

Report on the metallurgical residues from the
1989 to 1994 excavations at
Dysart, Co. Kilkenny

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Introduction

Excavations at Dysart in Co. Kilkenny, on a site inhabited from Early Medieval times to the eighteenth century (Murtagh 1994), revealed just under five kilograms of material related to the working of both iron and copper. The material was examined visually through a binocular microscope and the descriptions and weights were entered in the appended catalogue. Information on contexts, chronology, etc. was provided by site director Ben Murtagh.

Description of the material and features

Just under 5kg of remains connected with metalworking were recovered from the various trenches at Dysart (see catalogue). A lot of the slag is heavily weathered and has lost its original appearance, making interpretation difficult. Additionally, the site was subject to rather intensive treasure-hunting activities in modern times, leading to the disturbance of much of the finds and features. Only one feature is directly connected to metalworking, but others could either have been destroyed by later activity or are located outside of the excavated areas.

Most of the slag from Dysart has a more or less convincing drippy structure resulting from the solidification of fluid slag (Pl. 1). This is normally seen as the result of smelting, i.e. slag cooling as it leaves the furnace, but is also known to occur occasionally in smithing environments. Several of the drippy pieces in the assemblage are very likely the result of smelting, with the rest only potentially so. Other pieces of slag are bun-shaped lumps recognizable as smithing hearth cakes. One example consists of two such cakes fused together (Pl. 2), which is generally interpreted as the result of not cleaning out the hearth before the next operation.

Another type of material consists of concretions of hammerscale, small pieces of iron and earthy particles (Pl. 3). This is typical smithing hearth pan which forms as a layer in the immediate vicinity of the anvil. The included hammerscale is mostly flake-shaped, but globular pieces are also present. Flake hammerscale is the result of the hammering of hot iron, while the globular variety is formed during forge-welding (Dungworth and Wilkes 2009).

Several pieces of vitrified ceramics were retrieved during the excavations. One piece has a convex outer surface and is thus highly likely part of a ceramic bellows protector or tuyere. Another piece shows what might be a smoothed hollow, which is potentially the blowhole of one of these tuyeres (Pl. 4). Other ceramic material consists of three pieces of heavily heat-affected clay. Two of

these show teardrop-shaped sections (*c.* 4 by 3cm) and convex termini which are slightly larger than the rest of the piece (Pl. 5 and 6). One of these pieces has a small portion of smithing pan adhering to it. Near-identical pieces were observed at the late twelfth- to thirteenth-century site at Tuckey Street in Cork City (Rondelez 2012) (Pl. 7) and the eighth- to eleventh-century Viking site of Haithabu (Westphalen 1989:20,100; Westphalen 2004:26-27) (Pl. 8), in both cases from contexts connected to ironworking. At Haithabu, as at Dysart, there was evidence for copper-working, but not at Tuckey Street. At the latter site these were tentatively, and unconvincingly, interpreted as plugs for tuyeres (*ibid.*). An exact function for these “clay plugs” has not been found, but it is likely that they were placed within an iron object during forging, either to preserve a teardrop-shaped hollow during object (axe?) manufacture or to protect such a hollow during further alterations (carburization/brazing)¹.

Several pieces of material consisting of, or containing, copper alloy were also recovered. Most seem to be production waste and several shapes are discernible: thick flat pieces (Pl. 9), a droplet, a tubular length and semi-circular fragment (Pl. 10). Other pieces are more slag-like and several small flakes could be fragments of objects.

Pit (557) was the only feature probably related to metalworking. It measured 110 by 44cm and was *c.* 20cm deep. A large flat stone was embedded in the centre of its northern edge, partially overlying the fills (Pl. 11). The stone was sub-circular (49 by 39cm) and was fractured in the middle. The occurrence of relatively high amounts of smithing pan would indicate that this feature was used as a smithing hearth; the stone then likely functioning as an anvil. Late medieval stone anvils consistently occur on sites that also have evidence for smelting activities, suggesting that these are connected to bloom smithing (unpublished doctoral research by the author).

Spatial and chronological distribution of the remains

The assemblage can be broadly subdivided into three areas of recovery: inside the church at its eastern end (Trench J), around the western end of the church (Trenches E, F and I) and at the southern end of the Berkeley House (Trench D). Area J revealed 446g of possible smelting slag and around 140g of copper alloy material, including the tubular and the semi-circular piece. The material from around the western end of the church consisted of slag with flow-structure (898g), the possibly fused smithing hearth cakes (396g) and indeterminate slag (698g). The two pieces of (possible) tuyere were also found in this area, as were several smaller pieces of copper alloy

¹ Thanks to Tim Young for assistance in attempting to unravel this issue.

material, including lumps and the flatter pieces (92g). From Trench D came 995g of potential smelting slag, 383g of smithing hearth cake material, 174g of unclassifiable slag and 602g of smithing pan. All the smithing pan, and various other slag fragments, was recovered from the fill of probable smithing hearth (557). The same feature also contained the 'smithing plugs', together with probable smelting slag with a fresh appearance. An associated layer (556) yielded a small amount of copper-working residue, while the layer overlying this activity (550B) had more slag, both potentially smithing and smelting. Further trenches revealed small amounts of both possible smelting slag and copper alloy material. There are no characteristics which can distinguish the possible smelting slag from the different trenches, but both the technical ceramics and the copper alloy material do seem to differ according to area. The smithing pan is also confined to one area, while the other smithing residues are too small in number to permit conclusions to be drawn.

All the material from the Early Medieval contexts turned out to be natural. The earliest securely dated finds related to metalworking are those from the twelfth- to thirteenth-century layer (714) (Level V, Trench E) consisting of possible smelting slag, probable tuyere and undiagnostic lumps. Slag, some of it likely derived from smelting, was found in grave fills (710, Trench E and 1135, Trench I) and layer 718 (Trench E) from the next phase (Level VI) which was broadly contemporary (late twelfth to thirteenth century). Probably dating to the same period is the grave soil containing possible smelting slag to the north of the church building (Trench B), although this layer was disturbed by modern ploughing. The only feature related to metalworking, probable smithing hearth (557) located in the southern part of the Berkeley House (Trench D), was dated to the Anglo-Norman occupation levels VI to VIII (late twelfth to fourteenth century). Two other layers (1107, Trench I and 1213, Trench K) belonging to the same period revealed pieces of copper alloy material, while the former also had potential smelting slag. A burnt layer (833) in Trench F, belonging to the fourteenth century (Level VIII) contained a small amount of concreted iron and charcoal. The deposit overlying the hearth, layer (550 B, Trench D) contained both probable smelting and smithing slag. The features dated to about the seventeenth century (Level XII), and mostly occurring in Trenches F and I, revealed more slag, both potentially smithing and smelting, several pieces of copper alloy and a possible tuyere fragment. More copper alloy material and slag was recovered from the back-fills of the nineteenth-century treasure-hunting pits and the topsoil.

Discussion

Although small amounts of slag with flow-structure can be difficult to assign to either smelting or smithing, the relatively large amount of this material, and the appearance of some of it, would

indicate that smelting did take place at Dysart. Significantly, none of this material showed the large charcoal impressions typical of the slag produced in slag-pit furnaces. This type of iron smelting furnace, using vertical slag removal, was used near-exclusively in Ireland up to the coming of the Scandinavians in the ninth century. This would then fit in well with the emerging picture of these slag-pit furnaces being replaced in Ireland from the tenth century onwards by furnaces using lateral slag removal (shaft furnaces)² (unpublished doctoral research by the author). The furnaces at Dysart were either destroyed by later activity or remain unfound outside the excavated areas.

Smithing was carried out in or around hearth (557) at the southern end of the Berkeley House. The occurrence of globular hammerscale indicates that forge-welding was one of the activities carried out here. The clay 'plugs' are testimony to another type of smithing operation undertaken in the same area, but, as of now, its nature remains unknown. The tuyere fragments, together with potential and likely smithing slag, found around the western end of the church building suggest that further smithing was also carried out there.

Most, if not all, of the ironworking residues could be contemporary and date to about late twelfth to thirteenth century, while the occurrence of unweathered probable smelting slag in smithing hearth (557) would indicate that both processes were carried out at the same time. The evidence for bloom smithing, the stage between smelting and smithing, at Dysart is ambiguous. While the stone anvil appears to point towards the hearth being related to the refining of blooms, both the copper fragments and the 'smithing plugs' would indicate it was also used for other reasons. Moreover, the typical residue of bloom smithing activities, cakes of 2kg and larger, are lacking at Dysart. Other sites with evidence for both smelting and smithing, but no large cakes, however, are known, for example, at Gortnahown, Co. Cork (Young 2011:234) and Tonyquin, Co. Cavan (Rondelez 2014). Explanations for bloom smithing which does not result in large cakes include the production of slag-poor or small blooms and the sectioning of the blooms before processing.

The picture for the copper-working residues is less clear; while some of it was retrieved from late medieval layers, and a single small piece is associated with the smithing hearth, quite a substantial proportion of this material was found in later, seventeenth-century layers. No crucible fragments were recovered, but some of the larger pieces of waste copper appear to be the result of casting.

2 Although the slag-pit furnaces also had shafts, the term 'shaft furnace' has been used historically for furnaces with lateral slag removal.

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Catalogue

Find no.	Trench	Fill	Context type	Level	Date	Weight (g)	Description
NA	B	507	Disturbed grave soil	2	Med	2	Two tiny pieces of drippy slag.
NA	B	508B	Disturbed grave soil	2	Med		Heavily oxidised iron object.
NA	B	514	Disturbed grave soil	2	Med	20	Five small pieces of weathered rather light slag, some drippy. Possible smelting slag.
NA	B	515	Disturbed grave soil	2	Med	8	Two small pieces of rather light slag, one very drippy. Possible smelting.
NA	B	520	Topsoil	XV	Modern		Small round piece of probable natural iron oxide.
NA	B	522	Disturbed grave soil	2	Med	6	Five small pieces of slag, the largest is drippy. Potentially smelting.
NA	B	523	Disturbed grave soil	2	Med	16	Four small pieces of drippy slag. Potentially smelting.
NA	B	523	Disturbed grave soil	2	Med		Five pieces of natural stone.
NA	B	527	gravel soil	IV	Med		Tiny piece of natural iron oxide.
74	C	504	Topsoil	XV	Modern	5	Light, very shiny slag. Smelting?
530	D	550B	Soil layer	IX	Late medieval	383	Three lumps of slag, of which two are fractured, likely smithing hearth cakes.
530	D	550B	Soil layer	IX	Late medieval	387	Three lumps of rather dense slag, two fractured, with flow pattern. Possible smelting slag.
537	D	550B	Soil layer	IX	Late medieval	267	Lump of weathered dense flowed slag with impression of large charcoal particle. Probably smelting slag
821	D	556	Occupation layer	VI-VIII	Anglo-Norman	2	Small lump of copper alloy containing material
833	D	504	Topsoil	XV	Modern	14	Piece of heavily weathered and oxidised drippy slag. Possibly smelting.
849	D	575	Redeposited late medieval soil	XIIB	Post-medieval	208	Three heavily weathered lumps of slag. Two showing flow structure. Possible smelting.
858	D	587	Fill of hearth 557	VI-VIII	Anglo-Norman	602	Multiple fragments of smithing-pan.
858	D	587	Fill of hearth 557	VI-VIII	Anglo-Norman	174	Two irregular lumps of rather dense slag.
858	D	587	Fill of hearth 557	VI-VIII	Anglo-Norman	117	Three pieces of flowed slag. One example is very fresh and has slight vitrification on the upper surface.
858	D	587	Fill of hearth 557	VI-VIII	Anglo-Norman	61	Three pieces of vitrified 'clay-plugs' (discussion see text)
1098	D	?	Fill of hearth	VI-VIII	Anglo-Norman	2	Small shiny drippy piece of slag.

Find no.	Trench	Fill	Context type	Level	Date	Weight (g)	Description
			557				
529	E	710	Grave fill	VI	c. L12th/13th C	4	Two small slag fragments
529	E	710	Grave fill	VI	c. L12th/13th C		Two pieces of natural iron oxides.
529	E	710	Grave fill	VI	c. L12th/13th C	6	Flat, light shiny black slag with clear flow structure, likely smelting.
539	E	721	Fill of TH pit	XIV	c. E19th C	132	Three heavily weathered lumps of slag.
539	E	721	Fill of TH pit	XIV	c. E19th C	396	Bun-shaped lump of rather dense slag. SHC. Could be two smaller SHC's fused together.
539	E	721	Fill of TH pit	XIV	c. E19th C	49	Elongated drippy piece of slag. Possibly smelting slag.
539	E	721	Fill of TH pit	XIV	c. E19th C		Five pieces of natural iron oxide.
540a	E	706	Fill of TH pit	XIV	c. E19th C	251	Flat, squarish lump of dense slag. The upper surface has greenish vitrification at one edge.
540b	E	706	Fill of TH pit	XIV	c. E19th C	18	Small drippy piece of rather light slag. Could be smelting.
540c	E	706	Fill of TH pit	XIV	c. E19th C	20	Flat piece of heavily oxidised slag.
544a	E	714	Layer	V	c. 12th/13th C	198	Roundish lump of heavily weathered rather dense slag.
544b	E	714	Layer	V	c. 12th/13th C	95	Three pieces of rather dense drippy slag. Possibly smelting.
544c	E	714	Layer	V	c. 12th/13th C	16	Two fitting fragments of a piece of vitrified ceramic material with adhering slag. A convex outer surface is visible implying this is a tuyere fragment.
544d	E	714	Layer	V	c. 12th/13th C	19	Five small pieces and fragments of slag.
771a	E	717	Fill of TH pit	XIV	c. E19th C	179	Four pieces of weathered, rather dense slag. The largest piece is very likely smelting slag.
771b	E	717	Fill of TH pit	XIV	c. E19th C		Fragment of natural stone containing iron oxides.
771c	E	717	Fill of TH pit	XIV	c. E19th C		Fragment of heat affected sandstone.
848	E	718	Layer	VI	c. L12th/13th C	17	Two small pieces of heavily weathered drippy slag. Possible smelting.
1148	E	727	Fill of TH pit	XIV	c. E19th C	13	Small piece of weathered potentially drippy slag
1093	F	837	Grave soil	IV	EM?		Nine pieces of natural iron oxides.
1094	F	866	Grave fill	IV	EM?		Nine pieces of natural iron oxides.
1199	F	833	Fire layer	VIII	c. 14th C	21	Concretion of oxidised iron and charcoal fragments, no hammerscale
1143a	F	813a	Foundation layer	XII	c. L17th C	11	Piece of heat affected clay. A smooth hollow surface on one side could indicate this is tuyere material.
1143b	F	813a	Foundation layer	XII	c. L17th C	24	Two rounded lumps of copper alloy.
846	F2	818	Fill of TH pit	XIV	c. E19th C	1	Two thin pieces of copper alloy.
853	F2	818	Fill of TH pit	XIV	c. E19th C	18	Three lumps of copper alloy.
828	F2	834	Fill of TH pit	XIV	c. E19th C	254	Squarish, rather dense piece of weathered

Find no.	Trench	Fill	Context type	Level	Date	Weight (g)	Description
							ironworking slag. The upper surface has flow structure. Possibly smelting slag.
856	F2	829	Fill of TH pit	XIV	c. E19th C	86	Fragment of iron working slag with flow structure and heavy glazing.
1116	F2	832	Fill of TH pit	XIV	c. E19th C		Fragment of natural stone containing iron oxides.
1196	I	1135	Grave fill	VI	c. L12th/13th C	53	Irregular, rather dense piece of slag with frequent charcoal impressions.
836	I	1107	Layer	VI-VIII	Late med.	29	Flat piece of copper alloy material.
1191	I	1125	?	XII	c. L17th C	15	Thick, flattish lump of copper alloy.
1193	I	1101	Layer	XII	c. L17th C	5	Five small pieces of copper alloy containing material, one piece has charcoal inclusions.
825	I	1125 B	?	XII	c. L17th C	148	Rather dense lump of slag in two fragments. Shows flow structure and has greenish vitrification.
1195	I	1107	Layer	VI-VIII	Late med.	33	Elongated drippy piece of slag. Possibly smelting slag.
1202	I	1147	Grave fill	VI	c. L12th/13th C		Two small pieces of natural stone.
847	J	1062	Fill of TH pit	XIV	c. E19th C	2	Small piece of probable copper slag.
851	J	1061	Fill of TH pit	XIV	c. E19th C	83	Broadly semi-circular lump of copper alloy material.
1137	J	1061	Fill of TH pit	XIV	c. E19th C	45	Tubular piece of copper alloy.
1140	J	1063	Fill of TH pit	XIV	c. E19th C	7	Small flat droplet of copper alloy.
1192	J	1058	Fill of TH pit	XIV	c. E19th C	409	Concave piece of rather dense, oxidised slag. The lower surface shows flow structure, no vitrification. Possible smelting slag.
1136	J	1061	Fill of TH pit	XIV	c. E19th C	28	Two pieces of light drippy slag with highly shiny black patches. Smelting?
1141	J	1060	Fill of TH pit	XIV	c. E19th C	2	Small piece of somewhat drippy slag with charcoal impressions.
1139	J	1066	Fill of TH pit	XIV	c. E19th C	7	Clearly drippy, but heavily weathered piece of light slag.
823	K	1213	Layer	VI-VIII	Anglo-Norman	1	Tiny piece of copper alloy material.
845	K	1206	Layer	?	Anglo-Norman		Oxidised iron object.

Plates



Pl. 1. Drippy slag, likely the result of smelting, from (587), fill of smithing hearth (557)



Pl. 2. Likely double smithing hearth cake, from (721), fill of a modern treasure-hunting pit



Pl. 3. Smithing pan, with flake (a) and globular (b) hammerscale, from (587), fill of smithing hearth (557)



Pl. 4. Vitrified ceramic with smoothed hollow, likely tuyere fragment, from (813a), foundation layer, *c.* late 17th century



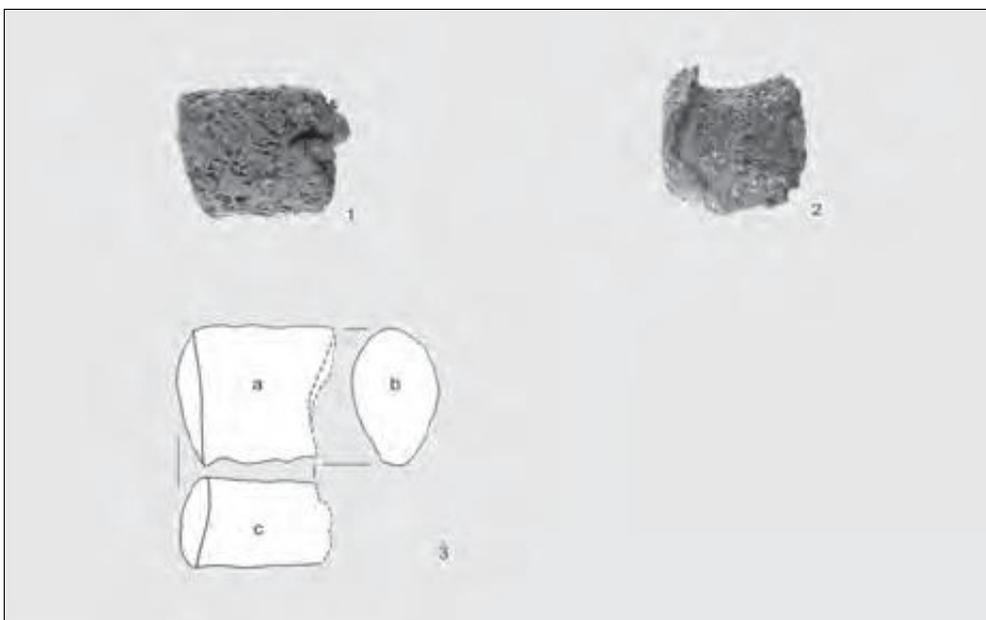
Pl. 5. Mushroom-capped 'smithing plug', from (587), fill of smithing hearth (557)



Pl. 6. 'Smithing plug' with adhering smithing pan seen from below,
from (587), fill of smithing hearth (557)



Pl. 7. 'Smithing plug' from Tuckey Street, Cork



Pl. 8. 'Smithing plug from Haithabu, Denmark (from Westphalen 2004:27)



Pl. 9. Flat piece of copper alloy production waste, from layer (1107)



Pl. 10. Tubular piece of copper alloy production waste,
from (1061) fill of modern treasure-hunting pit



Pl. 11. Smelting hearth (557) with stone anvil, from the east (courtesy of B. Murtagh)