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FICHE 2: CONTENTS

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The charred plant remains *S Boardman*

Appendix I: Treatment of the samples from Carronbridge:

Bulk samples were processed using a standard water separation machine (Kenward *et al* 1980). The light fractions (flots) were collected in sieves with mesh sizes of 1 mm and 300 microns, and the heavy fractions (retents) in a 1 mm mesh.

The 1 mm flots were sorted in completion, by eye or using a low power light microscope. The quantity of remains did not warrant the sorting of the 300 micron flots. Smaller 1 mm retents were totally sorted, but many of the retents were very large and stony; in these cases a fraction of 1/8, 1/4 or 1/2 was picked (depending on retent size and richness).

In general, there were few macroplant remains in the retents. Most were unidentifiable fragments, or grains of cereal species already seen in the flot. In the case of partially sorted retents, however, it is possible that certain rare macroplant components were missed.

Species represented

Key to tables 1 - 4

All figures refer to seeds fruits, nuts and nutlets, unless otherwise stated. F = fragments (not included in the calculation of sample totals).

Sample descriptions and locations:

B1/2/3/4 - Building 1, 2, 3, 4; CREM - cremation; DCH - ditch; ENT - entrance area (enclosure 4); FILL - general fill or layer; FURN - furnace; GULL - gulley; HTH - hearth; ?NAT - probable natural; NTERM - fill of North terminus ditch; PD - Penannular ditch; PH - post-hole; PIT1/2/3 - Pit 1, 2, 3; PP - post pipe; PT - palisade trench; RG - ring groove; SCP - scoop; SF1/2/3 - Sunken feature 1, 2, 3; STERM - fill of South terminus ditch.

TABLE 1 **Bronze Age cremations and burials**

F NO LOCATION	3006 Burial	3016 Cist 2	2004 Crem	2003 Crem
Species				
Hordeum (grain) hull cf symmetric	1			
Avena sp			2	2
Gramineae undiff.		1		
Plantago lanceolata L.			1	
Rosaceae undiff.			1	
Indet, seeds	1		2	
Indet, tubers		12		
Quantifiable fragments Vol of soil (litres)	2 17	13 8	6 74	2 36

TABLE 2A **Enclosure A: Inner ditch & entrance area**

F NO LOCATION F TYPE	019 NTERM DCH	357 NTERM DCH	173 NTERM DCH	206 STERM DCH	167 STERM DCH	022 ENT HTH	036 ENT GULL	132 ENT PH	223 ENT PH
Species									
Hordeum (grain) hulled asymmetric	6	6+1F	1	1		3			
hulled symmetric	1	2	1	3					
hulled cf asymmetric			1	1					
hulled	2+1F	5		4		1	1		
+ syn. H. vulgare L.									
H. indet asymmetric	1			2			1		
indet symmetric	3								
indet grains	7+1F	4	1	4		1	1		
cf H so. (grain)	1								
Avena so.		1F			3		1	1	1
cf A so.							1		
Cerealia indet		3			2				
Atriplex so.					1				
Chenopodium albua type							2		
Chenopodium/Atriplex			1F		1				
Galium aoarine L						2			
Polygonum persicaria/apathifolium			1			8	1		
P so.							3		
Polygonaceae/Cyperaceae					2				
Runex cf acetosella					1				
Viola so.			1						
Indet									
Quantifiable fragments Vol of soil (litres		20 4	6 12	15 28	10 10	15 12	11 10	1 12	3 14

TABLE 2B Enclosure A: Building 1

F NO LOCATION F TYPE	067 B1 RG	502 B1 RG	178 B1 PH	243 B1 GULL	589 B1 GULL	561 B1 SCP	547 B1 PH	503 B1 PH	590 B?1 PH	594 B?1 PH
Species										
Hordeum (grain) hulled asymmetric*				1	5			1	1	1
hulled symmetric					5					
hulled cf symmetric										
hulled			1F	2+1F	10					
+ *syn H vulgare L*										
H indet grains			1	1	2				1	1+1F
Avena so.		1	1				1			
Cerealia indet	1		1	3+2F			1		1	1
Chenopodium album type						1				
Chenopodium/Atriplex					1					
Leontodon autumnalis L										1
Plantago lanceolata L			1						1	
Polygonum persicaria/lapathifolium	1							3		1
P so.									1	
Indet				1F					1	3+1F
Quantifiable fragments Vol of soil (litres)	2 14.5	1 10	4 17	7 8	23 10	1 5	2 6	4 12	6 6	8 3

TABLE 2C Enclosure A: Buildings 2, 3, 4 & 6

NO LOCATION F TYPE	051 B2 RG	050 B3 RG	344 B4 PH	348 B6 PD	064 B6 PD	066 B6 PD	146 B6 RG	156 B6 RG	353 B6 RG	052 ?B6 HTH	110 ?B6 HTH
Species											
Hordeum (grain) hulled asymmetric*		1					1			1	
hulled							1				
* syn H vulgare L											
H cf hulled asymmetric								3			
cf hulled	2										
indet asymmetric				3	1		4	2			
indet symmetric		2		1				2			
indet grains	4	2		1		1	6	10	1	1	
cf H so.							1				
Triticum/Hordeum				1							
Avena so.	1	1	4				3	4	1	2	3
cf A so.				1							
Cerealia indet	1							14	1+1F		
Chenopodium album type								1			
Chenopodium/Atriplex								1			
Galeopsis tetrahit L	1				1				4+2F		
Gallium aparine L											
G so.								1			
Polygonum persicaria/lapathifolium										2	
P so.				1	1		1				
Indet								1	4		1
Quantifiable fragments Vol of soil (litres)	9 11	6 17	4 10	8 5	3 13	1 10.5	17 14	39 9	11 8	6 10	4 14

TABLE 2D Enclosure A: Sunken feature 1

NO LOCATION F TYPE	610 SF1 FILL	611 SF1 FILL	602 SF1 FURN	580 SF1 FURN	577 SF1 FILL	554 SF1 PIT	564 SF1 PIT	571 SF1 PIT	550 SF1 FILL	599 SF1 FILL	514 SF1 FILL	516 SF1 FILL	551 SF1 FILL	598 SF1 FILL
Species														
Hordeum (grain) hulled asymmetric*	5	2	1	6	1	6				11	3	2		9
hulled symmetric	1	1				7				8		2		6
hulled cf asymmetric			1						7					
hulled cf symmetric		1		3					3	1				
hulled	4			2	2	6			2	3+1F				10
* syn H vulgare L														
H vulgare L *(rachis internode)*	1									2				
H cf hulled							1							
indet asymmetric								1					1	
indet grains	6	2		10+2F	2	16+2F			14	33		1	5+1F	12+2F
Triticum dicoccum Schubl		1												1
T dicoccum (rachis internode)		1								1				
T cf dicoccum														1
T sp										2				1
Avena so.		1				1				4				2
cf A sp.						1								
Cerealia indet	2					1F			3	4+4F			1+1F	
Chenopodium album type						1			2					
Galium sp.							1							
Plantago lanceolata L						1								
Polygonum aviculare type	1													
P cf hydropiper						2								
p convolvulus L										1				
P persicaria/lapathifolium	2	1		6		5				2	1			
P sp.	1								2	1				
Raphanus raphanistrum L (capsule segment						1								
Runex sp		1				1+1F				1				
Indet				2+2F		1			1					
Quantifiable fragments Vol of soil (litres)	23 8	11 8	2 18	29 12	5 6	49 10	2 14	1 6	34 10	74 6	4 5	5 8	8 8	42 6

TABLE 2E **Enclosure A: Sunken features 2 & 3**

F NO AREA F TYPE	546 SF2 PP	581 SF2 FILL	582 SF2 FILL	517 SF2 FILL	568 SF2 FILL	614 SF3 FILL	016 SF3 FILL
Species							
Hordeum (grain) hulled asymmetric *	1			22	4	1	2
hulled symmetric	1			12	2	1	1
hulled	1			12+1F	1	3	1
* syn. H vulgare L							
H cf. hulled					1		
indet asymmetric				3			
indet symmetric				2			
indet grains	1		1	10	2	1	6
Triticum sp.						1	
cf. T sp.				1			
Triticum/Hordeum							1
Avena so.	1	1					3
cf. A sp.				1			1
Cerealia indet				5+2F			4F
Chenopodium album type			1				
Polygonum convolvulus L			1				
P persicaria/lapathifolium					1		
P sp.				1			
Indet							1
Quantifiable fragments Vol of soil (litres)	5 8	1 7	3 6	69 7	11 9	7 4	16 7.5

TABLE 2F Enclosure A: Pits and post-holes

F NO LOCATION F TYPE	505 PIT1 FILL	596 PIT2 FILL	170 PIT3 FILL	171 PIT3 FILL	342 PIT3 FILL	343 PIT3 FILL	027 PIT3 FILL	101 PIT4 FILL	062 PH FILL	371 PH FILL	387 PH FILL
Species											
Hordeum (grain) hulled asymmetric *			4	10	37		6	6			
hulled symmetric		1	1	4	14			2		1	1
hulled cf. asymmetric					4					1	
hulled		2	2+1F	5	12		1				
* syn H vulgare L											
H cf. hulled cf asymmetric											1
cf. naked asymmetric							1	1			
indet asymmetric					9					1	
indet symmetric					3						
indet grains		2+2F	1	16	15		14+1F	7+1F			
cf. H sp. (grain)		1									
Triticum dicoccum Schubl				1							
T dicoccum (glume bases)					4						
T cf. dicoccum				1	4	1					
T dicoccum/soelta				1							
T cf. aestivum					2						
T sp.					4						
Triticum/Hordeum			1	3							
Avena so.		1			18			6	1		
Cerealia indet	1+1F	1+5F		3+1F			1+1F	1	1		
Carex so. (biconvex)				1							
Chenopodium album type	1			2			1	2	1		
Chenopodium/Atriplex					1						
Corvius avellana L (nutshell)	2F										
Galeposis tetrahit L	2										
Polygonum aviculare type	1										
P convolvulus L					1						
P persicaria/lapathifolium	4		1			1		2			
P sp.	2						1				
Prunus cf spinosa			1								
Rumex crispus/obtusifolius								1			
R sp.								2			
Indet								1			
Quantifiable fragments Vol of soil (litres)	11 11	8 8	9 31	49 12	130 4	2 10	25 62	31 14.5	3 8	3 6	2 5

TABLE 3 ENCLOSURE B: DITCHES AND POST-HOLES

F.NO. LOCATION	4539 DCH	4537 DCH	4527 DCH	4533 DCH	4567 DCH	4511 PH	4513 PH	4514 PH	4515 PH	4517 PH
Species										
Hordeum (grain) hulled asymmetric *	1					6+1F	155	72	29	
hulled symmetric							72	29	9	
hulled cf. symmetric						1			3	
hulled						1	26	22	4+4F	
+ syn H vulgare L										
H indet asymmetric								6	1	2
indet symmetric								1	1	
indet grains			1			3	20	32	6+1F	
Triticu dicoccu Schubl						1	169	44	8	
T dicoccu (glue bases)							4			
T cf. dicoccu							52	21	1	
T dicoccu/soelta							2	4		
T cf. aestivu						2	2			
T so.						1	21	5	1	
T so. (glue base)							1			
Avena sp.						IF	13	5	5+1F	
Cerealia indet		1			1		24	5+25F	10+11F	
Bromus secalinus/sollis							2			
Carex so. (biconvex)							1			
Chenopodium album type				1					2	2
Polygonus aviculare type									1	
P persicaria/lanathirolium	1						6			
Polygonaceae/Cyperaceae							1			
Rubus sp.				1						
Rubex sp.									1	
Indet			1		1	2	1		2	
Quantifiable fragments Vol. of soil (litres)	2 6	1 8	2 17	2 32	2 12	17 12	572 10	246 11	84 10	4 9

TABLE 4 ENCLOSURE C: DITCHES, PALISADE TRENCH, POST HOLES AND ROMAN OVEN

F.NO. LOCATION F.TYPE	4531 DCH LOWER	452 DCH MID	4016 DCH MID	4059 DCH MID	4079 DCH MID	4066 DCH ?NAT	4505 PH FILL	4053 PH FILL	4523 PT FILL	4561 PT FILL	4564 PT FILL	4565 PT FILL	4024 OVEN FILL
Species													
Hordeus (grain)													
hulled symmetric													1
cf. hulled									1				
indet. grains					1			1					
Triticum cf. aestivum L.					1								
Avena sp.					3	1	1	1	1	2	2	2	1
cf. A. sp.											1	1	
Cerealia indet. (grain)	1	2	1		1				1				
(cula node)				1									
Chenopodium album type		1				2	2				1		
Chenopodium/Atriplex				2				1	3				
Galeopsis tetrahit L.				1									
Galium cf. aparine L.					1								
P. convolvulus L.				1									
Rosaceae undiff.													1
Indet.					1+1F			2	1		1		
Quantifiable fragments Vol. of soil (litres)	1 7	3 7	1 6	5 7	8 49	3 10	3 10	3 11	7 12	3 8	4 12	3 12	3 10

Cereal plants are represented by grains and a few chaff fragments. The majority of grains were identified as hulled barley (*Hordeum* sp.), mainly with asymmetric dimensions. In six row barley (*H. vulgare* L.), asymmetric grains outnumber symmetric grains by 2:1. All identifiable barley rachis internodes also belonged to the six row species; but with so few chaff fragments, the presence of other species, (eg *H. distichon* L.) cannot be ruled out.

The main wheat species appears to be emmer (*Triticum dicoccum* Schubl.). There were several grains which resembled emmer and spelt (*T. emmer/spelta*), and a few grains of possible bread wheat (*T.* cf. *aestivum* s.l.). Many grains were not identifiable to species. The few glume bases were identified as emmer or possible emmer.

Oats (*Avena* sp.) are represented by grain only, so it is impossible to determine whether cultivated species (*A. sativa* L., *A. strigosa* Schreb.), or merely wild species (*A. fatua* L., *A. sterilis* L.) are present.

There was a narrow range of wild species. Most could have grown as weeds of crops or in disturbed places generally (eg *Polygonum*, *Chenopodium* and *Atriplex* spp., *Galeopsis tetrahit* L., *Galium aparine* L.). Some species are common today in damp, sometimes wet places (eg *Polygonum lapathifolium*, *P. hydropiper*, *Carex* spp.). Wild edible species were represented by a few hazel (*Corylus avellana* L.) nutshell fragments, a sloe (*Prunus spinosa* L.) stone and a single seed of raspberry/bramble (*Rubus* spp.).

Enclosure A (Tables 2A - 2F)

A number of buildings and other features are represented: the inner ditch, features in the entrance area, Buildings 1-6, Sunken Features 1-3, and various pits and post-holes. Most samples were dominated by hulled barley. In a few poorer samples, oat was dominant. Wheat, principally emmer, was present in samples from the inner ditch, Sunken Features 1 and 3, and Pit 3. The quantities were low in comparison to other cereals. One sample (F. No. 342) produced two grains of possible bread wheat.

Two thirds of the samples produced less than twenty components.

Only three had more than fifty remains. These came from Sunken Features 1 and 2 (F. Nos. 599, 517) and Pit 3 (F. No. 342) and were dominated by barley with few non cereal remains. Whilst samples from Enclosure A lacked straw (culm) nodes, chaff and weed seeds, most were too small to be considered full processed crop products. Some may have resulted from small scale activities, such as final crop cleaning or cooking accidents. However, the general spread and homogeneity of the samples is likely to reflect considerable post-depositional disturbance at the site.

Most wild species from the Enclosure A samples were very general weeds (see above). Wild radish (*Raphanus raphanistrum* L.) and sheep's sorrel (*Rumex acetosella* agg.) indicate more acid conditions. The latter is a possible component of heath vegetation. Autumn hawkbit (*Leontodon autumnalis* L.) is also found in meadows, pastures and on screes.

Enclosure B (Table 3)

Two main context types were represented: ditch fills and the post-holes for a structure just inside the north of the east entrance. The ditch fills produced a scatter of barley grains and weed seeds. In contrast, the post-holes (F. Nos. 4513, 4514, 4515) proved to be the richest samples from the entire excavation.

The main cereal was hulled six row barley, but there were large quantities of wheat grains (up to 47% of total cereals). The principal wheat species was emmer. There were a few occurrences of possible bread wheat and emmer/spelt, and indeterminate oat grains were also present. These may have been contaminants of the main crops. The appearance of some wheat grains may also reflect preservation conditions.

These samples had few chaff fragments and weed seeds, despite having many more cereals than samples elsewhere. Only rye-brome/lop-grass (*Bromus secalinus/mollis*) was not seen previously. These species tend to grow on light, dry soils. The composition of the samples from the post-holes is suggestive of fully cleaned, stored crop products.

Enclosure C (Table 4)

Features containing plant remains included an oven, the enclosure ditches, the palisade trench and a post-hole. The oven (F. No. 4024), thought to be associated with the Roman temporary camp (Enclosure B), produced single grains of barley and oats, and one poorly preserved weed seed (Rosaceae undiff.). The remaining samples were extremely poor in plant remains. The most frequent cereals were indeterminate barley and oats. Single finds of possible bread wheat (*T.* cf. *aestivum*) and a culm (straw) node came from the middle ditch fills. There was a similar, but smaller range of wild species to those seen in samples from the other enclosures.

The routine and special soil analyses *S Carter*

The routine soil analyses

Methods: All samples were subjected to three analyses, with the soil in a field-moist condition. pH was determined in a 1:2.5 soil-distilled water mixture. Loss on ignition used c 10 g oven dry soil ignited at 400°C for 4 hours. Phosphate was determined using a spot test for easily available phosphate (Hamond 1983). Samples were rated on a three point scale (Low, Medium, High; Hamond, 1983, 57), using the time taken for a blue colour to develop following the addition of the two reagents to the sample.
Results: The results have been analysed by excavation trench, and only summary trench data and exceptional samples are referred to here. Phosphate results are summarised in Table 5. Most samples gave high ratings, but there is a clear difference in the frequency of medium and low ratings between Enclosure A and Enclosures B and C. The five low and medium readings from Enclosure A are from fills of the main enclosure ditches.

Table 5: Summary of spot phosphate test results:

Enclosure A (subdivided by quadrants of the enclosure)				
	Quadrant	Low	Medium	High	Total
	SE	3	1	99	103
	NW				0
	NE		1	62	63
Enclosures B and C					
	C	5	10	23	38
	B/C	4	10	21	35
Unenclosed Area				4	4

Loss on ignition results are almost all in the range 2-8% and only twelve samples exceeded 10%. Of these, the nine from Enclosure A are from contexts noted in the field as charcoal- rich. The two samples from the unenclosed area are associated with a cremation burial, and one sample from Enclosure B was turf redeposited in the ditch. This was the only context on site which was rich in organic matter.

pH results were in the range 5.3 - 6.9. The mean value for Enclosure A was 6.4 and for enclosures B and C, 6.0.

Discussion: The results show broad differences between Enclosure A and Enclosures B and C. This reflects differences in the dominant types of context excavated. Most contexts in Enclosure A were fills of small features or spreads of sediment caused by human activity. In the other enclosures, most of the contexts were sterile ditch fills, and the occupations were apparently much briefer than that of Enclosure A. With one exception, elevated loss on ignition results were caused by the presence of charcoal; and they were concentrated in Enclosure A. Individual pH and phosphate results seemed to have no archaeological significance.

A micromorphological analysis of the lower ditch fills of Enclosure B, the 'Turf' *S Carter*

The stoneless, banded loams forming the lower fill of the ditch of Enclosure B contrast sharply with all other ditch fills on site, including those of the earlier Enclosure C ditch which was on the same line. They were interpreted in the field as turf in both Clarke and Websters' excavations in 1953/4 and in the present excavations. The sediments were sampled for thin sectioning to address the following questions:

i) Does this sediment represent turves?

ii) If it does, what condition were they deposited in?

iii) What was their original nature?

Four undisturbed soil blocks were collected, three from the east ditch (contexts 4533, 4540, 4568) and one from the titulus (4552). Thin sections, 8.5 cm in size, were prepared from these blocks by the Department of Environmental Science, University of Stirling and described using standard methods (Bullock *et al*, 1985).

The micromorphological analysis of soil thin sections provides a description in terms of basic mineral and organic components, the organisation of these components and the nature of features resulting from soil processes (pedofeatures).

The mineral components are similar in all four sections, with a coarse fraction of fine and medium sand grains and a silty fine fraction. The fine fraction consists of quartz and mica grains, with phytoliths and diatoms in variable quantities. Coarse sand and larger mineral fragments are absent, except for very rare rounded stones. The coarse fraction is 20-30% of most of the sections, indicating a texture of sandy silt loam to silt loam. Basic organic components are very variable through the sections, and include pollen grains, fungal spore cases, wood charcoal and fragments of plant tissue.

The organic material tends to be concentrated in bands, whilst the coarse mineral material is often clustered and occasionally banded. They are further organised into a soil structure which varies from massive with almost no voids, through a channel structure with channel-like voids, to a

complex crumb/granular structure with channels and common packing voids. Textural pedofeatures are represented by rare coatings of limpid clay on void walls in limited areas of two sections. Amorphous pedofeatures are more abundant, consisting of two types of ferruginous nodule or mottle: i) fragmented pseudomorphic nodules developed in plant tissue fragments; ii) orthic impregnative nodules. Excrement pedofeatures were abundant and section 4533 was dominated by invertebrate excrement, ranging from very small (<100 µm) ellipsoidal excrement to large (>5 mm) mamillated excrement.

The absence of mineral particles larger than medium sand, and the presence of a range of common organic components, indicates that the source of these sediments is the A horizon of a stable invertebrate-sorted soil. This supports the field interpretation of turf, but only one of the sections (4568) has a structure which can be interpreted as part of an intact turf. A 1.5 cm thick band (area 2 in this section) is dominated by diatoms and phytoliths with some silt-sized mineral grains. Many of the diatoms are complete pennate frustules with a preferred orientation parallel to the boundaries of the band. This narrow band is the soil surface, with phytoliths derived from the now decomposed vegetation. Similar bands have been noted on other archaeological buried soil surfaces (Romans and Robertson 1983, 66). The stratigraphy and nature of the banding in section 4568 suggest that the turf surface (area 2) is associated with area 1, the band above it, and therefore that this turf was upside down in the ditch.

The absence of intact turves in three of the four sections reflects soil processes which have affected the turf before and after deposition in the ditch. The relationships of the various pedofeatures to the soil structure allows the reconstruction of the sequence of events.

The most recent features are vertical channels left by roots which have penetrated from the modern soil surface. The roots have mainly been consumed by invertebrates, leaving clusters of excrement in the channels. The channels cut through areas of impregnative ferruginous mottles formed by the movement of iron in waterlogged conditions. These mottles impregnate areas of crumb/granular structure which consist of invertebrate

excrement, indicating a phase of mixing prior to waterlogging. Not all sections are affected by this mixing, and the one intact turf identified has a massive structure cut only by modern root channels. The size sorted structure of the sediment suggests that the turves originally had a crumb structure. The massive structure of the turf in 4568 is therefore the result of compaction or slaking after the turf was cut, and the crumb/granular structure in some sections is the result of invertebrate mixing after deposition in the ditch.

The fragmented ferruginous nodules in all four sections pre- date the invertebrate mixing, and are therefore not the result of the phase of waterlogging which created the impregnative nodules. These nodules are pseudomorphs of plant roots and stem fragments, so it is suggested that they formed in the vegetation buried in the turf bank. Waterlogged, reducing conditions which would promote their formation would have been easily established in this situation.

The survival of one intact fragment of turf shows that at least some turves entered the ditch as coherent clods. Sedimentary banding in 4533 and 4540 shows that there was also disaggregated soil present. Stratigraphic evidence suggests that the turf was intentionally deposited in the ditch in one operation. The presence of disaggregated soil could have resulted from the breakdown of turves in the bank or in the ditch immediately after their redeposition, during the initial stages of compaction.

The soil that the turves were cut from must have had an extensive fine root system, and was therefore under some form of grassland. All structure and pedofeatures of this soil have been destroyed by subsequent physical disruption and soil processes. There is no evidence for the size of the cut turves.

Records of soil profiles taken before excavation indicate that the modern soil had a B horizon in the area of Enclosure A but not around Enclosures B and C. This was confirmed in excavation, and the B horizon was shown to pre-date all features in Enclosure A. Horizon depths for a typical Yarrow Series soil (Bown & Heslop, 1979, 145) like that at Carronbridge have a 27 cm thick B horizon. It is possible that the absence of the B horizon is the result of turf stripping. This implies that in almost 2000 years of pedogenesis a

new A horizon has formed in the original B horizon, but no new B horizon has developed (except in limited areas with very soft sandy subsoil). This is possible if tree cover was never re-established. More detailed soil mapping is required to identify the precise limits of the area of soil currently lacking a B horizon.

Conclusions: The distinctive sediment in the base of the Enclosure B ditch is a mixture of turf and turf-derived soil. It was dumped into the ditch, presumably from an adjacent turf bank, in one episode. Iron mobilisation in waterlogged conditions has created abundant emorphous ferruginous pedofeatures, and this is the cause of the banding visible in the field rather than actual turf boundaries. Modern soil profile depths may indicate the source of the turves close to Enclosure B.

Catalogue descriptions of the urns *A MacSween*

Vessel 1: (CB 89 find Nos. 1, 2, 3, 14 Context 3004)
Collar and neck sections of a tripartite urn.
Internal diameter of rim: 280 mm.
Maximum diameter (at shoulder): 330 mm.
Thickness of walls: 10-15 mm.

The rim has a simple internal bevel decorated with diagonal impressions of twisted cord. At some points there is a second line of impressions, the two lines forming chevrons.

The collar is straight or very slightly concave. Below the collar the vessel narrows in diameter at the neck before expanding to form a sharply defined shoulder. The collar and neck are each decorated with four rows of twisted cord impressions, forming a herringbone pattern. These impressions are deeper and longer than those on the internal rim bevel.

The fabric is a fine sandy clay tempered with around 50% of rock and possible organic fragments up to 10 mm in length (see Thin Section Petrology, below). In section, the exterior is red- brown and the interior black, indicating that the pot was fired upside down. N-shaped coil junctions are visible on some of the sherd breaks, and it is probable that the exterior of the vessel was slipped.

Vessel 2: CB 89 find No. 68 Context 3014
Several rim and numerous body sherds, 15 mm thick. The rim sherds have an inverted profile, but too little remained to enable the diameter to be determined. The vessel was made from a fine micaceous clay tempered with 30% of angular rock fragments up to 10 mm in length, and was red on the exterior and grey on the interior, again indicating that it had been fired upside down.

Thin section petrology of the urns *D Dixon*

Vessel 1: Examination of both the smoothes slice and the thin section showed that the pottery contained two types of fragments: angular dull grey inclusions, and gold/tan coloured inclusions.

Petrographic examination showed the grey fragments to be moderately weathered basalt, composed of olivine (one phenocryst, the rest groundmass), pyroxene, plagioclase and magnetite. The larger fragments, up to 8 mm in length, tended to be fairly rectangular; the smaller ones were more irregular.

The gold/tan inclusions vary in size and shape from a large chunk (6 mm by 4 mm), to round and elongate fragments. All are bright gold in transmitted light and isotropic under crossed polars; they are therefore not crystalline. The varied shapes and shrinkage cracks are not consistent with volcanic glass. An organic origin seems probable.

The clay contains very infrequent, very fine grace particles - small particles of disintegrated basalt, and others which are almost certainly quartz (although it is not possible to distinguish optically between minute fragments of quartz and feldspar).

Vessel 2: The section and smoothed slice showed a very uniform brown clay with angular grey fragments (some with red specks), ranging from very coarse (up to 10 mm) down to medium grade (2 mm).

The temper fragments are all porphyritic olivine basalt. The red specks are olivine phenocrysts which have been almost entirely hydrothermically altered, during or after extrusion, to a deep red serpentine mineral (iddingsite). The pyroxene phenocrysts are represented by aggregates of chlorite-type minerals. The groundmass olivines and pyroxenes are quite fresh, with plagioclase laths and magnetite.

The smallest fragments of basalt and basaltic minerals in the section are less than 1 mm long, and there are also small quartz fragments. The clay appears to be the product of the decomposition of basalt; the ubiquitous quartz could be derived from under- or over-lying sandstone.

Conclusions: The Carronbridge urns were probably locally made. The most likely source of the basalt in the fabric is one of the flows in the 'Carron Basalt Formation', a series of early Permian basalts which covered the Thornhill Carboniferous Basin.

Longworth (1984, 81) noted that thin section analysis of collared urns usually indicates local sources for the raw materials; and that it is rare to find pairs of urns showing close similarities in form and decoration. He concluded that the tradition was a domestic one, rather than a specialised industry. The thin section results for Vessel 1 support this hypothesis.

The cremated bone *S Parker*

Introduction

Cremations 1 and 2 had both suffered plough damage, and this was reflected in the condition of the cremated bone. The bone from Cist 2, which had suffered the worst disturbance, was more heavily worn than that from Cist 1. The most heavily worn bone was found in Cremation 3, however, which had not been disturbed.

The white colour of most of the bone from all three burials indicated that they were burnt at a consistently high temperature; although some bones from Cist 1, notably from the pelvis and spine, were less well burnt.

Non-osseous inclusions were rare in all the cremations, although there was some stone and charcoal in Cist 1.

The bone fragments from Cist 1 were the largest, and those from Cremation 3 the smallest; this is reflected in the amount of physical anthropological data which could be recovered from them.

Cist 1

The bone was well fragmented, and the surfaces of the fractures were clean. Their appearance was consistent with deliberate crushing of the bone after it was burnt. Some bone had been distorted, particularly cranial fragments. The compact bone was generally better preserved than the trabecular bone.

The colour ranged from a highly calcined white, through light blue, dark blue, light grey, and dark grey to black. Some trabecular bone was unburnt. Some fragments, mostly from the limbs, had turquoise or blue spots; and one proximal phalange had a red-brown shiny deposit on its surface. Most of the bone was white; the darker colours tended to appear on the extremities, and the lower spine and pelvic fragments. The darker colours were graded through the thickness of the bone, lightest on the outside and darkest on the inside.

Minimum number of individuals

Cist 1 seems to have contained the remains of three individuals of different ages. The cremated remains of one adult are usually expected to weigh approximately 2 - 2.5 kg; the remains from Cist 1 weighed approximately 4.7 kg, which in itself indicates that more than one individual was present. The anterior articular surface of the first cervical vertebra was duplicated, and three superior borders of the orbit were recovered, indicating the presence of at least two individuals. This is confirmed by the presence of bones and teeth from an adult and from a small child. There were also some very immature bones suggesting the presence of a third individual, an even younger child.

Age

The presence of fully formed and immature teeth and bones testifies to the presence of both an adult and a child. The child's dentition indicates an age of between 3 and 12 years, but the curvature of the mandible suggests that the age is towards the lower end of this range. A very tiny rib, an unfused vertebral arch and other very small and immature bones indicate that the third individual was an infant or neonate.

Sex

The fragmentary nature of the bones and the age of two of the individuals prevented the determination of their sexes.

Pathology

Two ribs had damage at their sternal ends, likely to have been caused by an infection. One of them had a smooth- surfaced depression of the kind that occurs as a result of an abscess. Two fragments from a right second metatarsal were misaligned in a way which indicates that they had been broken and healed.

Cist 2

All the fragments from this cist had a chalky texture, and the fracture

surfaces were worn and rounded. On the whole, the condition of the bone suggested that they had been more exposed to the effects of unprotected interment than those from Cist 1. All the bone was white, with soil staining.

Minimum number of individuals

There was no duplication of bones, and there was only slight evidence for developmental differences. It therefore seems likely that there was only one individual in this cremation.

Age

A fragment of maxilla with the recess for an unerupted tooth, and a number of fragments showing the billowy surface associated with an unfused epiphysis, indicate that the remains are those of a juvenile. The fragmented nature of the bone prevents accurate ageing, but the individual cannot have been over 15 years old.

Sex

It was not possible to sex this individual.

Inclusions

There were three fragments of bone which did not appear to be human, but examination by F McCormick could not confirm the non-human identification (pers comm).

Cist 3

Most of the bone from this burial had a chalky texture and was very fragmented, with worn fracture surfaces. A small collection of bone was clean, with very clear fracture edges. This bone seemed unburnt.

The majority of the bone was white. The unburnt bone was light brown.

Minimum number of individuals

There was no evidence to suggest the presence of more than one individual.

Age, sex and pathology

No evidence survived

Catalogue description of the cremated bone

Cist 1: Context 3004

Total weight: 4709 g

Fragment size range: Dust - 115 mm

Average fragment size: 10-15 mm

Condition of the bone

Well fragmented, with clean fracture surfaces. Some distortion, especially cranial fragments. Compact bone better preserved than trabecular bone. Some trabecular bone was unburnt.

Colour

Ranging from a highly calcined white through light and dark blue, light grey, dark grey to black. Some turquoise or green/blue spotting, especially on limb bones. One proximal phalange had a red/brown shiny deposit.

Most of the bone was white. The darker colours appeared on extremities and pelvic girdle fragments, and were graded through the thickness of the bone, with white on the outside.

Skeletal elements present

Skull: Parts of the parietal, temporal, frontal and occipital bones. Parts of an external auditory meatus and the malleus ear bone. Some of the bone from the base of the skull, including the rim of the foramen magnum, the condyles for the atlas, and the petrous portion.

Facial bone present included remains of three orbits, a malar bone,

an anterior nasal spine, the palate and much of the maxillary region. Fragments of mandible included two mandibular condyles, parts of the ramus, the cronoid process and the body of the bone (this, like the maxillary fragments, showed traces of tooth sockets).

Dentition:

Maxilla	right	-----321	--34----	left
Mandible	right	-7------	---45-7	left

Over sixty fragments of tooth root (mainly from molars). All the fragments which could be replaced were from a sub-adult, but included both permanent and milk teeth. None of the teeth retained enamel. They ranged in colour from white to blue/black. All the tooth roots were very friable.

Vertebrae: Mainly vertebral arches and articular surfaces. Cervical, thoracic, lumbar and sacral regions all represented, including: left and right portions of the first cervical, the dens of a second cervical and two fragments of atlas (each with the articular surface for the dens of the axis or second cervical). Several thoracic spinous processes, one of which had an unfused surface at its tip. Part of the sacro-iliac articulation (the alar), and a complete first sacral segment. Two pieces of an immature vertebral arch.

Scapulae: Part of the inferior border, some of the acromial spine and most of the surface of a glenoid cavity.

Clavicles: The clavicle readily becomes unidentifiable in the mass of tubular fragments found in cremations. However, two large fragments were identified as the sternal end of an unsided clavicle and the acromial or lateral part of a right clavicle.

Manubrium and Sternum: Many fragments of unidentifiable trabecular bone were recovered, some of which could be from these bones. An almost complete immature manubrium and parts of an adult sternum were

recovered.

Ribs: A right hand first rib. Several rib heads and tubercles. One very small, complete immature rib. Many fragments thought to be from ribs, including some fragments of very small ribs.

Humeri: The identification of humerus shaft fragments is problematic, especially in multiple cremations with individuals of different ages. Only distal ends or shaft fragments with distinguishing features have therefore been counted.

The trumpet brooch *L Allason-Jones*

Catalogue

Total length: 56 mm; width across head: 18.5 mm; length of catchplate turnover: 9 mm; diameter of foot: 8 mm.

Description

(CB 89 find No. 67, context 394)

Copper alloy trumpet brooch (illus 23) with traces of white metal coating on the catchplate and head. A short stop projects from the top of the head, but there is no sign of a headloop. The head is decorated with a design of two abutting circles on both flanks of the upper bow. The motifs have been heavily stamped so that the centres stand proud like bosses. A single shallow depressed line encompasses both groups of motifs. The upper bow drops through a sharp right angle and encroaches on the head by means of converging rib-and-groove motifs. The ring-and-boss motifs are stamped in a row below the knee, with two incised lines forming a triangle above. The total effect is zoomorphic.

Below the knee there are three projecting ribs, the central one of which predominates. Each curved rib is divided by two transverse grooves, but continues across the back as a single shallow ridge. The lower bow is of tapering triangular section and is divided into two vertical registers by a raised border, each register containing a raised wavy line which falls to fill the available space. The bow ends in a transverse rib which runs around the back below the catchplate. The foot is splayed and fluted, and ends in a countersunk boss.

The brooch was cast in one with the decoration below the knee. The circles or bosses, however, give the impression of having been stamped later, while the metal was still malleable (possibly during a secondary heating). Analysis of the surface plating has indicated a lead/tin coating with traces of silver, iron, antimony, and manganese. Insufficient silver was present to suggest silver plating, nor were traces of silver wire found between the central ribs. The presence of lead/tin alloy on the catchplate

suggests that it was not confined to limited areas as a decorative feature, but covered the whole surface of the brooch. No trace of enamelling was noted.

The penannular brooch, sword and sickle *O Owen and R Welander*

Catalogue

1. Silver-gilt penannular brooch
   'Pictish', late 8th to early 9th century AD
   Hoop diameter: 5.8 cm
   Pin length: 11.1 cm
2. Wrought iron two-edged sword blade fragment with remnant scabbard; in eight joining fragments.
   'Dark Age', late 9th to early 10th century AD
   Overall length (reconstructed): 740 mm
   Maximum width: 57 mm
   Maximum thickness: 10 mm
3. Wrought iron sickle blade in three joining fragments
   'Dark Age', late 9th to early 10th century AD
   Overall length (reconstructed): 120 mm
   Maximum width: 20 mm (approx)

Copper alloy and iron objects *B A Ford*

Copper alloy

1. Perforated sheet fragment, possibly part of a disc or decorative fitting, perforated in the centre (for a rivet hole?). Diameter of hole 5 mm. Thickness of sheet 0.5 mm.
CB 90 find No. 6, context 550 (fill of a pit in south-west corner of Sunken Feature A).

2. Four fragments of a tube made from a rolled sheet, tapering to one end. Probably part of a tag from the end of a lace. Thickness 0.5 m.
CB 90 find No. 49, context 145 (topsoil)

Objects of iron

1. Incomplete, very corroded cast iron plate, triangular in cross-section, with a raised edge. A very corroded circular projection, which was originally hollow, extends from the corner and is probably part of a hinge. Length 49 mm.
CB 90 find No. 4, context 545

2. Two badly corroded fragments from the arm of a very small horseshoe, with two rectangular nail holes. Length 52 mm, width 12 mm.
CB 89 find No. 43, context 84

3. Knife blade. Triangular blade tip missing; incomplete whittle tang set centrally to the blade. Length 210 mm, max. width 22 mm, thickness of blade back 12 mm, length of tang 40 mm.
CB 89 find No. 34, context 36

4. Three very corroded fragments of a triangular blade. Length 68 mm, width 20 mm, thickness of blade back 6 mm.
CB 89 find No. 38, unstratified

5. Nail with square flat head and a rectangular cross-section. Length 37 mm.
CB 89 find No. 47, context 36

6. Sickle with a narrow blade curving from the tang and straightening out towards the tip, which is missing. The tang is incomplete. The x-radiograph shows evidence that the cutting edge was originally finely serrated. Length of blade 458 mm, length of tang 73 mm.
CB 89 find No. 44, context 84

7. Three fragments of very corroded iron sheet. Thickness 2 mm.
CB 89 find No. 60, context 206

8. V-shaped staple; the tips of both arms are broken. Length 66 mm, width 44 mm.
CB 89 find No. 48, context 84

9. Very corroded washer. Diameter 27 mm, diameter of hole 9 mm, thickness 4 mm.
CB 90 find No. 38, unstratified.

The glass *J Henderson*

1. Globular 'black' (deep translucent purple) bead.
CB 89 find No. 27, context 3001, topsoil (near Cists 1 and 2).

2. Annular translucent bottle green glass bead.
CB 89 find No. 16, context 1001, topsoil (in north-west quadrant of Enclosure A).

3. Fragment of opaque white glass armlet.
CB 89 find No. 62, context 0170, pit fill (pit 3, Enc. A).

4. Translucent olive green vessel fragment.
CB 89 find No. 27, context 3001, topsoil (near Cists 1 and 2).

5. Weathered globular translucent brown bead.
CB 90, context 4527, (Temporary camp ditch).

6. Fragment of a 'faience' melon bead with gadrooned decoration on its exterior surface. The bead has a turquoise glazed surface and a silica-rich core.
CB 89 find No. 40, context 16 (top fill of Sunken Feature 3, Enclosure A).

Analytical techniques

The compositions of objects 1-3 were analysed. Samples were mounted in epoxy resin and polished. A Cambridge Microscan 9 electron microprobe was used to produce quantitative analyses for all major, minor, and trace elements detectable in the glass. A ZAF program was used to correct and quantify the results. Typical levels of detection are given in the table. The analytical technique is described more fully elsewhere (Henderson 1988).

The glass technology

Compositions 2 and 3 are basically soda-lime-silica glasses, with the typical levels of major and minor components normally found in Roman glass in Britain of the 1st to 3rd centuries AD. The alkali source used was probably a mineral such as natron, which would introduce c 1% chlorine (C_1); and the sand used would probably have introduced the aluminium and titanium oxides (Al_2O_3 and TiO_2). The green colour of composition No. 2 results from manganese and iron oxides, in this case present in the ratio of 1:1, which is typical of Roman glasses. The armlet fragment (No. 3) also contained manganese and iron oxides in a ratio of 1:1. However, in this case the 0.7% antimony oxide (Sb_2O_3) strongly suggests that the glass is opacified with crystals of calcium antimonate ($Ca_2Sb_2O_7$), although gas bubbles are also sometimes found to opacify such glass.

The composition of No. 1, a deep purple glass, is very unusual. The main feature is its mixed-alkali composition (soda Na_2O and potassium oxide K_2O), with a significantly lower chlorine level than found in compositions 2 and 3. The silica (SiO_2) level is also low, probably because the total alkali is high, but also because the manganese oxide (MnO) level of 6.6% is exceptionally high for a purple glass. It is unlikely that the production process used was intended to produce a visibly purple glass.

Artefact No. 4 was from a post-medieval wine bottle, and was not analysed. No. 1 may be of the same period.

The coarse stone *A Clarke*

1. Regular sub-spherical object of sandstone. Pecked all over to shape. Sandstone ball. 68 mm x 61 mm x 60 mm.
CB 89 find No. 12, context 0001 (topsoil, Enclosure A)

2. Large irregular boulder of sandstone with a steep-sided, round-based hollow worked in one face. Probable pivot-stone. 420 mm x 290 mm x 230 mm. Hollow c 80 mm diameter, 50 mm deep.
CB 90 find No. 3, context 0545 (upper fill of inner ditch, Enclosure A)

3. Fragment of a sandstone ball, probably burnt. Spherical, pecked all over to shape. Diameter c 40 mm.
CB 89 find No. 32, context 1001 (topsoil, Enclosure A)

4. Pebble whetstone of fine-grained sandstone. Sub-rectangular cross-section. One face is concave, and lightly pecked with possible remnants of a polish. 115 mm x 36 mm x 27 mm.
CB 89 find No. 31, context 1001 (topsoil, Enclosure A)

5. Small thin pebble of siltstone. About a dozen small neat notches have been worked down one side, forming a round-toothed edge. 51 mm x 29 mm x 4 mm.
CB 90 find No. 1, context 4500 (topsoil, inside Enclosure B)

6. Fragment of vesicular lava. Naturally worn on unbroken outer face. No measurements.
CB 90 find No. 5, unstratified (Enclosure B area)

The vitreous waste *E Slater*

1. 4 main pieces, 6 small pieces. Baked and heated clay. No vitrification, but a degree of porosity and fusion. 3 pieces with a high iron oxide content, mainly Fe203, and some complex iron silicates. Could be classed as slag.
CB 89 find No. 39, context 016 (Sunken Feature 3, top fill)

2. 2 pieces. 1 iron object, 1 piece of iron concretion.
CB 90 find No. 8, context 516 (clean gravel over top fill of Sunken Feature 1)

3. 8 pieces. i. 6 pieces red/orange baked or f ed clay, largest 20 x 20 x 16 mm. Heated in oxidising atmosphere. Fine- grained lamellar structure. 2 pieces have original, concave surface; max. thickness 16 mm.
ii. 2 pieces extensively heated on one surface under reducing conditions. The heated surface is black/grey, with a degree of porosity, and grades through to a red/orange in the interior. Coarser-grained, without lamellar structure.
CB 90 find No. 15, context 517 (black charcoal deposit, Sunken Feature 2)

4. 3 pieces, largest 40 x 30 x 15 mm. Fine-grained clay, very similar to 3i above. 2 pieces with a smooth original surface, flat or marginally concave.
CB 90 find No. 16, context 516

5. Originally 1 piece, 50 x 25 x 20 mm. Cinder.
Cb 90 find No. 13, Context 517

6. 2 pieces. i. Red/orange clay, 40 x 25 x 15 mm. Lamellar structure, with visible layering. There is a particularly thin layer on the original outer surface. This surface is smooth, mainly flat, but with some undulations.
ii. Clay, 35 x 30 x 10 mm, with a convex original surface. Heated on this surface, forming a thin vitreous layer 2 mm deep. No metalliferous or slag phases identified by XRD. Interior: red/orange clay grading to dark grey below the vitrified layer.

CB 90 find No. 10, context 550 (top fill of Sunken Feature 1, north-east corner)

7. 9 main pieces. i. 5 pieces of baked clay with red/orange inner surfaces grading to grey outer surfaces; the material was heated on the outer surfaces under reducing conditions. Max. dimensions 90 x 55 x 20 mm. The outer surfaces are porous; three show some vitrification. In four cases the heated outer face is original, and in all it is convex. No metalliferous or slag phases identified by XRD. All examined under x 80 optical microscope, and two under electron microscope.

These are structural ceramics heated on one face. If these had formed part of a furnace lining, the heated face would be concave rather than convex, and slag phases should be present.

ii. 2 pieces of fused lithics.

iii. 2 pieces baked and heated clay, similar to No. 1.

CB 90 find No. 11, context 550

Material found in topsoil:

8. 4 pieces heated lithics, some partly vitrified. One piece more likely to be heated naturally than anthropogenically.
CB 89 find Nos. 4, 6, 9

9. 2 pieces of cinder.
CB 89 find Nos. 30, 33

10. Originally one piece, 60 x 30 x 20 mm. Baked clay with black, reduced exterior and red, oxidised interior. Central void, possibly from burnt-out organic material.
CB 89 find No. 17

Vitreous waste: analytical methods

This is an assemblage of heat-modified materials, originally interpreted in the field as furnace debris and slag. Three main types of material are actually represented - fine-grained clays, coarser clays showing a greater depth of burning, and lithics. Nearly all the samples have been heated, with the heating directed mainly at one face. The samples were first examined visually and by optical microscopy at x 10 and x 80. The main areas of interest for the clays were the nature of the material, its texture, any secondary phases, degree of porosity and any vitrification. If a full, interior cross-section was not visible the piece was either broken in half or a small sample removed from one edge. Samples were taken from one face for X-ray diffraction, to identify any diagnostic phases such as fayalite 2(Fe, Mg, Mn)O.SiO2; pyroxenes (Fe, Zn, Mg, Mn)O.CaO.SiO2; or metal oxides. These are normally major constituents of man-made slags (Bachmann 1982). The surface sampled was the heated face, if one was present. Some samples were also examined by electron microscope to investigate the degree of vitrifaction or porosity.

Radiocarbon dates *M Dalland*

Calibration:

The dates were calibrated using data from Pearson *et al* (1986), producing a calibrated probability distribution (PD) for each date. The PD curves of the dates are shown in illus 24. The lines below each PD curve mark the short (SCR) and long continuous range (LCR). These are the shortest continuous ranges for which the probability of the date to lie within their limits adds up to ≥ 68.26% and ≥ 95.45%. These values are equal to the probabilities of the one and two sigma ranges of a Normal distribution. Table 7 shows the SCR and LCR of all calibrated dates from Carronbridge.

Adjusting the PD's of dates using stratigraphic data:

The true age of material from stratigraphically related samples must reflect their stratigraphic position, to the extent that a context must pre-date a stratigraphically later one even if their radiocarbon date ranges overlap. This enables the PDs of radiocarbon dates from such contexts to be adjusted to take account of their stratigraphic position in relation to other dated samples. The effects vary according to the degree of overlap of the PDs between the dates involved, and if a date lies between other dates. On this assumption, five dates were adjusted for stratigraphy. Table 8 shows the SCR and LCR of these dates before and after adjustment. In illus 24 the unadjusted PD of these five dates have been replaced by the adjusted PDs.

The stratigraphic adjustment only makes small changes to the SCR and LCR ranges of the dates (table 8). In one, the SCR and LCR remain the same with only a slight change in the probability of the date to lie within these limits; the other adjusted dates show minor reductions in their SCR and LCR. The date most affected by the adjustment is GU-2770 (from the primary fill of Enclosure A inner ditch). The SCR changed from BC 10 - AD 110 to the BC 35 - AD 75, a shift *circa* 30 years back in time, with the range reduced from 120 to 110 years (8%). The LCR changed from BC 105 - AD 135 to BC 85 - AD 110, a shift back in time of *circa* 25 years and a reduction of the range from 240 to 195 years (19%).

Difference between dates:

Using the PDs of two dates, one can calculate the PD of the age difference between two dates. Table 9 shows the SCR and LCR of the difference PDs of three pairs of dates. Table 10 shows the data behind these calculations at 50 and 100 years resolutions.

Using data from the difference PDs, one can evaluate the probability of a date being older or younger than other dates. The probabilities quoted below are based on the data in Table 10.

Hypothesis:	Probability:
GU-2767 is older than GU-2776 (Sunken Feature 1) (Building 1)	97.0%
GU-2766 is older than GU-2776 (Sunken Feature 2)	97.0%
GU-2771 is older than GU-2776 (Pit 5, cutting inner ditch)	95.2%

The probability that all three hypotheses above are true is calculated by multiplying the probabilities of each of the three hypotheses: 0.97*0.97*0.952 = 0.896 = 89.6%.

TABLE 6 UNCALIBRATED DATES

LAB.NO:	Context:	(BP):	± e:	Comments:
GU-2764	C 22	1820	50	Charcoal spread, enclosure.
GU-2765	C 580	1990	50	Pit, sunken feature 1.
GU-2766	C 517	1900	50	Sunken feature 2.
GU-2767	C 555	1910	60	Pit, sunken feature.
GU-2768	C 589	1930	60	Structure, enclosure A, phase.
GU-2769	C 624	2020	50	Sunken feature 3.
GU-2770	C 357	1970	50	Inner ditch, primary fill.
GU-2771	C 206	1880	50	Inner ditch, secondary pit.
GU-2772	C 52	1910	50	Hearth 1, building 6.
GU-2773	C 65	1860	50	Hearth 2, building 6.
GU-2774	C 101	2290	50	Pit 4.
GU-2775	C 504	2410	70	Pit 1.
GU-2776	C 120	1740	50	Building 1.
GU-2777	C 348	2920	50	Penannular ditch.
GU-2778	C 2003	2920	50	Cremation burial 3.
GU-2779	C 3004	6990	200	Burial 1 (Not calibrated).
GU-2780	C 3016	2950	50	Burial 2.
GU-2781	C 4029	1870	50	Oven, enclosure C.
GU-2932	C 354	1920	50	Building 6.
GU-2933	C 27	2600	50	Pit 3.

TABLE 7 CALIBRATED RADIOCARBON DATES

Sample:	BP:	S C R: Range:	Prob: %	L C R: Range:	Prob: %
GU-2764	1820q50 BP	AD 125 - AD 240	70.15	AD 85 - AD 325	95.95
GU-2765	1990q50 BP	BC 40 - AD 85	68.54	BC 105 - AD 120	95.54
GU-2766	1900q50 BP	AD 80 - AD 195	68.60	AD 0 - AD 230	95.70
GU-2767	1910q60 BP	AD 55 - AD 200	69.09	BC 25 - AD 235	95.49
GU-2768	1930q60 BP	BC 10 - AD 125	69.20	BC 55 - AD 215	95.64
	Adjusted	AD 0 - AD 130	68.98	BC 55 - AD 210	95.65
GU-2769	2020q50 BP	BC 95 - AD 35	68.88	BC 145 - AD 115	95.87
GU-2770	1970q50 BP	BC 10 - AD 110	68.43	BC 105 - AD 135	95.55
	Adjusted	BC 35 - AD 75	69.73	BC 85 - AD 110	95.67
GU-2771	1880q50 BP	AD 85 - AD 195	70.24	AD 25 - AD 240	95.68
	Adjusted	AD 90 - AD 195	70.36	AD 30 - AD 235	96.08
GU-2772	1910q50 BP	AD 20 - AD 140	68.81	BC 20 - AD 210	95.76
GU-2773	1860q50 BP	AD 90 - AD 200	69 96	AD 25 - AD 245	95.56
GU-2774	2290q50 BP	BC 460 - BC 375	69.39	BC 480 - BC 230	95.64
GU-2775	2410q70 BP	BC 570 - BC 380	68.58	BC 800 - BC 385	96.28
GU-2776	1740q50 BP	AD 210 - AD 355	68.30	AD 140 - AD 415	95.49
	Adjusted	AD 210 - AD 355	69.33	AD 140 - AD 415	95.81
GU-2777	2920q50 BP	BC 1220 - BC 1030	68.99	BC 1285 - BC 930	95.80
GU-2778	2920q50 BP	BC 1220 - BC 1030	68.99	BC 1285 - BC 930	95.80
GU-2780	2950q50 BP	BC 1295 - BC 1115	68.61	BC 1380 - BC 1020	95.48
GU-2781	1870q59 BP	AD 90 - AD 200	70.65	AD 25 - AD 240	95.75
GU-2932	1920q50 BP	AD 20 - AD 130	68.98	BC 25 - AD 205	95.76
GU-2932	Adjusted	AD 30 - AD 130	68.56	AD 10 - AD 210	95.49
GU-2933	2600q50 BP	BC 830 - BC 790	72.80	BC 850 - BC 570	95.56

TABLE 8 THE EFFECT OF STRATIGRAPHICAL ADJUSTMENT OF CALIBRATED DATES

DATE:	ADJUSTED FOR:	S C R: RANGE	PROB:	L C R: RANGE:	PROB:
GU-2776	GU-2768 > GU-2776	AD 210 - AD 355	69.33	AD 140 - AD 415	95.81
GU-2776	UNADJUSTED	AD 210 - AD 355	68.30	AD 140 - AD 415	95.49
GU-2771	GU-2770 > GU-2932 & GU-2771	AD 90 - AD 195	70.36	AD 30 - AD 235	96.08
GU-2771	UNADJUSTED	AD 85 - AD 195	70.24	AD 25 - AD 240	95.68
GU-2932	GU-2770 > GU-2932 & GU-2771	AD 30 - AD 130	68.56	AD 10 - AD 210	95.49
GU-2932	UNADJUSTED	AD 20 - AD 130	68.98	BC 25 - AD 205	95.76
GU-2768	GU-2768 > GU-2776	AD 0 - AD 130	68.98	BC 55 - AD 210	95.65
GU-2768	UNADJUSTED	BC 10 - AD 125	69.20	BC 55 - AD 215	95.64
GU-2770	GU-2770 > GU-2932 & GU-2771	BC 35 - AD 75	69.73	BC 85 - AD 110	95.67
GU-2770	UNADJUSTED	BC 10 - AD 110	68.43	BC 105 - AD 135	95.55

TABLE 9 DIFFERENCE BETWEEN DATES

DIFFERENCE BETWEEN:	RANGE:	PROB:	RANGE:	PROB:
GU-2771 1880q50 BP, and GU-2776 1740q50 BP	40 - 235	69.40	-45 - 330	95.90
GU-2766 1900q50 BP, and SU-2778 1740q50 BP	85 - 275	68.29	-10 - 360	95.53
GU-2767 1910q60 BP, and GU-2776 1740q50 BP	90 - 295	69.33	-15 - 390	95.89

TABLE 10 SUMMARY OF PROBABILITY DISTRIBUTIONS BETWEEN DATES

50 YEARS INTERVAL

DIFFERENCE:	C 555 older than C 120 (GU-2767 - GU-2776) >:		<:	D 517 older than C 120 (GU-2766 - GU-2776) >:		<:	C 206 older than C 120 (GU-2771 - GU-2776) >:		<:	DIFFERENCE:
800										800
750	0.0	100.0	.0							750
700	.0	100.0	.0	0.0	100.0	.0				700
650	.0	100.0	.0	.0	100.0	.0	0.0	100.0	.0	650
600	.0	100.0	.0	.0	100.0	.0	.0	100.0	.0	600
550	.0	100.0	.0	.0	100.0	.0	.0	100.0	.0	550
500	.0	100.0	.0	.0	100.0	.0	.0	100.0	.0	500
450	.2	97.7	.3	.1	99.9	.1	.0	100.0	.0	450
400	1.1	98.6	1.4	.5	99.5	.5	.2	98.8	.2	400
350	3.3	95.3	4.7	2.1	97.4	2.6	1.1	98.7	1.3	350
300	7.8	87.5	12.5	6.2	91.3	8.7	4.1	94.6	5.4	300
250	13.7	73.8	26.2	12.6	78.7	21.3	9.9	84.7	15.3	250
200	18.3	55.6	44.4	18.3	60.4	39.6	16.2	68.4	31.6	200
150	18.8	36.7	63.3	19.9	40.4	59.6	19.8	48.6	51.4	150
100	17.3	19.4	80.6	19.4	21.1	78.9	20.9	27.7	72.3	100
50	10.0	9.4	90.6	11.0	10.1	89.9	13.6	14.0	86.0	50
0	6.4	3.0	97.0	7.1	3.0	97.0	9.2	4.8	95.2	0
-50	2.1	.9	99.1	2.2	.8	99.2	3.3	1.5	98.5	-50
-100	.8	.1	99.9	.7	.1	99.9	1.3	.2	99.8	-100
-150	.1	.0	100.0	.0	.0	100.0	.1	.1	99.9	-150
-200	.0	.0	100.0	.0	.0	100.0	.1	.0	100.0	-200
-250	.0	.0	100.0	.0	.0	100.0	.0	.0	100.0	-250
-300	.0	.0	100.0	.0	.0	100.0	.0	.0	100.0	-300
-350	.0	.0	100.0	.0	.0	100.0	.0	.0	100.0	-350
-400	.0	.0	100.0				.0	.0	100.0	-400

100 YEARS INTERVAL

DIFFERENCE:	C 555 older than C 120 (GU-2767 - GU-2776) >:		<:	D 517 older than C 120 (GU-2766 - GU-2776) >:		<:	C 206 older than C 120 (GU-2771 - GU-2776) >:		<:	DIFFERENCE:
800	0.0	100.0	.0							800
700	.0	100.0	.0	0.0	100.0	.0	0.0	100.0	.0	700
600	.0	100.0	.0	.0	100.0	.0	.0	100.0	.0	600
500	.0	100.0	.0	.0	100.0	.0	.0	100.0	.0	500
400	1.3	98.6	1.4	.5	99.5	.5	.2	99.8	.2	400
300	11.2	87.5	12.5	8.2	91.3	8.7	5.2	94.6	5.4	300
200	31.9	55.6	44.4	30.9	60.4	39.6	26.2	68.4	31.6	200
100	36.2	19.4	80.6	39.3	21.1	78.9	40.8	27.7	72.3	100
0	16.3	3.0	97.0	18.1	3.0	97.0	22.8	4.8	93.2	0
-100	2.9	.1	99.9	3.0	.1	99.9	4.6	.2	99.8	-100
-200	.1	.0	100.0	.1	.0	100.0	.2	.0	100.0	-200
-300	.0	.0	100.0	.0	.0	100.0	.0	.0	100.0	-300
-400	.0	.0	100.0	.0	.0	100.0	.0	.0	100.0	-400
-500	.0	.0	100.0				.0	.0	100.0	-500