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Technological finds from Billingborough, S Lincolnshire

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Assorted finds which were thought to be of technological origin were submitted for examination and identification (AML No 830469). The bulk of the finds were either iron slag or fired clay though smaller amounts of other material were also noted. The total weight of the samples was about 4 kg. Individual identifications are given in the Table below. There is little difference in the range of materials present in contexts of different date which suggests that many of the finds in later contexts are redeposited from earlier levels. Certainly there is nothing that could not be iron age in origin.

The iron slag indicates ironworking, though probably on a fairly small scale as the total quantities are not large. The question is whether the iron was being smelted from its ores or just worked by a blacksmith. Some of the slag has the porous, open texture usually associated with smithing but much of it is rather denser and less vesicular which suggests higher temperatures than are normally obtained in a smith's hearth. Some of the slag is small, irregular pieces but some is in the form of plano-convex buns which collected at the bottom of the hearth or furnace. There is no tap slag (a sure indicator of smelting) but this would be very unusual in an iron age context as the furnaces in use then were of a non-tapping type. It is therefore possible but by no means certain that iron was being smelted at Billingborough. The occurence of several pieces of ironstone among the finds supports this suggestion but none of them had been roasted, a necessary preliminary to smelting, so their

presence could just be fortuitous. More detailed analytical work on the slag (which is now planned) may be able to confirm or refute the possibility that iron was smelted on site.

The rest of the slag is fuel ash slag which forms when silicate materials such as sand or clay are heated strongly in contact with the ash of a fire. The alkalis in the ash react with the silicates producing vitreous slags. Fuel ash slags contain far less iron than the iron slags and so are lighter in weight and often paler in colour. Fuel ash slags are not necessarily an indicator of industrial processes as they can form in any fire at high enough temperatures but they are often found associated with other evidence for metalworking. One specific form of fuel ash slag is described as hearth lining; the clay lining to a hearth is vitrified on the surface in contact with the fire so a gradient can be observed from glass surface through to ordinary fired clay further from the fire. Sometimes a bellows was put into the hearth so higher temperatures could be obtained. The usual evidence for this is a tuyere, a regular circular hole in the hearth lining with the immediate surroundings heavily vitrified as the air blast produces a localised hot spot. One example of a tuyere came from context 7 (167); the diameter of the hole was about 4 cms which is rather larger than is usually found.

The rest of the samples can be described as fired clay. There are a variety of fabrics but most are fairly fine and contain little temper. They show a range of firing conditions from strongly oxidising to reducing. Many of the lumps have some evidence for one or more original surfaces but it is difficult to assign forms and hence to suggest uses when the majority of pieces are so small. A few bits would appear to have been daub as traces of the wattles survive on them. Many of the pieces have a pale-coloured surface, either grey-green, cream or off-white. This

decolourisation of fired clay happens when the water mixed with the raw clay is brackish or saline or the clay is calcareous. The soluble salts in the clay tend to concentrate on the surface having migrated there in the water which evaporates as the clay dries out. These salts, particularly chlorides, will react with the iron present in the clay forming ferric chloride which volatilises readily at about 800°C leaving an iron-depleted surface layer to the clay which is pale coloured. The effect has been noted on fired clay associated with salt boiling but is found more widely in areas where the ground water is brackish. At Billingborough its occurance is not unexpected and does not necessarily mean that all the pale-surfaced fired clay was a by-product of salt-working.

Two final samples were small fragments of copper alloy sheet. They were analysed by x-ray fluorescence and shown to be bronze (copper + tin). This alloy was used from prehistoric times onwards so the composition of the metal cannot be used to date it. The fragments were probably parts of objects rather than waste from a metalworking operation.

Table: Identifications of finds

The dimensions given for the slag 'buns' are major diameter × minor diameter × depth (in cms).

Context	Finds no	
1	7	Copper corrosion products on a ferruginous lump. ? iron pan
	8	Bronze sheet fragment (Cu + Sn detected by XRF)
	22	Fuel ash slag
	25	Dense iron slag
	47	Iron slag (smithing)
	72	Dense iron slag

	101	Part of plano-convex bun of dense iron slag
	128	Dense iron slag
	148	Fragment of a plano-convex bun of iron slag
	149	Iron slag
	152	Iron slag (smithing)
	153	"
	154	"
	155	Hearth lining
	156	Iron slag (smithing)
	171	Iron slag
	177	Iron slag and fuel ash slag
	305	Iron slag
2	223	Fired clay lump with pale grey-green surface
4	225	Fired clay; pale grey-green colour
	226	Fired clay; red burnt core with white surface
	252	Fired clay; colours range from reddish brown to black and white
	377	Iron slag
	381	Iron slag
	382	Fired clay lumps red/pink to pale grey-green Fired clay with ?shell inclusions
7	157	Plano-convex bun of iron slag 8 x 6 x 2
	158	Fragment of bun of iron slag
	159	Iron slag
	167	Tuyere fragment (hole diameter - 4 cm)
	168	Iron slag
	176	Fuel ash slag
	178	Iron slag
	180	Fuel ash slag
	184	Hearth lining
	198	Iron slag
	199	Fuel ash slag
	204	Vitrified stone?
	208	Part of plano-convex bun of iron slag
	209	Hearth lining
	238	Iron stone
	244	Part of plano-convex bun of iron slag 8 x 6? x 3
	288	Dense iron slag and fuel ash slag
	334	Fired clay with sparse large (2 mm) inclusions. Buff/yellow/pink

	390	Part of bun of iron slag. ? x 8 x 4
	391	Fired clay (black)
8	182	Pink fired clay with off-white surface patches
	196	Red fired clay with large white (bone/chalk/ shell) inclusions
	217	Iron slag
	219	Bronze sheet fragments (Cu + Sn detected by XRF)
	354	?Fired clay, red and black ? daub
9	339	Ironstone
	351	Pink fired clay with off-white surface
10b	301	Fuel ash slag
20	133	Iron slag
	138	Fuel ash slag
26	103	Iron slag
	104	Fuel ash slag
	111	Iron slag
35	190	Red fired clay
	194	"
	213	Fired clay ? daub
	363	Fired clay with pale surface
	364	Coarse textured fired clay
43	389	Bun of iron slag 6 x 5 x 1½
78	313	Ironstone and ?ironpan
102	162	Iron slag
	164	Iron slag and fuel ash slag
	179	Fuel ash slag
125	396	Iron slag
134	200	Fuel ash slag
139	388	Dense iron slag
140	211	Iron slag
141	251	Pink to off-white fired clay
150	259	Iron slag
	260	Black and red fired clay
	373	Ironstone
225	310	Hearth lining
	350	Pink fired clay with a whitish surface
229	315	Red/pink/white fired clay
231	312	Iron slag
256	399	Fired clay