KM AML REPORT ~~[illegible]~~ 3649
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The slags etc from Wharram Percy Church, Yorkshire

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The material examined comprised the following AM lab nos 785206, 796397-8, 800265, 801177-88, 801208-46 and in addition a box of samples from the bell pit which had not been numbered. The appendix lists the individual identifications which are discussed below.

The unnumbered samples from the bell pit included the whole range of materials found in the other samples from the bell pit. There was orangey-brown "soft burnt clay" which was so lightly fired that it completely collapsed when put into water, burnt clay which was a little harder fired and contained some charcoal flecks and blobs of copper alloy and other fired clay which was rather finer textured than the rest and was interpreted as bell mould fragments. These last pieces contained vegetable temper and had areas of smooth, original surface; both core and cope portions of the mould were represented, the latter being 1-2 cm thick.* The mould material was fired to a red-brown colour except near the original surface (next to the bell) which was black to a depth of a centimetre or so. In addition to the fired clay, charcoal was found, much of it intimately mixed with blobs and dribbles of copper alloy. A selection of this metal was analysed by x-ray fluorescence and shown to be low lead, high tin bronze which is the sort of alloy used to cast bells (no fully quantitative analyses have been carried out). The unnumbered samples also included coal, one large smithing hearth bottom and pools and dribbles of mixed lead and lead oxides, most probably the skimmings from a melt that was about to be cast.

No attempt has been made to quantify the various materials reported above as it was not known whether they represented the entire fill of the bell pit or just samples from it. None of the coal (from the unnumbered samples) appeared part-burnt or had any traces of metal on it so there was no real evidence to suggest

it was used as a fuel in the bell-casting operation whereas the charcoal was intimately mixed with the waste metal and would therefore seem to have been used as fuel to melt the metal. The iron slag has no direct connection with the bell-casting; its presence, like that of the rest of the iron slag found in the church, is probably fortuitous; it may have been brought in with a batch of hardcore, for instance.

The lead/lead oxide masses are unexpected in a bell pit and probably have no connection with the bell-casting. Certainly the amount of lead in the bell metal has to be restricted as more than a percent of two affects the ringing tone of the finished bell. The lead is much more likely to be associated with the plumbing of the building; the roof, gutters and flashings may well have been of lead and the waste found is what one would expect where lead was being melted or remelted on any scale.

Some of the samples which did not come from the bell pit are obviously residual material from the bell casting operation redeposited in later contexts (eg finds nos. 1626-7, 1649). Others, such as the iron working slags, are probably also redeposited as mentioned above. The total amounts of material are not large which tends to reinforce the suggestion that most of it is not in situ but is redeposited in the contexts in which it was found.

Glossary of terms used

Iron slag is produced by iron working processes. Often it is possible to differentiate between smelting slags, such as tap slag, and smithing slags. The latter are often found in a plano-convex bun shape which collected at the bottom of the hearth (also called hearth bottoms).

Hearth lining is clay that is vitrified on one surface from contact with the fire in the hearth.

Fuel ash slag is silica-rich material such as sand or clay that has reacted with the ash in a fire at high temperatures. It need not be, though normally is, associated with metalworking or some sort.

After the above report had been written three further samples (AM 821388-90) were presented for examination. The first was some lumps of lightly fired clay while the other two were pieces of bell mould.

* This may have had an additional outer layer, to give it greater strength though none survives.

APPENDIX: IDENTIFICATIONS OF "SLAGS" FROM WHARRAM PERCY CHURCH

The items marked * have been re Lab numbered and sent to conservation.
The items marked B come from the bell-pit.
Question marks denote uncertainty.

AML NO	FINDS NO	DESCRIPTION/IDENTIFICATION
785206	954	Overfired vesicular grey clay
"	1109	Hearth lining and dribbles of copper alloy
"	1111	Spongey mass of lead and its oxides, probably skimmings from a melt of the metal
"	1487 ? B	Droplet of copper alloy
"	1556	Iron object *
"	1622	Charcoal
"	1626	Copper alloy dribbles
"	1627	"
"	1632	Smithing slag
"	1649	Copper alloy dribbles
796397	333	Fuel ash slag
796398	1670	Part-burnt coal
800265	348	Overfired clay
"	355	Part of bun of smithing slag
"	365	Iron nails *
"	366	Iron nail fragments *
"	372	" *
"	374	Iron fragments *
"	383	Lots of iron nails *
"	392	Iron fragment *
"	399	Iron nail *
"	415	Smithing slag and?lump of iron *
"	439	Iron nail *
"	446	Spongey mass of lead and its oxides (cf. finds no. 1111, above)

AML NO	FINDS NO	DESCRIPTION/IDENTIFICATION
800265	452	Iron stained stone
"	456	2 fragments plain window glass *
"	458	Burnt clay
"	462	Iron corrosion products and soil
"	466	Iron fragments and spherical iron-rich ?fossil (1 cm diameter)
"	467	Ferruginous (limonitic) sandstone?
"	515	Iron nail fragments *
"	516	" *
"	520	Roasted iron pyrites nodule
"	522	Large oval bun of dense iron slag
"	534	Iron nails *
"	551	Part-burnt coal
"	554	Iron nail head *
"	570	Iron nail *
"	645	Bun of smithing slag
"	786	Iron lump *
"	798	Dribble of copper alloy
"	826	Fuel ash slag
"	848	Smithing slag
"	865	Dense iron slag, possibly produced during smelting
"	870	Bun of smithing slag
"	871	Pyrites nodule (unroasted) and spongey mass of lead oxides (cf. finds no. 1111, above)
"	874	Part of bun of dense iron slag
"	876	Smithing slag
"	886	Iron slag (? smithing)
"	915	Part of bun of dense smithing slag
"	1283	Large bun of smithing slag

AML NO	FINDS NO	DESCRIPTION/IDENTIFICATION
800265	1284	Fuel ash slag
"	1431	Smithing slag
"	1531	Fuel ash slag and dribble of copper alloy
"	1532	Hearth lining
"	1609	Smithing slag
"	1662	Half of bun of smithing slag
"	1668	Smithing slag
"	1669	Fuel ash slag
"	1680	Bun of smithing slag
"	1682	Smithing slag
"	1685	"
"	1690	Fuel ash slag
"	1691	Iron nail *
"	1697	Smithing slag
"	1698	Fuel ash slag
"	1712	Burnt bone fragment
"	1718	Fuel ash slag
"	1874	Iron fragment *
"	1879	Dribble of copper alloy
"	1880	Smithing slag
"	1929	Overfired clay
"	1982	Iron slag, probably smithing
"	1992	Smithing slag, hearth lining and a bun of smithing slag
"	2104	Iron nail and smithing slag
"	2105	Fuel ash slag
"	2158	Smithing slag
"	2177	Fuel ash slag
"	1308	Iron staining on soil/stone

AML NO	FINDS NO	DESCRIPTION/IDENTIFICATION
800265	1645	Vesicular charcoal
801177	205	Part-burnt coal
801178	354	?Over fired clay with mortar on surface
801179	360	"
801180	372	Part-burnt coal
801181	616	Fired clay with accidental (ash) glaze
801182	683	Part-burnt coal
801183	693	"
801184	817	"
801185	854	"
801186	356	Tap slag
801187	954	Fuel ash slag
801188	2063	"
801208	1494	Copper alloy dribbles
801209	"	Hearth lining, fuel ash slag, copper alloy blobs and charcoal
801210	(Q19)B	Dribbles of lead
801211	1489	? Ashy soil
801212	1490 B	Lead dribbles
801213	1491 B	Mixed fired and unfired clay. Charcoal.
801214	" B	Part burnt block of unfired clay with chalk or mortar on some surfaces
801215	1568	Fire shattered flints and roasted ferruginous sandstone
801216	-	Coal
801217	1125 B	Two types of fired clay; one fine grained and hard fired, the other much softer and sandier. This latter could be bell mould material
801218	1126 B	Iron nails, unfired clay, fragments of bell mould, dribbles of copper alloy, stone, part burnt coal, charcoal and bone.

AML NO	FINDS NO	DESCRIPTION/IDENTIFICATION
801219	1127 B	Bell mould fragments; pink-coloured chalk
801220	1128 B	Blobs of copper alloy and fragments of bell mould, both core and cope
801221	1136 B	Coal, charcoal and dribbles of copper alloy
801222	1173	?Unfired brown sandy clay
801223	1340	Large lump of copper alloy
801224	1344 ?B	Blobs of copper alloy
801225	1407/8 ?B	"
801226	1240	Dense iron slag, probably smithing
801227	1425 ?B	Chalk with copper staining
801228	1427 ?B	Copper alloy blob
801229	1432 B	Copper corrosion products
801230	1454 ?B	Charcoal and blobs of copper alloy
801231	1471 ?B	Dribble of copper alloy
801232	1072 B	Deeply corroded copper alloy and part burnt coal
801233	1074 B	" and copper alloy blobs
801234	1077 B	Bun of smithing slag
801235	" B	Copper alloy blobs and fragments
801236	1079 ?B	Copper alloy blob
801237	1096 ?B	Part-burnt coal
801238	1104	Fired clay and mass of spilt copper alloy
801239	1108 B	Charcoal, bell mould, copper alloy blobs, flints, ?sandstone and pink-coloured chalk
801240	1118 B	Sandy clay, possibly part of core of bell mould but no original surfaces survive
801241	1119 B	Unfired clay
801242	1120 B	Bell mould fragments
801243	1121 B	Poorly fired sandy clay with vegetable tempering; possibly bell mould material

AML NO	FINDS NO	DESCRIPTION/IDENTIFICATION
801244	1122 B	?ashy soil
801245	1123 B	Copper alloy fragment
802346	1124 B	pink-coloured chalk, copper alloy dribbles, bell mould fragments, coal, charcoal and an iron nail

All the copper alloy was analysed qualitatively by x-ray fluorescence and shown to be low lead bronze.