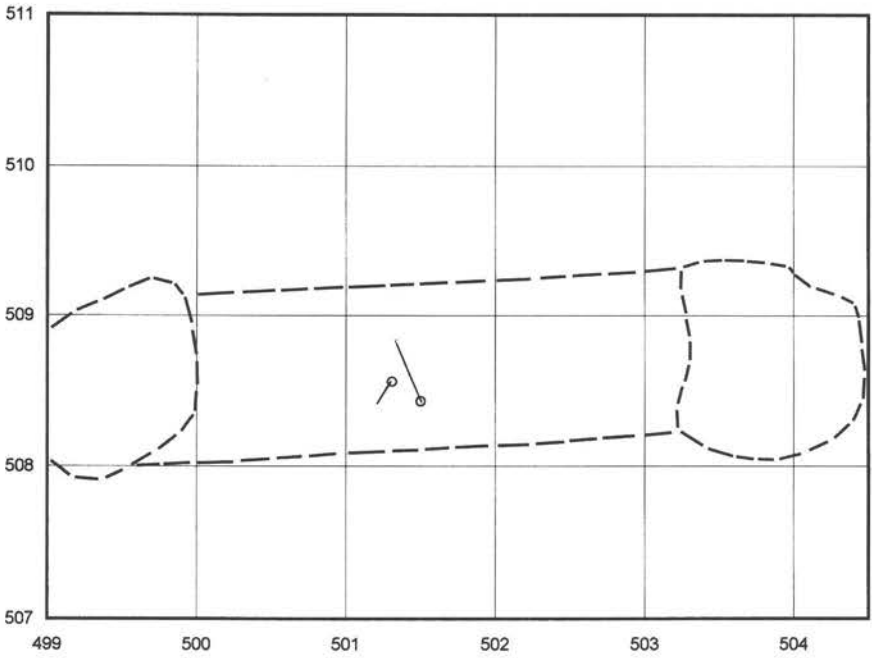


Fig. 24: Spatial distribution of antimere-matched bones assigned to Phase 1.

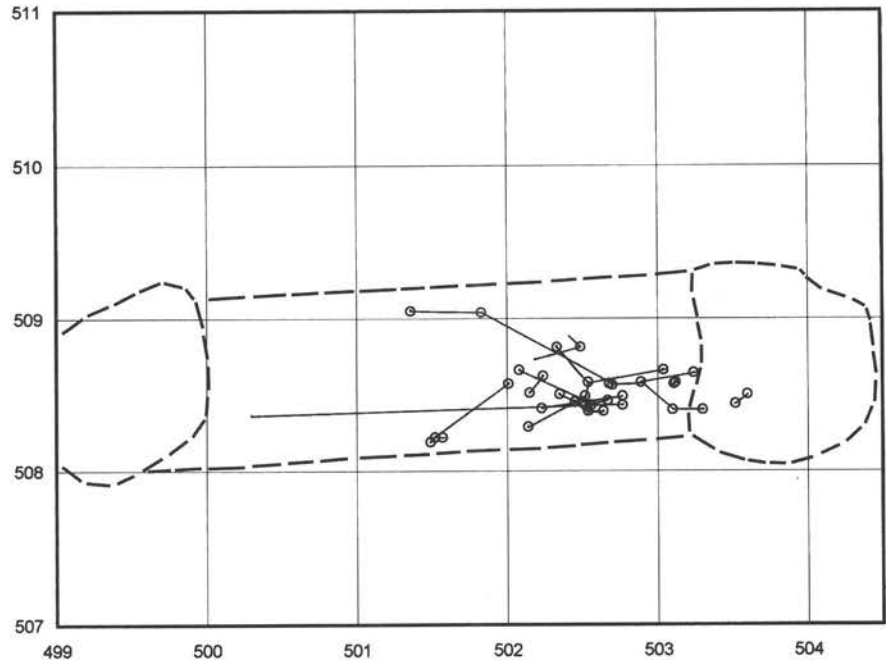


Fig. 25: Spatial distribution of cross-matched bones assigned to Phase 5.

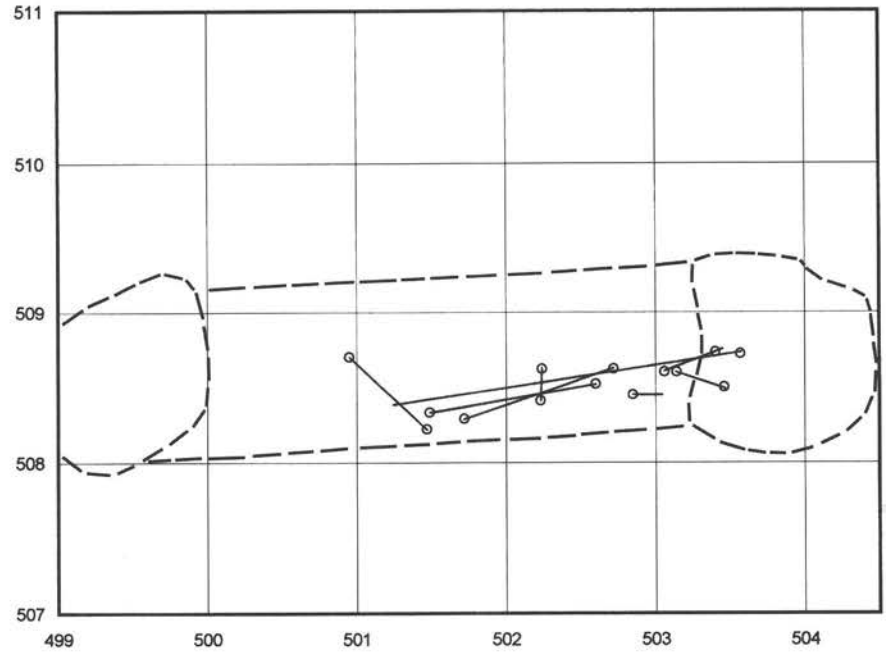


Fig. 26: Spatial distribution of antimere-matched bones assigned to Phase 5.

Whitwell provides evidence for both structured deposition of whole bodies or body segments and for post-mortem movements of body segments or individual skeletal parts. In Phase 1 the tighter clustering of anatomically adjacent parts of the skeleton and the smaller distance between cross-matched and antimeric-matched bones indicates less movement of skeletal parts than in the later Phase 5 where the skeletal remains appear to be more dispersed. However, there are strong grounds for inferring that in each phase the assemblage includes skeletal material that was originally deposited in the form of articulated whole or partial skeletons. Virtually all parts of the skeleton were represented in each phase of the assemblage, and where particular skeletal parts were under-represented this is interpretable in terms of natural taphonomic processes.

A recent review of Neolithic mortuary practices in the British Isles has identified some regularities in spatial patterns of deposition of human remains in chambered tombs and long barrows (Beckett and Robb 2006). These authors determined that the most frequent pattern of deposition at these sites involved sequential inhumation of intact, or largely intact, bodies, with extensive disturbance of the bones of earlier inhumations occurring during later depositional events. At a minority of sites there was also evidence for deliberate secondary funerary rites, with selected skeletal elements either being removed from the site or being brought to the site after primary inhumation elsewhere. The pattern of deposition of human remains at Whitwell matches the predominant mode for British early Neolithic multiple inhumation sites, as at Whitwell there is evidence for successive inhumations of intact bodies followed by disturbance of the remains but with no evidence for secondary mortuary rites.

Post-mortem taphonomic processes

As noted above, the lower than expected frequencies of the small bones of the hands and feet in the Whitwell assemblage may be attributable to the nature of the soils. The inclusion of re-worked loess in the soils below and within the Whitwell mortuary structure (Frederick, Appendix) is likely to have resulted in leaching of calcareous minerals from the skeletal remains. Small bones, with relatively greater surface areas, are more prone to this kind of degradation. Complete dissolution of bone can occur in soils with pH values of 6 or below (Nielsen-Marsh *et al.* 2007), and this level of acidity has been found in some of the ridge top soils above the Magnesian limestone in the Whitwell area (Crabtree and Trudgill 1987, 103).

Few bones were positively identified to have been subjected to animal interference. Rodent gnaw marks were found on the inferior edge of a right zygomatic, specimen 512/2 from Phase 5 (Plate 17) and on the distal end of the shaft of a left fibula. Possible carnivore puncture marks were also located, but due to the on-site treatment of the bones with preservative a clear identification was not possible. However, many bones were missing their epiphyseal ends, a common location for carnivore attacks (Smith 2006), and it is therefore possible that some losses of skeletal parts were caused by animal activities rather than by chemical erosion in the soil.

Five bone fragments were identified as having been burnt, all were long bone fragments which were too small to determine their species of origin with certainty. Two fragments (126 which was found at the base of Layer 31 in square 510/509, and 619 which was from the soil inside skull 316 in the linear mortuary deposit) were white coloured, indicating exposure to a high temperature, typically 800°C or greater. Their splintering and warping also indicates they were fresh or perhaps covered by flesh when burned (Buikstra and Ubelaker 1994, 96) and



Plate 17: Rodent gnaw marks on inferior margin of right zygomatic 512/2.

may represent fragments of cremated human bone. Other burnt bone fragments were black in colour with no warping or splintering, which suggests the temperature had been considerably lower. Their bone density was suggestive of animal origin, therefore it is possible these fragments were from food preparation or other activity rather than from a human cremation pyre. Two burnt bone specimens from within the linear mortuary deposit (617 and 619) were located towards the western end, but are not assignable to a particular phase of the deposit.

Conclusion

The sample of human skeletal remains from Whitwell includes a single skeleton and the disarticulated remains of an additional 16 individuals. The disarticulated assemblage contains all parts of the body, but as is commonplace in archaeological assemblages there is some under-representation of the smaller bones of the skeleton compared to the numbers expected if complete skeletons were represented. The assemblage contains sub-adult individuals and adults of both sexes, but the material is dominated by the adult remains (estimated to represent a minimum of 12 individuals) and older children (three of the four children were older than 6 years at the time of death). There are no young infants represented in the deposits, and the youngest age categories are therefore under-represented in comparison to standard demographic models. The adults are divided equally between males and females, and estimates of their age at death span the full range of expected longevity. Thus the linear mortuary contains a broad demographic spectrum, though with a deficit of the youngest age classes.

Estimated statures of the adult individuals are similar to the values recorded for other British Neolithic samples. The rates of dental disease also resemble the pattern established from Neolithic mortuary sites in southern England, with low frequencies of dental caries and abscesses, moderate rates of enamel hypoplasia and a high frequency of periodontal disease. The patterns of dental wear exhibited by the Whitwell population are distinctive in two ways: the molar wear suggests high occlusal loads and the consumption of tough, fibrous foodstuffs, a pattern that is more similar to that of hunter-gatherer populations than to agriculturalists. A distinctive pattern of extreme maxillary anterior dental wear, which was observed in two adult females, suggests a gender-specific non-dietary use of the teeth. This pattern of wear has also been detected amongst a Mesolithic population of southern Scandinavia.

Spatial patterning within the linear deposit, together with consideration of the skeletal part representation, suggests there has been some post-mortem rearrangement of skeletal parts after the primary deposits were created. This disturbance is more evident in the later Phase IVb/V where skeletal parts appear to have been moved along the axis of the mortuary structure. It is likely that whole bodies or segments of bodies were initially deposited within the linear mortuary structure, and that the separate phases of deposition appear to have involved remains of distinctly separate individuals.

ANIMAL BONES

By Pat Collins

Introduction

The animal bone remains comprise a small amount of large mammal (55 identifiable fragments: Table 13) and considerably more small mammal, i.e. species of rat-size or less (220 identifiable fragments: Table 14). In addition, seven bird bones were identified and 17 fragments of amphibian were recovered, although not identified further. In total, there are 1180 unidentified specimens, the vast majority of which are the post-cranial bones of small mammals.

Methodology

Identification was undertaken using the modern reference collection in the Department of Archaeology and Prehistory, University of Sheffield, with additional reference to published criteria for small mammal species (Corbet and Harris 1991; Lawrence and Brown 1973). Sheep and goat were not distinguished, as bones were either too young or damaged; likewise, for the same reasons, measurements and sexing were precluded. Neonatal bones were defined by their small size, under-developed morphology and light, porous texture, and are presumed to be from animals within a few weeks of birth. Specific wear stages for sheep/goat mandibular teeth are after Payne (1973). Other teeth are described thus: having 'early wear' (some or all cusps in wear but none joined by dentine), 'medium wear' (all cusps in wear, some or all joined by dentine) or 'heavy wear' (some or all infundibulum worn away).

Recording of the larger species was based upon the system devised by P. Halstead (Department of Archaeology and Prehistory, University of Sheffield), though amendments were made: in view of the small size of the assemblage every fragment which could possibly be identified was analysed. For identified specimens the following variables were recorded

where possible: anatomical unit, taxon, side of body, state of fusion/tooth eruption/wear, degree of fragmentation, traces of modification (gnawing/burning), presence and location of cut-marks, and skeletal abnormalities. Fragmented bones with fresh breaks that could be joined were counted as one unit for the fragments count. The minimum number of individuals (MNI) was calculated within each discreet context, taking side and age into account.

For the small mammals, identification was restricted to the mandible and loose mandibular first molar, with the following variables recorded: anatomical unit (mandible/loose M1), taxon, side of body and colour of bone (dark/light). The presence/absence of M1 in each mandible was also noted to facilitate MNI counts. Recording of the few bird bones recovered followed the mammal bone system, with a note made of bone colour. Scapula, coracoid, and all long bones except fibula were identified. For amphibian, as no pelvis were recovered, identification to frog/toad but not beyond was made on the general morphology and texture of fragmentary limb bones.

Other fragments were scanned for anything of interest and counted as 'unidentifiable'. These are listed in the archive database with anything of note recorded. A few identified bones were found to be unstratified or intrusive and are not included in analysis. Among these are five rabbit bones recovered from contexts 186 and 192, and are indicative of disturbed deposits, as this species was introduced to Britain in the Norman period (Cowan 1991).

Assemblage content and formation

Only selected contexts were sieved during excavation (primarily for molluscan remains), so that some material, notably small animals and the smaller bones of large ones, may not have been recovered (Payne 1972), while for those contexts that were sieved there is no record of mesh sizes used. Other finds are very few in number and appear to be sporadically distributed throughout the cairn. Although no bones analysed here are from contexts deemed to have a high risk of intrusion, certain deposits are likely to be more secure than others: for example, contexts 164a(1), 164a(2), 164ei, and 183a are all associated with primary cairn matrices and/or human burial deposits, while other contexts are part of the cairn fill.

The large mammals

Species represented are in order of abundance: pig (*Sus scrofa/domesticus*), sheep/goat (*Ovis aries/Capra hircus*), cow (*Bos taurus*), cf. dog/fox (*Canis/Vulpes*), hare/rabbit (*Lepus/Oryctolagus*), and a medium-sized carnivore (Table 13). Pig, sheep/goat and cow bones commonly occur at Neolithic burial sites in Britain. However, the single Lagomorph is rather problematic: the bone is a juvenile calcaneum from context 183a, which is a primary silt deposit associated with the single inhumation. The bone is complete, but unfused and slightly eroded. It does not appear intrusive and, for its size, is a better match for hare than rabbit. However, hare seems to be largely absent from England and Wales during the Neolithic, although there are isolated finds from a few sites (Yalden 1999, 127). On the other hand, the bone does not appear intrusive and nor is the context from whence it came considered of high risk for contamination. In view of the fact that this is a single juvenile specimen however, the identification is treated with great caution.

Generally, the large mammal bones are well-preserved, even though most are neonatal specimens. Some 40% of the bones show traces of fresh breakage made during recovery, whilst 27% display evidence of old breakage, which is no surprise given the fragility of neonatal bones. 25% of bones have traces of 'etching', possibly due to slight soil degradation

<i>Phase</i>	<i>Context</i>	<i>Species</i>	<i>Body part(s)</i>	<i>No. frags</i>	<i>MNI</i>
1	164a(2)	Sheep/goat	Loose tooth (I1/I2)	1	1
1	164a	Sheep/goat	Loose tooth (M1/M2)	1	1
2	183a	Cow	Loose tooth (P3)	1	1
2	183a	Hare/rabbit	Calcaneum	1	1
2	183d	Sheep/goat	Phalanx 1	1	1
2	188d	Sheep/goat	Loose tooth (M1/M2)	1	1
5	40	Cow	Tibia	1	1
5	40	Sheep/goat	Rib	1	1
8	163b	Pig	Various (head and limbs)	34	3
8	163b	Sheep/goat	Various (skull and ribs)	8	3
8	163b	Carnivore sp.	Loose tooth - canine	1	1
8	163b	Dog/fox	Skull	2	1
9	178	Sheep/goat	Mandible and loose M3	2	1
Total				55	

Table 13: Large mammal identified bone.

<i>Phase</i>	<i>Context</i>	<i>Species</i>	<i>Body part(s)</i>	<i>No. frags</i>	<i>MNI</i>
1	183d	Pygmy shrew	Mandible	1	1
3	178	Field vole	Mandible	1	1
5	164a(2)	Bank vole	M1	2	2
5	164ei	Field vole	Mandible	1	1
8	163b	Field vole	Mandible and M1	194	72
8	163b	Bank vole	Mandible and M1	8	4
8	163b	Wood mouse	Mandible	5	4
8	163b	Water vole	Mandible and M1	5	3
8	163b	Mole	Mandible	2	2
8	163b	Pygmy shrew	Mandible	1	1
Total				220	

Table 14: Small mammal identified bone.

or root damage. The etching is not restricted to one species or context, and not all finds from a context with etched bone show traces of it. Indeed, some of the intrusive material also shows etched traces, so it is no useful guide to defining ancient as opposed to modern material at this site. A cow tibia from context 40 is the only identified bone to show traces of carnivore gnawing, burning, butchery, and possible working, although one unidentified fragment from context 170 is also burnt. In addition, a few unidentifiable fragments from context 178 are coated with a 'glaze' which may be derived from proximity to burnt material. No bone shows signs of pathology or skeletal abnormality.

All the pig bones are derived from what appear to be the remains of at least two neonatal individuals and a phalanx 1 of an older individual in context 163b. As the remains are so young, however, it is difficult to gauge whether they are of domestic or wild species. The neonatal remains include fragments of skull, mandible, teeth, atlas, and fore and hind limbs, of which there are a few compact bones, but no loose epiphyses. It is unlikely this is a recovery bias, as a large amount of microfauna was also recovered from the same context.

The single pig mandible found has i2 and d2 erupted but unworn, and i1, c, and d3 in early wear. It is difficult, however, to age precisely because eruption times vary so much in modern data (Silver 1969). There are also a few neonatal sheep/goat skull bones, including a frontal smaller than that of a foetal Portland sheep in the Sheffield reference collection, and two sheep/goat ribs, both older than neonatal. The parietals of a probable neonatal dog/fox were also identified: these were checked very carefully, given their proximity to neonatal pig and sheep/goat remains when no other canid bones were found. Finally, there is also the deciduous canine of a medium-sized carnivore. It appears that although there is a collection of neonatal remains from 163b, there is no complete skeleton nor any record of bones being articulated when excavated.

The remains from other contexts are too sporadic to suggest they were deliberately placed there, although a few bones are found in association with human remains: the hare/rabbit calcaneum and a cow P3 were found in context 183a with the single inhumation in the circular cairn, and two sheep/goat teeth were found in contexts 164a (1) and (2) with the linear mortuary deposit. Otherwise, the only notable find is the cow tibia from context 40, a sandy deposit between boulders and slabs, in the north-east corner of the trapezoidal cairn. The tibia has knife marks on the proximal shaft: a diagonal cut on the posterior face and two adjacent longitudinal cuts on the lateral face. These could have come from regular butchery for the consumption of meat. More interesting, however, is the apparent 'paring' of the shaft at the distal end. There are no obvious knife or chop marks, but the shaft tapers and is grey around this area, as if it has been scorched. It is difficult say if the bone was used as an implement or for some other purpose, but the reduction of the shaft does not look like natural attrition. Although this bone was not measurable, the size and relatively slender build are consistent with that of a domestic cow rather than the wild counterpart, *Bos aurochs*, which is also found in Neolithic Britain. It is unfortunate that the assemblage is too small to provide any reliable insight into the economic practices associated with activity at Whitwell during the Neolithic.

Small mammals and birds

Most of the small mammals are derived from context 163b, a disturbance in the body of the oval cairn which also contained the neonatal pig bones, although other contexts also yielded a small amount. Species represented in order of abundance are: field vole (*Microtus agrestis*), bank vole (*Clethrionomys glareolus*), wood mouse (*Apodemus sylvaticus*) and water vole (*Arvicola terrestris*), mole (*Talpa europaea*) and pygmy shrew (*Sorex minutus*). Only seven bird bones, all from context 163b, were identified. All are *Turdidae* of redwing-size and may be from a single individual.

An important consideration is how contemporary the small mammal and bird bones are. It is possible that such small animals could have burrowed (in the case of the mammals) or fallen into the cairn at a later date than its original use, or even during excavation. They might also have arrived with soil deposits that were washed or blown in, which may be how the finer fill of the cairn matrix was formed. It was noted that the microfauna vary in colour from dark to much lighter-looking bone, and generally do not show signs of degradation in the form of 'etching' as was seen on some of the large mammal material. However, both dark and light bones were found in the same contexts, which suggests that the difference in colour may merely be the result of variation in the surrounding soil matrix. Thus, if they are contemporary, the small mammals are likely to reflect the local environment around the cairn at the time. The most common species in the assemblage is field vole, whose preferred habitat

is grassland areas such as meadows and field margins, although it is also found in less grassy areas providing sufficient cover, e.g. woodland, dunes and moorland. The other species found can also inhabit grasslands, even if it is not always their main habitat (Macdonald and Barrett 1993; Gipps and Alibhai 1991).

The relatively large amount of material from context 163b lends itself to further investigation: around a third of the field vole incisors, plus a small portion of other teeth of both field vole and bank vole, display attrition consistent with digestion (mainly light to moderate) by an owl (J. Williams *pers. comm.*). In addition, the breakage of both cranial and post-cranial material is not very high for the small species generally. The combination of a high proportion of field vole, evidence of mainly non-heavy digestion and low breakage would be highly consistent with the pellet remains of barn owl (Andrews 1990), which tends to hunt in grassland areas. Barn owls usually rest on posts or in farm buildings rather than trees, so that a wooden post or similar construction associated with the disturbance to the cairn would have provided a convenient base for such a bird. However, slightly lighter digestion overall would be expected from a single owl, so that the bones may be pellet remains from a barn owl nest, where digestion would be a little more intensive (Raczynski and Ruprecht 1974). The remains are too few to indicate a whole nest, though (J. Williams *pers. comm.*), suggesting that the material may have been disturbed before its final deposition.

Conclusions

The striking thing about the Whitwell bone assemblage is that there is no conclusive evidence to suggest that animal remains were deliberately deposited at the cairn as part of ritual or burial practices. The dearth of animal bones begs the question of whether animals were relatively unimportant in this context, or whether their importance is merely underestimated because their remains have simply not survived, or were removed before the cairn was sealed. Certainly, there is plenty of evidence from many other Neolithic burial sites in Britain to suggest that animals did play a role in mortuary practices (see Kinnes 1992 for a general overview), both in the regularity and sometimes relatively large numbers in which they occur, and in the way that patterns suggest the careful and deliberate deposition of animal remains, for example, at Fussell's Lodge, Wiltshire (Grigson 1960) and Hazleton North, Gloucestershire (Levitan 1990).

The 'cache' of bones from context 163b appears to be the result of natural and anthropogenic activity. The bones were contained in the fill of a disturbance for which a radiocarbon date of 2140-1970 cal BC (WQ-9 Δ 865) has been obtained from the neo-natal pig. The nature of this Early Bronze Age disturbance is not fully explained archaeologically, although the small mammal remains are here suggested to have been deposited by owls, implying the presence of standing timber.

Excepting the remains from context 163b and taken at face value, the material appears to comprise random bones that have accidentally been incorporated into the final burial deposits and cairn matrix. There are various ways in which this could have happened: it is possible that some material fell or was washed into the cairn matrix, but this is unlikely to explain the presence of bone in primary deposits associated with human remains. In the mortuary deposit selected material might have been cleared away before the deposit was sealed, leaving but a few stray fragments of whatever had been removed. While some degree of movement and mixing of the linear mortuary deposit at Whitwell appears to have occurred (Chamberlain, above), there is no evidence that any human bone was removed.

THE LAND MOLLUSCS

By Pat Wagner

Introduction

During the excavation, samples were taken from the following groups of contexts: a column through the cairn and the underlying deposits; the shallow feature [177] and the deeper pit [182] at the end of the linear passage; the matrix of the multiple burials [164], including material enclosed within, or associated with, some of the skulls; and the large pit at the end of the linear chamber [194]; single inhumation matrix, including material from directly from around the skull [248], and from the two pits [206 and 207] located north and south of the single inhumation.

Major problems encountered were the low numbers and poor condition of molluscs from several contexts, and the length of time between collection and preparation of many samples for analysis. The variable condition of material made it impossible in most instances to determine whether a specimen was juvenile or simply broken. Differences in the state of preservation and numbers of snail shells appears to correlate broadly with different features of the cairn, which could suggest that different conditions or processes were involved in formation of the fossil assemblages.

Non-standard sample sizes had been processed ranging from 0.1 to over 39kg for some bulked samples. An approximate number of specimens per kg is offered as a simplistic way of standardising density. A factor which affects interpretation is the presence of rock rubble on the site. Rock rubble assemblages characterised by *Oxychilus*, *Vitrea* and *Discus* have been described by Evans and Jones (1973). These assemblages live in shell-supported sediments in interstices of the limestone, however the percentage of natural rock rubble in the unprocessed samples is not always known. Results of the analysis presented in the systematic order given in Kerney and Cameron (1979) are in the archive. The burrowing snail *Ceciloides acicula* (Müller) was present in low numbers in some samples and is of scant palaeoecological significance.

The publication of local land snail assemblages, both modern and fossil, has been an invaluable adjunct to the interpretation of the results (Jenkinson and Gilbertson 1984).

Discussion

Species making up the assemblages from all the cairn-associated contexts, with a number of important differences described below, are essentially the same species as those found in Dog Hole Fissure, Creswell, Derbyshire, in deposits dated c.10,000 BP, and live snail species collected in the vicinity (Jenkinson and Gilbertson 1984).

Column samples show a sharp demarcation in numbers of snails present between the 70 and 75cm spits. This represents the interface of cairn material and the underlying stratum. Material from spits below the cairn is minimal in terms of condition and size (apices and fragments only) and these elements could be interpreted as intrusive via later biological activity e.g. root action. This sub-cairn sterility is reflected in bulked samples from beneath the linear chamber where <1 shell per kg occurs. This would suggest that elution processes beneath the cairn had not occurred and that the ground surface may have been razed prior to the cairn's construction. Similarly the fills of distal pit 194, associated with the linear mortuary structure, are almost devoid of molluscs (2 per kg) which could suggest that this early feature is an insertion into a

cleared substrate. In contrast, several later protected contexts had rich molluscan faunas in a very good state of preservation.

Two of the mollusc species *Spermodea lamellata* (Jeffreys) and *Acicula fusca* (Montagu) are noteworthy when compared to evidence for their modern distributions as plotted by Kerney (1976). Neither of these species has been reported previously living or fossil from central England and both are particularly linked with old deciduous woodland (Kerney and Cameron 1979). *A. fusca* is a relatively thermophilous species which does not appear in Britain until the late Boreal and is rarely encountered on archaeological sites of Neolithic and later date (Evans 1972). Today *S. lamellata* is very local in occurrence in the south but generally distributed in the north and is another species which appears to have arrived in the late Boreal (*ibid.*) Modern distribution patterns of these species indicate they are not restricted by thermal limitations. Thus the most evident cause for their absence from the modern record would be loss of habitat. Another old woodland associated species present in significant numbers is *Acanthinula aculeata* (Müller). The presence of these three species firmly indicates that significant tree cover was contemporary and in close proximity during accumulation of the cairn matrices. All of these woodland species are found in the earlier archaeological contexts but *Acicula fusca* is absent from the later contexts which may reflect this species' intolerance of disturbance. However, material from later contexts associated with the linear mortuary chamber was more weathered, with most of the external microstructure eroded. This could be a consequence of exposure of empty shells to the atmosphere which would result in normal surface weathering. Ultimately these processes would have led to total dissolution had some intervening preservation process, e.g. burial, not occurred.

The assemblage derived from material collected *around* skull 248, of the single burial, contains over one hundred juvenile *Oxychilus cellarius* (Müller). Evans (1972) described this species as being found in numbers in the mortuary at Waylands Smithy and inferred the presence of decaying flesh. Although virtually ubiquitous throughout all the contexts, this context was evidently a breeding population and a preponderance of juveniles could imply a rapid event in summer effectively preserving the living assemblage as an instant, rather than cumulative, death assemblage. The only other context in which juveniles of this species could be identified with confidence was derived from *inside* skull 248. Material from this protected context was the exception to the generally poorly preserved later material from the linear chamber and was as abundant and well preserved as that from earlier contexts. Included in this assemblage was a single specimen of the fragile *Vitrina pellucida*. Although *V. pellucida* is a catholic species that may be found in a range of damp habitats it is not recorded from any other context. Small numbers of anomalous specimens are usually thought to be transported attached to birds or via their droppings, but in this instance the fragile shell would not have permitted the latter taphonomic process.

CHARCOAL

By Ian Tyers

Methodology

The material was scanned using medium power binocular microscopes and the identifiable material sorted into groups. Selected fragments were then split and temporarily mounted to

allow microscope comparison with permanent reference slides and reference keys such as Schweingruber (1982) and Wilson and White (1986) to confirm aspects of the identifications. The weight in 0.01g units for each jar or packet of material was recorded using a Precisa 620C electronic balance. Any obvious mineral component was removed where possible, but in most cases the given weights are an overestimate of the charcoal component due to attached mineral fragments. Where most characteristics for an identification are seen, but a clinching characteristic is unseen, the prefix '*cf.*' is used which may be defined as 'comparable to' (Table 15).

Results

Three positive categories of identification were obtained:

Quercus spp. (oak), by far the dominant material, readily identifiable and robust, none of the fragments gives any indication of the original age or size of the material used. The material is too small to reliably estimate original diameters of the stems.

cf. Corylus/Alnus (comparable to hazel or alder). A widespread but smaller component of the assemblage was not readily identifiable with the fragments available and techniques employed, but appeared to be either hazel or alder. Comparison of the fragments appeared to indicate only a single type was spread throughout although it remains possible this category covers more than one type of tree. As with the oak fragments no overall age/size estimates were possible.

Corylus (hazelnut) shells. Hazelnut shells are remarkable dense and seem to survive charring with ease. The frequent presence of this material may contribute to a more positive identification of the previous category.

Identified material indicates exploitation of a very limited range of hardwood species. Hazel is often seen as the under-storey component of oak woodland and the presence of these two types seems to indicate that this was the local woodland type at this period.

DISCUSSION

By Blaise Vyner

It is perhaps as well that the preparation of this report has been extended sufficiently in time to encompass an initial series of curiously early radiocarbon dates and ultimately the realization that these had been adversely influenced by preservation treatment applied to bony remains from the site. The lengthy gestation of the report has also allowed results of this excavation to be informed by results of a number of other long-awaited excavation accounts. It is particularly important to point out, given the initial results of radiocarbon dating for this site, that the revised radiocarbon measurements for Whitwell, which have been analysed using Bayesian statistical approaches (Bayliss *et al.* 2007), are consistent with dates from a number of other well-known Neolithic funerary monuments, which have recently been similarly processed (Whittle *et al.* 2007, 127). Although excavated evidence from north Midlands sites remains extremely poor, it is clear that mortuary activities at Whitwell began more-or-less precisely contemporaneously with those at cairns in southern England, that is, in the mid 38th century BC, and, as at those sites, extended over a period of perhaps no more than a century.

The Whitwell cairn is one of 11 or so potential Neolithic cairns or barrows identified in the Peak District, a small group of monuments characterized by typological variety and lack of

<i>Context</i>	<i>Reference</i>	<i>Phase</i>	<i>Weight</i>	<i>Species</i>	<i>English name</i>
183, sample around skull of single inhumation.	S109	2	0.06 g	<i>cf. Corylus/Alnus</i>	Hazel/alder type
164, skull 248 in linear mortuary deposit.	Sf248	1	0.11	Not identified <i>Quercus</i>	Oak
164c, immediately above linear mortuary deposit.	Sf186	5	0.18		
177, shallow scoop at passage end, fill context 175.	S187, sf 914 OxA-9646 OxA-10214 OxA-9647 OxA-10219	5	3.00 0.82	Not identified <i>Quercus and Corylus shell</i>	Oak and hazel
177, shallow scoop at passage end, fill context 175.	S193, sf 929	5	18.97g 10.89g	Unidentified <i>Quercus and cf. Corylus/Alnus</i>	Oak and hazel/ alder type
194, base of west mortuary structure pit.	S29	1	0.09	<i>Corylus shell</i>	Hazel
201, shallow scoop in passage adjacent to 177.		5	5.21	<i>Quercus</i>	Oak
177, shallow scoop in passage.	S209	5	2.34 g 0.93 g	Not identified <i>Quercus</i>	Oak
183, from single inhumation skull.	S211	2	0.03 g	<i>Quercus and cf. Corylus/Alnus</i>	Oak and hazel/ alder type
164, sample from skull 512, linear mortuary deposit.	S212/214	1	0.01	<i>cf. Corylus/Alnus</i>	Hazel/alder type
164, sample from skull 316, linear mortuary deposit.	S219, sf316	1	0.05 g	<i>Corylus shell</i>	Hazel
164, sample from skull 395 linear mortuary deposit.	S231	1	0.10 g	<i>Corylus shell and cf. Corylus/Alnus</i>	Hazel and hazel/alder type
164, within linear mortuary deposit.	Sf599	1	0.99 g	<i>Quercus and cf. Corylus/Alnus</i>	Oak and hazel/ alder type
187	Sf956		0.12 g	<i>Corylus/Alnus</i>	Hazel/alder type
178	Sf874		0.48 g	not identified	

Table 15: Charcoal identification. S = sample; sf = small find

modern excavation evidence (Barnatt 1996, 21-22). In contrast to the Whitwell cairn, most of these monuments are thought to have been chambered, with no confirmed evidence for a composite mortuary structure. Whitwell is also distinguished as a site where the trapezoidal cairn encapsulates an oval cairn, and in this it bears some similarities within the region with the part-excavated cairn at Minning Low, Derbyshire (Marsden 1982). Although there is scarcely more evidence from Whitwell than from any other site, the possibility of Bronze Age activity chimes with the observation that a number of Peak District Neolithic cairns have Bronze Age mounds built upon them (Barnett 1996, 22). To the south, across the east Midlands as a whole, Neolithic barrows and cairns are largely unknown, although long enclosures, thought to be related to Neolithic funerary activity, are found in lowland locations (Clay 2006, 75). Beyond this, however, discussion within the regional context is not helpful in teasing out the structural or chronological sequence at Whitwell, for which the broader range of excavated Neolithic barrows and cairns is drawn upon here.

Setting and location

There is little evidence to suggest that the cairn's location had been the site of activity prior to use of the site for funerary purposes. Most finds of pottery and flint beneath the cairn appear to have been deposited as part of the ritual associated with deposition of skeletal material. However, a microlith (14) from below the cairn is a Mesolithic type, and a thin-end scraper (15) may also be of this period (Garton, above). The trapezoidal cairn covered and to some extent preserved an old ground surface or palaeosol, although the looseness of construction and relative shallowness of the cairn had prevented preservation of any organic component, since anaerobic conditions were not maintained. It should also be noted that the cairn construction retained many interstices which may have allowed small items to percolate within and through the body of the cairn, a condition noted also in association with stone-built cairns and other features of probable Middle Bronze Age date on the North York Moors (Harding and Ostojazagórski 1994, 62-63). Analysis of the silty soils beneath the cairn confirms the presence of loess at this location, while further sampling from Creswell Crags also identified surviving loess deposits (Frederick, Appendix). As Frederick points out, although of tangential interest in relation to the present account, the existence of the loess soils is important for the potential survival of sealed Upper Palaeolithic archaeological deposits in this area. While absence of a buried soil, or any surviving molluscan evidence beneath the Neolithic cairn might indicate that the area had been stripped of topsoil before cairn construction, it is equally possible that the cairn was constructed in an area which was either naturally open or which had been cleared some time previously, and where there had been some erosion of topsoil. The presence of one, if not two, flint artefacts of Mesolithic type tends to support the latter interpretation and, since there is no evidence for site clearance in advance of cairn construction at any other excavated Neolithic cairn, this explanation is preferred for Whitwell.

The site lies on a gently sloping shoulder of land with a southern aspect. It is likely that this area was generally wooded in the fourth millennium BC, the molluscan assemblage from the cairn structure indicating the nearby presence of old deciduous woodland (Wagner, above), seemingly through the period of Neolithic use of the site. Molluscan and faunal assemblages from nearby Dog Hole Fissure, Creswell, show that deciduous woodland was in existence locally from the mid-seventh millennium BC (Jenkinson and Gilbertson 1984). Two small pits in the passage of the Phase 5 cairn at Whitwell contained a small amount (less than 5g; Tyers, above) of carbonized hazelnut shells indicating use of local wild resources. The

site contained no evidence for agricultural development, although some early clearance is in evidence in north Derbyshire, where post-holes at Lismore Fields contained emmer grains and chaff dated to 3990-3150 cal BC (Monckton 2006, 265). All the pits present beneath the Whitwell cairn were associated with funerary use of the site, and the absence of any disturbances or undulations in the ground surface which might have been created by removal of tree roots suggests either that the actual cairn location did not support trees, or that any that were there had been cleared some time previous to the inception of funerary activity. While use of fire would have resulted in the remaining trunks and roots eventually rotting leaving little evidence, the lack of any evidence for this makes it likely that the site was chosen as an open spot within woodland which, as molluscan evidence suggests (Wagner, above), probably surrounded the site.

An absence of pre-existing tree cover at the actual cairn site is comparable with that seen elsewhere, as at Street House, Cleveland (Vyner 1984, 187) and Wayland's Smithy, Oxfordshire (Whittle 1991, 68), although at these and other sites there is evidence for varying degrees of earlier activity. A small assemblage of Mesolithic flint was present at Street House (Vyner 1984, 187); pottery and flint debris at Wayland's Smithy is also suggestive of occupation, if not more specific activity (Whittle 1991, 92). Evidence for pre-mound activity was also present at Haddenham, Cambridgeshire (Evans and Hodder 2006, 190), although this appears to be of Early Neolithic date and quite distinct from funerary use of the site. At Hazleton North, Gloucestershire, there was sufficient pottery and flint debris to merit the term midden, in addition to a linear arrangement of stake holes (Saville 1990, 16-20), while a yet more substantial concentration of midden material underlay the cairn at Ascott-under-Wychwood, Oxfordshire. Here a period of around 50 years intervened between the midden and the cairn, suggested to be linked through tradition or memory (Whittle 2007, 348), if not, in a suggested alternative model, even more directly (Bayliss *et al.* 2007, 38-39). Notwithstanding the evidence from this latter site, it remains far from clear that Neolithic funerary activity was focused specifically on locations of significant earlier use, as opposed to being located in areas of once more generalised activity, the evidence having been preserved by chance beneath the monument, as was suggested in the case of Skendleby, Lincolnshire. (Evans and Simpson 1991, 7).

Molluscan evidence, supported by analysis of the soils (Frederick, Appendix), indicates that at Whitwell the cairn was originally constructed in a woodland clearing. The extent of woodland regeneration, or the nature of any local agricultural activity subsequent to completion and presumed abandonment of the cairn, is unknown. There is evidence to suggest that by the Early Bronze Age there had been more widespread clearance of local woodland in favour of open grassland which could have been grazed: some 1500 years after construction and mortuary use of the cairn it was disturbed, for reasons unknown, by the excavation of a pit in which was deposited portions of neonatal pig which produced a radiocarbon date indicating that this activity took place in the period 2140-1970 cal BC. The pit, if that is what it was, remained open sufficiently long to accumulate the pellets of roosting owls, the bony component of which included field voles, whose habitat, like that of the barn owls which ate them, is open grassland.

There is no further evidence for the vegetational history of the area: whether it saw periods of woodland regeneration and clearing, or whether early clearance was maintained and extended, are questions which cannot be answered on the present evidence.

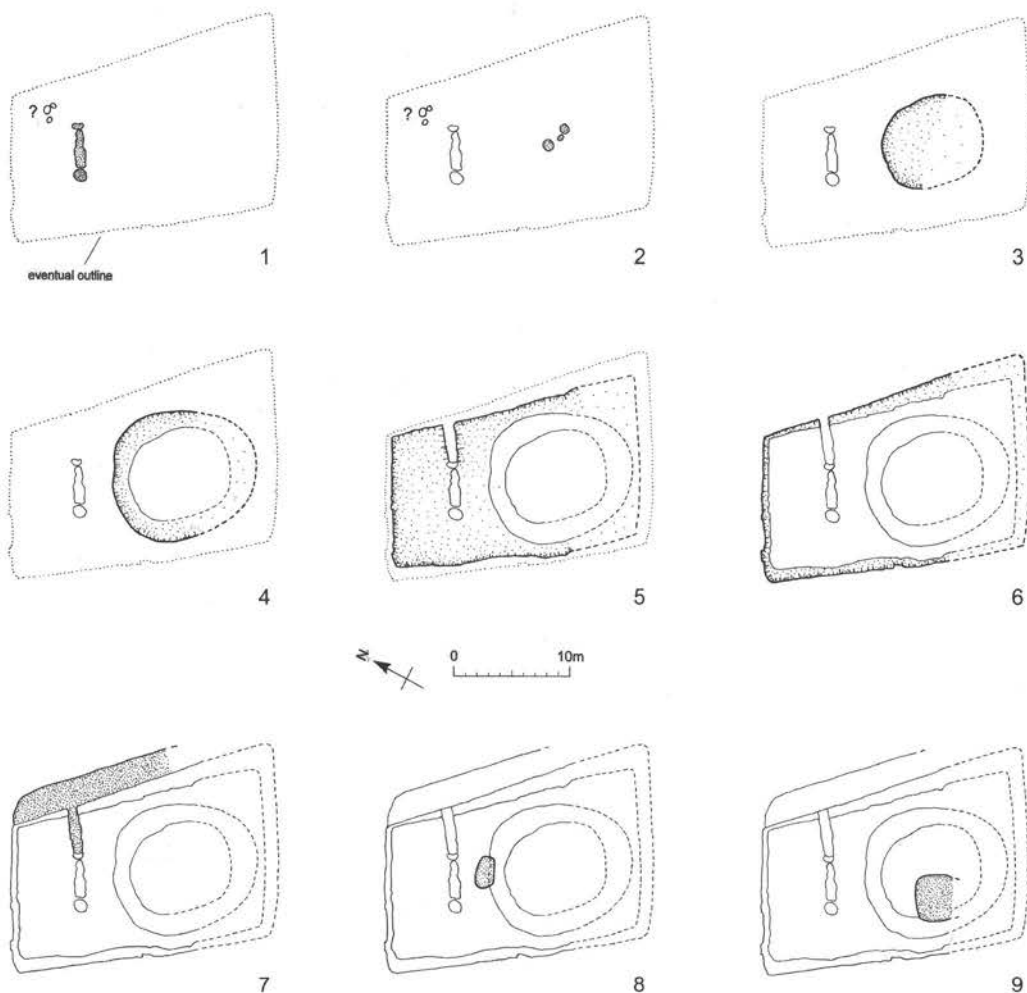


Fig. 27: Whitwell cairn – schematic phasing diagram.

The first mortuary structure

The first apparent activity at the site appears to have been associated with the collective deposition of human skeletal remains (Phase 1: mortuary structure 1) (Fig. 27). These comprised a linear deposit of bones defined at either end by posts and to the sides by limestone blocks and perhaps other structural features. Internally the structure measured 3.5m long by 1.0m wide. This deposit was aligned east-west, the pit at the west end being the largest, 1.30m in diameter, its fill suggesting the former presence of a standing timber. The eastern end pit was smaller and D-shaped, 1m long by 0.40m at its widest. The bone deposit was clearly defined by straight edges, marked along the southern edge by an intermittent line of limestone blocks, suggesting the presence of a timber flanked by a low bank. Bone distribution suggests that an internal division may have been present around 1.3m from the east end. This combination of post settings, stone blocks and the clear outline of skeletal deposits suggests the existence of

a timber mortuary structure of the kind evidenced at Street House (Vyner 1984, 159-61), and known in some detail from a number of other sites, including Lochhill, south-west Scotland (Masters 1973, 100). The Whitwell mortuary structure is similar to that at Street House in size and apparent method of construction, and is suggested to have been a light rectangular timber or composite timber and wattle structure placed between, and perhaps supported by, the upright end posts. At Street House the carbonized timber remains provided clear evidence for a substantial proximal post which could have been totemic (Vyner 1984, fig. 9), and a similar reconstruction has been proposed for the first phase of the mortuary structure at Pitnacree, Perthshire (Scarre 2007, 27).

The Whitwell evidence does not add greatly to information about the likely original form of Neolithic mortuary structures, although it does confirm the essential linearity of the arrangement, the recurrent use of vertical timbers at either end of the structure, and the potential for it to be placed at locations other than at one end of the cairn (Vyner 1986). At Whitwell the large circular 'proximal' pit was located at the west end of the structure, while the smaller 'distal' pit was at the east end. As elsewhere, the vertical timbers appear to have precluded access from either end and suggest that access for deposition and/or re-ordering of skeletal remains was gained from the side. Beyond that, there is increasing evidence that, perhaps not unexpectedly, the detail of construction varied according to local custom and availability of materials, although monumental size would have influenced construction methods and materials. At Haddenham, where there was extensive survival of mineralized wood remains, the structure comprised a roofed timber trough, internally overall 6.5m long by 1.5m wide (Evans and Hodder 2006, 89-102). Although this form is preferred by Kinnes to be the norm (1992, 83), the evidence from Street House and Whitwell, as well as at the first phase structure at Pitnacree (Coles and Simpson 1965, 41), clearly indicates the presence of upright timbers sufficiently large to have monumental stature rather than simply representing the ends of a box-like container. Indeed, at Haddenham the façade trench contains a large pit (F.704), which is somewhat unsatisfactorily explained as the proximal pit for the mortuary structure, the coincident east end of which comprised much slighter timbers than the pit would actually have accommodated (Evans and Hodder 2006, 95 and fig. 3.16). It would thus appear that at Haddenham the surviving mortuary structure may not have been directly associated with the timber originally in the façade trench, indeed, the surviving timbers may represent a reconstruction of at least its eastern end.

Typically, mortuary structures possess end-posts which either supported or flanked an intervening structure. While this could have taken the form of a low trough, an interpretation also favoured for Wayland's Smithy I (Whittle and Wysocki 1991, 94), the scale of the proximal and distal posts perhaps more credibly suggests a somewhat taller and slighter construction which (*pace* Kinnes 1992, 83) had little need for sophisticated carpentry techniques (Vyner 1986, 13). As noted further below, the re-modelled structure of Phase 5 at Whitwell introduced a construction which may more nearly have represented a trough or box, flanked at both ends by independent standing timbers.

The disposition of bones within the mortuary deposit suggests that whole bodies or large parts of bodies were deposited in this phase of activity (Chamberlain, above), with little post-depositional movement beyond that required to create space for later deposits. In this instance the under-representation of small bones is interpreted as a function of *in situ* degradation of the bone, rather than loss during exhumation. The possibility of preliminary exhumation or initial burial before cairn deposition has been revived recently in the light of animal attrition

of skeletal material from the cairn at Parc le Breos Cwm, Gower, South Wales (Whittle and Wysocki 1998, 173). Such activity could have taken place some distance from the eventual resting place of the remaining bones. The possibility that at Whitwell there might have been some activity, however limited, which involved movement of semi-articulated corpses outside the mortuary structure is nevertheless suggested by the presence of a small concentration of human bones to the north-east of the distal pit of the mortuary structure associated with a possible paved area (Fig. 5). Comparison may be made with the kerbed enclosure with paved platform at Street House interpreted as a possible excarnation area (Vyner 1994, 162-62), or the kerbed paved area extending from the south end of the mortuary structure at Slewcairn, south-west Scotland (Masters 1983, 104). The presence in this area of a cow tibia, seemingly cut to make a pointed tool, the end of which had been burnt, raises the possibility that this was associated with processes of sorting or mixing.

With the exception of this cow tibia, animal bone is notably absent from levels associated with construction and use of the Neolithic structures at Whitwell (Collins, above), although a few fragments of burnt bone in the mortuary deposit are thought to be animal (Chamberlain, above). Notwithstanding an absence of animal bone, rituals associated with use of the mortuary structure involved the acquisition and deposition of sherds of carinated bowl within the mortuary structure and on the adjacent ground surface (Beswick, above), this phase lying within Cleal's early or developing ceramic phase of the Neolithic, c. 3850 – 3650 cal BC (Cleal 2004, 181). The Whitwell mortuary deposit is noteworthy for the presence of 14 fragments from a minimum of 9 leaf-shaped flint arrowheads, almost all broken, which were included with the skeletal material (Garton, above). None was embedded in any bone, and while bone condition precluded potential survival of impacted tips, nevertheless, the damaged nature of some of the arrowheads suggests that these were not grave goods, but had arrived as inclusions within the bodies. Three damaged flint arrowheads were also present in the bone deposit at Wayland's Smithy I (Whittle *et al.* 2007, 107), while similar objects have been found at a number of other Cotswold-Severn chambered cairns (Darvill 2004, 168-69). At Whitwell the presence of arrowheads might strengthen the suggestion that partial corpses could have been a result of the delayed retrieval of bodies from skirmishes (Schulting and Wysocki 2005, 127), but it is not clear how many corpses were associated with arrowheads, while an absence of potentially fatal trauma evidence on the bones (Chamberlain, above), combined with evidence for skeletal deposition over an extended period tends to imply a less dramatic origin for the majority of corpses.

Adjacent mortuary activity

Radiocarbon dates for the single inhumation suggest that it was placed approximately mid-way through the deposition sequence in the adjacent mortuary structure. Deposition of pottery and flint material over the area occupied by both stages of the oval cairn indicates that the cairn is secondary to activity associated with the linear mortuary deposit. However, there is no stratigraphic evidence to confirm that the paired pits which embraced the single inhumation share that secondary relationship. The first mortuary structure and the paired pits and single inhumation sealed beneath the stage 1 oval cairn should perhaps be viewed as so nearly contemporary as to negate any preferential phasing. It is appreciated, also, that the inclusion of the paired pits and adjacent single inhumation in a single phase (Phase 2: linear mortuary zone and single inhumation) (Fig. 27) may well conflate two distinct structural phases. The term 'phase' is thus used here principally to aid clarity of description.

The disposition of the features beneath the stage 1 oval cairn suggests that a sequence of structural activities took place before cairn construction. It would appear that the paired pits are the earliest features, their spatial relationship to the single inhumation indicating influence rather than function. Here comparison may be made with flanking pits 206 and 207 beneath the cairn of Wayland's Smithy I, suggested to represent an early linear area which preceded a timber mortuary structure built on a different axis (Whittle 1991, 93). At Whitwell the single inhumation, probably within a timber chamber or some other enclosing structure, was deposited at the south-west corner of the linear area outlined by the pits and on the same axis. The nature of enclosing material suggests a surrounding chamber more nearly related to the limited area of the inhumation than to the space between the pits (Fig. 8) and secondary, however slightly, to activity which had focused on and between the pits. The presence of a concentration of snail shells within the skull of the deceased suggests decaying flesh (Wagner, above), but is not helpful as an indicator of how long the deposition may have been left before construction of the enclosing cairn.

Information regarding the nature and structure of this phase of funerary deposition at Whitwell is very limited, a characteristic shared with other non-megalithic deposits beneath round barrows of earlier Neolithic date (Kinnes 1979, 59-62). Features which may be to some extent comparable with those beneath the Whitwell cairn are present beneath an oval barrow at New Wintles Farm, Eynsham, Oxfordshire, where two pits had been set almost 3m apart, the space between them flanked by shallow ditches, and the arrangement encircled by a shallow segmented ditch. Fragments of human bone suggest the features were associated with funerary activity (Kenward 1982). Attention may also be drawn to a very low oval cairn at Bedd yr Afanc, Pembrokeshire, which encloses paired linear settings of boulders, internally 10.5m long by 1m wide (Barker 1992, 39-40), which might be viewed more satisfactorily as a linear mortuary zone than a stone chamber. Features beneath a barrow at Whiteleaf Hill, Buckinghamshire, provide potentially the best parallel for this phase of activity at Whitwell. The possibility that here there was a two post mortuary structure has been confirmed by recent re-excavation of the barrow (Hey *et al.* 2007). The structure was around 1m wide by 6.2m long and most of a single inhumation had been deposited, perhaps in a rectangular box or other container, close to the north-eastern edge of the linear area (Childe and Smith 1954, fig. 2). A radiocarbon date from residue on a sherd of pottery in the Whiteleaf barrow mound, 3660 – 3520 (95% probability), post-dates deposition of the inhumation by between 45 and 150 years (Hey *et al.* 2007) but allows a near-contemporaneity with the Whitwell inhumation deposit. Other recorded instances of formal burials of articulated inhumations from the earlier Neolithic include three single inhumation graves in the monumental complex at Radley, Oxfordshire (Garwood and Barclay 1999, 275-76), but these have radiocarbon dates suggesting a somewhat later deposition horizon than the Whitwell inhumation: 3800-3100 cal BC (5356, Oxa-4359), 3650-3100 cal BC (5354, Oxa-1882) and 3380-3090 cal BC (5355, BM-2710). Poorly-known single inhumations of earlier Neolithic date are also recorded from a stone chamber in the circular or 'rotunda' cairn within the Cotswold-Severn chambered cairn at Notgrove, Gloucestershire, and from beneath a small barrow at Knap Hill, Wiltshire (Darvill 2004, 61).

The first oval cairn

Construction of the stage 1 oval cairn is suggested to belong to a phase distinct from initial deposition of the single inhumation deposit (Phase 3: oval cairn stage 1) (Fig. 27). Placed

within a wooden box or chamber set between two pits, and probably covered by a small cairn, the earlier ritual and deposition can be distinguished from the larger covering cairn, even though little time may have elapsed between the two episodes. Given the damage which the monument had sustained, there remains a certain amount of uncertainty as to whether the early cairn at Whitwell was in fact oval rather than circular. However, the east and west wall of both stages of cairn are noticeably straighter than the northern wall, which exhibits a more continuous curve, and the suggested oval form is, therefore, preferred. Structural evidence makes it clear that at Whitwell both stages of oval cairn pre-date construction of the trapezoidal cairn which encapsulates them, while the spread of potsherds, in particular (Beswick, above), indicates that ritual activity associated with the adjacent mortuary structure took place before the oval cairn was established.

Despite the fact that the stage 1 oval cairn was to be extended only a short period after construction, the walled finish was not an interim edging or revetment, but formed an integral element of its construction and was intended to provide a careful finish to the cairn, which perhaps would have resembled the suggested reconstruction of the rotunda grave at Notgrove (Darvill 2004, fig. 24). As discussed further below, this wall is not to be compared with the rougher edging often provided to internal structural components in Cotswold-Severn cairns such as Hazleton North (Saville 1990, 35-49, fig. 46), or even the somewhat better finish provided to the inner revetment wall at Gwernvale, Powys (Britnell 1984, 60-61), which was completed with the addition of an outer revetment in stone selected to provide a high quality wall face.

A feature of the Whitwell cairn is the use of both cream and pink coloured limestone, both of which occur in the immediate area and may not, at the time, have required quarrying. For the most part the cairn was constructed of cream limestone, but a concentration of pink limestone occurred around the single inhumation and in the north-east sector of the cairn wall in such a way as to suggest that the differential colouring was deliberate. This is a feature noted at a number of megalithic sites (Lynch 1999), including the Dalladies, north-east Scotland, long barrow (Piggott 1973, 33). At Whitwell the contrasting colours appear to have been used to emphasise sectors of the cairn, but only in a general way, and thus not directly comparable with the more specific use of different colour and textures observed in some Clava cairns (Bradley 2000, 20-23).

Round and oval cairns appear contemporaneously with rectangular and trapezoidal cairns in the British Neolithic and contain analogous deposits (Kinnes 1979; 2004, 142). Although the structural sequence seen at Whitwell, where an oval cairn is the primary construction, not unexpectedly appears to be the norm when an enclosing cairn was constructed, as seen in the three-stage cairn construction at Trefignath, on Anglesey (Smith 1987, 31-33). Limited evidence for a cairn contained within the tailed cairn at Minning Low has been noted above (Marsden 1982), and there is nothing further to note here beyond the probable complexity of a number of cairns in the region (Barnatt 1996, 21-22). In construction the Whitwell oval cairn is best compared with the rotunda cairn, 7m in diameter and 0.8m high, contained within the Notgrove Cotswold-Severn cairn and another cairn, c.5m in diameter, again within a Cotswold-Severn cairn, at Sale's Lot, also Gloucestershire, (Darvill 2004, 61). Both these round cairns contained a central stone cist.

The later oval cairn

Some short period after construction of oval cairn 1 the cairn was enlarged by the addition

of a skin of limestone rubble finished with another carefully constructed wall (Phase 4: oval cairn stage 2) (Fig. 27). There is no indication of any other activity connected with this operation. While this addition of material enlarged the cairn, the primary intent appears to have been to amend the cairn's orientation while retaining its general outline. It is this change in orientation, by some 10°, which confirms the completeness of the stage 1 original cairn and its drystone wall, and suggests a passage of time between the two constructions. However, use of both cream and pink limestone was maintained in this later phase of cairn construction.

Construction and use of the trapezoidal cairn

A trapezoidal walled cairn was constructed so as to enclose the mortuary structure and adjacent oval cairn, the near SE – NW alignment presumably imposed to some extent by the arrangement of these features (Phase 5: trapezoidal cairn stage 1) (Fig. 5; Fig. 27). Continued recognition of the mortuary structure, or at least the skeletal deposits it contained, was confirmed by construction of a stone-lined passage, 3.2m long, which led from the eastern side of the new cairn to the east end of the mortuary deposit.

In structure this cairn was very similar to the stage 1 oval cairn, comprising a low mound of limestone boulders and rubble encased within an integral wall of limestone slabs. The slab wall to the passage formed an integral part of the wall surrounding the cairn, which was provided with a neat break at the passage entrance (Pl. 12). The excavated evidence is not sufficiently clear to allow detailed identification of the cairn's construction. The impression given is that the massive boulders comprising the cairn's base had not been set in a well-defined arrangement, but in places a partial diagonal row pattern can be detected, as for example, at the cairn's rear to the north of the passage (Pl. 9). Towards the edges, where the cairn diminished in height, the base comprised substantial flat limestone slabs. As with the oval cairn, there was no clear distinction between the cairn body and surrounding wall, and it seems likely that these components were built as a single construction process. While the cairn edges were finished with neat drystone walling, it is not clear how the cairn's upper surface was finished. Weathering and subsequent plough damage could account for the sandy silt infill between the boulders, and doubtless for much of the smaller stony content of the cairn, but the use of small rubble to infill gaps between the cairn body and passage wall, and between the two phases of cairn outer wall (Pl. 13) suggests that the cairn mound was originally finished with small rubble, creating a fairly smooth surface. It is unclear whether or not the outline of the oval cairn remained visible, but it seems likely that it did not. Building of the trapezoidal cairn represented final closure of the earlier phases of funerary activity, and, with creation of the passage, instigated a period of renewed deposition in a reconstructed mortuary structure.

The re-built mortuary structure's form is not fully clear. End-posts of the first mortuary structure had been removed and their sockets infilled before construction of the cairn, yet the first phase mortuary deposit appears to have been carefully maintained, its outline undamaged. This suggests that the deposit was contained within a structure which was independent of, or only semi-dependent on, the flanking posts. A timber or wattle walled trough, part-supported by a low flanking bank, would retain its shape after the removal of end-posts and any covering structure, while renewal or replacement of the uppermost containing components could have been achieved without great disturbance to the skeletal deposits. Clear definition of a second phase of mortuary deposit, particularly along its southern side certainly indicates that integrity of the containing structure had been maintained or renewed (Pl. 3). Deposition of skeletal material, seemingly semi-articulated, continued with the placement of bones on top of an

intermittent layer of limestone slabs within the mortuary structure.

Construction of the passage leading to the east end of the mortuary structure confirms that this was the intended access for further deposition of corpses or part corpses and associated rituals. An initiation ritual may be evidenced in a pair of shallow oval scoops adjacent to the infilled post hole at the east end of the mortuary structure. The scoops contained a mixture of charcoal and ash and each had been carefully covered with limestone slabs, over which, it is presumed, access to the mortuary structure was gained. There was no evidence for the form of passage roofing: local limestone does not provide slabs of the necessary size to fully bridge the passage, while the cairn appears to have been too low to have contained a corbelled construction. Instead, a timber roof, perhaps covered with a thin layer of rubble, may be proposed. The cairn mound stood to a maximum height of 0.60m. Although it had suffered from erosion and plough attrition, the quantity of displaced material does not suggest that its original height could have been much greater than 0.80m. From the beginning, then, the passage and second stage mortuary structure, if fully contained within the cairn, must have had a head-height of little more than 0.75m, or perhaps 0.80m if the roof had been placed across the passage level with the cairn surface, a not wholly likely circumstance, since it would have revealed the cairn's internal workings.

Access would have been restricted and difficult along such a low and presumably dark space, but in these respects no more restricted than that provided in some stone chambered cairns (Darvill 2004, 108). The existence of a passage at Whitwell invites regional comparison with the cairn at Minning Low where what may have been an oval cairn, 40m long by 18m wide, contains perhaps six stone chambers. Chamber 1 was near-central and approached by a roofed passage 1.5m long, 0.5m wide and 1.05m high (Marsden 1982, 9). Also in Pennine England, on Bradley Moor, Kildwick, West Yorkshire, a substantial cairn has a chamber which appears to have been approached by a walled passage (Raistrick 1931, 253). Useful comparison can also be made with the structures contained within the round barrow at Pitnacree, Perthshire, although published evidence from the excavation is by no means unequivocal. Here a first phase is suggested to have included a timber mortuary structure with massive end posts which rotted *in situ*, no bones were present, but the presence of human teeth indicates that other bony remains had not survived the soil conditions. The structure is suggested to have been replaced by a stone enclosure which covered a number of cremations and was approached at the east end by a walled passage (Coles and Simpson 1965, 39-40 and fig. 3). This is not the place for a detailed critique, but consideration of the photographic evidence (*ibid*, pl. XVI) suggests that identification of the stone enclosure is mistaken: what seems to be visible is the ghost outline of two timbers which formed the base of side walls of a structure extending between the flanking posts. Stones around the exterior of the structure being those of the cairn base, those within it, to judge from published sections, being the result of the cairn body having fallen into the structure as it decayed. The degree of slumping in this area suggests that the contained structure could have been at least 1.0m high. Assuming that the mortuary structure was initially free-standing, the approach passage is presumed to have been constructed in conjunction with the enveloping cairn, although whether this was associated with any re-modelling of the structure is not clear. Similar sequences may be postulated for Dalladies, north-east Scotland, where a timber mortuary structure was replaced by a stone version set within the larger end of a trapezoidal cairn (Piggott 1972), and Slewcairn, where the enclosing cairn incorporated a stone-lined passage which approached the south end of the mortuary structure (Masters 1983, 104). Recitation of these examples from what remains only

a limited number of sites where the evidence is capable of interrogation tends to underline the similarities rather than the dissimilarities of the various structures and, by inference, the associated rituals.

Extension and re-orientation of the trapezoidal cairn

Phased development of the oval cairn at Whitwell is closely mirrored by the extension and re-alignment of the trapezoidal cairn which was built to enclose it (Phase 6: trapezoidal cairn stage 2) (Fig. 27). As with the oval cairn, the first phase trapezoidal cairn was extended, very shortly after construction of the first, with the addition of cairn material along its sides, again finished with a neat drystone wall. At this cairn, also, the differing width of the added material clearly indicates that the intention was not simply to enlarge the mound, but to alter its orientation, in this instance to a SE – NW bearing, a change of 5° (Fig. 5; Pl. 13). The passage at the north-east corner of the cairn leading to the east end of the mortuary structure, was maintained in this phase, its side walls extended to the new alignment of the cairn wall. Perhaps not surprisingly, given the assumed short period of intervening time, no distinction in deposition or chronology of the mortuary deposit can be identified. In this phase, also, the use of pink limestone in the north-east portion of the cairn was continued. It remains unclear how much of the south end of the Whitwell cairn has been lost. Of the Peak District long barrows whose dimensions are recoverable, seven have lengths of between 32 and 50m, while Long Low is exceptional with a length of 210m (Barnett 1996, 21). The cairn at Minninglow, which may encapsulate a small mound, was also around 50m long. The suggested minimum length for the trapezoidal cairn at Whitwell is around 23m, based on the necessity to enclose the oval cairn, but the actual cairn is likely to have been somewhat longer, probably within the range 32 to 50m to judge from the regional examples quoted above. Whether or not any significant elements were contained in the lost portion of the cairn cannot be known, but the surviving presence of two funerary deposits rather reduces that likelihood.

The end of mortuary activity

Closure of the trapezoidal cairn and the seeming end of Neolithic ritual activity at Whitwell is marked by a series of linked constructional events (Phase 7: sealing of the trapezoidal cairn) (Fig. 27). The passage leading into the cairn appears to have been blocked deliberately with limestone slabs and displaced mound material, perhaps augmented with material from elsewhere, placed along the side of the cairn, effectively hiding the entrance to the passage. This activity appears to have been concentrated mainly or wholly along the cairn's eastern side and against the wall section flanking the passage entrance.

The suggestion that this deposit along the eastern edge of the cairn was a result of deliberate slighting of the cairn wall carried out not too long after sealing of the cairn is supported by the reduced height of the cairn wall south of the passage entrance and, especially, by the distribution of sherds from what may have been a single coarseware vessel (Vessel 7, Fabric 3: Beswick, above). These sherds have a singular and at first somewhat puzzling distribution, with a group found outside the eastern edge of the material placed against the east side of the cairn, and a single large sherd found sealed in the uppermost level of the linear mortuary deposit. If, however, the sherds are viewed as the last survivors of a more widespread scatter of pottery which once extended across the cairn they may be seen as representing a phase of activity which accompanied this closing episode of cairn use. This may have involved deposition of sherds on or in the upper levels of the cairn, and over the material against the

cairn, as well as on the ground surface east of the cairn. Post-depositional processes would have resulted in some colluvial material being brought downslope against the eastern side of the material piled against the east side of the cairn, thus providing early protection for sherds on the ground surface in that area. On upper levels of the cairn, however, sherds would not have been protected from weathering, while plough erosion from at least the later medieval period onwards would have resulted in sherds present in the uppermost levels of the cairn being exposed to weathering to which the material would not have been resistant for more than a few winters (Swain 1988, 87-88), perhaps no more than ten years at the most. If this interpretation is correct, it can be claimed that this is further evidence to suggest that the material piled against the east side of the cairn must have been deposited very shortly after the cessation of use of the cairn, and was not the result of an extended period of erosion.

Blocking of the passage at Whitwell, and piling of rubble against its entrance, is reminiscent of that found placed against the entrance to the chamber at Green Low, Aldwark, Derbyshire, some 35km to the south-west, where the rubble extended up to 5m from the chamber entrance (Manby 1965, 10). The extent to which material found placed against the outer walls of cairns is a result of natural decay or artificial contrivance has long been a point of discussion in relation to Cotswold-Severn cairns. Deposits against the cairn walls at Hazleton have been interpreted as the result of decay (Saville 1990, 256-57), as have similar deposits against the cairn walls at Ascott-under-Wychwood (McFadyen *et al.* 2007, 122-23), where the reported evidence is admittedly not incontrovertible (McFadyen and Whittle 2007, 355). However, evidence from both Gwernvale (Britnell 1984, 150) and Pen-y-Werlod (Savory 1984, 24) is strong enough to support the alternative interpretations offered. While the considerable effort involved in constructing carefully-finished cairn walling might suggest the intention of continued visibility 'while the monument was in use' (Saville 1990, 257), the successively hidden cairn walls at Whitwell indicate that such visibility might have been a very transitory experience, and certainly does not rule out the possibility that a neat wall face might be damaged and/or covered very shortly after construction.

Early Bronze Age disturbance

An episode of activity, of uncertain nature and duration, is indicated by the neo-natal pig bones, radiocarbon dated to 2140-1970 cal BC (95% probability). The activity appears to have included excavation of a crater which penetrated to the lower part of the wall of the stage 2 oval cairn, and the deposition of bones (at least) of young pigs and sheep/goat together with bones from small mammals which may have been deposited by roosting owls (Collins, above). There is also a large sherd of carinated bowl which appears to have been re-deposited at this time (Phase 8: Early Bronze Age activity) (Fig. 27). The cairn wall and fill in this area appeared to have been repaired using rounded limestone blocks in contrast with the angular material used elsewhere. The possibility that earlier funerary monuments might have been selected for renewed ritual activity is attractive but perhaps increasingly implausible given the now widely evidenced short periods of early funerary activity (Whittle *et al.* 2007, 132-33) as well as the closing nature of the final activities. Construction in the Early Bronze Age of burial mounds on top of Neolithic cairns is by no means unusual. The practice appears to have been especially common in the Peak District of Derbyshire, some 25km to the west of Whitwell (Barnatt 1996, 22), and is also recorded in Yorkshire at Kilham long barrow (Manby 1976, 129) and Street House cairn, in Cleveland (Vyner 1984, 166). The intervening period is often not closely dated, but at Whitwell probably extended from shortly after the last deposition of

skeletal remains, 3630-3540 cal BC (95% probability) until the deposition of the pig remains, 2140-1970 cal BC (95% probability), some 1500 years. In the absence of evidence for any intervening activity during this long period, perhaps some other explanation should be sought for the renewal of interest in this location in the Early Bronze Age.

The observation that Early Bronze barrow builders often chose topographically prominent locations for their monuments is not to suggest that such locations were highly visible from any distance – tree cover may well have obscured even the nearer view – but to note the ready ability of the prehistoric population to identify high points in the landscape. Pre-existing monuments would doubtless be readily recognizable as high points or specific features in the landscape, without necessarily any recognition of their identity, thus it might be anticipated that builders of Bronze Age monuments would on occasion unwittingly choose an earlier funerary monument for their site. In developing this discussion the Street House Neolithic cairn is again a case in point, since it was overlain at its eastern end by a Bronze Age barrow, and particularly because of what appears to have been the deliberate deposition of a group of fine V-bored jet buttons. These had been placed, not with one of the cremations contained in the Bronze Age barrow, as might be expected, but on the tail of the Neolithic cairn (Vyner 1984, 168, fig. 5). At the time of excavation it was speculated that these may have represented a votive offering, made after realisation of the nature of the earlier monument (Jelley 1984, 182). In considering deposition of the pig bones at Whitwell and the aberrant reconstruction of the oval cairn in the disturbed area the possibility is raised that this site, also, was recognized as a monument during its disturbance and that some repair was made to the fabric and spirit of the place.

The survival of Whitwell cairn

In recent centuries Whitwell cairn was not a landmark: the monument was not identified on any editions of the OS map, nor was there any local recognition of the site by name or folklore. Arable agriculture from at least later medieval times onwards, combined with radical re-organisation of the landscape in the 20th century, makes it all the more surprising that it survived (Phase 9: the survival of the Whitwell cairn) (Fig. 27). When discovered the cairn stood in the south-east corner of a squarish field defined by angular boundaries, part of an extensive system of geometrically laid out enclosures lying to the east of Creswell village, shown on the second edition OS map of 1899. At this time the model colliery village, begun in 1896 (Stocker 2006, 112), was only just being established. Here the pattern of elongated curvilinear enclosures reflecting the medieval agricultural system extended westwards from the village and contrasted strongly with the rectilinear field system to the east. This geometric field system was at the time of very recent origin. Comparison with the OS map of 1886 is instructive, as it shows that the pattern of elongated curvilinear enclosures continued across the area east of the village, maintaining a general SW – NE axis and probably enshrining the arrangement of medieval cultivation strips. At that time the cairn, which was not depicted on the map, lay in the south-west corner of a long field with curvilinear boundaries. In the three years between the issue of the two OS maps, and coincident with the establishment of the colliery village, the surrounding enclosure pattern had been subjected to a root and branch revision of boundaries. In this process almost all of the older curvilinear boundaries had been removed, although a few SW – NE alignments were preserved, and a pattern of angular fields with a general SE – NW axis had been established, a re-orientation which was eerily reminiscent of the successive re-orientations of the Neolithic cairn. It is hard to believe that

the re-arrangement of the agricultural landscape was not associated with the establishment of the new colliery village, and hard, also, to believe that the Neolithic cairn could have escaped removal in this process.

That it did is at least partly explained by the fact its southern end was oversailed by a SW – NE running hedged boundary which was one of the few to survive re-arrangement of the enclosures. The monument simply switched corners of successive fields. How much attrition there had been through agriculture is not clear, although the surviving shape and height of the cairn suggests that damage was limited. The hedged boundary itself would have protected the underlying deposits, while until recent years, agriculture tended to be less intensive along field edges because hedges encourage either parched or wet soils, depending on aspect. The presence of large boulders would also have helped to maintain the overall monument form: the plough team would not wish to expend unnecessary effort, while farmers would wish to avoid damage to the plough. Undated quarrying of the stony fill of the oval cairn may well reflect opportunistic quarrying for boundary material at one or other period of boundary construction. None of this, of course, assists in establishing the original length of either the oval or the enclosing trapezoidal cairn, for which assessment of the surviving portions combined with inter-site comparison allows only a 'best guess'.

APPENDIX

The geological context of the cairn by C. D. Frederick

Observations made during the excavation identified a stratigraphic feature beneath the monument that was described as a 'palaeosol' [159/170] which upon examination of curated samples appeared to be a loess that had been preferentially preserved beneath the monument. Although the nature and origin of deposits predating the cairn are of tangential significance in understanding the site, in this particular case the issue holds potentially significant regional implications for understanding ancient (specifically Upper Palaeolithic) archaeological landscapes in this region. At issue here is the geological origin of the silty to loamy surface soils which mantle the Magnesian limestone outcrop. This is a contentious issue which has been discussed in some detail in the literature before now (Piggott 1962; Bryan 1970), and a closer examination of the deposits preserved beneath the Whitwell cairn appeared to offer a unique opportunity to contribute to this debate with evidence gathered from a rare exposure.

Two hypotheses have been advanced to explain the presence of silty soils on the Magnesian limestone: 1) the deposition of loess, and 2) *in situ* weathering of limestone. Piggott (1962) examined soils formed on the Carboniferous limestone of the Peak District by documenting the granulometric and mineralogical constituents of the soil and the underlying limestone and concluded that these soils were largely the product of loess deposition. Bryan (1970) examined a broader range of Peak District soils and cast doubt on Piggott's work, concluding that loess-enhanced soils were primarily to be found on plateau tops whereas slope soils were largely stripped by solifluction. More recently, Canti (n.d.) examined the potential loessic inputs to soils associated with Wardlow Pasture Barrow in Staffordshire and concluded that these soils could have formed from *in situ* weathering of veins contained within the bedrock.

With this debate in mind, examination of the soils beneath the monument was designed to test the hypothesis that the palaeosol was a loess, and not the insoluble residue derived from weathering of the limestone. Three soil columns were examined in detail, two collected from the quarry face exposure of the Neolithic cairn, and one from a test pit that was excavated

near the Creswell Crags visitor centre at a point identified by Colcutt (1995; 1996) where the soils appeared to be of a loessic origin. The latter was examined in order to obtain optically stimulated luminescence dates for these deposits, which could not be performed for the soil samples in curation. The methods employed in the analysis included granulometry, micromorphology, loss-on-ignition, oxidisable carbon analysis, calcium carbonate content, heavy mineral analysis, and optically stimulated luminescence dating. In addition to these stratigraphic profiles, a sample of the Magnesian limestone was digested in hydrochloric acid and the residue examined for its particle size distribution and heavy mineral content. Details concerning the methods employed and the results of this work are provided in Frederick (n.d.), a copy of which is on file at the Creswell Crags visitor centre.

The results of this investigation indicate that the deposits on the slopes beneath the Whitwell cairn and in proximity to Creswell Crags are complex and ancient. The deposits within the long profile were separated into five distinct Depositional Units (hereafter abbreviated DUI to DUV) which were easily separable into two groups: Group A, an ancient fluvial-colluvial deposit, and Group B, loess and loess-derived sediment. The stratigraphic location of these deposits is shown on Figure 28, and a summary of the geomorphic events inferred from the long profile is listed in Table 16.

Group A: Ancient fluvial-colluvial sediments

The long profile collected from the quarry face revealed approximately 1.8m of ancient sediments that appear to have been deposited in three separate depositional events (DUI, DUII, and DUIII), two of which were fluvial and one of which was a colluvial. The oldest of these sediments rested unconformably upon the limestone bedrock/head and the entire suite appears to have been preserved in a bedrock depression.

First phase (Depositional Unit I)

Photographs of the quarry cut that exposed the cairn reveal that the first phase of Group A deposits were approximately 0.45m thick, retained depositional structure and consisted of thin beds of alternating darker and lighter coloured sediments. The darker coloured beds appear to be incipient topsoils which retained their dark colour but lacked significant oxidisable carbon, which suggests that they are quite old. These sediments exhibited a mean particle size of approximately 62 microns at the base of the sampled column, and coarsened to a mean of around 350 microns near the top, and all of these samples were bimodal with a second mode in the clay range which was probably secondary and of a pedogenic origin.

Second phase (Depositional Unit II)

The middle Group A deposit is a colluvial sediment which encroached on the depression from upslope. Although the majority of this deposit appears to be reworked fluvial sediments, photographs of the quarry face show a clear tongue of limestone rubble associated with this deposit which indicates the presence of barren bedrock nearby at the time of deposition. This tongue of limestone debris was not present in the coarse fraction of the sample column, but was present in the fine-grained fraction, which was slightly more calcareous. The mean texture of this deposit was considerably finer textured than the preceding phase, ranging from 15 to 62 microns, and it was considerably more poorly sorted as well. Much of the clay in this deposit was of a smectitic nature and appears to be secondary illuvial clay associated with the formation of a brown earth soil following deposition of this unit.

Third phase (Depositional Unit III)

The epipedon of the soil associated with the A2 deposits was apparently eroded from the surface during deposition of the third Group A deposit. The subsequent sediment was very similar to the first phase deposit, and appears to have been deposited by a stream as well. The mean particle size of this sandy deposit ranged from 350 microns at the base to approximately 4.75 microns at the top, and petrographic examination of the deposit suggests that much of the clay in this unit was illuvial pedogenic clay formed during a second phase of brown earth soil development.

Collectively, the Group A deposits are associated with a completely different landscape from that present during the life of the Neolithic cairn, and consist of sediments deposited during a complex series of Pleistocene-age erosional and depositional events. The height, position on the landscape, pedogenic alteration and lithology of these deposits all suggest that these are ancient sediments that are not associated with any of the known river terraces. The most likely correlation is with glacial outwash sand and gravel which have been recorded from various sections through Yorkshire and the East Midlands (e.g. Eden *et al.* 1957; Gaunt *et al.* 1972; Smith *et al.* 1975; Gaunt and Girling 1996; 1997; and Smith 1973). Two sources have described similar deposits in this area previously: Eden (*et al.* 1957) recorded a section containing 1m of reddish pebbly sandy material resting upon limestone on Red Hill north-north-east of Whitwell (SK 533775), at an elevation of more than 90m, that they interpreted as glacial outwash: Reeve (1976) notes the presence of a similar deposit in Whitwell Wood, between Whitwell and Creswell, which is mapped as the Wick series and described as brown earth soils formed within a siliceous clastic deposit of either ancient (i.e. Permian or Bunter sandstone) or Pleistocene (glaciofluvial or head) age.

Interestingly, the Group A sediments bear a strong resemblance to the sandy deposits preserved in the fill of Pin Hole Cave at Creswell Crags.

Group B: Loess and loess-derived sediments

The deposits comprising Group B consist of two silt dominated sedimentary units (DUIV and DUV) present in the long profile and in the vicinity of the cairn. The lowest of these is the yellow silt 'paleosol' (159/170), which rests unconformably upon the reddened deposits of Group DUIII. It was represented in the long profile by a single sample, and the cairn appeared to be constructed directly upon this deposit. This sediment had a mean particle size of approximately 20 microns, was slightly calcareous, and composed primarily of angular quartz.

The depositional Unit V deposits are the sediments that surrounded and buried the Neolithic cairn and comprise the top 0.70m of the long profile. Small amounts of limestone and siliceous gravel were present throughout the DUV deposits, and these appear to have been derived from the cairn body and the Group A sediments, respectively. The mean particle size of this deposit was around 15 microns and the fine fraction was almost completely leached of calcium carbonate. Being the uppermost deposit, it is not surprising that the organic matter content of this unit was high at the ground surface (around 3%) and decreased progressively with depth. The mineralogy and texture of this deposit is distinctly different from the underlying Group A sediments and it was clearly not derived from them.

Work at the quarry expansion locality

Unfortunately, dating the deposits from the archived soil samples was not possible. However,

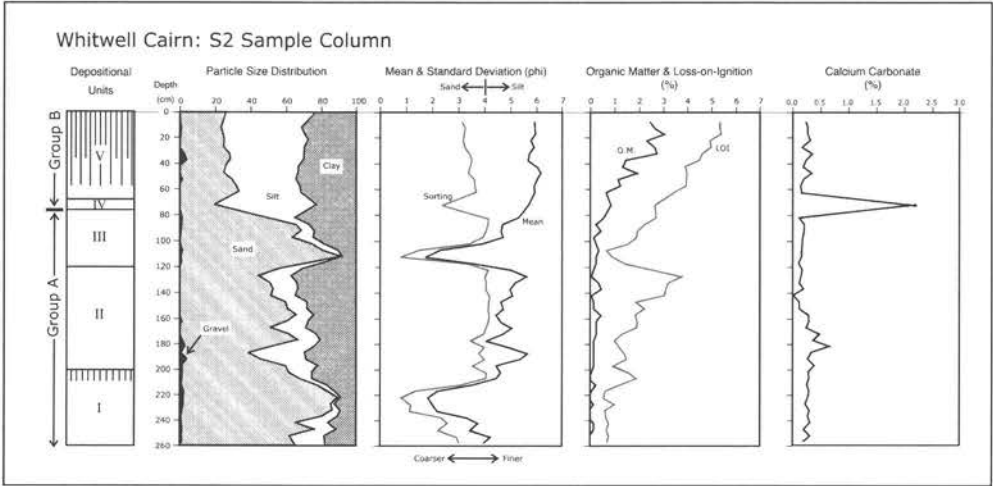


Fig. 28: The long soil profile – analytical results.

Geomorphic event	Process	Deposit
i	Fluvial deposition	Depositional Unit I
ii	Slope erosion	Depositional Unit II
iii	Soil development	Brown earth soil formed in Depositional Unit I and Depositional Unit II deposits
iv	Erosion	None (stripping of the epipedon of soil)
v	Fluvial deposition	Depositional Unit III
vi	Soil development	Brown earth soil formed in A3
vii	Erosion	None (stripping of the epipedon of soil)
viii	Loess deposition	Depositional Unit IV
ix	Erosion	None (cairn built on loess, lacking topsoil)
x	Colluvial deposition	Depositional Unit V (slope reworked loess)

Table 16: Geomorphic events inferred from the analysis of the long profile samples.

subsequent archaeological work performed in advance of quarry expansion near Creswell Crags visitor centre identified some deposits that appeared to be of a loessic nature (Colcutt 1995; 1996). A test unit was excavated near one such locality, Test Pit 2 of Knight and Priest (1995) and two OSL samples were collected. The rationale underpinning this dating was that if the loess-like sediment was loess, then OSL dating would be able to determine an age for its transportation. If on the other hand it was the insoluble residue of the limestone liberated by solution, then OSL dating would find the grains to be in a state of saturation and it would not be possible to calculate an OSL age for the sediment. The samples were dated by Dr Mark Bateman at the Sheffield Centre for International Drylands Research Luminescence Laboratory, using the single aliquot additive dose method (see Bateman 1999 for details).

The top half of this test unit exposed silty sediment similar to the Group B sediments in the Whitwell Cairn long profile, and a sandy sediment (judged in the field to have been derived

from a separate parent material and somewhat similar to the Group A sediments) comprised the lower 0.40m of the profile and rested directly upon the limestone bedrock. The OSL sample collected from a sandy deposit at 0.75m below surface yielded a mean age of 110 ± 22 ka and a minimum age of 70 ± 4 ka. The sample collected from the base of the silty sediment at a depth of 0.55 m yielded a mean age of 37 ± 5 ka and a minimum age of 26 ± 1 ka. The fact that OSL ages could be calculated for both samples demonstrates that these sediments have been exposed to sunlight and are not merely the insoluble residue of the limestone.

Summary

In summary, the results of this work demonstrate that the geological origins of the deposits on this slope are complex and quite ancient. Fluvial, colluvial and aeolian processes have all left fragmentary traces on the slope. The yellow silt beneath the Neolithic cairn (159/170) exhibits attributes that best fit a loessic origin and this deposit appears to have been preserved preferentially beneath the cairn. Photographs of the quarry cut show that the yellow silt is difficult to discern outside the structure and this is probably due to more intense pedoturbation away from the feature. The physical attributes of this deposit, such as particle size distribution and carbonate content, are consistent with previously identified late Quaternary loess in the UK (Ballantyne and Harris 1994). In particular, it is most similar to loess described from Northern Wales (Lee and Vincent 1981) but slightly coarser (less clayey, slightly sandier) than the Yorkshire loess documented by Catt *et al.* (1974). This deposit, and the overlying colluvially reworked loessic deposit which buried the monument, are mineralogically distinct from the underlying Group A deposits and the interface between the two is a depositional one, not an artefact of pedogenesis. The presence of the yellow silt 'palaeosol' (DUIV) resting directly upon bedrock as is shown in the quarry face section drawing is also inconsistent with an E horizon formation process, as there was no underlying argillic horizon. The OSL age of the silt dominated deposit examined near the Creswell Crags visitor centre at the Whitwell Quarry expansion locality demonstrates that, although imprecise, this silty deposit is not merely the insoluble residue of weathered limestone bedrock. The sand grains in this deposit had been reset in the last 37 ka, and probably sometime around 26 ka, and this minimum age is consistent with one of the two peaks in loess deposition observed in Europe (Mark Bateman *pers. comm.*).

Granulometric examination of the insoluble residue of the Magnesian limestone at this locality demonstrates that there is a strong similarity to the 'palaeosol', but it is somewhat finer textured (a medium to fine silt rather than a coarse silt) and contained an appreciable amount of clay. Mineralogical analysis of the insoluble residue clearly demonstrated that the two deposits derive from distinctly different sources.

The implications of these conclusions for Upper Palaeolithic archaeology are regionally significant and suggest that archaeological sites of this age may lie buried within and beneath the silty soil even in upland settings. Areas where thick silt dominated deposits are present should be probed to bedrock during survey to search for Palaeolithic remains.

In terms of the sequence of events that led up to the construction of the Neolithic cairn two observations are warranted. Photographs of the quarry cut show slabs of the cairn walls resting directly upon the yellow loess deposit, and not on a humic topsoil formed on the loess. Analysis of the long profile soil column also supports this observation and demonstrates that there was not a humic topsoil beneath the monument. This suggests that the surface upon which the cairn rests was either a denuded surface from which the topsoil had been naturally

eroded, or that the topsoil had been stripped by builders of the monument. No evidence was found during the excavation to support stripping of the sod prior to construction. It is clear, however, that the loessic cover over the limestone at the time the cairn was constructed was generally quite thin and probably would have supported a woodland cover in its natural state. But the absence of a topsoil, if not stripped by the builders of the monument, may suggest that this structure was built in an existing clearing which had experienced some erosion prior to construction.

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