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The Knowe of Rowiegar, Rousay, Orkney: description and dating of the human remains and context relative to neighbouring cairns

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ABSTRACT

The Neolithic chambered cairn at Knowe of Rowiegar, Rousay, Orkney, was excavated in 1937 as part of a campaign that also saw excavations at sites such as Midhowe and the Knowe of Lairo. Not fully published at the time, and with only partial studies since, the human bone assemblage has now been largely re-united and investigated. This included an osteological study and AMS dating of selected bones from this site and other Rousay cairns in the care of University of Aberdeen Museums, as well as the use of archival sources to attempt a reconstruction of the site. It is suggested that the human remains were finally deposited as disarticulated bones and that the site was severely damaged at the time the adjacent Iron Age souterrain was constructed. The estimation of the minimum number of individuals represented in the assemblage showed a significant preponderance of crania and mandibles, suggesting the presence of at least 28 heads, along with much smaller numbers of other bones, while age and sex determinations showed a preponderance of adult males. Seven skulls showed evidence of violent trauma, while evidence from both bones and teeth indicates that there were high levels of childhood dietary deficiency. Although detailed analysis of the dates was hampered by the 'Neolithic plateau', a Bayesian analysis of the radiocarbon determinations suggests the use of the site during the period 3400 to 2900 cal BC. *This is shown to be similar to that of other dated Orcadian Neolithic cairns and may represent different responses to two periods of severe climate deterioration.*

INTRODUCTION

BACKGROUND

Along the south-west and south coasts of the island of Rousay, Orkney, there are a number of megalithic chambered cairns of the sort described by Henshall (1963: 45–120) as Orkney–Caithness (O–C) type, rectangular, stalled cairns. Indeed, of the 13 Orcadian cairns so described, seven are on the island of Rousay, with five of them lying along this south/south-west stretch of coastline (illus 1). Also along this coast are a horned cairn with tripartite chamber (Knowe of Lairo) and a Bookan-type, two-storey round chambered cairn (Taversoe Tuick). There is, however, no representative of the other principal Orcadian cairn type, referred to by Henshall as the Maes Howe-type, on the island of Rousay.

Ten of the 15 Rousay chambered cairns, including all seven along the south/south-west coast, were excavated between 1932 and 1941 by the land-owner, Walter G Grant, usually in collaboration with Dr J G Callander, Director of the then-named National Museum of Antiquities of Scotland, until the latter's death in 1938, and later with V Gordon Childe. The results of the earlier of these excavations were published in the *Proceedings of the Society of Antiquaries of Scotland* between 1934 and 1938, with the latest, Knowe of Lairo, excavated in 1936, published in 1943. The earlier publications normally contained reports on the human remains by Professor Alexander Low of the University of Aberdeen. The Grant excavations, and publications, in Rousay are listed chronologically in Table 1. The excavations from 1937 onwards,

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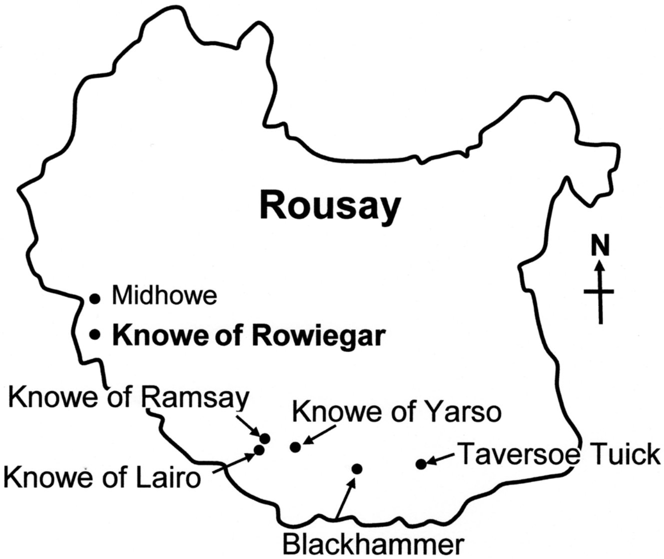


Illus 1 Location of Neolithic chambered cairns along the south/south-west coast of the Orkney island of Rousay. O–C stalled cairns are underlined

with the exception of Taversoe Tuick, were not published as individual reports and exist only as Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) reports or short notes. Details are given in the inventory in Davidson and Henshall (1989).

THE KNOWE OF ROWIEGAR

The excavation of Knowe of Rowiegar was undertaken in early 1937 by workmen of the Trumland estate, within which it stands, overseen by the estate factor James K Yorston Jr and directed by the estate owner Walter G Grant, in consultation with Dr J G Callander. Very little exists of records made during the excavation, although some photographs were taken after completion of the excavation. These are housed in the Orkney Library and Archive in Kirkwall. In addition, a short movie film was made of the excavated site, showing considerable detail of the cairn structure. This is an amateur, black-and-white, silent film entitled 'Knowe of Rowiegar' and is held by the Scottish Screen Archive as '1937c, Director – filmed by Dr William Kirkness, Ref No 2360'. On the film it states that it was directed by D Wilson. A plan with sections and elevations of the excavated cairn, attributed to W Grant and possibly drawn by D Wilson, was subsequently published by RCAHMS (1946: 218–20). The site was not maintained after excavation and now consists of only a few projecting orthostats on rough grassland below Ward Hill, adjacent to the seashore opposite the small island of Eynhallow, and a few hundred metres eastwards of the impressive, protected site of the stalled cairn of Midhowe.

Although considerable information exists about the structure of the cairn, details of contexts and the positions of excavated finds were poorly recorded. A large quantity of animal bones along with some human bone fragments and a small amount of pottery were sent to Dr Callander in Edinburgh and are now lodged with National Museums Scotland. The majority of the human bone was sent to Professor Low of the Department of Anatomy, University of Aberdeen, who had written reports on the human remains from previous excavations by Grant. The human remains from the Knowe of Rowiegar do not, however, appear to have been examined in detail at the time, with only a later brief assessment of minimum number of individuals (MNI) from maxillae and mandibles by Dr Dorothy Lunt, quoted in Davidson and Henshall (1989: 133). In 1972 the bones were seen by Dr Colin Renfrew and listed by Scott McCracken (unpublished). A further listing, in this case of only part of the assemblage, was undertaken by John Bernal in 2001 (unpublished but discussed in Bernal 2003 and Bernal et al 2005). In 2002, with the assistance of Professor Lord Colin Renfrew, the full assemblage of human bones from the Knowe

TABLE 1
Rousay excavations by W G Grant

Excavation date	*Cairn name (Davidson & Henshall invent no)*	*Cairn type after Davidson and Henshall (1989)*	*OS map reference*	*Human remains (MNI – minimum number of individuals)*	*Report publication*
1932–3	Midhowe (37)	O–C, rectangular, stalled	HY 372 304	MNI 25	Callander and Grant 1934
1934	Knowe of Yarso (32)	O–C, rectangular, stalled	HY 404 279	MNI 29	Callander and Grant 1935
1935	Knowe of Ramsay (30)	O–C, rectangular, stalled	HY 400 280	Small quantities of fragmented bone	Callander and Grant 1936
1936	Knowe of Lairo (28)	O–C, long, horned, tripartite chamber	HY398 279	Possibly three bodies	Grant and Wilson 1943
1936	Blackhammer (3)	O–C, rectangular, stalled	HY 414 276	Two males	Callander and Grant 1937
1937	Knowe of Rowiegar (31)	O–C, rectangular, stalled	HY 373 297	MNI 28 (assessment in present study)	No report
1937	Taversoe Tuick (49)	O–C, round. Bookan-type	HY 425 276	Several bodies, some cremated	Grant 1939
1938	Bigland Round (2)	O–C, round. Tripartite chamber	HY 438 325	Not reported	No report
1940	Kierfea Hill (26)	O–C, round. Tripartite chamber	HY 424 361	Not reported	No report
1941	Knowe of Craie (27)	O–C, round. Tripartite chamber	HY 419 315	One skeleton	No report

of Rowiegar was brought together and a more detailed analysis initiated. Information on all earlier examinations of the Knowe of Rowiegar human bone assemblage, other than that of Dr Lunt, is held by the University of Aberdeen Museums.

Previous to receiving the human bone assemblage from the Knowe of Rowiegar, Professor Low had examined material from Midhowe chambered cairn (Low 1933), Knowe of Yarso and Knowe of Lairo (amongst others) and after each of these examinations Mr Grant had presented some of the human bones to the University of Aberdeen. At the present time, therefore, amongst the osteology collections of the University of Aberdeen there are a partial skeleton including the skull and a second skull from the Midhowe cairn, a skull from the Knowe of Lairo and two skulls and a femur from the Knowe of Yarso.

PROJECT OUTLINE

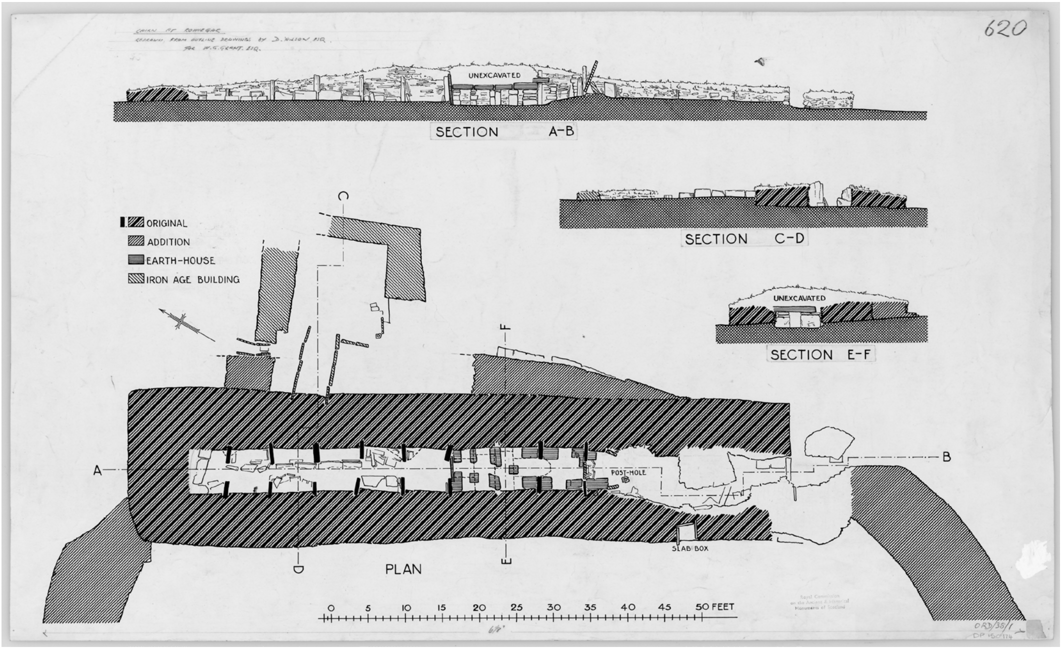
The main objective of this project was to provide an analysis of the human bone assemblage from the Knowe of Rowiegar, along with AMS radiocarbon dating of selected bones from the assemblage. Both the structure of the Knowe of Rowiegar cairn and its human bones are discussed in the context of all the Neolithic tombs along the south/south-west coast of the island of Rousay and in particular, comparisons are made with the neighbouring cairns of Midhowe and the Knowe of Yarso. Radiocarbon dating of samples from all the Rousay material held at the University of Aberdeen is reported, analysed and discussed in relation to the nature of the island and to its wider context within the Neolithic of Orkney in general.

DESCRIPTION OF THE KNOWE OF ROWIEGAR

THE CAIRN AND ITS HISTORY

The Knowe of Rowiegar lies close to the present day shoreline of a small bay below Ward Hill, towards the south-west of Rousay (NGR HY 373 297). The cairn has been described in limited detail by the RCAHMS (1946: 218–29), Henshall (1963: 214–15) and Davidson and Henshall (1989: 136–8) who classed it as an Orkney-Cromarty type stalled chambered cairn. Davidson and Henshall suggested that it may have been similar in size and form to the nearby, well-preserved Neolithic stalled cairn of Midhowe, but the Knowe of Rowiegar was much disturbed in antiquity by the intrusion of a souterrain-type structure into the south-east end of the main chamber (illus 2, taken, with permission, from the RCAHMS Inventory for Orkney 1946: 219, attributed to W Grant). The cairn and chamber structure to the south-east has been largely destroyed but it was surmised by Davidson and Henshall (1989) that the chamber had originally contained about 12 cells and that the entrance had been at the south-east end. These assumptions were presumably based on the length of the excavated main north-east wall of the cairn compared with the size of the cells in the undamaged north-west end of the chamber and on the lack of any obvious entrance passage through the remains of the main side walls.

The remaining, less disturbed, part of the chamber of the tomb is divided into cells by a parallel series of large slabs (orthostats) inset into the chamber walls and protruding into the chamber space on each side along its length. A gap exists between the opposite pairs of slabs, allowing access along the length of the chamber. The innermost six of the cells survived (roofless) until excavation, although Davidson and Henshall (1989) suggest that the north-west end of the chamber had been damaged since, unlike most tombs of this kind, there is no end slab or wall, and there were possibly intrusive slabs present in the end cell. When the south-east end and centre of the monument was converted into a souterrain, the six north-east cells of the original chamber were sealed off by a large slab wedged between the sixth pair of uprights. This provided the end wall of the souterrain. The presence of the blocking slab suggests that from the time of completion of the souterrain, presumably in the Iron Age, the contents of the end six cells were left undisturbed until the excavation in 1937.



Illus 2 Plan and sections of the Knowe of Rowiegar. From RCHMS Inventory for Orkney (1946), attributed to W G Grant, with permission of RCAHMS

ORIENTATION

The long axis of Knowe of Rowiegar long cairn and its main chamber is oriented south-east/north-west and the entrance is believed to have been at the south-east end. Of the 11 cairns on Rousay classifiable as either long cairns (ten of the 11) or round but with an elongated chamber (one – Bigland Round), nine are sufficiently preserved to allow assessment of the chamber size and its orientation and the position of the entrance passage. Of these nine cairns, all have the main axis of the chamber lying between east-to-west and south-east-to-north-west. In eight cases, the entrance is at one end, opening from the east or south-east end of the chamber, which is the most frequent orientation for the entrance in Orkney chambered cairns (Davidson & Henshall 1989: 86). In one Rousay cairn (Blackhammer), the entrance passage opens into the south (long) side of the chamber, about one-third of the way from the south end. The pattern of orientation may have related to the cosmological beliefs of the builders, but it is worth noting that, in the six cairns which lie along the south/south-west coast of Rousay, the orientation follows the topography of the terraced landscape, which is defined by the underlying Rousay flagstone, with softer beds more heavily eroded to form terraces. While the other cairns are built on the hillside a little further inland, Midhowe and Knowe of Rowiegar were built on the narrow terrace immediately adjacent to the shore (which itself has a south-east/north-west orientation). A flat building-base would be much easier to find running parallel to the shore than in any other orientation since the land rises quite steeply behind the shore, although it should be noted that the sea level was lower in Neolithic times. The positioning of the chamber entrance to the east could reflect the need for shelter from the predominantly westerly wind.

NATURE AND NUMBERING OF CELLS

Since only part of the original chamber remained at the time of excavation, all the descriptions which follow relate to the nature and contents of the end six cells of the original Neolithic monument.

Form of the cells

The pairs of internal dividing slabs of the chamber formed cells which varied from 1.5m to 1.8m in length. The slabs projected into the chamber, on average, about 0.6m. Each cell therefore consisted of a pair of stalls, each stall typically of floor area slightly less than 1m². These lay along the north-east and south-west sides of the chamber and were separated by a section of the central passage which, within each cell, had a floor area of slightly more than 1m².

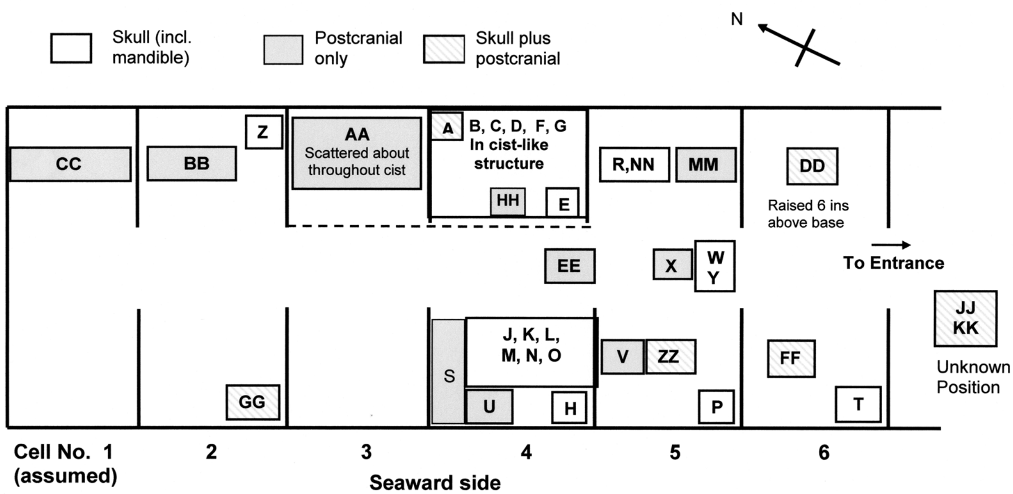
Numbering of cells

The information provided by the excavator with regard to the position of the bones within the chamber refers to the cells numerically as 1 to 6. On the plan produced by Grant, however, the cells are not numbered. To understand the distribution of material within the tomb it is, therefore, necessary to make an assumption about the direction of numbering, ie is the innermost cell number 1 or number 6? In the reports of their previous excavations of the Rousay long cairns, Grant and his co-workers numbered the cells starting with the cell nearest the entrance. This is seen in the report of the excavation of the Knowe of Yarso (Callander & Grant 1935) – although in this case there were only three cells. On the large plan of Midhowe accompanying the original report (Callander & Grant 1934), the cells are clearly numbered starting with cell 1 adjacent to the entrance at the south-east end.

This direction of numbering, however, may not hold true for Knowe of Rowiegar. National Museums Scotland hold a copy of a letter from Callander to James Yorston Jr in which Callander queries the order of numbering as follows (the reference to Cell No 8 relates to a bead found in the outer part of the chamber):

> What you call Cell No. 8 I take to be the long chamber at the Trumland (south-east) end of the cairn from which all the upright slabs had been dragged out. This would mean that your numbers which start at the west end are as follows – 1–6, the cells or stalls; then we have the roofed-in part … (Callander 1937).

This is accompanied by a hand-drawn sketch on which the innermost (north-west) cell is labelled 1 and numbering proceeds sequentially towards the south-east. Callander asks Yorston to confirm this, but no reply to Callander's letter has, as yet, been found. James Yorston Jr was the main actual



Illus 3 Diagrammatic representation of the innermost six cells of the Knowe of Rowiegar chamber, along with an approximation of human bone deposition within them

excavator (under the supervision of Walter Grant) at the Knowe of Rowiegar site, as his father had been at earlier digs by Grant and Callander. It is extremely likely that the notes with the bundles of bones (see below) were written by him. On this basis it is assumed in the present report that the cells are numbered from the north-west end of the chamber, as suggested by Callander. This is shown in illus 3.

Shelves

The existence of shelf- or bench-like structures has been described at both Midhowe and Taversoe Tuick (Turner 1903; Callander & Grant 1934; Grant 1939; Davidson & Henshall 1989: 25–7). Similar structures are known to have existed in a number of Orcadian tripartite and stalled cairns (Reilly 2003). Some of the stalls at Knowe of Rowiegar, especially on the north-east side of the chamber, contained masonry that appears to be additional to that from the collapse of the roof. RCAHMS (1946: 218) remark that there was plentiful evidence for the existence of shelves, presumably referring to this masonry, although they do not specify the nature of the evidence or the position of the shelves.

At Midhowe, shelves were reported in the east-side stalls of cells 5 to 11 (Callander & Grant 1934). These had been formed by placing upright slabs across the entrances to each stall and laying a horizontal slab on each upright slab. The horizontal slab extended back to the rear of the stall (the side-wall of the chamber), forming the shelf or bench at a height of about 9 to 18 inches (23cm to 46cm) above ground level. No mention is made of how the shelves were supported at their side or rear edges. At Taversoe Tuick a similar arrangement was described in at least two of the stalls in the lower chamber of the cairn (Turner 1903; Grant 1939). In this case, the rear edges of the shelves were supported by a ledge cut into the native rock (the lower chamber being subterranean), and the spaces below the shelves were filled with rubble and masonry (shown in Henshall 1985). Crouched human skeletons were reported to have lain on some of the shelves at Midhowe and a similar crouched, articulated skeleton was found on one shelf at Taversoe Tuick. Reilly (2003) has suggested that in some cases the top of the shelves or benches may have been made of wood – this would account for the projecting stones at the Knowe of Yarso whose purpose could have been to support a wooden shelf.

The RCAHMS plan of the Knowe of Rowiegar shows masonry in stalls 2 to 5 on the eastern side of the chamber and there is an indication of similar masonry in or adjacent to the western stalls of cells 2 and 5, as seen in the post-excavation photograph (illus 4). The slabs on the north-east side, if vertical as shown on the RCAHMS plan, could provide front supports for shelves raised about half a metre from ground level – higher than those at Midhowe. As will be described, the original excavator provided rough

ILLUS 4 Photograph of the northerly six cells of the Knowe of Rowiegar chamber shortly after excavation. Cells 3 to 6 have been labelled. Photograph courtesy of Orkney Archive

Table 2
Notes placed by excavator giving position of bundles (later bags) of human bones

Bag	*Cell*	*Side*	*Notes (other than cell/side)*
A	4	NE	In cist. This skull was so thin it would hardly hold to lift
B	4	NE	Parcel 2. From cist
C	4	NE	Parcel n. 3. In cist
D	4	NE	Parcel 4. One skull. In cist
E	4	NE	Parcel 5. One skull
F	4	NE	Parcel 6. On east side of cell. One skull in cist
G	4	NE	Parcel 7. In cist
H	4	SW	Parcel 1. South west in corner nearest Trumland
J	4	SW	Parcel 2. Skull fragments
K	4	SW	Parcel No 3
L	4	SW	Parcel 4
M	4	SW	Parcel 5
N	4	SW	Parcel 6
O	4	SW	Parcel 7
P	5	SW	Broken skull. In south corner
R	?5	NE	Close to best preserved skull in this box
S	4	SW	Along the side
T	6	SW	One skull in south corner lying on left hand side of face. In corner nearest Trumland
U	4	SW	Nothing
V	5	SW	Nothing
W	5		One skull in passage. Inside entrance to cell. Beside another broken skull
X	5		Passage. From inside of entrance in middle of floor
Y	5		One skull in passage. Just inside entrance of cell in middle
Z	2	NE	In east corner. One skull broken. Corner next Trumland
AA	3	NE	Scattered about through cist. In north corner furthest from Trumand
BB	2	NE	Note – two vertebrae joined
CC	1	NE	Nothing
DD	6	NE	About 6 inches above bottom level

Bag	*Cell*	*Side*	*Notes (other than cell/side)*
EE	4		In passage. Just inside entrance to cell
FF	6	SW	Nothing
GG	2	SW	In south corner nearest Trumland
HH	4	NE	Remains found in cist-like structure. One of two bags
JJ	None		(Unknown location, found loose in box)
KK	None		(Material from unknown location in tissue paper)
MM	5	NE	East side

notes with the newspaper-wrapped bundles of human bones, giving approximate locations of the find-site for those bones (Table 2). Reference is made in these notes to the finds being in 'cist' or 'cist-like' structures or being 'scattered about the cist', presumably referring to a box-like structure formed by these slabs. There is, however, no mention of horizontal slabs, either in situ or fallen, which would represent the shelves. It is not possible, therefore, to speculate as to whether the bones were originally on or below shelves or laid into open-top boxes. There is, however, no evidence to suggest the presence of any articulated skeletons at Knowe of Rowiegar.

ARRANGEMENT OF BONES

Description of bags and labels

As noted above, at the time of excavation, the human bones were gathered up in small groups, each group being wrapped in newspaper and provided with a label stating the approximate position of the bones within the chamber. The packages of human bone were boxed and sent to the University of Aberdeen, where they were stored and occasionally examined. At one examination, by Colin Renfrew and Scott McCracken in 1972, the bones were removed from the newspapers and placed into bags. For ease of reference, each bag was given an alphabetic identifier.

Illus 3 is a diagrammatic representation of the information available about each of the lettered bags of human bones. The contents of each bag is identified as cranial material, postcranial material or a mixture of the two, and the cell from which the bones were removed is as stated on the excavator's note. All but two bags had a cell-identifier. Any further information as to position has been used in placing the bag's position on the diagram. For example, one package of bones contained a label stating 'Cell No. 5, Broken skull in SE corner, SW side (seaward side)'. This package was subsequently given the code letter P and was found to contain fragments from at least two crania plus several mandibles. Its approximate location is shown in illus 3. The labels placed in the bone packages are insufficient to allow the precise positioning of the bones in the stall. For example, although the packages now labelled as A to HH are all identified as coming from the landward side of cell 4, there is no way of knowing the order in which they lay in that stall, as the identifying letter is not related to position within the stall. For most packages, only the cell number and the side of the chamber on which it lay are recorded. Two bags, given bag labels JJ and KK, had no original labels. Bones in bag JJ were found loose in one of the boxes used to transport the bones from Rousay to Aberdeen. The bag labelled KK contained bones found wrapped in tissue paper, but without a label, in this same box. Both bags contained a mixture of mandibles and small postcranial bones.

Arrangement of bones between and within cells

The distribution of human bone is very uneven between the cells, with the majority of the bones being found in cells 4 and 5. Within these cells, bones – especially skulls – are found on both sides of the central aisle. No crania or mandibles appear in cells 1 or 3 and only one partial skull (Z) and a maxilla and two mandibles (in mixed bag GG) appear in cell 2. Relatively little of the human material is found in the middle of the cells – small amounts occur in the aisles of cells 4 and 5, in both cases, close to the entrance to the cell (ie its south-east end).

It is not possible to ascertain the extent to which the pattern of distribution found by the 1937 excavators reflects the layout of bodies and bones during the Neolithic use of the cairn or whether there was major disturbance of this arrangement prior to or at the time of re-use of part of the cairn as a souterrain. As already mentioned, the Knowe of Rowiegar underwent considerable disturbance prior to its excavation. The end six cells are, however, unlikely to have been disturbed, other than by the collapse of the roof, after being blocked off during the Iron Age. This implies that the arrangement of the bones in the chamber was either that of the original users of the cairn or was produced by the Iron Age 'intruders' (or a combination of these). Whilst it is impossible to state definitely who arranged the bones, comparison with the arrangement of bones at Midhowe and Knowe of Yarso offers a slight suggestion of what the arrangement may have been during the Neolithic. At both Midhowe and Knowe of Yarso it is likely that, after the Neolithic, the bones were disturbed only by roof collapse and, in the latter, by stone looting, ie there was no major human intrusion into the chamber, such as is seen at Knowe of Rowiegar. In both cases, the excavators reported a specific orientation for many of the skulls. At the Knowe of Yarso, the great majority of the human remains were in the innermost of the three cells. Those in the centre had been extensively disturbed during stone looting, but at the edges the – presumably original – arrangement had been largely preserved. The skulls had been separated from the other bones, including the mandibles, and laid in rows along the chamber side walls. They were positioned upright, top of head uppermost, and facing into the centre of the chamber (Callander & Grant 1934). At Midhowe, although most of the skeletons were said to have been articulated, in three of the 'articulated' skeletons the skull had been removed from the rest of the body or skeleton and placed adjacent to it, but in an upright position and, again, facing into the centre of the chamber. At least two other skulls had been dissociated from their postcranial skeletons and placed in this same orientation. It seems, therefore, that the Neolithic users of the Rousay cairns had a preference for separating the skull from the rest of the body and placing it upright and facing into the centre of the chamber. At the Knowe of Rowiegar it is not possible to comment on the orientation of the skulls, but the fact of their dissociation from the rest of the skeleton, the grouping of skulls together, as seen at Knowe of Yarso, and the suggestion that the skulls were broken by a blow to the top of the skull (from the roof collapsing or as a deliberate action – see next section) does suggest that the arrangement seen on excavation is compatible with the practices of the original users of the chambered cairns of southern Rousay, and does not necessarily imply disturbance in the Iron Age.

Since the stall width (orthostat to orthostat), as taken from the RCAHMS plan, is in excess of 1.5m and the average breadth of a Neolithic skull (taken from semi-intact skulls at the Knowes of Yarso and Lairo) was about 14cm, the skulls could easily have sat in a row along the backs of the stalls of cell 4 (which contained most skulls), with a similar arrangement to that in the Knowe of Yarso, although no evidence for this is preserved.

THE KNOWE OF ROWIEGAR HUMAN BONE ASSEMBLAGE

The Knowe of Rowiegar human bone assemblage is of modest size when compared with the assemblages of Quanterness (Crozier 2012) and Isbister (Lawrence 2012). As listed in Table 3, a total of 20 skulls were uniquely identified, along with numerous unallocatable skull fragments. These were mainly found centrally in the bone distribution (cells 4 and 5) with the postcranial bones and fragments being more peripheral. As listed in Table 4, there were 162 identifiable postcranial bones, some of which were broken or incomplete. Few unidentifiable postcranial fragments were found.

STATE OF THE HUMAN REMAINS

Breakage

All of the skulls and many of the long bones in the Knowe of Rowiegar human bone assemblage are broken. In some cases, the edges of the breaks appear fresh and clean so fracture may have occurred at the time of excavation or transport. Other broken surfaces are eroded and dirty, suggesting a greater antiquity for the damage. Some edges, especially of skull fragments, appear gnawed. The breakage of the skulls has the appearance of shattering. There is often a fairly large number of fragments with

Table 3
Skulls for which sufficient reconstruction was possible to ensure they represented unique individuals. (NP – not possible)

Designator	*Position cell/side*	*Age*	*Sex*
A	4/NE	Child	NP
B	4/NE	*c* three years	NP
C(1)	4/NE	Adult	?male
C(2)	4/NE	Adult	Male
D(1)	4/NE	Young adult	?male
E	4/NE	Adult	Male
F/T(1)	4/NE:6	Adult	Male
G	4/NE	Adult	?male
H(1)	4/SW	Adult	Male
H(2)	4/SW	Child	NP
J	4/SW	Adult	Female
K(1)	4/SW	*c* two years	NP
K(2)	4/SW	Adult	?female
L	4/SW	Adult/elderly	Male
M	4/SW	Elderly	Male
N	4/SW	Adult	Male
O	4/SW	Adult	Female
P(1)	5/SW	Adult	Male
P(2)	5/SW	Young adult	?male
Z	2/NE	Adult	?female

TABLE 4
Number of postcranial bones in the Knowe of Rowiegar human bone assemblage within chamber. In italics – note is of later date. Bones sided where possible

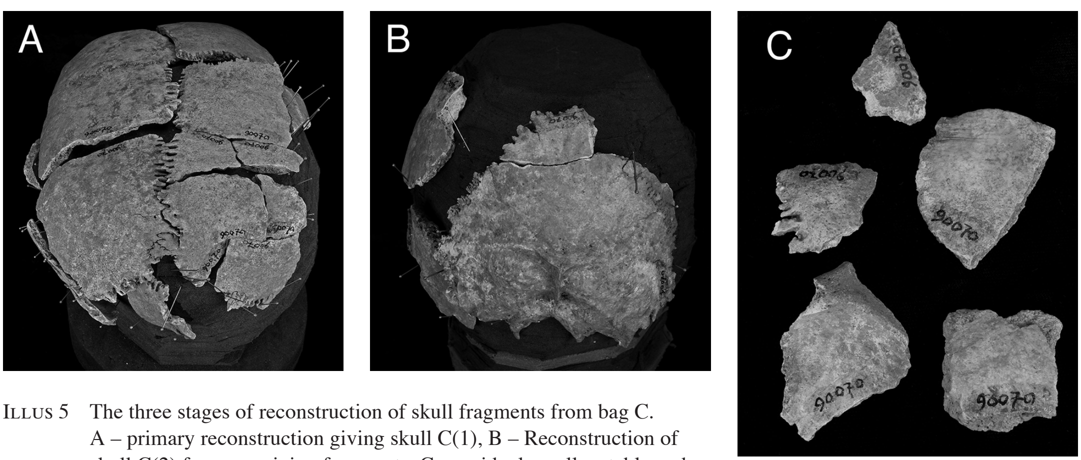
Bone Type	*Total number*	*From left side*	*From right side*	*Comments*
Cervical vertebra	10			six atlas, four axis
Thoracic vertebra	0			
Lumbar vertebra	14			two fused
Sacrum/coccyx	0			
Rib	2			both first rib
Sternum/manubrium	0			
Clavicle	9	6	3	
Scapula	2		2	
Humerus	12	5	7	
Radius	5	2	3	
Ulna	9	4	5	
Carpal	0			
Metacarpal	5	4		
Hand phalange	0			
Innominate	7	3	4	
Femur	5	3	2	
Patella	10	5	5	
Tibia	11	6	5	
Fibula	4	1	3	
Calcaneus	15	8	7	
Talus	16	8	8	
Other tarsal	0			
Metatarsal	21	9	8	
Foot phalange	3	2	1	
Tibial epiphysis	1	1		
Humeral epiphysis	1	1		

a seemingly random assortment of shapes and sizes. The edges of the fragments are usually straight or gently curved with the broken edges vertical through the skull bone. The corners of the fragments are sharp as seen in illus 5A. This is a classical pattern for 'dry bone' fracturing, ie where the breaks occur in bone which has lost most of its organic and water content – and hence its elasticity – during a post-mortem period of at least weeks to months (Lovell 1997 quoted in Roberts & Manchester 2005: 115).

Skull reconstruction

To help sort the contents of those bags which contained cranial material, a form of 'reconstruction' was undertaken for each skull. A number of head-like shapes (formers) were made from polyethylene foam (Plastazote). The skull fragments from a bag were separated out and sorted by cranial region. At this stage it became obvious whether the fragments originated from one or more skulls. The major skull represented in the bag was given the designation (1) after the bag code letter, and an attempt would be made to 'reconstruct' this skull by attaching the fragments onto the former, supporting them using entomological pins. Only those fragments which actually fitted together, ie were contiguous, were put on the former, to ensure that all pieces were from a single skull. Once all possible fragments had been mounted, the remaining, unattached fragments were examined to see whether any of them could be fitted together. If so, these were pinned to a second former and this skull was designated as (2) for this bag code. This procedure continued until no further pieces could be matched, leaving a number of fragments which were not contiguous with any of the designated skulls. If any of the remaining pieces matched a reconstructed skull in colour, texture and thickness, such that they were likely to be part of that skull, they were applied to the appropriate part of that former, but always with a lower certainty of match than the contiguous fragments. At the end of all these procedures, a small number of unmatched fragments frequently remained. These were set aside for attempted cross-matching with skulls from other bags. A set of reconstructions from bag C is shown in illus 5. It should be noted that, because this 'reconstruction' was onto a solid former, it was not possible to take any osteometric measurements from the reassembled skulls.

The final stage in the reconstruction process was an attempt at cross-matching, ie comparing those fragments from each bag which could not, with certainty, be allocated to any of the reconstructed skulls of that bag, with the reconstructed skulls of other bags, especially those designated by the excavators as coming from the same stall. It was hoped that where



ILLUS 5 The three stages of reconstruction of skull fragments from bag C. A – primary reconstruction giving skull C(1), B – Reconstruction of skull C(2) from remaining fragments, C – residual, unallocatable and unmatchable fragments

cross-matches were found, they might indicate the relative position of the skulls, since the most likely place to find a displaced fragment would be in a bag containing an adjacent skull. Unfortunately this attempt was not successful and very few cross-matches could be made with any certainty. In general, the fragments which remained after all possible reconstructions were small, and weathering, erosion and gnawing caused problems in fitting them to other fragments or skulls.

Cause and date of damage

The damage to the skulls can be ascribed to one of four causes (or a mixture of them):

1. Mortuary practices at the time of interment or shortly thereafter, ie during the Neolithic.
2. Later damage, probably at the time of modification of the cairn to form a souterrain, ie during the Iron Age but before sealing the end of the souterrain.
3. The roof of the cairn falling onto the exposed skulls, which would probably have occurred between insertion of the souterrain and the time of excavation of the cairn since the chamber from cell 6 north-eastwards towards the entrance appears to have been intact at the time of conversion to a souterrain, and hence it is likely that cells 1 to 6 were also intact.
4. Damage during or after excavation, ie recent damage. As discussed above, this shows as fresh, clean, sharp breaks through the bones. Unfortunately, from the amount of dried mud adhering to the bone fragments, the excavation appears to have taken place in damp conditions and this often disguises the freshness of the breaks, so not all recent breakage can be identified.

Direct evidence from the skulls is insufficient to distinguish between the first three possible causes of damage, but there is some indirect evidence from analysis of the contents of the individual bone bundles produced at the time of the collection of the bones and from the pattern of the breakage of the skulls. On examining the contents of the bundles, especially where these contained only cranial material (as is mostly the case in bundles from cell 4), and on attempting to reconstruct the skulls, it became obvious that although a bundle could contain bone fragments from more than one skull, there was little material from skulls which were the main components of other bundles, ie there was little 'cross-talk' between the bundles. This suggests that the skulls were found in the places in which they had been smashed and had not undergone disturbance after the breakage (with one notable exception (skull F/T1) to be discussed later). It also suggests that the skulls were broken by a force that limited the tendency of the fragments to fly large distances after the traumatic impact.

The poor recovery of skull fragments, and hence the large gaps in the reconstructed skulls, makes it difficult in some cases to suggest the position of the damage-causing impact on the skull. However, it is likely that the smallest fragments would be formed where the greatest energy was deposited, ie at or close to the site of impact (as when the shell of an egg is cracked by hitting it with a teaspoon). Where an assessment can be made (eg skull C(1) in illus 5), it is seen that a cluster of smaller fragments is surrounded by pieces of increasing size. In most of these cases, the small fragment cluster is located on or close to the apex of the cranium, suggesting a blow from above onto a skull which was sitting in a vertical position. The mandibles were not attached to the crania, so the crania were sitting on the maxillary/occipital surface, as is reported for skulls in the innermost cell at the Knowe of Yarso by Callander and Grant 1935. It is also noticeable that in many reconstructions there is a marked absence of fragments to fill the centre of the cranium (ie fragments from the rear of the frontal and upper parts of the parietals), which may suggest that these were broken into smaller fragments which failed to be recovered, since detailed recovery of material was not attempted, as evinced by the total lack of recovery of loose teeth, and sieving was not employed in any of the Grant excavations. This

Illus 6 Reconstruction of skull H(1) viewed from above, showing area of missing fragments

pattern of skull damage is shown in illus 6. Again this may, indirectly, suggest a blow from above.

Using this indirect evidence, the three types and times of pre-excavation damage can be considered:

1. Were the skulls broken during the Neolithic use of the cairn, ie was the breakage an element of the mortuary practices at the site? The breakage pattern of the skull fragments where this can be assessed (ie where not eroded or gnawed) was generally of the 'dry bone' type, meaning that it did not occur at or close to the time of death. The crania were dry with most of the organic content lost, and the mandibles had been removed before breakage occurred. At least three stages are, therefore, indicated with the skulls first being defleshed (in or out of the cairn), then the intact crania being positioned in their final resting place and finally the crania being smashed before being left undisturbed.
2. Were the skulls deliberately broken during the Iron Age, perhaps as part of activities that saw such sites as 'the homes of ancestors and as places where the powerful remains of ancestors were housed' (Hingley 1996: 241)? It is possible that such activities could also have altered the layout of human bones, while the pattern of breakage suggests that this would have to have been done quite carefully. There is, however, no evidence for such practices occurring at similar sites. In any case, it must have been done before the sealing off of the end six cells of the chamber.
3. Could the skulls and other bones have been broken when the roof of the cairn collapsed, at some date between the Iron Age occupation of the site and the excavation? It was suggested by the excavators of Midhowe that this was the case for that monument (Callander & Grant 1934: 334), but breakage was sporadic at Midhowe rather than being almost universal as at Knowe of Rowiegar. It is possible that many of the skulls at the Knowe of Rowiegar were, as at Knowe of Yarso, lined up along the sides of cells, especially cells 4 and 5. There is some evidence that the roof above these cells was absent prior to the 1937 excavation: a plan of the Rowiegar site by D Wilson (an Orkney surveyor who made most of the plans of the Grant excavations) dated July 1935 and held at the University of Aberdeen, clearly shows that the tops of some orthostats were visible in the region, which on excavation was found to be occupied by the six end cells (ie beyond the souterrain which is labelled as 'roofed'). At least two pairs of orthostats are shown plus another pair of structures drawn in black. Comparing his plan with the plan and section of the excavated structure in the RCHMS inventory (1946) suggests that these unroofed cells will be either 3 and 4 or 4 and 5. Cell 4, which contains most of the skulls, did not, therefore, have a roof. It is possible that roofing material had fallen onto the skulls in antiquity, either smashing them then or

allowing them to be smashed when the fallen slabs were dragged out.

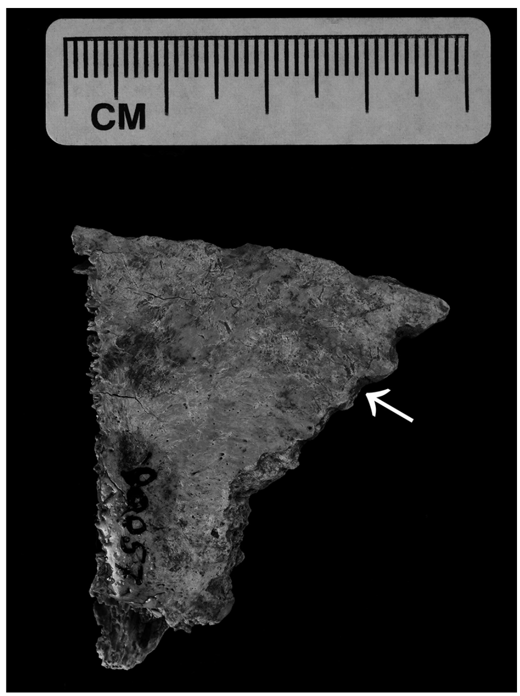
In part, due to the lack of existing full bone assemblages for Midhowe and Knowe of Yarso, it is difficult to reach a conclusion about the timing of the breakage of the skulls at Knowe of Rowiegar, but a prehistoric date appears the most likely and breakage of skulls during roof collapse seems the most likely cause. The Late Iron Age destruction of the souterrain at the Cairns, South Ronaldsay, in which 'the roof slabs were ripped off, the chamber filled in and the majority of the roof lintels broken up' (Towrie 2013) may be a possible parallel.

Barber (1997), in describing the excavation of a stalled cairn at the Point of Cott, Westray, discusses breakage and loss of bones due to erosion processes in terms of microclimate development in different parts of the chamber, resulting in different rates of bone erosion. This may account for some of the low bone numbers found at Knowe of Rowiegar as well as apparent loss of parts of the skulls. Unfortunately, however, the collection techniques employed at the time of excavation were too poor to allow evaluation of such factors.

Gnawing

Although gnawing by large animals was not seen at Knowe of Rowiegar, a number of the skull fragments exhibit signs of gnawing by small animals, presumably rodents. The majority of the gnawed fragments were found in bone bundles attributed to the south-east (seaward) corner of cell 4 of the cairn. The gnawing is shown in illus 7 with a fragment of the frontal bone from the skull of an 8- to 9-year-old child. This individual possessed a complete metopic suture, which is seen on the left side of the photograph, and which is distinct from the gnaw marks on the right side. Although it is not possible to say when the gnawing took place, it must have occurred after skeletonisation and after the skull was shattered, since it occurs along a broken edge which links with other 'old' breaks. This pattern is found in most of the gnawed skull fragments. A possible candidate for the gnawing rodent is the Orkney vole (*Microtus arvalis orcadensis*). This is a sub-species of the common vole (*Microtus arvalis*) which does not occur in mainland Britain. No vole skulls are recorded amongst the animal bones from the Knowe of Rowiegar, which are held by National Museums Scotland, and were listed soon after excavation by Miss M I Platt (*c* 1937) in an unpublished manuscript held by NMS, although the collection has not subsequently been examined in detail. *Microtus arvalis orcadensis* skulls are, however, listed by Platt among the animal remains from the neighbouring chambered tomb of Midhowe (Callander & Grant 1934). *M. arvalis orcadensis* has also been found in the Mainland Maes Howe-type cairn of Quanterness (Schulting et al 2010) where gnawing of human bone has been observed.

The Orkney vole is larger than most *M. arvalis* types and studies of vole skulls from Orcadian chambered tombs suggest that in the Neolithic



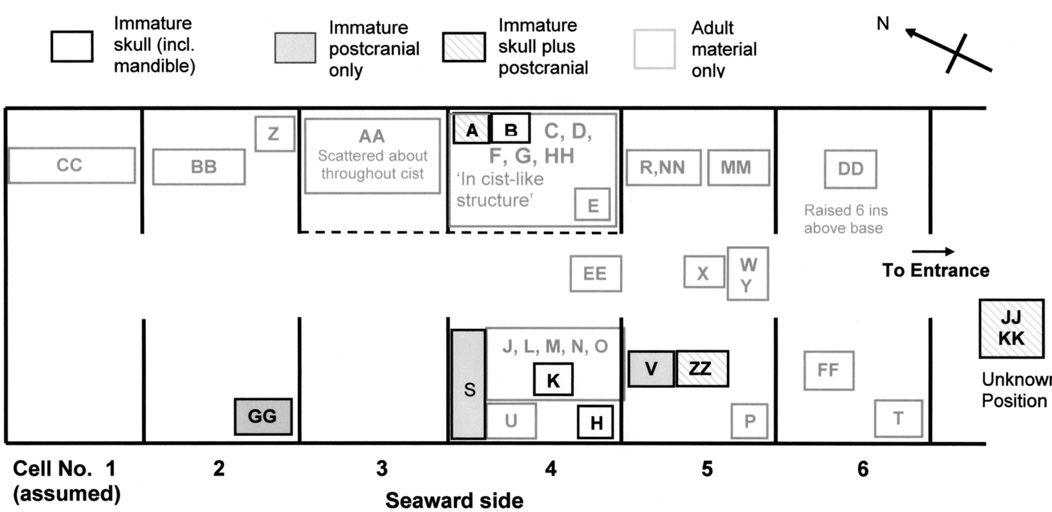
ILLUS 7 Fragment of juvenile frontal bone from skull H(2) showing metopic suture on the left and rodent gnawing on the right. Gnawing indicated by arrow

it was even larger. To test the possibility of the Knowe of Rowiegar gnawing originating from this species, measurements were made of the width of the individual gnaw marks. For 11 gnaw marks on Knowe of Rowiegar bones which were clear enough to measure (from three bone fragments), values were obtained for the width of the hole at its deepest part – ie the part of the gnaw mark which is most likely to directly relate to the width of the upper incisor pair which made the hole. These provided a mean width of 2.17mm ± 0.362 SD. There are a large number of skulls of modern *M. arvalis orcadensis* in the Zoology collection of the University of Aberdeen, which enabled measurements of the width of the gnawing incisor teeth to be made. Usually the two maxillary incisor teeth are very close together providing the animal with a single gnawing tool. The double width was, therefore recorded. From ten skulls, derived from a number of Orkney islands, the mean double width of the upper incisors was 2.45mm ± 0.289 SD, and of the lower incisors was 2.03mm ± 0.323. It is, therefore, possible that *M. arvalis orcadensis* is indeed the gnawing rodent which left these traces on the Knowe of Rowiegar bones.

NUMBER AND DISTRIBUTION OF THE BONES

General distribution of human skeletal material

The human bone assemblage was presented in 39 bags. Of these, 21 contained only cranial material, a further seven contained a mixture of cranial and postcranial bones and fragments, and the final nine contained only postcranial material. Of the 21 bags containing only skull fragments, 13 were from cell 4 and another four from cell 5. This is shown in illus 3, in which it is clear that the crania are concentrated into the centre of the surviving group of cells, with much of the postcranial material occupying more peripheral positions. In those bags indicated as containing a mixture of cranial and postcranial bones, most of the cranial material consisted of mandibles with a few maxillae. Of the total of 23 mandibles in the assemblage, only ten were found in the 'skulls only' bags and several of these do not match with any of the reconstructable skulls in their bag. The distribution of mandibles is strikingly different from the distribution of reconstructable skulls. Of the mandibles, two are from cell 2, four are from cell 4, eight are from cell 5 and two from cell 6. The remaining six were in bags JJ and KK, which were not ascribed to specific



ILLUS 8 Distribution of juvenile skeletal material throughout the six remaining cells of Knowe of Rowiegar

locations in the chamber. A similar dissociation of crania and mandibles was reported from the Knowe of Yarso (Callander & Grant 1935: 332). A high proportion of the Knowe of Rowiegar maxillae were detached from the crania and these, also, tended to be placed away from the main concentrations of reconstructable skulls and calvaria.

Juvenile material, ie child to mid/late teens, was found in cells 2, 4 and 5 and in the two 'unallocated' bags JJ and KK. Nine of the bags contained juvenile bones and/or skull fragments and the distribution of these is shown in illus 8. In most cases, with the exception of bags A and B, adult bones or fragments are also found in the bags with juvenile material. There is no distinction in distribution pattern between adult and juvenile material. Similarly, where the sex of a bone could be ascertained with certainty, male and female remains showed similar distribution patterns.

From the notes placed in the bundles of bones (Table 2) it can be seen that the great majority of all the human cranial material was placed within the stalls at the sides of cells 4 and 5, with little difference in the quantity of material between the north-east and the south-west sides, unlike the distributions in either Midhowe or the Knowe of Yarso. In the latter, there was a scatter of human bone, mainly skulls, over the whole floor area of cells 3a and 3b (although there had been considerable disturbance here during stone robbing), and in the former, the great majority of all human bones was found on the north-east side of the chamber, with little in the centre or on the south-west side. At Knowe of Rowiegar, only four bundles of bones are recorded from the centre of cells 4 and 5, and these are all designated as being at or near 'the entrance' – presumably the east side of the cells.

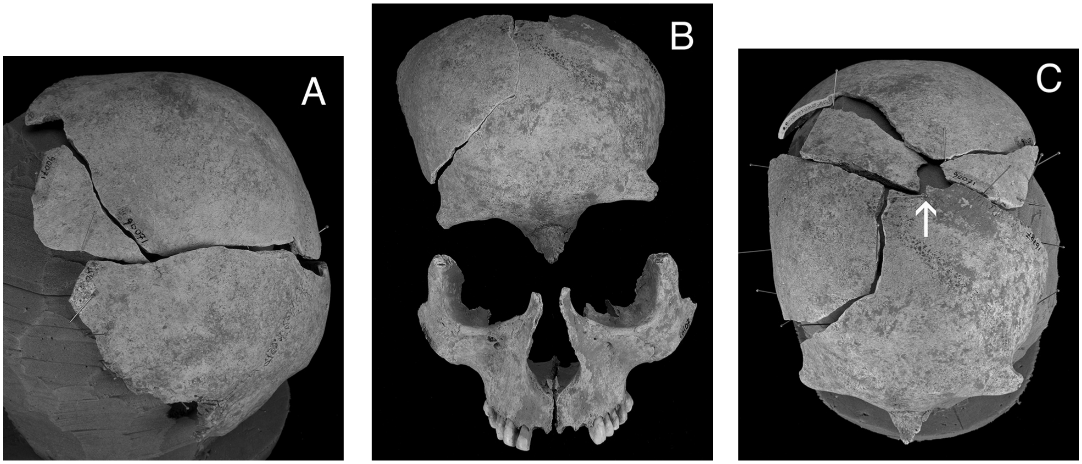
Skull elements

It is not possible to suggest a total number of skulls present in the Knowe of Rowiegar human bone assemblage, due to the broken and degenerate state of the remains. As already described, attempts were made at skull reconstruction and this was achieved to the extent that a total of 20 individuals could be uniquely identified on the basis of skull bones other than the mandible and maxilla. These are listed in Table 3.

In almost every bag of skull bones there were pieces which could not be included as contiguous elements to the main reconstructed skull or skulls from that bag. In some few cases, these bone fragments could be matched onto a skull from another bag but most remained unallocated, suggesting there were more individual skulls originally present than were reconstructed in this study. The only major apparent displacement of skull fragments from one cell to another was that of part of skull F, from the north-east side of cell 4 (in the 'cist'). The front and facial elements of this skull were found in a bag of skull material labelled as coming from the south-west side of cell 6. It had been given the designator T(1). The skull material from cell 4, which was reconstructed as skull F, was from the parietal and occipital bones plus a sliver of the frontal bone. When these two skull reconstructions were positioned together, the fit was perfect, including the position of a hole (to be discussed later) whose edges were shared by each contributing part. The combined skull is designated F/T(1), the two parts and the reconstruction being shown in illus 9. It seems possible that the skull was originally positioned in cell 4, and broken there, after which the face with attached frontal bone, which could have been intact at the time, was lifted out of the 'cist-like' structure in cell 4 and placed into cell 6. If, however, the skulls were broken by the roof collapsing onto them at some time after the blocking off of the end six cells in the Iron Age, then the transport of half a skull could not have occurred before the time of excavation. In this case it is possible, and seems the most likely explanation, that some post-excavation error has occurred in the bagging or labelling. Similar major movement of fragments has not occurred with other skulls, although other cases exist in which the face had remained almost intact when the cranium was shattered (eg skull O, an adult female from cell 4, shown in illus 10).

Postcranial elements

Table 4 lists the total number of each postcranial bone present in the Knowe of Rowiegar assemblage. The most frequently represented



Illus 9 Skull reassembled from skulls F (cell 4 north-east) and T(1) (cell 6 south-west). A –Reconstruction of Skull F fragments seen from the left. These provide the left side of the full reconstruction: B – Reconstruction of the T(1) fragments seen from the front. These provide the face and frontal bone areas of the full reconstruction: C – Final reconstruction seen from above. The two lower fragments are T(1) and the upper fragments are F. The arrow indicates a hole at the junction between T(1) and F which became apparent on reconstruction

individual bones are the talus and the calcaneus. These are substantial and sturdy bones with thick cortical bone layers and may be expected to have good characteristics for survival against erosion and be observable by anyone collecting the bones, eg at excavation or during collection for re-deposition at some earlier time. These reasons for continued existence of a bone type do not, however, always predict survival, as seen in the femur (usually one of the best bones for survival) of which only five are still present in the assemblage. This can be compared with the study by Simon Mays (1992) of bone recovery rates from a medieval burial site in which the femora and tibiae had the highest recovery rate (both in the order of 90% from a site where whole body interment took place with no disturbance between burial and excavation).

It may be expected that bones with a thin cortex and a high trabecular content would be the most vulnerable to erosion in the damp environment of the chambered tomb, and hence be poorly represented. This may account for the low numbers of ribs, sternal bones and vertebrae (Table 4). Where bones were moved in antiquity or where excavation techniques were inadequate – for example, there is no report of sieving of the excavated sand/soil in the Grant reports, although re-examination of excavation spoil after it had been rain-washed is mentioned in the Knowe of Yarso report – then small bones such as phalanges, carpals and tarsals (other than the calcaneus and talus) will be under-represented. But in addition to these expected distortions in the frequency of recovered bones, there are

Illus 10 Intact upper face of Skull O

some surprising anomalies in the Knowe of Rowiegar assemblage. For example, amongst the 21 metatarsals to survive, 13 are the first metatarsal (the great toe). It is also noteworthy that both the surviving ribs are 1st ribs, and one of these is from a juvenile, which would be expected to have a lower survival potential than the more robust and larger adult ribs. All ten of the cervical vertebrae which survived were either C1 – the atlas (6) or C2 – the axis (4). This tendency for a disproportionate representation of the atlas and axis has been observed in the human bone assemblages from other cairns, in particular from Isbister, as discussed by Davidson and Henshall (1989: 54) and Reilly (2003). No fully satisfactory explanation has been offered, although excarnation of the body with selection of elements for subsequent placement in the chamber has been proposed (Hedges 1983), though there is little other evidence for this practice at the Knowe of Rowiegar. The higher than expected number of C1 and C2 vertebrae may, however, reflect the removal of the head before the body had become fully skeletonised, which is consistent with their careful placing in the cairn.

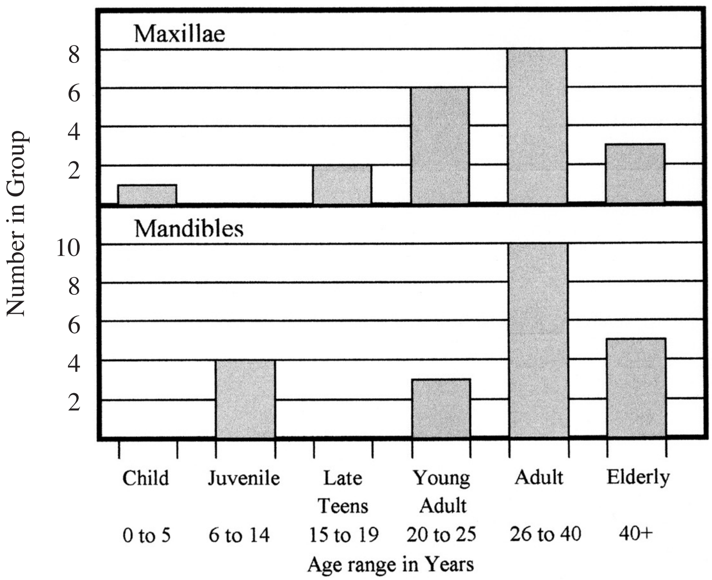
The anomalies in survival rates of the different bones, and the general poor representation of all postcranial elements, taken along with the pattern of distribution of the human bones within the surviving part of the cairn chamber, suggests that normal taphonomic processes cannot account for the pattern of survival. Unintentional poor retrieval of the bones is also an unlikely explanation if consideration is given to the preponderance of small bones in the retrieved assemblage, since during excavation one would expect the larger bones, eg long bones, to be more obvious to the excavators. This argument also applies to the collection and re-deposition of bones during disturbance of the cairn in the Iron Age. It is, therefore, likely that selective processes of bone deposition were employed during some early phase of use of the cairn, ie that, at least within the end six cells, the bodies were defleshed elsewhere (either in a separate area of the tomb as has been suggested for Midhowe (Davidson & Henshall 1989) or separate from the cairn and then selected bones were placed into the 'final resting place' area of the tomb. It is also possible, however, that a preponderance of the postcranial material had been placed in the no-longer-existing six to eight cells and that this was lost at the time of insertion of the souterrain.

A further possible explanation for anomalies in the proportions of bone types in the bone assemblages is the selective removal of bones, with their possible re-deposition in another chambered cairn. This pattern of interaction with human bones in the Neolithic has been widely discussed, eg by Reilly (2003), but there is no direct evidence available from the Knowe of Rowiegar to show that such transfer of bones between cairns took place.

AGE AT DEATH

Relatively few possibilities exist for assessment of the age at death of the Knowe of Rowiegar population due to the very fragmentary state of the bones. The postcranial bones cannot be used in this respect due to their limited number and erratic survival, and the reconstructed crania were generally too incomplete to offer reliable age information other than within the wide categories used in Table 3. Amongst the 20 reconstructed skulls four were from children or juveniles, two were from young adults and the rest were fully adult or elderly individuals. There was better survival amongst the maxillae (some attached to or associated with reconstructed skulls) and the mandibles, in both of which there was some survival of in situ teeth which could be used for age estimation. In both maxillae and mandibles, age at death was assessed initially by tooth eruption in children and juveniles using the scheme of Ubelaker (1978) and Schaefer et al (2009), and by tooth wear in adults using the scheme of Lovejoy (1985) as quoted in White and Folkens (2005: 367). The results were then grouped into broader categories to reflect the small numbers and uncertainties in the assemblage. The results are shown in illus 11.

Despite the small numbers involved, visual inspection of illus 11 suggests that the patterns of age at death demonstrated by the maxillae and the mandibles are essentially similar, both showing substantial mortality during early



Illus 11 Distribution of estimated age-at-death for mandibles and maxillae

adult life and a peak in adulthood. Such a pattern would be expected in a population with negligible obstetric or general medical care, but the mortality curve shape could also be affected by selective deposition of remains, or poor collection strategies during excavation.

SEX, STATURE AND SKULL SHAPE

Sex determination and distribution: reconstructed skulls

Due to the highly fragmented condition of the skulls, the normal systematic procedure of scoring from a minimum of five indicators for assessment of sex could not be applied. Assessment, therefore, is of an ad hoc nature, using any of the standard indicators which were available. Sex assessment, therefore, must be regarded as being less certain than in studies where entire, intact skulls are used.

All 20 reconstructed Knowe of Rowiegar skulls were examined for assessment of sex. Four were too young to allow sex assignation. Of the remaining 16, two were determined as female, two were rated as possible females, four were possible males and the remaining eight were determined as male (Table 3). This preponderance of males amongst adult human remains has been reported from other Neolithic chambered cairns, eg in unpublished notes by Professor Low on the Midhowe skeleton assemblage. Amongst the 25 skeletons he identified he listed 11 as male and only three as female or possible female (the rest were not sexed or were too young for sexing). Very little sex determination was attempted on the bones from the Knowe of Yarso due to their fragmentary condition, but Low states that of the five skulls which were reasonably intact, two were male, one female and the other two were possible males. A similar excess of males over females has been described in Orcadian chambered cairns of the Maes Howe type, including Quanterness and Isbister (Davidson & Henshall 1989).

Sex determination and distribution: postcranial skeleton

Of the six adult innominate bones recovered, two were from females and four from males. A further one was represented by a set of unfused juvenile pelvic bones. Sex determination based on long bones is not possible, being both less dependable than when based on the pelvis or skull, and restricted by the small number of long bones in the Knowe of Rowiegar assemblage. The humerus is the most frequent long bone in the assemblage, with a total of 12 being present (Table 4). Of these, two are from juveniles and three others are broken or incomplete and hence can provide no information based on bone length. However, a common criterion for sex determination using the humerus is the humoral vertical humeral head diameter (HVHD), as described in Bass (1995: 156) quoting ranges from Stewart (1979). Determination of HVHD was possible on all ten adult humeri (five from the left side and five from the right) and the results are shown in illus 12 along with the allocations to sex given in Bass (1995). Fifty per cent of the HVHD values fall in the region suggested to be clearly female, whilst only 20% are clearly male. The remaining three are indeterminate, although one of these is on the borderline for female. If the values are grouped according to the scheme in Lawrence (2012, cited from Stewart 1979) then six of the humeri are female, one is possibly female and two are male, Both schemes show a much higher number of females than males, a result which appears at odds with the preponderance of males seen among the skulls. At other Orcadian Neolithic sites, with larger bone assemblages, such a disproportion has not been reported, eg at Isbister, South Ronaldsay, Lawrence (2012: 222) reported HVHD values from 60 humeri. Of these 21 (35%) were in the female or ?female range whilst 30 (50%) were in the male or ?male range.

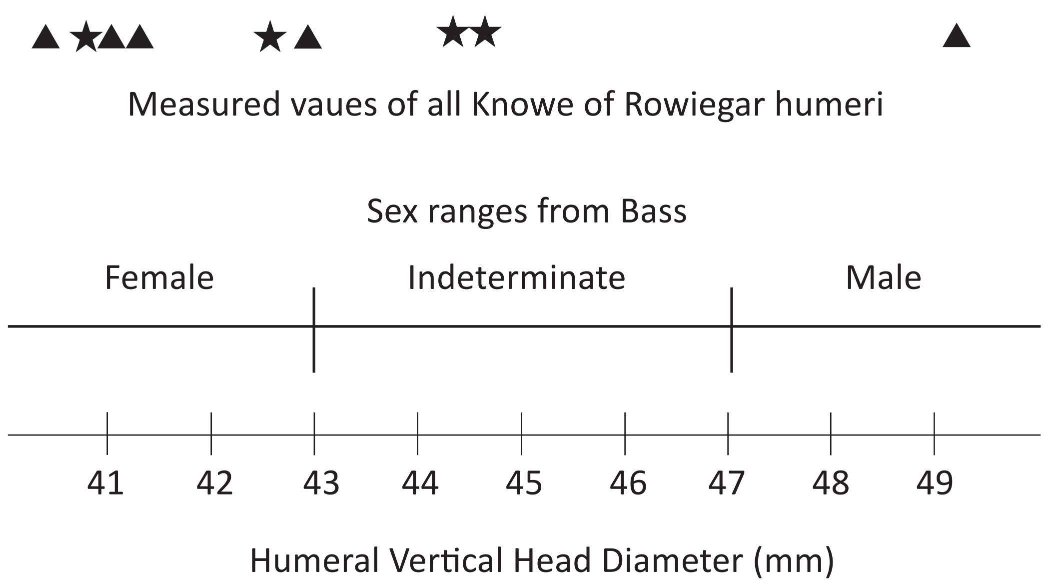
There may be several factors accounting for or contributing to the preponderance of possible female humeri at the Knowe of Rowiegar. These could include selective deposition of female arms in the Neolithic (either deliberately or accidentally) or selective survival of female humeri through taphonomic processes and excavation. In addition, it must be kept in mind that possibly less than half of the original number of cells have survived in the cairn, so the present assemblage of bones may not be all the bones which were originally deposited.

Stature determination

Stature estimation from the long bones, for example, using the tables of Trotter and Gleser (1952), depends both on the ethnic group and on the sex of each individual. Based on the difficulties discussed above in ascertaining the sex of the individuals for certain long bones, and the low numbers of femora and tibiae (the most reliable bones for stature determination), no assessment of stature was undertaken.

Skull shape

Only one skull, NN(1), was sufficiently intact to enable reliable length and breadth measurements to be obtained (length 182mm, breadth



Illus 12 Distribution of values for humeral vertical head diameter from Knowe of Rowiegar compared with sex-associated ranges of these values in the literature. ▲ Right humerus, Left humerus ★

138mm) and one other skull, F/T(1) could be reconstructed well enough for reasonably reliable measurement (length 203mm, breadth 135mm). These yield cranic indices of 75.8 and 66.5 respectively, the first being borderline dolichocranic and the second being markedly so. During general reconstruction of the skulls, an overall impression of dolichocrania was obtained, with no skull showing the rounder characteristics of brachycrania. This is in keeping with general observations of head shape from Neolithic assemblages, eg Turner (1915) and Brodie (1994).

MINIMUM NUMBER OF INDIVIDUALS

The minimum number of individuals (MNI) represented in the Knowe of Rowiegar human bone assemblage is given as 17 by Dorothy Lunt, quoted in Davidson and Henshall (1989) and as 19 by Lawrence (2012: 240) based on 'mandibles and increased because postcranial elements indicate the presence of a juvenile aged 1–2'. These, however, are re-assessed below. Due to the fragmented and incomplete nature of the human bone assemblage at Knowe of Rowiegar, assessment of MNI is unlikely to provide an accurate value for the actual population of the tomb. As discussed elsewhere, the postcranial skeleton is highly under-represented in the assemblage – consideration of unique postcranial bones (from Table 4) shows that the most numerous is the right humerus, but only seven of these are present. Most elements of the skull are better represented, and of these, the maxilla and the mandible yielded the largest numbers of unique individuals. Table 5 lists these bones, with a break-down by age, based on tooth development and wear. From these data, an MNI of 23 may be obtained, derived from the mandibles. It is noteworthy, however, that most of these mandibles are broken. In some cases, only part of the mandible is present and it is possible that some of the smaller fragments come from the same individual. The criteria used for inclusion in the MNI were that (a) at least one tooth was present which could be used to make some assessment of the age of the individual (even if this was only as an adult or juvenile) and (b) that the fragment could not be fitted to any other fragment. The problem of fragments coming from the same individual, however, applies in only a very small number of cases and would reduce the MNI by one or two at most. Lawrence (2012), as noted above, derived an MNI of 19 largely from the mandibles. The discrepancy between the MNI derived in the present study and that of Lawrence is likely to arise from individual decisions about inclusion or exclusion of particular fragments. The problem of exclusion from the sample does not arise with the maxillae. Some of these are also broken, but comparison of the fragments shows no possible match, hence the maxilla-based MNI of 20 is secure.

Table 5 demonstrates the discrepancy in spread of age at death between the maxilla and mandible populations, especially seen in the younger groups. Although the MNI is normally taken as the highest number which can be derived

TABLE 5
Minimum number of individuals (age based on tooth development and wear). 'Total derivable' takes the higher number from maxillae or mandibles in that age group, as discussed in the text

	Child (neonate to 5 yrs)	*Juvenile (6 to 14 yrs)*	*Late teens*	*Young adult*	*Adult*	*Elderly*	*Total*
Mandible	0	3	0	1	16	3	23
Maxilla	1	0	2	3	11	3	20
Total derivable	1	3	2	3	16	3	28

from any one unique bone in an assemblage (here, the mandible), an alternative strategy can be proposed, based on the age discrepancy between mandibles and maxillae. To do this it is assumed that the larger number, between maxillae and mandibles in each age group, gives the MNI in that age group. The argument for this is that if there are, for example, three mandibles and four maxillae in a certain age group then there must be a minimum of four individuals in that group. Using this derived number for each age group, an MNI of 28 is obtained from the combined maxillae and mandibles of the Knowe of Rowiegar collection (Table 5). No other unique skull bones (eg occipital, right or left temporal) are present in numbers as high as the maxillae and mandibles.

In all these assessments of the Knowe of Rowiegar human bone assemblage, it has been necessary to bear in mind that only the end six of a possible ten to 14 cells have survived. Many more human remains could have been lost at the time of the Iron Age re-use of the monument. However, the pattern of skeleton distribution within the existing Knowe of Rowiegar cells does seem to match that seen at Midhowe and the Knowe of Yarso, with only some cells containing human remains, whilst other cells are empty or contain only animal remains, and the MNI is remarkably similar to those reported for Midhowe (25 individuals) and Knowe of Yarso (29 individuals), and unlike the much larger numbers reported from Quanterness (50) and Isbister (85) by Crozier (2014) and Lawrence (2012) respectively.

OSTEOLOGY: ABNORMALITIES AND PATHOLOGY

The majority of diseases and abnormal conditions leave little or no trace on the human skeleton and those that do often require examination of several different elements of the skeleton to ensure accurate diagnosis (see discussion in Smith & Brickley 2009: 119–21). For the Knowe of Rowiegar, this is further complicated by the poor state of preservation of many of the bones and the disarticulation of the skeletons, which prevents examination of entire individuals. In addition, there may have been selection of skeletal elements for final interment, limiting the number of postcranial bones available for study, and possibly poor recovery at excavation. Despite this, a large number of the bones in this assemblage show signs of disease, abnormality or trauma and many of these conditions are not, or are not solely, reflections of advancing age of the individuals.

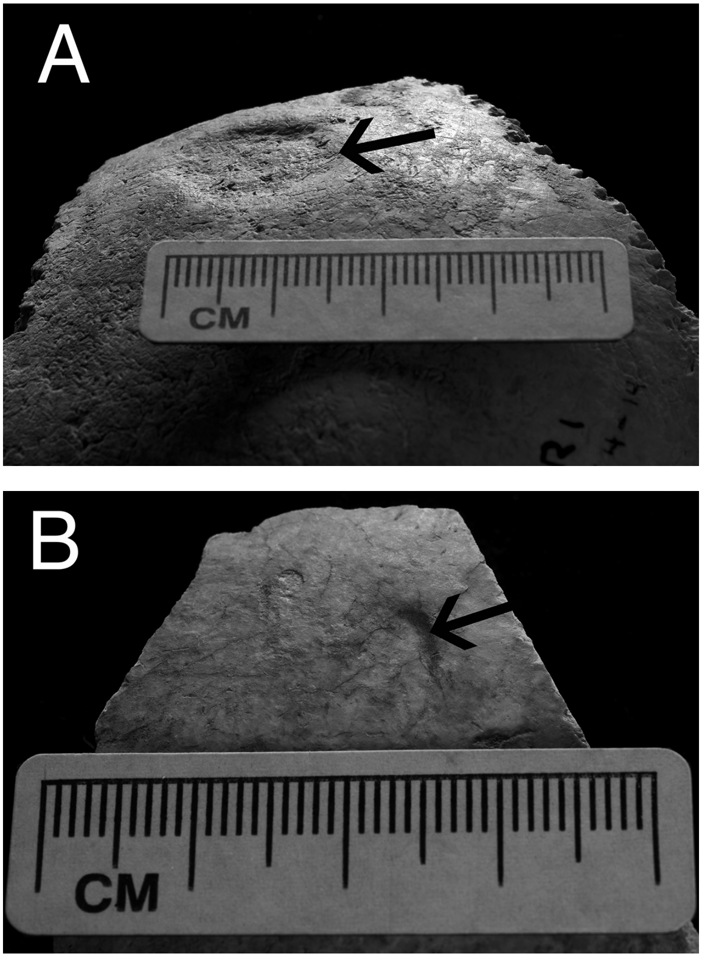
THE SKULL

The only obvious abnormalities in the skulls, other than those associated with the dentition, which are described separately, are pre- and peri-mortem injuries (trauma) and porotic changes possibly related to dietary deficiencies in childhood. No signs were seen of infectious diseases.

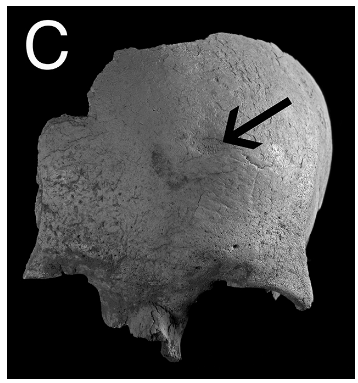
Trauma

Examination of the skulls for signs of trauma was made difficult by their extensive fragmentation and by poor recovery techniques at excavation. Despite these problems, seven skulls exhibited possible or likely signs of pre- or peri-mortem injury (two children, one young adult male, two adult males, one adult female and one elderly male). Of these, one child, one young adult male and the elderly male displayed healing of the injury.

The three healing wounds are shown in illus 13. The first is an oval depression, likely to be an incompletely healed wound, with a raised border to its left. The wound is on the left side of the frontal bone of a six-year-old child H(2). The suture to the left of the photograph is an unfused metopic suture. Illus 13B shows a fragment of the left parietal of a young adult male D(1). The very slight depression is well healed and is made more obvious by the slightly rounded bony ridge above it. Illus 13C shows the frontal bone of an adult-to-elderly male L(1). In this case the depression is just to the left of centre of the frontal bone and it is enhanced by a large, raised, bony area immediately below the indentation. Roughening of the skull surface above the depression may



Illus 13 Healed blunt force trauma in the skull (arrowed in each case). A – Partially healed in six-year-old child. B – slight depression and ridge in young adult male. C – in frontal of adult/elderly male



indicate that healing is incomplete, suggesting that the traumatic event had occurred later in the life of the victim. All three wounds are to the left of centre of the skull and are consistent with a possible attacker being a right-handed person, standing in front of the victim and using a small, blunt instrument, eg a small stone, as a weapon. The wounds could also have been caused by thrown stones. Although the blow was sufficient to cause a depressed fracture of the outer table of the bone, and force it into the diploë, none of the skulls show signs of injury to the inner table at the impact point, hence allowing survival and healing.

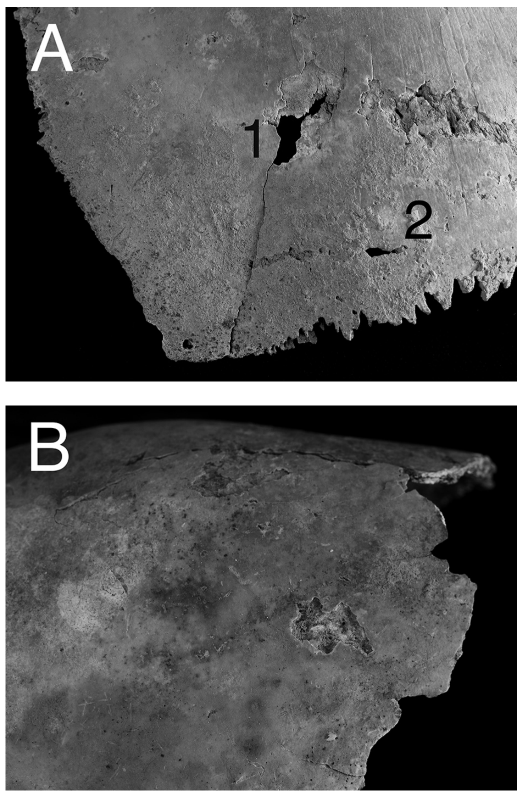
The remaining four injured crania show wounds without any signs of healing. The injury in each case is peri-mortem and in some cases may have been the cause of death. Illus 9C shows the reconstruction of the skull of a male in his 30s, with a large impact hole in the left parietal. Cracks radiate downwards from the hole, which resulted in the separating of a fragment of the parietal bone. The hole is larger on the endocranial than on the exocranial surface and shows the features of a blunt force trauma wound. A somewhat similar presentation of wound is seen in skull G(1) in illus 14. In this case, in the frontal bone, just above the right upper orbital margin of an adult male. Again, the hole caused by the blow is shared between two bone fragments and, in addition to the radiating cracks which take part in the breakage, there are also smaller radiating

Illus 14 Right frontal bone of skull G(1) showing possible blunt force trauma

fractures in both fragments. The hole is of a similar size to that in skull F/T(1), but shows less enlargement on the endocranial surface, although there is sufficient to make it likely that this is a peri-mortem rather than a post-mortem injury.

Another possible case of deliberate (peri-mortem) injury is seen in skull A(1), a child of about five years old. There appear to be several wounds on and through this skull, two of which are shown in illus 15A and another in illus 15B. At the position of illus 15A, the skull is only between 1.8mm and 2.4mm thick, which does not allow for comparison of hole sizes in the two tables. The pair of injuries taken as a whole, however, has the appearance of peri-mortem trauma. The larger hole (labelled '1' in the photograph) is centred in and appears associated with a slight depression in the right parietal close to the bregma (the suture on the left of the photograph is the coronal and that along the bottom is the sagittal). A fracture runs from hole 1 down to the sagittal suture. A smaller hole (hole 2) lies close to the sagittal suture and a fracture runs from this towards the coronal suture, but terminates at the fracture running from hole 1, indicating that hole 1 and its fracture occurred before hole 2 and its fracture. Although the interval between the injuries may have been short, they did not occur at the same time. Both holes appear elongated, which would be consistent with sharp force trauma caused, for example, by a spear or arrowhead. In such a thin skull this would not require much force to achieve, and both wounds, if delivered in life, would almost certainly result in the death of the child. A further injury on the same parietal bone, but close to its contact with the temporal, is shown in illus 15B. This has the appearance of a comminuted fracture caused by a blunt instrument. In this case the injury has not penetrated the skull but, if caused in this way, would very likely have been fatal. However, because of the state of the bone it is also possible that this apparent injury is the result of small animal activity.

A final, more certain, case of blunt force trauma is shown in illus 16A and B. This is the frontal bone of an adult female Z(1), showing a comminuted fracture on the right side, about 2cm back from the upper orbital margin and just above the temporal line. The outer table (illus 16A) has



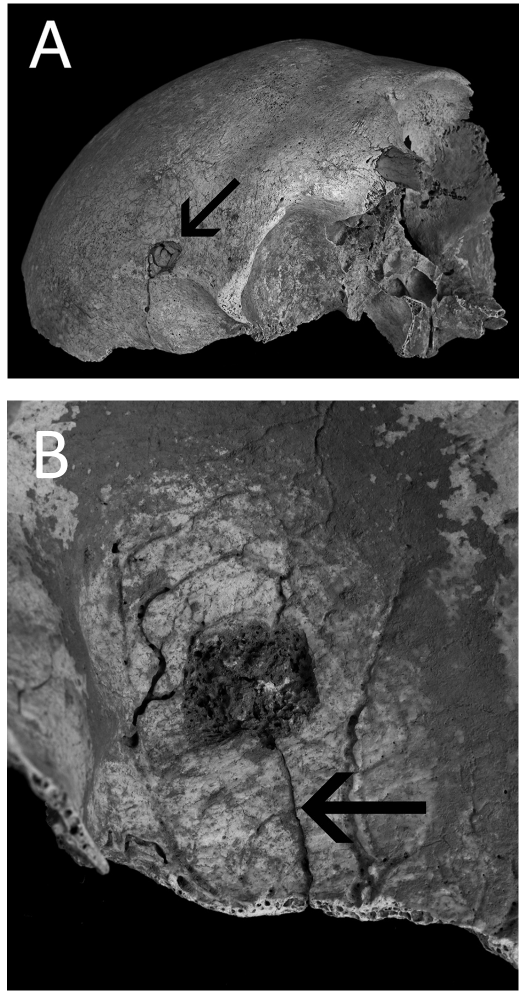
Illus 15 Right parietal of child skull A(1). A – Initial wound (1) and later wound (2) caused by a small, flattened weapon. B – Possible blunt force trauma with incomplete penetration of the skull

been shattered into small fragments, which have been pushed into the diploë. The inner table (illus 16B) has been lost, presumably also shattered and pushed into the soft tissue beneath the wound and lost as this decayed. However, the fragments of the outer table and the diploë have remained, so no actual hole penetrates the skull. A long fracture radiates downwards from the injury.

Disease

Porotic areas were seen on the exocranial surface of the vault (porotic hyperostosis) or in the orbital roof (cribra orbitalia) of several of the Knowe of Rowiegar skulls, with, in some cases, both conditions being present in the same individual. Cribra orbitalia is shown in illus 17 in skull NN(1), a young adult male. Porotic hyperostosis and cribra orbitalia have been associated in the archaeological literature with anaemia in childhood, and especially with iron deficiency anaemia (Roberts & Manchester 2005: 223) in which the bone marrow is called upon to increase the production of red blood cells in the hope of transporting more oxygen to the tissues. This can result in the thinning of the outer table of the skull and remodelling of the trabecular structure in the diploë, causing a breakthrough in the outer table – which shows as pores on the skull surface. A recent suggestion has been made that these conditions may be more generally associated with the effects of general dietary deficiency in childhood rather than specifically with iron deficiency (Walker et al 2009).

Eighteen of the Knowe of Rowiegar skulls had sufficient bone for the assessment of porosity on the outer surface of the cranium, although in no case was the skull complete. In seven of the skulls some degree of porosity was observed (two children, one young adult male, two adult males and two adult/elderly males). The porous areas were mainly located on the parietals and were generally of limited extent. In one case, however (Skull P(1), an adult male), there were large areas of porosity located symmetrically on the right and left parietals, towards the rear of these bones. This is a typical pattern reported for porotic hyperostosis. Unfortunately this skull lacked face and orbits, so cribra orbitalia could not be sought. Due to the fragility of the orbital bones, only 11 skulls had sufficient bone in the orbital roof to allow examination for cribra orbitalia, and of these, several had only a centimetre or less of bone rimming the upper orbit, which limited the value of the examination. Four individuals, however, showed the typical patches of porosity which defines this condition (one child, one young adult male and two adult females). Two of these showed extensive porosity, one of which also showed signs of porosity on the frontal bone, especially close to the bregma and a small patch on the left parietal.



Illus 16 Skull Z(1) showing comminuted fracture from blunt force trauma. A – exocranial and B – endocranial views

Illus 17 Skull NN(1) showing cribra orbitalia (arrowed)

If, indeed, this porosity is associated with childhood malnutrition leading to anaemia, whether iron-deficiency or otherwise, then it seems that dietary deficiency occurred in a high proportion of the children in the Knowe of Rowiegar population.

DENTAL PATHOLOGY

Impaction

Relatively few tooth impactions were observed amongst the in situ Knowe of Rowiegar teeth, and all were of the third molar. Amongst the mandibles, one had a mesioangular impaction of the M3 on the left side (illus 18), whilst the corresponding right tooth was normally positioned. In another case (illus 19), where only the left side of the mandible was present, there is a complete horizontal impaction. Amongst the maxillae, one case had the left M3 angled backwards. The distribution of wisdom tooth impaction in the Knowe of Rowiegar assemblage therefore appears consistent with that of modern populations, both in overall extent and in being more common in the mandibular than the maxillary teeth (Hillson 1996: 113).

Illus 18 X-ray of left mandible P(2), a possible male in early 20s, showing impacted third molar

Periodontal disease

Periodontal disease (inflammation of the tissues round the teeth which can cause resorption of the alveolar bone) is common amongst the Knowe of Rowiegar skulls. It may be presumed that dental hygiene was not good in this population. An example of periodontal disease is seen in the fragment of mandible in illus 20, where the alveolar bone has been absorbed back to below the level of bifurcation of the roots in the first and second molar teeth.

Illus 19 Lingual view of partial left mandible JJ(1), showing horizontal impaction of third molar in an adult male

Caries

Dental caries are rare amongst the Knowe of Rowiegar individuals, as has been consistently reported for prehistoric populations (Brothwell 1981: 153; Roberts & Manchester 2005: 69). The only example was seen on the occlusive surface

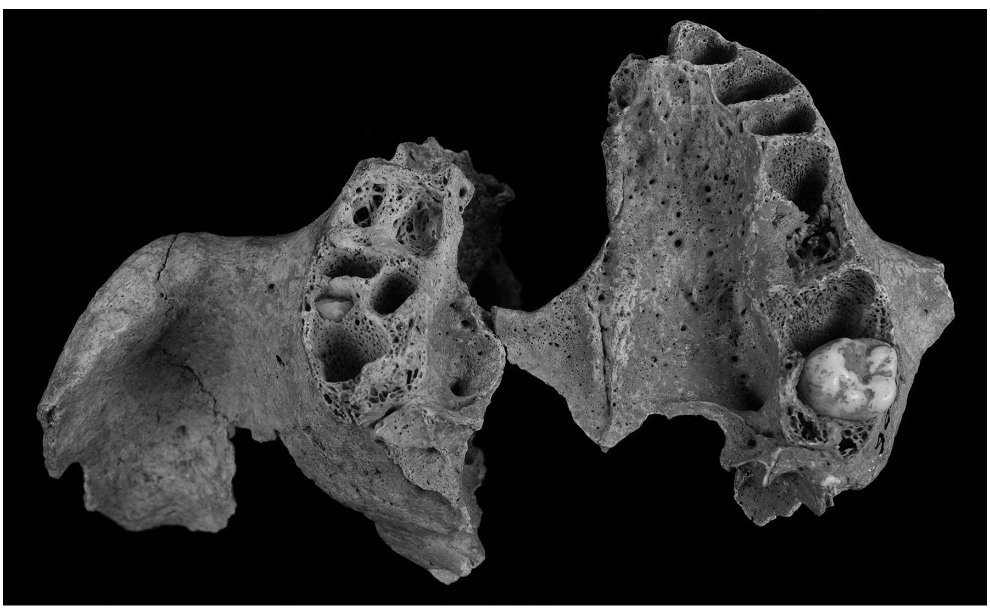
Illus 20 Periodontal disease in mandible KK(1) causing recession of the alveolar bone round the teeth, with exposure of the tooth roots

Illus 21 Dental carie in heavily worn molar in maxilla FF(2)

of the one remaining tooth of an aged individual with considerable other dental disease (illus 21).

Abscesses

Abscesses of varying severity were observed, particularly in the maxillae. Of a total of 23 mandibles, an abscess was observed in only one case (4.5%), whilst of the 20 maxillae, four showed abscesses (20%). Of these, two were of particular note due to the extent of the spread of the damage. Illus 22 shows a view of the palate and teeth from an adult individual with extensive



Illus 22 Maxilla L(1) showing extensive palate erosion most likely arising from a dental abscess

Illus 23 Small palate erosion in maxilla P(2) linked via a fistula (indicated by inserted probe) to a abscess behind a (missing) canine

dental disease including several abscesses. One of these, presumably from a tooth on the left side of the maxilla, has extended its erosion to the palate. The maxilla and palate are in two pieces, split along the centre line, but when these are held together, as in the figure, it is observed that almost all of the bony palate has been lost to the abscess, with very little remaining even of the right side of the palate. The edges of the hole are smoothed and show signs of neoosteogenesis similar to the new bone formation seen round bone degeneration areas in osteomyelitis-related diseases such as syphilis, leprosy or tuberculosis, none of which is likely in this case. The appearance of this lesion might, at first sight, suggest a cleft palate. However, an infant born with this degree of cleft palate would be unable to suckle and it has been suggested that in the Neolithic would be unlikely to receive the special care (expression of mother's milk and spoon-feeding) that would be required to raise it (Roberts & Manchester 2005: 52). Since the maxilla L(1) is that of an adult, cleft palate would be an unlikely explanation.

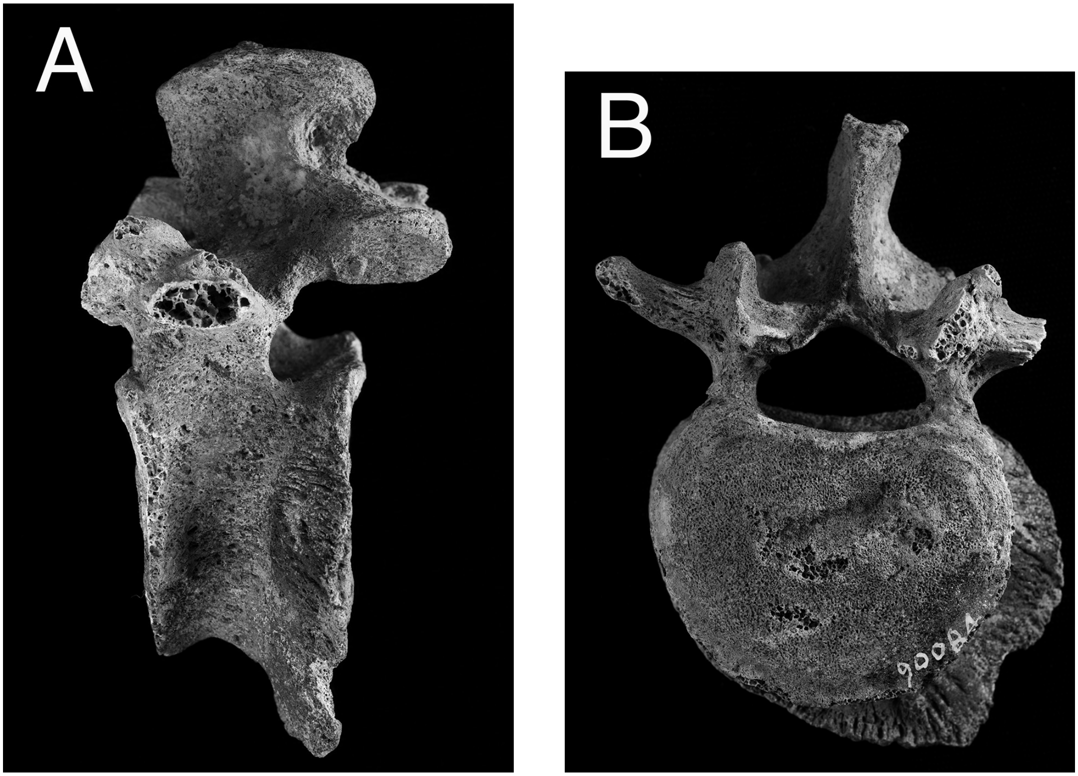
A similar but less extensive lesion is seen in another palate (P(2)). In this case, the left canine is missing, allowing a periapical hole (abscess) to be observed. A fistula passes from this through to the lingual side of the maxilla and into the maxillary sinus, from which there is a hole in the palate. This connection is demonstrated in illus 23 with the placement of a probe through the fistula from the canine socket into the palate hole. Such extensive abscess-based lesions as those illustrated could be linked to the death of the individual, since the infection can spread into the bloodstream inducing general sepsis.

Enamel hypoplasia

Several examples of enamel hypoplasia were observed. Macroscopically, these are usually exhibited as horizontal grooves across part or all of the buccal/labial surface of the permanent teeth. Such hypoplastic defects in the enamel are common (Hillson 1996: 165–7), especially in populations exposed to dietary stress or experiencing bouts of illness during early childhood whilst the tooth crowns are forming. They derive from cessation of enamel production during the period of stress, often followed by a temporary excess of enamel production when the stress relieves, hence producing a groove and ridge. Since the enamel is a non-living substance, the grooves cannot be caused by stress episodes occurring after the time of deposition of the

Table 6
Signs of enamel hypoplasia in maxillary and mandibular teeth from Knowe of Rowiegar. Figures are total number observed (each maxilla or mandible counting as one observation irrespective of the number of teeth involved), with percentage of assessable cases in brackets

	Obvious grooving	*Light grooving or pitting*	*No enamel hypoplasia*	*Total assessable*	*Total unassessable*
Maxillae	2 (10%)	7 (35%)	11 (55%)	20	3
Mandibles	2(10%)	4 (20%)	14 (70%)	20	6



Illus 24 Lumbar vertebra from Bag FF showing: A – osteophytosis in lateral view and B –Schmorl's node on cephalad surface of vertebral body

enamel. Attempts have been made to use the position of the groove on the tooth to determine the age at which the stress occurred (reviewed in Hillson 1996: 165–72), but with limited success. The frequency of macroscopic enamel hypoplasia in the Knowe of Rowiegar population is shown in Table 6. It is seen that approximately one-third of the population show some evidence of this stress indicator. Some maxillae and mandibles contained no teeth or the teeth were too worn for examination of the buccal enamel. The collection at the University of Aberdeen holds six other skulls of Neolithic age from long cairns on the island of Rousay. Of these, one is without teeth, two others, one from the Knowe of Lairo and the other from Midhowe, show smooth enamel; but the other three, two from the Knowe of Yarso and one from Midhowe, show grooves across the buccal surface of the molars. Since these skulls date from a similar time as those from the Knowe of Rowiegar, there may be some suggestion of a general stress, possibly of dietary origin, in the population during this period of the mid to late Neolithic.

POSTCRANIAL

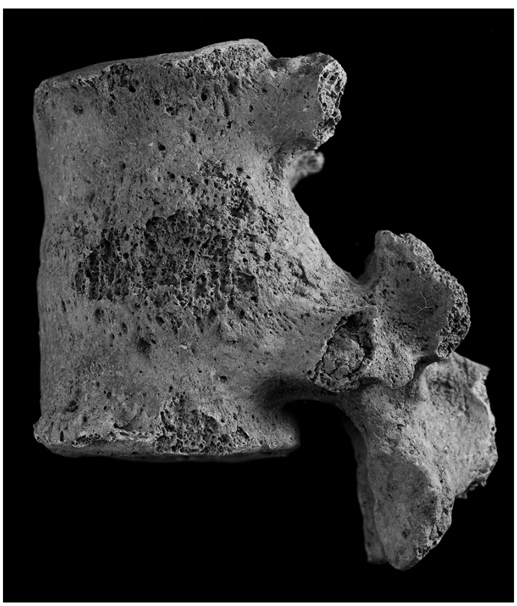
The total number of postcranial bones in the assemblage is only a small proportion of what would be expected if the bodies, as represented by the skulls, had been interred complete and intact and then fully recovered at excavation (Table 4). Despite the small number of bones, a considerable number of signs of disease and abnormality are visible. Many of these, eg arthritic changes in the joints, relate to the effects of aging and of hard manual labour on the individuals, but others may be indicative of adverse environmental conditions, such as disease, poor diet or trauma.

Arthritic changes

Osteophytosis (lipping) and similar degenerative changes are seen in nearly all the lumbar vertebrae in the assemblage. There are, however, only 14 of these and all are from adult, possibly elderly, individuals. Only one of the ten cervical vertebrae, all of which are C1 (atlas) or C2 (axis), shows osteophytosis, although several others show abnormalities of shape. In some cases, the lipping on the lumbar vertebrae is severe and Schmorl's nodes are also seen (illus 24). In most cases, the extent of osteophytosis would have been insufficient to cause major disability, other than back pain, to the individual affected, but in one case, two lumbar vertebrae are completely fused together, with general smoothing of the vertebral outline, in a typical case of ankylosing spondylitis (illus 25). This would almost certainly have caused major disability to the person concerned.

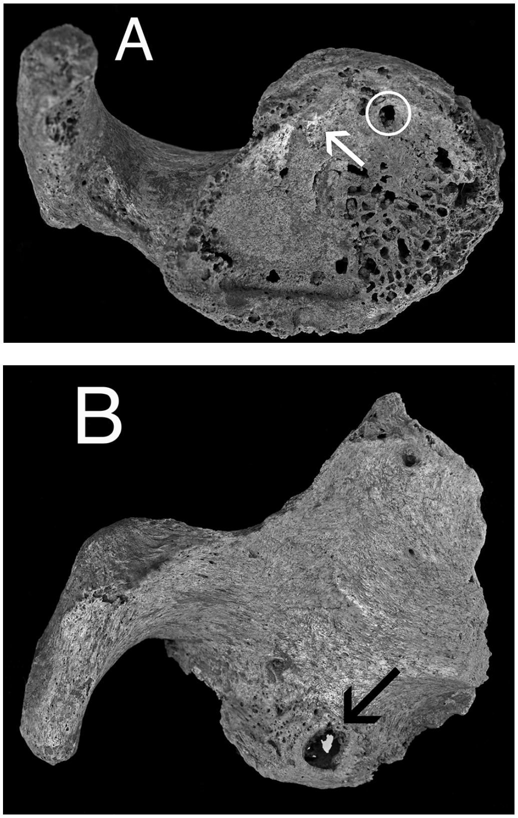
Osteophytosis and similar degenerative changes were also seen on the joints of other bones, especially the metatarsals (illus 26) and some long bones. Although the life expectancy of this population would be short compared with that of a modern population, there was a considerable proneness to degenerative disease. No examples of ankylosis were seen other than that described above, although retrieval of smaller bones of the hands and feet is unlikely to have been complete, hence distorting the picture.

One right scapula (Bag JJ) showed very extensive degenerative change (illus 27). There is large scale pitting and some eburnation of the glenoid cavity, with one of the pits appearing to be associated with a cystic lesion on the dorsal surface of the scapula, which has penetrated completely through into the glenoid cavity.



Illus 25 Ankylosing spondylitis in lumbar vertebrae from Bag BB

Illus 26 1st metatarsal showing extensive lipping at the distal end



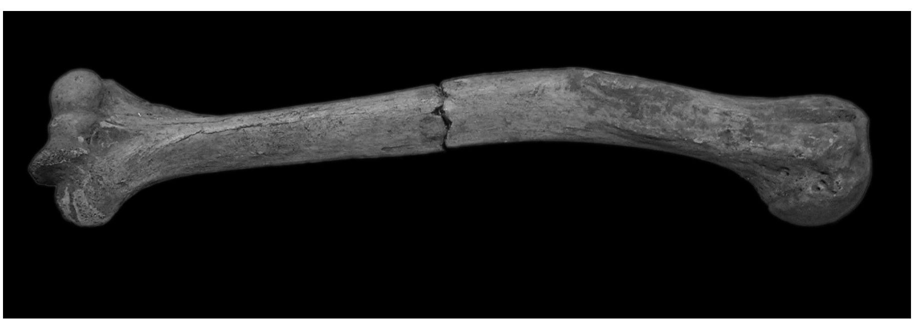
ILLUS 27 Scapula fragment JJ. A – Glenoid cavity showing eburnation (arrowed) and penetrating pore (circled), along with general pitting and osteophyosis; B – Dorsal surface showing cystic lesion which penetrates to the glenoid cavity

There is osteophytosis all round the glenoid cavity. Although a comparison with the left side is impossible, such a pattern of degeneration might be compatible with heavy use of the right arm (Roberts & Manchester 2005: 144).

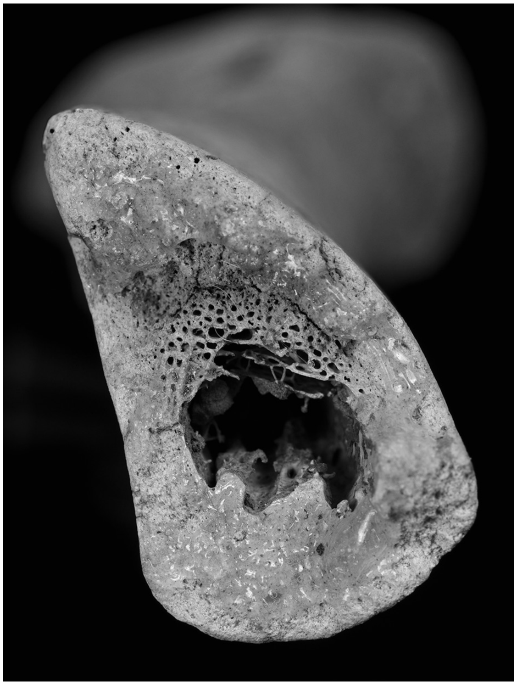
Other pathologies

Amongst the relatively few long bones in the postcranial assemblage, only one, a right humerus (bag HH), showed marked distortion (illus 28). The bone has been snapped at some stage post-mortem, but is otherwise complete and shows no sign of breakage in life. There is distinct curvature in the distal half of the shaft, which may be symptomatic of rickets or some similar vitamin D or calcium deficiency during childhood. Unusually for rickets, however, the bend is in a non-weight-bearing bone and there is no swelling of the ends of the bone.

Due to the extensive breakage of the long bones, many of the cross sections could be examined. As expected, there was considerable variation in cortex thickness and medullary cavity size for each bone type, but generally these are within the normal range. However, in one case, a left tibia, there was considerable abnormality. The outer appearance of the bone was somewhat abnormal, with thickening at the proximal end of the diaphysis (the shape of the proximal epiphysis is lost by erosion). In cross section through the centre of the diaphysis, thickening of the cortex is revealed along with extensive filling of the medullary cavity with spicular bone (illus 29). This appears to be a sclerosing dysplasia but, without being able to examine the rest of



ILLUS 28 Right humerus HH showing bending of shaft

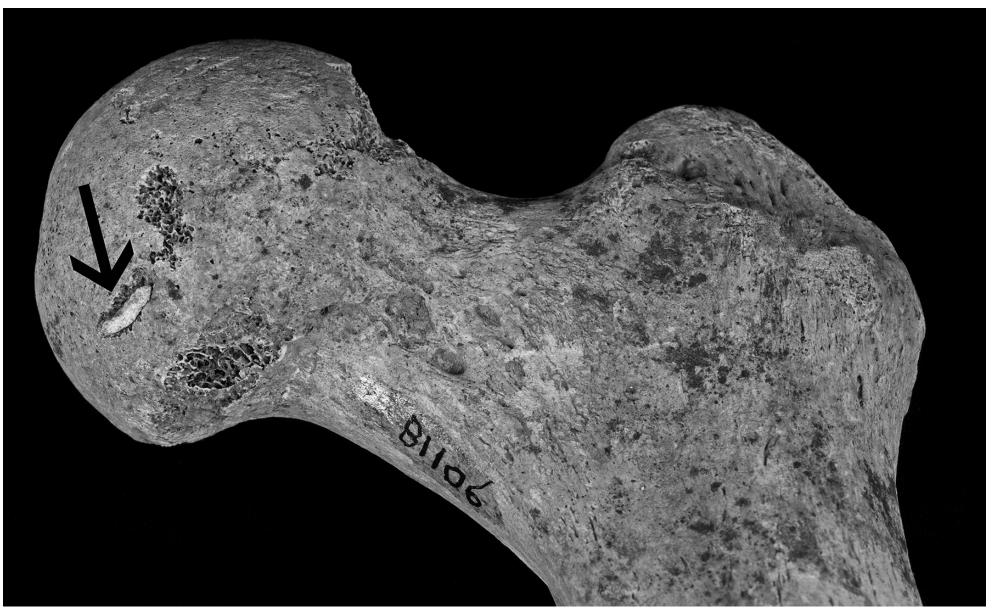


Illus 29 Left tibia showing thickened cortex and bony inclusion in the medullary cavity

the skeleton, it would be difficult to diagnose the actual disease. Several possibilities exist, such as Ribbing disease, most of which are mainly limited to the lower limbs and are most frequently found in females (Chanchairujiva et al 2001; Zhang et al 2011). These are rare disease types which, at their extreme, can lead to the complete filling of the medullary cavity with the new bone deposit. They are associated with considerable pain and fatigue in the lower limbs.

Possible trauma

Amongst the postcranial bones, only two show features which could be indicative of trauma or other human involvement. The first of these appears on a distal end fragment of an adult, male, left femur (illus 30). There is a long scratch on the anterior surface of the femoral head, just above the rim of the head. The scratch mark terminates in a deeper indentation into which is embedded a fragment of white stone (arrowed). The scratch mark shows the same appearance of erosion as the surrounding bone, ie it appears to have occurred in antiquity rather than during excavation. From the position, so close to the rim



Illus 30 Front view of proximal end of left femur showing long scratch mark terminating with intrusive stone fragment (arrowed)

of the femoral head, this area would be exposed from the acetabulum during backward movement of the leg, so it would be possible for the injury to be caused by a lance or arrow penetrating the body from the left side, with the tip of the weapon breaking as it penetrated the bone. If this was the case, then the weapon would have passed close to or through several large blood vessels including, at its tip, the left femoral artery which, if severed, would almost certainly lead to lethal bleeding. Investigation of the nature of the white stone fragment is ongoing.

The second sign of human involvement is found on a possibly male, adult, left tibia where three cut marks are observable on the anterior crest, at about the middle of the diaphysis (illus 31). These show no signs of healing but could have occurred round about death, as an in-life injury or during a de-fleshing process after death. It is also possible they occurred during excavation, although they do not have the fresh, clean appearance seen on newly broken bones.

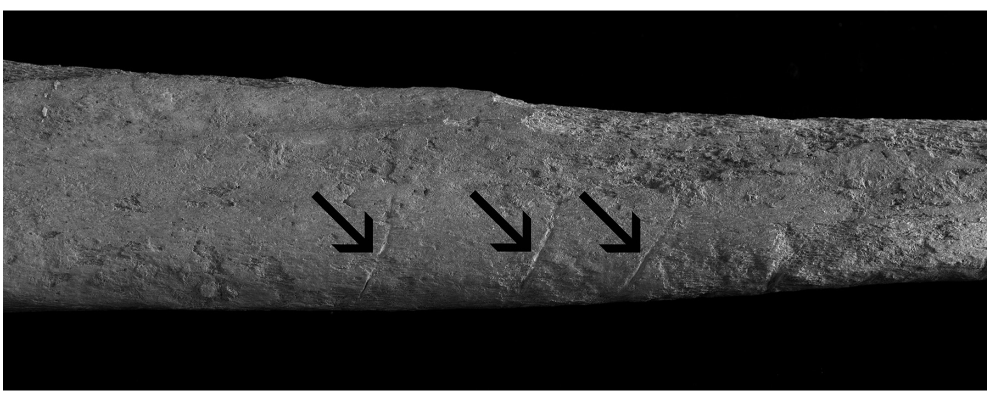
RADIOCARBON DATING AND ISOTOPE ANALYSIS

PREVIOUS DATES

Radiocarbon dating, using both the original direct counting method and the more recent, and more precise, AMS technique has been used for many years to establish a chronology for the Orcadian cairns. Dates obtained prior to 1985 are listed by Renfrew (1985: 264–9) and discussed in Davidson and Henshall (1989: 85–7), with more recent discussion by Ashmore (2000). Some of the dates were obtained from materials other than bone (eg underlying soil in Maes Howe), and all yield calendar dates with large standard deviations. This resulted in a corpus of dates covering a wide range and lacking the precision necessary to help with answering questions about the evolution of cairn types or the duration of use of individual monuments.

Since that time, and especially with the development of AMS dating techniques and Bayesian methods for the treatment of data, dating has become more precise, although the 'Neolithic plateau' (see below) still causes a problem. Sets of dates using AMS methods have been obtained from the Point of Cott (Barber 1997) and Holm of Papa Westray North (Ritchie 2009), both of which are stalled cairns. A larger set of dates has been built up from human bone from the 'hybrid' chamber of the round cairn at Isbister, South Ronaldsay (Lawrence 2006; Lawrence & Lee-Thorpe 2012). The Maes Howe-type cairn of Quanterness, on re-examination of its human remains, has also produced a large number of AMS dates which have seen a detailed analysis (Schulting et al 2010).

Prior to the present study, four dates had been obtained from bones from the Knowe of Rowiegar (see Table 7). Two of these were reported by Renfrew (1979) and are from animal



ILLUS 31 Diaphysis of left tibia with cut marks (arrowed)

bone using direct counting. The other two were obtained using AMS methodology, one on animal and one on human bone located in the National Museums Scotland collections (Sheridan 2005). Both of the AMS dates and one of the others are reasonably compatible with the results presented in this study.

SAMPLING AND RESULTS

Following initial analysis of the human bone assemblage from the Knowe of Rowiegar, a number of bones were selected for radiocarbon analysis. Fifteen of the reconstructed skulls provided adequate, un-degraded material from the cranial vault (normally from the parietal or the frontal bones), ensuring that each sample came from a separate individual. The right humerus was chosen to represent the postcranial skeletons as this was the most frequently occurring long bone, of which seven were selected as suitable, each representing a single individual. It is possible that some individuals were represented in both groups of samples. It should be noted that none of the Knowe of Rowiegar bones had been treated with consolidants or preservatives.

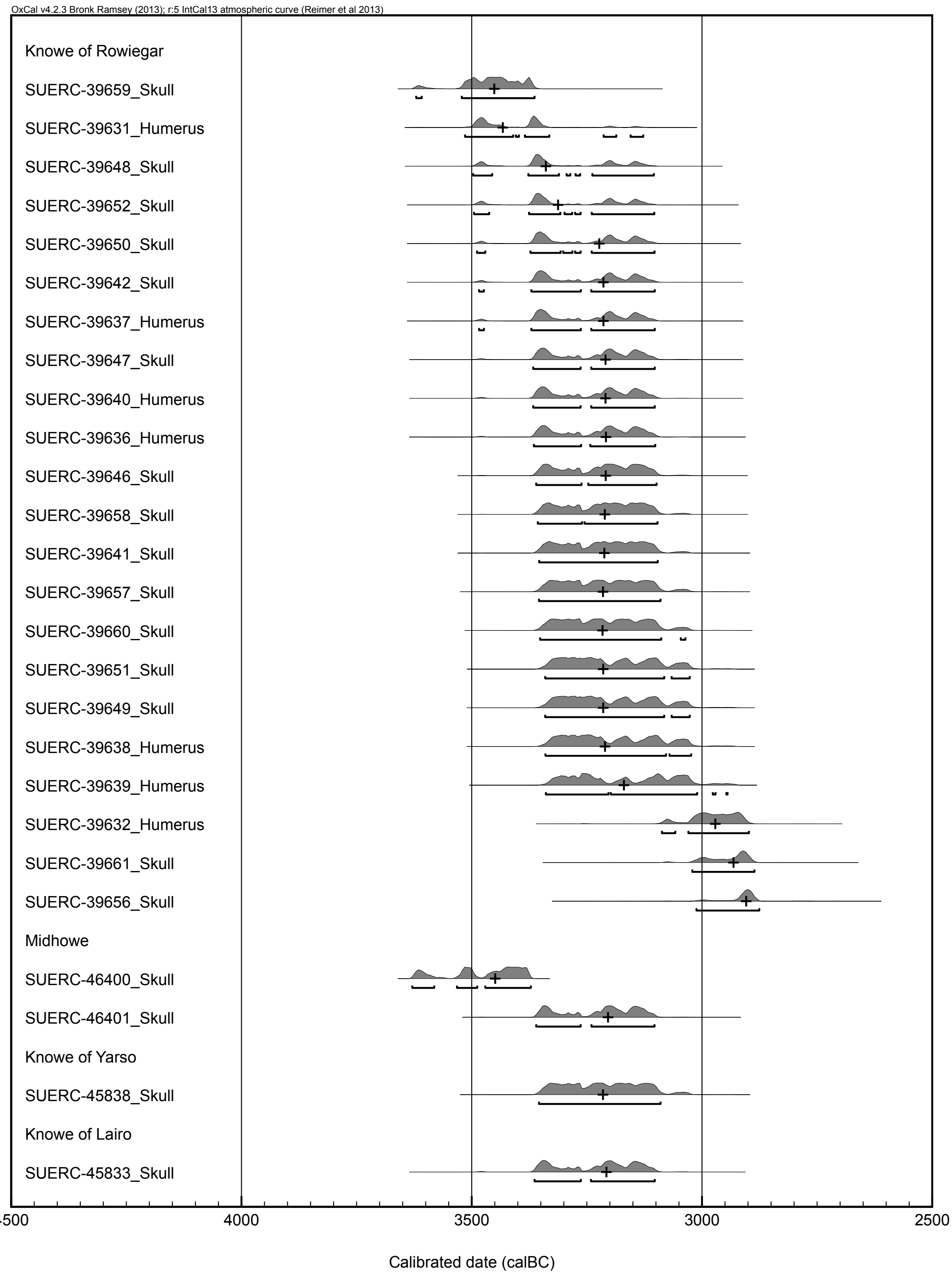
In addition to the bones from the Knowe of Rowiegar, samples were taken from other human bones from Rousay chambered cairns in the University of Aberdeen collection – Midhowe (two samples), Knowe of Yarso (one sample) and Knowe of Lairo (one sample). Samples avoided areas close to labels or areas that had been treated with consolidants. AMS radiocarbon determination and associated stable nitrogen and carbon isotope analysis was undertaken by the Scottish Universities Environmental Research Centre (SUERC). All samples yielded C:N ratios within the widely accepted in vivo range of 2.9 to 3.6 (DeNiro 1985). Calibration was carried out using OxCal 4.1 (Bronk Ramsey 2009), with results already published (Curtis & Hutchison 2013). Details of the samples and results are listed in Table 8 and plotted in illus 32.

BAYESIAN MODELLING

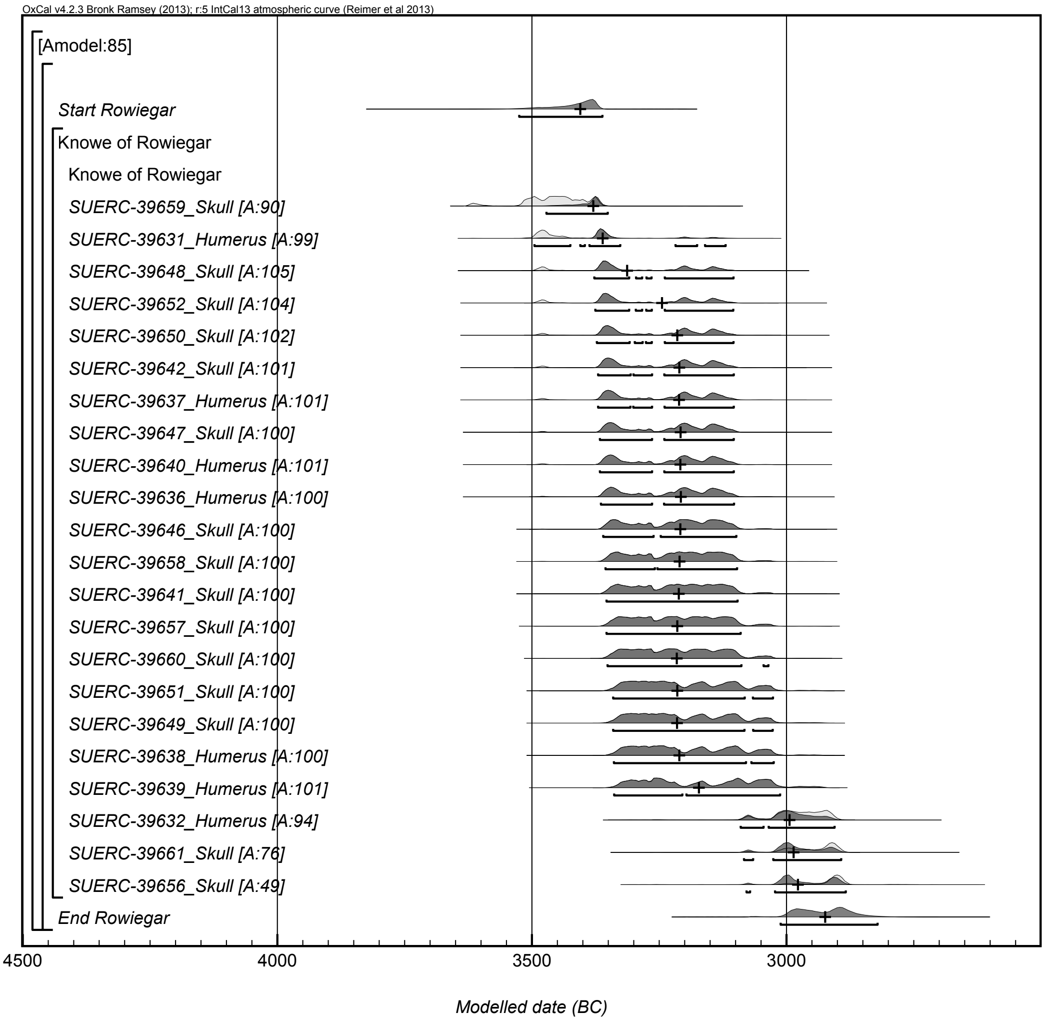
Unfortunately, as the results from this study fall during a period (*c* 3350 cal BC to *c* 3000 cal BC) in which some portions of the calibration curve are flattened, a single ^{14}C determination can generate a wide uncertainty in the calibrated date BC. This region is sometimes referred to as the 'middle Neolithic plateau' (Bayliss et al 2007). This can be seen in illus 32, in which the median dates (shown as a small cross) often fall in low probability density areas of the 95.4% (underline) intervals of the chart. As a result, the uncertainty of 20 of the calibrated dates over a 300-year period makes them practically indistinguishable from each other. Despite this challenge, and although limited by the lack of stratigraphic information, a number of possible models for the monument's chronology can be proposed. Two main models were considered in this study, using OxCal 4.2. For the first (model 1), the dates are treated as a single phase as discussed in Bronk Ramsey (2009), with no assumption about the

TABLE 7
Previously obtained dates for bone from the Knowe of Rowiegar recalibrated using OxCal 4.2 (Bronk Ramsey 2009)

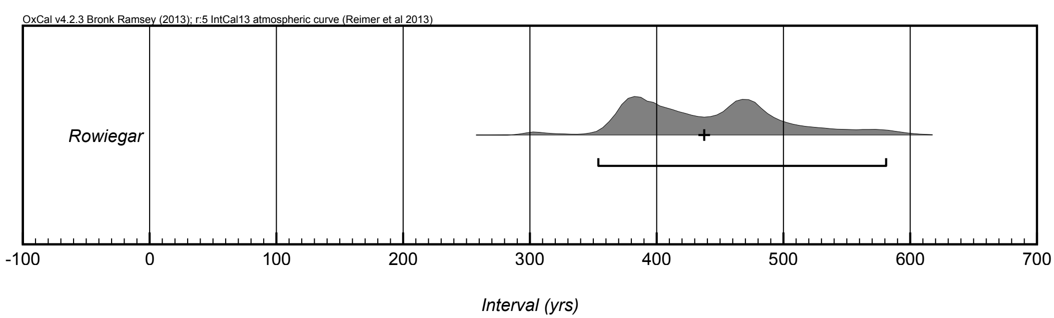
Lab no	*Bone type*	*Date BP*	*Calibrated date BC (at 95.4% probability)*	*Reference*
Q1221	Cattle bone	4305 ± 60	3265–2700	Renfrew (1979)
Q1227	Deer bone	4005 ± 60	2855–2340	Renfrew (1979)
UB6421	Human skull	4516 ± 37	3360–3095	Sheridan (2005)
UB6420	Sheep skull	4435 ± 36	3330–2925	Sheridan (2005)



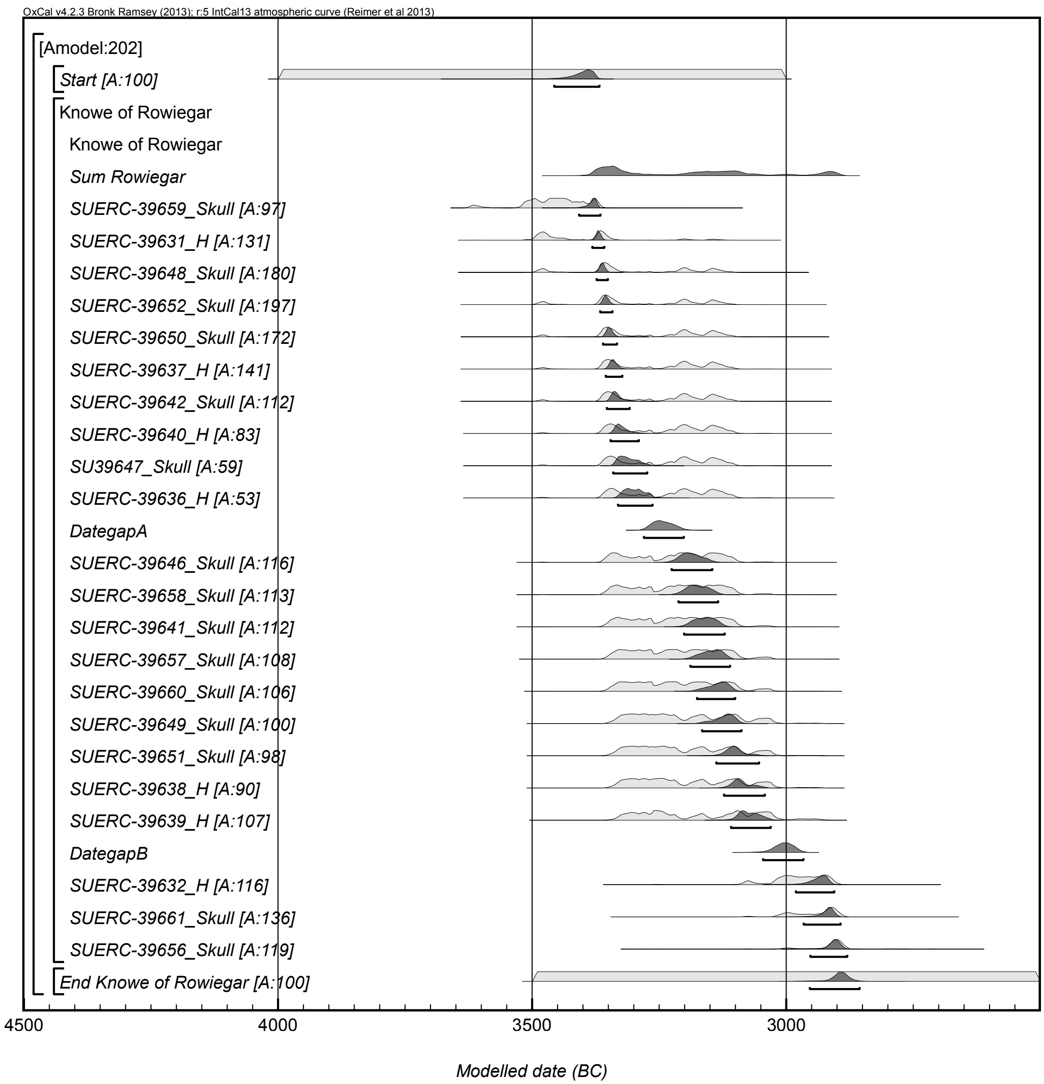
Illus 32 Calibrated radiocarbon dates for Knowe of Rowiegar and Midhowe, Knowe of Yarso, Knowe of Lairo. Note that the median dates (shown as small crosses) often fall in low probability density areas of the graphs



Illus 33 Knowe of Rowiegar Bayesian Model 1



Illus 34 The span of use of Knowe of Rowiegar, based on model 1, at the 95.4 probability level

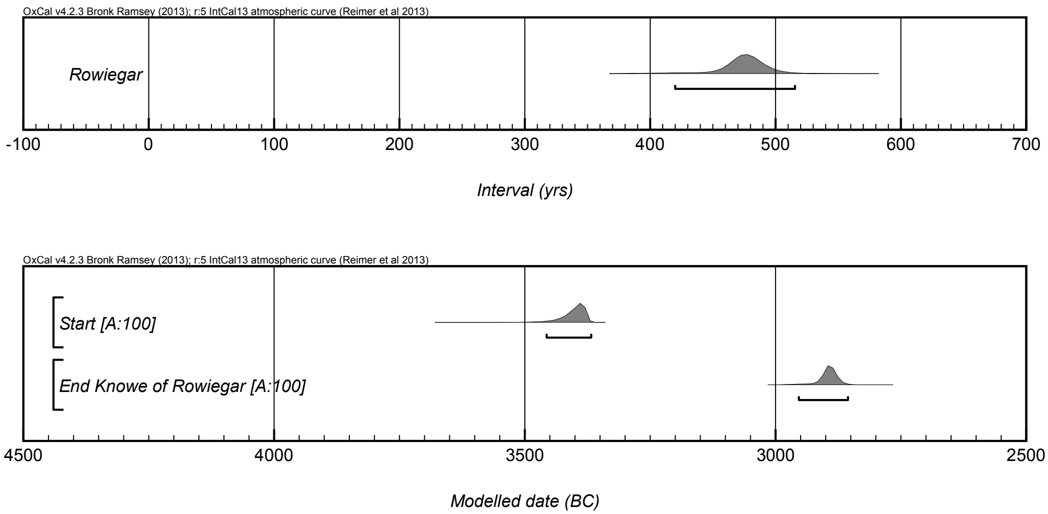


ILLUS 35 Rowiegar model 2. Each sequential date is modelled with a variable interval from a log normal distribution, calculated and optimised during the analysis

distribution of the dates of death, but rather just a single set of individuals from a single context, while a second model (model 2) considered the deaths as being sequential over time.

Bayesian modelling of model 1 is shown in illus 33, with brackets down the left side defining the model and the Index Amodel 85 implying that the model is acceptable. An Amodel Index below 60 would indicate problems with the model. The model suggests a start boundary of approximately 3520–3360 cal BC and an end boundary of 3010–2810 cal BC, both at 95.4% probability to encompass the dates of death of the individuals analysed. Illus 34 shows the span of dates to be between about 350 to 580 years.

For model 2, deaths were assumed to be sequential over time. Given the uncertainty in calibration at this period, a series of random orderings of the dates were evaluated. Although the model index varied, it was demonstrated that



Illus 36 Upper: Model 2 use span for Knowe of Rowiegar. The 95.4% probability span of Knowe of Rowiegar is between 420 and 520 years. Lower: the model 2 start and end boundaries are approximately 3400 BC and 2900 BC

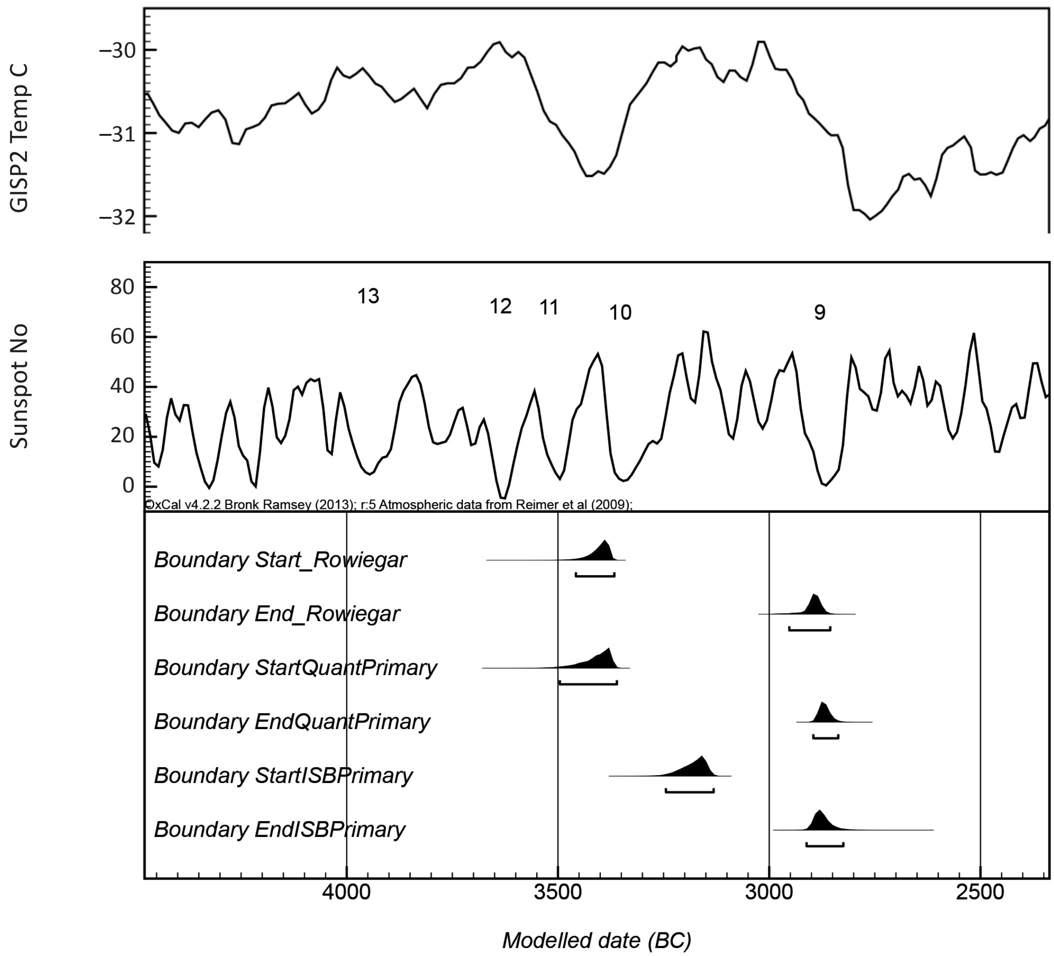
no change to the start and end boundaries occurs when different ordering of dates is applied. In illus 35, the dates are therefore simply ordered by uncalibrated date for convenience and repeatability. In model 2, the span of dates of death at Knowe of Rowiegar is shown to be between about 420 to 520 years from approximately 3400 to 2900 cal BC (illus 36).

A cluster analysis (after Ward & Wilson 1978, and Wilson & Ward 1981) identified two potential gaps in the sequence of Knowe of Rowiegar radiocarbon determinations, before 4455 BP and before 4540 BP. These may represent missing burials (since part of the tomb was destroyed in antiquity) or gaps in the use of the tomb. In illus 34, the gaps were dealt with by inserting spaces for two unknown dates, DategapA and DategapB. Model 2 also assumes a variable interval between each death event. This is a realistic assumption where there is no evidence of multiple co-eval deaths and the deaths have an association, as in a communal burial, ie are a select group. Model 2 assumes a priori a log normal uncertainty interval between deaths. The log normal distribution is modified in the OxCal Bayesian analysis to optimise the posterior interval distribution between each date. The Amodel index of 202 shows good agreement for model 2 in which deaths are assumed to occur throughout the period of the tomb's use, whereas model 1 makes no assumptions about this. In the absence of direct archaeological evidence, both models therefore represent plausible scenarios of use of the tomb.

DATING COMPARISONS WITH OTHER SITES

The dates were also analysed to see how the chronology of the Knowe of Rowiegar relates to wider phenomena. Model 2 for the Knowe of Rowiegar was compared with Bayesian models for the start and end boundaries of the primary use phases (as defined by the respective authors) of the sites of Quanterness (22 dates) and Isbister (18 dates) (Schulting et al 2010), including recent updates for Isbister (Lawrence & Lee-Thorpe 2012). The start and end boundaries of the Bayesian models for the three sites are compared in illus 37, in which the start boundaries for the Knowe of Rowiegar and Quanterness appear similar, and the end boundaries for all three sites show coincidence.

A visual comparison with the climatic data offered by the GISP2 Temperature Greenland Ice Core (Alley 2004) shows a close relationship between periods of deteriorating climate and



Illus 37 Upper Plot: GISP2 Temperature Greenland Ice Core curve. Lower Plot: Comparison of Knowe of Rowiegar with Quanterness (Quant) and Isbister (ISB) start and primary phase end boundaries with Sunspot No. curve shown above. Sunspot Numbers below 15 lasting more than 20 years is considered a Grand Minimum. The Grand Minima are labelled with numbers 13, 12, 11, 10 and 9

the start and end boundaries for the dates from the three monuments during the period between 3400 and 2900 cal BC . Further comparison with another measure that has been suggested as indicative of periods of climate change – sunspot activity (Solanki et al 2004) – is also offered in illus 37 lower plot. It has been suggested (Usoskin et al 2007) that low sunspot numbers, of value less than 15 and lasting for more than 20 years, termed grand minima, are a proxy for poor climate, though it is acknowledged that sunspot activity also has a direct impact on carbon isotope ratios.

STABLE NITROGEN AND CARBON ANALYSIS

Analysis of ^{13}C and ^{15}N shows acceptable collagen preservation. The $\delta^{13}C$ measurements average –20.4‰ ± 0.43, which is typical of a prehistoric northern European diet with protein derived largely or entirely from C3 terrestrial sources (Schulting & Richards 2002; Richards

TABLE 8
Results of radiocarbon and stable isotope analysis of the 26 samples taken for this study. Dates calibrated in OxCal 4.1 and modelled in OxCal 4.2 (Bronk Ramsey 2009)

Sample	*Sex (NP – not possible)*	*Age*	*Lab No*	*Date BP ± s.d.*	*Date cal BC at 95.4% probability*	*δC[13] 0/00*	*δC[13] 0/00*	*C:N ratio*	*Bayes model 2 date cal BC at 95.4% probability*
Knowe of Rowiegar									
Skull A	NP	5 yrs	SU39641 (GU26863)	4510±35	3355–3096	–20.3	11.1	3.2	*3205–3120*
Skull B	NP	2–3 yrs	SU39642 (GU26864)	4555±35	3486–3103	–20.9	11,2	3.3	*3355–3305*
Skull C(1)	Male?	Adult	SU39646 (GU26865)	4525±35	3361–3100	–20.3	10.2	3.2	*3230–3145*
Skull D(1)	Male?	Adult	SU39647 (GU26866)	4545±35	3367–103	–19.9	9.8	3.3	*3345–3270*
Skull E	Male	Adult	SU39648 (GU26867)	4575±35	3498–3105	–20.6	10.8	3.3	*3375–3350*
Skull F/T(1)	Male	Adult	SU39649 (GU26868)	4475±35	3341–3027	–20.9	10.8	3.2	*3170–3065*
Skull H(1)	Male?	Adult	SU39650 (GU26869)	4560±35	3490–3104	–20.4	11.6	3.3	*3365–3330*
Skull J	Female?	Adult	SU39651 (GU26870)	4475±35	3341–3027	–19.5	10.3	3.4	*3140–3050*
Skull L	Male	Adult	SU39652 (GU26871)	4570±35	3496–3104	–20.4	11.1	3.3	*3370 – 3340*

Sample	*Sex (NP – not possible)*	*Age*	*Lab No*	*Date* BP ± *s.d.*	*Date cal* BC at *95.4% probability*	δC^{13} *0/00*	δC^{13} *0/00*	*C:N ratio*	*Bayes model 2 date cal* BC *at 95.4% probability*
Skull M	Male	Adult	SU39656 (GU26872)	4290 ± 35	3014–2876	–19.5	10.5	3.3	*2960–2880*
Skull N	Male	Adult	SU39657 (GU26873)	4500 ± 35	3355–3091	–20.7	11.2	3.3	*3190–3110*
Skull O	Male?	Adult	SU39658 (GU26874)	4515 ± 35	3358–3097	–20.8	10.8	3.3	*3215–3130*
Skull NN(1)	Male	Young adult	SU39659 (GU26875)	4665 ± 35	3621–3364	–20.3	10.5	3.3	*3405–3365*
Skull P(1)	Male	Adult	SU39660 (GU26876)	4495 ± 35	3352–3035	–20.5	11.1	3.3	*3180–3100*
Skull H(2)	NP	8–9 yrs	SU39661 (GU26877)	4320 ± 35	3022–2887	–20.5	10.1	3.4	*2970–2890*
Humerus AA	–	Adult	SU39631 (GU26856)	4605 ± 35	3516–3128	–20.5	10.4	3.2	*3385–3355*
Humerus CC	–	Adult	SU39632 (GU26857)	4355 ± 35	3089–2898	–20.2	10.8	3.3	*2985–2905*
Humerus EE	–	Adult	SU39636 (GU26858)	4540 ± 35	3366–3102	–19.9	10.5	3.3	*3335–3260*
Humerus HH1	–	2 yrs	SU39637 (GU26859)	4555 ± 35	3486–3103	–20.8	11.5	3.2	*3360–3320*
Humerus HH2	–	Adult	SU39638 (GU26860)	4470 ± 35	3341–3024	–20.8	10.8	3.3	*3125–3040*
Humerus HH3	–	Adult	SU39639 (GU26861)	4455 ± 35	3340–2944	–19.7	10.6	3.3	*3110–3030*

Sample	*Sex (NP – not possible)*	*Age*	*Lab No*	*Date BP ± s.d.*	*Date cal BC at 95.4% probability*	*δC13 0/00*	*δC13 0/00*	*C:N ratio*	*Bayes model 2 date cal BC at 95.4% probability*
Humerus ZZ	–	7 yrs	SU39640 (GU26862)	4545 ± 35	3367–3103	−20.5	11.2	3.2	*3350–3290*
Knowe of Yarso									
Skull	Male	Adult	SU45838 (GU30088)	4500 ± 35	3355–3091	−20.2	10.2	3.3	*3345–3220*
Knowe of Lairo									
Skull	Male	Adult	SU45833 (GU30086)	4537 ± 34	3364–3103	−20.8	11.2	3.2	*3360–3265*
Midhowe									
Skull 1	Male	Adult	SU46400 (GU30636)	4700 ± 30	3630–3372	−20.5	10.3	3.2	*3415–3365*
Skull 2	Male	Late teens	SU46401 (GU30637)	4531 ± 28	3361–3103	−20.6	10.3	3.3	*3370–3320*

et al 2003; Schulting 2011). The $\delta^{15}N$ measurements average 10.45 ± 0.46‰. There is thus no corroborating support for any substantial marine diet input. The stable isotope analysis accompanying the radiocarbon results are a by-product of the AMS process mainly used for control purposes, while any more detailed analysis cannot rely on the human data alone, but requires isotope values for coeval fauna. Diachronic trending is problematic when the uncertainty is wide as in the calibrated plateau dates, as seen in illus 32 where it was highlighted that the median date was unrepresentative of the probability density distribution curve. Using the model 2 median dates narrows the uncertainty of the calibrated dates in this model, but there is no diachronic trend evident; the low RSq(adj) figures typically less than 5%, implying that the linear trend line is a poor predictor for the data. A weak relationship between diet and sex, using the stable isotope values, has been suggested by Lawrence (2012) in his Isbister data. The paucity of female skulls in the present study prevents analysis of this.

DISCUSSION

The south/south-west coast of the island of Rousay is remarkable for its large number of Neolithic chambered cairns. This fringe of fertile land on an otherwise largely infertile island (other than the north-east corner) has attracted a substantial population throughout much of the human habitation of the Orcadian archipelago, as evinced by the similarly large number of brochs in the same area and the extensive occupation of this land, called Westerness, during the Norse period. In more recent times, Barry (1805: 61–2) states that Rousay had a population of about 700 at the time of his writing, mostly concentrated in the north-east and along the south/south-west coastal lands. In the 1841 census (before the main clearance of the island), Westness (the lands including Midhowe and the Knowes of Rowiegar and Yarso) was inhabited by 135 people (quoted in Thomson 1981: 51).

The Knowe of Rowiegar, although it would have been an imposing monument in the landscape, is a construction project which could be undertaken by a fairly small population within a reasonable time-scale (a year or so), particularly given the nature of the landscape and the available building material. The cairns of the south of Rousay are built on natural terraces which would require relatively little preparation to receive the monument. The local stone splits readily into slabs for construction of the interior parts of the cairn and the stones of much of the mound would be available on the surface in the immediate vicinity.

The minimum number of individuals of 28 people interred in the cairn would have been a very small proportion of the population, even if it represents a single phase, but even more so if the site was used over a long period for successive interments, as proposed in model 2. Factors such as poor recovery at excavation, possible loss of human skeletal material during the restructuring of the monument in the Iron Age or possible removal of bones as part of the rituals of the original Neolithic users of the monument may have led to considerable reduction in the size of the assemblage. Examination of the spread in age and sex amongst the skulls leads to the conclusion that neither of these factors was important in the selection of bodies for interment, nor did sex or age appear to define where in the chamber the skull would be placed. Detailed examination of the Knowe of Rowiegar assemblage showed extensive signs of disease and injury. In a population with a derived MNI of 28, there are seven cases of trauma or possible trauma evident in the skull and two possible cases of trauma in the postcranial skeleton. This high level of trauma, possibly linked to interpersonal aggression, was also found in the skeletal assemblages of Isbister (Lawrence 2012) and Quanterness (Crozier 2012). There are also numerous signs of malnutrition or dietary inadequacy, particularly in infancy, and many signs of general bodily stress. As most signs of trauma, disease and malnourishment occur in the non-preservable soft tissues of the body, this level of evidence of such population stresses in the skeletal assemblage indicates a high level of violence and ill-health. The times during which these people lived were both brutal and challenging.

Previous typological studies have associated stalled cairns with Unstan Ware pottery (ie Unstan bowls and associated wares), also noting that Maes Howe-type cairns appear to have been associated with Grooved Ware. It has been suggested (eg Renfrew 1979: 210–11) that Unstan Ware predates Grooved Ware, hence making the stalled cairns older than those of the Maes Howe type. The few pottery sherds found at the stalled cairn of Knowe of Rowiegar were indeed all of Unstan Ware (Davidson & Henshall 1989), but the results from this study and the dates of the primary phases of the Maes Howe-type cairns of Quanterness and Isbister suggest that all of these monuments were in use at approximately the same time. It has also been suggested (Richards 1988: 43) that O–C-type tripartite chambered cairns are older than the long stalled cairns, and these latter may be derived from the tripartite forms. The Knowe of Lairo is one of only three tripartite cairns on Rousay, the other two, Bigland Round and Kierfea Hill, being round cairns (with no existing bone remains), whilst the Knowe of Lairo has a less usual long, horned shape. The date of the skull from the Knowe of Lairo falls centrally in the range of dates established in this study, challenging this argument, though this does not directly challenge ideas relating types of pottery with types of cairn, as no Grooved Ware was found at the Knowe of Rowiegar. As Ashmore (2000: 306) has commented, however, the 'simple equation of tomb types with pottery types, let alone broad communities, is not viable.'

It has been argued that 'there is strong evidence for many key turning points in Scottish and north-west European prehistory – what we call moments of "crisis" – to be associated with evidence for widespread and abrupt natural changes in climate' (Tipping et al 2012).

While the plateau in the Neolithic part of the calibration curve causes wide uncertainties in the calibration from radiocarbon to calendar date BC, analysis of the dates from the Knowe of Rowiegar (and Quanterness) may show such a moment, with the start of the usage of the cairns around 3400 cal BC, coinciding with a period of deteriorating climate. The period of the climatic maximum which had greeted the earliest Neolithic settlers to Orkney was coming to an end. The birch and hazel scrubland of this earlier time had largely given way to more open conditions and blanket peat formation had started (see review in Renfrew 1985). This argument is supported by the osteological analysis of the bones from the Knowe of Rowiegar, which show a number of features that could relate to long-term dietary stress. With little previous evidence for the disposal of the dead involving such major monumentality, it is possible that this change may have been a response to the deteriorating climate and difficult social conditions of the time. This was followed by a long period of better climate, during which the monument was used for mortuary practices, while the latest deposition of human remains in the Knowe of Rowiegar, Quanterness and Isbister about 2900 cal BC may reflect another moment of even more severe climate change that led to the abandonment of the use of the monument for burials.

As for the distribution of the skeletal material, this study suggests some clear patterns. The skulls were mostly placed in cells 4 and 5 on both sides of the chamber, whereas the relatively few elements of the postcranial skeleton were generally more peripheral, with few postcranial elements found in the 'skull' cells. This emphasis on the curation of heads is shown by the MNI of 28 for skulls, compared with only seven for postcranial elements, while the higher than expected number of C1 and C2 vertebrae (as also noted at Isbister) may, however, reflect the removal of the head before the body had become fully skeletonised. This pattern is known elsewhere, such as at the Knowe of Yarso, where most of the skulls appear to have been carefully placed in the innermost of the three cells, standing upright and facing in to the inner space of the chamber (Callander & Grant 1935). Richards (1988) and Reilly (2003) have discussed the processes by which whole bodies were processed over time, including the dismemberment of decayed skeletons within cairns, rather than excarnation outwith the cairn. Reilly also follows Jones (1998) in suggesting that human remains may have been moved between the stalled cairns of south-east Rousay. The excavations of the Knowe of Rowiegar did not discover any articulated skeletons, with a similar pattern seen at Knowe of Yarso and that could also be envisaged for Quanterness and Isbister, as there are few indications of articulated skeletons amongst these large bone assemblages. This pattern of use, however, is strikingly different from that seen at Midhowe, despite its proximity and architectural similarity to Knowe of Rowiegar. With only part of the Knowe of Rowiegar surviving and the human bone assemblage from Midhowe missing, it is not currently possible to make a full comparison between the Knowe of Rowiegar and Midhowe, or with other Rousay cairns, to show how the sites related, such as whether bones may have been removed from primary interment in Midhowe to later use in mortuary practices at the Knowe of Rowiegar.

It is important to remember that the excavation records of the Knowe of Rowiegar and the other Rousay cairns cannot be used to determine multiple phases of use, instead recording the approximate appearance of the sites when they were abandoned. It is therefore possible that the combination of articulated and disarticulated skeletons at Midhowe reflects normal practice, in which fresh bodies were laid on the shelves in the chamber and left to deflesh, after which bones were placed elsewhere in the cairn, or removed, probably to make way for placement of further bodies, with similar practices taking place in the Knowe of Rowiegar. Alternatively, what was found at excavation may be the result of exceptional practices that took place when the sites were abandoned. In either case, it is striking that the modelled latest date of about 2900 cal BC for the final use of the Knowe of Rowiegar coincides with that for Quanterness and Isbister, possibly reflecting the abandonment of traditional practices during a period of crisis caused by severe climatic deterioration, rather than gradual change and the re-modelling of the monuments.

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