APPENDIX 5: CHARRED PLANT REMAINS AND CHARCOAL FROM CINDER HILL, CUTACRE

Denise Druce

Following the assessment of some 33 bulk samples taken during the open-area excavations, five samples from Cutacre were selected for analysis of charred plant remains (CPR), and these and a further eight were selected for charcoal analysis. Eight of the samples came from the Bronze Age settlement at Cinder Hill (Site 42S; *Ch 2*, *p 25*), whilst the remaining five came from several features associated with the medieval iron-working site, also at Cinder Hill (Site 42N; *Ch 3*, *p 44*).

These analyses were a very high priority for study, given the limited palaeobotanical data currently available from prehistoric and medieval sites in the North West (*cf* Hall and Huntley 2007; Huntley 2010a). In the latter instance, although a project focusing on the nature of fuel use in medieval charcoal production and iron industries had been carried out in the Lake District (*cf* Huntley 2010a), prior to the current work, information relating to fuel use was lacking for any medieval metalworking site in the southern part of the North West region (*ibid*). The analysis follows recommendations made in the medieval period agenda and strategy for the *Regional Archaeological Research Framework for the North West*, which notes that studies should be directed towards medieval iron-working sites in Greater Manchester (Newman and Newman 2007, 110).

Charred Plant Remains from the Cinder Hill Bronze Age Settlement

Methodology

Of the five samples selected for analysis from the Bronze Age settlement, two were derived from postholes (***555*** and ***836***) forming elements of the primary four-post structure (*Ch 2*, *p 29*), whilst a single sample came from a posthole (***553***) forming part of the adjacent fence/windbreak (*Ch 2*, *p 30*). The remaining samples were derived from the roundhouse, specifically from a posthole (***828***) forming an element of its post-ring, and a sample from its drip-gully (*Ch 2*, *p 28*).

Between 10 litres and 40 litres of each sample was processed, either by hand flotation or using a modified Siraf-type flotation machine. The resulting flots were collected onto a 250 μm mesh and air-dried. The residue was also dried and checked for any residual organic material and finds. The flots were examined with a Leica MZ6 binocular microscope, and any charred plant remains were extracted, identified where possible, counted, or quantified. Other material, such as charcoal, bone fragments, ceramic building material (CBM), and metal waste, was also quantified, using a scale of one to four, where one represents less than five items and four more than 100 items. Identification was aided by comparison with the modern reference collection held at OA North, and with reference to the *Digital Seed Atlas of the Netherlands* (Cappers *et al* 2006). Nomenclature follows Stace (2010).

Results

The three samples from the primary four-post structure and adjacent fence/windbreak all contained common to abundant cereal grains (Table 24). Although a high proportion, especially from ***554*** (posthole ***555***), were too distorted to identify with any confidence, the better-preserved comprised barley (*Hordeum* sp), including the naked variety *Hordeum vulgare* var *nudum*; the latter can be recognised by their rounded profile, blunt apex, and the distinct wavy cross-rippling on their surface (Jacomet 2006). The presence of a number of 'twisted' grains indicates that a many-rowed (probably six-row) variety (*Hordeum vulgare* L) was also under cultivation (*ibid*). Posthole ***553***, from the fence/windbreak, and posthole ***555***, from the four-post structure, also contained rare/frequent wheat (*Triticum* sp) grains. Their poor preservation, combined with a lack of wheat chaff (the diagnostic part of the cereal plant), means, however, that the wheat could not be identified to type.

The samples were more-or-less devoid of cereal chaff and seeds/fruits of crop weeds, which often accompany cereal-processing waste. It is likely, therefore, that the cereals represent a fully processed crop. Of note, though, were the enlarged embryo

Context No				***554***	***834***	***552***	***820***	***843***
Sample No				79	81	86	106	111
Feature				Fill of posthole ***555***; part of the primary four-post structure	Fill of post-pipe ***849*** in posthole ***836***; part of the primary four-post structure	Fill of posthole ***553***; part of fence/ windbreak	Fill of drip-gully ***970***	Fill of post-pipe ***842*** in posthole ***828***; part of roundhouse post-ring
Group No				880	880	880		
Sample Size L				10	10	4	10	10
Flot size				1200	900	140	550	350
Notes				Many of the barley grains had enlarged embryo ends, with or without small coleoptiles	Many of the barley grains had deep indentations left by sprouted coleoptiles			
Cereal grains								
	Hordeum sp 2-4 mm	barley		87 indet/93 str/153 tw	9 indet/1 str/32 tw	5 indet/5 str/18 tw	4	3
	Hordeum sp <2 mm	barley		42 indet				
	cf *Hordeum vulgare* L var *nudum* Hook f 2-4 mm	naked barley		12 indet/15 str/12 tw	1 indet/2 str/2 tw	3 indet		
	Triticum sp	wheat		6		2		
	Indeterminate cereal grains 2-4 mm			390	29	29	1	
	Indeterminate cereal grains <2 mm			24				
Total cereal grains				**834**	**76**	**61**	**5**	**3**
	Indeterminate cereal grain fragments			(4)	(2)	(1)		
Cereal chaff								
	Cereal culm nodes						1	

Table 24: Charred plant remains from the Cutacre Bronze Age site

Context No				***554***	***834***	***552***	***820***	***843***
Total cereal chaff							**1**	
Weed seeds								
	Persicaria lapathifolia (L) Delarbre	pale persicaria	CW, especially damp ground					1
	Spergula arvensis L	corn-spurrey	C, calcifuge on usually sandy soils					1
Total weed seeds								**2**
Other plant remains								
	Corylus avellana L nutshell fragments	hazel			2		1	
	Immature *Corylus avellana* L cup	hazel					1	
	Salix spp catkin	willow		1				
	Indeterminate buds						2	
	Poaceae rhizome fragment	grass family	G					1
Other remains								
	Charcoal			(4)	(4)	(4)	(4)	(4)
	Calcined mammal bone			(1)				
	Metalworking waste			(1)				
	Daub			(2)	(1)			
	Coal			(1)			(1)	
	Havm			(1)		(1)		

Key: C=cultivated; G=grassland; W=waste; Havm=heat-affected vesicular material; indet=indeterminate; str=straight; tw=twisted

Table 24: Charred plant remains from the Cutacre Bronze Age site (cont'd)

ends and coleoptile remains/incisions evident on many of the barley grains, including the naked grains, which suggest that many had germinated. Other charred plant remains recovered from the four-post structure included a few hazelnut (*Corylus avellana*) shell fragments from posthole ***836*** and a single willow (*Salix* sp) catkin from posthole ***555***. This latter feature was also notable for the presence of other waste material, such as calcined mammal bone, metalworking debris, and comminuted daub fragments.

The two features associated with the nearby roundhouse, post-pipe ***828*** and drip-gully ***970*** (*Ch 2, p 28*), contained very sparse remains, comprising rare barley grains, a single cereal culm node, and two seeds, consisting of pale persicaria (*Persicaria lapathifolia*) and corn-spurry (*Spergula arvensis*), which are both considered typical weeds of cultivated ground. Corn spurry prefers acidic soils and pale persicaria damp conditions (Stace 2010), and both would be in keeping with the local geology and ground conditions (OA North 2010). All five of the samples analysed also contained rich charcoal assemblages (*p 349*).

Discussion

The cereal-rich deposits from Cinder Hill came from three postholes (***553***, ***555***, and ***836***), forming elements of a four-post structure and the nearby fence/windbreak; these postholes also contained significant amounts of charred material, including charcoal (*p 349*). Similar four-post structures are often interpreted as raised structures for storing grain, fodder, straw, or other foodstuffs and are often associated with Middle and Late Bronze and Iron Age settlements (*cf* Gent 1983; Brück 2001; Cunliffe 2005).

Given the presence of a probable raised four-post structure at Cinder Hill, one possibility is that the material represents cereals that were stored within the structure, prior to it being burnt down. It may therefore have functioned as a granary. However, another interpretation can be postulated based on the spatial arrangement of the cereal-rich postholes. Two (***555*** and ***836***) formed the north-western side (and front?) of the primary structure, whilst the third was from the posthole (***553***) in the fence/windbreak located nearest to it (*ie* nearest to postholes ***555*** and ***836***). The fact that none of the other postholes contained cereals may suggest that the remains represent material generated from activities taking place between the primary structure and the windbreak, rather than being the remains of stored cereals. Although no obvious hearths were recorded, the presence of small amounts of calcined mammal bone, daub/fired clay, and metalworking waste may indicate small-scale 'workshop' activity, possibly within a limited protected 'courtyard'. Indeed, whilst it is possible that the structure was used for storing grain, the lack of cereal chaff from the site suggests that the barley grains were in a fully processed state and therefore more likely to comprise a stage just prior to cooking, or another form of food preparation. The numerous sprouted or part-sprouted grains also suggest that the cereals had germinated, perhaps representing a spoilt harvest, or the remains of malted grain.

If the cereals do represent malted grain, the grains would have been 'parched' over a hearth or in an oven or kiln, to halt the germination process. It is at this point that the grains would have been exposed to fire, and thus to the inherent risk of becoming charred (Dineley and Dineley 2000). Malt extract provides an excellent source of B-vitamins and is also the prime ingredient for sweet malt (ingredient for barley cakes), and for brewing ale (*ibid*). There is also a significant amount of evidence to suggest that the malting of cereal grains was widely practised during the Bronze Age in Britain (*ibid*). As well as the grains, the basic ingredient for malting is water, and thus, if the four-post structure was the focus for malting activities, then its postion next to a stream would have been beneficial.

This evidence can also be linked to those limited remains recovered from roundhouse ***812*** to determine the types of crops cultivated in the Bronze Age at Cinder Hill. This evidence suggests that both naked barley and wheat were the main cultivated crops. Although modern varieties of naked barley are likely to differ substantially from former indigenous forms, studies (Dickin *et al* 2010) suggest that it is high in beneficial soluble fibre. This, coupled with its ease of processing, means that it is ideal as a food crop. In addition, barley will grow in adverse conditions, thus making it an ideal choice for the inclement weather of northern England and Scotland. On the negative side, its germination rate of the seed grain, and thus the resulting yields, is much lower than for other cereals, as a result of the vulnerability of the exposed embryos of the naked grains (*ibid*).

Although relatively little is known about Middle Bronze Age agricultural activity in the region, as few settlement sites of this period have been excavated (Hodgson and Brennand 2006; Huntley 2010b), there is one settlement which is directly comparable in date, and also produced a moderate-sized assemblage of charred plant remains. This was at Irby, on the Wirral, which produced numerous cereals, radiocarbon dated to *c* 1500-1100 cal BC (Philpott and Adams 2010). There, also, there was a clear emphasis towards the cultivation of naked barley, mirroring the evidence from Cinder Hill. At

Irby, emmer wheat (*Triticum dicoccum*) also appears to have been a favoured crop, though rare spelt wheat (*Triticum spelta*) grains and chaff were also recorded (Huntley 2010b). It is, however, unclear which type of wheat was cultivated at Cinder Hill, as the grains could not be identified to type. At Irby, hulled barley, which has a higher yield than naked barley, was also recorded. More generally, the evidence from many sites in Britain suggests that this barley type began to supersede naked barley during the later Bronze Age (Godwin 1994; van der Veen 1992; Huntley and Stallibrass 1995; Hastie 2010).

As at Cinder Hill, many of the cereal-rich deposits at Irby derived from postholes, which may indicate structures associated with cereal storage, or possible processing (Huntley 2010b). However, these appeared to form elements of a circular structure, and, unlike Cutacre, the samples produced abundant cereal chaff and emmer-wheat grains still contained within their spikelets. The material from Irby therefore is perhaps more likely to represent semi-processed, stored, grain (*ibid*). It is likely, for example, that in damp climates most cereals were stored still in their spikelets as a means of protecting the grain (Hillman 1981).

Charcoal

Methodology

Following assessment, of the 13 samples selected for charcoal analysis, eight were from elements of the Bronze Age settlement at Cinder Hill (Site 42S; *Ch 2*, *p 25*). Of these, one came from one of the fence/windbreak postholes (***553***); two were from postholes (***555*** and ***836***) associated with the primary four-post structure; one was from a posthole (***853***) forming part of the replacement four-post structure; and the others were from the drip-gully (***970***), the post-ring (posthole ***828***), and two from the porch (postholes ***869*** and ***956***), all which formed elements of the roundhouse. The remaining samples were obtained from features associated with the medieval iron-working site (Site 42N; *Ch 3*, *p 44*). These were derived from pits ***715*** and ***535***, tapping pits ***581*** and ***720***, and charcoal-burning pit ***864***.

Analysis followed standard procedure, where *c* 100-50 fragments (or the entire assemblage if less than this) of charcoal >4 mm or, failing this >2 mm, in size were identified. The percentage volume of the material analysed in relation to the whole flot was also calculated. The charcoal fragments were initially sorted into groups based on the features visible in transverse section using a Leica MZ6 binocular microscope at up to x40 magnification. Representative fragments of each group were then fractured to reveal both radial and tangential sections, which were examined under a Meiji incident-light microscope at up to x400 magnification. Identifications were made with reference to Schweingruber (1990), Hather (2000), and modern reference material. Nomenclature follows Stace (2010).

Results

The level of identification varied according to the observed genera/family and/or the state of preservation. In many cases, the fragments could only be taken to an approximate level of identification (*ie* to sub-family level, *eg Alnus glutinosa*/*Corylus avellana* (alder/hazel, both in the Betulaceae family)), as some of the key diagnostic features that are needed to distinguish the species were not observed. In other cases, the level of identifications was limited due to the similarities of species within a family or genus (*eg* willow and poplar (*Salix* sp/*Populus* sp) cannot be separated anatomically). In general, the preservation was good. Those fragments categorised as indeterminate came from distorted knotty wood.

Bronze Age settlement

Four-post structures and fence/windbreak

Five of the eight postholes forming elements of the two sequential four-post structures were assessed (OA North 2010) and all contained abundant charcoal fragments comprising predominantly oak (*Quercus* sp), alder/hazel (*Alnus glutinosa/Corylus avellana*), and/or ash (*Fraxinus excelsior*). Closer examination of three of the posthole fills (primary four-post structure postholes ***555*** and ***836***, and replacement four-post structure posthole ***853***; *Ch 2*, *p 29*) confirmed this (Table 25), and also indicated that ash charcoal formed a large element of the assemblage in posthole ***853***. In addition, all three samples contained a mixture of both oak and ash heartwood, and small roundwood (small twig fragments with less than ten years' growth), and many of the oak and ash fragments in posthole ***853*** comprised very slow-growing wood.

Given that nearly all of the postholes associated with the four-post structures, including post-pipes ***849*** and ***851*** (postholes ***836*** and ***853*** respectively), contained abundant charcoal, it is tempting to suggest that the material represents the burnt remains of the primary four-post structure. The presence of cereal grains and other waste material in postholes ***555*** and ***836***, however, suggests that the features are also likely to have contained some general debris, derived from activities that were undertaken close to the primary four-post structure.

Both the assessment and analysis data from the possible fence/windbreak differed slightly from

Context No		***552***	***554***	***834***	***850***	***820***	***843***	***872***	***955***
Sample No		86	79	81	84	106	111	112	107
Feature Description		Fill of posthole ***553***; part of fence/ windbreak	Fill of posthole ***555***; part of the primary four-post structure	Fill of posthole ***836***; part of the primary four-post structure	Fill of posthole ***853***; replacement four-post structure	Fill of drip-gully ***970***	Fill of post-pipe ***842*** in posthole ***828***; part of roundhouse post-ring	Fill of post-pipe ***871*** in posthole ***869***; part of roundhouse porch	Fill of posthole ***956***; part of roundhouse porch
Sample Size L		4	10	10	10	10	10	10	10
Flot Size ml		140	1200	900	100	550	350	400	200
% of >4 mm identified		50%	6.25%	12.5%	100%	12.5%	50%	25%	50%
% of >2 mm identified					25%				
>10 mm fragments				Rare					
Comments					Oak and ash, slow growing				
Alnus glutinosa (L) Gaertn	alder	11r	1r		1		3		
Alnus/*Corylus*	alder/ hazel	83r	25r	53r	29r	15	45r	27r	36r
Fraxinus excelsior	ash	1	6h	5	36hr				2
Quercus sp	oak	15hr	95hrs	74hrs	56hr	82hrs	93hrs	82hr	105hr
Salix sp/*Populus* sp	willow/ poplar			1					
Indeterminate		17rs	21r	52	6rs	6b	4	9rs	11r
Total no of charcoal fragments identified		110	127	133	122	97	141	109	143

Figures given are actual counts

Key: h=heartwood present; r=small roundwood (twig fragments) present; s=sapwood present; b=bark present

Table 25: Charcoal from the Bronze Age features at Cinder Hill

that in the postholes associated with the four-post structures, in that they were clearly dominated by alder/hazel (OA North 2010). Closer examination of the alder/hazel charcoal from posthole ***553*** (*Ch 2, p 30*) indicates that the majority of the fragments consist of alder roundwood. In addition, posthole ***553*** also contained debris, in the form of charred cereal grains, possibly derived from cereal-related activities occurring between the primary four-post structure and the windbreak, as did the postholes comprising the structure (*p 345*).

Roundhouse

Postholes ***828***, ***869***, and ***956*** from the roundhouse, and associated ring gully ***970*** (*Ch 2, pp 27-8*), all contained abundant charcoal fragments dominated by mature oak. The presence of small oak twigs, and frequent to common alder/hazel roundwood, suggests, however, that this may represent a mixture of material. In most (nine) of the postholes, there was evidence for a post-pipe, surrounded by backfilled material, which suggests that the post may have decayed in situ rather than the structure being dismantled (*Ch 2, p 27*). There is no reason to suggest, therefore, that this structure had burnt down, and it is likely that the charred material derived from activities that occurred within, or adjacent to, the structure.

Discussion

The charcoal evidence from the Bronze Age features suggests that the main structural and/or fuel woods being used at the site were oak, alder, and ash. Although the recovery of several taxa and cereal remains from the postholes suggests they may have become filled with a range of material, the abundance of oak, over alder and ash, in the postholes comprising the primary four-post structures is noticeable. The slightly different relative quantities and qualities of the ash and oak from posthole ***853*** compared to the rest of the fills analysed may also provide tentative support for the interpretation that it was a replacement.

Oak and ash would have provided both superior structural material and fuel wood (Edlin 1949). Given the presence of charcoal fragments in the features associated with the roundhouse, and the fact that there was no immediate evidence for this structure being burnt down, it is likely that oak and alder were also being utilised as domestic fuel. Alder wood, however, makes poor fuel unless it is converted into charcoal (*ibid*). If the arc of posts associated with the rectangular structure was indeed acting as a windbreak, it is tempting to suggest that the higher quantities of alder roundwood in these features may represent the burnt remains of hurdles or fences. Alternatively, they may indicate the remains of alder fuel being used for specific activities taking place there. It is highly likely that the local woodland was being utilised, which was composed of mature oak and ash trees on the higher, drier slopes, and alder on the lower, damper areas flanking the nearby stream.

Medieval bloomery

Two pits (***715*** and ***535***; *Ch 3, p 50*), two slag-tapping pits (***581*** and ***720***, respectively associated with furnaces ***588*** and ***722***; *Ch 3, p 44*), and the fill of a possible charcoal clamp (***864***; *Ch 3, p 49*) were analysed for their charcoal content (Table 26). All five of these features were overwhelmingly dominated by mature oak wood. The slow-growing nature of much of the oak from the furnace tapping-pits, indicated by extremely closely spaced growth rings, suggests the use of a tree or trees under stress. Oak sapwood (the outer edge of the branch/trunk) was limited to the sample taken from the possible charcoal clamp. Rare/frequent fragments of alder (*Alnus glutinosa*), and/or hazel (*Corylus avellana*) and holly (*Ilex aquifolium*) were also recovered; however, these made up only a small percentage (<10%) of the charcoal, and may therefore represent firewood or kindling.

Oak is considered a superior fuel wood (Edlin 1949) and would therefore have provided an excellent commodity for both charcoal and iron production. Indeed, it is likely that the industries worked in tandem; oak charcoal provided an intense, almost smokeless, easily controlled fire (*ibid*) that would have been preferable whilst smelting iron. The ideal position for charcoal production was in wooded areas, where the heavy branchwood or coppice was cut (*ibid*). Iron-making industries would ideally have been situated in similar places, where iron ore was near the surface (*ibid*). Although there is a suggestion that bloomery furnaces were often located to take advantage of coppice rotations (*Appendix 3*), the dominance of mature oak wood, at least 50 years in age, in both the charcoal clamp and furnaces at Cutacre suggests that the fuel wood used in this particular case was not being sourced from coppiced woodland. That is not to say, however, that the site was not placed to take advantage of other types of woodland management and/or the waste wood generated from other industries, such as timber manufacturing.

Conclusion

Although the amount of charred plant remains from Cinder Hill was relatively small, the presence of germinated naked barley suggests that the Bronze Age four-post structures may have been used for the preparation of locally cultivated cereal-based products, such as sweet malt or ale. The presence of other debris, such as calcined bone, comminuted

Context No		***503***	***534***	***582***	***725***	***865***
Sample No		101	50	63	66	85
Feature Description		Fill of pit ***715***	Fill of pit ***535***	Fill of tapping pit ***581***	Lower fill of tapping pit *720*	Fill of charcoal-burning pit ***864***
Sample Size L		10	10	8	10	10
Flot Size ml		450	500	300	650	1400
% of >4 mm identified		100%	50%	100%	25%	3.125%
% of >2 mm identified				12.5%		
>10 mm fragments					Rare	
Comments		Oak, slow growing	Oak, slow growing	Oak, slow growing	Oak, slow growing	
Alnus glutinosa (L) Gaertn	alder		2		1	1
Corylus avellana L	hazel		1			
Alnus/Corylus	alder/hazel	6	8	8	1	1rs
Ilex aquifolium	holly	2	2			
Quercus sp	oak	146h	154h	113h	153h	136hs
Indeterminate		3	2	8	24	24
Total no charcoal fragments identified		154	167	121	155	138
Other remains						
Coal/havm		++				

Figures for charcoal are actual counts. Other remains are quantified on a scale of +-++++, where + = 5 or less, ++ = 6-25, +++ = 26-100, ++++ = >100. Key: h=dominated by heartwood; s=sapwood present; r=roundwood present; havm=heat-affected vesicular material

Table 26: Charcoal from the medieval bloomery at Cinder Hill

daub, and metalworking waste, may also provide tentative support for small-scale activities, which required a hearth or oven/kiln.

Interpreting the taphonomy of material within postholes is often fraught with difficulties; however, certain trends in the charcoal data suggest that the local woodland, comprising oak, ash, and alder, was likely to have been utilised for both construction and fuel. The slow-growing nature of much of the oak and ash forming the charcoal from replacement post ***853*** (*Ch 2*, *p 29*) suggests that these trees were under some degree of stress.

Investigations at medieval charcoal-production and iron-working sites in the Lake District (Newman and Newman 2007; Huntley 2010a) have shown that the two industries are often linked. The similarity in dates and nature of the charcoal assemblages from both the clamp and iron-working furnaces at Cinder Hill suggest that the same situation existed there. Indeed, during the early post-medieval period, iron smelting was one of the four main industries sustained by charcoal production (the others were the making of steel, glass, and gunpowder; Edlin 1949).

Without knowing the exact scale of the charcoal production and iron smelting at Cinder Hill, it is difficult to gauge what effect the industries had on the local woodland. It has been suggested (Rackham 2003) that by 1250 coppicing was almost universal and had overlapped with wood pasture in many parts of Britain. In this context, the charcoal and iron-production industries at Cinder Hill may have been utilising wood generated from other types of woodland management and/or the by-product of other wood-based industries, such as timber manufacturing.