Excavation of Culhawk Hill ring-ditch house, Kirriemuir, Angus

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Introduction
Circumstances of the excavation

Partial excavation of Culhawk Hill ring-ditch house, Kinnordy Estate, Kirriemuir, Angus, was commissioned by Historic Scotland as part of their continuing programme of research into the impact of biota on archaeological sediments. After excavation the monument was reinstated. All works were conducted by AOC Archaeology in July and August 1996.

This monument is scheduled under the terms of the Ancient Monuments and Archaeological Areas Act 1979, and scheduled monument consent was granted for the excavation of elements of the site with a requirement for post-excavation analysis and publication of the project.

The following specialist reports are summarised here but may be consulted in full in the site archive:

Macroplant remains
Dorothy Rankin

Soil micromorphology
Clare Ellis

Routine soils samples
Clare Ellis

Artefacts
Thomas Rees

Correlation of rabbit and tree disturbance
Thomas Rees

Charcoal identification
Alan Duffy

Site description
Culhawk Hill ring-ditch house (NO 3495 5598) is located to the immediate south of the summit of Culhawk Hill (Illus 1), at an altitude of 300m OD. The site was visible as a slight circular bank with an opening to the south which encircled a penannular ditch. The bank was predominantly turf covered with no visible stones except in the south-east quadrant where significant quantities of exposed stone were visible. The bank appeared to extend on the eastern side of the entrance to form a lobe. This feature appeared particularly massive and stony in comparison to the rest of the bank. The ditch was deepest on the eastern side of the site and elsewhere was ephemeral and often obscured by tree boles. The level area within the penannular ditch was approximately 10.5m in diameter. The overall diameter of the site was 20m.

At present the site is covered by rough grasses and moss, but until the 1940s, when the area was felled clear, Culhawk Hill was wooded. The tree stumps from this period are still visible, while the extensive mounds of brash which originally lay across the hillside (Mr Small, pers comm) have now gone. Culhawk Hill is currently used as rough grazing by Balstard Farm, a tenant farm within Kinnordy Estate. The hillside below the site is infested with rabbits and there has been encroachment onto the south-west side of the site.

Previous investigations
Prior to the work carried out by AOC Archaeology the ring-ditch house (NMRS ref: NO 35 NW 37) had been surveyed in detail only once in 1985 (Illus 2), when the site was identified for the first time. The 1985 survey plan shows a penannular stone bank, 20m in diameter and about 3m thick, with a shallow internal ditch, 3m to 4m wide. An
entrance is indicated at the south of the site by a break in both the bank and the ring ditch. The monument also appears to be free of field clearance rubble. The records from the original survey, by Sherriff and MacKnight, are held by the National Monuments Record of Scotland.

The site of the ring-ditch house on Culhawk Hill was scheduled by Historic Scotland in 1988. Since then the condition of the scheduled area, and hence the site, has been monitored on three occasions by a Historic Scotland monument warden: in January 1989; June 1992; and December 1995. The records from these visits, held by Historic Scotland, show the scheduled area to have been free of rabbit infestation in 1988 with rabbit encroachment first being identified in 1992.

Archaeological background

Culhawk Hill along with Castle Hill and Clune Hill, roughly 1km to the north-east, were covered by dense coniferous woodland in 1857 (Ordnance Survey 1857-62). This presumably reflected the marginal nature of this block of upland during the late 18th and 19th century. With the clearance of this woodland in the mid-20th century the consequence of this marginality became clear in the survival of a broad range of upstanding archaeological features.

Aside from the site being discussed here, there is also a putative barrow and a stone circle on Culhawk Hill (NMRs refs: NO 35 NW 39 and NO 35 NE 41 respectively). The rocky ridge which
forms the summit of Castle Hill is surmounted by a fort (NMRS refs: NO 35 NE 6) and on a terrace to the south-east of the summit, at an altitude of 270m, there is another upstanding ring-ditch house (NMRS ref: NO 35 NE 33). In this case the overall diameter is up to 16m over a ring ditch up to 3m broad by 0.3m deep and the external bank 1.7m thick. The entrance was in the south-east, where the wall was noted to increase to 3m in width (Sherriff 1982).

Post-medieval settlement is also evident with at least two deserted settlements at the base of Castle Hill (NMRS refs: NO 35 NE 44 and 52). Rig and furrow remains are also frequently visible on the lower slopes of all three hills and on the saddle linking them (NMRS refs: NO 35 NW 46 and 45 and NO 35 NE 28, 29, 30 and 54).

Ring-ditch houses. Ring-ditch houses have been characterised as round houses where a concentric division of space was created by the presence of a ditch in the interior, normally running around the inside edge of the exterior wall (Feachem 1965; RCAHMS 1967). Ring ditches are variable in depth, can be continuous or segmented, and often yield evidence of having been either paved or infilled with rubble (Hill 1982a, 12; Kendrick 1995, 61). It is uncertain whether the ditch was an integral deliberate feature (Kendrick 1995, 61) or whether it was an erosional by-product of the utilisation of the space (O’Sullivan, forthcoming). Additionally ring ditches have been linked to the use of the interior of structures as byre houses (Feachem 1965; Reynolds 1982). Very few ring-ditch houses have been both excavated and dated; however Hill (1982a, 12) suggested a restricted period in the middle centuries of the 1st millennium cal BC. More recent work at Lairg (O’Sullivan, forthcoming) has shown that similar features also span a period of several hundred years in the early to mid-2nd millennium cal BC, contra Hill (1982a).
**Palaeoenvironmental sources.** There are no immediately relevant regional pollen sites in proximity to Culhawk Hill (Tipping 1994). The closest investigated site is Stormont Loch, 2km south of Blairgowrie (Caseldine 1993), which, in the absence of any dates, can only be linked by inference into any chronology.

**Geology and soils**

**Clare Ellis**

**Solid and drift geology.** The site is underlain by Devonian Lower Old Red Sandstone which accumulated under semi-arid fluvial conditions (Francis et al 1970). Some 4 to 5km to the north of the site the hills comprise Upper Dalradian Ben Ledi Grit of the Southern Highland Group. These grits were deposited in a rapidly sinking syncline and represent the remnants of turbidity currents. During the Caledonian orogeny the rocks were deformed and metamorphosed. This Highland area emerged as a mountainous tract during the Devonian bordered to the south by the Midland valley. The Lower Old Red Sandstone was deposited in this subsiding trough of the Midland valley which runs parallel with the Highland Boundary Fault. Culhawk Hill is located on the south-facing slope of a north-north-east / south-south-west ridge of Old Red Sandstone and conglomerate; locally these are interbedded with Devonian extrusive lavas, volcanic conglomerates and tuff near the base of the sequence. The Devonian phase of sedimentary deposition was followed by one of uplift and compression. This resulted in the folding of the older rocks, the formation of the Strathmore syncline and the main movement of the Highland Boundary Fault (Francis et al 1970). The site affords spectacular views to the south over the undulating, rolling topography of the Strathmore valley.

The glacial deposits and features within the study area are all probably of Late-Devensian age. The drift geology of the immediate site environs resulted from the second major ice advance and these deposits predominantly comprise glacial tills derived from Old Red Sandstone conglomerates, sandstones and lavas. Some of these underlying drift deposits have been reworked and sorted by fluvo-glacial processes and post-glacial fluvial processes. The drift deposits are important in as much as they determine the nature of the soils and much of the localised topography.

**Soils and land capability.** Culhawk Hill ring-ditch house is located on humus-iron podzols / brown ranker soil of the Stonehaven Association. Walker et al (1982a) regard this podzolisation (degrading) of brown forest soils as a relatively recent phenomenon. The land capacity for agriculture has been defined (Walker et al 1982b) as suited to improved grassland and rough grazing (5-2). The soils on the southern side of the ridge comprise freely and imperfectly drained brown forest soils with rare patches of poorly drained non-calcareous gleys. Immediately to the south of the site, at the base of the foothills, is Kinnordy Moss, a small area (around 1km²) of valley or basin peat which has a depth greater than 1m in places.

The soils of the Strathmore valley have been divided into a number of series but these generally comprise freely drained brown forest soils (Stonehaven and Balfrowine Associations). The predominance of brown forest soils is due to the underlying till, relatively low rainfall, relatively high temperature and intensive drainage (Walker et al 1982a). The agricultural capacity of much of the land within the Strathmore valley is land capable of producing a moderate range of crops (31 and 32). Mixed within the brown forest soils are a humus-iron podzols (Forfar Association) and small patches of loamy and sandy alluvial soils surrounding the ridge upon which Culhawk Hill ring-ditch house is located.

To the north of the ridge the soils comprise freely drained humus-iron podzols (Sourhope and Stonehaven Associations), imperfectly drained brown forest soils (predominantly Doune and Gourdie Associations) and patches of poorly drained non-calcareous gleys (Gourdie Association). The land of the Old Red Sandstone hills which lie immediately to the north of Culhawk Hill and is bounded by the Highland Boundary Fault has been categorised as capable of producing a narrow range of crops (41 and 42).

**The survey**

The quantification of the impact of rabbits and trees on the site was one of the main objectives of the project. Consequently a detailed survey was undertaken using a total station instrument, producing a close contour interval record of the upstanding monument and, within a zone measuring some 40m wide around the monument’s outermost visible limits, a coarser interval survey of the topographic context of the monument.

Details of the damage from rabbits, including rabbit trails, feeding, basking and defecation areas, were recorded onto this survey to provide an overall view of the current intensity of the infestation. In addition, the location and size of tree stumps were also recorded to allow an assessment of the age and density of woodland which had once covered the hillside.

**Excavation strategy and methodology**

Although initially classified as a ring-ditch house, the unusual location of this site, just off the summit of the hill at an altitude of 300m OD, obliged
consideration of alternative interpretations. Of these, perhaps the most credible was that the site had served as the focus for, or resulted from, 'ritual' activities associated with death and burial.

The excavation of the interior of the site was determined to be of primary importance as the features identified there would effectively discriminate between the use of the site as a structure (represented by a ring of post-holes) or as a ritual locus (represented by features and deposits such as pits containing urned cremations). The presence of post-holes within the inner area would focus most attention on to the form and nature of the bank and ditch and their relationship with the inner area. Had 'ritual' activity such as urned cremations been recovered then the excavation of a large area beyond the bank would have been as important as the investigation of the nature of the bank and ditch.

Initially the area enclosed by the ring-ditch was excavated (Area A), in four quadrants, to the sterile sub-soil. Negative features penetrating the subsoil were half-sectioned. Five radial trenches were cut out from Area A, through the bank and ditch (Areas B, C and D) and across the entrance way (Areas E and F) (Illus 3). Each of these trenches were positioned so as to create continuous east / west and north / south sections across the site (Illus 4).

All features were photographed with colour slide and monochrome print film and were drawn in plan and section at appropriate scales. Samples retained from excavated features included: standard bulk samples for wet-sieving; routine soil samples for characterisation of sediment types; special or purposive samples including large concentrations of wood charcoal for potential radiocarbon dating; and kubiena tins to allow investigation of sediment interfaces through soil micromorphology.
The constraints on the project meant that not all of the archaeological sediments within the trenches opened were investigated. Areas A, B, C, D and E were all investigated to the satisfaction of the excavator; however, Area F, the eastern side of the entrance, was only partially investigated.

**Stratigraphic sequence**

A series of phases are identified below. These associations have rarely been made by positive stratigraphic relationships, but rather by inference from common and coherent distributions of features. These inferences are explained and argued for in the discussion and used here only to facilitate clarity and ease of presentation.

**Subsoil and bedrock**

The subsoil was relatively consistent across the whole site. The bedrock by comparison varied across the site. In Area B and the western side of Area A the bedrock was solid and horizontally bedded. In the southern portion of Area A and in Area E this solid bedrock became increasingly fragmentary and irregular in nature. In comparison the north and east of the site appeared to be underlain by a moderately consolidated clay with numerous stone inclusions.

The construction and use of the ring-ditch house

*The central stone surface*. A stone surface (Context 69) was identified at the centre of the site underneath the intersection of the excavation baulks. This surface consisted of two main elements:

i) a roughly circular central area of shattered fragments of sandstone slabs, about 1m in diameter, with individual stones varying in length from 50mm to 90mm and up to 30mm thick;

ii) an edging, around the shattered stone, of rounded to sub-angular stones, about 200mm by 100mm by 100mm. Many of these stones also had evidence of fracture.

Beneath the stone surface was an amorphous but rounded cut, 0.25m deep, which contained two sediments (Contexts 92 and 93). These sediments, and the cut, had all been severely affected by bioturbation.

*The post-holes*. Fifteen post-holes in a circle were identified in the interior of the site, primarily within Area A. This circle of post-holes has a 9.5m diameter and encloses an area of 70.86m². The post-holes are all of a comparable size and shape, 0.5m in diameter and 0.5m deep, having vertical sides and level bases, with the lower portion having been cut through bedrock. Their distribution appeared to be very regular; they were consistently 1m apart and at the very edge of the ring-ditch. The only significantly larger gap was at the southern point in the circuit where there was a 2m break, which aligned with the break in both the ring-ditch and the bank. None of these post-holes showed any sign of damage consistent with the removal of timbers, nor had any of the post-holes been recut.

Three post-holes were identified in the area between the common break in the bank and the ring-ditch (Area E). These post-holes again shared the characteristics of the interior post-holes.

*The fills of the post-holes*. The fills of the fifteen post-holes excavated in the interior of the site comprise the packing stones and soil filling. The packing stones in at least five of the post-holes appeared to be in situ indicating that posts of between 0.2m and 0.25m diameter had rotted in situ. In the other
ten post-holes the packing stones had slumped. This could have resulted from either the removal of the posts or their rotting in situ. No post pipes could be identified in the fills, except by inference from the presence of apparently in situ packing stones. The fills of the entrance area post-holes were broadly similar except that only one of the fills contained in situ packing stones.

The ring ditch. Excavation of the ring ditch showed that its sub-surface form matched its surface form, having two breaks in its circuit. The southern break was 2.8m broad and aligned with both the break in the bank and the broadest gap between the interior circle of post-holes. The limits of the western break were not exposed, but it is a minimum of 2.3m broad and based on surface topography could be as much as 3m. The western break in the ring-ditch matches a particularly shallow area of solid bedrock.

Overall the ring ditch enclosed a sub-circular area of 103.87m², with the enclosed area having a diameter of between 11m and 12m. The ring ditch where excavated appeared as a relatively slight feature which gradually sloped down from the interior of the site (around 10° declination) and then rose more abruptly as it approached the bank (around 30° inclination). The ditch was deepest, at 0.44m, on the eastern side of the site (Area C). The ring ditch where exposed, varied in width from 3.8m to 1.2m.

The secondary stone surface. A smaller stone surface (Context 72) was identified close to the bank and outside the circle of post-holes, in the western break of the ring ditch. The stone surface was formed by six medium-sized slabs which were edged by at least 12 medium-sized angular to sub-angular stones. Overall the surface was sub-circular to oval in plan with a diameter of between 0.6m and 0.7m. Beneath the stone surface was a sediment within a cut (Contexts 95 and 96 respectively), thought to be heat-affected subsoil and its interface with the underlying unaltered subsoil. The heat-affected subsoil contained numerous fragments of wood charcoal.

The bank. Excavation of the bank showed that its sub-surface form matched its surface form, being penannular with one break in the south, of 2.6m. The bank was from 0.45m to 0.75m high and from 4m to 4.5m broad. The bank was steepest at the north-west of its circuit and highest at the south-east. While the slope difference from the north-west to the south-east of the site was 2.25m, the variation in the bank reduces this to a 1.72m drop between the crests of the bank.

Where excavated, the bank appeared as a homogenous sediment which could barely be distinguished from the natural soil profile. Only in the western portion (Area B) was the bank material visibly different and hence distinguishable from other contexts. Even in this instance the identification of whether bank material was in situ or slumped could not be made.

Stone was present around the outer edge of the bank, but only in significant quantities around the east and south of the circuit. A definite exterior wall face was identified in two of the radial trenches (Areas C and E; Contexts 10 and 85 respectively) and its presence can be inferred in the south-east of the site (Area F) where substantial quantities of stone were identified. This wall face was closest in the east (Area C) where there was the continuous band of stone, two stone broad, at the outer edge of the bank. A bedding trench was consistently located beneath this wall face (Areas C and E; Contexts 106 and 20 respectively). This proved to be a shallow cut into the subsoil, rarely going deeper than the visible stones of the outer wall face, and in Area E continuing both as a thin band of soil (Context 21) and beneath this a layer of weathered subsoil (Context 24).

The exterior gully. To the north of the site (Area D) the cut of a slight gully (Context 76) was identified outside, and up-slope, of the bank. The cut ran across the width of the radial trench, aligned east to west, and was up to 1.7m broad, 0.28m deep and infilled by Contexts 77 and 78.

The degradation of the ring-ditch house

The fills of the ring ditch. In three of the sections through the ring-ditch (Areas D, E and F), only a single homogenous fill was identified within the ring ditch (Contexts 13, 84 and 87 respectively). The exception to this pattern was in the east (Area C) where five separate contexts (Contexts 4, 5, 7, 17 and 107) were recorded filling about 100mm of the bottom of the ring ditch. Two of these contexts (Contexts 4 and 17) were silty loams, which were rich in organic material and were thought possibly to have derived from turf layers, while the other three were possible in-wash bands of material.

The fill of the exterior gully. Two contexts were identified filling the exterior gully, up-slope of the north portion of the bank (Area D). These contexts (Contexts 77 and 78) were both thought to be in-wash layers derived from either the degradation of the bank, to the immediate south, or from general hill-wash from uphill of the gully.

The ring-groove enclosure

The ring groove. A ring groove was identified in each of the radial trenches that were fully excavated (Areas B, C, D and E; Contexts 79, 98, 81 and 100 respectively). The ring groove proved very
hard to identify, and only in the north and west (Areas D and B) could the form of the ring groove be clearly identified as being 0.25m wide and 0.2m deep with a V-shaped cross-section. The ring groove was not symmetrical with the upstanding elements of the site, cutting both the bank (Areas B, C and D) and the upper fill of the ring-ditch (Area E). The ring groove appeared to break in the south, in common with the bank and ring ditch.

The fill of the ring groove. The fills of the ring groove (Contexts 74, 80, 82, 99 and 101) were all comparable in their nature, being an amalgam of a dense linear band of small to medium packing stones and limited quantities of soil. The packing stones were up to 0.29m long, more typically around 0.15m, and lay with their long axis perpendicular to the subsoil surface. This characteristic form of packing stones was the main reason for the ring groove being identified in the south and east of the site (Areas E and C).

Soil formation, rabbit and root activity

The modern soil profile was identified as a brown forest ranker, comprised of a topsoil and turf (Contexts 1 and 2 respectively) which overlay the whole site. The assumption is that this material has formed, or has been altered through pedogenesis, since the last human use of the site.

Extensive rabbit and root activity was identified across the site during the excavation. The bulk of the rabbit and root activity was recorded by drawing and photography. However, a total of six contexts (Contexts 33, 34, 37, 38, 41 and 42) were assigned to rabbit and root activity when such activity produced sizeable negative features which, prior to excavation, could have been interpreted as anthropic in origin.

Artefact analyses

Coarse stone

A stone spindle-whorl was recovered from the topsoil (Context 2) approximately 1.5m to the west of the central stone surface (Context 69). The spindle-whorl (Illus 5) is almost circular in shape, measuring between 35mm and 37mm in diameter and 10mm thick. The outer edge has an abraded convex cross-section and there is slightly offset hole, 11mm in diameter, through the piece.

Lithics

Moderate quantities of quartz and quartzite were recovered from the site during the excavation. Such material is naturally occurring in the area, and it could equally represent either the natural background level of this material or deliberately modified artefacts.

A rapid assessment of whether the quartz and quartzite assemblage had undergone systematic alteration failed to produce any convincing evidence that a coherent worked assemblage was present. While this does not exclude the possibility that some of the individual stones had been both altered and used, it does suggest that the form of the majority of the assemblage is the product of natural processes.

Samples analyses

Soil analyses

Clare Ellis

Methodology. All samples were subjected to four analyses, using soil in a field moist condition. The measure of the alkalinity or acidity of a soil, pH, was determined in a 1:2.5 soil to distilled water mixture. Loss on ignition (LOI%) used about 10g oven-dry soil ignited to 400°C for four hours. Determination of phosphate used a spot test for easily available phosphate (Hamond 1983). Samples were rated on a three-point scale using the time taken for a blue colour to develop following the addition of the two reagents to the sample. The scale was high (0–30 seconds), medium (30–90 seconds) and low (more than 90 seconds). Calcium carbonate content (CaCO₃%) was assessed semi-quantitatively using a simple field test and the samples assigned to five classes (based on Hodgson 1976, 57).

Results. There was no discernible calcium carbonate in any of the contexts analysed. The available phosphate was low in all the samples. The pH ranged from 4.05 to 5.21 with a mean pH of 4.9 and
standard deviation (σ) of 0.27. The percentage loss on ignition values (LOI%) ranged from 4.62 to 23.76, with a mean value of 12.91 and σ of 4.36.

Discussion. The pH values show that the soils and sediments are moderately acid. The apparent lack of phosphate in the soils is curious because many of the contexts analysed were derived from clearly anthropic features, eg post-holes. There are three possible explanations for the lack of phosphate. The first is that the sediments do not contain and have not received easily available phosphate, implying that the fills have not been affected by human / animal activity upon the site. The logical conclusion of this scenario is that the post-hole fills must be derived from rapidly back-filled natural and / or in situ degraded wooden posts; however, such a simple explanation does not account for the lack of phosphate in the horizontal contexts.

A second hypothesis is that physical weathering of the soil has resulted in the downward movement of clay-sized particles resulting in a net downward shift of phosphate into the subsoil (Hamond 1983). Such illuviation processes may have occurred and in conjunction with the limited soil depth over most of the site this is a plausible explanation; however, many of the post-hole fills occurred at a greater depth than 250mm and so higher levels of phosphate would therefore be expected in these.

The third and most likely explanation is that the phosphate has undergone some conversion to inorganic forms (mineralisation) and / or the phosphate has increasingly occluded within the soil’s crystal lattice and the phosphate anions are redistributed amongst the aluminium cations (Hamond 1983). Acid soils (pH 4.5–7) of low phosphate status with a surplus of clay minerals relative to sesquioxides show an opposite trend in phosphate availability with pH change (White 1987). The exchangeable Al³⁺ hydrolyses to form hydroxyaluminium ions which act as sites for phosphate absorption. These ions are prone to polymerisation so that the hydroxyaluminium complex, with phosphate occluded, forms on the surface of clay minerals resulting in a low phosphate concentration (White 1987).

Much of the soil and sediment can be classified as humose mineral soil and there are some very organic rich contexts which are technically organic soils. There are a few contexts whose location and organic content make them worthy of discussion. The B horizon of the humus-iron podzol / brown ranker has a LOI of 12% and it is likely that this horizon is the basis for many of the site contexts. The ditch sediments all have LOI% values higher than that of the mean (with one exception). It is possible that these contexts represent a series of in-washed, organic-rich topsoil, or more likely perhaps the in situ growth of organic soils within what would have been a damp, sheltered and probably abandoned shallow ditch. The two silts from beneath the central stone spread have a low LOI% and this is probably a consequence of prolonged exposure to low temperature fires. The higher LOI% of Context 95 from beneath the smaller stone spread (Area B) indicates that this sediment has not been significantly affected by fire. The organic content of the post-hole fills ranges from 7.68 to 21.23%; the fluctuation of organic content appears to largely reflect the amount of rootlet penetration and rabbit disturbance, rather than major differences in the archaeological organic content.

Systematic phosphate sampling. A series of column samples were taken from the north / south and east / west baulks which ran across the site with the view to investigating potential areas of occupation and concentrated animal activity. The phosphate results derived from the routine analysis indicated that there is no measurable easily available phosphate within the soils and sediments. Twenty-one columns of samples, from a total of thirty-six, were analysed for phosphate. Unfortunately, all the phosphate readings were low and so no inferences can be made concerning the formation processes and use of the ditch and the interior of the site.

Soil micromorphology
Clare Ellis

Aims. Eight kubiena tins of soil were taken from a variety of archaeological contexts, but only five were selected for processing. The main objectives of micromorphological analysis of soils and sediments for the five processed tins were:

i) Tin 3 sampled across the cut of the ring-groove, including sediment from either side. The sample was taken to determine the nature of the sediments, the nature of the cut and to give an indication of the duration of time elapsed between the erection of the bank and the cutting of the ring-groove.

ii) Tin 4 comprised a sample of bank material and the underlying subsoil. The aim of micromorphological analysis was to explore the nature of the bank construction which was thought from field observations to comprise turves and earth.

iii) Tin 5 was taken from below the central stone spread. The aim of micromorphological analysis was to assess whether the underlying deposit had been altered by heat.

iv) Tin 6 was taken from the fill of the external gully, outside the bank (Area D). The aim of micromorphology was to determine the nature of the deposits and to provide informa-
tion on whether the material may have
derived from the bank.

v) Tin 8 was sampled from the fill of the ring
ditch, on the eastern side (Area C), where
complex horizontal stratigraphy survived. The
aim of micromorphological analysis was to
determine the nature and formation processes
of the lower ditch sediments.

Methodology. The samples were prepared for thin
section analysis using the methods of Murphy
(1986) and analysed using the descriptive termino-
logy of Bullock et al (1985). The full descriptions
are contained in the archive report.

General descriptive characteristics of the deposits. The
sampled sediments share many micromorpho-
logical characteristics. The porosity of the deposits
ranges from 5 to 30%, with the majority of the
contexts exhibiting 10 to 20% porosity. The sedi-
ments generally have a complex microaggregated
structure; the main elements are granular, channel
and vugxy. Generally the matrices are yellowish
brown in colour when viewed in plane polarised
light (PPL); this colour is indicative of a relatively
high proportion of colloidal, amorphous organic
matter. The sediments are matrix supported, with
an open porphyric related distribution and very
weakly speckled to undifferentiated b-fabrics. The
basic coarse mineral component is dominated by
monocrystalline quartz, which is set within gener-
ally organic rich, clayey silt matrices. Spherical
excrement pellets and mammilated excrement
pellets, commonly in the form of dense or partially
fused microaggregates, dominate the sediment
microstructures. All the sediments show evidence
of extensive and intensive bioturbation.

The bank and the ring groove. Tin 3 contained two
sediments and one interface (Contexts 73, 80 and
79), and was the only one where the different
contexts were identifiable in thin section. The
contexts represent two sediment types which were
very similar and can be classified as moderately
sorted fine sandy silt loams with complex
microaggregated structure. The bank material
(Context 73) was more compact than the fill of the
ring-groove cut (Contexts 80 and 79 respectively).
This was because it had been subjected to more
compression caused by the weight of the soil over-
burden and therefore it was also slightly less
susceptible to worm activity. Comparison of the
bank material from Tin 3 and the same context
from Tin 4 showed that these two sediments are
very similar. It is also interesting to note that the
sedimentary characteristics of the fill of the ring
groove and the bank material are also very similar.
These comparisons demonstrate that the ring
groove was cut into actual bank material and the
cutting and re-filling of the ring groove probably
took place soon after bank construction.

It was hoped that micromorphological analysis
would enable further information to be gained
concerning the construction materials used in the
bank. Both Tins 3 and 4 contained rare, fragment-
ary phytoliths which clearly indicate the presence
of grasses (including cereals). Unfortunately the
presence of phytoliths alone are not enough to
confirm the presence of turves on or within the
bank and the biological activity has produced
relatively homogenised, microaggregated sedi-
ments in which relic features have been destroyed.

Central stone spread. Context 93 (Tin 5) is a poorly
sorted clayey silt with a weakly speckled b-fabric.
It would appear from the negative micromorpho-
logical evidence (for example a lack of burnt
remains and lack of evidence for the effects of heat)
that the central stone spread may not have oper-
ated as a hearth. However, an alternative function
and use of the overlying central stone spread
(Context 69) could not be identified from the
micromorphological analysis.

The fills of the external gully. The fills of the external
gully (Tin 6, Area D, Contexts 77 and 78) are
poorly sorted fine sandy silt loams with a lower
organic content than the basal ring-ditch sediment
(Context 107). The sedimentary characteristics of
Contexts 77 and 78 are very similar to those of the
bank material (Context 73). It is apparent from the
micromorphological and soil analysis data that the
fills of the external gully did not develop in a
sedimentary sink, rather it is likely that these
contexts were originally derived from an exposed
or semi-exposed eroding area of fine silt loam,
possibly the bank.

There has been extensive bioturbation and
homogenisation of both external gully fills, so
much so that they were not distinguishable in thin
section. Bioturbation has also resulted in the
widespread destruction of expected relic features
which would have provided clues to the precise
formation processes of the sediments.

The fills of the ring ditch. It has been shown that
despite being derived from the same ring ditch the
ditch sediments are laterally variable. The ditch
sediment derived from the north face of the east
section (Tin 8, Area C) was an organic rich, moder-
ately sorted, fine sandy silt loam. The micro-
morphological data (relatively high organic
content, rare charcoal fragments, rare phytoliths
and diatom fragments and a lack of archaeological
debris) would indicate that the sediment (Context
107) probably developed after the abandonment of
the site. The extensive bioturbation of the sediment
by worms has resulted in the homogenisation of
the sediment structure making interpretation of
the mode of formation of the context problematic. The high organic content of this context comprises both detritus and material which has developed in situ. The environment in which Context 107 developed can be envisaged as a shallow damp ‘sedimentary’ sink probably episodically fed by drainage water containing fine sandy silt and organic matter.

Discussion of bioturbation. Throughout this summary and the full archive report a recurring theme has been the extensive homogenisation of the sediment structure through bioturbation. The deposits analysed have been subjected to intensive and probably extensive bioturbation and although the organism responsible for the majority of the bioturbation remains to be positively identified all the evidence indicates that it is one of the Enchytraeidae species.

Enchytraeids, a species of worm, are common in acid soils and *Cognettiia sphagnorum* is especially characteristic of organic rich soils (Dawod and FitzPatrick 1993). The soil on Culhawk Hill has been classified as a freely drained, well-aerated, relatively thin humus-iron podzol / brown ranker (Walker et al 1982a). The site is currently under rough pasture, although it was, until the 1940s, covered by a probable mid-19th-century coniferous woodland, thus the pasture is a maximum of 50 years old. In most natural or semi-natural acid soils enchytraeid populations vary between 1000 and 100,000 per square metre and for arable soils the values quoted ranged between 2000 and 10,000 per square metre (Dawod and FitzPatrick 1993). However, Dawod and FitzPatrick (1993) reported that the average number of enchytraeids for a two-year-old pasture located on a podzol and with a pH of 4.5 was approximately 46,500 thousand per square metre, with values decreasing with increased alkalinity (for example at pH 5.5 the mean enchytraeid population was 10,100 per metre square). It was shown that the large enchytraeid population resulted in the production of numerous faecal pellets which gradually fused to form the soil matrix. In comparison the mean pH value for all of the excavation’s soil samples and those specific contexts analysed by thin section are 4.9 and 5.0 respectively.

The form of the faecal microaggregates observed in thin section are also very similar to those described by Dawod and FitzPatrick (1993) as characteristic of small Enchytraeidae species; predominantly oval to spherical in shape, diameters between 50–70μm and 100–200μm (those from the excavation averaged approximately 60μm, with some larger faecal pellets around 100–300μm), dark to light brown in colour and composed of a mixture of mineral grains and organic matter. These comparative data, coupled with the form of the faecal pellets in thin section, indicates that the major agent of bioturbation was a probably high and significant Enchytraeidae population.

Rabbit damage was clearly visible on the site and prior to analysis was assumed, along with tree-roots, to be the primary cause of physical disturbance and destruction of important archaeological deposits. It is therefore of interest that the current micromorphological analysis has shown that bioturbation and its associated by-products dominate the sampled sediments. The extent and intensity of this bioturbation has resulted in the homogenisation of the contexts in all but one sample and it can be assumed that such context homogenisation has occurred to a lesser or greater extent across the site. Whereas rabbit and tree-root disturbance causes archaeological damage within the immediate vicinity of the burrow or channel, it has been demonstrated in this report that bioturbation, primarily by Enchytraeidae and also other worm species, causes less visually dramatic but potentially more devastating damage to archaeological deposits. It is also interesting to note that many context boundaries were visible during excavation, for example Tin 6 (Contexts 77 and 78), but this same boundary was not visible in thin section. The primary reason for the loss of context visibility can be explained, not by any obvious structural differences between the contexts (there were none), but by the observation of larger blocks of colour or hue in the field than is possible in thin section. The micromorphological analyses of thin sections from these excavations has demonstrated that microbiological activity, which is not obvious to the naked eye, can result in the mixing and ‘smudging’ of context changes and boundaries through the homogenisation of the soils and sediments.

Macroplant remains

Dorothy Rankin

Method. A total of 50 standard bulk samples varying between 1 litre and 34 litres in volume were processed using a system of flotation and wet sieving, adapted from the Siraf system (Williams 1973). The floating debris (the flot) was collected in mesh sizes 0.3mm and 1mm and the non-floating residue (the retent) was wet sieved through a 1mm mesh. All flots were sorted by a trained technician using a binocular microscope and all items of archaeological and ecological interest were recorded and extracted. All retent material was sorted by eye or with the use of a low-powered magnifying lens and again all items of interest were recorded and removed. The identifications of weed seeds and cereals (Table 1) were made using modern comparative material from the reference collection of AOC Archaeology. The nomenclature
for wild species follows that of the *Flora Europaea* (Tutin et al 1964–80).

The samples. Many of the samples processed proved to contain no, or very limited quantities of, charred material. These samples often contained uncharred material that is inferred to be modern in origin. Two groups of samples, from the fills of internal post-holes and the secondary stone hearth, had relatively high levels of charred material with only limited evidence of later contamination. Preservation of macroplant material was by charring, although the condition of the remains was generally poor; with many grains showing signs of abrasion, probably due to the post-depositional environment as well as the charring conditions. As a result, identifications have had to remain general or tentative in some instances. In all cases it was the grains alone, without any remains of chaff, that were recovered. The majority of samples contained a high proportion of uncarbonised organic material. The majority of this is in the form of fibrous rootlets and in a smaller number of samples, chips of coniferous bark.

The fungal sclerotia, *Cenococcum geophilum* Fr., was present in thirty-nine samples (Table 1). This mycorrhiza-forming fungus is commonly associated with Calluna heaths and alpine pastures. However, it has been shown to grow in arable fields in certain conditions (Jensen 1974). The wide distribution pattern of sclerotia derived from the samples makes it unlikely to be of any significance in terms of understanding the taphonomic processes of the excavated areas.

The fills of the internal post-holes. These contained both charred and uncharred remains, the uncharred material being interpreted as contamination. The charred remains included cereals and weed seeds. Barley dominated the small cereal assemblage, which consisted exclusively of grains. The majority of caryopses could only be identified as indeterminate barley (*Hordeum vulgare* indet.). This was due to their poor condition. However, there were individual examples where the remnants of the lemma and palea had fused to the grain surface, and so it was possible to distinguish these as hulled barley (*Hordeum vulgare* – hulled). Well-preserved caryopses could be further identified as having a twisted profile, characteristic of the hexaploid varieties as well as symmetrical profiles, which occur in both two and six-row varieties. The ratio of grains with asymmetrical to symmetrical profiles was 2:1. This is characteristic of six-row barley.

While four caryopses of oat were also present, their diagnostic elements (flower-bases) were not recovered and so identifications were made on the basis of grain morphology alone. These, and those found in the other samples, measured within the range of cultivated oats (*Avena sativa* L and *Avena strigosa* Schreb); however, their size also falls within the higher size range for wild oat (*Avena fatua* L).

Some caryopses were either badly degraded or very distorted, and so identification to species was not possible. Such grains were identified as indeterminate cereal (*Cerealia* indet) based on their vescularity and morphological characteristics.

The weed seeds identified were a sparse component of the assemblages; only five samples contained carbonised weed seeds. The weed seeds included fat hen (*Chenopodium album* L), ribwort (*Plantago lanceolata* L), knotgrass (*Polygonum aviculare* agg), chickweed (*Stellaria* cf *media*), and heath grass (*Sedum decumbens* [L] Bernh) which, except for the last of these, are common weeds of cultivated or disturbed ground.

The secondary stone surface. There were nine charred cereal grains and also present were a charred invertebrate egg and a probable rhizome. The cereal grains were predominantly of barley which was identified as hulled where diagnostic structures remained intact on the caryopses (*Hordeum vulgare* – hulled). Oat (*Avena sp*) was also identified and the remaining caryopses were identified as indeterminate cereal (*Cerealia* indet). No uncharred material was recovered except for the fibrous root material that was widespread in nearly all the samples.

**Discussion**. The occurrence of six-row hulled barley in the assemblage is in keeping with the overall palaeobotanical assemblage for the Iron Age in Scotland. Although there has been very little palaeobotanical research of Iron Age assemblages in Angus, the assemblages from Fairy Knowe, Stirling (Boyd 1983), Wardend of Durrus, Aberdeenshire (Boardman 1995) and Camelon, Falkirk (Dimbleby and Sheldon 1978) all produced evidence for hulled barley. Further afield, sites such as Dun Mor Vaul on Tiree (Renfrew 1974) and Balloch Hill, Argyll (Dickson 1982) also produced a predominance of hulled barley in their assemblages.

Oats were also identified in the samples, although in lesser quantities. Evidence for the cultivation of oats before the Iron Age is rare due to the difficulties of differentiating the cultivated from the wild species. In order to do this, the remains of their flower bases are required but they are fragile components and are often destroyed by charring. However, an exceptional discovery of carbonised floret bases of *Avena sativa* L at Ulva Cave, from a context dated to the Neolithic (4990 ± 60 uncal BP [GU-2707]), may change previously held perceptions about its cultivation in Scotland (Bonsall et al 1994). By the Iron Age the small oat (*Avena strigosa*) appears as the most frequently
Table 1. Macroplant remains.

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Key for material: SF = soil formation; RG = fill of ring groove; RD = fill of ring ditch; EG = fill of external gully; PH = fill of post-holes.

Cultivated type (Boyd 1988). Indeed, in Scotland the small oat is still cultivated albeit in the harsher climatic regions of the Western and Northern Isles (Hinton 1991). Unfortunately, with a total of nine caryopse of oat from all the samples, it has not been possible to determine with certainty, on the basis of morphology alone, the presence of the small oat, although the very tightly closed hilum on the ventral surfaces of the grains does differ from the more flared hilum of the wild oat. There is a possibility therefore that small oat is the species represented in these samples.

The assumption is that the weed seed assemblage was harvested with the cereal grains. The weed seed assemblage comprised both low-growing weeds, Plantago lanceolata, and tall-growing ones, Chenopodium album. The presence of low growing weeds may indicate that the crop was
Table 1 continued.

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Uncharred remains

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<td>Bryophyta indet</td>
<td>moss</td>
<td>calyx</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>not identified</td>
<td>seed</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>not identified</td>
<td>2</td>
</tr>
<tr>
<td>Invertebrate</td>
<td>not identified</td>
<td>body part</td>
</tr>
<tr>
<td>Invertebrate</td>
<td>worm</td>
<td>egg casing</td>
</tr>
</tbody>
</table>

Key for material: PH = fill of post-holes; SS = secondary stone surface; BK = bank.

reaped by cutting low, harvesting both ears and straw at once, at least in those crops with which it was associated. The lack of chaff and straw at the site suggests that the crop was subsequently winnowed before being brought onto the site, although their absence may be related to differential preservation.

The presence of both perennials (Plantago lanceolata and Siseliogia decumbens) and annuals (Chenopodium sp, Polygonum sp) may indicate that the soil in which the cereals grew was not too disturbed in that perennials were able to survive, but with which crops is uncertain. When mouldboard ploughing became prevalent in the Roman and medieval period, perennial weed contaminants decreased in cereal assemblages as the mouldboard had far more impact on the soil and its weeds than ard ploughing. The use of deeper ploughing implements during the Roman period is also linked to the decline of species such as heath.
grass from weed seed records (Hillman 1982). The decline of such damp-loving species is also linked to improvements in drainage of later periods.

The presence of heath grass (*Sielingia decumbens*) is more interesting. In recent history it has not been associated with cultivation or the products of cultivation, unlike the other weed seeds present in the samples. Heath grass, as its name suggests, grows on mainly acid heath, moorland and hill pasture. Its occurrence in two samples from the fills of the internal post-holes may reflect its use as a building material or could indicate the nature of the local environment. However, heath grass is a common occurrence in palaeobotanical assemblages of the Iron Age elsewhere in Britain and northern Europe (including Grauballe Man's stomach [Højlbaek 1958]). In Scotland *Sielingia decumbens* occurs in the earliest palaeobotanical assemblages as illustrated by its presence in the Neolithic levels at Skara Brae, (Hillman 1982, 906). Its presence, rather like the widespread occurrence of sedges seen in other palaeobotanical assemblages, is considered to be partly associated with the production of crops in poorly drained areas prone to dampness and waterlogging (van der Veen 1992) and partly associated with less penetrative ploughing methods (Hillman 1982).

The charred plant remains from the fills of the internal post-holes may derive from sweepings from a domestic hearth. A process could be envisaged where the living floor would be swept and as a result the debris from food preparation and cooking would accumulate at the bases of the structural timbers and so migrate down into the fills of the post-holes.

The hearth, on stratigraphic evidence, has been closely associated with the interior post-holes. The charred plant material from the hearth is similar in composition to the material from the post-holes and so the idea that the stone hearth was a contemporary feature which was an integral part of the use of space can be supported by the botanical evidence. However, the exact purpose of this hearth is not clarified by the evidence either. The charred assemblage is very small and so interpretation is difficult. However, it may represent the remains of a clean crop because no charred weed seeds were recovered.

Interestingly, the central stone hearth in the middle of the post-hole structure produced absolutely no plant remains from the two samples which were taken. This may suggest that the central stone hearth was used for other non-cooking uses, although the restricted nature of the evidence must be remembered.

Vitrified fuel ash
Andrew Heald
Two small fragments of material, initially identi-
Table 2: Summary of radiocarbon dated samples.

<table>
<thead>
<tr>
<th>Lab no</th>
<th>Date BP uncal</th>
<th>d13C (%)</th>
<th>Identification</th>
<th>Fragments</th>
<th>Weight</th>
<th>Context</th>
<th>Fill of</th>
</tr>
</thead>
<tbody>
<tr>
<td>GU-7283</td>
<td>2210 ± 50</td>
<td>-26.0</td>
<td>Betula sp</td>
<td>2</td>
<td>13.61g</td>
<td>59</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Corylus avellana</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alnus glutinosa</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ulmus sp</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA-26971</td>
<td>2060 ± 45</td>
<td>178.7</td>
<td>Betula sp</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA-26972</td>
<td>1980 ± 45</td>
<td>37.5</td>
<td>Corylus avellana</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA-26973</td>
<td>2000 ± 45</td>
<td>180.6</td>
<td>Ulmus sp</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GU-7284</td>
<td>2200 ± 50</td>
<td>-25.9</td>
<td>Betula sp</td>
<td>4</td>
<td>7.33g</td>
<td>61</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calluna</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Corylus avellana</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA-26974</td>
<td>2090 ± 45</td>
<td>176.6</td>
<td>Betula sp</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA-26975</td>
<td>1995 ± 45</td>
<td>179.6</td>
<td>Corylus avellana</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA-26976</td>
<td>2055 ± 45</td>
<td>178.2</td>
<td>Calluna</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GU-7285</td>
<td>3770 ± 80</td>
<td>-26.1</td>
<td>Alnus glutinosa</td>
<td>4</td>
<td>6.58g</td>
<td>84</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Corylus avellana</td>
<td>3</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Betula sp</td>
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<td></td>
<td></td>
<td></td>
<td>Salix sp</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA-26977</td>
<td>1805 ± 45</td>
<td>178.7</td>
<td>Betula sp</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA-26978</td>
<td>4105 ± 50</td>
<td>178</td>
<td>Corylus avellana</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA-26979</td>
<td>4215 ± 50</td>
<td>177.9</td>
<td>Alnus glutinosa</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GU-7286</td>
<td>2080 ± 70</td>
<td>-26.0</td>
<td>Corylus avellana</td>
<td>3</td>
<td>5.18g</td>
<td>95</td>
<td>Layer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calluna</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

iii) Context 84, the fill of the terminal of the ring-ditch, Context 83, in Area E. This material is inferred to be charcoal available in the interior of the main structure after its abandonment, when the ring ditch was being filled. As such the material should post-date the construction and occupation of the structure, although it may include material from these earlier activities.

iv) Context 95, the sediment underlying the secondary stone surface. The charcoal is inferred to derive from either earlier hearths or from charcoal available when the secondary stone surface's was constructed. Hence the charcoal should principally be contemporary with the use of the hearth and hence the occupation of the structure.

Only fragments of charcoal from the >4mm fraction were identified; however, the total weight of charcoal includes fragments from the <4mm fraction, which was sorted at a later date, to increase the weight of charcoal available for bulk radiocarbon dating. The samples consisted of mainly small, less than 5mm, angular fragments of charcoal. These appear to represent species of small deciduous roundwood, Betula sp (birch), Corylus avellana (hazel), Calluna (heather), Ulmus sp (ash), Alnus glutinosa (alder), and Salix sp (willow). Bulk samples for conventional radiometric dating were taken from all four contexts. In addition, three discrete fragments of charcoal were sub-sampled for single entity dating from each of Contexts 59, 61 and 84. The only basis on which these fragments were selected was that each fragment from the sample context should be of a different wood species. In all thirteen samples were submitted for dating.

Radiocarbon dating. The identified charcoal samples were submitted to the Scottish Universities Research and Reactor Centre for the conventional (liquid scintillation) bulk dates. The AMS single entity samples were initially prepared by the Scottish Universities Research and Reactor Centre and then dated by the University of Arizona AMS facility (Table 2).

Calibration. The calibrated date ranges were determined from the University of Washington, Quaternary Isotope Laboratory, Radiocarbon Dating Program, 1987. The 20-year atmospheric calibration curve was used throughout and the calendar age ranges, obtained from the intercepts, are expressed at both the one and two sigma levels of confidence (Table 3).

The bulk sample dates. The four conventional bulk dates (GU coded dates in Table 2) clearly show three broadly coeval dates and one anomalous
Table 3: Calibrated radiocarbon dates

<table>
<thead>
<tr>
<th>Lab no</th>
<th>Date BP uncal</th>
<th>1 sigma</th>
<th>2 sigma</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>GU-7283</td>
<td>2210 ± 50</td>
<td>cal BC 379-195</td>
<td>cal BC 390-122</td>
<td>59</td>
</tr>
<tr>
<td>AA-26971</td>
<td>2060 ± 45</td>
<td>cal BC 156-31</td>
<td>cal BC 193-cal AD 23</td>
<td></td>
</tr>
<tr>
<td>AA-26972</td>
<td>1980 ± 45</td>
<td>cal BC 40-cal AD 70</td>
<td>cal BC 102-cal AD 114</td>
<td></td>
</tr>
<tr>
<td>AA-26973</td>
<td>2000 ± 45</td>
<td>cal BC 89-cal AD 55</td>
<td>cal BC 111-cal AD 83</td>
<td></td>
</tr>
<tr>
<td>GU-7284</td>
<td>2200 ± 50</td>
<td>cal BC 388-168</td>
<td>cal BC 400-50</td>
<td>61</td>
</tr>
<tr>
<td>AA-26974</td>
<td>2090 ± 45</td>
<td>cal BC 183-77</td>
<td>cal BC 341-cal AD 1</td>
<td></td>
</tr>
<tr>
<td>AA-26975</td>
<td>1995 ± 45</td>
<td>cal BC 56-cal AD 59</td>
<td>cal BC 108-cal AD 86</td>
<td></td>
</tr>
<tr>
<td>AA-26976</td>
<td>2055 ± 45</td>
<td>cal BC 152-cal AD 9</td>
<td>cal BC 191-cal AD 26</td>
<td></td>
</tr>
<tr>
<td>GU-7285</td>
<td>3770 ± 80</td>
<td>cal BC 2335-2044</td>
<td>cal BC 2460-1970</td>
<td>84</td>
</tr>
<tr>
<td>AA-26977</td>
<td>1805 ± 45</td>
<td>cal AD 133-250</td>
<td>cal AD 88-337</td>
<td></td>
</tr>
<tr>
<td>AA-26978</td>
<td>4105 ± 50</td>
<td>cal BC 2869-2585</td>
<td>cal BC 2883-2499</td>
<td></td>
</tr>
<tr>
<td>AA-26979</td>
<td>4215 ± 50</td>
<td>cal BC 2908-2702</td>
<td>cal BC 2919-2623</td>
<td></td>
</tr>
<tr>
<td>GU-7286</td>
<td>2080 ± 70</td>
<td>cal BC 192-9</td>
<td>cal BC 362-cal AD 70</td>
<td>95</td>
</tr>
</tbody>
</table>

date (Context 84, GU-7285), one and a half millennia older. On the basis of these dates alone the hearth (Context 95, GU-7286) would have been interpreted as contemporary with the structural elements of the ring-ditch house (Contexts 59 and 61, GU-7283 and GU-7284 respectively) thus confirming the stratigraphic interpretation.

The anomalous date (Context 84) should have been coeval or younger than the other dates, based on the stratigraphy interpretation (above). Since this is not the case there are three principal explanations:

i) The stratigraphy was misunderstood and multiple contexts of differing origin were treated as one, consequently the bulk sample contained a very diverse range of charcoal from multiple and chronologically widely dispersed contexts.

ii) The site phasing was misunderstood and although the sampled context represents a chronologically narrow period of sediment formation this process occurred at a considerable chronological distance from other sediment formation process on site.

iii) The stratigraphic relationships were correctly understood, but the sediment formation process incorporated material including charcoal from chronologically diverse sources.

The bulk conventional dates alone cannot resolve which one of these explanations, if any, is correct.

The single entity sample dates. Two of the three sets of single entity dates (AA-26971-3 and AA-26974-6) are broadly coeval and comparable with their companion bulk dates. Of course, this coevality may be an illusion, it is an inference based on a selection of available charcoal. There is no justification in presuming that these selections are representative of the assemblage of charcoal recovered from the context or, indeed, of all the botanical material that was included with the context when it formed.

However, not surprisingly, the context which produced an anomalous bulk date (GU-7285) produced a trio of non-coeval single entity dates (AA-26977-9). Two of the charcoal fragments (AA-26978-9) were Neolithic in date, while the third (AA-26977) was broadly contemporary with the fragments from the other contexts. This assemblage of dates is therefore susceptible to a similar interpretation as that given for the bulk date, except that in this instance we now know that the invisible activity represented by the anomalous bulk date is Neolithic.

Summary. Both dating protocols, working from unrepresentative samples, identified Context 84 as containing charcoal with an age range which contradicted its stratigraphic location. Neither protocol could be used to unambiguously amend the interpretation of the stratigraphy, although both offered conditional insights. Equally, while each dating protocol has presented broadly comparable dates for the charcoal from Contexts 59 and 61, neither could definitively show that a limited age range of charcoal was present in the sediment.

In retrospect the bulk dates on their own presented a choice of three conflicting and equally credible interpretations for the anomalous date. The single entity dates narrow that choice, but they must not be portrayed as dates that truly reflect the age of the context. Now, if you apply Ockham's razor to both sets of evidence, you might come up with the following:
i) The bulk sample dating reflects a long chronology of site use, with the main surviving architectural phase dated to the later Iron Age. It is likely that amongst previous phases of site use, some activity can be identified to the early 2nd millennium BC.

ii) The single entity dates can best be interpreted as resulting from a long chronology of site use, with the main surviving architectural phase occurring between the 1st century BC and the 2nd century AD. Third millennium BC activity survives as a minor component of site use.

Discussion
Site stratigraphy
The stratigraphical information has been presented as a series of phases starting with the construction of a ring-ditch house, which subsequently degraded, and then had a ring-groove enclosure built on its upstanding remains. This sequence is, to some extent, based on inference.

The ring groove has been shown, stratigraphically, to post-date both the construction of the bank and the filling of a portion of the ring ditch. Additionally, the soil micromorphology analyses have indicated that the ring groove was excavated soon after the bank was constructed. Equally, the external gully, up-slope of the site, has been shown to pre-date the slumping of the bank. No interrelationship between the main portion of the ring ditch and the bank could be evidenced, except mutual respect. The homogenisation, principally by soil microfauna, of the sediments overlying the interior and filling the ring ditch has removed any stratigraphic link between the internal features of the site and multiple encircling features.

The radiocarbon dates and the macroplant report both support the post-holes and stone surfaces in the interior being contemporary and in comparable depositional environments. The absence of charred macroplant remains from the major part of the ring ditch, the bank and the ring groove prevents this association being extended.

The linkage between interior features and the bank and ring ditch is argued on the form and distribution of these features. The ring ditch clearly respects the secondary stone surface, on the west of the interior, and the interior post-holes all lie at, and respect, the immediate inner edge of the ring ditch. Although these relationships suggest contemporaneity they are not confident guides. The overall distribution of features and their individually discrete nature, with the exception of the ring groove, suggests them to be part of a simple single-phase construction, and hence contemporary.

The main contradictory evidence is the anomalous dates from the fill of the terminal end of the ring-ditch at the entrance. Clearly, there was charcoal from earlier, Neolithic, activity within the sediment. If this Neolithic charcoal dates the formation of the sediment then the bank and part of the ring ditch would pre-date this, with the ring groove being cut soon after the bank. The internal features, possibly including the other part of the ring ditch, would have been built two millennia later, respecting a series of features which would have been visible as denuded earthworks. This would appear an improbable chronology for the site and therefore, based on the stratigraphic interpretation, the anomalous dates should not be treated as relating to the formation of this context.

The ring-ditch house
The main elements of the site, the bank, the post-holes, the ring ditch and the stone surfaces, are interpreted as representing the remains of a single coherent structure which had an overall diameter of 20m. The radiocarbon dates from contexts associated with the ring-ditch house indicate it to have been occupied at some point during the 4th century cal BC and 2nd century cal AD. These dates are slightly later than the previously suggested restricted period of construction of ring-ditch houses in the middle centuries of the first millennium cal BC (Hill 1982a, 20). This slight variance probably reflects the absence of numerous excavated and dated examples of similar structures.

The roof: The circle of deep, regular post-holes in the interior are all of a common size and their bases are rock cut, implying that they held substantial timbers. These upright timbers would have supported the rafters for the roof, possibly by being linked by a ring beam (Reynolds 1982, 51). The rafters were probably footed into the bank, which would have also formed the exterior wall of the house, and so further supported the roof. The lateral forces at the foot of rafters are severe, suggesting that they could not simply rest on the surface of the wall but would have needed to be tied in.

Accepting a roof pitch of around 45° for a thatched roof (ibid, 51) then the inner posts would have stood to 5.75m and the apex of the roof would have been 10m high. The rafters, if they were single timbers, would have needed to be up to 14m long.

The need for symmetry in a conical roof, to avoid distortional thrust, has been stressed (Hill 1984, 80), and the absence of variation in the size, form and distribution of the post-holes implies that the timbers held by these post-holes rose to a common level to support the rafters. Given that the structure was built on sloping ground the symmetry of the roof would also need to be maintained at the distal ends of the rafters. This could be compensated for partly by the heightening of the
downslope wall, reflected in the increased use of stone in the southern and eastern circuit. The 1.7m drop between the tops of the bank across the site may suggest that they were not matched in height and that there may also have been an increase in the pitch of the roof on the downslope side.

The entrance. There appears to be only one entrance to the ring-ditch house, at the south of the site. The entranceway was not fully excavated so the form of the entrance cannot be clearly reconstructed. However, the presence of three post-holes suggests that there was a wooden ‘porch’ extending out from the bank.

The bank at the entrance has been shown to be higher at this point of its circuit and to have substantial quantities of stone in its external face. The bank also appears to extend on the eastern side of the entranceway to form a lobe. As this area was not fully excavated it could not be determined whether this was because a shelter wall extended out from the bank or if the higher, stonier nature of the bank at this point simply meant that it survived as a broader feature after its collapse.

This lobe at the entrance also appears reminiscent of the record for the ring-ditch house at Castle Hill (NMRS ref: NO 35 NE 33), 1km to the northeast. While the house there was much smaller, around 16m, the wall by the entrance, in the southeast, was noted to increase significantly in width (Sherriff 1982).

The stone surfaces. The cautious nomenclature used for these features reflects the discrepancies in the evidence for their function. Visually both appeared reminiscent of stone-built hearths. The secondary stone surface does appear to be a hearth, as it was underlain by charcoal-rich sediment, which appeared also to have been heat affected. The placement of this hearth, outside the circle of inner post-holes, is not problematic as the rafters (based on the discussion above) would have been about 2m above the hearth.

The role of the central stone surface is in greater doubt. Visually a number of the stones making up the stone surface appeared to be heat damaged. The sediment underlying the surface did not incorporate any charred material and did not, in the thin section taken, appear to have been heat altered although low loss on ignition suggests exposure to low temperature fires. If it is not a hearth, the function of the central stone surface is uncertain.

The origin and function of the ring ditch. The excavation could not determine whether the ring ditch was integral to the building or a feature of the use of the interior. However, its fragmented circuit, shallow gradients, variable depth and cross-section appear to be consistent with the ditch being the product of a variable process.

The function of the ring ditch is harder to determine. Its form, being deepest on the east side, clearly shows that it would not act as a drain for any water. The soil micromorphology work identified the basal sediments in the ditch as having formed in damp, stagnant conditions, consistent with the ditch being filled by natural processes once the house was abandoned. Therefore the ring ditch was probably open and being kept clean during the use of the house. The absence of any deliberate paving or rubble layers, common in other ring ditches (Kendrick 1995; Hill 1982a; Triscott 1982; Neighbour 1995), may indicate that this clean and presumably eroding surface was the preferred or accepted form for the ditch. Should this be the case the determination of function can only be based on its form and relationship with other internal features.

The division of space. The ring-ditch house has evidence for both the radial and annular division of the interior. The annular division of the interior of structures is a common feature during the latter half of the first millennium cal BC in Scotland (Hill 1982b, 29; Rideout 1992, 116). The principal annular division is provided by the ring of fifteen regularly spaced post-holes. The area enclosed, which is roughly a third of the interior, is level and contains at its centre the large edged stone surface. The only easily recognisable artefact, the stone spindle-whorl, was recovered just to the west of the central stone surface. There was no identifiable radial division within this inner area.

The height of the apex of the roof, above the centre of the interior, has been inferred to be around 10m. Such a huge height must offer the potential for additional floors supported by the timber posts, which also held the rafters and ring beam. Additional floors have often been postulated (Kendrick 1982) but are almost impossible to prove. Such additional floors have often been suggested as the primary space for domestic activity, with the ground floor being a focus for storage and cattle byres (Reynolds 1982, 54). While there is the potential at Culhawk Hill for an additional floor it is unlikely that there was such a simple division of space on the ground floor because the small hearth is probably related to domestic activity. A similar break in the ring ditch at High Knowes, just inside the entrance, has been postulated as the location for access to an upper floor (ibid, 53).

The remaining two-thirds of the interior is dominated by the irregular, but predominantly shallow, ring ditch. The ring ditch has two breaks, both of which produce radial divisions of this outer, annular portion of the interior. In addition the lateral variability in the form of the ring ditch may reflect more subtle radial divisions of space. This is not uncommon; all of the ring-ditch houses at Dougalsmuir had lateral variations in the depth.
of the ring ditch. House 6 in particular also had a break to the west of its entrance (Kendrick 1995, 43).

The presence of the small hearth reinforces a differentiation in the use of space in the outer, annular portion of the interior. The mutual respect between the ring ditch and the small hearth may imply that they relate to specific functions which were incompatible. In addition, the broadest and deepest portion of the ring ditch was on the opposite side of the interior from this hearth, perhaps again reinforcing a different and incompatible use of these two features.

The setting of the ring-ditch house. The location of the ring-ditch house is spectacular and exposed. At 300m OD the house site overlooks a large swathe of Strathmore and, on a good day, the east coast is visible. Although the house is set slightly off the exact summit of Culhaw Hill it lies on the skyline of the hill when viewed from the valley floor, 150m lower, to the south-west, south and east. When approached from the west or north the site is obscured by the hill.

The ring-ditch house appears to have been free standing, with no other upstanding features visible in proximity to it. This is in contrast to other excavated examples where ring-ditch houses are either found in groups, such as Douglassmuir (Kendrick 1995), or with smaller ancillary buildings, such as Dryburn Bridge and Brommou (Hill 1982b, 29). While other ring-ditch sites are in imposing positions, such as Arbory Hill and Cow Castle (Hill 1982a, 21), these tend to be defended, multiple-house sites.

The visual impact of a 10m high, 20m broad round house on the skyline of a substantial ridge would be awesome. It is hard to imagine monumentality on this scale, and the implications as to the resources needed to construct such a structure are impressive.

The radiocarbon dates. The thirteen radiocarbon dates from Culhaw Hill clearly fall into two groups. Ten of the dates lie in a tight group in the 4th century cal BC to the 2nd century cal AD. The contexts sampled for these dates were all elements of the ring-ditch house (two post-hole fills and the secondary stone surface respectively). Other excavated, and dated, examples of ring-ditch houses have been used by Hill (1982a, 12) to suggest a restricted period in the middle centuries of the 1st millennium cal BC for the construction of ring-ditch houses. The closest example of this is Douglassmuir (Kendrick 1995, 58) where all the radiocarbon dates lie between the 8th and 5th centuries cal BC. The slightly younger dates for Culhaw Hill probably reflect the scarcity of dating evidence for this form of structure.

The taphonomy of the three other dates (GU-7285, AA-26978-9) has already been discussed. Clearly these dates derive from, or have been affected by, charcoal from a previous phase of site use in the 3rd millenium cal BC. There appears to be no located features which can be confidently associated with this activity, although the limited area excavated does not preclude Neolithic features being located in close proximity.

The degradation of the ring-ditch house. The evidence from the post-holes associated with the ring-ditch house is that none of them were recut or had their timbers replaced. There is also no clear evidence that the timbers were ever removed, and they may have rotted in situ. The evidence from the ring ditch shows that this initially filled up slowly, through the formation of organic soils, and subsequently by the in-wash of eroding topsoil. This would suggest that, unlike the timber uprights, the roof was probably removed rather than collapsing into the interior.

The external gully by comparison filled from the start with in-washed material, probably reflecting both that as a drainage channel it mitigated against the formation of organic soils and that the bank started to degrade and erode once the structure deteriorated.

Overall the suggestion is of a structure which was maintained for only a short period and was then partly dismantled with the remainder allowed to collapse and degrade in situ. The presence of only one artefact within the area excavated could suggest a very limited period of occupation on the site.

The ring groove

The duration of the interval between the construction of the ring-ditch house and the ring groove is unquantified, although the soil micromorphology suggests the time frame to be short. The form of the ring groove is a narrow slot which was densely packed with packing stones. This suggests that the ring groove contained a continuous wooden fence. The ring groove appeared to break at the entrance to the ring-ditch house suggesting a common use of the break in the exterior bank. The date of the filling of this stretch of the ring ditch alters significantly the options for what the ring groove represents.

A later enclosure. The ring groove cut the fill of the ring ditch at the entrance, which, if this portion underwent a similar infilling as the rest of the ring ditch, implies it was constructed after the abandonment of the ring-ditch house. Additionally, in Area B, although the bank material could not be identified as either in situ or slumped, the form of the bank at this point strongly suggests that the ring groove is cutting slumped bank material (Illus
4). This implies that the ring groove was cut subsequent to the collapse of the ring-ditch house. Thus when the house site appeared as an earthwork the ring groove held a continuous fence, sited predominantly around the summit of the bank, but slipping down into the interior at the entrance to the site.

The ring groove is more likely then to mark the re-use of the house site as an enclosure, perhaps for stock control on the hill. The potential for this enclosure to have acted in a more complex social role, perhaps as a remembrance of the ring-ditch house, should not be ignored.

An element of the ring-ditch house. The alternative possibility is that this portion of the ring ditch on the west of the entrance to the house was infilled separately from the main stretch of this feature. This would open up the possibility that the ring groove could represent a remodelling of the house. It is not inconceivable that the bank was the first element of the structure to deteriorate, perhaps due to its substantially earthen nature. The ring groove could then be designed to replace the bank and act either to support the distal ends of the rafters or, if they were earth-fast in the ground, as a wind- and weather-proof external wall.

Conclusion

The excavations at Culhawk Hill ring-ditch house have produced a clear picture of the range of features present, their interrelationships and the general nature of the sediments filling them. From this evidence there appears to be at least three phases of activity.

The earliest phase of activity, during the Neolithic, is evidenced by the survival of residual charcoal. No artefacts or features can be confidently ascribed to this period.

The second phase is the construction of a massive 20m diameter ring-ditch house. This structure incorporated the ring ditch, the exterior bank, the post-holes, two stone surfaces (one of which is a definite hearth) and the external drainage gully. The interior of the site provided rare evidence for both the radial and annular division of space within the house. Sediments associated with the house have been dated to the between the 4th century BC and the 2nd century AD. This suggests the construction of the site towards the end of the accepted chronology for ring-ditch-style round houses.

The scale and location of the site are of particular note. The structure would have dominated the skyline for an extensive area of Strathmore and would have been a considerable engineering task both to build and to maintain. The absence of timber replacement and the gradual formation of organic soils in the ring ditch suggest only a short term occupation followed by the abandonment and dereliction of the structure.

Subsequently, after an unquantified period, a penannular ring groove was cut into the exterior bank, and in places through the upper fills of the ring ditch. This ring groove, which respected the entrance in the south, is thought to have held a continuous wooden fence and is more likely to be an enclosure built on the degraded remains of the ring-ditch house.

Overall the excavations have recovered valuable information from a type of site which rarely survives as an upstanding monument. However, the excavations have shown that this site has suffered extensive homogenisation of the sediment structure caused by bioturbation. The deposits analysed have all been subjected to intensive and probably extensive bioturbation and although rabbits and tree roots have had an impact, the most severe bioturbation has come from microfauna.

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Abstract

Investigations at Culhawk Hill by AOC (Scotland) Ltd excavated a scheduled ring-ditch house, which had two main phases. The earlier, dated to between the 4th century cal BC and the 2nd century cal AD, was a 20m diameter ring-ditch house comprising: a penannular bank; a discontinuous ring ditch; a circle of post-holes; and two possible hearths. Subsequently a penannular ring groove, which held a continuous wooden fence, was constructed. Traces of on-site activity from the third millennium BC were also identified.

Keywords: ring-ditch house, ring groove, Iron Age, bioturbation