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Report 2011/19

Archaeometallurgical residues from Little Down, Catherton, Shropshire

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2nd January 2011

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(with a contribution by A.J. Clapham)

Abstract

Several contexts yielding archaeometallurgical residues were sampled by D. Poyner during building works at Little Down, Catherton, Shropshire, during 2009-10. These samples were numbered and related to photographs of the contexts seen in section in the building footing trenches. This report describes a small quantity of slag and some bulk samples from amongst that material.

Approximately 10kg of material were examined. Of this seven samples(5.7 kg) were collected stratigraphically from a burnt, stone-floored, 'hearth', two (1.8kg) derived from a pit with a substantial slag fill and three (1.0kg) were more general collections of material from various foundation trenches.

The archaeometallurgical materials from Little Down suggest that ore roasting, iron smelting and most probably bloomsmithing took place at this site. The stone floored 'hearth' was probably a structure for ore-roasting ,in which the raw ore would be prepared for smelting. The metallurgical assemblage found in the 'pit' is residue from the smelting furnace(s). The slags are represented by rather small and weathered fragments (although large pieces were collected they were not included in the submitted material) dominated by pieces of tapped bloomery slags. It is difficult to date this collection directly, but the tapped slags would be likely to be either Roman or medieval: such material would most likely be of 1st to 4th or 9th to14th centuries.

*The charcoal assemblage was dominated by birch, with most pieces showing 7-8 years growth. To clarify the dating, a fragment of birch (*Betula*) charcoal from the fill of the 'hearth' was submitted for AMS dating and returned a date of Cal AD 1287-1399.*

In summary, although there was no convincing structural evidence for a furnace, there was clear evidence from residues for the various activities associated with a slag-tapping bloomery, with the residue evidence being compatible with the latest 13th- 14th century AMS date from charcoal from the hearth.

Contents

Methods

All investigated materials were examined visually. Macroscopic and microscopic remains were described and organized by material classes and recorded to a database (Tables 1 and 2).

Archaeometallurgical residues were not studied with use of any high-magnification optical inspection, nor any other form of instrumental analysis. Therefore, description of materials in this report is limited and must be regarded as provisional.

Charcoal from the site was investigated by Clapham (2011), whose report is incorporated herein.

A single twig of birch charcoal was submitted to Beta Analytic for AMS dating.

This project was undertaken for the Four Parishes Heritage Group.

Results

General nature of the archaeometallurgical residues

Samples were collected from the foundation trenches of a redevelopment at Little Down, Catherton, Shropshire by David Poyner. Of the collected material, 9.4kg of hand-picked material and bulk samples wre submitted for examination. A large amount of material (5.7kg) was collected from a stone-floored 'hearth' exposed by two trenches (although the total sample weight is skewed by the inclusion of several large stones from the structure). A lesser amount (2.7kg) of material was collected from a much larger cut feature, described here as a 'pit', but for which the 3-dimensional shape was uncertain. A further 1kg of material was collected more generally from the foundation trenches of the new barn.

The hearth feature (fors tratigraphy see Figure 3) yielded samples with a total of 528g of macro- and micro-archaeometallurgical residues of which 300g mainly indeterminate forms of slag and 150g was fragments of iron ore. Small quantities of micro-residues with hammerscale and rusted iron were also found.

The samples from the 'pit' provided a total of 2315g of archaeometallurgical residues of which 954g were tap slag fragments and 854g were probable tap slags; there was also 400g of fired clay, a small quantity of charcoal and some indeterminate slag. Microresidues included a small quantity of flake hammerscale.

Handpicked samples from the site included a further 685g of archaeometallurgical residues, mainly tapslag and iron ore. Small quantities of coal, coke, bone and pottery are probably associated with the use of the area as a later post-medieval farmyard.

Description of the residues

Tap slag: The tap slag (21 fragments) comprised 1360g (51%) out of the 2672g of slag from the site, and it is likely that the 952g (36%) of "probable tap slag" is also in this category and that much of the 284g (11%) of "indeterminate slag" is material fragmented into pieces too small or so weathered to be surely recognised as being derived from iron smelting.

The assemblage from the 'pit' provides a good collection of the various tapped slags. A few fragments of tapslags were also included in the picked material from the general area of the new barn. The tapslags had variable shape and thickness. In general they can be characterised by being dense and with a particularly dark colour, occasionally maroon. Almost all examples of tap slag show a top surface with flow lobes; just two fragments are with 'wrinkles'. Most of them have moulds of small charcoal fragments on their base in a grey glossy colour. This suggests that the tapping was undertaken onto a bed of charcoal.

Probable tap slag: Some fragments of slag were difficult to classify with certainty to the 'tap slag' category. 'Probable tap slag' contributes 952g of the slag from the site (36% by weight). This collection includes 21 fragments with a maximum weight of 156g and thickness of approximately 45mm. These slags lack the clear flow structures of the tap slags, but are characterized by variable density, rough texture and very rusty top surface, bottom side with charcoal moulds in grey and occasionally maroon colour, sometimes with attached pebbles, ore particles or charcoal.

Indeterminate slag: The slag lumps, which were too small for certain identification, very weathered or abraded, were classified as "indeterminate slag". These materials comprised about 11% of the overall slag assemblage. They consist of 10 slag particles which weigh 284g. It is very likely that a large part of these residues are derived from the bloomery furnace (broken tap slags or furnace slags) but others may possibly be bloom smithing slags (less diagnostic fragments of SHC and slag formed within the smithing hearth but outside the main SHC). In general they can be characterised by being very rusty, having medium or low density, a chaotic structure of small and large charcoal moulds in a particularly dark colour, with occasionally secondary oxides in a glossy black/maroon colour. Most of them have small charcoal moulds on their bases usually in a grey glossy colour. Some indeterminate slags had charcoal fragments, fired clay pieces, sand/pebbles and ore grains attached. 3 fragments of slag contained probable inclusions of metallic iron: they were characterized by a thick crust of orange rust with sand grains, pebbles and small fragments of charcoal attached or by black glossy secondary oxides. Some of these slags were weakly magnetic.

Fuel ash slag: One fragment of fuel ash slag was present in the hand-picked material (76g, 3% by weight of the overall assemblage). It was plano-convex, porous and had a very weathered texture. The upper surface was glossy and pale grey in colour.

Fired clay*:* 470g of material was identified as fired clay. This has variable size and shape (max. 188g, approx. thickness 40mm). The pieces are characterized by poorly mixed clay in various colours from grey through pale orange to dark orange/red. In some cases they show moulds of organic materials (probably straw, hay or small sticks). Almost all the fired clay fragments were found in the 'pit'. They might be materials from the upper levels of furnace construction.

Iron ore: The assemblage contained 24 pieces of iron ore weighing a total of 254g. They include small crushed pieces of roasted and fresh iron ore of variable size and weight.

***Stone**:* Stone formed the largest group of materials from the site (3346g) which comprised 12 pieces of burnt sandstones (2976g) and 13 small stones/large pebbles (370g). All the burnt sandstone was found in the 'hearth', mainly as its 'floor'.

***Iron**:* One rusted fragment of iron (72g) was found on site of new barn. It had a thick crust of rust with attached small sand grains, pebbles, charcoal, ore and slag particles. It was weakly magnetic. It was not possible to determine whether this material is 'gromp', half-products associated with the ironworking or even a rusted artefact.

Charcoal

A moderate amount of charcoal was recovered from the 'pit' (samples 3 and 4; 24.85g) and a small amount (17.04g) in the 'hearth' feature (samples 1 and 7). This material was submitted to A.J Clapham (Historic Environment and Archaeology Service, Worcestershire County Council) for further investigation and to help the selection of a sample for dating.

Charcoal: Details (A.J. Clapham)
This section is abstracted from Clapham (2011).

Processing and analysis: The cell structure of all the non-oak identifications samples was examined in three planes under a high power light field/dark field (epi-illuminating) microscope and identifications were carried out using reference texts (Hather 2000) and reference slides housed at the Worcestershire Historic Environment and Archaeology Service.

Some of the samples could be identified to species level, either anatomically or because only one species of a genus was likely to have been present on the site at the time of deposition. Identification has been taken only to genus level in cases where there is more than one native species of a genus and the cell structure of these is very similar (e.g. *Salix* sp). Other identifications included more than one species of a genus because similarities in the wood structure make it difficult to separate them to species level (eg Maloideae). Nomenclature follows that of (Stace 1997).

Results:A total of four samples and 27 fragments were provided for identification from Little Down, Tables 3 and 4. Only two taxa, birch and hazel were identified from Little Down. Twenty-one of the charcoal fragments were of birch with two being of hazel. Four fragments of root wood from sample 3 could not be identified. Of the 27 fragments, 8 provided diameter measurements and 11 provided ring counts. Chart 1 shows a more normal distribution that indicates that the harvest cycle was between 7 and 8 years, but larger timbers were also used.

Dating

A single piece of birch charcoal from a small twig with bark present from sample <001> (Figure 3, layer (3)) was submitted to Beta Analytic for AMS dating (Beta – 311354). The measured age was 640 +/- 30 BP, with $^{13}C/^{12}C$ ratio of -25.8 o/oo, giving a conventional radiocarbon age of 630 +/- 30 BP.

The calibrated age range (at 2-sigma) is Cal AD 1280 to 1400 (Cal BP 660 to 550)using the calibration supplied by Beta Analytic, or Cal AD 1287-1399 using Oxcal v4.1.

Interpretation

The described materials from Little Down are mainly residues from iron-making (bloomery iron smelting and possibly primary smithing). Small amounts of materials hand-picked from the site (like ceramics, mortar, bones, fragments of coal and coke) may be connected with modern (probably 19th/20th century) activity and are probably associated with a former farmyard surface immediately overlying the ironworking deposits of 13th-14th century age.

Interpretation of the two cut features is not straightforward. A small amount of raw and roasted iron ore particles was found in the charcoal layer in the stone-floored 'hearth'. The fill of the hearth provided a small quantity of slag (indeterminate slag and probable tapslags) and a small amount of hammerscale. The scale suggests that smithing, probably bloomsmithing (primary smithing), was undertaken in the area. The degree of oxidation within the subsoil below the hearth indicates strong and prolonged heating, but bloomery furnaces do not normally have a stone floor (although rare examples are known) and the fill does not contain as much hammerscale as might be expected from a smithing hearth. Therefore, the structure was probably, but not certainly, an ore-roasting hearth where ore was roasted before smelting.

The metallurgical assemblage found in the 'pit' is dominated by rather small and weathered fragments of tapped bloomery slags. These are not closely dateable, but are entirely compatible in their technology with the late 13th to 14th century date from the charcoal-rich fill of the hearth.

The original purpose of the pit remains uncertain, although it should be noted that furnaces of this later medieval period frequently have rather large tapping pits (e.g. Eastwall Farm, Staffordshire, Wessex Archaeology 2004, p13 and Figure 3; Coed y Brenin, Crew pers. comm..) . Their main purpose may have been to permit easy access to the mouths of the long tapping channels/tunnels frequently found in furnaces of this date, but in some instances they may also have served as quarry pits for clay for the furnace superstructure. A similar interpretation may be applicable here.

References

CLAPHAM, A.J. 2011 Charcoal from Ned's Garden, Cindermill and Little Down bloomery sites, Shropshire. Unpublished Report 1860 (Project P3301), Historic Environment and Archaeology Service, Worcestershire County Council, 6 pp. + 6 tables +5 figs.

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Table 1: Summary catalogue of material from Little Down

sample no	Context: location/layer	type	weight (g)	quantity	description
2010/1	hearth, just below the orange clay	soil sample	281	3	burned sand stones
			4.9	5	fragments of fired oxidized red clay with organic temper, poorly mixed
			60	1	unprocessed soil sample - lump of clay mixed with charcoal, stones, ore and mortar
			32.25	1	iron ore
			15.4	1	fragment of slag with iron bit, surface covered by secondary oxides in orange or black glossy colour
			14.01	4	fired clay fragments with one surface in reduced grey colour and other in pale grey
			22.86	3	very rusty, medium density slags with charcoal prints, sand and ore grains attached to the surface
			13.75	1 bag	charcoal fragments
			36.85	1 bag	magnetic material - sieved <212um, mixture of small ore pieces and rust/ore powder
			94.46	1 bag	non-magnetic - sieved 212um, mixture of sand and charcoal with small amount of pebbles, fired clay and mortar
2010/2	hearth, orange clay	soil sample	288	1 bag	unwashed material - clay mixed with charcoal, fired clay and stones
			7.33	1 bag	magnetic material - sieved < 212um - ore, spheroidal and flake hammer scale, ore and rust dust
			43.47	1 bag	non-magnetic material - sieved < 212um - mixture of sand with fired clay, charcoal, pebbles and ore
			34	3	small lumps of fired clay, charcoal and stones
2010/3	pit	soil sample	370	7	fragments of fired clay with mineral and organic temper, probably 'furnace' walls. Two large pieces of fired clay (188g & 132g), thickness 40mm, outside surface in reddish colour, inside with rust and charcoal layer. On outside surface of smaller clay fragment is visible print after wooden stick. On outside surface of bigger clay fragment is visible square hollow
			112	1	stone with attached fragment of clay and charcoals
			17.89	2	rusty slags with fragments of reduced fired clay and charcoal
			0.11	1	wooden/charcoal stick from fragment of 'furnace' wall
			28.54	1 bag	magnetic material - sieved < 212um - small ore particles with ore and rust powder
			27.23	1 bag	non-magnetic material - sieved < 212um - mixture of sand, stones, and small amount of charcoal, slag and fired clay in grey colour
2010/4	pit, surface layer of the east of the pit	soil sample	24.74	1 bag	large fragments of charcoal
2010/5	hearth, orange clay from the top of the hearth	soil sample	150	1 bag	not washed material - lump of soil with charcoal, stones and ore pieces
			13.4	2 bags	magnetic material - sieved < 212um - mixture of ore, slag, ore and rust powder with flake and spheroidal hammer scale
			125.16	2 bags	non-magnetic - sieved < 212um - mixture of ore fragments, fired clay, charcoal, pebbles, slag and sand

sample no	context	type	weight (g)	quantity	description
2010/6	hearth, black layer	soil sample	218	1 bag	not washed material - 13 small lumps of slag amalgamated with charcoal, ash, sand stone and ore pieces (164g); 1 lump of not fired clay with pieces of charcoal, stones, ore and fired clay (54g)
			42.82	1 bag	magnetic material - sieved < 212um - ore, slag, spheroidal hammer scale, ore and rust dust
			122	1 bag	non-magnetic - sieved < 212um - mixture sand with small fragments of clay, ore, slag and stones
2010/7	hearth, below 6, layer of clay or sand stone	soil sample	7.19	1 bag	magnetic material - sieved < 212um - mixture of ore, flake and spheroidal hammer scale and ore/rust dust
			41.69	1 bag	non-magnetic material - sieved < 212um - mixture of sand with ore, slag, pebbles and little amount of charcoal
			3.29	2	charcoal
			7.98	1	weakly fired clay, poorly mixed, pale red colour
			21.07	4	stones
				1	modern wood fragment
			118	9	different kinds of iron ore, some with silt core
			834	2	not washed material - lumps of not fired clay with slag, small ore particles and charcoal
			98	4	fragments of thin, high density slag with crystals. Top surface in dark black colour, bottom in grey and maroon colour with marks after charcoal.
			164	2	pieces of very chaotic, rusty slag with attached iron bits, charcoal and stones. Slags surface is covered by dense secondary oxides in dark black/maroon colour and softer orange one. At the larger fragment of slag are visible bright yellow spots of sulphide.
2010/8	hearth, thin reddish layer between the clay and stone floor of the hearth	soil sample	10.54	1 bag	magnetic material - sieved < 212um - mixture of ore with ore and rust dust
			18.78	1 bag	non-magnetic material - sieved < 212um - mixture of sand with charcoal, sand stone pieces and one fragment of fired clay
2010/9	hearth, stones from the floor	soil sample	7.97	1 bag	magnetic material - sieved < 212um - mixture of ore with rust and ore dust
			21.92	1 bag	non-magnetic material - sieved < 212um - mixture of sand with charcoal, pebbles and mortar
			2695	9	burned sand stones
2010/10	pit	soil sample	19.33	1 bag	magnetic material - sieved < 212um - mixture of rust, slag/hammer scale flakes, rust and ore dust
			144.46	1 bag	non- magnetic material - sieved < 212um - mixture of sand and charcoal with small particles of slag , clay, pebbles and mortar
			1872	32	one (558g) vesicular slag with crystals, rusty surface, top surface with flows, bottom surface with marks after charcoal, 55mm thickness 1 fragment of dense slag (154g), 25mm thickness, chaotic structure, top surface with 'wrinkles' in rusty maroon colour, bottom surface with charcoal prints in grey glossy colour. 1 fragment of low density, vesicular slag (156g), 45mm thickness, top surface rusty and black, bottom surface with charcoal prints in grey colour. One slag edge has maroon colour.

sample no	context	type	weight (g)	quantity	description
					8 dense fragments of slag (436g) with small pours and crystals, top surface rough and rusty, bottom side with charcoal prints and attached to it charcoal bits and pebbles 3 very low density slags (106g) with small pours and crystals between them, top surface in grey/black/maroon colour, bottom side with charcoal prints. 5 very rusty medium density slags (156g) with small pours, rough top surface, bottom side with attached charcoal particles and bits of silt stone. The largest slag fragment (114g) has 'v' shape and is covered with dense black and glossy secondary oxides layer. 11 pieces of flat slag flows (242g), dense structure with small crystals, top part in maroon/ black colour, bottom surface with charcoal prints. One fragment of slag with 'wrinkles'. 2 very rusty fragments of slag (64g), chaotic structure, charcoal prints and dense secondary oxides in glossy black/maroon colour on the both sides.
			38.91	2	stones
			30.08	2	poorly fired clay with organic and mineral temper, to the one surface are attached ore and charcoal particles
2010/A	trench in new barn	soil sample	50.46	1 bag	not washed material - lump of soil with small fragments of ore and charcoal
				1 bag	bones (7.5g)
			1.21	1 bag	magnetic material - sieved < 212um - mixture of ore and rust dust
			49.35	1 bag	non-magnetic material - sieved < 212um - mixture of sand with fragments of charcoal, ore and bones
2010/B	trench outside barn		16.36	2	fragments of thin dense tap slag, bottom side is in grey colour with charcoal prints, upper surface is occasionally glossy and maroon (13.30g + 3.06g);
			3.06	1	poorly mixed fired clay with mineral temper
			21.67	5	fragments of iron ore
			72	1	fragment of iron in core of rust with attached particles of slag, pebbles, charcoal and ore
2009/1	site of new barn			4	pottery, three fragments with yellow glaze and one piece with dark drown glaze
			390	6	fragments of dense vesicular tap slag, tapped on the charcoal
			76	1	fuel ash', plano-convex, porous and very weathered texture, glossy pale grey colour of the top surface
			198	6	stones
			82	9	fragments of iron ore
			8.15	1	pieces of coal
			6.69	1	fired clay in pale red colour
			9.28	5	fragments of coke
				1 bag	8 fragments of bones
	total:		9338.61		

Table 2: Summary of metallurgical residues and related material classes by location

context area	tap slag	prob. tap slag	indet. slag	fired clay	fuel ash slag	ore	iron	coal	coke	charcoal
hearth	0	98	202	61	0	150	0	0	0	17
pit	954	854	82	400	0	0	0	0	0	25
General site of new barn	406	0	0	10	76	104	72	8	9	0
	1360	952	284	471	76	254	72	8	9	42

Table 3 Charcoal counts and species from Little Down, Shropshire

Species	Common names	Sample 1	Sample 3	Sample 4	Sample 7	Total
Betula sp	birch	15		4	2	21
Corylus sp	hazel			2		2
root wood			4			4
Total		15	4	6	2	27

Table 4 Diameter (mm) and ring counts for charcoal fragments at Little Down, Shropshire

Sample	***Betula* (birch)**	***Corylus* (hazel)**
1	17.5/20	
	21/20	
	17/8	
	18/8	
	0/17	
	19/10	
	0/7	
4	32/17	15/17
	0/20	
	18/9	
Average	20.35/13.6	15/17

Figure 1 Distribution of annual rings of all species at Little Down, Shropshire

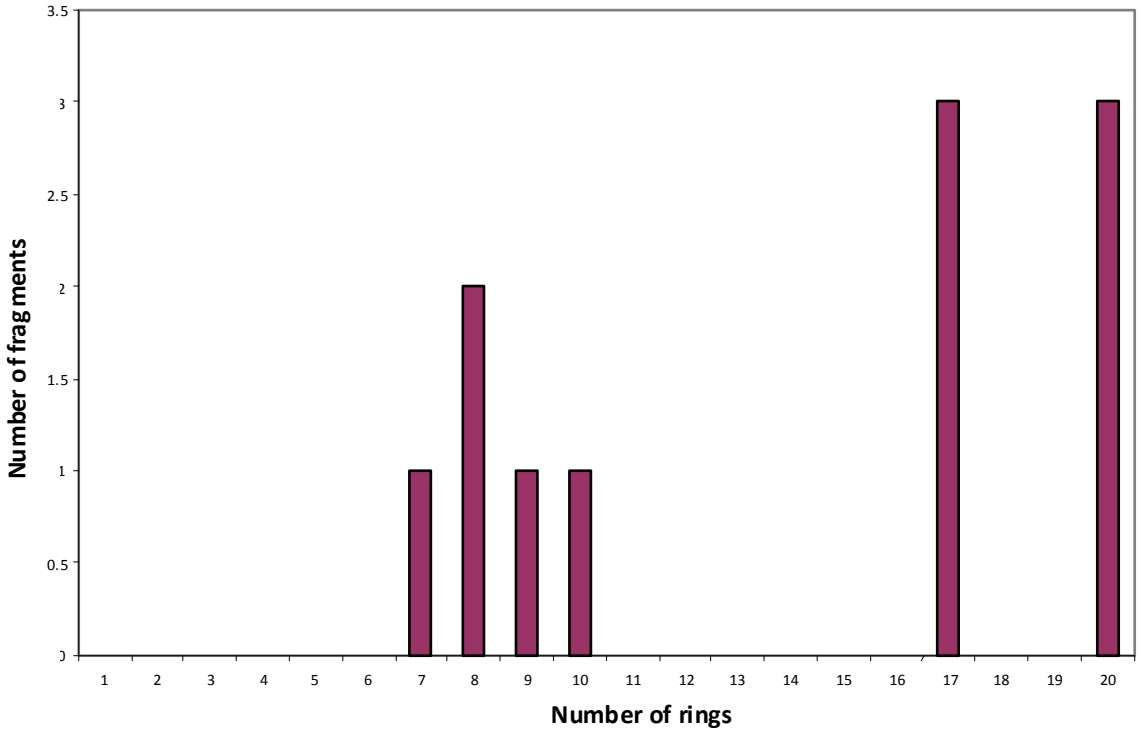

Figure 2. Oxcal graphical output for AMS date from birch charcoal from sample 001 (Beta 311354): Cal AD 1287-1399.

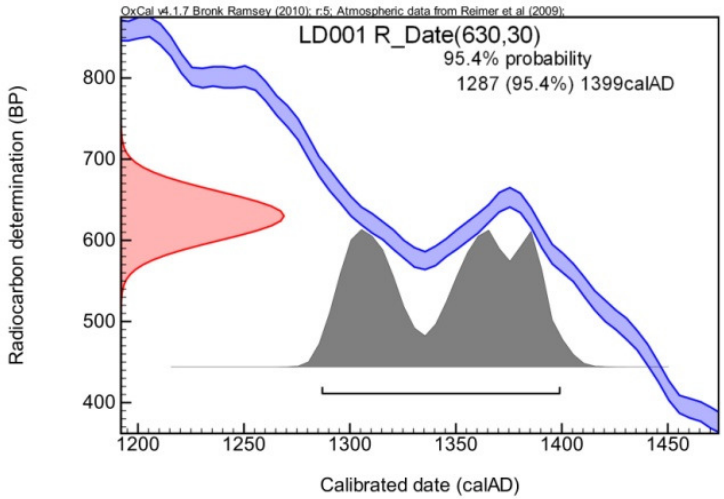

Figure 3. Stratigraphy of the ‘hearth’

(1) is the white mortar from the C19 outbuilding,

(2) is a pink/orange clay
(samples #2 & #5)

(3) is the dark charcoal rich layer just above the stones
(sample #1, cal AD1287-1399 & sample #6).

(4) is the stone floor
(sample #9)

(5) is the oxidised clay beneath

Photos and interpretation D Poyner

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