5 ENVIRONMENTAL ANALYSES

An environmental sampling strategy was established using both standard and judgemental methods to obtain routine soil samples from relevant archaeological deposits, and where appropriate, target deposits and other features regarded as archaeologically significant.

5.1 Bone, by Sue Anderson

A total of 292 fragments of bone were hand-collected from nineteen features; material collected from samples was not analysed as it was all too small for identification. The majority of this material was calcined and heavily fragmented. The main exceptions were a single juvenile cattle metapodial shaft from pit 381 in Structure C and an unidentified fragment in post-hole 020 within Structure A; these unburnt pieces may indicate a recent date for those features, or potentially intrusive finds. Unburnt fragments were also collected from earlier features, but these were all fragments of tooth enamel, which tends to survive where bone does not. Most of the burnt fragments were too small for identification, but all were probably of animal rather than human origin. However, a few small fragments of ?fallow deer antler were recovered from pit 138 (near Structure C) and post-hole 427 (entrance to Structure B inner ring). The latter included a tine which appeared to have been cut across the tip (although calcined bone can have this appearance due to shearing of the bone during burning), and there was a small shaped fragment, possibly also antler, which is indicative of bone/antler working. The fragment measured 11mm in length and was roughly shaped with an irregular hexagonal section (5 × 4mm); it may be a roughout for a pin shaft which was broken and discarded.

This bone represents only a small fraction of the animal remains once present on the site, but the acidic nature of the soil (pH 5.6) has resulted in the loss of all unburnt material other than a few fragments assumed to be of recent date. Despite this, study of the material has provided limited evidence for working of osseous material, adding another dimension to the craft and industrial activities which took place on the site.

5.2 Charred plant remains, by Ruth Pelling

5.2.1 Introduction

As part of the excavation a series of samples was taken for the extraction of charred plant remains. Typical sample contexts included occupational deposits (Structures B and C), the enclosure ditch of Structure B, a variety of other pits and post-holes. Where possible every context related to a fill was sampled. Forty per cent of the total assemblage was processed for plant macro remains. Sample size varied according to the nature of the feature being excavated. Post-hole samples were in the region of 10–15 litres, while more substantial samples of 20 to 57 litres were taken from the occupation layer 034 in Structure C.

5.2.2 Methodology

Samples were processed by bulk water flotation. The resultant flots were collected onto 500μm, 1mm, 2mm and 4mm mesh sizes. The flots and residues were sorted by members of CFA. For each flot 100% of the 2mm and 4mm fractions was sorted. For smaller samples 100% of the 1mm fraction was also sorted, while for larger flots 25% or 50% of the 1mm fraction was sorted. Any identifiable and quantifiable plant remains were extracted for identification. The 500μm flot was scanned for smaller carbonised seed remains. The residues were sorted down to 2mm.

Identifications of seeds and chaff were made at the Environment Unit, Oxford University Museum of Natural History, using a reference collection held in the museum. Nomenclature and taxonomic order follows Clapham, Tutin & Moore (1987).

5.2.3 Results

Fifty samples were sorted, of which 29 produced small quantities of charred seeds and chaff. The results are displayed in Tables 3–6 and are discussed by feature or feature type.

Structure B

Eight samples from palisade ditch fill 004 and four post-holes within its interior produced small numbers of charred remains (Table 3). The occasional cereal grains included hulled barley but also one grain of hulled wheat which most closely resembled emmer (*Triticum dicoccum*). In the absence of any glume base it was not possible to be more precise with the identification.

Occasional weed seeds included *Polygonum persicaria* and another ruderal species *Stellaria media* (chickweed). A single sloe stone was also present. A single seed of possible *Thalictrum* sp. (meadow rue) was rather abraded. *Thalictrum* sp. can occur as a

Table 3 Charred plant remains from Structure B

	Sample	75	87	88	94	121	133	136	155
	Context	**005**	**005**	**005**	**005**	**351**	**412**	**419**	**424**
	Feature	**004**	**004**	**004**	**004**	**004**	**411**	**417**	**424**
	Volume	**2**	**16**	**2**	**11.5**	**?8.5?**	**20**	**4**	**2**
Cereal Grain									
Hordeum vulgare	barley, hulled grain	–	1	–	3	1	2	–	–
Hordeum vulgare	barley grain	–	–	1	1	1	1	–	–
Triticum cf. *dicoccum*	cf. emmer wheat grain	–	–	–	1	–	–	–	–
Avena sp.	oats, grain	–	–	–	–	–	2	–	–
Cerealia indet	indeterminate grain	1	1	–	1	3	–	1	–
Weed/Wild									
Chenopodium album	fat hen	–	–	–	–	–	1	–	–
cf. *Thalictrum* sp.	meadow rue	–	1	–	–	–	–	–	–
Stellaria media agg.	chickweed	–	1	–	–	–	–	–	–
Polygonum persicaria	persicaria	–	–	–	–	1	4	–	2
Polygonum sp.		–	–	–	–	1	–	–	–
Prunus spinosa	sloe stone	–	1	–	–	–	–	–	–
Gramineae	grass, small seeded	–	–	–	–	1	–	–	3
Gramineae	grass, large seeded	–	–	–	3	–	–	–	–
Monocotyledons	rhizome/root fragment	–	3	–	–	–	–	4	1
weed indet		–	3	–	1	1	2	–	–
Query		–	1	–	–	–	–	–	–

meadow species, on more rocky limestone or ridges or on sand dunes.

Structure C

Four samples from occupation layer 034 produced large flots dominated by charcoal but also containing seeds and chaff (Table 4). Grain was again dominated by hulled barley (*Hordeum vulgare*), including asymmetrical internal grain indicative of six-row barley (in six-row barley the ratio of asymmetrical to straight grain is 2:1). Two oat grains were also present. Chaff was restricted to three cereal-sized straw culm nodes. Dominating the assemblages in three samples, however, were numerous monocotyledon rhizome fragments. Possible *Arrhenatherum elatius* (false oat-grass) tubers were also present. The finds suggest some sort of uprooting or possible presence of turf.

Weeds were again dominated by arable/ruderal species such as *Chenopodium album* (fat hen), *Polygonum persicaria* (persicaria) and *Fallopia convolvulus* (black bindweed) and the cereal-sized grasses including *Bromus* subsect *Eubromus* (brome grass).

Some evidence of hedgerow species and possibly collection of wild resources is present in the form of hazelnut shell (*Corylus avellana*) and sloe stone (*Prunus spinosa*), although both could have entered the assemblage with firewood.

Pit 381 in this structure also produced small quantities of barley and wild species.

Structure G/H

Samples from six post-holes and two hearths in Structure G/H produced occasional grain and weed seeds (Table 5). Remains were present in a density of 1.48 items per litre of deposit. The occasional grain included hulled barley (*Hordeum vulgare*) and oats (*Avena* sp.), one of which had germinated. It is likely the germination was the result of no more than occasional spoilt crop. The different species of oats cannot be distinguished on grain alone, thus in the absence of floret base (the diagnostic part of the plant) it was not possible to determine whether the grain was from wild or cultivated oats.

No chaff was present, although weed seeds were present in six samples (post-hole fills 116 and 286 and hearth fill 128). Also present in two post-holes were occasional fragments of hazelnut shell (*Corylus avellana*). The weeds are dominated by

Table 4 Charred plant remains from occupation layer 034 and pit 381 in Structure C

	Sample	108	112	114	115	166
	Context	**034**	**034**	**034**	**034**	**380**
	Feature	**–**	**–**	**–**	**–**	**381**
	Volume	**20**	**42**	**?20**	**57**	**2**
Cereal Grain						
Hordeum vulgare	hulled barley, twisted grain	–	1	–	–	
Hordeum vulgare	barley, hulled grain	5	7	5	5	2
Hordeum vulgare	barley grain	2	3	–	1	1
Avena sp.	oats, grain	–	–	1	1	–
Cerealia indet	indeterminate grain	5	2	1	1	–
Chaff						
Cereal size	culm nodes	3	–	–	–	–
Weed/Wild						
Chenopodium album	fat hen	–	2	–	2	–
Leguminoseae	small seeded	–	–	–	1	–
Polygonum persicaria	Persicaria	–	–	3	1	1
Polygonum sp.		–	2	–	–	2
Fallopium convolvulus	black bindweed	–	–	–	1	–
Corylus avellana	hazelnut shell fragment	–	–	1	–	–
Prunus spinosa	sloe stone	1	–	–	–	–
Labiatae	large seeded	–	1	–	–	–
Lapsana communis		–	–	1	–	–
Carex sp.	Sedges	–	–	–	1	–
Bromus subsect *Eubromus*	brome grass	–	–	–	1	–
cf. *Arrhenatherum elatius*	false oat-grass tuber	–	2	–	1	–
Gramineae	grass, small seeded	–	1	–	1	–
Gramineae	grass, large seeded	–	–	–	1	–
Monocotyledons	rhizome/root fragment	82	84	3	27	–
weed indet		–	5	1	3	–
berry/fruit indet		–	–	–	1	–

common arable/ruderal species, notably *Chenopodium album* (fat hen) and *Polygonum persicaria* (persicaria).

The primary fill of post-hole 055 in Structure G produced an assemblage similar to those from layer (034) in Structure C. The most prominent category of remains were the large number of monocotyledon rhizomes. Hulled barley dominated the cereal remains including occasional rachis fragments. A single oat was the only other cereal present. Weeds included the ruderal/arable species (eg *Chenopodium album*, *Polygonum persicaria*). The remaining post-hole samples produced much smaller assemblages with a single oat and occasional barley grains, arable/ruderal weed seeds, grass seeds and monocotyledon rhizomes. The density of remains was very low, ranging from 0.2 to 3.5 items per litre.

Pits and other features

Three samples from two large sub-rectangular pits (146 and 152) near Structure C produced occasional remains (Table 6). All samples were very small (2 litres). Charred remains included occasional barley grain, hazelnut fragments and ruderal/arable weeds (*Polygonum persicaria*, *Fallopia convolvulus*).

Post-hole 063 in Structure F contained small quantities of barley grain and fat hen, and the ring-groove of Structure A (017) also produced barley grains. Two pits or post-holes to the south of Structure H

Table 5 Charred plant remains from Structure G/H

	Sample	3	4	30	34	66	68	91	101	105
	Context	**036**	**038**	**116**	**118**	**128**	**209**	**285**	**059**	**211**
	Feature	**035**	**037**	**119**	**119**	**127**	**208**	**124**	**055**	**207**
	Volume	**23**	**0.2**	**4.5**	**4.5**	**2**	**2**	**2**	**2?**	**2**
Cereal Grain										
Hordeum vulgare	hulled barley, twisted grain	–	–	–	–	–	1	–	–	–
Hordeum vulgare	hulled barley, straight grain	–	–	–	–	–	1	–	–	–
Hordeum vulgare	barley, hulled grain	1	–	2	2	–	3	3	4	–
Hordeum vulgare	barley grain	1	3	1	–	–	–	–	5	–
Avena sp.	oats, germinated grain	1	–	–	–	–	–	1	1	–
Avena sp.	oats, grain	–	–	–	–	–	–	1	–	–
Cerealia indet	indeterminate grain	–	–	–	–	–	2	4	5	–
Rachis										
Hordeum vulgare	barley rachis	–	–	–	–	–	–	–	5	–
Cerealia indet	rachis	–	–	–	–	–	–	–	3	–
Weed/Wild										
Chenopodium album	fat hen	1	–	–	–	2	–	5	4	–
Atriplex sp.	Orache	–	–	–	–	–	–	1	–	–
Polygonum persicaria	Persicaria	–	–	1	–	–	–	5	1	–
Corylus avellana	hazelnut shell fragment	–	–	–	–	–	–	7	–	1
Labiatae	large seeded	–	–	–	–	–	–	1	2	–
Bromus subsect *Eubromus*	brome grass	–	–	–	–	–	–	–	1	1
Gramineae	grass, small seeded	–	–	–	–	1	–	–	3	–
Monocotyledons	rhizome/root fragment	–	–	–	–	–	–	1	57	–
weed indet		1	–	–	–	–	–	2	2	2
bud indet		–	–	–	–	1	–	–	–	–

(232 and 240) contained small quantities of grain and weed seeds.

5.2.4 Discussion

Charred plant remains occurred in low densities in the samples, but were consistently present. Cereal remains suggest some cereal cultivation or at least utilisation. The general absence of chaff makes it difficult to make any statement about cereal production/preparation. The weed seeds may in part have derived from weeds within the arable crop which entered the assemblages as sieving waste.

The cereal crop record is consistent with other sites of this date in northern Scotland. Barley is both wind and salt tolerant so is well suited to northern coastal environments. It formed the principal cereal throughout mainland Scotland and the islands at this time (Boyd 1988). While it is possible that emmer wheat was also being cultivated there is no evidence of it being a significant crop at the site and it may simply be present as a weed of the barley crop. Emmer wheat was cultivated throughout the prehistoric period in Scotland and does appear to be the secondary cereal at many sites (ibid). Given the absence of oat chaff it was not possible to establish if the oats were cultivated or wild. Evidence of *Avena strigosa* (cultivated oats) does exist for the first time in Scotland in the Iron Age.

The weed assemblages contain several species characteristic of spring-sown barley. Included in this group are *Chenopodium album, Fallopia convolvulus* and *Stellaria media*. There is a slight hedgerow element with the *Corylus avellana* and *Prunus spinosa*. There is no evidence of heathland exploitation. *Arrhenatherum elatius* is a coloniser of abandoned arable or of pasture which ceases to be grazed. It is a characteristic species of succession to scrub land. The presence of the tubers in association with large numbers of rhizomes might indicate the use of turves as fuel. Evidence of the use of turves, although more commonly of heathland, has also been recorded at Late Bronze Age sites in the Isles

Table 6 Charred plant remains from other features

	Sample	11	12	71	74	79	96	97
	Context	064	016	142	233	241	149	151
	Feature	063	017	146	232	240	152	152
	Volume	4	16	2	4	2	2	2
Cereal Grain								
Hordeum vulgare	barley, hulled grain	2	–	2	–	–	–	–
Hordeum vulgare	barley grain	–	2	–	1	–	–	–
Cerealia indet	indeterminate grain	–	–	–	–	–	–	1
Weed/Wild								
Chenopodium album	fat hen	1	–	–	–	1	–	–
Polygonum persicaria	persicaria	–	–	–	–	–	–	2
Polygonum sp.		–	–	–	–	–	–	1
Fallopium convolvulus	black bindweed	–	–	–	–	–	–	1
Corylus avellana	hazelnut shell fragment	–	–	1	–	–	2	–
Monocotyledons	rhizome/root fragment	–	–	–	–	–	–	1
weed indet		–	–	–	1	–	–	1

of Scilly (Ratcliffe & Straker 1996), from Hengistbury Head in Dorset (Nye & Jones 1987, 323) and from Late Iron Age hearth deposits from Howe in Orkney (Dickson 1994). Fenton (1978, 207) records the more recent use of heathland turves for fuel in the absence of available peat in Orkney.

Such assemblages are typical of small-scale subsistence cereal production (van der Veen 1991, 121); there is no evidence of surplus production. It is possible that the cereal diet was supplemented by the collection of wild resources such as hazelnut and sloe although, as mentioned above, these remains may have derived from firewood.

5.3 Charcoal, by Michael Cressey

Charcoal was identified to species level on samples recovered from post-holes, pits, suspected occupation layers and palisade slots in order to select adequate material for radiocarbon dating. Other information on the types of wood that was available for exploitation during the sites occupation has been obtained. The samples examined include both hand-picked samples from secure contexts and samples from routine wet-flotation. In addition to the hand-picked samples, approximately 25% (representing 40 bulk samples) was subjected to processing by flotation. Table 7 summarises the results by species.

Table 7 Charcoal species and total weight

Species	total weight (g)	main type
Salix sp.	0.56	sf
Rosaceae type	20.25	rw
Quercus sp.	48.90	t
Alnus glutinosa	0.29	sf
Corylus avellana	72.58	rw
Pinus sylvestris	0.26	sf
Prunus type	0.26	sf
Betula type	25.53	rw

Key: sf=single fragment, rw=roundwood, t=mainly timber

5.3.1 Roundwood and timber

Eight species of roundwood and a large quantity of timber are represented in the charcoal assemblage from the site. *Quercus* sp. (oak) and *Corylus avellana* (hazel) are the most dominant species, represented by 48g and 72g of charcoal respectively, followed by 25g of *Betula* sp. (birch) charcoal. Rosaceae type (apple, cherry and hawthorn group) provided 20g of charcoal. *Salix* (willow), *Pinus* (pine) and *Alnus glutinosa* (alder) provided only trace amounts of charcoal at below 1g.

5.3.2 Charcoal cache associated with the smithing hearth

A large quantity of oak charcoal (2.2kg), all derived from squared timber, was recovered from post-hole 207, part of Structure G. Of this material, 12% consisted of worked fragments with either oblique facets, or evidence for saw-cuts and adze marks.

Table 8 Comparative species abundance derived from Seafield West 1 and 2 and Beechwood Farm

Site and type	Species	% abundance
Seafield West 1 (Pyre deposit)	*Corylus avellana*	71
	Betula sp.	9
	Quercus sp.	14
Seafield West 2 occupation sites	*Corylus avellana*	49
	Betula sp.	17
	Quercus sp.	33
Beechwood Farm, burnt mound & trough	*Corylus avellana*	60
	Betula sp.	22
	Quercus sp.	17

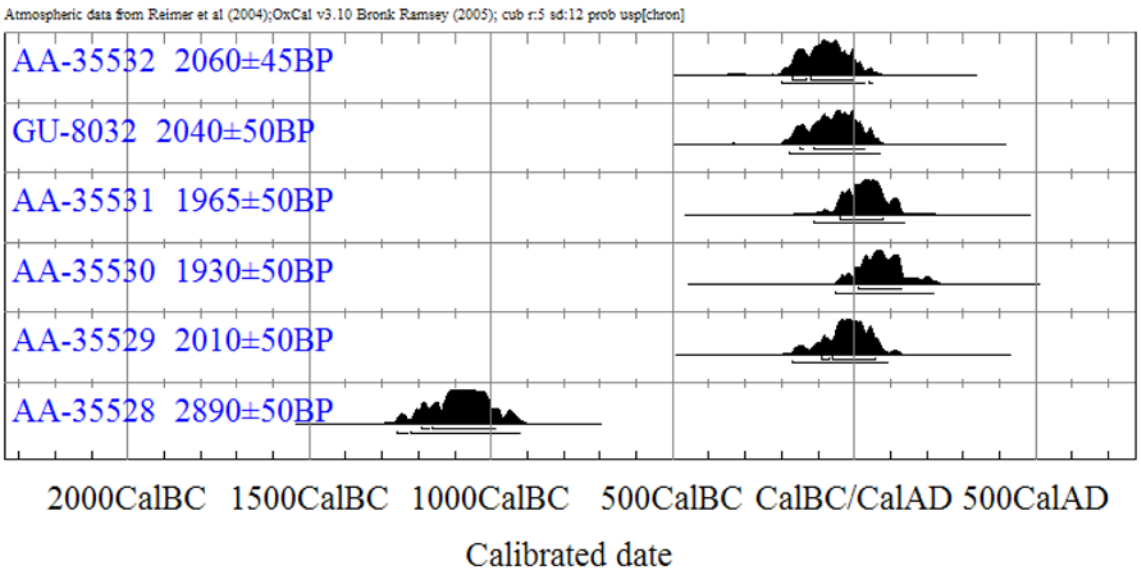
Some of the oak fragments are large (20–30mm^3): it is probable that large fragments of oak charcoal were selected in favour of other types of wood in order to maintain the high temperatures required for metalworking. Conversely, the large quantity of oak may simply represent a large quantity of waste material that was readily available for conversion to charcoal for smithing purposes. It is important to note here that the charcoal recovered from post-hole 207 is a product of manufacture in its own right and would have been produced in a small 'stack', covered with soil and allowed to burn in reducing conditions until the carbonisation process was completed (Hodges 1989).

5.3.3 Comparative species abundance at two nearby Prehistoric sites

Comparisons between the species abundance of hazel, birch and oak from Seafield West Area 1 (Cressey & Sheridan 2003) and Area 2 and the nearby Beechwood Farm burnt mounds and trough (Cressey & Strachan 2003) are provided in Table 8. The data from these three sites show that hazel was locally dominant within the Late Bronze Age and Iron Age. Hazel thrives on base-poor soils typical of the type found at Seafield West. Birch, a light-demanding pioneer, and oak are also trees that can thrive on fairly acid soil and both are a well-represented component of woodland throughout Scottish Prehistory.

5.4 Radiocarbon dating

Five single entity (AMS) charcoal samples (cf Ashmore 1999) and one bulk charcoal sample retrieved by wet sieving were submitted to the Scottish Universities Research Reactor Centre (SURRC) for radiocarbon dating. The charcoal consisted in all cases of non-abraded pieces within



Illus 15 Graph showing the distribution of calibrated radiocarbon dates

Table 9 Radiocarbon dating results

Lab no.	Feature	Material	Age BP uncal	Age range at 2 σ	δ 13 C (‰)
GU-8593 (AA-35528)	Pit 085 in Structure E (fill 086)	*Betula* sp. charcoal	2890 ± 50	cal 1260 BC–AD 920	–25.7
GU-8488 (AA-35532)	Structure G post-hole 111 (fill 113)	*Corylus avellana* charcoal	2060 ± 45	cal 200 BC–AD 50	–26.5
GU-8032	Hearth cache 125; upper fill of Structure G post-hole 207	*Corylus avellana* charcoal	2040 ± 50	cal 180 BC–AD 70	–26.4
GU-8491 (AA-35529)	Structure B1 post-hole 447 (fill 448)	*Corylus avellana* charcoal	2010 ± 50	cal 170 BC–AD 90	–28.2
GU-8489 (AA-35531)	Fill 351 in terminal of Structure B2 palisade trench	*Quercus* sp. charcoal	1965 ± 50	cal 110 BC–AD 140	–24.6
GU-8490 (AA-35530)	Structure B post-hole 417 (fill 419)	*Quercus* sp. charcoal	1930 ± 50	cal 50 BC–AD 220	–25.2

a sample size of *c* 3–4mm. Table 9 lists the results obtained from radiocarbon dating. The calibrated age ranges were determined using Oxcal ver 3.10 software and illus 15 shows their relative distribution against the radiocarbon calibration curve.

The radiocarbon date obtained from the same context as the sword mould places it firmly within the Late Bronze Age, and provides indirect evidence for possible occupation and metalworking activity of this period here.

The results from radiocarbon dating on charcoal recovered from the post-pipe within post-hole 111 that formed part of Structure G, and the charcoal fuel cache (125) which formed the upper fill of post-hole 207 fall within the same radiocarbon age range and overlap statistically. It is likely that both fills post-date the demolition of Structure G and are related to the use of the hearth associated with Structure H, placing the likely use of this structure somewhere between the 2nd century BC and the first century AD.

Statistically the three dates relating to Structure B are contemporary, although the possibility that there were two phases of structures on the same site means that they may be only broadly so. The dolphin-type brooch from the palisade trench is typologically of the 1st–2nd centuries AD, but this could date the end of use of the structure. No radiocarbon dates were obtained from Structure C, but the Roman headstud brooch found in the layer overlying the ring-ditch suggests that this layer and Structure B are likely to be broadly contemporary. Both brooches must have arrived at the site later than AD 70 (Section 4.3).