

Analysis of the pyrotechnical residues
from Blackhall Place, Mullingar,
Co. Westmeath
(E2497/C040)

Introduction

A large area was excavated ahead of construction work at the location of the former Dominican priory in the western part of Mullingar, Co. Westmeath (Breen 2007). Just under 47 kg of material recorded as relating to metalworking was identified, with nearly half of this (21.8 kg) retrieved from the modern fills of an earlier feature. Several kilogrammes of material belonged to the late medieval period and comprised iron, copper and lead working residues.

Description of the material

The bulk of the material falls into two broad categories: on the one hand dense slag, often with charcoal inclusions and in several cases forming bun-shaped lumps, and on the other hand light to medium density pieces of a cindery substance, often with a shiny exterior and frequently containing stoney inclusions.

The former category is readily recognizable as the typical residues associated with early charcoal black smithing. The bun-shaped lumps (Pl.1), previously frequently misidentified as 'furnace bottoms', represent the iron lost during smithing fused with material from the fuel, the sides of the hearth and potentially added substances. These are commonly known as Smithing Hearth Cakes (SHC). Early iron smithing also led to the formation a wide range of other, less well formed slaggy residues, several examples of which are also represented in the Mullingar material.

The other, cindery, material (Pl.2) is less easily identifiable. It is very homogeneous, generally light and often contains stoney material. Many of the pieces have tiny, often shiny, globules attached to their outer surface. These are reminiscent of globular hammerscale, but are non-magnetic to slightly magnetic, whereas hammerscale is typically highly magnetic. Moreover, globular hammerscale is regarded as the result of forge welding (Young 2011) and will normally be found together with flake hammerscale, which results from hot-forging of iron. No flake shaped particles were observed adhering to the Mullingar material. It is possible that these globules are related to the so-called 'fuel ash spheroids' mentioned in the same work (ibid.:28-29). No fuel residues were observed as inclusions in this cindery material, which could imply a complete burning of coal (or charcoal) or, more likely, the use of peat as fuel. The use of coal would generally also result in pieces of shale ("coal-shale") being incorporated into the waste material, something not observed in the Mullingar residues. The material is sometimes slightly magnetic, which does not necessarily point to the working of iron, but could be the result of impurities in the fuel (e.g. pyrite or iron sulphide in coal) or of the use of iron containers or implements. No iron particles or droplets were observed as inclusions in this material and a non-metallurgical origin is suggested, most likely the cinders from an industrial heating installation (boiler, flour drying, etc.).

Another type of material consists of vitrified clay with adhering slag. Although no fragments show evidence of a blow-hole, the piece from deposit c.146 has a clear curving rim (Pl. 3), indicating this is a fragment of a clay tuyere or bellows protector. The curvature allows calculating the original circumference of the piece to around 16 cm. It is assumed the other vitrified clay material also represents tuyere fragments. Ceramic tuyeres are a common feature associated with early iron smithing in Ireland, and they seem to have still been in use by the 17th and possibly 18th or 19th century (Young 2004, 2008).

The non-ferrous residues include small lumps (Pl. 4) of, and ashy layers containing, copper on the one hand, and flat pieces showing flow structure and with a high lead content (Pl. 5) on the other.

Distribution and stratigraphy of the residues

The distribution of the residues resulting from metalworking are represented on Fig. 1 (the tallest column representing the lead residues at the western side of the site equals just over 3 kg). Pieces from contexts with medieval material were distinguished from contexts with later material by using bright versus lighter colours. The iron smithing slag is fairly spread out, but one concentration (or possibly two) can be made out in the centre of the excavation area. Perhaps significantly, all the tuyere material was found within this concentration/these concentrations. The occurrence of the majority of both the slag and the tuyere material from later contexts in the same area(s) indicates this later material was very likely part of the medieval assemblage, but moved and redeposited by later activity.

The bulk of the non-ferrous residues is clearly concentrated on the western side of the site, with only a single piece of copper containing material found elsewhere. A mould or crucible (fragment?) from c333 listed in the finds register, but not included with the study material, could indicate some non-ferrous working also took place in the central concentration area(s). The main lead-working hearth (F24) is not directly dated (it cuts medieval features and is covered by a post-medieval deposit), but a nearby layer (c.666) containing lead waste, copper waste and medieval material suggests the non-ferrous working in this area also to be late medieval. Just over 3 kg of the lead residues were recovered from the hearth which measured 35 by 23 cm and was 35 cm deep. The weight of the material, if it does not represent a multi-phase accumulation of debris, points to relatively large amounts of lead being liquefied. This could be connected to the making of stained glass windows, the conversion of lead bars to roofing or vice versa, when the roof was being removed.

All the above material seems broadly contemporary, i.e. (late) medieval based on the associated ceramics, but when the pottery analysis is finalized it may be possible to distinguish chronologically between areas and/or metals. Also, once the stratigraphy and chronology of the wall/foundation trenched has been clarified, the distribution of the material will be better delineated and might, for example, clarify if the material in the centre of the excavation area consists of one or more concentrations.

Lead-working hearth F24 was interpreted as associated with another nearby hearth (F29) (Breen 2007:46-47), while another hearth (F257) was located on the border between the areas A3c and A3f. The latter contained medieval material, and although it contained no metalworking residues, it could be connected to the nearby metalworking residues. There were no hearth features observed near the central concentration area(s), which could either mean that they were destroyed by later activity, the material was imported from elsewhere (unlikely due to the distribution and nature of the material, i.e. spread out over multiple layers and frequently including small fragments) or the metalworking was undertaken at waist-height. Waist-high forges are normally square and stone or brick built. The latter may be indicated by one piece of slag from c.365 showing it was attached to a vertical flat surface. No feature corresponding to a waist-high forge was found in the report, but this type of installation can, after dismantlement, leave very few traces.

Over three quarter (77.13% or 21.8 kg) of the cindery material (total 28.3 kg), by weight, was recovered from two fills (c.105 and c.123) of the large stone lined feature (F113). These layers contained both medieval and later finds. Further cindery residues were recovered from various garden soils and organic layers (3.24 kg), rubble layers and deposits (1.09 kg), a wall (c.12; 59 g), a kiln (c.59; 24g), a pit (c.1446; 141 g) and a ditch (c.642; 471g). Three deposits with medieval material (c.631, c.633 and c.635) contained a combined 1.45 kg of the same cindery material,

suggesting the ceramic material to be residual. Although fill c.197 of ditch c.198 contained both large amounts of medieval material and a small SHC, it also had some of the cindery material, which is either intrusive or dates this feature to a later period.

Conclusions

The medieval material points to the smithing of iron and the melting down of copper and lead. In all, the medieval metalworking at Blackhall Place does not seem to have been long lived or conducted in a specially created space. It is likely that the residues represent short periods of activity, likely associated with construction, repair or, in the case of the lead, possibly demolition works.

The cindery material would seem to be dumped material from a nearby industrial process. No such industries can be made out on the 1840 or 1910 OS maps, but the amounts are relatively small, which could indicate the material was produced in a small boiler or other heating installation. The lack of indications for the use of either coal or charcoal could imply that peat was used, a fuel source readily available in the Mullingar area.

Bibliography

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Figures

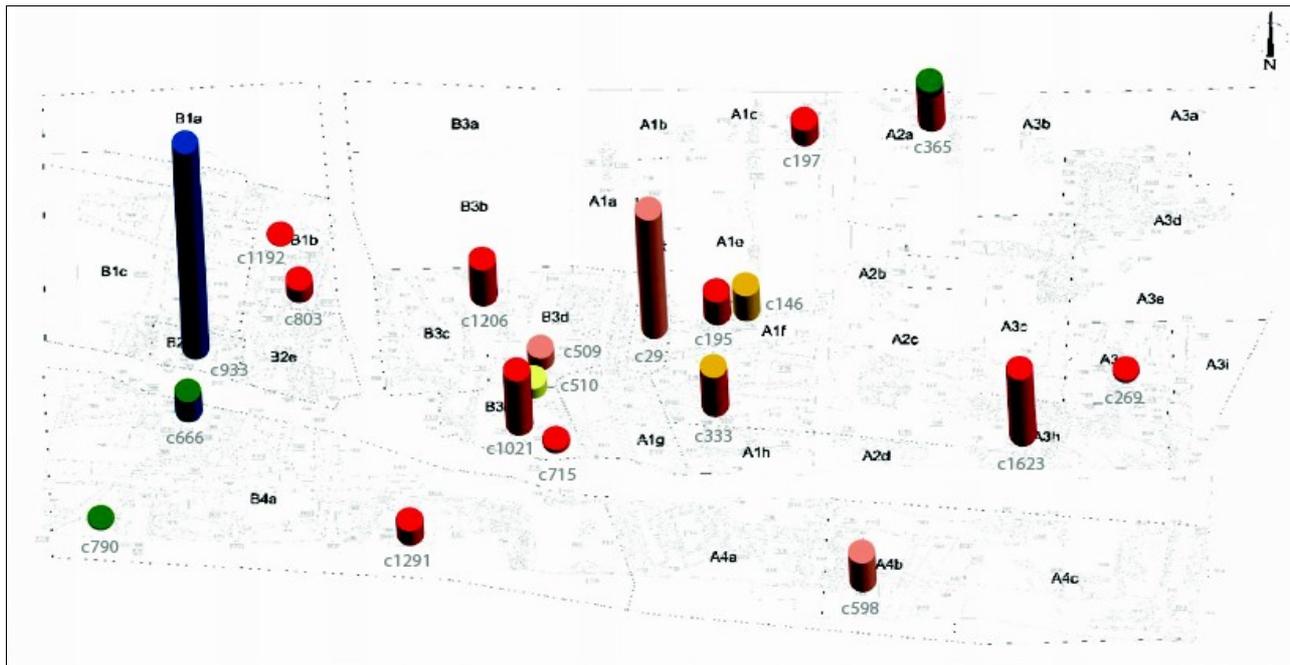


Fig. 1 Distribution of the located iron, lead and copper working residues.

Key: Red: iron slag from medieval contexts; Pink: iron slag from later contexts; Yellow: vitrified ceramics (tuyere) from medieval contexts; Pale yellow: vitrified ceramics (tuyere) from later contexts; Blue: lead working residues (medieval); Green: copper working residues (medieval).

Plates



Pl. 1. Smithing Hearth Cake with rusty upper crust, from c.1206



Pl. 2. Large piece of cindery material, showing frequent stone inclusions, sample 62 from area A2.



Pl. 3. Tuyere fragment showing outer curving rim, from c. 146



Pl. 4. Small lump of copper (alloy), from c. 1132



Pl. 5. Piece of lead production waste, from c. 933

Catalogue

Fill	Cut	Feature	Sample no.	Description	Weight (g)
4	NA		12	Two pieces of shiny cindery material with stoney inclusions (quartz)	114
4	NA		12	Heavily corroded iron object	16
4	NA		14	Small lump of cindery material	16
4	NA		56	Piece of dark rather dense, vitrified material with protruding shiny lobe. Burnt limestone inclusion.	63
4	NA		74	5 fragments of cindery material	195
4	NA		98	6 pieces of rather dense slag with rusty patches. Charcoal inclusions/impressions	333
4	NA		115	Small piece of cindery material with burnt limestone inclusion.	10
4	NA		116	Three pieces of light cindery vitrified material. Burnt limestone.	84
5	NA		54	Large piece of light cindery material	367
12	NA	193	17	Four pieces of cindery material, limestone inclusions.	51
12	NA	193	108	Fragment of shiny cindery material	8
14	NA	185	6	Small fragments of iron	
15	NA		7	Piece of heat affected brick	
15	NA		34 (1)	Piece of cindery material	104
15	NA		34 (2)	c. 40 pieces of light cindery material, some with burnt limestone inclusions.	1322
16	NA		43	Dark grey clayey material with compacted ashy layers with copper inclusions	91
16	NA		91	10 fragments of granite like stone	
16	NA		91	Piece of heavily corroded iron	
16	NA		99	Two fragments of heavily corroded iron plate	
16	NA		118	Small piece of cindery material.	1
29	NA	127	64	Large bun-shaped SHC	1787
42	NA		93	Two pieces of cindery material with stoney inclusions	54
43	NA		77	Small piece of heavily vitrified brick	
51	NA		21	Elongated piece of cindery material.	19
58	NA		44	Small nodule of probably heavily corroded iron	
58	NA		90	24 pieces of light cindery material, some with burnt limestone inclusions.	1270
86	NA	251	28	Piece of heavily vitrified brick	
94	NA	194	16	Piece of coal	
94	NA	194	105	7 pieces of heat affected brick, some with adhering cindery material	
98	NA		63	7 pieces of cindery vitrified material, some with stoney (quartz) inclusions	242
98	NA		63	1 piece of corroded iron plate	
105		113	72	Two pieces of cindery material with stoney inclusions	92
105		113	87	27 pieces of light cindery material. Burnt limestone inclusions.	795
105		113	94	c. 50 pieces of light cindery material. Burnt limestone inclusions.	1277
105		113	128	62 pieces of cindery vitrified material Inclusions of burnt limestone.	699
105		113	129	100+ pieces of cindery vitrified material. Stoney (quartz/limestone) inclusions	4018
105		113	130	100+ pieces of cindery vitrified material. Stoney (quartz/limestone) inclusions	2391
123		113	55	100+ pieces of cindery vitrified material. Stoney (quartz/limestone) inclusions	2830
123		113	69	28 pieces of light shiny cindery material. Burnt limestone inclusions.	255
123		113	73	Five pieces of shiny material with stoney (quartz) inclusions.	79

Fill	Cut	Feature	Sample no.	Description	Weight (g)
123		113	120	c. 40 pieces of light cindery material. Burnt limestone inclusions.	761
123		113	120	Three pieces of highly oxidised iron, one with coal inclusions.	
123		113	122	32 pieces of light cindery material. Burnt limestone inclusions.	1349
123		113	124	14 pieces of light heavily vitrified material. Quartz inclusions	184
123		113	124	Two pieces of corroded light iron-rich material (burnt iron?).	
123		113	124	Piece of iron	
123		113	125	c. 40 pieces of light cindery material, some with burnt limestone inclusions.	598
123		113	127	5 pieces of shiny vitrified material with stoney (quartz) inclusions.	322
123		113	127	Two pieces of corroded iron	
123		113	131	18 pieces of cindery material and vitrified brick	427
123		113	132	100+ pieces of cindery vitrified material, some with stoney (quartz/limestone) inclusions	2832
123		113	134	100+ pieces of cindery vitrified material, stoney (quartz/limestone) inclusions	2927
146	NA		67	Fragment of vitrified ceramics (tuyere) with adhering slag. Diameter c. 15 cm. Finely sorted clay with calcium rich inclusions. Charcoal inclusions.	377
147	NA	135	37	Fragment of vitrified brick	
148	NA	135	66	7 pieces of dark grey clay impregnated with copper	37
179	NA	176	102	Three pieces of low quality brick	
187	NA		113	Piece of heavily corroded iron	
191	71	155	18	Piece of cindery material with quartz inclusions	24
195	NA	135	61	Irregular rusty SHC with adhering lump of dense grey slag. Charcoal and burnt bone inclusion.	345
197	231	150	95	1 smallish well shaped round SHC, oxidised. Charcoal inclusions.	231
197	231	150	95	8 pieces of light cindery material. Stoney (quartz/limestone) inclusions.	220
213	NA		36	Piece of mortar	
213	NA		59	5 pieces of heat affected brick	
213	NA		65	8 pieces of highly vitrified brick	
213	NA		65	9 pieces of corroded iron plate	
213	NA		88	Piece of light cindery material	105
213	NA		88	Five pieces of corroded iron	
213	NA		107	Two fragments of vitrified brick	
218	NA		110	Small fragment of cindery material	7
227	NA	258	81	Piece of concrete	
269	NA		117	Fragment of shiny rather dense slag	36
314	NA	231	84	Piece of heavily vitrified white material, with shiny outer surface. Probably heavily burnt stone.	67
333	NA	144	15	Small fragment of rather dense slag with slight flow structure	20
333	NA	144	19	Two pieces of relatively dense oxidised slag, charcoal impressions	117
333	NA	144	19	Vitrified ceramic material (likely tuyere) with adhering slag. Ceramic material is finely sorted and slightly oxidised.	81
333	NA	144	68	Fragment of flat, oxidised SHC, charcoal impressions.	433
365	NA		45	8 pieces of very dense homogenous slag, one piece showing flow structure	516
365	NA		45	One piece of heath affected stone with adhering vitrified material. Some droplets of copper containing material attached to the surface.	80
365	NA		51	Two pieces of rather dense slaggy material with one piece having been attached to a vertical surface	96

Fill	Cut	Feature	Sample no.	Description	Weight (g)
395	396	156	78	Piece of heavily corroded iron	
400	402		71	Small piece of mortar	
509	NA		29	Roughly half of a flat SHC with a blob of lighter material adhering on the upper surface	180
510	NA		9	Vitrified ceramic material (likely tuyere) with adhering slag. Ceramic material is finely sorted and oxidised.	29
510	NA		40	14 pieces of cindery material, some with limestone inclusions	138
510	NA		114	Piece of corroded iron	
511	1446	109	79	Small piece of cindery material.	6
522	NA		2	Piece of rather dense slag with greenish glaze on one end	30
523	1446	109	126	5 pieces of shiny vitrified material. Burnt limestone inclusions	141
527	NA		106	One piece of light cindery material	7
537	526	192	112	Small lump of heavily corroded iron	
555	NA	201	50	Piece of light cindery material	189
555	NA	201	53	Two small, unusually shiny pebbles (?) attached (but now broken) by iron containing rod. Jewelry?	
567	NA	112	41	Heat affected limestone	
598	NA	204	80	Dense rounded SHC with oxidised upper part, charcoal inclusions	431
631	NA		89	c. 40 pieces of light cindery material, some with burnt limestone inclusions.	1235
633	NA		119	Three pieces of cindery material, one rather dense one adhering to vitrified (sand?) stone	205
635	NA		111	Four small fragments of cindery material	11
649	642	69	52	Large piece of light cindery material	471
666	NA	63	4	Elongated piece of solidified lead	298
666	NA	63	4	Small piece of copper stained material	2
668	NA		101	Four fragments of corroded iron	
672	NA		20	Three pieces of cokes	
672	NA		21	Piece of cokes	
672	NA		32	Piece of heat affected (coal?) shale	
672	NA		76	Piece of oxidised iron	
715	NA	117	24	Fragment of dense slag with iron oxide encrustations	50
790	NA		3	Rather dense piece of slag with green copper coating	13
794	NA		25	Piece of heat affected (sand?) stone.	
803	NA		75	Three pieces of corroded iron	
803	NA		92	Fragment of very dense homogenous slag	184
844	NA		31	Heavily corroded piece of iron (nail?)	
857	856	278	23	Piece of mortar	
874	NA		138	Piece of heavily corroded iron	
933	930	24	136	Multiple flat pieces of solidified lead, with charcoal impressions.	3099
946	873	276	38	Fragment of dense, nearly homogenous slag with charcoal impressions	205
981	NA		39	Three pieces of very corroded iron	
1021	NA		133	Elongated, dense SHC with rusty encrustation on both sides, charcoal inclusions and impressions. Patch of calcium rich material at one end	373
1021	NA		133	Rounded SHC with extension on one side, generally rusty with denser rust on lower side. Charcoal inclusions/impressions.	443
1030	NA		109	Two fragments of a piece of heavily corroded iron	
1132	NA		137	Large droplet of copper (alloy)	35
1136	1028	48	135	Multiple pieces of compacted clay	
1184	1184	59	26	Fragment of fired clay	
1192	NA		11	Small droplet of light shiny slag	6
1206	NA		5	Piece of heat affected limestone	
1206	NA		121	Elongated dense SHC with iron rich upper crust, charcoal impressions	538

Fill	Cut	Feature	Sample no.	Description	Weight (g)
1231	NA		123	Two pieces of very light shiny cindery material	20
1291	NA	91	27	Roughly half of a bun shaped SHC with a thin oxidised layer on the upper surface	216
1623	1623	250	97	Large rather irregular, dense SHC (potentially two fused SHC's) with oxidised upper layer. Charcoal inclusions/impressions	1003
?			70	4 pieces of light vitrified material with stoney (quartz/limestone) inclusions	394
12			96	Two pieces of light cindery material	18
N/A			1	Three fragments of coal (anthracite)	
N/A			8	7 fragments of compacted ashy and heavily copper stained material	41
N/A			10	Heavily corroded iron object	
N/A			13	Fragment of shiny rather light cindery material with some limestone inclusion	52
N/A			30	Fragment of heat affected brick	
N/A			33	Three shiny lobes of vitrified material	41
N/A			42	Elongated rather dense SHC, charcoal inclusions	219
N/A			46	4 pieces of corroded iron	
N/A			47	Small piece of cindery material.	26
N/A			48	Corroded iron object	
N/A			49	Three pieces of cindery material, quartz inclusions	41
N/A			57	Two heavily corroded iron objects (nails?)	
N/A			58	Fragment of heat affected brick	
N/A			60	Piece of corroded iron	
N/A			62	Large piece of light cindery material	1549
N/A			82	Large fragment of dense homogenous slag, charcoal inclusions	354
N/A			83	1 piece of low quality brick	
N/A			85	c. 40 pieces of light cindery material, some with burnt limestone inclusions.	1934
N/A			86	c. 50 pieces of light cindery material. Burnt limestone inclusions.	1302
N/A			100	Piece of burnt bone with clayey encrustation	
N/A			103	Small, rather dense SHC with oxidised upper surface. Some charcoal inclusions	168