Ironworking in late medieval Ireland, *c*. AD. 1200 to 1600

Two volumes

Volume II: Site Catalogue, Appendices and Bibliography

By

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Thesis submitted as a requirement for obtaining the Degree of Doctor in Philosophy

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Submitted December 2013

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Site Catalogue

The alphabetical catalogue consists of all the sites quoted in the various chapters and includes location and excavation information, as well as context and dating details on those sites. It is introduced by both a map (Fig. S.1) and a table (Table S.1) of all the relevant sites. The material from a substantial amount of sites has been subjected to specialist analysis, while additional assemblages were studied for this research. All the site information, including metallurgical, stratigraphical and chronological considerations, was subjected to an in-depth critical review. In many cases this has led to a major re-interpretation of the findings, both in the published and unpublished accounts. Sites which were not included in the Catalogue, are listed in Appendix 7, together with the reasons for their exclusion.

Each entry has both technical fiche and a site summary. The technical fiche has location information, which includes the townland names, the civil parish and the coordinates of the sites. This is followed by the Site Monuments Registry (SMR) number. Both the excavation licence number and the person, and his or her afilliation, to whom this licence was issued are given, as well as the period during which the site was excavated.

The site summary has informations on the following. Under ironworking activity the sites are classified as locations for smelting, bloom smithing and/or smithing. When the latter two occur together this is labelled (bloom)smithing. The significance of the sites is based on the fact if it has in-situ activity, its scale and is also influenced by the quality of the data. The deposition is either primary or secondary and when primary deposits are so heavily truncutated as to affect the interpretation of the site the designation damaged is assigned. The investigation level refers to the extent the site itself was excavated, not only its ironworking component. Excavations in urban unvironments, where site boundaries are non-existent, are termed urban. The sample size, where available, is given in weight or volume. On sites with multi-period ironworking, only the sample size of the late medieval material is given. The materials present are diveded into slag, tuyere material and other ceramics. Other ceramics includes furnace and hearth wall fragments, but also vitrified ceramic material which could represent tuyeres. It does not include technical ceramics, such as crucibles, which

are clearly related to non-ferrous metallurgy. In several cases, the sites discussed yielded only objects subjected to metallographic examination and chemical analysis. Instead of a full summary, these are labelled as such.

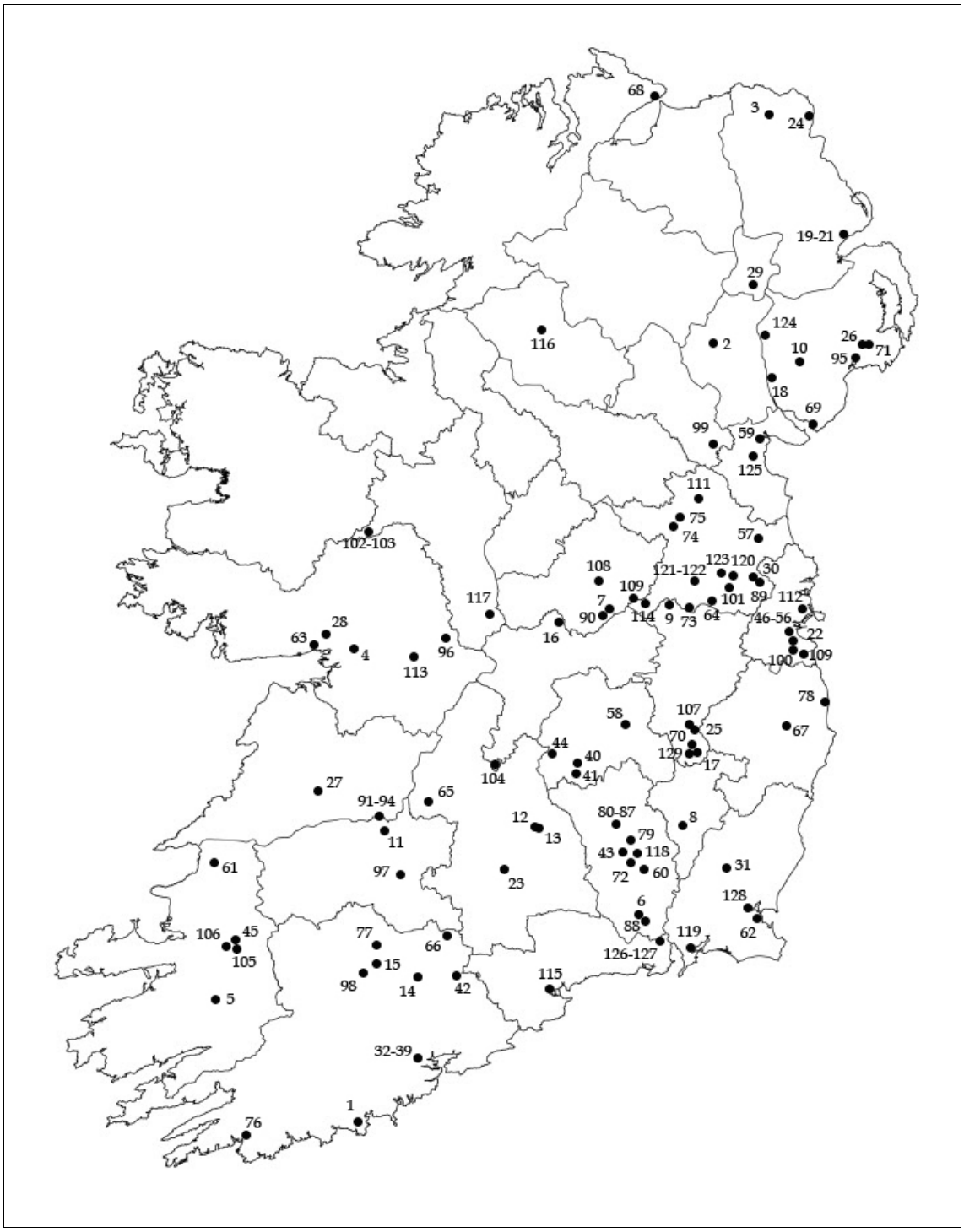

Fig. S.1 Map of the sites in the Catalogue

Table S.1 List of the sites in the Catalogue

Aghmanister and Spittal, Co. Cork

Site no. 1

Townland: Aghmanister and Spittal
Civil Parish: Abbeymahon
Coordinates (ITM): E546364, N541738
SMR: CO136:022

Excavation licence: 09E0281
Director: Barra Ó Donnabháin (University College Cork)
Excavated between 2009 and 2011

Site summary:

Ironworking activity: Smithing

Significance: High

Site deposition condition: Primary

Investigation level: Partial excavation

Ironworking features: Forge building, hearths, hearth wall, anvil supports

Dating evidence: Pottery, documentary

Sample size: 220kg

Material present:						
	Slag	✓	Tuyeres	✓	Tools	✓
	Hammerscale	✓	Other ceramic	✓	Iron artefacts	✓

Description

Excavations at a supposed late medieval leper hospital at Aghmanister and Spittal, Co. Cork revealed evidence of extensive *in situ* metalworking.[96] All the metallurgical residues from this site were subjected to visual examination, including the micro-residues from the features potentially related to metallurgy (Table S.2). The site consists of a rectangular stone building with an adjacent area enclosed by a low stone wall. The building was constructed right next to an abandoned ringfort and was possibly a Cistercian monastery founded in AD 1172, but moved to another location before AD 1278 (Ó Donnabháin 2010: 7). The building measured c. 23 by c. 9m externally and had walls about 1m thick. It is divided by an internal wall into an eastern and a western part and about 60% of the area of the latter was excavated. The interior of this room was almost completely covered by a clay floor, with the exception of a small strip at its eastern side.

96 All the excavation results were generously made available by the director Barra Ó Donnabháin (UCC).

During the first phase of activity, several deep pits, most of them undercut, were dug on the western side, while larger, shallower pits were found along the northern wall. The largest of the latter contained 858g of slag and a rather high hammerscale content in its upper fill (around 0.5mg/20ml) (See Fig. 8.15d), suggesting that some iron smithing was carried out at this stage. The same pit also yielded green-glazed pottery, an arrow-head, a lead weight and a possible book strap. Next, a three-sided structure measuring c. 6.3 by 4.8m internally and consisting of shallow wall-slots was constructed inside the room (See Figs. 8.1j and S.2).

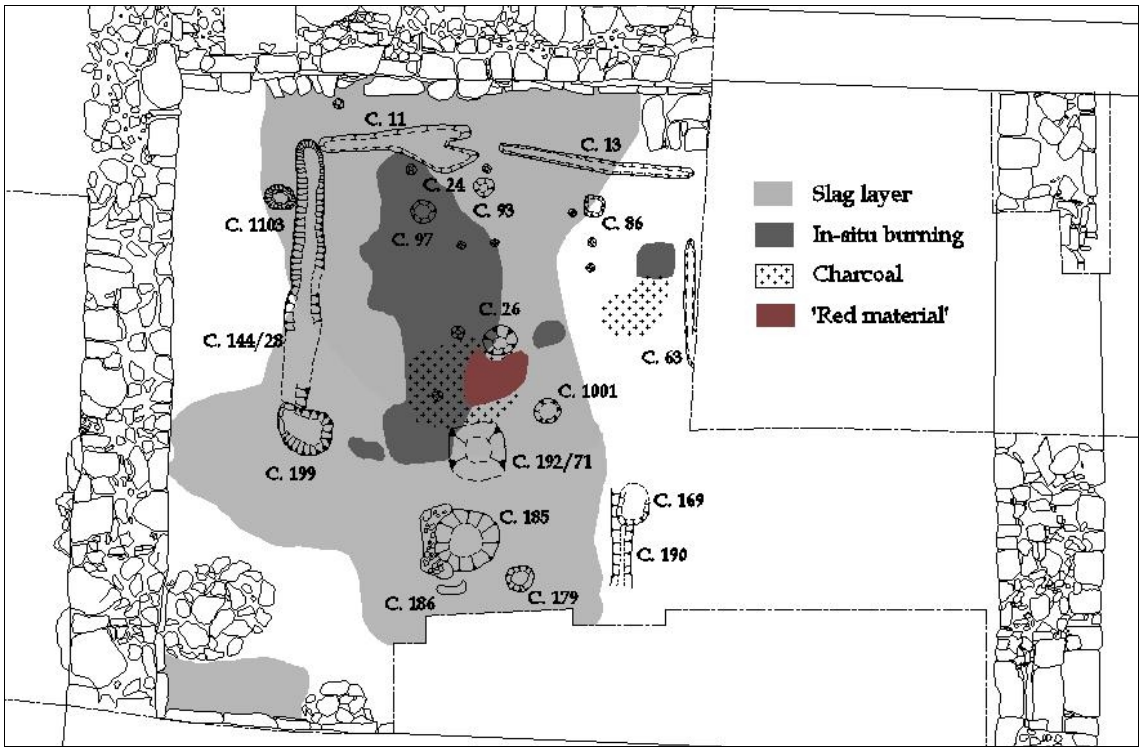

Fig. S.2 Aghmanister, Co. Cork. Plan of the ironworking area (Phase 3)

On the southern side, which was heavily truncated by later burials, a length of a slot-trench and an adjacent posthole suggest that the eastern part of the structure continued in this direction. Several internal postholes, probably had a structural function. Three hearths, noted here as northern, central and southern, were uncovered. The southern hearth measured 0.65 by 0.49m and was 0.35m deep and had an upstanding clay rim along its western edge. This rim was heath-affected on its northern and truncated end. Its single fill held very high concentrations of hammerscale (Table S.2b), but no slag. A posthole-like feature to its south-east, which contained a vertically-set packing stone, is interpreted as an anvil-support. Just to the north of this, a pit (0.55m diameter, 0.52m

deep) showed multiple layers all with high to very high hammerscale content, but again with very little slag (15g). A posthole-like feature to its north-east could represent an anvil-support. Immediately north of this hearth, a layer of charcoal was uncovered with a deposit of unusual red (burnt?) slag fragments overlaying it. The northern hearth measured 0.55 by 0.45 by 0.25m, had low hammerscale concentrations and some slag (178g).

The floor area extending from the central hearth and past the northern hearth, was affected by heat. This was interpreted as the result of the building burning down and could be related to the deposit of red slag mentioned above. More than 150kg of slag were found covering most of the interior of the wooden structure and more material was found outside it. A plot of all the material found, shows the highest concentrations of material between the northern side of the wooden structure and the stone wall, south of the same wooden wall and in the south-western corner of the same stone building. Inside the wooden structure a slightly higher amount was found around the southern hearth. These undoubtedly represent dumping areas.

The slag consisted almost entirely of amorphous lumps, many of which showed flow-structure. Only a handful of smithing hearth cakes were present, all weighing less than 150g, while wedge-shaped pieces of very dense slag alluded to larger smithing hearth cakes. The material also included multiple pieces of smithing pan next to pieces of the red (burnt?) slag, already discussed. Rounded pieces of iron oxide with hammerscale inclusions are poorly understood, but probably represent some kind of weathered smithing pan. The distribution of the previous three categories of material show a concentration of both the smithing pan and the red material around the central hearth, while the rounded material was found in the northern dumping areas, but also around the southern hearth.

Over 500 fragments of tuyere material were also found. The material was generally very fragmentary, but original frontal diameters of 0.15 to 0.18m can be proposed. Some pieces showed striking patches of adhering white clay, sometimes displaying a clear border between the normal tuyere matrix and the white clay (See Fig. 8.10d). It is assumed that this could be evidence of repairs carried out on the tuyeres, but a functional (chemical?) use cannot be excluded. Several pieces of ceramic material were found which could not be positively identified. These seem to be part of elongated tubular artefacts, which could imply long and narrow tuyeres, but at least one piece had a distinct 90° angle running along its long axis. Further research on these pieces is

required, but a connection with non-ferrous metallurgy can be assumed. All of these pieces, together with copper blobs, copper-stained slag and pieces of copper, were found in the northern dump area, except for one blob of copper retrieved just south-west of the northern hearth. Among the iron objects found at Aghmanister, nail featured most prominently, next to buckles, a copper-alloy-coated key, an arrow-head, sheers and multiple small pieces of probable waste iron.

In summary, the three hearths can be characterized as follows:

- *southern hearth*: one fill, high hammerscale content, probable anvil-support, clay rim, concentration of general slag, possible weathered smithing pan and tuyere material
- *central hearth*: multi-layered, high hammerscale content, concentration of fresh smithing pan
- *northern hearth*: single fill, low hammerscale content, no concentration of materials

It is difficult to confidently determine the functions of the first two hearths. Perhaps the southern hearth can be seen as having a reheating function, while the central hearth could be related to actual manufacturing. The northern hearth would not seem to be related to ironworking, but it is unclear if non-ferrous metallurgy activities were carried out here or if the hearth is unrelated to metalworking. At the time of writing no radiocarbon analysis was carried out, nor was the pottery subjected to specialist analysis. The handful of sherds are late medieval and were preliminarily identified as Saintonge-like and Cork-type Ware. Together with the documentary evidence, this would suggest a late thirteenth- to early fourteenth-century date for the metalworking activities.

Cut	Fill	Type	C/B	TI	TC	OT	UN	Tot
NA	001	Deposit					6190	6190
NA	005	Deposit					5483	5483
NA	006A	Deposit	77	0	57	1374		1508
NA	006B	Deposit	0	0	0	177		177
NA	006C	Deposit	8.7	0	2.3	134.7		145.7
NA	006D	Deposit	0	7	0	0		7
NA	006E	Deposit	44	27	0	385		456
NA	006F	Deposit	5	12	5	738		760
NA	006G	Deposit	0	1	0	8		9
NA	006H	Deposit	0	0	0	0		0

NA	006I	Deposit	1550	170	229	109		2058
NA	006J	Deposit	234	48	0	112		394
NA	006K	Deposit	31	56	0	105		192
NA	006L	Deposit	0	0	0	0		0
NA	006M	Deposit	5492	1337	552	522		7903
NA	006N	Deposit	1119	195	183	272		1769
NA	006O	Deposit	239	0	55	0		294
NA	006P	Deposit	0	0	0	0		0
NA	006Q	Deposit	517	50	0	13		580
NA	006R	Deposit	440	130	27	32		629
NA	006S	Deposit	2845	691	314	185		4035
NA	006T	Deposit	4227	1014	329	160		5730
NA	006U	Deposit	3545	749	295	582.5		5171.5
NA	006V	Deposit	990	88	173	159		1410
NA	006W	Deposit	168	79	16	53		316
NA	006X	Deposit	5460	711	639	121		6931
NA	006Y	Deposit	13917	2033	1123	153		17226
NA	006Z	Deposit	7444	1325	717	82		9568
NA	006AA	Deposit	7800	1527	644	60		10498
NA	006BB	Deposit	9130	1129	1500	11		12098
NA	006CC	Deposit	4367	593	654	428		6303
NA	006DD	Deposit	584	28	437	60		1109
NA	006EE	Deposit	1625	225	196	1		2102
NA	007	Deposit					1409	1409
008	009	Slot-trench					301	301
011	012	Slot-trench					5971	5971
013	014	Slot-trench					279	279
015	016	Pit					858	858
015	066	Pit					102	102
026	027	Post-hole					41	41
028	029	Slot-trench					1297	1297
037	038	Stake-hole					14	14
039	040	Pit					185	185
041	042	Hearth					178	178
050	051	Stake-hole					12	12
060	062	Post-hole					326	326
078	081	Post-hole					22	22
NA	100	Deposit	474	0	96	0		570
NA	103	Deposit	10512	7258	1972	2489		22231
NA	108	Deposit	93	0	0	0		93
118	116	Grave	188	186	58	129		561

121	119	Grave	675.5	483.4	77.3	380.2		1616.4
NA	125	Deposit	18822	7012	2754	6171		34759
NA	130	Deposit	49	0	0	0		49
132	131	Pit	566	489	50	87.2		1192.2
414	137	Pit	1074	353.5	102.5	174		1704
NA	144	Slot-trench	0	0	0	95		95
NA	151	Deposit	560	418	70.3	587.5		1635.8
NA	154A	Deposit	573.8	364.7	150.3	980.4		2068.4
NA	154B	Deposit	316.8	129.2	10	745.1		1201.1
NA	154C	Deposit	0	0	0	84		84
NA	154D	Deposit	3696	1531.6	168	1626.3		7021.9
NA	154E	Deposit	2993	1095	226	458.5		4772.5
NA	154F	Deposit	325	165	5	83.3		578.3
NA	154G	Deposit	640	459	155	82		1336
NA	154H	Deposit	1072	668.8	119	85.5		1945.3
NA	154I	Deposit	69.5	71	0	3		143.5
159	160	Grave	109.5	18	0	0		127.5
NA	162	Deposit	329.5	0	0	0		329.5
164	163	Pit	13	0	0	0		13
167	166	Grave	41	0	0	0		41
171	170	Grave	950.5	232	108	141		1431.5
NA	175	Deposit	336	394	232	509		1471
NA	176	Deposit	0	58	21	19		98
179	178	Anvil-support	155	26	5	0		186
192	189	Pit	0	0	0	15		15
NA	212	Deposit	0	51	0	0		51
NA	225	Deposit	0	0	0	14		14
NA	252	Deposit	67.4	0	0	0		67.4
307	302	Pit	160	0	0	0		160
NA	604	Deposit	201	0	0	0		201
NA	607	Deposit	118	0	0	0		118
NA	610	Deposit	0	9	0	0		9
NA	612	Deposit	31	18	38	0		87
NA	618	Deposit	186	0	0	0		186
NA	621	Deposit	534	0	48	0		582
NA	623	Deposit	163	0	0	0		163
NA	624	Deposit	27	0	0	9		39
NA	631	Deposit	43	0	0	0		43
NA	709	Deposit	0	0	0	10.6		10.6
NA	710	Deposit	612	0	0	0		612
NA	1101	Deposit	13	0	30.5	48		91.5

1104	138	Pit	414	0	0	0		414
1104	138E	Pit	0	29	0	0		29
1105	1109	Pit	0	0	0	17		17
1107	1108	Pit	0	6.6	0	25		31.6
NA	NA	Spoil					7626	7626
Total			47476.5	21525.8	6495.9	14794.8	129673.2	219966.2

Table S.2a Weights of the material related to metalworking from Aghmanister, Co. Cork (in gram), per type. C/B: Cakes and beards, TI: Tuyere-influenced slag, TC: Technical ceramics, OT: Others, UN: Unspecified

Cut	Fill	Type	MagW	HSW	Flat%	Glob%
015	016	Pit	0.98	0.515	50	10
015	055	Pit	0	0	0	0
015	056	Pit	0	0	0	0
015	066	Pit	0.2	0.2	100	0
NA	019	Deposit	1.14	0.34	30	12.5
041	042	Hearth	0.43	0.15	30	5
NA	045	Deposit	0	0	0	0
NA	054	Deposit	0.19	0.063	40	5
082	084	Slot-trench	0.17	0.085	90	0
185	184a	Hearth	13.543	10.834	75	5
185	184b	Hearth	16.093	12.874	75	5
NA	186	Deposit	0.281	0.023	50	10
192	188	Hearth	2.666	2.333	80	10
192	189	Hearth	19.748	17.280	80	10
192	191	Hearth	0.671	0.547	80	10
192	193	Hearth	3.786	2.797	80	10
192	194	Hearth	1.233	0.832	75	10
192	195	Hearth	1.620	1.227	80	10
192	196	Hearth	1.014	0.772	80	5
NA	1000	Deposit	0.01	0.004	50	0
1004	1005	Pit	0	0	0	0
1004	1006	Pit	0	0	0	0
1104	138A	Pit	0.164	0.070	80	15
1104	138B	Pit	0.056	0.034	100	0
1104	138D	Pit	0.023	0.021	90	5
1104	138E	Pit	0.005	0.005	100	0

Table S.2b Results of visual examination of microresidues from Aghmanister, Co. Cork. Separated by magnet from the sample residues. MagW: Weight of magnetic fraction (mg/20ml), HSW: Weight of hammerscale fraction (mg/20ml), Flat%: Percentage of flat hammerscale (estimated), Glob%: Percentage of globular hammerscale (estimated).

Armagh, Upper English Street

Site no. 2

Townland: Corporation
Civil Parish: Armagh
Coordinates (ITM): E687451, N845298

Director: Norman Crothers (DOENI)
Excavated between September 1990 and March 2011

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Urban		
Ironworking features: None					
Dating evidence: Pottery			Sample size: Unknown		
Material present:	Slag	✓	Tuyeres	✓	Tools ✓
	Hammerscale		Other ceramic		Iron artefacts ✓

Description

In Upper English Street, Armagh, several features with late medieval ironworking residues were uncovered (Crothers and Gahan 1999). Some of the material was found in disturbed layers, but three features located close together, a ditch C.103, a curved gully C.12 and a large pit C.52, contained both dense slag and tuyere fragments (ibid.: 59, 64). The ditch held a small whetstone and a nail, the gully a shaft of a large nail, while a grooved stone, possibly used for sharpening, was recovered from the pit (ibid.: 70). The illustration of some of the slag pieces makes clear that they represent smithing hearth cakes (ibid.: 68) (See Fig. 8.15a). All three features also contained Everted Rim Ware sherds (Gahan 1999: 78). This smithing activity cannot be closer dated than the late medieval period.

Armoy, Co. Antrim

Site no. 3

Townland: Glebe
Civil Parish: Armoy
Coordinates (ITM): E707720, N933244
SMR: ANT013:010

Licences: AE/04/155 and AE/05/50
Director: John O Neill
(Queen's University Belfast)
Excavated between Oct. 2004 and Sept. 2005

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Primary			Investigation level: Full excavation		
Ironworking features: Forge structure?					
Dating evidence: Pottery			Sample size: 3150g		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

During the excavation of an area north of a round tower and a nineteenth-century church in Armoy, Co. Antrim, a large ditch, a lignite-working area and a souterrain were uncovered (Nelis et al. 2007). These features were all dated to the early medieval period and some evidence of ironworking was present in the ditch, inside the souterrain and elsewhere. Subsequently, the central area of the souterrain was expanded and remodelled into an area measuring 4 by 2.1m, flanked by a dry-stone wall surviving up to three courses high (ibid.: 71–73). The deposits in this area contained evidence of burning, and slag and pottery provisionally dated to the twelfth and thirteenth centuries. All the ironworking residues from this phase of activity were found in the two main deposits, C.271 (1177g) and C.298 (1975g) (2010b: 9–10). The latter contexts also included one nail and two pieces of unspecified metal. The slag included one relatively large smithing hearth cake (820g), four (possible) fragments of smithing hearth cakes and five pieces of vitrified clay. The vitrified clay fragments could not positively be identified as being tuyere fragments. The large size of this feature precluded it from being a smithing hearth, and it was suggested that the feature might represent a small smithy (ibid.: 3). No evidence for a covering stucture was recorded.

Athenry, Abbey Row/Bridge Street, Co. Galway

Site no. 4

Townland: Athenry
Civil Parish: Athenry
Coordinates (ITM): E550305, N727869
SMR: GA084:001

Excavation licence: E4226
Director: Nial O'Neill (Eachtra Archaeological Projects Ltd.)
Excavated between September and October 2011

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Urban		
Ironworking features: None					
Dating evidence: Pottery			Sample size: 8725g		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale	✓	Other ceramic	✓	Iron artefacts ✓

Description

Metalworking remains were found during excavations ahead of a water-supply scheme in Athenry, Co. Galway (O'Neill and Delaney 2011). The material from this scheme was visually examined as part of this doctoral research (Table S.3). The first site was located at Abbey Row in the east of the town. Here, the largest concentration of material (1667g) was found in a deposit C.025 towards the northern end of the trench, which also contained Saintonge Ware and unspecified medieval pottery (ibid.: 39). Probably due to the eroded condition of the material from this layer, only one piece was identifiable as a potential smithing hearth cake fragment. This assemblage also contained a weathered likely tuyere fragment, a further piece of vitrified ceramic material and a fragment of white, glassy slag. The corroded nature of this assemblage indicates that it is unlikely to be *in situ* material. Some 15 to 20m to the south, another deposit C.011 returned a smaller amount of slag material (326g). This layer contained both medieval and post-

medieval pottery. Neither of these features was sampled, but a layer located between them C.018 yielded plentiful evidence of ironworking in the form of hammerscale. The layer above this C.019 contained as yet undated pottery, so at this stage it is not possible to connect the hammerscale with either of the two slag containing deposits. Two further deposits in this trench, C.024 and C.028, both stratigraphically late, had respectively relatively abundant and a few fragments of hammerscale. The same trench also returned probable evidence for copper metallurgy in the form of fragments of objects and possible slag. Except for a single small fragment from deposit C.017, all this material was found in deposit C.007. The latter layer remains undated at present, the former is post-medieval. The substantial quantity of material (6364g) from the trench at Bridge Street was recovered from one deposit C.071 which sealed pit C.074. Deposit C.071 itself is not dated, but the basal layer C.073 of the pit contained green-glazed pottery (O'Neill and Delaney 2011: 21–22). The slag assemblage contained frequent smithing hearth cakes, most of them rather amorphous, with the weight of the complete examples ranging between 200 and 450g. A piece of vitrified ceramics could not be conclusively identified as either tuyere or hearth-lining material. Due to the lack of hammerscale in the sample, the material in this pit should be interpreted as dumped material. A further three pieces of slag (363g) were recovered from a deposit C.060 from the trench at Market Square/Burke's Lane; a smithing hearth cake fragment, an oxidized lump and a small drippy piece. A stratigraphically unrelated deposit some 20m away C.059, had a small amount of hammerscale. Several nails and unidentied iron objects were recovered from the above features.

Cut	Fill	Type	Location	Description	Weight (g)
NA	7	Deposit	AR	Fragment of copper alloy object, possibly pipe	
NA	7	Deposit	AR	9 small pieces of copper alloy (waste?, part of same object?)	
NA	9	Deposit	AR	4 microscopic fragments of metallic iron, no oxidisiation (from tools during digging?)	0.1
NA	11	Deposit	AR	Fragment of dense smithing hearth cake with slight flow pattern on the base	151
NA	11	Deposit	AR	4 lumps of rather dense heavily oxidized slag	175
NA	12	Pipe trenches	AR	Large block of concrete with some oxidization of iron on the exterior	
NA	17	Deposit	AR	Small piece of concreted material with Cu staining, possibly copper working slag	5
NA	18	Deposit	AR	Mixture of flake hammerscale, microscopic slag fragments and iron oxides	0.1

NA	24	Deposit	AR	Mixture of flake hammerscale, microscopic slag fragments and iron oxides	0.1
NA	25	Deposit	AR	Large piece of slag, probably part of a smithing hearth cake	849
NA	25	Deposit	AR	23 pieces of slag, some heavily corroded and encrusted	794
NA	25	Deposit	AR	One piece of white, glassy slag	24
NA	25	Deposit	AR	30 pieces of iron oxide, probably heavily corroded iron objects	
NA	25	Deposit	AR	2 pieces of vitrified ceramics, likely tuyere material. One with heavily corroded outer surface	
NA	28	Deposit	AR	Mixture of iron oxide and iron rich stones, only a few possible hammerscale fragments	0.1
45	34	Pit	AR	Mixture of iron oxide and iron rich stones, only a few possible hammerscale fragments	0.1
45	35	Pit	AR	Mixture of (burnt?) iron rich soil and iron oxides, very few possible hammerscale fragments	0.1
NA	59	Deposit	BL	Few pieces of flake hammerscale	0.1
NA	60	Deposit	MS	Dense fragment of substantially larger smithing hearth cake	207
NA	60	Deposit	MS	Rounded lump of heavily oxidized slag	147
NA	60	Deposit	MS	Small fragment of drippy slag	9
NA	71	Layer	BS	Flattish, elongated dense smithing hearth cake	355
NA	71	Layer	BS	Rounded, elongated and oxidized dense smithing hearth cake	439
NA	71	Layer	BS	Irregular, oxidized dense smithing hearth cake	337
NA	71	Layer	BS	Irregular, oxidized dense smithing hearth cake	265
NA	71	Layer	BS	Rounded, oxidized dense smithing hearth cake	216
NA	71	Layer	BS	8 fragments of smithing hearth cakes, dense and heavily oxidized	1613
NA	71	Layer	BS	Largish lumps of dense, heavily oxidized slag, possibly smaller badly formed smithing hearth cakes	1678
NA	71	Layer	BS	37 smallish pieces of generally dense slag, some showing flow pattern	1438
NA	71	Layer	BS	Piece of flat slag with a shiny upper concave surface and flow pattern on the base	23
NA	71	Layer	BS	5 pieces of iron oxide, probably heavily corroded iron objects	
NA	71	Layer	BS	One flat pieces of vitrified ceramics, either wall lining or tuyere material	
74	73	Pit	BS	Mixture of iron oxide and iron rich stones, only a few possible hammerscale fragments	0.1
NA	1	Deposit	NG	Small amount of microscopic, flake hammerscale	0.1
NA	2	Deposit	NG	Small amount of microscopic, flake hammerscale	0.1
Total					8725

Table S.3 Description of the material related to metalworking from Athenry, Co. Galway. AR. Abbey Road, BL. Burke's Lane, MS. Market Square, BS. Bridge Street, NG. North Gate

Ballydowny, Co. Kerry

Site no. 5

Townland: Ballydowny
Civil Parish: Aghadoe
Coordinates (ITM): E495026, N591972
SMR: KE066:144(07)

Excavation licence: 02E0055
Director: Jacinta Kiely
(Eachtra Archaeological Projects Ltd.)
Excavated in 2002

Site summary:

Ironworking activity: Smelting		Significance: High	
Site deposition condition: Primary		Investigation level: Complete excavation	
Ironworking features: Furnace			
Dating evidence: C14		Sample size: 30.5kg	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

The site at Ballydowny, Co. Kerry revealed two areas of ironworking activity (Kiely and O'Callaghan 2010). An oval pit C.28 measuring 1.17 by 0.65 by 0.18m, contained five fills, four of which contained slag (ibid.: 1) (See Figs. 6.3 and S.3).[97] Most of the material was described as small amounts of amorphous slag, and one smithing hearth cake, but also included a piece of slag weighing c. 20kg (Fairburn 2010b: 74–75). This piece, measuring 0.56 by 0.24 by 0.14m, was slightly curved, had ore particles attached and was classified as furnace-lining (ibid.: 75; Kiely and O'Callaghan 2010: 1) (See Fig. 6.10). An adjoining deposit C.37 containing burnt clay and slag (530g) included three pieces designated as tap slag (Fairburn 2010b: 74). A fragment of unspecified charcoal from the fill containing the large slag piece was dated by radiocarbon analysis to AD

97 There are discrepancies between the context and sample numbers containing slag in the report (Kiely and O'Callaghan 2010: 1, 46) and the specialist report (Fairburn 2010b: 74) leading to different fills of this feature being described as containing slag. Also the stratigraphic sequence of the layers is unclear as the matrix of the relevant area (Kiely and O'Callaghan 2010: 82) does not contain the data relating to this feature.

1263–1325 (59.2%) and 1344–1394 (40.8%) (2σ) or AD 1276–1306 (60.9%) and 1363–1385 (39.0%) (1σ) (Kiely and O'Callaghan 2010: 87). More features relating to ironworking were encountered elsewhere on the same site producing smithing hearth cakes and tuyere fragment, hence relating to smithing activities. These features, although undated, were assumed to also be late medieval (ibid.: 1). The furnace is highly unusual, both in its dimensions and the size of the piece of slag it contained. The morphology of the feature is somewhat reminiscent of a domed furnace, but these have never been recorded with large lumps of slag. Slag pieces of a similar size are, at least in pre-modern Europe, either large flows of tap slag or produced in slag-pit furnaces, neither of which applies to the Ballydowny piece. Its date of operation lies somewhere between the mid-thirteenth and the late fourteenth centuries.

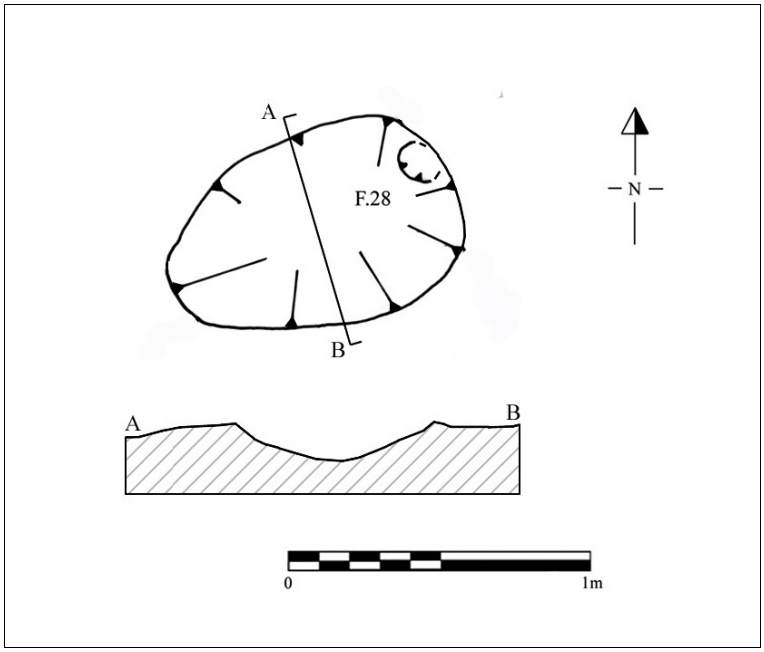

Fig. S.3 Ballydowney, Co. Kerry. Plan of furnace C.28 (after Kiely and O'Callaghan 2010: 15)

Ballykeoghan AR015, Co. Kilkenny

Site no. 6

Townland: Ballykeoghan
Civil Parish: Dunkitt
Coordinates (ITM): E657600, N620344

Excavation licence: E2502
Director: Graeme Laidlaw (Valerie J. Keeley Ltd.)
Excavated between July and September 2006

Site summary:

Ironworking activity: Smithing
Significance: High

Site deposition condition: Primary
Investigation level: Complete excavation

Ironworking features: Forge building, hearths, anvil supports, pits

Dating evidence: C14
Sample size: 79kg

Material present:						
	Slag	✓	Tuyeres	✓	Tools	
	Hammerscale	✓	Other ceramic	✓	Iron artefacts	✓

Description

At Ballykeoghan[98], Co. Kilkenny (AR015) three adjacent areas of intensive ironworking, with associated copper-working, were excavated (Laidlaw 2010) (Fig. S.4). In total more than 75kg of metalworking residues were recovered from the site, about one third of which consisted of hammerscale. The main area of activity was concentrated around three large features, enclosed on two sides by a series of gullies (See Fig. 8.1f and S.5). The first of these, hearth C.285, measured 1 by 0.7 by c. 0.4m[99], was sub-circular in plan, had one heavily heat-affected edge and had five stakeholes at its base (ibid.: 15). Its basal fill had large amounts of hammerscale[100] and smithing pan, while four of the upper fills had smaller amounts of hammerscale, as did one of the stakeholes (Young 2010a: 91–92).

98 Both the final excavation report and the publication on the site (Laidlaw 2011) have this site erroneously situated in the townland of Ballykillaboy.
99 The text gives 80mm as the depth, but the profile drawing of this feature shows differently (ibid.: 155).
100 Due to the large amount of data, no weight information per feature is given for this site. The interested reader is directed to the specialist report by Tim Young for the individual amounts.

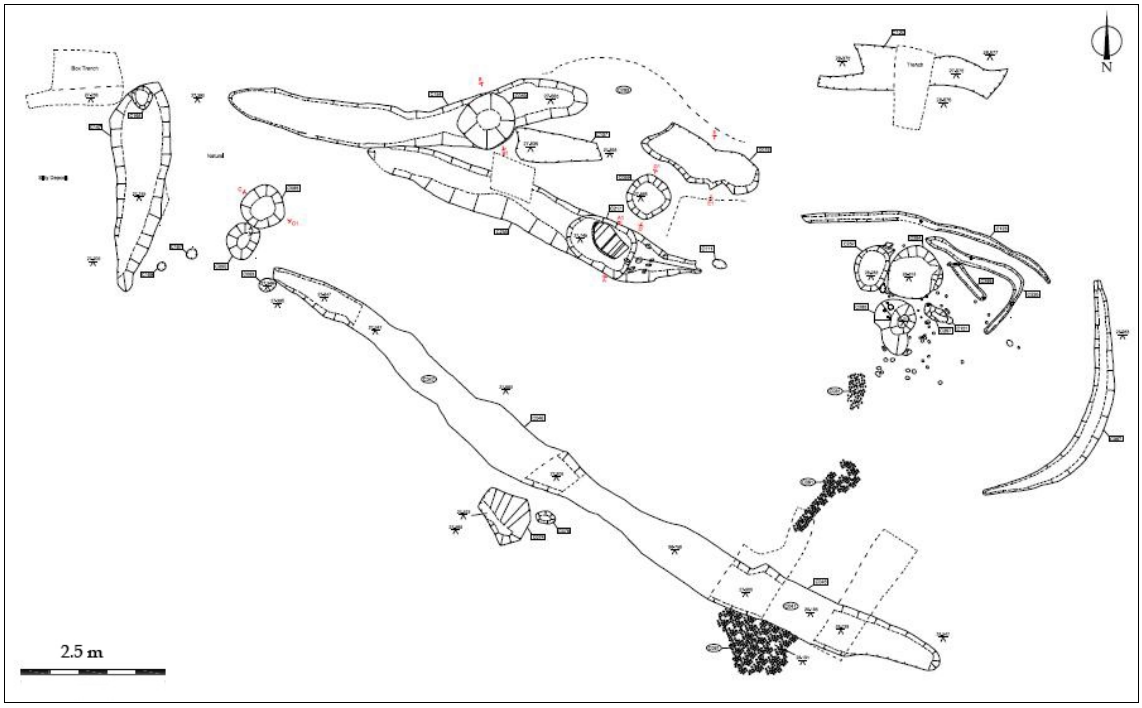

Fig. S.4 Ballykeoghan AR015, Co. Kilkenny. Post-excavation plan (Laidlaw 2010: 152)

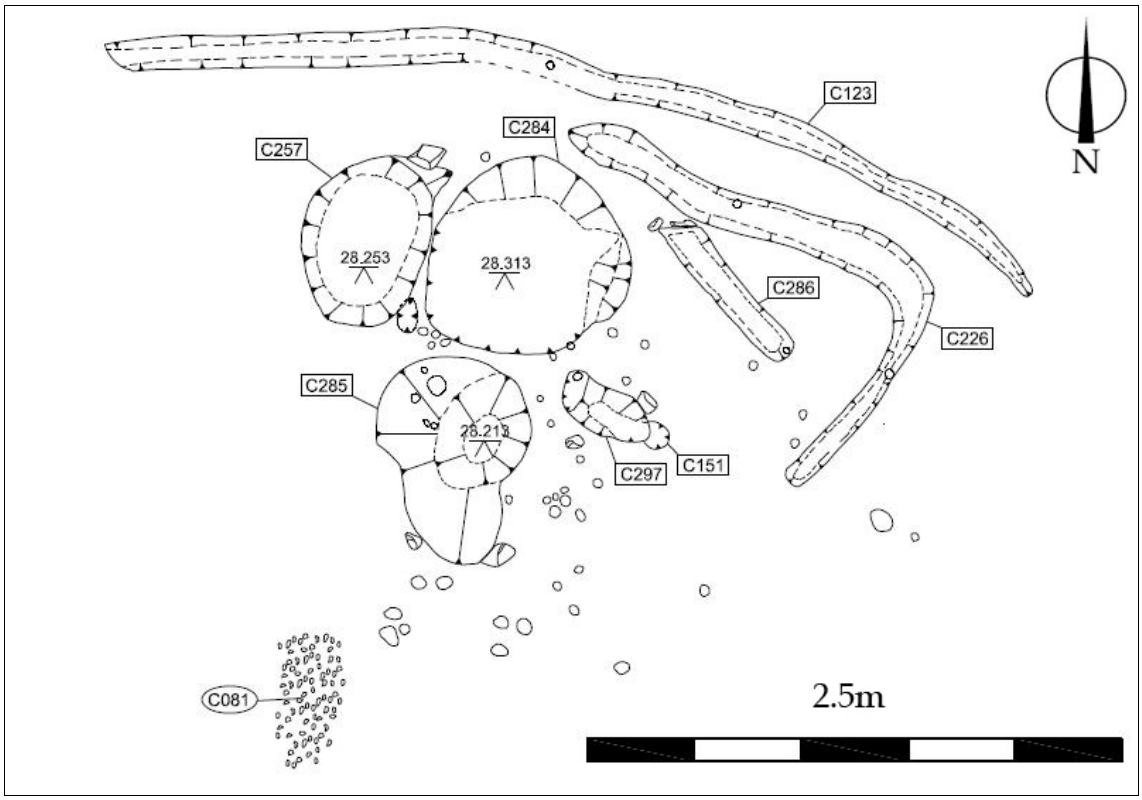

Fig. S.5 Ballykeoghan AR015, Co. Kilkenny. Post-excavation plan of the main metalworking area (after Laidlaw 2012: 152)

A second feature, C.284, described as a pit and measuring 1 by 0.9 by 0.4m, was also sub-circular in plan (Laidlaw 2010: 15). Similarly, the basal fill contained smithing pan

with substantial amounts of hammerscale and four other fills had smaller amounts of the latter (Young 2010a: 91–92). The third feature, C.257, interpreted as a possible anvil-block setting, measured 0.8 by 0.6 by 0.3m and had several stones set at its side creating a vertical edge (Laidlaw 2010: 16, 19). All three of its fills contained smithing pan and copious amounts of hammerscale (Young 2010a: 91–92). Both C.284 and C.285 were covered by four irregular deposits (Laidlaw 2010: 17). One of these, C.192, had substantial amounts of both smithing pan and hammerscale, while two others only had moderate hammerscale (Young 2010a: 91).

Radiocarbon analysis of a fragment of coppiced young oak from the deposit with the larger amounts of smithing residues returned a date of AD 1495–1507 (0.7%) and 1511–1601 (16.6%) and 1616–1695 (35.8%) and 1726–1813 (35.2%)[101] (2σ) or AD 1529–1541 (5.1%) and 1634–1681 (44.2%) and 1738–1754 (6.9%) (1σ) (ibid.: 95; O'Carroll 2010: 35). These layers were again covered by a larger deposit, C.44, but without covering C.257 (Laidlaw 2010: 14). This deposit contained further large amounts of smithing pan and hammerscale (Young 2010a: 81, 91). Two final deposits, C.82 and C.145, with substantial amounts of smithing floor and hammerscale were located between features C.257 and C.286 (Laidlaw 2010: 17; Young 2010a: 82–83, 91). C.82 additionally yielded a small smithing hearth cake and likely tuyere material (ibid.: 77). Two features, one of which (C.297, 0.32 by 0.2 by 0.15m) was interpreted as a possible anvil (block) setting (ibid.: 66) and the other (C.204, 0.18 by 0.12 by 0.14m) as a large stakehole (Laidlaw 2010: 16–17) were located respectively to the east of the three features and between them. The former had high amounts of hammerscale, the latter none (Young 2010a: 92). To the east and south of the three above hearth/pits, and among them, multiple stakeholes were uncovered (Laidlaw 2010: 11). Six (C.13, C.17, C.21, C.23, C.25 and C.27) of the eight of those located to the south contained small slag fragments with some containing copper (Young 2010a: 73, 91). Several of the stakeholes to the east of the pits were set in a U-shaped pattern, enclosing possible anvil block setting C.297, and were seen as a bellows emplacement (Laidlaw 2010: 12–13).

A deposit, C.178/212, associated with these latter stakeholes contained some hammerscale (ibid.: 14; Young 2010a: 91). Radiocarbon analysis of an oat grain from another associated deposit, C.228, containing animal bone and some slag fragments, returned a date of AD 1471–1665 (98.9%) and 1785–1792 (1.1%) (2σ) or AD 1517–1594 (71.3%) and 1618–1650 (28.6%) (1σ) (Laidlaw 2010: 13, 95; Young 2010a: 88). On the north and east side, several gullies curved around this complex of features

101Four further minor date ranges were omitted.

(pits/hearths, postholes and stakeholes). Only two of these, C.67 and C.226, contained small amounts of hammerscale, as did a posthole, C.270, between these gullies (Laidlaw 2010: 10–11; Young 2010a: 91). There was also a cobbled surface, a probable pathway, approaching this concentration from the south (Laidlaw 2010: 12).

Further west a second concentration of features with metalworking was located. Among these were two linear features (C.154 and C.236) that both contained smithing residues, respectively four smithing hearth cakes, vitrified ceramic material plus other slag types and three smithing hearth cakes, tuyere material and plus slag (Laidlaw 2010: 10; Young 2010a: 78). A feature (C.59/71) was cut into the fill of C.154 and was interpreted as a hearth with various phases of use (Laidlaw 2010: 21–22). Radiocarbon analysis of a twig of oak retrieved from its basal fill returned a date of AD 1435–1527 (66.9%) and 1553–1633 (33.1%) (2σ) or AD 1444–1514 (83.4%) and 1600–1617 (16.6%) (1σ), but only the upper fill, interpreted as natural accumulation, contained small amounts of hammerscale (Laidlaw 2010: 21, 95; Young 2010a: 92).

Another feature, pit C.217, measuring 1.80 by 0.9 by 0.24m, was cut into the upper fill of the other linear feature C.236 (Laidlaw 2010: 20). A large flat stone was present at its base. Its lower fill contained fourteen smithing hearth cakes, tuyere fragments, vitrified ceramic material, other slag types and hammerscale, while the upper fill had five smithing hearth cakes, tuyere material, substantial amounts of hammerscale and other slag types (Young 2010a: 93). Three further pits were located broadly between the two linear features just discussed. The first, C.107, an elongated pit, had one smithing hearth cake, vitrified ceramic material and some slag blebs (Laidlaw 2010: 20; Young 2010a: 77). A second, C.69, measuring 0.91 by 0.84 by 0.21m and interpreted as a hearth, had eight smithing hearth cakes, possible tuyere material, vitrified ceramic material, some hammerscale and other slag types in its single fill (Laidlaw 2010: 21; Young 2010a: 76, 92). The third feature, C.78, an elongated pit, contained two smithing hearth cakes, vitrified ceramic material, hammerscale and other slag types (Laidlaw 2010: 20; Young 2010a: 76, 92).

Two deposits in the same area (C.61 and C.197) yielded respectively one smithing hearth cake, and nine smithing hearth cakes, tuyere material, vitrified ceramics, hammerscale plus various other slag types (Laidlaw 2010: 22, 114; Young 2010a: 78, 92, 93). Further to the south, three additional features contained slag. Two adjacent pits, C.74 and C.79, contained respectively a smithing hearth cake, tuyere material plus various slag and four smithing hearth cakes, vitrified ceramic material plus

blebby slag (Laidlaw 2010: 23; Young 2010a: 76–77).

Further west, the fill of a hearth (C.85/90) with a succession of burning events contained one smithing hearth cake (Laidlaw 2010: 22; Young 2010a: 78). The basal layer of the same feature contained a fragment of *Prunus* charcoal which returned a radiocarbon date of AD 1494–1509 (1.2%) and 1510–1601 (24.0%) and 1616–1686 (39.3%) and 1731–1808 (28.1%) (2σ) or AD 1526–1556 (18.4%) and 1632–1677 (49.1%) and 1766–1772 (2.7%) and 1777–1800 (23.1%) (1σ) (Laidlaw 2010: 22, 95). Finally, two fills of a long linear feature (C.46) south of the two concentrations of smithing activity, together yielded together eleven smithing hearth cakes, tuyere fragments, vitrified ceramics and other slaggy material (ibid.: 24–25; Young 2010a: 73, 77–78).

Wood identification of samples from eight contexts from the site showed a predominance of oak next to minor occurrences of blackthorn/cherry and alder (O'Carroll 2010: 35). Only twelve iron objects were recovered from the site, next to 65 of copper-alloy, mostly nails and unidentified artefacts.

In the first area, various deposits of smithing residues covered almost the whole area, with the exception of hearth C.257, indicating that this was the younger of the features. Multiple finds of copper sheet and rivets, but no casting debris, suggested cold-working of copper next to the iron smithing (Young 2010a: 67). The two other pits, with a very similar build-up: a basal layer of smithing pan and hammerscale and more sterile layers above, are here interpreted as abandoned, older hearths. That this activity was carried out inside a structure is demonstrated by the tiny amount of material (hammerscale) included in the nearby and related gullies. Due to the short distance between the features and the inner-most gully (C.226), it is likely that this represents a foundation slot for a clay wall. The cobbled pathway would also suggest that it led to an actual structure.

The second concentration, and the other more isolated features, would then represent pits where the heavier waste material was dumped. If this interpretation is correct, then at least three of the four radiocarbon dates relate to late events in the site's history. The smithing activity at Ballykeoghan is likely to have been carried out over a long period, with the earliest, at the second concentration, probably dating to the fifteenth to early sixteenth centuries. Later activity would seem to date to the sixteenth and possibly the seventeenth centuries.

Ballykilmore 6, Co. Westmeath

Site no. 7

Townland: Ballykilmore
Civil Parish: Newtown
Coordinates (ITM): E641735, N737236

Excavation licence: E2798
Dir.: John Channing (Valerie J. Keeley Ltd.)
Excavated between Nov. 2004 and May 2005

Site summary:

Ironworking activity: Smelting, (bloom)smithing

Significance: High

Site deposition condition: Primary/secondary

Investigation level: Partial

Ironworking features: Hearth

Dating evidence: C14

Sample size:

Material present:					
	Slag	✓	Tuyeres	✓	Tools
	Hammerscale	✓	Other ceramic	✓	Iron artefacts ✓

Description

The site at Ballykilmore, Co. Westmeath consisted of a cemetery within a circular enclosing ditch, where burials had taken place since early medieval times (Channing 2012) (Fig. S.6). A rectangular stone building, tentatively interpreted as the remains of a church, was abandoned in the thirteenth century (ibid.: 10, 31). Remains of ironworking, dating to both the fifth to seventh centuries and the late medieval period were excavated, the latter concentrated in two areas.

Area 1[102]

The first area was concentrated south of the eastern entrance of enclosure ditch C.104. Evidence of late medieval smelting was located in upper layers of the filled-up enclosing ditch.[103] Here two features, C.979 and C.1183, were interpreted as furnaces

102 The area designations were not used in the original report but were added here to facilitate discussion of the activities.

103 In the context description, C.979 is described as "cut into the top layer C.162" of the enclosing ditch (Channing 2012: 81). Elsewhere, it is described as belonging to Phase B/C of the ditch fills, the

(ibid.: 23, 77). The first feature, C.979, cut into one of those upper layers, contained an assemblage almost exclusively relating to smelting (Young 2012c: 458–459). It included extremely brittle slag which had flowed between large wood fragments (See Fig. 6.9), pieces of what would have been furnace cake, concretionary sheet, tuyere fragments and a small amount of smithing slag (7839g in total). It is likely that blowholes were meant instead of tuyeres as the latter are generally not connected to smelting operations in Ireland, and would be expected to have led to comments on this, by this author, if they had been tuyeres. The feature wherein the material was found, which measures 1.02 by 0.7 by 0.24m, had a fractured iron-stained stone at its base the curve of which respected the edge of the feature (Channing 2012: 631; Bolton 2012: 209–213), suggesting it was a smithing hearth with an anvil-stone rather than a furnace (See Fig. 8.6a). A long bone fragment from this context was dated by radiocarbon to AD 1298–1371 (75.8%) and 1378–1407 (24.2%) (2σ) or AD 1308–1331 (38.2%) and 1338–1361 (41.6%) and 1386–1397 (20.1%) (1σ) (Channing 2012 vol. 1: 300).

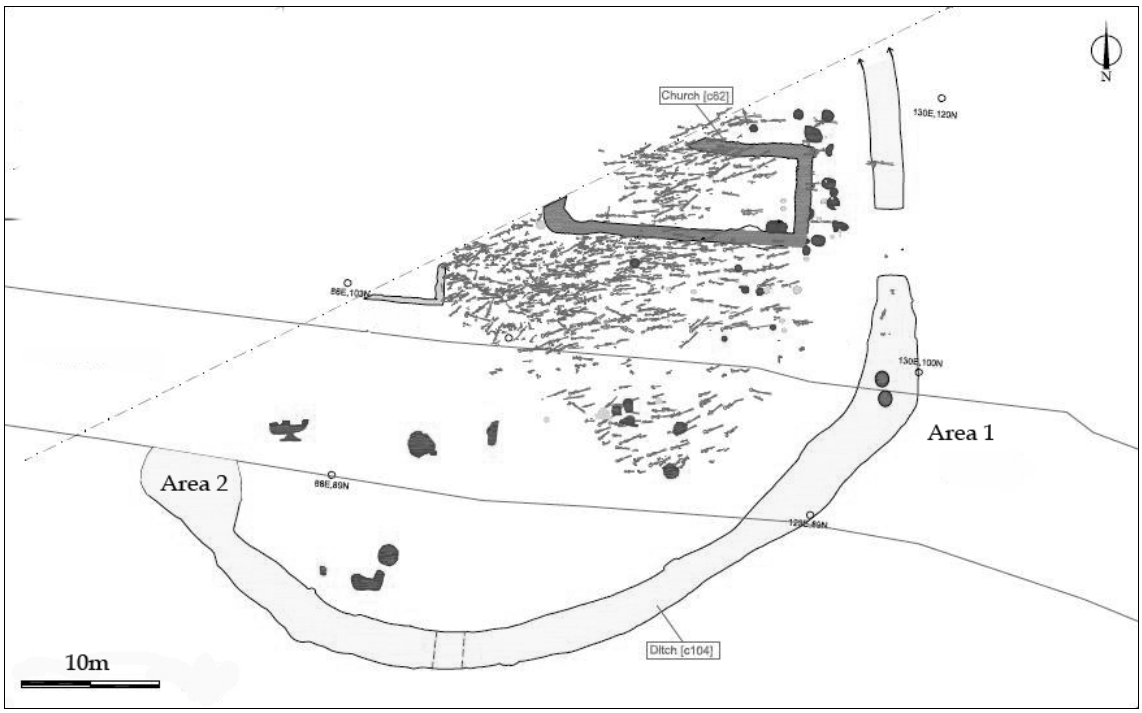

Fig. S.6 Ballykilmore 6, Co. Westmeath. Site plan (Channing 2012: 622)

middle of the three phases (ibid.: 23). Context C.162 is variably described as belonging to Phase A, the earliest of the ditch fill phases (ibid.: 21, 26) and is illustrated as occurring half-way a section face, near to where the slag-containing feature was situated (ibid.: 625). Perhaps importantly, no smelting slag was recovered from the lower two phases (A and B/C) of the ditch fills, but a fill (C.115) of the upper phase (D), illustrated as the top layer of the ditch (ibid.) and related to the nearby smithing activities, did include weathered smelting slag with large wood impressions (Young 2012c: 453–454).

Another nearby feature, C.1183, measured 0.7m diameter, was 0.35m deep and had concave sides (Channing 2012: 82). The slag retrieved from it consisted of a fractured block of friable slag (918g) (Young 2012c: 459). Although the slag could represent furnace cake slag, both the lack of the lower, drippy smelting slag and the shape of the pit would argue against this being a furnace pit. Several upper fill layers of the same ditch C.104 and in the same area contained further large amounts of ironworking debris (Channing 2012: 21). Layers C.115 and C.147 yielded abundant material (respectively 22330 and 7963g) which included small- to large-sized smithing hearth cakes (see Fig. 8.14) and some weathered smelting slag (Young 2012c: 452–454). Also included were fragments of very large pieces of the convex frontal parts of tuyeres (up to 0.3m diameter). Other pieces of ceramic material, which included fragments of tuyere material and had concave faces, were interpreted as support pieces for the tuyeres (ibid.: 389). Layer C.147 additional yielded an iron knife, a possible bracket and a strip of iron (ibid.: 123). Layer C.1181 had less material (3753g), but it did include part of a large smithing hearth cake (3453g reconstructed weight) (ibid.: 452). No hammerscale or smithing pan were recorded from this area.

Area 2

About 50m west, in a pit cut into the upper layers of the enclosure ditch, more ironworking remains were excavated (ibid.: 23–24). This feature (C.1231) was interpreted as a possible lime kiln based on the occurrence of frequent charcoal and stones and, had over 35kg of ironworking debris from ten different contexts (Young 2012c: 454–457). No further information on these contexts is available in the report. The material included several smaller (Fig. S.7) and some very large smithing hearth cakes (up to 4kg reconstructed weight), multiple fragments of large tuyere-fronts (up 0.3m diameter) and many occurrences of hammerscale. This feature was not directly dated, but as it was cut into the upper levels of the ditch and due to the similarity of the residues, it was very probably contemporary with the material from the first area.

Slag from both areas was chemically analysed (Table S.4). The high calcium content in both of these and the smelting slag from the same site led Young (2012b: 20) to interpret at least part of the former to be the result of bloom smithing. Particles of trapped bloom material were observed inside a piece of slag from Ballykilmore, Co. Westmeath, but analysis results only mention 0.42% Ca, 67.48% Fe and 19.5% O

(Young 2012c: 384, 464). Ballykilmore represents both smelting and two areas of (bloom) smithing. The smelting was carried out in a furnace which was probably situated somewhere near to the top levels, or on one of the banks, of the back-filled enclosing ditch, which might be the reason why no traces of it were found. Another explanation could be that the furnace was situated lower down and was not recognized as such when the ditch was sectioned.

Fig. S.7 Ballykilmore 6, Co. Westmeath. Small smithing hearth cake. Scale: 100mm (Young 2012c: 425)

The frequent occurrence of slag pieces with large wood impressions indicates a furnace with an organic fill under its charge, either a slag-pit furnace or a shaft furnace with a raised hearth. Based on the similarity of the material, the fourteenth-century, likely early fourteenth-century, date for the probable smithing hearth (C.979) which contained the smelting debris is supposedly representative for all the activity. The smithing, at least part of which was bloom refining, produced both exceptionally large smithing hearth cakes and tuyeres. The supports for the latter are currently unique. The site was still used as a cemetery when the ironworking was taking place (Channing 2012: 66).

	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
1	0.26	0.36	2.19	32.52	0.2	0.95	7.4	0.14	0.66	59.74
2	0.2	0.25	1.33	16.1	0.56	0.39	4.73	0.09	0.45	71.81
3	0.23	0.36	1.62	20.81	0.5	0.71	6.92	0.12	0.59	70.11
4	0.25	0.43	1.98	26.09	0.62	1.01	9.72	0.14	0.73	63.35
5	0.27	0.44	1.68	26	0.63	0.59	9.58	0.13	0.75	60.37
6	0.19	0.33	1.38	18.77	0.48	0.48	6.1	0.1	0.51	70.74
7	0.13	0.08	0.99	7.03	0.73	0.12	1	0.05	0.24	81.87
8	0.15	0.13	1.45	14.94	1.03	0.26	2.86	0.06	0.29	70.24

Table S.4a Results of chemical analysis of smelting slag from Ballykilmore, Co. Westmeath (Young 2012c: 400)

1 Brittle flow slag. Ballykilmore, Co. Westmeath, BYK1 [XRF on fused beads]
2 Thin crust, base of a straight wall. Id., BYK2 [id.]
3 Thin crust. Id., BYK3 [id.]
4 Hemispherical hollow mass. Id., BYK4 [id.]
5 Dense, rounded nub. Id., BYK6 [id.]
6 Rounded, rusty dense slag Id., BYK7 [id.]
4 Sinter? block, BYK8 [id.]
8 Sinter? material, friable, BYK20 [id.]

	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
1	0.21	0.49	1.82	22.17	0.42	0.75	2.84	0.16	0.54	73.39
2	0.16	0.53	1.33	22.98	0.35	0.82	6.75	0.95	0.86	65.52
3	0.31	0.62	2.26	25.87	0.61	1.13	9.92	0.18	2.05	56.92
4	0.12	0.20	0.86	10.55	0.40	0.16	1.54	0.07	0.42	83.87
5	0.12	0.10	0.88	7.49	0.78	0.16	1.02	0.05	0.29	79.47
6	0.27	0.74	2.89	30.94	0.39	1.29	7.94	0.22	2.26	54.42

Table S.4b Results of chemical analysis of (bloom)smithing slag from Ballykilmore, Co. Westmeath (Young 2012c: 398, 400)

1 Part of large thick crust cake. Ballykilmore, Co. Westmeath (Area 1), BYK15 [XRF on fused beads]
2 Thin crust smithing hearth cake. Id., BYK19 (small) [id., average of three analyses]
3 Smithing hearth cake (small). Id. (Area 2), BYK13 [id.]
4 Low density smithing hearth cake (small). Id., BYK16 [id.]
5 Sinter? Id., BYK17 [id.]
6 Thick crust cake or burr fragment. Id., BYK18c [id.]

Ballyloughan Castle, Co. Carlow

Site no. 8

Townland: Ballyloughan
Civil Parish: Sliguff
Coordinates (ITM): E674522, N658533
SMR: CW019:018

Director: William de Paor (Office of Public Works)
Excavated in 1955

Site summary:

Ironworking activity: Smithing		Significance: Medium		
Site deposition condition: Primary		Investigation level: Partial excavation		
Ironworking features: Hearth				
Dating evidence: Pottery		Sample size: Unknown		
Material present:	Slag ✓	Tuyeres	Tools	✓
	Hammerscale	Other ceramic	Iron artefacts	✓

Description

During the excavation of the north-eastern tower of Ballyloughan Castle, Co. Carlow an area of dark refuse material was uncovered on the interior of the curtain wall (de Paor 1962) (Fig. S.8). Ballyloughan was built around AD 1300 and its hall was converted to a tower house later on, suggesting a military use throughout the late medieval period (ibid.: 2; McNeill 1997: 192–193). The deposit surrounded a pit, and together these contained pottery, tiles, bone and multiple metal artefacts, including a chisel-blade (ibid.: 14). Also from the pit came nine fragments of "iron bloom from a reduction furnace". The pit itself is described as shallow and the accompanying figure shows it to have been a circular structure with a diameter of c. 0.65m (ibid.: 6). The assemblage probably represents a smithing hearth with the "blooms" being smithing hearth cakes or fragments thereof. The same author used the same description for material found at Mellifont Abbey, Co. Louth, this time under the heading "furnace bottoms" (de Paor et al. 1969: 140). The strip of copper found in the associated layer (de Paor 1962: 13)

could indicate non-ferrous metalworking in the same area. Iron objects from from the pit and layer included a small fragment of chain mail, a possible knife-blade, a chisel-blade, a bolt and a possible part of a buckle (ibid.: 13–14). The pottery found in the pit and the layer consisted of coarse, probably hand-made cooking ware and green-glazed pieces of jugs with a grey to terracotta coloured fabric. Based on this pottery, the assemblage was dated to the fourteenth century, but only a general late medieval date will be accepted.

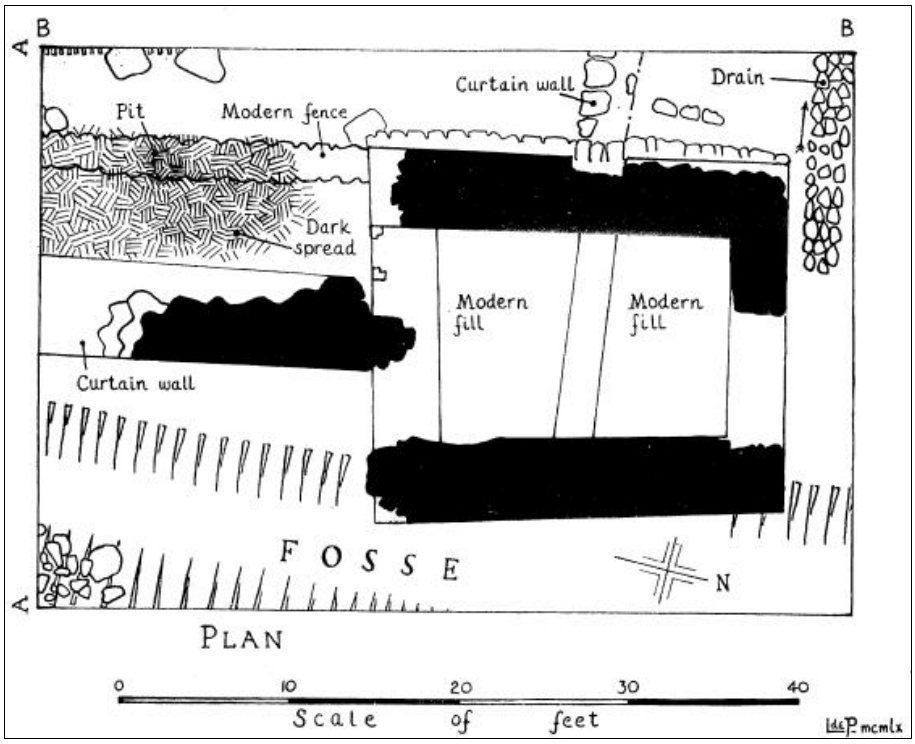

Fig. S.8 Ballyloughan Castle, Co. Carlow. Site plan (de Paor 1962: 6). The ironworking is situated around the “pit”

Ballyonan, Site 1, Co. Kildare

Site no. 9

Townland: Ballyonan
Civil Parish: Ballynadrummy
Coordinates (ITM): E668755, N742302

Excavation licence: 02E1087
Director: Rob O'Hara (ACS)
Excavated in September 2002

Site summary:

Ironworking activity: Smelting		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: C14		Sample size: 815g	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At site 1 in the townland of Ballyonan, Co. Kildare, a spread of charcoal containing slag was excavated (O'Hara 2008). The roughly circular spread measured 1.1 by 1 by 0.1m and contained hand-made pottery fragments together with multiple small slag fines (815g) (ibid.: 3; Photos-Jones 2008a: 7). Radiocarbon analysis of a fragment of oak charcoal from the spread returned a date of AD 1177–1304 (96.0%) and 1365–1384 (4.0%) (2σ) or AD 1225–1283 (1σ) (O'Hara 2008: 3, 22). All wood identified from this feature was oak (O'Carroll 2008). Chemical (Table S.5) and mineralogical analysis led Photos-Jones (2008a: 6) to conclude that the slag was the result of smelting, while the feature itself was seen as a smithing hearth (ibid.: 8). The interpretation as smelting slag is upheld, but this is partly based on its high manganese content, while the spread gave no evidence of having been used directly in connection with ironworking. The slag would then have been produced in the broad thirteenth, likely mid- to late thirteenth, century.

Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
n.d.	7.69	7.17	34.67	n.d.	n.d.	14.64	0.42	9.29	22.30

Table S.5 Results of chemical analysis of slag from Ballyonan, Co. Kildare (Photos-Jones 2008a: 31, 37) Slag fines. Ballyonan 1, Co. Kildare, SASAA BALLY01 [SEM-EDAX, average of three area analyses].

Ballyroney Motte, Co. Down

Site no. 10

Townland: Ballyroney
Civil Parish: Drumballyroney
Coordinates (ITM): E721555, N839481
SMR: DOW035:031

Director: David M. Waterman

Site summary:

Ironworking activity: Unknown		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Artefacts		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

A "considerable amount" of slag was found in a layer with artefacts dated to the early thirteenth century during excavations at Ballyroney Motte, Co. Down (Waterman 1955: 98). The layer was situated on top of a mound representing the remains of a motte.

Ballysimon, Co. Limerick

Site no. 11

Townland: Ballysimon
Civil Parish: Derrygalvin
Coordinates (ITM): E561885, N655650

Excavation licence: 99E0422
Dir.: Tony Cummins (Aegis Archaeology Ltd)
Excavated between September and December 1999

Site summary:

Ironworking activity: Smithing		Significance: Low		
Site deposition condition: Primary?		Investigation level: Complete Excavation		
Ironworking features: Hearth?				
Dating evidence: Pottery		Sample size: 2130g		
Material present:	Slag ✓	Tuyeres	Tools	
	Hammerscale	Other ceramic	Iron artefacts	✓

Description

Excavations on a ring-work at Ballysimon, Co. Limerick revealed evidence of limited metalworking (Collins and Cummings 2001). In total, just over two kilograms of slag were recovered from nine different contexts (ibid.: 44). The majority of the slag (1520g) was found in C.106, for which no details are available in the publication. One feature, C.63, described as a small metalworking pit (no dimensions given), had one fragment of slag (50g) (ibid.: 24), while a keyhole-shaped feature, C.226, with an original diameter of nearly 1 metre, later enlarged, revealed a piece weighing 260g (ibid.: 27). More slag was recovered from a corn-drying kiln located outside the enclosing ditch (ibid.: 37). Several examples of iron artefact were recovered from the site, nearly all nails, as well as a complete copper ingot (ibid.: 43–44). Local medieval pottery and Saintonge Ware dated to the thirteenth to fourteenth centuries were recovered from various features, including the basal layer of the enclosing ditch and one of the two internal buildings (ibid.: 22, 24, 43). This date range was seen as representative for the site as a whole (ibid.: 39).

Blackcastle AR31, Co. Tipperary

Site no. 12

Townland: Blackcastle
Civil Parish: Twomileborris
Coordinates (ITM): E619305, N657722
SMR: TN042:052

Excavation licence: E2374
Dir.: Mick Drum (Valerie J. Keeley Ltd.)
Excavated between Sep. 2006 and 2007

Site summary:

Ironworking activity: Smithing		Significance: High		
Site deposition condition: Primary		Investigation level: Complete excavation		
Ironworking features: Forge building, hearth, anvil?, rubbish dump				
Dating evidence: C14, pottery		Sample size: Unkown		
Material present:	Slag ✓	Tuyeres	Tools	✓
	Hammerscale	Other ceramic	Iron artefacts	✓

Description

The site excavated at Blackcastle AR31, Co. Tipperary, across the stream from the townland of Borris [337] which had remains of late fifteenth- to sixteenth-century iron smelting, had extensive evidence for late medieval smithing (Stevens 2010) (Fig. S.9). Large amounts of metallurgical waste, together with a possible chisel, were recovered from a midden on the western side of a mill-race (ibid.: 830). Pottery retrieved from the same deposit included ten pieces of local wares and two sherds of Glazed Red Earthenware (McCutcheon et al. 2010: 78).

The midden was situated inside two parallel ditches which also enclosed an almost square building. This building measured 7.8 by 7.4m externally and 6 by 5.8m internally and was marked by a shallow gully interpreted as a wall impression which would have held the clay wall (Stevens 2010: 32, 676) (See Fig. 8.1g). Several postholes were associated with this gully, one of which yielded a rectangular sectioned punch (ibid.: 32, 143). A hearth (0.8 by 0.7 by 0.12m) was located in the south-west

quadrant of the building and had four fills, each of which contained hammerscale (ibid.: 34). The protruding limestone visible on the photograph could have functioned as a working platform and/or as a stone anvil. A possible sharpening stone and a heavy chisel with a rectangular striking platform, interpreted as a stone worker's tool, were recovered from the floor levels of this structure (ibid.: 116, 135). None of the material connected to this smithy is discussed in the specialist report.

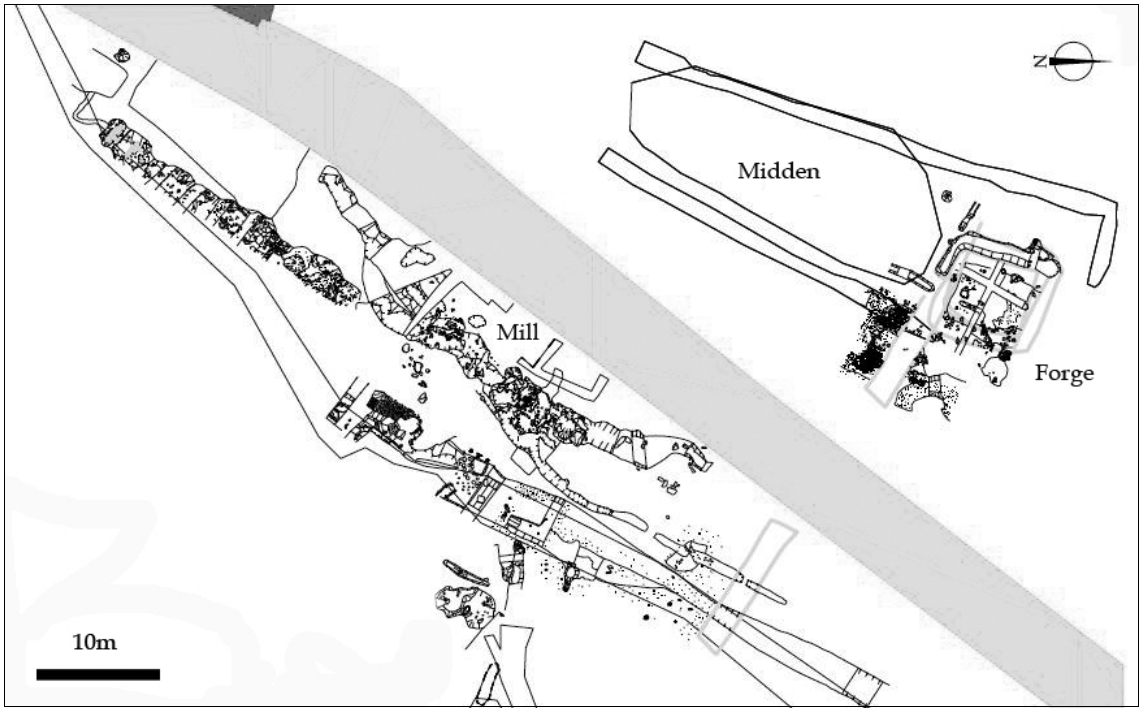

Fig. S.9 Blackcastle AR31, Co. Tipperary. Site plan (after Stevens 2010: 279)

Charcoal from an organic sub-floor level of this structure was dated by radiocarbon to AD 1219–1280 (2σ) or AD 1227–1233 (10.5%) and 1240–1248 (16.8%) and 1251–1275 (72.7%) (1σ) (Stevens 2010: 365). Both the mill house and race of the thirteenth-century mill, after abandonment, are recorded as yielding metallurgical waste, possibly small amounts (ibid.: 799–803). One of the fills (C.793) of the mill race with metalworking residues also contained several sherds of late medieval local wares (Cashel-type and Leinster Cooking Wares) (McCutcheon et al. 2010: 77), while a deposit containing metallurgical waste within the mill house also held a possible whetstone (Stevens 2010: 115, 822). The residues from this area are not included in the specialist report. The smithing at Blackcastle appears to date to the thirteenth, likely mid- to late thirteenth century, is located next a mill and comprized a smithy with an associated dump (Stevens 2010: 12).

Borris AR31, Co. Tipperary

Site no. 13

Townland: Borris
Civil Parish: Twomileborris
Coordinates (ITM): E619325, N657710
SMR: TN042:052

Excavation licence: E2374
Director: Mick Drum (Valerie J. Keeley Ltd.)
Excavated between Sep. 2006 and 2007

Site summary:

Ironworking activity: Smelting, (bloom)smithing

Significance: High

Site deposition condition: Primary

Investigation level: Complete excavation

Ironworking features: Furnaces, hearth

Dating evidence: C14, pottery

Sample size: > 31kg

Material present:						
	Slag	✓	Tuyeres		Tools	
	Hammerscale	✓	Other ceramic	✓	Iron artefacts	✓

Description

At site AR 31, in the part of the excavation located in the townland of Borris, County Tipperary, evidence of iron production was uncovered (Stevens 2010) (Fig. S.10). The late medieval component of the site, consisted of a vertical water mill (early thirteenth-century construction date), three corn-drying kilns (radiocarbon dates of respectively late twelfth to thirteenth centuries, fourteenth century and late fifteenth to early seventeenth centuries), a well (containing a hoard of fourteenth-century coins) and three areas of smithing activity. Specialist analysis was carried out on the metallurgical remains of this site, which were found to be related solely to (bloom) smithing (Wallace and Anguilano 2010: 61). Because of additional information in the report, which was seemingly not available when the specialist report was composed, the evidence will be re-examined.

The first feature, C.511, was oval in plan, measured 1.2 by 0.8m and consisted of a shallow hollow (0.16m depth) leading into a deeper pit (0.32m depth) (Stevens 2010

vol. 1: 42) (See Fig. 6.7a–c).[104] The shallow area had a burnt base which was covered with a thin white to grey ashy layer. The next fill, extending into the pit, was charcoal-rich and contained, according to the context description, frequent pieces of iron slag (30 to 100mm) and a large piece with surface flow-patterning with a length of 0.7m. The latter is visible in the accompanying pictures.

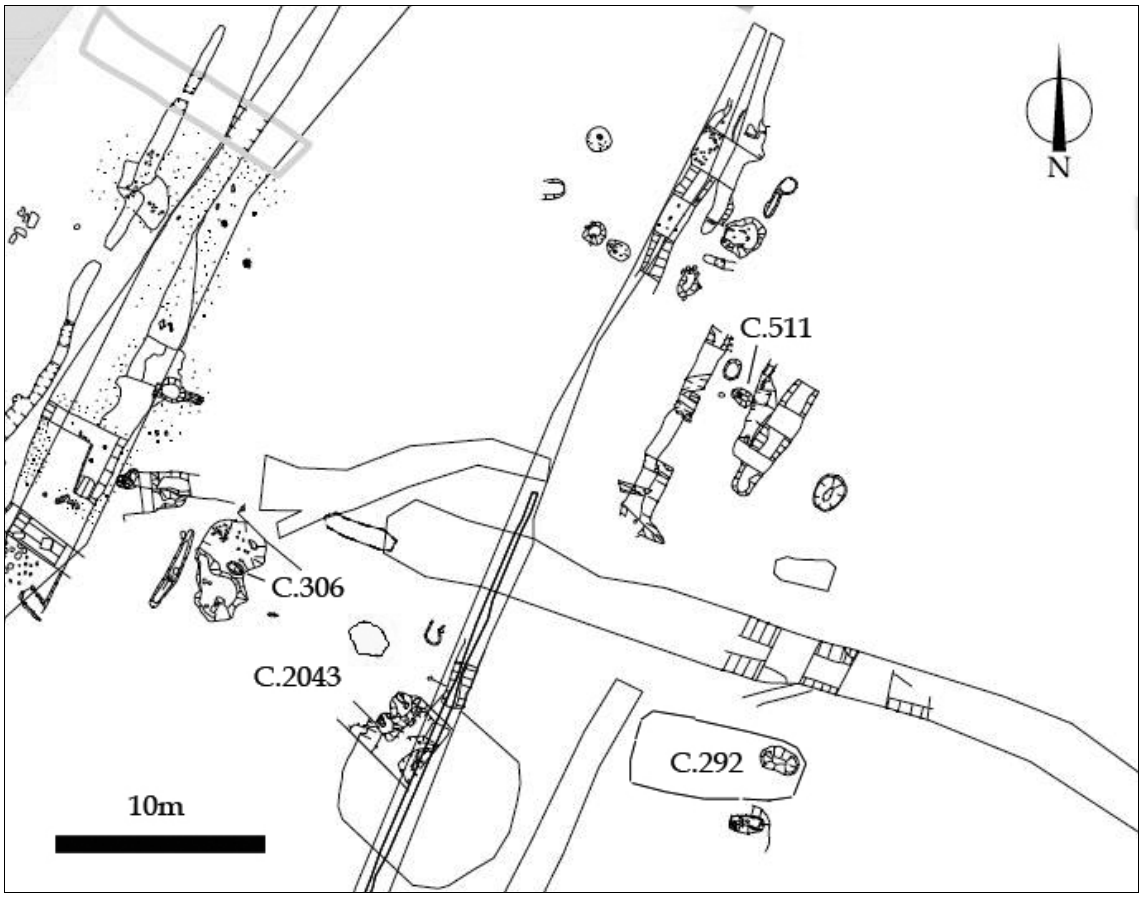

Fig. S.10 Borris AR31, Co. Tipperary. Post-excavation plan of the ironworking area (after Stevens 2010: 274, 279)

In the specialist report, which does not mention the large piece, the slag from this context is described as consisting mainly of hammerscale (c. 5kg), together with slightly larger rusty nodules, distinctive drippy pieces and two large furnace bottoms (1.5 and 0.8kg apiece) (Wallace and Anguilano 2010b: 481). These furnace bottoms are depicted and show a distinct white crust on the base which is probably the same as the white material lining the furnace bowl visible on the picture of that feature. It is argued here that the material most likely represents the result of smelting with the cakes pointing to *in situ* furnace bottoms, while the drippy pieces and the large piece with flow-structure

104 Confusingly, the description of this feature starts off using the number of the second feature to be discussed. The location details and features mentioned around it show that C.511was intended.

are tap slag. The “hammerscale” then likely represents smelting fines. This feature can then be reinterpreted as the base of a shaft furnace with adjoining tapping-hollow. A sherd of Leinster Cooking Ware was retrieved from the upper fill of this feature, while a piece of Cashel-type Ware was found in the fill, which was similar to the latter, of a nearby pit (Stevens 2010 vol. 1: 42; McCutcheon et al. 2010: 70–71, 77).

The second feature, C.306, was 1.12m in length, 0.58m in width and had a maximum depth of 0.27m (Stevens 2010 vol. 2: 530) and also consisted of a shallow area connected to a deeper hollow, this time with less steep edges (See Fig. 6.7d). The upper area had heavily heat-affected clay lining at its base, a crescent-shaped fill of clay and an upper charcoal-rich fill containing frequent slag inclusions, up to 0.7m long (ibid. vol. 1: 55). Again there is a discrepancy with the description in the specialist report, where the material is given as containing three smithing hearth cakes and a smaller drippy piece (total weight c. 1.8kg) and just under 5.5kg of hammerscale (Wallace and Anguilano 2010b: 52). A picture of this assemblage shows a largish piece with clearly visible flow-structure, likely smelting slag, next to the cakes (ibid.: 380).

Based on the similarity with the first feature (C.511) and the mentioning of the 0.7m-long piece, this feature is also reinterpreted as a shaft furnace with a tapping-hollow. No dated material was available for this feature, but a fill of the pit cut by furnace C.306 contained a sherd of Cashel-type Ware (Stevens 2010: 55; McCutcheon et al. 2010: 70–71, 76). The latter pit also contained slag, but this was not included in the specialist report.

A large rectangular feature (C.292), measuring 8 by 4m and 0.1m deep, was located eleven metres south of the first furnace (C.511) (Stevens 2010: 42–44). It was interpreted as a sunken-floor working area, had an ash-filled pit (C.633), a stone-lined feature (C.499) and a pit cut into its base (C.628). The main feature had three fills of which the lower- and uppermost covered the entire area. The text mentions 40% of all slag from this feature as recovered from the lower fill (ibid.: 43), but the specialist report has 21kg from the upper fill and a further 7kg labelled under the cut number (Wallace and Anguilano 2010b: 383). None of the basal features are recorded as containing slag. The residues are described as small- to medium-sized drippy and flattish pieces, but no smithing hearth cakes were included (ibid.: 375). The upper fill of this feature yeilded a sherd of Cashel Ware (McCutcheon et al. 2010: 74).

The stone-lined feature C.499, which measured 1.98 by 1.12 by 0.7m deep, was lined with stones on all four sides, up to three courses high (Stevens 2010: 43). Small

particles of copper were found in one of its lower fills. Another pit, C.533, is alternatively described as sited in, and on the edge, of rectangular feature C.292 in the full report (Stevens 2010: 45) and as nearby, and on the edge of, the same feature in the specialist report (Wallace and Anguilano 2010b: 375–376). It does not appear on the plans. The feature measured 0.7 by 0.5 by 0.24m and had three fills, the lower of which contained 4kg of slag of very similar appearance to that from C.292 with the addition of heat-affected ceramic material (ibid.: 377). Slag from this pit and both of the above furnaces was subjected to chemical analysis (Table S.6).

The middle fill of the ditch (C.385) separating the furnace and the above feature also contained metallurgical waste together with a coin minted between AD 1310 and 1314 (Stevens 2010: 720, 822), but no pottery. The metalworking residues do not appear in the specialist report. This ditch cut feature (C.537) was interpreted as a smithing hearth (Stevens 2010: 41–42). None of the fills, however, are recorded as containing metalworking residues, only the upper fill contained heat-affected clay interpreted as a collapsed superstructure. Radiocarbon analysis on organic material from one of the fills of this pit returned a date of AD 1291–1399 (2σ) (ibid.: 364). Three more pits (single fills C.314, C.323 and C.327), all rather irregular and located west of furnace C.511, contained metallurgical waste (ibid.: 821). This material is also absent from the specialist report. It is suggested here that the metallurgical material from the above features (sunken floor, pits and ditch) constitutes dumped material from the nearby furnace C.511. Slag from this deposit as well as both features reinterpreted as furnaces were chemically analysed. The results are remarkably similar, note for example the high manganese content in all the samples, indicating that all this material was the product of the same smelting process.

Located between the two furnaces, about seven metres east of C.306, an oval feature (C.2043) measuring 0.87 by 0.62 by 0.14m with concave sides and a flat base was uncovered (ibid.: 55) (See Fig. 8.6b). Its base consisted of heat-affected clay with charcoal inclusions and the fill above it contained 66 pieces of slag including two large smithing hearth cakes (diam. c. 0.2m) left *in situ* at the base of this fill (ibid.; Wallace and Anguilano 2010b: 378). Radiocarbon analysis on hazel charcoal from the basal layer of this feature returned a date of AD 1452–1526 (49.4%) and 1543–1634 (50.6%) (2σ) or AD 1468–1522 (56.2%) and 1574–1584 (7.6%) and 1590–1625 (36.2%) (2σ) (Stevens 2010: 364). This feature could represent bloom-smithing activity connected with one or both of the furnaces.

To the west of furnace C.511, two more pits (C.313 and C.322) contained additional slag (ibid.: 530–531). These features were neither dated, nor were their residues included in the specialist report. The charcoal from this feature consisted mainly of hazel (22.7g) with smaller amounts of oak (3.7g), spindle (1.3g) and willow (1.2g) (Lyons 2010: 465). Other features further east, unconnected to ironworking, were broadly contemporary. Radiocarbon analysis on organic material from a corn-drying kiln and the gully of a circular slot-built structure gave comparable results[105], the structure dating more narrowly to the sixteenth century (ibid.: 364–365). Both the kiln and the same gully each contained a sherd of Cashel-type Ware (McCutcheon et al. 2010: 76, 78).

The consistency of the analysis results for Borris, and the very strong likelihood that one of the assemblages represents smelting, then strengthens the validity of the interpretation of the material in both the features reinterpreted as furnaces and the dump, as relating to smelting. The smithing hearth, located between these furnaces and having medium-sized slag preserved *in situ*, is potentially a hearth for refining the blooms of those furnaces. If so, the whole assemblage then dates to the late fifteenth to sixteenth centuries and had associated settlement and corn-drying activity nearby. It would also be contemporary with the nearby tower house (Stevens 2010: 12).

	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
1	1.42	1.41	11.55	29.66	0.43	2.11	2.73	0.25	11.36	43.23
2	1.58	1.45	12.04	30.19	0.46	2.18	2.72	0.21	11.27	42
3	1.52	1.44	12.16	29.47	0.46	2.2	1.83	0.11	11.62	43.33
4	1.62	1.39	11.3	29.18	0.43	2.08	2.36	0.07	10.82	45.74

Table S.6 Results of chemical analysis of slag from Borris, Co. Tipperary (Wallace and Anguilano 2010b: 383, 386)

1 Two grey pieces, one drippy. Borris, Co. Tipperary, 24189_12B [XRF] from C.306
2 Tiny fragments. Id., 24189_13 (ibid.) [id.] from C.511
3 Rusty coloured, amorphous slag. Id., 24189_17A (ibid.) [id.] from C.292
4 Same piece. Id., 24189_17B (ibid.) [id.] from C.292

105 Another similar slot-built structure returned a seventeenth-century radiocarbon date (Stevens 2010: 364).

Bridgetown Priory, Co. Cork

Site no. 14

Townland: Bridgetown Lower
Civil Parish: Bridgetown
Coordinates (ITM): E569170, N599850
SMR: CO034:027(02)

Excavation licence: 98E0377
Director: Eamonn Cotter

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Partial excavation		
Ironworking features: None					
Dating evidence: Stratigraphy			Sample size: 683g		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic		Iron artefacts

Description

Excavations of a trench on the western side of the north-west corner of Bridgetown Priory, Co. Cork revealed a layer rich in iron slag (Cotter 1998). This layer (C.17) was situated on top of a wall (C.24) which was part of an annex built against the priory wall and interpreted as post-dating the dissolution of the priory in the sixteenth century, although the western part of C.24, above which the metalworking remains were found, could have been part of the original building (ibid.: 6). In total, 683g of metalworking residues were retrieved. The material was visually examined as part of this doctoral research (Table S.7). The collection consists of two types of slag, dense rusty-brown and frothy with various colours, and several pieces of vitrified ceramic material. Both types of slag are consistent with smithing residue assemblages from other sites, with the denser material interpreted as fragments of smithing hearth cakes and the lighter material closer to the source of oxygen and influenced by the composition of the tuyere. This latter would seem to be confirmed by the similarity of both the slag adhering to the

vitrified material and the less dense slag material. The ceramic material is reminiscent of fragments of vitrified tuyeres, and the probable indication of a blow-hole on one of the pieces would also point in this direction. The assemblage found at Bridgetown represents fairly typical remains connected with blacksmithing using charcoal. The material was not found in features connected to metalworking or together with iron finds which could give some indications of the technology used or the products made. The smithing activities could be connected to a phase of construction, renovation or dismantling, when iron was needed or recuperated. Alternatively, one of the buildings belonging to the owner of the complex after the Dissolution could have functioned as a place where iron was forged for agricultural or other uses.

Cut	Fill	Type	Description	Weight (g)
NA	17	Deposit	Elongated smithing hearth cake, rusty brown al round with crystallization (presumably fayalite) on the upper surface and some flow structure on the lower part. Relatively dense material with imprints of charcoal on both sides	119
NA	17	Deposit	Relatively dense pieces of slag ranging from brown-grey to rusty brown in colour. Five fractured pieces shown shiny, near metallic internal material. Frequent imprints of charcoal and occasional inclusions of rounded quartz fragments	116
NA	17	Deposit	Markedly lighter material, ranging from reddish black to mid-grey in colour which is both dull and shiny. Frequent inclusions of rounded quartz fragments and occasionally larger stones/pebbles. This material has a distinctive frothy appearance and in the rare cases where fractures are visible, the internal material is dull mid-grey. Occasional imprints of charcoal	312
NA	17	Deposit	Fragments of vitrified clay material. The clay has a high sand content and contains frequent smaller and larger pieces of rounded quartz. The colour ranges from reddish brown to dark grey/black, from the interior towards the exterior. The externally adhering slag ranges from mid-brown to black and is both shiny and dull in appearance. The larger piece shows the vitrification continuing towards the interior in one place, a probable indication of a blowhole.	86

Table S.7 Description of the material related to metalworking from Bridgetown Priory, Co. Cork

Caherduggan, Co. Cork

Site no. 15

Townland: Caherduggan North
Civil Parish: Caherduggan
Coordinates (ITM): E556932, N605337
SMR: CO025:012(02)

Excavation licence: 11E0071
Director: Colm Moloney
(Rubicon Heritage Services Ltd.)
Excavated between March and Dec. 2011

Site summary:

Ironworking activity: (Bloom) smithing			Significance: Medium		
Site deposition condition: Secondary			Investigation level: Partial excavation		
Ironworking features: None					
Dating evidence: C14			Sample size: 32kg		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale	✓	Other ceramic	✓	Iron artefacts

Description

At Caherduggan, Co. Cork, a multi-period site was excavated, which included a tower house together with several concentrations of ironworking (Moloney and Hourihan 2013). Most of the material from the concentration closest to the tower house, in area 3, was recovered from the upper fill of a recut C.146 of an oval ditch (ibid.: 17; Young 2013: 290). As a radiocarbon date of AD 1521–1575 (33.3%) and 1583–1590 (1.3%) and 1624–1667 (59.8%) and 1783–1796 (2σ)[106] was retrieved from material from the layer over the basal fill of the original ditch C.175, this material, and smaller amounts from features nearby, are considered likely to post-date the late medieval period. The smithing hearth cakes from these features are noticeably smaller than those described below.

Further north-east, in area 4, a substantial defensive ditch C347 contained more ironworking waste. Four of its upper fills, C.353, C.354[107], C.349 and C.348, contained respectively 12063g, 3285g, 11096g and 518g of metallurgical residues (Moloney and Hourihan 2013: 22; Young 2013: 291–292). Fill 353 was located on the side of the ditch

106 The BP dates are not included in the report, but were separately obtained from Jonathan Millar (Rubicon Heritage Services Ltd.).

107 This fill is given as 359 in the slag listing and as 354 in the summary. 359 is a voided context (Moloney and Hourihan 2013: 292, 295).

and was tipped in from the north. The material from the first three fills included several smithing hearth cakes, some of which weighed more than 3kg, tuyere fragments and a possible piece of iron ore (1040g), while that from the fourth and upper fill consisted of one smithing hearth cake. A shoe dated to the late fifteenth or early sixteenth centuries was retrieved from the fill below C.353, while clay pipe fragments were found in fill C.348 (Moloney and Hourihan 2013: 22). One of its middle fills, C.394, contained a probable frontal piece of a tuyere which could date to anywhere between the thirteenth, the radiocarbon date of the material from the basal fill of the ditch, and the fifteenth to seventeenth centuries, the date of the finds mentioned above (Moloney and Hourihan 2013: 21–22; Young 2013: 294).

North of this ditch, the remains of four circular post-built structures were uncovered. One of these, Structure 1, had small amounts of slag and vitrified ceramics in three of its postholes (C.185, C.199 and C.203) (Moloney and Hourihan 2013: 23–24; Young 2013: 292–293). Radiocarbon analysis of a charred wheat grain from posthole C.199 returned a radiocarbon date of AD 1474–1636 (2σ) or AD 1493–1525 (31.8%) and 1558–1602 (48.0%) and 1613–1631 (20.2%) (1σ) (Moloney and Hourihan 2013: 24). A posthole (C.289) belonging to structure 3 contained 4g of possible tuyere material, but as this posthole cut an earlier (early medieval?) feature (C.273) containing copious amounts of metalworking residues, the material is potentially residual (Moloney and Hourihan 2013: 26–27; Young 2013: 292). Organic material from another posthole belonging to the latter structure was radiocarbon dated to AD 1438–1515 (88.9%) and 1595–1618 (11.1%) (2σ) or AD 1445–1480 (1σ) (Moloney and Hourihan 2013: 27).

A nearby lime kiln (C.327) contained a further smithing hearth cake (1055g) in one of its upper fills, while a hammerscale particle was found in a layer associated with its use (Moloney and Hourihan 2013: 23; Young 2013: 290, 293). Radiocarbon analysis on a grain of charred oat returned a date of AD 1261–1300 (93.7%) and 1368–1381 (6.3%) (2σ) or AD 1272–1290 (1σ) .[108] The material from the kiln could suggest small-scale smithing activity in the late thirteenth century, while the later remains are potentially the result of late fifteenth- to sixteenth-century, likely late fifteenth-century, bloom smithing.[109] The latter activity was probably located nearby but outside the excavated area.

108 The results of this analysis were not incorporated in the report.

109 Young (2013: 280) put forward the possibility that this material could represent older material, but the deposition of substantial quantities of it in the ditch on two separate occasions likely suggests otherwise.

Cappydonnell Big 1, Co. Offaly

Site no. 16

Townland: Cappydonnell Big
Civil Parish: Ardnurcher or Horseleap
Coordinates (ITM): E627229, N737351
SMR: OF002:021(02)

Excavation licence: E2653
Director: Tim Coughlan
(Irish Archaeological Consultancy Ltd.)
Excavated between Oct. 2005 and April 2006

Site summary:

Ironworking activity: Smithing

Significance: Low

Site deposition condition: Secondary

Investigation level: Complete excavation

Ironworking features: None

Dating evidence: C14

Sample size: 490g

Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

Excavations of a multi-period site at Cappydonnell Big 1, Co. Offaly uncovered a large variety of features, concentrated around an irregular-shaped enclosure (Coughlan 2010). Several radiocarbon dates show that the ditch was in use in the centuries before the Anglo-Norman invasion, while similar dates from internal features range from the seventh to ninth centuries, suggesting a seventh- to eight-century construction date (ibid.: 18). The ditch was not completely filled until the post-medieval period (ibid.: 17). The late medieval component consisted of a possible rectangular post-built structure with three associated hearths, four corn-drying kilns, two possible storage pits, each with four postholes, and a metalworking area with an associated L-shaped structure (ibid.: 25–32). Nine radiocarbon dates were retrieved from features belonging to this phase (Table S.8)

Feature	Material dated	Date (2σ)
Posthole C.112 from possible rectangular structure	Birch	AD 1525–1558 (23.8%) and 1631–1665 (74.4%) and 1785–1793 (1.7%)
Posthole C.114 from possible rectangular structure	Hazel	AD 1451–1523 (61.2%) and 1559–1563 (1.2%) and 1571–1630 (37.6%)
Hearth C.118 related to possible rectangular structure	Hazelnut	AD 1486–1604 (78.9%) and 1607–1641 (21.1%)
Gully C.155 of L-shaped structure	*Pomoideae*	AD 1486–1604 (78.6%) and 1607–1643 (21.4%)
Posthole C.160 of L-shaped structure	*Pomoideae*	AD 1488–1603 (80.1%) and 1609–1638 (19.9%)
Kiln C.296	Barley	AD 1450–1522 (67.8%) and 1573–1627 (32.2%)
Kiln C.510	Hazel	AD 1445–1521 (78.2%) and 1576–1582 (0.8%) and 1591–1621 (20.9%)
Posthole from storage pit C.225	Barley	AD 1470–1533 (37.3%) and 1536–1635 (62.7%)
Posthole from storage pit C.139	Hazel	AD 1474–1636

Table S.8 Late medieval radiocarbon-dated features at Cappydonnel Big, Co. Offaly

A curved piece of dense, hard slag (440g) was found in a fill from kiln C.510, while an amorphous piece of light siliceous material (50g), possibly metallurgical ceramics, was retrieved from another of its fills (ibid.: 28; Photos-Jones 2010: ccxxii). Three features near the L-shaped structure provided the remaining slag, none of which however was directly dated. A circular pit with convex sides and measuring 0.68 by 0.65 by 0.24m contained 1000g of slag in its lower fill described as amorphous, porous, clinkery and siliceous (Coughlan 2010: 34; Photos-Jones 2010: ccxxii).

A nearby feature, alternatively described as a tree bole, a pit and a probable furnace, had two stakeholes or root activity at its base (Coughlan 2010: 34, xxix, xlix).[110] The plate of this feature would suggest the interpretation as a tree bole to be correct, due to the very irregular base, protruding stones, and so forth (ibid.: 427, Plate 58). The fill contained a large fragment of slag, with no description, and small fragments described as similar to those from the pit, in total 2255.5g (Photos-Jones 2010: ccxxii).

An associated spread of material contained a further 593.3g of small slag fragments, again described the same. Some of the fragments are described as drippy, both by the report author and the specialist (Coughlan 2010: 34; Photos-Jones 2010: ccxxviii). Based on the occurrence of a relatively large proportion of interstitial glass in the slag as seen through SEM microscopy, the material was designated as smelting slag.

110 The stakeholes are erroneously described as cutting the base of the pit (C167) as opposed to the tree bole/furnace (C597) on p.34.

We have seen, however, that this is not always the case (Chapter 1.2.4). Several particles of globular, iron-rich material were observed in the slag, which were interpreted as bog ore. The hollow nature of at least some of these would suggest that they could also be seen as entrapped hammerscale particles.

One piece of slag from the kiln was chemically analysed (Table S.9). The interpretation of this site is difficult due to the limited description of the material, the uncertainty of the contemporary nature of the features and the lack of a clear furnace or smithing hearth. The piece of slag from the kiln is probably a concave smithing hearth cake, so at least we have some evidence for late fifteenth- to sixteenth-century smithing activities at Cappydonnell Big 1.

Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
1.31	0.58	3.77	31.45	1.14	1.59	5.25	0.35	0.28	54.64

Table S.9 Results of chemical analysis of slag from Cappydonnel Big, Co. Offaly (Photos-Jones 2010b: 330, 332).

Possible metallurgical ceramics [?]. Cappydonnell Big 1, Co. Offaly, SASAA 323.19 [SEM-EDAX, area analysis]

Carlow Castle, Co. Carlow

Site no. 17

Townland: Carlow
Civil Parish: Carlow
Coordinates (ITM): E672334, N676422
SMR: CW007:018(02)

Excavation licence: 96E0105
Dir.: Kieran O'Conor (Office of Public Works)
Excavated between May and July 1996

Site summary:

Ironworking activity: Smithing?		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations in advance of conservation work at Carlow Castle, Co. Carlow uncovered a palisaded ditch and a corn-drying kiln both pre-dating the building of the stone keep in c. AD 1210–1215 (O'Connor 1997a; 1997b: 15). The ditch was interpreted as the remains of a ring-work preceeding the masonry castle. The material filling these features contained animal bone, iron slag and both Leinster Cooking Ware and glazed pottery.

Carnmeen, Co. Down

Site no. 18

Townland: Carnmeen
Civil Parish: Newry
Coordinates (ITM): E708774, N830949
SMR: DOW046:024

Excavation licence: AE/06/254
Director: Paul Masser
(Headland Archaeology (UK) Ltd.)
Excavated after December 2006

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Primary			Investigation level: Complete excavation		
Ironworking features: Hearths					
Dating evidence: C14, pottery			Sample size: 66.4kg		
Material present:	Slag	✓	Tuyeres	Tools	✓
	Hammerscale	✓	Other ceramic ✓	Iron artefacts	✓

Description

At Carnmeen, Co. Down, at and near the site of an older ringfort, several areas with ironworking residues were uncovered (McMeekin 2012) (Fig. S.11). In AD 1157, the monastery at Newry was granted to the Cistercian Order together with lands which included Carnmeen (ibid.: 6).

Around the same time, on the location of a ringfort now out of use, an east/west-orientated stone building was constructed probably measuring c. 8.6 by 6.7m or c. 17 by 8.6m (Area B) (ibid.: 23, 61). Over 10kg of metalworking debris were retrieved from the area of this building and in the upper fill of a nearby souterrain (B), the majority consisting of vitrified ceramic material (7162g), smithing hearth cakes (1126g) and undiagnostic slag (1297g)[111] (ibid.: 79; Cruickshanks et al. 2012: 45–46). Radiocarbon analysis on hazel charcoal from the same upper souterrain fill returned a seventh- to eighth-century date, but also contained pottery dated to the early to mid-thirteenth

111 As no context nor finds/sample registers are included, and not all features are discussed in the text, the precise location of the residues can often not be traced.

century (McMeekin 2012: 18). Four crucible fragments were also recovered from the same area (Hunter and McLaren 2012). One was found in a pit, another in a posthole and the other two in separate waste deposits. One of these deposits (C.20099), seen as the result of the collapse of the structure, also contained metalworking waste, predominantly thirteenth-century finds and a charred nutshell which returned a radiocarbon date of AD 1190–1196 (0.8%) and 1207–1285 (99.2%) (2σ) or AD 1225–1234 (19.5%) and 1236–1271 (80.5%) (1σ) (McMeekin 2012: 24, 145). The other deposit, interpreted as an occupation layer within the same structure, yielded more thirteenth-century artefacts, but also a fragment of hazel charcoal returning a seventh- to tenth-century radiocarbon date (ibid.: 19, 164).

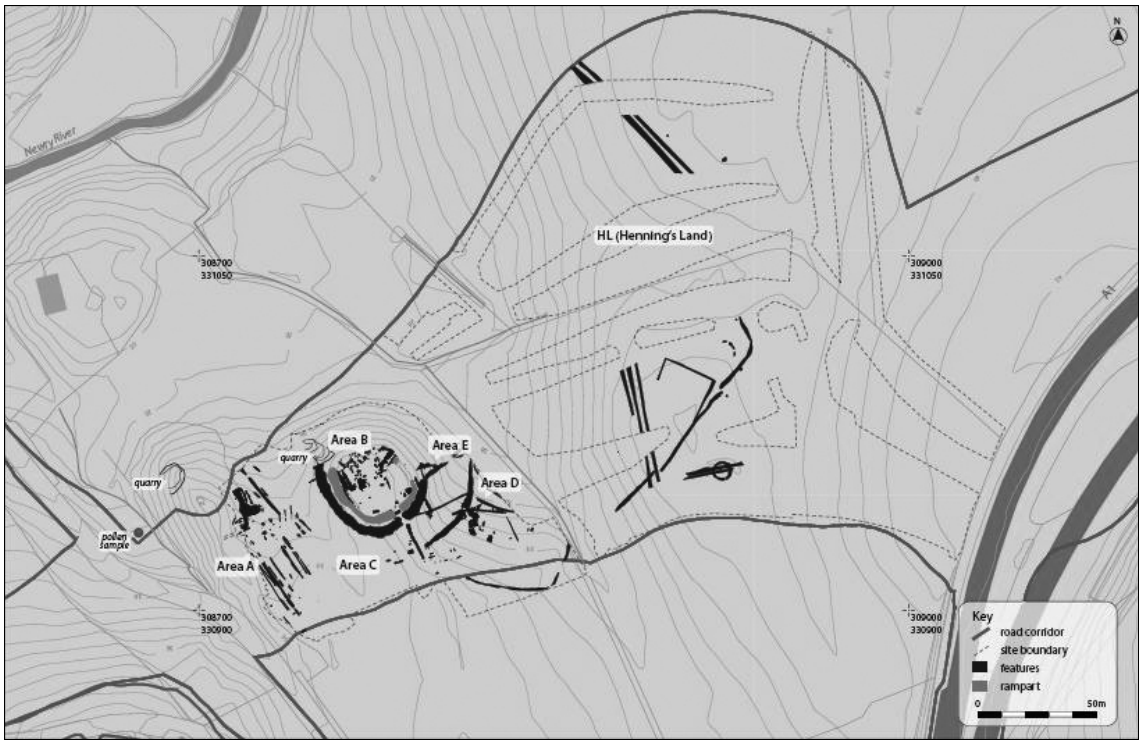

Fig. S.11 Carnmeen, Co. Down. Site plan (McMeekin 2012: 324)

A second souterrain, located about 50 metres west of the stone building (Area A), contained over 14kg of vitrified waste in its fills, most of which was fuel-ash slag, probably unconnected to metalworking, but also vitrified lining (731g) and smithing hearth cakes (430g) (ibid.: 144; Cruickshanks et al. 2012: 44–45). This souterrain had various phases of use, including a remodelling as a corn-drying kiln in use from the tenth/eleventh to thirteenth centuries, and was disturbed in the nineteenth century (McMeekin 2012: 27, 32).

Fifty metres to the south an isolated hearth (20007) was uncovered. More than 1.2kg of metalworking residues were recovered from this feature, the majority consisting of hammerscale (910g) and smithing pan (238g) (ibid.: 144; Cruickshanks et al. 2012: 44). A fragment of oak charcoal from the fill of this hearth returned a radiocarbon date of 991–1055 (53.7%) and 1077–1154 (46.2%) cal AD (2σ) (McMeekin 2012: 146).

To the east of this feature, in an area (D) to the south-east of the entrance of the former ringfort, the largest concentration of metallurgical residues, over 20kg, was encountered (ibid.: 144). Several ditch sections and re-cuts (C.20154, C.20188 and C.20200) included smithing hearth cakes[112] and vitrified lining amongst undiagnostic slag. A whetstone, probably reused as a hammer-stone, was recovered from ditch C.20188 (ibid.: 106). Hazel charcoal from the fill of the first ditch returned a radiocarbon date of AD 1047–1088 (11.7%) and 1122–1139 (3.5%) and 1149–1262 (84.8%) (2σ) or AD 1156–1225 (97.7%) and 1234–1237 (1.2%) and 1249–1250 (1.2%) (1σ) (ibid.: 36, 145). Three fills of the second ditch which had slag[113] also comprized organic material on which radiocarbon analysis was performed giving a date of AD 1039–1212 cal AD (2σ) or AD 1046–1093 (46.5%) and 1120–1140 (18.1%) and 1148–1185 (34.6%) and 1204–1205 (0.7%) (1σ) (oat grain) and two identical dates of AD 895–924 (12.3%) and 938–1033 (87.6%) (2σ) (alder and oat grain) (ibid.: 145). The two fills with the earlier dates, however, contained thirteenth-century pottery (ibid.: 35, 36).

South of these ditches several features held ironworking residues. One of these, large pit C.20067, contained hammerscale and radiocarbon analysis on an oat grain returned a date of AD 1219–1306 (91.3%) and 1363–1385 (8.7%) (2σ) or AD 1255–1297 (99.2%) and 1375–1375 (0.8%) (1σ) (ibid.: 71, 145; Cruickshanks et al. 2012: 46). Other pits, C.20060 and C.20526, in the same area are recorded as containing hammerscale. Another pit (C.20445), close to the previously mentioned ditches, yielded iron slag and thirteenth-century pottery (McMeekin 2012: 36).

A further ditch (C.20250), to the north of, and parallel with, the three ditches discussed earlier, held more ironworking remains (2.8kg) (Cruickshanks et al. 2012: 46). Radiocarbon dates, both on hazel charcoal, were obtained from two fills of the same ditch, one of which gave AD 1219–1298 (98.8%) and 1372–1377 (1.2%) (2σ) or AD 1257–1289 (1σ), while the other returned a date of AD 1037–1209 (2σ) or AD

112 Several larger ones were, based on their size, interpreted as the result of smelting (Cruickshanks et al. 2012: 43), but large smithing hearth cakes are not unusual in Irish contexts.

113 The stratigraphy of these layers in unclear from the report.

1044–1098 (53.1%) and 1119–1142 (21.3%) and 1147–1174 (25.5%) (1σ) (McMeekin 2012: 145). The first of these fills also contained frequent thirteenth-century pottery (ibid.: 15).

The last area with evidence of metalworking is known as Henning's Land and is located about 150 metres east of the former ringfort (ibid.: 36). Here, two fills of a hearth (C.21107) measuring 1.04 by 0.89 by 0.21m contained smithing hearth cakes and other slag, weighing more than 12kg in total.[114] Radiocarbon analysis on hazel charcoal from its bottom fill gave a date of AD 1043–1105 (23.8%) and 1118–1224 (76.2%) (2σ) or AD 1058–1073 (11.1%) and 1155–1215 (88.9%) (1σ) (ibid.: 146). The middle and upper layers of two nearby ditch sections yielded further slag and vitrified lining (ibid.: 37).

The site at Carnmeen appears to have no less than four areas where iron smithing was carried out. Isolated hearth (C.21107) dated to the eleventh to twelfth centuries and is the only feature which can be interpreted as a potential smithing hearth.[115] Around the entrance to the former ringfort, dates ranging from the eleventh to twelfth centuries, early to late thirteenth century and thirteenth, likely mid- to late thirteenth, century were returned. Thirteenth, and likely mid-thirteenth, century activity was recorded in the stone building, while further away, at Henning's Land, eleventh to thirteenth, likely late twelfth to early thirteenth, centuries activity was carried out. At one of these areas, inside the stone building, copper was also worked. The wider area seems to have been used for smithing activities more or less continuously from the eleventh to the late thirteenth centuries.

114 Here also iron smelting was, probably erroneously, implied because of the occurrence of large diameter slag cakes (see footnote 21).

115 The report mentions two other pits (C.20060 and C.20526) which contained hammerscale (McMeekin 2012: 46), but no further information on these was available.

Carrickfergus, Joymount, Co. Antrim

Site no. 19

Townland: Carrickfergus
Civil Parish: Carrickfergus
Coordinates (ITM): E741529, N887874

Site summary:

Objects subjected to metallographic examination and chemical analysis

Description

The doctoral thesis by Scott (1976: 268–273) includes metallographic examination and chemical analysis results on six nails from an excavation at Joymount in Carrickfergus (Table S.10). These could not more closely dated than between the twelfth and seventeenth centuries (ibid.: 215). No further information on this excavation was found.

	C	P	Al	Mn	Ni	Ti	Cu
1	0–0.05	0.031	0.031	0.023	0.01	0.085	0.03
2	0	tr.	0.05	0.006	0.002	0.413	0.02
3	0–0.4	0.005	0.01	tr.	0.04	0.013	0.01
4	0	0.008	0.005	tr.	0.007	0.006	0.002
5	0	0.012	0.003	0.012	0.01	0	0.003
6	0–0.7	0.006	0.007	0.008	0.004	0.016	0.001

Table S.10 Analyses results for iron objects from Carrickfergus, Joymount, Co. Antrim (Scott 1976: 268–273)

1 Nail. Ferrite/pearlite, even carburization, slag-rich (CFJ/46)
2 Nail. Ferrite, much slag (CFJ/53)
3 Nail. Ferrite/pearlite, uneven carburization (CFJ/75)
4 Nail. Ferrite, much slag (CFJ/89)
5 Nail. Ferrite (CFJ/105)
6 Nail Ferrite/pearlite, uneven carburization (CFJ/195)

Carrickfergus, 11–17 Market Place, Co. Antrim

Site no. 20

Townland: Carrickfergus
Civil Parish: Carrickfergus
Coordinates (ITM): E741221, N887418

Director: Tom G. Delaney
Excavated between 1972 and 1979

Site summary:

Ironworking activity: Smithing			Significance: Low	
Site deposition condition: Secondary			Investigation level: Urban	
Ironworking features: None				
Dating evidence: Artefacts			Sample size:	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts ✓

Description

During excavations at 11–17 Market Place, Carrickfergus, Co. Antrim ironworking residues were found on a cobbled floor (Simpson and Dickson 1981: 80). The limited published data only records that this was found in the lowest levels and consisted of "iron slag and furnace bottoms", without dating information. Scott (1976: 116), in his unpublished doctoral thesis, added that next to the furnace bottoms, two small blooms were also found, seemingly in the same area. Of one of these blooms, both the metal and slag inclusions, which amount to smelting slag, were subjected to chemical analysis (Table S.11a and b). Metallographical examination of the slag-free part of the iron of the same bloom revealed that it consisted of ferrite and pearlite, showing random carbon distribution (ibid.: 270). Additionally, eighteen pieces of smithing slag were chemically analysed (Table S.11a). Both metallographic examination and chemical analysis were carried out on twenty-four iron objects (Table S.11c). The date of these iron objects ranged from the twelfth to the seventeenth centuries (ibid.: 215) and included sixteen nails, five knives, two bars and a ring. Chemical analysis for three objects from Market Place (CFM/1426a and b and CFM/1528b) for which no metallographic examination was carried out and which have no descriptions, are not included in the table.

	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
1	n.d.	1.66	1.89	n.d.	0.39	n.d.	0.14	0.17	0.13	n.d.
2	n.d.	4.31	2.84	n.d.	0.01	n.d.	1.54	0.17	0.13	n.d.
3	n.d.	3.32	20.79	n.d.	0.01	n.d.	8.39	0.17	0.39	n.d.
4	n.d.	3.32	11.34	n.d.	0.53	n.d.	2.80	0.17	0.39	n.d.
5	n.d.	0.33	3.78	n.d.	0.11	n.d.	1.40	0.17	0.02	n.d.
6	n.d.	4.98	22.68	n.d.	0.09	n.d.	1.40	0.83	0.13	n.d.
7	n.d.	3.32	18.90	n.d.	1.08	n.d.	1.40	0.17	0.13	n.d.
8	n.d.	1.82	18.90	n.d.	0.01	n.d.	5.59	0.17	0.26	n.d.
9	n.d.	2.32	18.90	n.d.	0.16	n.d.	1.96	0.17	0.13	n.d.
10	n.d.	1.66	11.34	n.d.	0.30	n.d.	0.42	0.17	0.13	n.d.
11	n.d.	1.66	3.78	n.d.	0.62	n.d.	1.40	0.17	0.04	n.d.
12	n.d.	1.66	22.68	n.d.	0.05	n.d.	2.80	0.17	0.64	n.d.
13	n.d.	1.66	20.79	n.d.	0.01	n.d.	0.01	0.17	0.04	n.d.
14	n.d.	2.32	37.81	n.d.	0.07	n.d.	0.28	0.67	0.52	n.d.
15	n.d.	1.66	18.90	n.d.	0.02	n.d.	0.03	0.17	0.05	n.d.
16	n.d.	2.32	11.34	n.d.	0.02	n.d.	1.40	0.17	0.13	n.d.
17	n.d.	1.66	3.78	n.d.	0.01	n.d.	0.28	0.36	0.04	n.d.
18	n.d.	1.66	18.90	n.d.	0.28	n.d.	1.40	0.17	1.55	n.d.
19	n.d.	2.31	26.46	n.d.	0.02	n.d.	2.80	0.17	0.27	n.d.

Table S.11a Results of chemical analysis of slag from Carrickfergus, Market Place (Scott 1976: 202)

1 Slag trapped in bloom. CFM/1265,[QCA][116]
2 Slag. CFM/448, [id.]
3 Slag. CFM/470, [id.]
4 Slag. CFM/564, [id.]
5 Slag. CFM/571, [id.]
6 Slag. CFM/608, [id.]
7 Slag. CFM/638, [id.]
8 Slag. CFM/825, [id.]
9 Slag. CFM/827, [id.]
10 Slag. CFM/847, [id.]
11 Slag. CFM/865, [id.]
12 Slag. CFM/1021, [id.]
13 Slag. CFM/1172, [id.]
14 Slag. CFM/1240, [id.]
15 Slag. CFM/1286, [id.]
16 Slag. CFM/1423, [id.]
17 Slag. CFM/1478, [id.]
18 Slag. CFM/1509, [id.]
19 Slag. CFM/1519, [id.]

C	P	S	Si	Al	Mn	Ni	Ti	Cu	Slag
0–0.15	0.06	n.d.	n.d.	0.2	0.03	0.007	0.03	0.01	n.d.

Table S.11b Results of chemical analysis of a bloom fragment from Carrickfergus, Market Place (Scott 1976: 273) [QCA]

116 The doctoral thesis and an earlier publication by the same author(Scott 1971; Scott 1976) refer to quantitative chemical analysis without specifying the method used.

	C	P	Al	Mn	Ni	Ti	Cu
1	0	0.006	0.05	0.43	0.01	0.059	0.07
2	0–0.78	0.035	0.01	0	0.006	0.674	0.006
3	0–0.1	0.005	0.03	tr.	0.02	0.008	0.009
4	0–0.89	0.122	0.03	0.04	0.007	0.36	0.007
5	0–0.89	0.027	0.04	0	0.002	0.197	0.002
6	0.05–0.09	0.01	0.03	0	0.02	0	0.01
7	0–0.45	0.017	0.04	0	0.006	0.042	0.004
8	0–0.89	0.009	0.04	0	-	0.11	0.006
9	0–0.1	0.006	0.005	tr.	0.01	0.059	0.004
10	0–0.65	0.004	0.003	tr.	0.04	0.06	0.32
11	0–0.35	0.009	0.05	0	0.01	0	0.01
12	0.3–0.89	0.003	0	0.083	0.001	0.12	0.004
13	0 0.1	0.026	0.01	0.003	0.01	0.264	0.01
14	0–0.08	0.19	0.02	0	0.01	0.601	0.01
15	0–0.08	0.004	0.02	0.007	0.008	0.022	0.005
16	0–0.89	0.13	0.01	0.018	0.01	0.11	0.32
17	0–0.35	0.009	0.02	0.004	0.007	0.03	0.007
18	0.6–0.89	0.006	0	0.005	0.002	tr.	0.004
19	0–0.6	0.142	0.01	0	0.01	0.59	0.007
20	0–0.1	0.009	0	tr.	0.02	0.32	0.01
21	0–0.1	0.01	0.01	0	0.01	0	0.004
22	0–0.15	0.014	0.005	0.03	0.01	0.46	0.01
23	0–0.06	0.064	0.004	0.005	0.01	0.013	0.009
24	0.05–0.89	0.002	0.03	0.038	-	0	0.01

Table S.11c Results of chemical analysis and metallographical examination of iron objects from Carrickfergus, Market Place (Scott 1976: 268–273) [QCA]

1 Nail. Ferrite, slag-rich (CFM/447)
2 Nail. Ferrite/pearlite, very uneven carburization (CFM/630)
3 Nail. Ferrite/pearlite, evidence of die-forging (CFM/739)
4 Nail. Ferrite/pearlite, very uneven C and P distribution (CFM/789)
5 Nail. Ferrite/pearlite, uneven carburization (CFM/857)
6 Nail blank? Ferrite/pearlite, uneven carburization (CFM/868)
7 Nail blank? Ferrite/pearlite, even carburization, slag-rich (CFM/1056)
8 Ring. Ferrite/pearlite, fairly uneven C distribution, some grain-size segregation (CFM/1061)
9 Bar. Ferrite/pearlite, even carburization (CFM/1082)
10 Nail blank? Ferrite/pearlite, even grains, much slag (CFM/1083)
11 Nail. Ferrite/pearlite, uneven carburization, some P segregation (CFM/1165)
12 Nail. Ferrite/pearlite, highly uneven C and P distribution (CFM/1209)
13 Nail. Ferrite/pearlite, highly contorted structure, high C edge (CFM/1221)
14 Nail. Ferrite/pearlite, fairly even carburization (CFM/1236)
15 Nail. Ferrite/pearlite, uneven carburization (CFM/1283)
16 Bar. Ferrite/pearlite, fairly uneven carburization (CFM/1310)
17 Nail blank? Ferrite/pearlite, low C, some P segregation (CFM/1425)
18 Nail. Ferrite/pearlite, slag-rich (CFM/1512)
19 Nail blank? Ferrite/pearlite, low C, even distribution (CFM/1528a)[117]

117 The catalogue gives (CFM/1528b) which was not examined metallographically (Scott 1976: 269).

20 Knife. Ferrite/pearlite/cementite, centre: pure Fe, sides: carburized, no heat-treatment (CFM/989)
21 Knife. Ferrite/pearlite/cementite, uneven carburization, sides low C steel/pure Fe (CFM/1074)
22 Knife. Ferrite/pearlite/troostite/martensite, edge and pattern? welded, centre: uneven carburization, edge, high C steel, quenched, slag-rich (CFM/1179)
23 Knife. Ferrite/pearlite, edges welded?, slag-rich (CFM/1246)
24 Knife. Ferrite/martensite, unevenly carburized steel, quenched (CFM/1380)

Carrickfergus, Market Square/ St. Nicholas Church, Co. Antrim

Site no. 21

Townland: Carrickfergus
Civil Parish: Carrickfergus
Coordinates (ITM): E741228, N887382

Excavation licence: AE/10/142
Director: Ruairi Ó Baoill (QUB)
Excavated between August 2010 and July 2011

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Carrickfergus, between St. Nicholas' Church and Market Square a rectangular area and an adjacent narrow trench were excavated ahead of infrastructure works (Ó Baoill and Murray 2011). In the trench, a slot-trench was exposed which contained iron slag, parts of a medieval cooking pot and coal (ibid.: 34, 59, 62).

Carrickmines Castle, Co. Dublin

Site no. 22

Townland: Carrickmines Great
Civil Parish: Tully
Coordinates (ITM): E721816, N724031
SMR: DU026:005(05)

Excavation licence: 00E0525
Director: Marc Clinton
(Valerie J. Keeley Ltd.)
Excavated in 2005

Site summary:

Ironworking activity: Smelting?, smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Complete excavation		
Ironworking features: None					
Dating evidence: C14, pottery			Sample size: 2500g		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

A small assemblage (1485g) of smelting slag and one smithing hearth cake were recovered from the castle-site at Carrickmines, Co. Dublin (Young 2012f: 1338). It included pieces which had flowed against a wall and showed a high proportion of flow lobes, suggesting that they originated from a shaft furnace. Analysis of the material confirmed that some of the pieces were smelting slag and had solidified in an oxidizing environment, that is to say not in a pit under the furnace (Young 2012a). Other pieces, morphologically similar, were chemically closer to the smithing slag (ibid.: 1366–1367). The feature C.518 wherein the material was found, was probably located in the far south-eastern corner of the excavation, outside the defensive ditch. No dating information for this context was available.

Two additional small pieces of possible smelting slag were found in two adjacent areas at the eastern limit of excavation (ibid.: 1344). One of these was found in a deposit (C.780) together with five fragments of Leinster Cooking Ware (McCutcheon 2012c:

448), the other in a foundation layer (C.1355) of a floor of a house in use from the thirteenth to eighteenth centuries (Breen 2012: 209, 272; ibid. Context Register: 39, 41, 43).[118] At the same site, small amounts of smithing slag were found dispersed across the site (Breen 2012; Young 2012e, 2012f). One possible concentration of activity was located at the centre of this large site and consisted of several structures enclosed by defensive ditches (Breen 2012: 270–271). A ditch (C.233) associated with the earliest of these structures (B) included a smithing hearth cake, slag with flow-structure and possible smithing pan (1110g in total) (Young 2012f: 1342, 1344, 1348). Two fills of this ditch included Leinster Cooking Ware and Dublin-type Ware (McCutcheon 2012c: 443, 466).

A stratigraphically later structure (C), considered as having an industrial function, contained further residues (Breen 2012: 270). One of the structure's two defining gullies (C.712) yielded flowed material and possible smithing pan (388g in total), while the other gully (C.869) held a small smithing hearth cake and dense slag (325g in total) (Young 2012f: 1341–1343). Both gullies yielded large amounts of pottery including Leinster Cooking Ware, Dublin-type Wares and a sherd of Saintonge Polychrome Ware (McCutcheon 2012c: 442, 470), while gully (C869) also contained a coin minted in AD 1280 (Breen 2012: 98). This probably points to iron smithing being carried out near these structures in the thirteenth century, but the actual place of activity remains elusive. During that period, Carrickmines was the center of a small undefended manor (ibid.: 17).

118 The context and feature registers were separate from the four-volume report.

Cashel, Bank Place, Co. Tipperary

Site no. 23

Townland: Cashel
Civil Parish: St. Johnbaptist
Coordinates (ITM): E607685, N640736
SMR: TS061:025

Excavation licence: 04E0111
Director: Joanne Hughes (Headland Archaeology (Ireland) Ltd.)
Excavated in 2005

Site summary:

Ironworking activity: Bloom (smithing)			Significance: High	
Site deposition condition: Primary			Investigation level: Complete excavation	
Ironworking features: Hearths, anvil?				
Dating evidence: Pottery			Sample size: > 13.9kg	
Material present:	Slag	✓	Tuyeres	Tools ✓
	Hammerscale		Other ceramic	Iron artefacts ✓

Description

Excavations at Bank Place in Cashel, Co. Tipperary uncovered extensive *in situ* remains of late medieval ironworking (Hughes 2009). The plot was located at the street-front side of what would have been the main street passing through medieval Cashel. Seven possible smithing hearths were found in proximity to each other (Fig. S.12) .

The first hearth (C.244) measured 0.8 by 0.6m and had a flue-like projection at its south-eastern side (ibid.: 19, 58).[119] Its basal fill, a charcoal-rich deposit, and upper fill both contained globules of slag which were interpreted as hammerscale (NI)[120] (ibid.: 19, 59). No datable material was retrieved from this feature.

Immediately to the south-west, a second, pear-shaped hearth (C.224/253), originally interpreted as two features, was uncovered which measured 1.7 by 0.85 by 0.25m. Its single fill contained metalworking debris and two metallic layers, potentially hammerscale-rich (NI) (ibid.: 19, 59). The same fill also yielded a sherd of Cashel-type Ware (McCutcheon 2009a: 92). Further to the south-west an elongated pit (C.251)

119 The excavation (Hughes 2009: 138) does not show the flue and the feature has larger dimensions.
120 The material from this context does not appear in the specialist report. This is the case with several other features, which will also be marked as (NI), Not Investigated.

measuring 1.3 by 0.5 by 0.26m contained material described as “iron(?) slag” (NI) and a large smithing hearth cake (1540g) (Hughes 2009: 19, 59; Chadburn 2009: 98). A further fragment of Cashel-type Ware was found in this pit (McCutcheon 2009a: 92).

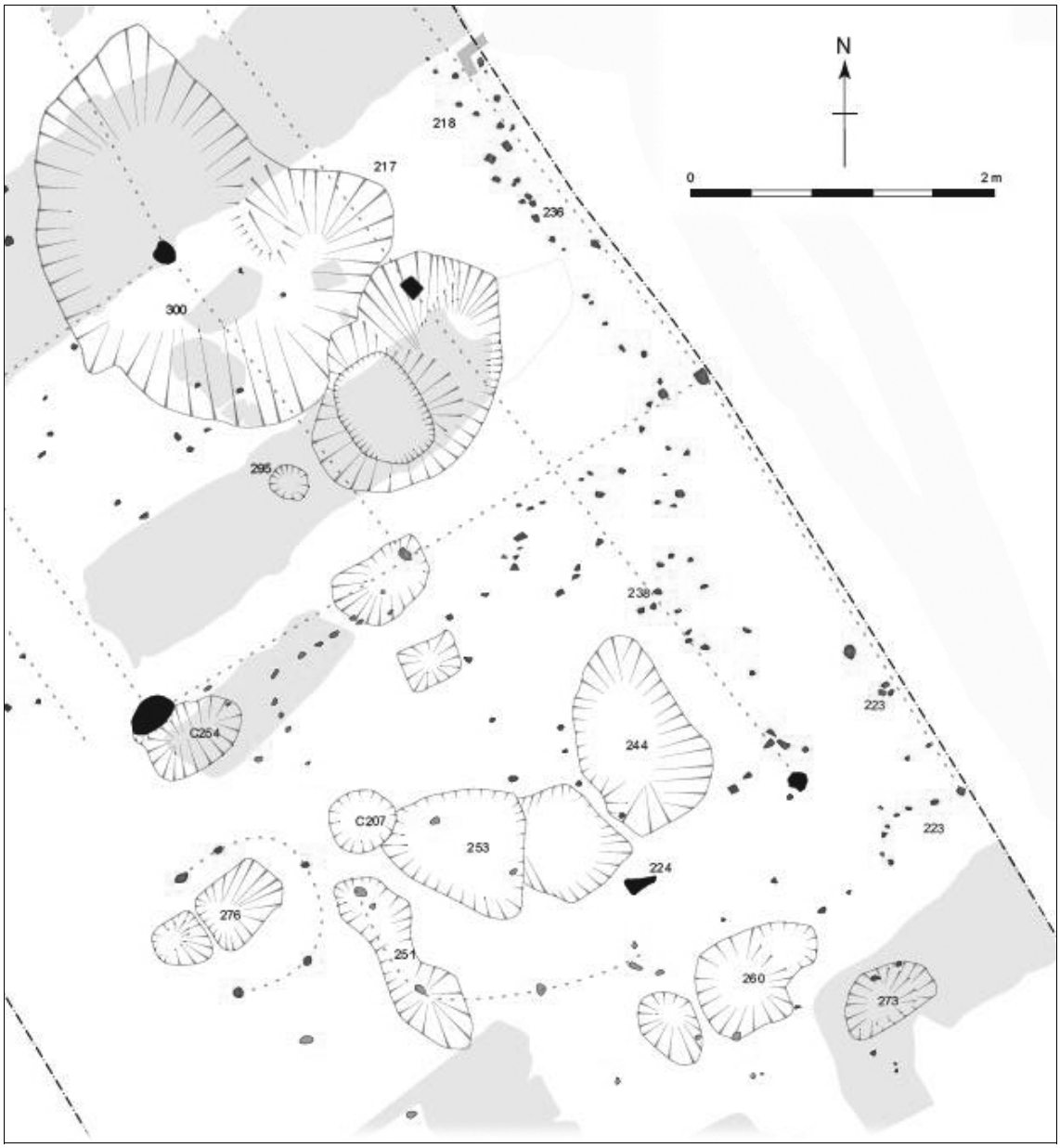

Fig. S.12 Cashel, Bank Place, Co. Tipperary. Plan of ironworking area (after Hughes 2009: 138)

Further south-west again was feature (C.276), consisting of two conjoined pits and alternatively interpreted as two possible postholes and a smithing hearth (Hughes 2009: 19, 62). The larger of these measured 0.6 by 0.5 by 0.2m and had a curving row of stakeholes on one side. Neither metalworking residues, nor pottery are recorded from its fill. To the north of this, hearth (C.254) was uncovered. This feature measured 0.75 by 0.45 by 0.25m and its single fill contained iron slag (NI) and two pieces of Cashel-type

Ware (Hughes 2009: 19, 59; McCutcheon 2009a: 92).

To the south-east of the first three hearths was an irregular feature (C.260) which measured 1 by 0.7 by 0.28m, contained a large stone slab and had a flue-like structure on its northern side (Hughes 2009: 18, 59). Its basal layer was a thin metallic film (hammerscale?) (NI) and the fill immediately above this contained a piece of Cashel-type Ware (McCutcheon 2009a: 92). The final hearth (C.273) was located next to and south-east of the latter and measured 0.66 by 0.44 by 0.2m (Hughes 2009: 18, 60). Its lower fill consisted of grey metallic clay (hammerscale?) and had very occasional inclusions of slag (NI). No datable material was found in this feature.

The whole area in which the above hearths were located was covered by several deposits, some containing high concentrations of charcoal, burnt material and slag. Layer (C.204) contained slag (NI) and a whetstone (See Fig. 8.12b) and is described as containing iron particles (hammerscale?) (ibid.: 23, 56). A sherd of Cashel-type Ware and another of Saintonge Green-Glazed Ware were also found in this deposit (McCutcheon 2009a: 92). Layer (C.205) was also described as containing iron particles and the slag described from this context consisted of a large smithing hearth cake (2270g) and other slag (4340g) (Hughes 2009: 23, 56, 78–79; Chadburn 2009: 98).[121] No datable material was found in this layer. A third deposit (C.214) contained a small whetstone next to slag (Hughes 2009: 21, 57). The latter material which was studied consisted of four amorphous pieces (Chadburn 2009: 98). No datable material was retrieved from this deposit, except for a sherd of nineteenth-century pottery probably compressed into it (Hughes 2009: 21).

Several deposits were also uncovered further to the north-west of the area already discussed. Centrally located was a large heat-shattered stone (C.215) the surviving dimensions of which were 1.5 by 0.95 by 0.1m (ibid.: 21, 57). Four amorphous pieces of slag (258g) were recorded from the fill between the stone fragments as well as 21 sherds of Cashel-type Ware (Chadburn 2009: 98; McCutcheon 2009a: 92). This stone was set in deposit (C.218) which contained a droplet of slag (10g), but no pottery (Chadburn 2009: 98). This area was truncated by a later wall and, to the west, by a drainage pipe. Two small deposits (C.209 and C.264), both recorded as having metalworking debris, were seen as the result of this later activity (Hughes 2009: 27, 56, 60).

To the north-west, a gravelly deposit (C.269) contained one smithing hearth cake (650g) as well as three sherds of Cashel-type Ware and one piece of Saintonge Green-

121 The larger smithing hearth was not included in the specialist report.

Glazed Pottery (Hughes 2009: 24, 60; Chadburn 2009: 98; McCutcheon 2009a: 92). A final deposit (C.220) was alternatively described as above C.254, part of the hearth concentration, and around the area of the large stone (C.215) (Hughes 2009: 23, 24, 57). A total of 3090g of slag was described from this deposit, consisting of three smithing hearth cakes, fragments thereof and amorphous material (Chadburn 2009: 98). It also yielded seven pieces of Cashel-type Ware (McCutcheon 2009a: 92). The only iron artefacts recovered from the site were various nails.

There was no evidence of a structure in the area of the hearth concentration, although several stakehole configurations could represent screens (Hughes 2009: 138). To the north, however, multiple postholes appear to form a building with dimensions 5.2 by 4.6m. Although not directly dated, this building was seen as late medieval (ibid.: 21–25), but the internal features, including the shattered stone (C.215), were seen as unrelated.[122] The site therefore represents smithing activities presumably taking place over a relatively prolonged period, all seemingly in open air on the street front.

122 Pers. comm. Joanne Hughes by email (26 August 2013).

Castle Carra, Co. Antrim

Site no. 24

Townland: Castle Park
Civil Parish: Culfeightrin
Coordinates (ITM): E724970, N933460
SMR: ANT015:014

Director: Declan Hurl (Environment and Heritage Service
Excavated between 1996 and 2004

Site summary:

Ironworking activity: Smithing			Significance: Low	
Site deposition condition: Primary			Investigation level: Complete excavation	
Ironworking features: Hearth?				
Dating evidence: Pottery			Sample size: Unknown	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts ✓

Description

Excavations at Castle Carra, Co. Antrim revealed limited remains of late medieval ironworking (Hurl 2007; Hurl and McSparron 2004). This small fortification was built in the fourteenth century and metalworking debris, including the remains of a crude "furnace", was found on the floor of its interior and was interpreted as left by ironworkers who had moved into the structure after it had been abandoned. This activity post-dated the defensive use of the building and subsequent excavation revealed further slag, including a "furnace bottom", together with green-glazed, other medieval pottery and iron objects (Hurl 2007). This material does probably represent ironworking carried out in an abandoned building, but most probably constitutes smithing.

Castledermot, Abbey Street/Market Square/Main Street, Co. Kildare

Site no. 25

Townland: Castledermot
Civil Parish: Castledermot
Coordinates (ITM): E678203, N685143
SMR: KIL040:002

Excavation licence: 04E0750
Director: Áine Richardson (Eachtra Archaeological Projects Ltd.)
Excavated between June and Dec. 2004

Site summary:

Ironworking activity: Smithing			Significance: Low	
Site deposition condition: Secondary			Investigation level: Urban	
Ironworking features: None				
Dating evidence: Pottery			Sample size: > 4.9kg	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts ✓

Description

Excavation of a long, narrow trench ahead of sewage works through the middle of Castledermot, Co. Kildare, and passing through two of the medieval town gates, uncovered many features containing ironworking residues (Harte and Richardson 2010). The northern-most feature, ditch C.24, located outside the medieval town walls, had two pieces of slag in its basal fill together with a sherd of Leinster Cooking Ware (ibid.: 14). Further south, the first concentration of slag-containing features was found around where the medieval Dublin Gate was located.

Here, two ditches (C.49 and (C.51), two pits (C.59 and C.73) and a deposit (C.53) yielded respectively three, one, three, two and eleven pieces of slag (ibid.: 14–15, 17). The material from ditch C.51 and the two pits was found together with sherds of Castledermot-type pottery and Leinster Cooking Ware. A second concentration of features was located about 50m north of the marketplace. In this area, six pits (C.316,

C.320, C.325, C.331, C.337 and C.352) contained respectively nine (weighing 4.9kg), six, one, one, eleven and one, pieces of slag (ibid.: 17–19). Two shallow features in the vicinity yielded a further three pieces of slag (ibid.: 18). Nearly all these features also contained Castledermot-type Ware and Leinster Cooking Ware (ibid.: 17–19).

Between this area and the market, slag was found in a further five deposits, that is to say C.332 (two pieces), C.333 (six pieces), C.375/390 and C.376 (one piece each) and C.379 (four pieces) (ibid.: 23–24). The same types of pottery were again recovered from these deposits, while the first two also contained imported wares such as Redcliffe Ware (McCutcheon 2010d: 195). At the southern end of the market, slag was recovered from a foundation trench (C.270, one piece) and a ditch (C.398, four pieces) (ibid.: 21, 23). The ditch contained Castledermot-type Ware as did the trench, but together with Dublin-type Cooking Ware.

Between the market and the southern Tullow Gate, three pieces of slag (over 1kg in weight) were recovered from pit C.106 and one piece from the fills of pits C.235, C.237 and C.238 (ibid.: 29–30). In all cases, Leinster Cooking Ware and Castledermot-type Ware were recovered from the fills. All the slag material was described as either amorphous or smithing hearth cakes (Fairburn 2010a: 344). Both concentrations of material probably represent nearby *in situ* smithing activities, and in the case of Dublin Gate, possibly related to building activities. While some material is associated with thirteenth- to fourteenth-century pottery, most of the features can only be labelled as late medieval.

Cathedral Hill, Co. Down

Site no. 26

Townland: Demesne of Down
Civil Parish: Down
Coordinates (ITM): E748127, N844428
SMR: DOW037:071

Director: Bruce Proudfoot (QUB)
Excavated between 1953 and 1954

Site summary:

Ironworking activity: Smithing			Significance: Low	
Site deposition condition: Primary			Investigation level: Partial excavation	
Ironworking features: Hearth				
Dating evidence: Pottery			Sample size: Unknown	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts ✓

Description

At the site of Cathedral Hill, Downpatrick in Co. Down, a trench across an early medieval defensive ditch was excavated in 1953 (Proudfoot 1954). The last phase of activity consisted of the construction of an "iron bloomery" cut into the fill of the outer ditch and described as a shallow hollow (ibid.: 98–99). No dimensions are given but the section drawing shows a hollow measuring 1.4m across by 0.6m deep. Glazed pottery from this feature was dated to the thirteenth century (ibid.: 101). The following year an additional trench was excavated alongside the latter (Proudfoot 1956). The continuation of the "bloomery" was uncovered and now interpreted as a trench used for smelting iron (ibid.: 61–68).

A bloom, not mentioned in the publications, was recovered from these thirteenth-century levels (Schubert 1957: 140). It was described by this author as a rectangular oblong piece measuring c. 200 by 50 by 50mm (8 by 2 by 2 inches) long and weighing about 665g (1lb 7 ½oz). It showed signs of having been cut with a sharp

object and was very corroded. Twenty years later, the same bloom was investigated by Tylecote (1977). The remaining bloom, minus the material previously removed by cutting, now weighed 500g, but was only about 115mm long (4.5 inches) (See Fig. 6.12). The Schubert length was seen as an error and this was corroborated by the excavation director of the site. Metallographic examination of the bloom showed that it consisted of ferrite (ibid.), while chemical analysis of a limited amount of elements showed relatively low values overall (Table S.12).

C	P	S	Si	Mn	Slag
0.08	0.06	0.04	0.16	0.02	7.25

Table S.12 Results of chemical analysis of a bloom fragment from Cathedral Hill, Co. Down (Schubert 1957: 340).

Clareabbey, Co. Clare

Site no. 27

Townland: Clareabbey
Civil Parish: Clareabbey
Coordinates (ITM): E534661, N675772
SMR: CL033:120

Excavation licence: E2021
Director: Graham Hull (Thames Valley Archaeology (Ireland) Ltd.)
Excavated between Nov. 2010 and Feb. 2011

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Partial excavation		
Ironworking features: None					
Dating evidence: C14, pottery			Sample size: 18kg		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale	✓	Other ceramic	✓	Iron artefacts ✓

Description

At Clareabbey, Co. Clare an excavation adjacent to an outer wall of the kitchen and part of the cloister of the Augustinian abbey unearthed evidence of metalworking (Hull 2012; Bermingham et al. 2012: 75–85).[123] An elongated waste pit (C.6), parallel to the abbey wall, contained slag (1631g), all of which was described as undiagnostic (Keys 2012a: 51). Radiocarbon analysis on charred grains of wheat from the same feature returned a date of AD 1032–1210 (2σ) or AD 1043–1105 (58.3%) and 1118–1144 (23.5%) and 1146–1166 (18.1%) (1σ) (Hull 2012: 72). An adjacent shallower pit (C.45) contained a small fragment of undiagnostic slag (Keys 2012a: 52). A shallow ditch or gully (C.35), also parallel to the abbey wall but further away, yielded substantial amounts of metalworking waste (10591g), including five smithing hearth cakes and small amounts of hammerscale (ibid.: 51–52). It also contain a horseshoe nail. A charred hazelnut from the same feature returned a radiocarbon date of AD 1215–1320 (82.5%)

123 An earlier published article on the same site does not mention the metalworking (Hull and Joubert 2008)

and 1350–1391 (17.5%) (2σ) or AD 1229–1231 (0.8%) and 1243–1246 (2.3%) and 1252–1301 (83.5%) and 1367–1382 (13.4%) (1σ) (Hull 2012: 72). A ditch similarly orientated as, and cut by, the former (C.123) contained further metallurgical residues (465g), mostly undiagnostic slag, but also a possible smithing hearth bottom fragment and tap slag (Keys 2012a: 52).[124]

Three (C.40, C.38 and C.41) of four postholes in a row, and continuing the line of the first ditch/gully, also contained metalworking waste, respectively 873g (smelting slag? and hammerscale), 1g (undiagnostic) and 114g (undiagnostic). Radiocarbon analysis on a piece of pig bone from posthole (C.38) returned a date of AD 1058–1064 (0.4%) and 1069–1071 (0.1%) and 1155–1292 (99.5%) (2σ) or AD 1212–1276 (1σ) (Hull 2012: 72). Another feature (C.14), a shallow ditch at right angles to the abbey wall and post-dating it, contained further residues (549g), including "run cinder", "tap slag" and undiagnostic material (ibid.: 15; Keys 2012a: 51–52). Just under 4kg of further metallurgical residues were recovered, either from modern deposits or from stratigraphically unconnected layers (ibid.: 50–52). As concluded in the report, the residues were probably deposited at the excavated area, but produced elsewhere (ibid.: 50). They also appear to have been deposited at different times, that is to say probably during the late thirteenth century, but also before that date.

124 Several pieces from Clareabbey were designated as tap slag and interpreted as indicating smelting (Keys 2012a: 50). Although this would need confirmation it is suggested here that these are fluid slags connected to smithing activities.

Claregalway, Co. Galway

Site no. 28

Townland: Claregalway
Civil Parish: Claregalway
Coordinates (ITM): E537239, N733283
SMR: GA070:109

Excavation licence: E4248
Director: Nial O'Neill
(Headland Archaeology (Ireland) Ltd.)
Excavated between Nov. 2010 and Feb. 2011

Site summary:

Ironworking activity: (Bloom) smithing		Significance: Medium		
Site deposition condition: Secondary		Investigation level: Partial excavation		
Ironworking features: None				
Dating evidence: C14, pottery		Sample size: 147.5 kg		
Material present:	Slag ✓	Tuyeres	Tools	
	Hammerscale	Other ceramic	Iron artefacts	✓

Description

At Claregalway, Co. Galway two areas with evidence of late medieval ironworking were excavated on opposite sides of a river (Mac Domhnaill 2013). The area north of this river, across the road from Claregalway Castle, consisted of a series of pits, ditches and deposits yielding 147.5kg of slag relating to smithing (Cosham 2013: 317). The activity was divided into four phases.

The first phase was represented by eight pits containing 17309g of slag in total. Radiocarbon analysis on charred cereal grain from the fill of pit (C.1008) below the one containing the slag returned a date of AD 1164–1264 (2σ) or AD 1189–1197 (10.5%) and 1207–1257 (89.5%) (1σ) (Mac Domhnaill 2013: 13, 237). Similar analysis on human bone from the basal fill of pit (C.1040), below two fills containing slag, returned a date of AD 1055–1076 (3.3%) and 1154–1262 (96.7%) (2σ) or AD 1164–1223 (1σ) (ibid.: 12–13, 236). These two pits also contained late medieval pottery, respectively Galway-type Ware and Green-glazed Saintonge Ware (McCutcheon 2013: 263).

The second phase of activity was represented by ten pits and a posthole, containing 47865g of slag in total. Radiocarbon analysis on animal bone from the basal fill of pit (C.1114), all five fills of which contained slag, returned a date of AD 1227–1298 (97.9%) and 1371–1378 (2.1%) (2σ) or AD 1265–1287 (1σ) (Mac Domhnaill 2013: 15, 236–237). Human bone from the main fill of pit (C.1120), which also contained slag, gave a radiocarbon date of AD 1272–1318 (59.0%) and 1352–1390 (41.0%) (2σ) or AD 1280–1302 (62.0%) and 1352–1390 (41.0%) (1σ) (ibid.: 16, 236). One of the other pits, (C.1105), all three fills of which contained slag, yielded a coin minted between AD 1280 and 1289 (ibid.: 20; Jones 2013: 291). Pottery from several of these pits consisted of Galway-type Ware, Galway-type Cooking Ware and Green-glazed Saintonge Ware (McCutcheon 2013: 263–264).

The third phase of activity consisted of four pits, a ditch and a cobbled surface yielding 14001g of slag in total. A fill of three pits (C.1128/1134/1135) contained Green-glazed Saintonge Ware and Saintonge Green-painted Ware, while Green-glazed Saintonge Ware was also recovered from ditch (C.1018)[125] (McCutcheon 2013: 263, 264; Curtin 2013: 269). A piece of clay pipe was recovered from pit (C.1065) (Mac Domhnaill 2013: 21).

The final phase consisted of two substantial deposits covering the majority of the features described above, three ditches and a pit, yielded 54336g of slag. The two deposits, (C.1005) and (C.1006), which contained the bulk of the residues belonging to this phase, contained multiple fragments of post-medieval pottery, next to thirteen sherds of medieval pottery (Galway-type Coarseware, Galway-type Ware, Galway-type Cooking Ware and Green-glazed Saintonge Ware) (ibid.: 22; McCutcheon 2013: 263; Curtin 2013: 269). The also contained several iron objects, such as several nails, a knife, a key and some buckle fragments. Two of the three ditches, (C.1021) and (C.1074), contained one sherd of Galway-type Ware each, while pit (C.1129) yielded a sherd of North-Devon Gravel-tempered Ware (Mac Domhnaill 2013: 21, 23; Curtin 2013: 269; McCutcheon 2013: 263–264). Two pieces of flowed copper-alloy material could indicate copper-working in this latter phase (Cosham 2013: 326).

The area south of the river, close to Claregalway Abbey, was the location of a cemetery with boundary ditches. Five boundary ditches, dated to the second phase of activity, contained 2683g of slag. Radiocarbon analysis on a piece of animal bone from the basal fill of ditch (C.2017), below the fill containing slag, returned a date of AD

125 The text mentions a sherd of Unglazed Red Earthenware recovered from this pit (Mac Domhnaill 2013: 20), but this does not appear in the specialist report (Curtin 2013).

1270–1316 (62.8%) and 1354–1389 (37.2%) (2σ) or AD 1279–1301 (67.2%) and 1368–1382 (32.8%) (1σ) (ibid.: 27, 236). The same fill contained Green-glazed and Polychrome Saintonge Ware (McCutcheon 2013: 264). A fragment of animal bone from the upper fill, containing slag, of the same ditch was radiocarbon dated to AD 1262–1309 (80.7%) and 1361–1386 (19.2%) (2σ) or AD 1271–1297 (96.5%) and 1374–1376 (3.5%) (1σ) (Mac Domhnaill 2013: 27, 236). Radiocarbon analysis on a piece of animal bone from ditch (C.2089), from the fill below the one containing slag, returned a date of AD 1306–1363 (56.2%) and 1385–1425 (43.7%) (2σ) or AD 1322–1348 (53.8%) and 1392–1413 (46.2%) (1σ) (ibid.: 28, 237). One of the fills of ditch (C.2009) contained a sherd of Green-glazed Saintonge Ware (ibid.: 29; McCutcheon 2013: 264).

The metallurgical residues consisted of smithing hearth cakes, fragments thereof and undiagnostic slag, while no pieces of vitrified ceramic material were observed (Cosham 2013: 317–318). Small amounts of hammerscale were also recovered from several of the fills in the northern area (ibid.: 318–319). The material from the southern area was generally of lower quality and was either the result of secondary deposition or even activity pre-dating the cemetery (ibid.: 319). The activity appears to be more or less continuous from at least the early thirteenth until the seventeenth centuries and possibly beyond. Although the two deposits (C.1005) and (C.1006) were dated to the last phase of activity, it would seem possible that a substantial part of this material was deposited in previous centuries.

Coney Island, Co. Armagh

Site no. 29

Townland: Coney Island
Civil Parish: Tartaraghan
Coordinates (ITM): E693714, N864075
SMR: ARM002:002

Director: Peter Addyman
Excavated between 1962 and 1964

Site summary:

Ironworking activity: Smithing?		Significance: Medium	
Site deposition condition: Primary		Investigation level: Partial excavation	
Ironworking features: Hearths			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations on Coney Island, Co. Armagh, located in Lough Neagh, revealed an area of late medieval ironworking to the south of a motte (Addyman 1965). The main features of the metalworking area were two large hearths (ibid.: 91). The first, hearth A, consisted of a U-shaped setting of stones, many of them heat-affected, enclosing an area of c. 1.5 by c. 1m[126] and set on a circular area of clay. At the front of the stone setting a hollow was present, measuring c. 1 by c. 0.9m. In and around this feature, thick layers of dark soil contained slag, often large pieces, and sherds of Everted Rim Ware, pottery decorated with cordons and incisions and smallish vessels (ibid.: 91–92). This hearth partially overlay an earlier one (hearth B) of similar construction. A patch of red burnt clay and forming a basin in the soil, was described as located c. 1.5m (5ft) removed from hearth A, and contained "iron-rich slaggy material … [suggesting] this was a tapping pit" (ibid.: 91). Over 20m (70ft) to the north, a number of small pits were

126 The dimensions are not given in the text and are taken from the plan.

uncovered containing slag described as usually broken up, often with curved surfaces and sometimes weighing many pounds.

Hearth A, was built on a cobbled surface which terminated in a straight line at a grey band interpreted as the remains of a sod wall. Confusingly, the above does not correspond with the accompanying plan (ibid.: 88). There is no feature drawn near the two hearths and a pit with slag and marked “iron tapping hearth” is located c. 4.5m north of the first hearth A. This site is difficult to interpret, but the reference to slag with curved surfaces probably indicates that smithing activities took place.

The dating of the site was no less problematic. In the original article, three phases were proposed: E (Early Christian) with Souterrain Ware but without features, F (Anglo-Norman) comprising the motte with imported glazed ware found in its ditch and G (Late Medieval) the ironworking area with the above-described pottery. Based on the occurrence of Souterrain Ware together with Everted Rim Ware at the site of Doonbought Fort, Co. Antrim, it was suggested that all the above phases consisted of a single phase (McNeill 1977: 82–83). The relationship between phase G and the subsequent Post-Medieval period (H) is also unclear from the text as on the one hand it is claimed that an interval represented by soil-growth was present (Addyman 1965: 92) while on the other hand the finds, that is to say pottery from phase G are described as coming mostly from its upper levels and indistinguishable from hand-made pottery from phase H. The ironworking could therefore belong to any part of the late medieval period.

Cookstown, Co. Meath

Site no. 30

Townland: Cookstown
Civil Parish: Cookstown
Coordinates (ITM): E704830, N753025

Licence: 03E1252ext.
Director: Richard Clutterbuck (CRDS)
Excavated between January and May 2004

Site summary:

Ironworking activity: Smithing
Significance: Medium

Site deposition condition: Primary
Investigation level: Complete excavation

Ironworking features: Hearths, anvil supports

Dating evidence: Pottery
Sample size: 6028g

Material present:						
	Slag	✓	Tuyeres		Tools	
	Hammerscale	✓	Other ceramic	✓	Iron artefacts	✓

Description

Excavations at the site of Cookstown, Co. Meath, revealed several structures dating to late medieval period, comprising a partially excavated rectangular house and a smaller structure with a narrow annex (Clutterbuck 2009). The structures were built adjacent to an abandonned ringfort.

The smaller structure, measuring 8.5 by c. 5m (Fig. S.13), was clearly the focus of ironworking activities and its enclosing gully contained just over 4.2kg of slag and fragments of metallurgical ceramics (ibid. vol. 1: 29–30; Photos-Jones 2009b: 172–175). A further 225g of slag was found from the floor of the enclosed area (Clutterbuck 2009 vol. 1: 30; Photos-Jones 2009b: 174). In the interior of this structure, somewhat off-centre to the west, a doughnut-shaped gully (0.65m wide and 0.28m deep, enclosing an area of c. 2 by 1m) was uncovered (Clutterbuck 2009 vol. 1: 31). Nine[127] of its sixteen fills contained slag with a weight of 1245g (ibid.; Photos-Jones 2009b: 172–

127 Photos-Jones describes material from 8 layers , while the context description (Clutterbuck 2009 vol. 2: 43) list slag as found in an additional one (C.3009). No weight information is available for the latter.

174). One of the fills also had “iron scale”, presumably hammerscale (Clutterbuck 2009 vol. 2: 93). Two of the four postholes inside the area enclosed by this gully also contained slag, respectively 26g and 27g (ibid.: 72, 90; Photos-Jones 2009b: 174). The first of these postholes abuts a shallow circular charcoal-rich deposit (1.02 by 0.6 by 0.09m) containing 54g of slag (Clutterbuck 2009 vol. 2: 70; Photos-Jones 2009b: 173). A shallow pit measuring 0.9 by 0.8 by 0.06m, cutting the top fill of the gully, contained a further 210g of slag (Clutterbuck 2009 vol. 1: 32; Photos-Jones 2009b: 174).

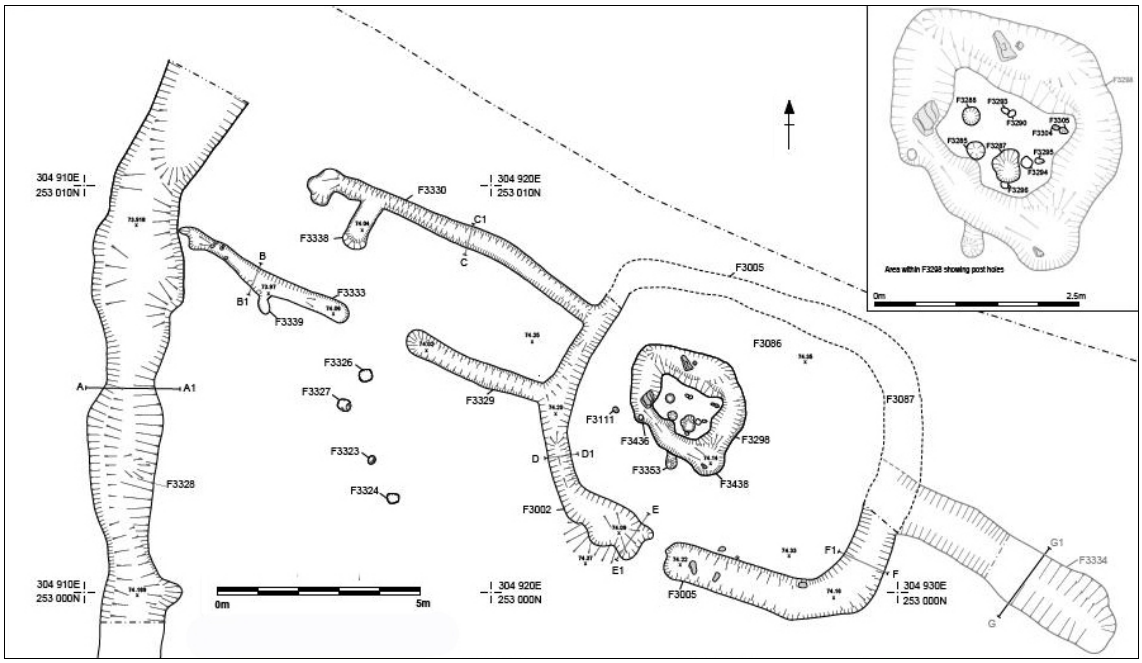

Fig. S.13 Cookstown, Co. Meath. Post-excavation plan of the metalworking area (after Clutterbuck 2009 vol. 2: 107)

On the exterior of this structure only the ditch dividing the plots of this structure and the house contained a final 40g of slag and 12g of metallurgical ceramic material (Clutterbuck 2009 vol. 1: 33; Photos-Jones 2009b: 172). An oval clay disc in three parts (45 by 7 mm thick), perforated in the middle (12 mm) and heat-affected on one side was recovered from a shallow ditch adjoining the eastern side of the enclosure with the ironworking residues and was interpreted as a disc tuyere (Clutterbuck 2009 vol. 1: 31, vol. 2: 94) (Fig. S.14). Next to ironworking waste, ten pieces of copper sheet were recovered (ibid.: 64), possibly indicating the use of this metal in combination with iron.

Large amounts of pottery were recovered from the majority of features containing metallurgical residues and consisted almost exclusively of local wares (Leinster Cooking Ware, Dublin-type Coarseware, Dublin-type Ware, Dublin-type Fineware and Dublin-type Cooking Ware) and two sherds of Saintonge Green-Glazed

Ware (McCutcheon 2009b: 380–383). The occurrence of the Dublin-type Coarseware would indicate a thirteenth-century date for the assemblage.

Fig. S.14 Cookstown, Co. Meath. 'Disc tuyere' (Clutterbuck 2099 vol. 1: 32)

In the specialist metallurgy report, most of the material is described as light and frothy, while other material was denser, some showing a drippy structure (Photos-Jones 2009b). Only one piece, from the enclosing gully, was described as a potential smithing hearth bottom (ibid.: 173). Chemical analysis on two of the slag pieces, gave no conclusion as to wether they were the result of smelting or smithing (ibid.: 182) (Table S.13a), but the lack of convincing furnace slag or structures and two potential smithing hearths (the charcoal spread within the interior gully and the pit cutting its upper fill) would point to iron smithing being carried out at Cookstown. A small piece of corroded iron from Cookstown was also analysed (Photos-Jones 2009b: 515) (Table S.13b). It was found in a pit together with Leinster Cooking Ware, Dublin-type Wares and slag (Clutterbuck 2009: 32). Next to this piece, several nails, two knives a horseshoe and a rowlspur were recovered from late medieval contexts (ibid.: 64).

If the interpretation of the charcoal spread and the shallow pit as a smithing hearths is correct, which is uncertain as the latter also contained domestic refuse, then at least some of the nearby postholes could represent anvil-sockets. The surrounding gully is interpreted in the report as a quenching trough related to ironworking (Clutterbuck 2009: 31). Troughs, however, are rarely found on archaeological sites (see Chapter 8.2.3) and barrels or other wooden containers seem to have been used for this purpose.

Also, there would be no reason why a trough would need to surround the whole working area. The occurrence of many layers within this feature would indicate that it was open during use, so a gully to keep the smithing area dry might be proposed. This would then also imply that this building was not roofed, as was suggested in the report, due to the lack of structural roofing elements (ibid.: 29). As the outer, enclosing gully contained frequent finds it was also assumed this was open during use (ibid.: 176) and hence not a foundation trench.

One possible interpretation is that initially a limited area was used for smithing, enclosed by the "interior" gully and using the charcoal spread as hearth, while later, after the gully was filled up, further smithing was carried out, this time using the later pit as hearth, inside a larger area within the "enclosing" gully. If so, judging by the pottery, these two phases would have occurred within a relatively short period. The annex to the same structure was interpreted as a workshop (ibid.: 53), but, if so, it is unlikely to have been used for metalworking as the associated gullies contained no metalworking residues. Also, the "disc tuyere" is very different from known tuyeres and was most probably too small to provide protection for bellows and should therefore probably be reinterpreted, as either related to another fire-using technology or as being accidentally burned.

	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
1	0.34	0.14	3.41	21.35	0.15	0.85	2.16	0.26	0.24	70.76
2	0.89	0.29	4.65	27.02	0.27	1.09	2.22	0.18	0.31	62.88

Table S.13a Chemical analyses of slag from Cookstown, Co. Meath (Photos-Jones 2009b: 517, 523)

1 Fayalitic slag. Cookstown, Co. Meath, SASAA 260.39.A3 [SEM-EDAX, area analysis of entire surface]
2 Fayalitic slag. Id., SASAA 260.43 (ibid.) [id., area analysis]

C	P	Al	Mn	Ni	Ti	Cu
n.d.	0.14	0.106	0.302	n.d.	0.162	n.d.

Table S.13b Chemical analyses of iron object from Cookstown, Co. Meath (Photos-Jones 2009b: 515–519).

Corroded iron. Ferrite/pearlite, spot analysis on low-sulphur ferrite (SASAA 260.35)

Coolamurry, Co. Wexford

Site no. 31

Townland: Coolamurry
Civil Parish: Rossdroit
Coordinates (ITM): E692307, N638095
SMR: WX025:057

Licence: 04E0323
Director: David A. McCullough
(Valerie J. Keeley Ltd.)
Excavated between April and May 2004

Site summary:

Ironworking activity: Smithing
Significance: High

Site deposition condition: Primary
Investigation level: Complete excavation

Ironworking features: Forge building, hearths, hearth wall, anvil supports?

Dating evidence: C14, pottery
Sample size: 53.4kg

Material present:						
	Slag	✓	Tuyeres		Tools	
	Hammerscale	✓	Other ceramic	✓	Iron artefacts	✓

Description

Excavations at Coolamurry, Co. Wexford, uncovered three areas of ironworking of varying intensity (McCullough 2009; McCullough and Young in press). Area A, located in the north of the cutting, consisted of a pit with an associated deposit of metalworking residues (McCullough 2009: 6). The hearth was circular and measured 1 by 0.9 by 0.2m, had a stakehole at its western edge (60mm diameter by 0.11m deep) and a larger burnt stakehole (0.14m diam. by 30mm deep) half a metre to the north-east. The fill of the hearth included smithing hearth cake fragments, vitrified lining, smithing pan and other slag types (502g in total), together with over 1.5kg of residues recovered through sieving, mostly consisting of hammerscale (Young 2009a: 104). Radiocarbon analysis on a fragment of oak charcoal from the fill of this hearth returned a date of AD 993–1187 (99.1%) and 1199–1206 (0.9%) (2σ) (McCullough 2009: 35).[128]

A large deposit of material, about 2.5m to the east, contained just over 10kg of

128 The radiocarbon dates in the unpublished report (McCullough 2009: 35) are wrongly calibrated. This will be corrected in a forthcoming article (McCullough and Young in press).

slag, including nine smithing hearth cakes, fragments of the same, vitrified lining and various other types of slag, together with 126g of mostly hammerscale recovered through sieving (Young 2009a: 104–106). Oak charcoal from this deposit was radiocarbon dated to AD 688–754 (15.4%) and 759–903 (73.1%) and 915–968 (11.4%) (2σ) (McCullough 2009: 35). Two sherds of Leinster Cooking Ware were recovered from the same deposit (McCutcheon 2009d: 18).

Area B, located about 20 metres south-west of area A, consisted of a hearth with associated features (McCullough 2009: 7). The oval hearth, measuring 0.92 by 0.82 by 0.3m, contained five fills, had a series of stakeholes along its circumference on the northern side and a burnt stakehole (0.16m diameter and 30mm deep) located 0.35m to the north-west (ibid.: 7, 148). Only the second most recent fill is recorded as including relatively small amounts (148g) of hammerscale (Young 2009a: 107).[129] Radiocarbon analysis of oak charcoal from this fill and the one above it gave dates of respectively AD 1164–1271 (2σ) and AD 973–1180 (1σ) (McCullough 2009: 35).

Area C, about 8 metres to the south-east of the former, also consisted of a hearth set in a larger shallow bowl-shaped feature, which had gullies curving around it on its southern side (ibid.: 8–9) (Fig. S.15 and see Fig. 8.1c). The oval hearth, measuring 1.2 by 0.8 by 0.25m, had one fill from which no residues are recorded (ibid.: 8, 152).[130] The hollow in which this hearth was situated contained a large amount of metalworking debris (14.6kg) and micro-residues retrieved through sieving (13.9kg) (Young 2009a: 107–111). It contained fourteen smithing hearth cakes, fragments thereof, vitrified lining, smithing pan and other slag types including some with flow-structure. Radiocarbon analysis was carried out on two fragments of oak charcoal from this feature, which gave dates of AD 993–1059 (45.7%) and 1064–1074 (2.6%) and 1075–1155 (51.7%) (2σ) and AD 1031–1186 (98.7%) and 1199–1206 (1.3%) (2σ) (McCullough 2009: 35). Three pieces of slag, including two smithing hearth cakes were retrieved from the smithing hearth in area C. These were chemically analyzed (Table S.14). Hammerscale from Coolamurry was also analysed, the results of which were not included in the current research. Mineralogical examination of slag from the same site showed incorporated sand-grade grains of quartz, probably the remnants of welding sand (Young 2009a: 53–54).

129 The mentioning of small iron particles, likely hammerscale, in its basal fill (McCullough 2009: 7) suggests some material was not sieved or available for inclusion in the specialist report.

130 Except for a confusing entry in the context register (McCullough 2009: 151), no information on this feature was found in the report. It seems possible this feature was not sampled, sieved or made available for analysis (see previous footnote).

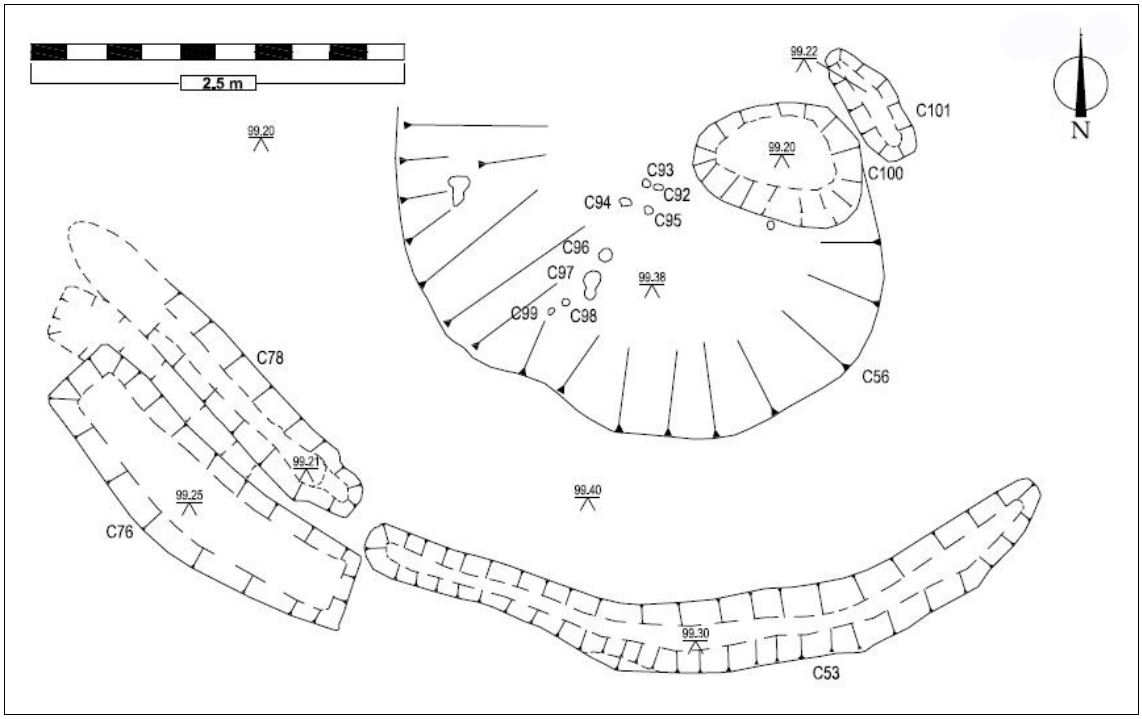

Fig. S.15 Coolamurry, Co. Wexford. Post-excavation plan of Area C (after McCullough 2009: 218)

Two gully sections (C.53 and C.78) curved around the southern side of this hollow (ibid.: 8–9). The first one contained a probable fragment of a smithing hearth cake, some smithing pan and other slag (total 204g) (Young 2009a: 111). The second contained neither pottery nor residues. An earlier gully, cut by the latter, contained two sherds tentatively identified as Souterrain Ware (McCutcheon 2009d: 18). A rectangular feature (C.76) along the outside of the curving gullies contained a substantial amount of metalworking residues (8426g), including ten smithing hearth cakes, fragments of the same, vitrified lining and other types of residues (Young 2009a: 111–113). The same feature also yielded five sherds of Leinster Cooking Ware and fifteen of Wexford-type Coarseware (McCutcheon 2009d: 18).

There seems to be a discrepancy between the radiocarbon dates and the pottery from the site. This probably indicates the influence of the “old wood-effect”, which means the site probably dates to the late twelfth, early/mid-thirteenth centuries (McCullough and Young in press: 7–8). All identified charcoal taxa from several features were oak (O'Carroll 2009). A structure enclosing hearth C was suggested (ibid.: 8). This would seem very likely as the gullies curving around the hearth contained hardly any slag. The gullies could have either been located on the outside of a mud-walled building or contained its walls. The rectangular feature which included both ironworking residues and most of the pottery on the outside of these gullies is then

probably an elongated rubbish pit. Striking is the complete lack of tuyere material. It was proposed that the stakeholes along the edge of hearth B represented a clay wall functioning as a bellows protector (ibid.: 17). Clear anvil-block supports were equally lacking, but could have been represented by the near-identical burnt features near hearths A and B, although their dimensions are very small (ibid.: 10). In total, only four iron objects were recovered from the site, two nails, a 'corrosion shadow' (?) and a rush light holder (ibid.: 12).

	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
1	0.26	1.46	4.60	19.61	0.24	1.28	2.50	0.31	0.18	59.47
2	0.49	0.95	5.24	29.52	0.17	1.35	1.69	0.34	0.20	53.02
3	0.43	1.18	5.99	26.41	0.24	1.23	1.43	0.34	0.20	45.32

Table S.14 Results of chemical analyses of slag from Coolamurry, Co. Wexford (Young 2009a: 59, 60, 65)

1 Dense dull slag. Coolamurry, Co. Wexford, Mon10 [XRF on fused beads]
2 Smithing hearth cake. Id., Mon16 [id.]
3 Smithing hearth cake. Id., Mon17 [id.]

Cork, 3–5 Barrack Street

Site no. 32

Townland: Cork City
Civil Parish: Cork City
Coordinates (ITM): E567235, N571565
SMR: CO074:122

Licence: 99E0650
Director: Sheila Lane
Excavated between November 1999 and January 2002

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Primary			Investigation level: Urban		
Ironworking features: Hearths, anvils?					
Dating evidence: Pottery			Sample size: Unknown		
Material present:	Slag	✓	Tuyeres	Tools	✓
	Hammerscale		Other ceramic	Iron artefacts	✓

Description

Excavations at three properties 3–5 Barrack Street, just across the southern bridge outside the medieval town of Cork revealed remains of late medieval ironworking (Lane and Sutton 2002, 2003). In a cutting at the front of the most northerly property, 3 Barrack Street, two deposits (C.4 and C.6) contained both slag and various types of pottery (Ham Green, Saintonge and French wares) dated to the late twelfth to thirteenth centuries (ibid.: 8). Deposit C.6 was cut by a pit (C.7) that also contained slag, but now with Ham Green, Redcliffe and Cork-type Wares, indicating a mid-thirteenth-century date.

In a second cutting at the same property, further back from the street, a pit (C.22) was exposed containing slag with unspecified late thirteenth- to early fourteenth-century pottery (ibid.: 9). At the second property, 4 Barrack Street, three hearths (C.116, C.117 and C.118) represented by large heat-affected stones measuring respectively 1.45 by 1.3m, 0.86 by 0.82m and 1.28 by 102m were uncovered (Lane and Sutton 2002: 6). The

later might have been used as anvils. Slag, three large hone stones, several iron knives and nails and unspecified thirteenth-century pottery were found inside these hearths, while larger quantities of slag were recovered from layers below and above (ibid.: 8).[131] The area comprising the hearths and related burnt layers was bounded by two dry-stone walls to the east and west.

At the third property, 5 Barrack Street, two trenches were opened. In the one closest to the street the uppermost medieval layer (C.55/56/60) contained both slag and thirteenth- to fourteenth-century pottery (Lane and Sutton 2003: 12). In the other trench, a deposit (C.40) contained slag and twelfth- to early thirteenth-century pottery (ibid.: 10). Both these trenches revealed hearth structures on different levels (ibid.: 10–12). The site at Barrack Street seemingly represents an area where metalworking was carried out over a substantial period of time. The three thirteenth-century hearths from 4 Barrack Street are probably related to metalworking, presumably iron smithing, but no evidence for related structures was found. More smithing activity probably took place in the area at other times during the late medieval period.

131 No information on the contexts containing this latter slag was available.

Cork, Christ Church

Site no. 33

Townland: Cork City
Civil Parish: Cork City
Coordinates (ITM): E567185, N571757
SMR: CO074:034(01)

Licence: E146
Director: Dermot Twohig
Excavated between 1975 and 1977

Site summary:

Ironworking activity: Smithing		Significance: Low		
Site deposition condition: Secondary		Investigation level: Urban		
Ironworking features: None				
Dating evidence: Pottery		Sample size: Unknown		
Material present:	Slag ✓	Tuyeres	Tools	
	Hammerscale	Other ceramic	Iron artefacts	✓

Description

Along South Main Street, at the site of Christ Church, ironworking residues were recovered from two areas (Cleary 1997).[132] In area C, a post-and-wattle house of probable mid-thirteenth-century date was interpreted as possibly belonging to a metalworker (ibid.: 35–40). Evidence for this is noted as by the density of ash around the hearth and the occurrence of iron slag, furnace bottoms, crucibles and various metal objects (ibid.: 40). The publication then goes on to state that no furnace bottoms or crucibles were found nearby the building, but a large amount of iron slag was found among several planks (C.31) leading to the front of the house. Various iron artefacts, including a knife, an arrowhead, horse fittings and shears (ibid.: 61).

Close-by and further south, in area H, two dumps of slag were found. The first, a large deposit C.108 (5.5 by 3.5m), was located close to South Main Street and consisted of alternating layers of conglomerated slag and charcoal (ibid.: 80–81). This deposit

132 This information in this publication is based on incomplete notebooks.

yielded “furnace bottoms” (ibid.: 81). The second dump, C.96, measured 4.2 by 2.9m and was located in the south-east of area H. Both dumps were about 25m away from the building in area C and were dated to the mid-thirteenth to fourteenth centuries (ibid.: 27, 80). Although there are suggestions of *in situ* ironworking at Christ Church, the evidence provided does not give certainty. The activity, based on the mentioning of furnace bottoms, was probably iron smithing, with the crucibles pointing to complementary copper-working.

Cork, North Main Street

Site no. 34

Townland: Cork City
Civil Parish: Cork City
Coordinates (ITM): E567001, N572192
SMR: CO074:034(01)

Licence: 94E0080
Director: Maurice Hurley
Excavated in 1994

Site summary:

The site was originally interpreted as a water-powered forge. This is here refuted

Description

Excavations at North Main Street, in an area south-west of the bridge connecting North Island to the Shandon area of Cork, unearthed an enigmatic site (Hurley and Sheehan 1997). The relevant archaeological features were located on a plot which fronted on to the medieval main street of the town.

The most prominent structure was near-square (4.75 by 4.45m) foundation of a stone structure (ibid.: 46) (Fig. S.16). A pit (c. 1.9 by 1.2m), located within the northern part of the structure, was splayed towards the east and had a depth of 1.5m, of which at least 1.2m was dug below the stone foundation.[133] A shallow L-shaped drain or flue led into this pit. The sides of this pit and drain, as well as the sides of the platform as a whole, were lined with dressed stone. All elements of this stone platform were clay-bonded. No slag and little charcoal was recovered from this structure. Some of the stones rested on two large beams, one of which formed the eastern side of a box-like structure south of the platform. The southern side of this box (4 by 1.5m) was made up of more timbers, while the western side consisted of a stone wall, interpreted as a later addition (ibid.: 45, 46). A smaller, adjoining timber-framed box (2 by 1.5m) was located east of the former.

On the western side, in line with the larger box-like feature, a row of staves were found to the south of an east/west-orientated layer of small pebbles (ibid.: 45). On the eastern side, more staves were found at the eastern end of the smaller box. About 3.5m

133 Depth deduced from the section drawing (Hurley and Sheehan 1997: 44). The dashed base of the pit is interpreted as not having been bottomed.

south of this complex a large wooden block (c. 1 by 0.6m)[134] was set on a foundation of slabs of stone which continued north as far as the larger box (ibid.: 46). The slabs were covered by a layer of clay which was overlaid by a charcoal-rich layer, while no slag was found in the area. A substantial bowl-shaped depression on the upper surface of the wooden block contained a lump of material described as slag, congealed iron or a hammerscale accumulation (ibid.: 46, 49).[135]

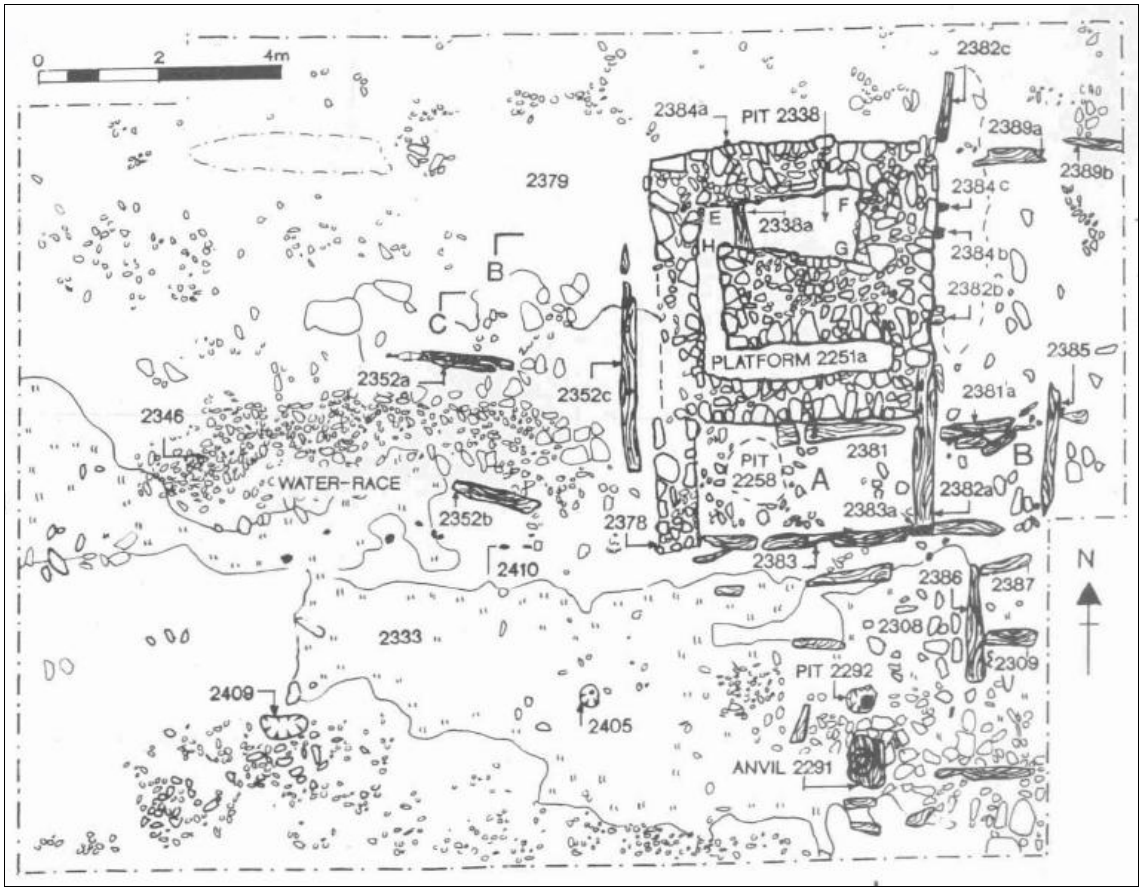

Fig. S.16 Cork, North Main Street. Post-excavation plan of the site (after Hurley and Sheehan 1997: 44)

A substantial wooden post was located directly between this wooden block and the larger box, at a distance of about 1m from the former (ibid: 46). The site was interpreted as representing a water-powered forge, with the platform having functioned as a "furnace", the two boxes as wheel pits, the staves on both sides as supports for timber head and tail races, the wooden block as an anvil and the large post as a fulcrum post.

The authors, however, had reservations. The above interpretation was seen as somewhat suspect due to the placement of the "furnace" and the anvil on opposite sides

134 Dimensions deduced from plan (ibid.).

135 The preservation of the material for further study is specifically mentioned in the publication (ibid.: 49), but could not be found amongst the finds from this site held at Cork City Museum.

of the water source, but was seen as acceptable because no hearths were found in the anvil area (ibid.: 49). The position of the fulcrum post implies that the hammer would have operated at right angles to the water wheel, while these are normally parallel. Also a comparable post to the fulcrum post was located 4.2m further west. Additionally the lack of slag was seen as potentially problematic, but it was argued that another water-powered forge (Bordesley Abbey) also had little slag. While it is suggested that Bordesley Abbey is probably not a water-powered forge (see Chapter 10.3.2), lack of slag does not necessarily indicate a lack of ironworking activity, especially since the area was not sampled for hammerscale (ibid.: 49).

The main problem, however, seems to be the interpretation of the stone foundation as relating to metalworking. The pit and drain would have no conceivable function in smithing, while the total absence of slag is suspicious. The stone foundation, which is clearly related to the box-like features, is very likely unrelated to ironworking. A waist-high hearth, in the anvil area and which left no traces, could still be proposed. The bowl-like hollow at the top of the “anvil”, however, ishardly compatible with wear resulting from the hammering of large pieces of iron (or smaller pieces held by tongs), as the survival of upstanding rims would be very unlikely. This, together with the reservations expressed above, puts into question the interpretation of this site as a water-powered forge.

Cork, Phillips' Lane

Site no. 35

Townland: Cork City
Civil Parish: Cork City
Coordinates (ITM): E566927, N572172
SMR: CO074:034(01)

Licence: 97E0205
Director: Maurice Hurley
Excavated between June and August 1997

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Urban		
Ironworking features: none					
Dating evidence:			Sample size: 948g		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic	✓	Iron artefacts

Description

Although no metallurgical residues are mentioned in the published account (O'Donnell 2003a) of the excavations at Phillips' Lane on Cork's North Island, a small amount of material was found in the stores of Cork City Museum and subjected to visual analysis in view of this thesis. Several pieces of metallurgical residues were labelled as coming from feature C.68. This number is not mentioned in the published report, but the features C.66 to C.67 and C.69 to C.87 are all related to two stone built houses, one dating to the fourteenth century, the other generally to the late medieval period (ibid: 91–97). The material is consistent with known early iron smithing residues (Table S.15). It is interesting to note however that one piece shows a thin concave rim of clay on one edge of the slag (See Fig. 8.10c), while another consists of vitrified ceramics with a convex face and a rounded edge. The first piece probably represents the vitrified remains of the upper edge of the smithing hearth which would have had a clay-built hearth wall with a blow-hole or no bellows-protector at all, while the second piece

represents the remains of a clay tuyere. Two pieces of slag from C.68 have charcoal particles embedded in the slag, while one has both charcoal and coal inclusions. If the date of C.68 proves correct, then the site has evidence for the use of coal in medieval Cork and rare indications of the use of a hearth wall and this in conjunction with tuyeres being utilized.

Cut	Fill	Type	Description	Weight (g)
NA	1	Deposit	Fairly dense piece of cindery slag with inclusions of (coal?)shale	320
?	68	?	Fractured piece of a smithing hearth cake with adhering concave rim of vitrified clay on the upper edge indicating hearth wall	321
?	68	?	Fairly light piece of drippy slag with slight flow stucture	107
?	68	?	Rounded lump of fairly dense slag with pinkish clay adhering on three sides	167
?	68	?	Convex piece of vitrified clay with probable rounded edge, most likely tuyere material	33
Total				948

Table S.15 Description of the material related to metalworking from Cork, Phillips' Lane

Cork, 35–39 South Main Street

Site no. 36

Townland: Cork City
Civil Parish: Cork City
Coordinates (ITM): E567227, N571667
SMR: CO074:034(01)

Licence: 04E0371
Director: Hillary Kelleher (UCC)
Excavated between July 2004 and May 2005

Site summary:

Ironworking activity: Smithing
Site deposition condition: Secondary
Ironworking features: None
Dating evidence: Pottery

Significance: Medium
Investigation level: Urban
Sample size: 22.5kg

Material present:						
	Slag	✓	Tuyeres	✓	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts	✓

Description

At 35–39 South Main Street, three plots were uncovered where over twenty wattle-walled houses were constructed between the late eleventh and the late thirteenth centuries (Rondelez In Press). This material was examined for inclusion in this study (Table S.17). Out of a total of just under 22.5kg of metalworking residues, 8kg was found in levels dated earlier than the Anglo-Norman period, while 5.66kg was recovered from late medieval levels. The material is clearly related to forging activities demonstrated by the frequent occurrence of smithing hearth cakes (See Fig. 8.15b). Due to the complexity of the site, the information relating to the contexts containing metallurgical waste is given in table form (Table S.16).

Plot	Structure	Feature	Date	Context no.	Weight (g)	Types
Early to late twelfth century						
NA		Reclamation clays	E 12th C	406, 494, 659	132	VC
1	House 1	Floor	E 12th C	586	1	
1	Ibid.	External deposit	E 12th C	618	16	
1	House 2	Trackway	E 12th C	768	1024	SHC
1	House 3	Occupation layer	E 12th C	712	221	Li
1	House 4	Occupation layers	E 12th C	744, 750	2239	VC, 3SHC
1	Ibid.	Occupation layer	E – M 12th C	721	11	

2	House 3	Floors/wattle panel	E 12th C	612, 621, 671	788	SHC
2	Ibid.	Occupation layers	E 12th C	585, 642	603	SHC, 2Tu
2	House 4	Occupation layers	E 12th C	474, 532	3	
2	Ibid.	Pathway	E 12th C	559	420	SHC
2	House 5	Sub-floor	E – M 12th C	269	87	
2	House 7	Occupation layer	E – M 12th C	254	302	SHC?
2	Houses 1/3	External deposit	E 12th C	703	128	
2/3	Boundary	Fence	E 12th C	412, 480	150	
2/3	Ibid.	Pathway	E 12th C	516	4	
2/3	Ibid.	Layers	E 12th C	204, 625, 695	1032	4VC, Tu, SHC
Total					7161	
Late twelfth to fourteenth centuries						
2	House 8	Floor	L 12th C	589	132	
2	House 9	Occupation layer	L 12th C	500	1067	SHC, Tu
3	House 3	Occupation layers	M 12th to E 13th C	306, 319	1036	SHC
3	House 7	Floor	L 12th to M 13th C	253	3	
3	Ibid.	External deposit	L 12th to E 13th C	162	102	
3	Ibid.	Pathway	12th to 13th C	77	3	
3	Pits	C99	L 12th to E 13th C	99	80	
3	Ibid.	C122	M 13th C	116	658	
3	Ibid.	C135	M to L 13th C	105	149	SHC
3	Ibid.	C144	M to L 13th C	129	204	
3	Ibid.	C366B	E to M 13th C	362	39	
3	Ibid.	C370	L 12th to E 13th C	367	16	
3	Ibid.	C608	M to L 13th C	607	9	
2/3	Boundary	Laneway	M 13th C	85	32	
2/3	Ibid.	Layers	13th to 14th C	89, 91, 145	2453	SHC, [Coal]
?	Layer		“medieval”	8	1958	4SHC, VC, Coal
Total					7941	

Table S.16 Overview of the metalworking residues per phase, Cork, 35–39 South Main Street. VC= Vitrified ceramics, Li= Vitrified lining, Tu= Tuyère, SHC= Smithing hearth cake.

The period between the early and late twelfth century at 36-39 South Main Street is characterized by the construction of wattle-walled houses. Slag was recovered from the interior of seven of these, all located on plots 1 and 2, though in several cases in small to minute amounts. Larger concentrations were found inside House 4, Plot 1 (2239 g) and House 3, Plot 2 (1391 g), both dated to the early twelfth century. If the quantities recovered from House 4, Plot 1, of which only a fraction was excavated, are representative for the complete building, the structure might have been the setting for at

least small-scale smithing, if not a smithy. The material from the interior of this structure consists of 30 pieces of ironworking residue, including three smithing hearth cakes and two pieces of undiagnostic vitrified ceramic material. The occurrence of several hundred grams to over a kilogram of slag in several of the other houses is not easy to explain. Most of the material was recovered from occupation layers and thus cannot be the result of accidental, or intentional, addition to the floors. In-situ smithing is also unlikely, unless the smithing technology, which was complex and required specialized tools, was very widespread among the inhabitants of Cork at that period, or smiths were undertaking work in different locations. Of particular interest is the occurrence of both recognisable tuyere material and vitrified lining from two different houses dated to the early twelfth century, respectively House 3, Plot 2 and House 3, Plot 1. This might indicate different ethnic groups, Irish and either Scandinavians or others, active as smiths during this period.

The deposition of ironworking residues inside of houses continues when the wattle structures are replaced by earth-fast stave-walled ones, but now on Plots 2 and 3. Similarly, the amounts recovered from floors and occupation layers vary between over 100 g, in House 8, Plot 2, to over one kilogram, in House 9, Plot 2 and House 3, plot 3. As only a quarter of the latter structure was excavated, and if the amount of recovered slag is representative for the complete building, this could also represent a building where sustained iron smithing took place. Notably, none of the timber-framed sill-beam houses yielded any ironworking residues from their interior, except for 3 g of slag recovered from House 7, Plot 3. Instead, small amounts of slag are found deposited in pits at the back of Plot 3 (1155 g from 7 pits) and more substantial amounts dumped on the boundary between Plots 2 and 3 (2485 g).

There is a striking correlation between the three medieval phases, represented by different house-types, and the distribution of their ironworking residues. The period characterized by the wattle-walled houses, from the early to twelfth century, sees deposition of smithing material within the houses on Plots 1 and 2, with a possible smithy represented by House 4, Plot 1. In the next period, around the late twelfth to early thirteenth centuries, when earth-fast stave-built structures appear, the residues are similarly deposited inside houses, but now on Plots 2 and 3, with a possible blacksmith's workshop at House 3, Plot 3. The subsequent thirteenth- and fourteenth-century timber-framed buildings have no ironworking residues in their interiors; these are now dumped in pits at the back of the plot and on the plot boundaries.

Context no.	Find no.	Context description	Date	Weight (g)	Description
1	881a	Overburden	Modern	124	Small lump of rather dense slag, probably related to ironworking
1	883	Overburden	Modern	90	Piece of light clinkery slag with unusual honeycombed material adhering
1	[888?]a	Overburden	Modern	409	Relatively dense SHC
1	[888?]b	Overburden	Modern	15	Small piece of relatively dense drippy slag
1	892	Overburden	Modern	253	Fragment of rather dense probable ironworking slag
1	898	Overburden	Modern	417	Dense, dark SHC
1	911a	Overburden	Modern	79	Piece of rusty coloured slag
1	911b	Overburden	Modern	354	Rusty coloured SHC with extra slag drip on the base
1	911c	Overburden	Modern	156	Rounded, rusty coloured SHC
1	911d	Overburden	Modern	151	8 pieces of rusty coloured slag
1	915a	Overburden	Modern	186	Piece of frothy, blistery slag, somewhat cinder-like
1	915b	Overburden	Modern	211	Three pieces of rather dense slag
1	916a	Overburden	Modern	464	Relatively dense, rounded SHC
1	916b	Overburden	Modern	79	Fragment of relatively dense slag, probably ironworking
4	50	Nineteenth/ twentieth century building	19th to 20th C	14	Piece of white glassy slag (non-ferrous?)
4	51	Nineteenth/ twentieth century building	19th to 20th C	58	Fragment of rather dense slag with red encrustation
4	52	Nineteenth/ twentieth century building	19th to 20th C	141	Piece of rounded slag (SHC), rather dense, probably ironworking
4	53a	Nineteenth/ twentieth century building	19th to 20th C	155	One complete and one fragment of rusty lumps of slag
8	1824	“Medieval stratigraphy”	Late Medieval	702	Rather dense, regular SHC
8	1836	“Medieval stratigraphy”	Late Medieval	7	Small piece of glassy slag
8	1845a	“Medieval stratigraphy”	Late Medieval	102	Piece of rather dense slag, probably ironworking
8	1858	“Medieval stratigraphy”	Late Medieval	77	Fragment of rather dense probable ironworking slag, with blue iron phosphate encrustations
8	1881	“Medieval stratigraphy”	Late Medieval	25	Fragment of rather dense probable ironworking slag
8	1891	“Medieval stratigraphy”	Late Medieval	247	Piece of relatively dense slag, probably ironworking, with adhering ceramic material (tuyere?)

Context no.	Find no.	Context description	Date	Weight (g)	Description
8	1892	“Medieval stratigraphy”	Late Medieval	26	Fragment of rather dense probable ironworking slag
8	1905a	“Medieval stratigraphy”	Late Medieval	232	Small bun-shaped SHC
8	1905b	“Medieval stratigraphy”	Late Medieval	129	Small round SHC
8	1913a	“Medieval stratigraphy”	Late Medieval	38	Drippy piece of dark light glassy slag
8	1916a	“Medieval stratigraphy”	Late Medieval	92	Two pieces of rather dense slag
8	[x]a	“Medieval stratigraphy”	Late Medieval	281	Fragment of relatively dense, reddish SHC, with frequent iron phosphate encrustation
33	3	Layer between walls C16/23 and laneway C36	Modern	106	Lump of bubbly, dark slag
41	[15]	Bricks in hollow C66	18th C	1341	Large rusty coloured SHC
55	5	Fill of hollow C66	18th C	88	Fragment of rather dense probable ironworking slag with inclusions of small pebbles on base
62	26	Fill of hollow C66	18th C	390	Well formed SHC with iron phosphate staining
77	152	Organically-rich layer east of path C193	12th - 13th C	3	Piece of slag drip with gypsum growth, non-ferrous?
80	[2]a	Base of pit C79	Modern	237	Two pieces of light greyish white slag (non-ferrous?)
85	11	Laneway between plots 2 and 3	M 13th C	32	Small piece of drippy, rather dense dark slag
89	[58]a	Silt layer adjacent to lane C85	13th to 14th C	414	Two pieces of relatively dense slag, probably ironworking, with gypsum crystallization on the surface
91	[25]a	Silt layer adjacent to lane C85	13th to 14th C	127	Three pieces of rather dense rusty coloured slag
91	[25]b	Silt layer adjacent to lane C85	13th to 14th C	118	Two fragments of dark glassy slag
99	25	Pit C99	L 12th to E 13th C	80	Fragment of rather dense probable ironworking slag, with blue iron phosphate encrustations
105	17	Fill of pit C135	M to L 13th C	36	Fragment of drippy slag with lime encrustation
105	20	Fill of pit C135	M to L 13th C	113	Incomplete small SHC, rather dense
116	75	Fill of pit C122	M 13th C	200	Piece of dark, rather dense slag with flow structure
116	76a	Fill of pit C122	M 13th C	380	Piece of stone?, iron oxide? With adhering slag
116	76b	Fill of pit C122	M 13th C	78	Lump of rather dense slag

Context no.	Find no.	Context description	Date	Weight (g)	Description
129	16a	Fill of pit C144	M to L 13th C	199	Four pieces of rather dense, black slag
129	20	Fill of pit C144	M to L 13th C	5	Small piece of dark slag
145	68	Organic layer adjacent to lane C85.	L 12th to 14th C	121	Piece of dripped, rather dense slag
145	[x]	Organic layer adjacent to lane C85.	L 12th to 14th C	1673	Large dense rounded SHC
162	S72	Organic layer associated with House 7, Plot 3	L 12th to E 13th C	102	Rusty coloured slag fragment, probably ironworking
204	2	Back-yard accumulation over fence C412	E 12th C	67	Piece of vitrified ceramics, showing curvature, with adhering glassy slag (tuyere)
204	24	Back-yard accumulation over fence C412	E 12th C	248	Piece of rather dense slag, probably ironworking
204	25	Back-yard accumulation over fence C412	E 12th C	27	Fragment of drippy, rather dense dark slag with iron phosphate coating, some of it crystallized
204	33	Back-yard accumulation over fence C412	E 12th C	70	Two pieces of vitrified ceramics (tuyere/lining) frequent angular quartz inclusions
253	1	Clay floor of House 7, Plot 3	L 12th to M 13th C	3	Fragment of reddish slag
254	15	Occupation level within House 7, Plot 2	E to M 12th C	302	Thin bowl-shaped SHC or vitrified crucible??
269	2	Sub-floor organic layer in House 5, Plot 2	E to M 12th C	82	Small piece of rather dense slag, fully encrusted
269	3	Sub-floor organic layer in House 5, Plot 2	E to M 12th C	5	Small drip of light slag
306	12	Occupation level, House 3, plot 3	M 12th to E 13th C	1017	Dense regular SHC (in three pieces)
306	S166	Occupation level, House 3, plot 3	M 12th to E 13th C	1	Tiny piece of slag
319	S223a	Occupation level, House 3, plot 3	M to L 12th C	18	Piece of glassy, white slag (non-ferrous?)
345	13a	Fill of pit C353	17th C?	277	Two pieces of relatively light slag with flow-structure
361	20	Hardcore under stone surface (C355) of backyard	Modern	30	fragment of relative dense slag, probably ironworking
362	27	Fill of pit C366B	E to M 13th C	39	Five small pieces of relatively light slag
367	60	Fill of pit C370	L 12th to E 13th C	16	Light, glassy slag ('fuel ash slag')

Context no.	Find no.	Context description	Date	Weight (g)	Description
406	3	Reclamation clay	E 12th C	78	Lump of dark glassy slag
412	1	Boundary fence between plots 2 and 3	E 12th C	32	Drip of dark glassy slag
412	2	Boundary fence between plots 2 and 3	E 12th C	14	Small fragment of relatively dense, slag with a pinkish red coloured coating (non-ferrous?)
474	2	Possible occupation layer, House 4, Plot 2	E 12th C	2	Drip of dark glassy slag
480	1	Plots 2-3 stave-built boundary fence	E 12th C	104	Piece of grey, glassy slag
494	5	Reclamation clay	E 12th C	48	Piece of white flat vitrified ceramics (tuyere?, lining?) some inclusions of angular quartz, red material in vitrification (copper?)
495	2	Occupation layer, House 9, Plot 2	L 12th C	168	Fragment of dark, dense slag, probably ironworking
496	5	Occupation layer, House 9, Plot 2	L 12th C	80	Drippy piece of dark glassy slag
500	5a	Occupation layer, House 9, Plot 2	L 12th C	511	Rather dense, squarish SHC
500	5b	Occupation layer, House 9, Plot 2	L 12th C	52	Fragment of vitrified ceramics with adhering glassy slag, edge and curvature = tuyere
500	5c	Occupation layer, House 9, Plot 2	L 12th C	37	Two pieces of clayey material, one with adhering white slag
500	18	Occupation layer, House 9, Plot 2	L 12th C	176	Flat fragment of relatively dense slag, nearly entirely encrusted
500	19	Occupation layer, House 9, Plot 2	L 12th C	43	Three pieces of relatively light, glassy slag
516	4	Clay over trackway (C651)	E 12th C	4	Small blob of glassy, light slag
532	S342	Ash layer in House 4, Plot 2	E 12th C	1	4 tiny pieces of slag
546	2a	Stone drain	18th to 19th C	504	Dense kidney-shaped SHC
559	17	Pathway related to House 4, Plot 2	E 12th C	420	Rather well shaped, dense SHC, with additional slag at the base
585	46	Occupation layer in House 3, Plot 2	E 12th C	415	Rather dense SHC, entirely encrusted
586	1	Floor in House 1, Plot 1	E 12th C	7	Piece of vitrified ceramics (tuyere/lining) some inclusions of angular quartz
589	1a	Floor in House 8, Plot 2	L 12th C	132	Piece of dripped light, glassy slag
607	1	Fill of pit C608	M to L 13th C	9	Round piece of rather dense white slag with good gypsum (?) crystallization. Non-ferrous?

Context no.	Find no.	Context description	Date	Weight (g)	Description
612	S435	Wattle panel in House 3, Plot 2	E 12th C	55	Smallish round piece of rather dense slag with iron phosphate concretions
618	58	Layer of shells associated with House 1, Plot 1	E 12th C	16	Piece of glassy, white slag dripping (non-ferrous?)
621	18	Floor in House 3, Plot 2	E 12th C	46	Two pieces of dark brown frothy slag
625	1	Clay adjacent to Plot 2-3 boundary fence C480	E 12th C	21	Piece of vitrified ceramics (tuyere/lining) some inclusions of angular quartz
642	1a	Occupation level in House 3, Plot 2	E 12th C	138	Lump of rather dense slag with ceramic material attached (tuyere?, unrelated?)
642	1b	Occupation level in House 3, Plot 2	E 12th C	23	Lump of grey glassy slag
642	2	Occupation level in House 3, Plot 2	E 12th C	27	Piece of vitrified ceramic material with clear curved edge (= tuyere)
659	1	Reclamation clay	E 12th C	6	Drip of white, glassy slag (non-ferrous?)
671	6	Floor in House 3, Plot 2	E 12th C	687	Large rather dense regular SHC with additional slag at the base
695	[3]a	Clay adjacent to fence C694	E 12th C	658	Rather dense, well shaped SHC, with a fragment of ceramic material adhering to the side (lining or tuyere)
695	[3]b	Clay adjacent to fence C694	E 12th C	11	Small piece of vitrified ceramics (lining or tuyere)
703	3a	Layer south of Houses 1 and 3, Plot 2	E 12th C	9	Small blob of glassy, light slag
703	6	Layer south of Houses 1 and 3, Plot 2	E 12th C	110	Four pieces of relatively light glassy slag, somewhat greyish white (non-ferrous?)
703	7	Layer south of Houses 1 and 3, Plot 2	E 12th C	9	Three pieces of light glassy slag, with iron phosphate coating
712	3	Occupation deposit in House 3, Plot 1	E 12th C	221	Glassy slag with adhering, seems to be concave i.e. lining
721	1	Occupation deposit in House 4, Plot 1	E – M 12th C	11	Drip of white, glassy slag (non-ferrous?)
744	2a	Occupation layer in House 4, Plot 1	E 12th C	125	Five pieces of drippy slag
744	2b	Occupation layer in House 4, Plot 1	E 12th C	62	Fragment of vitrified ceramics, more or less straight, light pink clay with numerous inclusions, a lot rounded (lining or tuyere?)
744	2d	Occupation layer in House 4, Plot 1	E 12th C	13	Vitrified ceramics containing part of the blowhole (lining or tuyere?)
744	[9]a	Occupation layer in House 4, Plot 1	E 12th C	682	Dense irregular SHC

Context no.	Find no.	Context description	Date	Weight (g)	Description
744	[9]b	Occupation layer in House 4, Plot 1	E 12th C	280	Relatively dense SHC
744	[9]c	Occupation layer in House 4, Plot 1	E 12th C	213	Three pieces of relatively dense slag, probably ironworking
744	[9]d	Occupation layer in House 4, Plot 1	E 12th C	42	Three pieces of light slag
750	[23]a	Occupation layer in House 4, Plot 1	E 12th C	355	Relatively dense, irregular SHC
750	[23]b	Occupation layer in House 4, Plot 1	E 12th C	294	Five pieces of relatively light, glassy slag
750	[23]c	Occupation layer in House 4, Plot 1	E 12th C	173	Nine pieces of relatively light, glassy slag
768	1	Trackway associated with House 2, Plot 1	E 12th C	1024	Large dense irregular SHC with vitrified ceramics attached (lining?, tuyere?), clay has more rounded quartz inclusions

Table S.17 Description of the material related to metalworking from Cork, 35–39 South Main Street

Cork, 40–48 South Main Street

Site no. 37

Townland: Cork City
Civil Parish: Cork City
Coordinates (ITM): E567271, N571646
SMR: CO074:034(01,02)

Licence: 03E1170
Directors: Máire Ní Loingsigh
(Sheila Lane and Associates)
Excavated between 2003 and May 2004

Site summary:

Ironworking activity: Smithing		Significance: Unknown	
Site deposition condition: Unknown		Investigation level: Urban	
Ironworking features: Unknown			
Dating evidence: Unknown		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At the site of 40–48 South Main Street, evidence for both copper- and ironworking was recovered from a deposit dating around AD 1200 (Ní Loingsigh 2008).[136] Vitrified clay lining and hammerscale are recorded, and a photograph of a piece of slag probably represents a smithing hearth cake (ibid.; Fairburn 2005a: 8, 17).

136 The full excavation results for this site are in the process of publication.

Cork, 1–4 St Peter's Avenue

Site no. 38

Townland: Cork City
Civil Parish: Cork City
Coordinates (ITM): E567046, N572024
SMR: CO074:034(01)

Licence: 97E0079
Director: Maurice Hurley
Excavated between April and May 1997

Site summary:

Ironworking activity: Smithing		Significance: Low		
Site deposition condition: Secondary		Investigation level: Urban		
Ironworking features: None				
Dating evidence: Pottery		Sample size: Unknown		
Material present:	Slag ✓	Tuyeres	Tools	
	Hammerscale	Other ceramic	Iron artefacts	✓

Description

On North Island, at 1–4 St Peter's Avenue, further remains of metalworking were uncovered (Hurley and Johnson 2003). A peaty deposit, C.21, contained iron slag, nails and various types of pottery (frequent Saintonge Ware, Redcliffe, Cork-type, Merida, Frechen and Tin Glazed Earthenware) (ibid.: 135).

Cork, Tuckey Street

Site no. 39

Townland: Cork city
Civil Parish: Cork City
Coordinates (ITM): E567222, N571748
SMR: CO074:034(01)

Licence: 97E0040
Director: Mary O'Donnell
Excavated between March and May 1997

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Primary?			Investigation level: Urban		
Ironworking features: Hearths?					
Dating evidence: Pottery			Sample size: 10.3kg		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

In a side street off the main street and close to the medieval walls, further evidence for ironworking was found at the site of Tuckey Street (O'Donnell 2003b). The metallurgical residues (10336g) from this site were visually examined as part of this PhD research (Table S.18). In the published account, the medieval activity at Tuckey Street was divided into five phases based on the pottery types found.

Nearly all the metallurgical residues were recovered from phases 2 to 4, which were dated to the late twelfth and early thirteenth centuries by the occurrence of Ham Green B pottery, Minety-type Wares and other pottery types (ibid.: passim). At the northern end of the cutting, on level 2, two consecutive hearths were uncovered. The earliest, C.93, had no cut and maximum extent of the charred material was 1.04 by 0.65m, while the later one, C.91, had a sub-circular hearth measuring 0.73 by 0.48 by 0.22m (ibid.: 18). Both were filled with ash and charred soils. No slag was recovered from these features. The metalworking residues from this phase were recovered from pit

C.68, about three metres further north and posthole (pit?) C.96, just east of the hearths. The latter yielded a single smithing hearth cake (143g) and the former contained 1219g of residues, including a smithing hearth cake, slag with flow-structure and vitrified ceramic material.

Next to this, C.68 also contained seven pieces of ceramic-like material covered in a shiny, dark grey thin slag layer. The better-preserved pieces showed a teardrop-shaped profile and a domed, slightly overhanging "cap" at one terminus. These artefacts measured about 30 to 40mm along the longest axis of their width and none showed a full length (See Fig. 8.11a). Phase 2A produced smaller amounts of metalworking residues from layer C.82 (59g), which directly overlay hearth C.91, and ditch C.83 (86g), to the south of the hearths (ibid.: 19). The features from phase 3, also dated to the late twelfth/early thirteenth centuries, were concentrated in an area to the immediate east of the hearths of phase 2. This phase contained one hearth with a scorched clay base, C.58, measuring 0.58 by 0.48 by 0.08m in a first phase and 0.64 by 0.5 by 0.05m in a second (ibid.: 20). No slag was recovered from the hearth, while two smithing hearth cakes were found in clay layer C.74, which was associated with this hearth.

The bulk of the material from phase 3, however, was found in the adjacent layers C.33/38 further north (3531g). This included eight complete smithing hearth cakes, fragments of the same, possible and likely tuyere material and three pieces of the slag-covered ceramic-like material. On level 4, the metallurgical residues were found in a clay layer deposited over the same area as level 3 and containing material dated to the same period. These layers were C.27 (178g), C.43 (8g), C.43/55/77 (779g, all complete or fragmentary smithing hearth cakes) and especially C.65 (ibid.: 22–23). The latter layer contained 1836g of material including four smithing hearth cakes, partial ones, probable tuyere material and seven pieces of the ceramic-like material with slag film. Two punches or awls were recovered from layer C.43/55/77 (ibid.: 23). Small amounts of material from phase 5, dated to the mid- to late thirteenth century, were found in ditches C.16 (91g) and C.34 (11g) and could be residual, but four pieces of slag (392g) in a layer belonging to the same phase, C.18, may well point to continued metalworking at a later stage (ibid.: 23–24).

The bulk of the metalworking was found in features belonging to three phases (and a sub-phase) which are characterized by the same pottery types dated to the late twelfth to early thirteenth centuries and the same types of ceramic-like material covered in slag. It is likely that the iron smithing activities took place within a relatively short

period. None of the hearths is recorded as containing metalworking debris, but the possibility exists that they functioned as smithing hearths. If they did, they were not located inside a structure.

Cut	Fill	Type	Description	Weight (g)
16	16	Ditch	Piece of grey, glassy slag with mother-of-pearl shine	91
NA	18	Deposit	Three lumps of rather dense slag	348
NA	18	Deposit	Piece of grey, glassy slag with mother-of-pearl shine	44
NA	27	Deposit	Four pieces of rather dense smithing slag	178
NA	33	Deposit?	Nicely formed rather dense smithing hearth cake	335
NA	33	Deposit?	Seven pieces of slag, some of the larger ones might be parts of smithing hearth cake	189
NA	33	Deposit?	Five pieces of vitrified clay with adhering slag. The convex shape of some might suggest tuyeres rather than hearth lining	225
NA	33	Deposit?	Two pieces of ceramic-like material covered in shiny, grey slag film	29
NA	33	Deposit?	Piece of corroded iron	
NA	33/38	Deposit	Nicely formed rather dense smithing hearth cake	296
NA	33/38	Deposit	Well formed flat, rather dense smithing hearth cake	295
NA	33/38	Deposit	Nicely formed rather dense smithing hearth cake	242
NA	33/38	Deposit	Multiple pieces of rather dense slag, some likely fragments of smithing hearth cakes	600
NA	33/38	Deposit	Two pieces of drippy grey, glassy slag with a mother-of-pearl like shine	65
NA	33/38	Deposit	Piece of irregular slag with remnants of vitrified clay visible. The convex shape of the ceramics could indicate tuyere	206
NA	33/38	Deposit	Three pieces of corroded iron	
34	34	Ditch	Small piece of heat-affected ceramic material with adhering slag	11
35	35	Ditch	Probable lump of corroded iron	
NA	38	Deposit	Well formed, bun-shaped smithing hearth cake. Rather dense	123
NA	38	Deposit	Complete, irregular smithing hearth cake	147
NA	38	Deposit	Lump of slag probably a complete smithing hearth cake	148
NA	38	Deposit	Small irregular smithing hearth cake	115
NA	38	Deposit	Incomplete irregular smithing hearth cake	182
NA	38	Deposit	Eleven small pieces of slag	173
NA	38	Deposit	Four pieces of vitrified ceramics with adhering slag, one piece showing blow-hole	45
NA	38	Deposit	Piece of white ceramic material with regular rounded quartz inclusions, has slag adhering. Rounded edge suggests tuyere	92
NA	38	Deposit	One piece ceramic-like material covered in shiny, grey slag film	24
NA	38	Deposit	Two small pieces of corroded iron	
NA	43	Deposit	Small piece of drippy, bright red (burnt?) slag	8
NA	46	Deposit	Slightly elongated, rather dense smithing hearth cake	296

NA	65	Deposit	Elongated rather dense smithing hearth cake	383
NA	65	Deposit	Small, rather dense smithing hearth cake	198
NA	65	Deposit	Very irregular, light smithing hearth cake	144
NA	65	Deposit	Lump of rather dense slag, probable smithing hearth cake	183
NA	65	Deposit	Nine pieces of light to rather dense slag, some drippy, some probable fragments of smithing hearth cake	289
NA	65	Deposit	Piece of grey, glassy slag	47
NA	65	Deposit	Six pieces of vitrified ceramics with adhering slag. One piece seems to have a straight face, another a convex part separate from the adhering slag, the latter suggestive of tuyere material	413
NA	65	Deposit	Seven pieces of ceramic-like material covered in shiny, grey slag film	179
NA	65	Deposit	Two large iron nails	
68	68	Pit	Near complete, dense smithing hearth cake, with some hearth base material adhering	277
68	68	Pit	Rather dense pieces of slag, most showing flow structure to some degree	606
68	68	Pit	Light, glassy blebs of slag with mother-of-pearl like shine	92
68	68	Pit	Five pieces (one broken) of vitrified clay with adhering slag, unclear if tuyere of hearth lining	69
68	68	Pit	Seven pieces (one broken) of ceramic-like material covered in shiny, grey slag film	175
68	68	Pit	Three pieces of corroded iron	
NA	74	Deposit	Probable accumulation of at least two smithing hearth cakes	1204
NA	74	Deposit	smithing hearth cake consisting of two layers, the lower dense and rounded, the upper irregular and lighter	494
NA	74	Deposit	One piece ceramic-like material covered in shiny, grey slag film	9
NA	77	Deposit	Well formed flat, rather dense smithing hearth cake	324
NA	77	Deposit	Part of a larger smithing hearth cake consisting of two layers, dense, rusty at the base, lighter, irregular at the upper part	383
NA	77	Deposit	Four pieces of probable smithing hearth cake fragments	72
NA	82	Deposit	Two small lumps of slag	50
NA	82	Deposit	Small piece of ceramic material with adhering slag	9
83	83	Ditch	Lump of irregular grey porous glassy slag	86
83	83	Ditch	One large and one small nail	
NA	84	Deposit	Heat affected stone	
NA	84	Deposit	Iron pin	
NA	90	Deposit	Probable lump of corroded iron	
96	96	Posthole	Rather irregular, light smithing hearth cake	143

Table S.18 Description of the material related to metalworking from Cork, Tuckey Street

Cuffsborough 5, Co. Laois

Site no. 40

Townland: Cuffsborough
Civil Parish: Aghaboe
Coordinates (ITM): E634308, N680821

Licence: E2249
Director: Eamonn Cotter (ACS)
Excavated between March and April 2006

Site summary:

Ironworking activity: Smithing
Significance: High

Site deposition condition: Primary
Investigation level: Complete excavation

Ironworking features: Forge building, hearths

Dating evidence: C14
Sample size: 22kg

Material present:						
	Slag	✓	Tuyeres		Tools	
	Hammerscale	✓	Other ceramic	✓	Iron artefacts	✓

Description

Excavations at Cuffsborough 5, Co. Laois revealed two phases of ironworking, one dated to the Iron Age, the other to the late medieval period (Cotter 2009a). The later ironworking consisted of four deposits of metallurgical debris forming a roughly rectangular area oriented north-east/south-west, which was heavily truncated by later activity (ibid.: 7–9, 20) (Fig. S.17 and see Fig. 8.1e).

The most south-westerly most of these deposits C.78 contained significant amounts (1654g) of smithing pan which included slag and coal fragments (Young 2009e: 80). This was similar to the contents of the layer to the north-east of this C.77, which contained more of the material (4961g), including one smithing hearth cake. The following deposit C.76 had occasional slag (NI)[137] (Cotter 2009a: 9), while the most north-easterly C.7 also yielded large amounts of smithing pan, one smithing hearth cake, vitrified ceramic material and coal inclusions, 6037g in total (Young 2009e: 72–73). Under layer C.76, a circular pit C.84 was found measuring 0.9m in diameter and 0.48m deep (Cotter 2009a: 27). Its basal fill contained several pieces of slag and coal fragments (total 505g), while its upper fill had two coal fragments (Young 2009e: 81).

137 The material from this context does not appear in the specialist report. This is the case with several other features, which will be marked as (NI), Not Investigated.

Another pit (C.92) nearby, heavily truncated by later activity, contained occasional slag (NI) (Cotter 2009a: 28). At its eastern corner four postholes containing slag were set in a rough L-shaped pattern. The first, C.75, which was shallow and so not definitely a posthole, yielded undiagnostic slag and a probable tuyere fragment (total 220g), while another, C.64, contained a prilly mass of slag with embedded coal and clinkery material (total 377g) (Young 2009e: 80). Radiocarbon analysis of a fragment of oak charcoal from the fill of the latter returned a date of AD 1469–1648 (2σ) or AD 1514–1600 (78.4%) and 1617–1641 (21.6%) (1σ) (Cotter 2009a: 17).

The two other postholes (C.70 and C.94) held respectively occasional and frequent slag (both NI) (ibid.: 9, 10). Both the rectangular pattern of the deposits and the postholes in one of its corners suggest that the smithing activities were carried out inside a building. Pit C.84 could have been a smithing hearth, although both the basal fill and its depth are a-typical. A better candidate seems to be pit C.90, which measured 1.4 by 0.79 by 0.18m. No fill is mentioned and it is likely that it was filled by the slag-rich deposits above and around it. Iron objects related to these deposits include several nails, a buckle, a shears-blade and a bracket (ibid.: 55) The site at Cuffsborough 5 is interpreted as a coal-fired forge that probably dates to the sixteenth century, and probably belonging to the last three quarters of it.

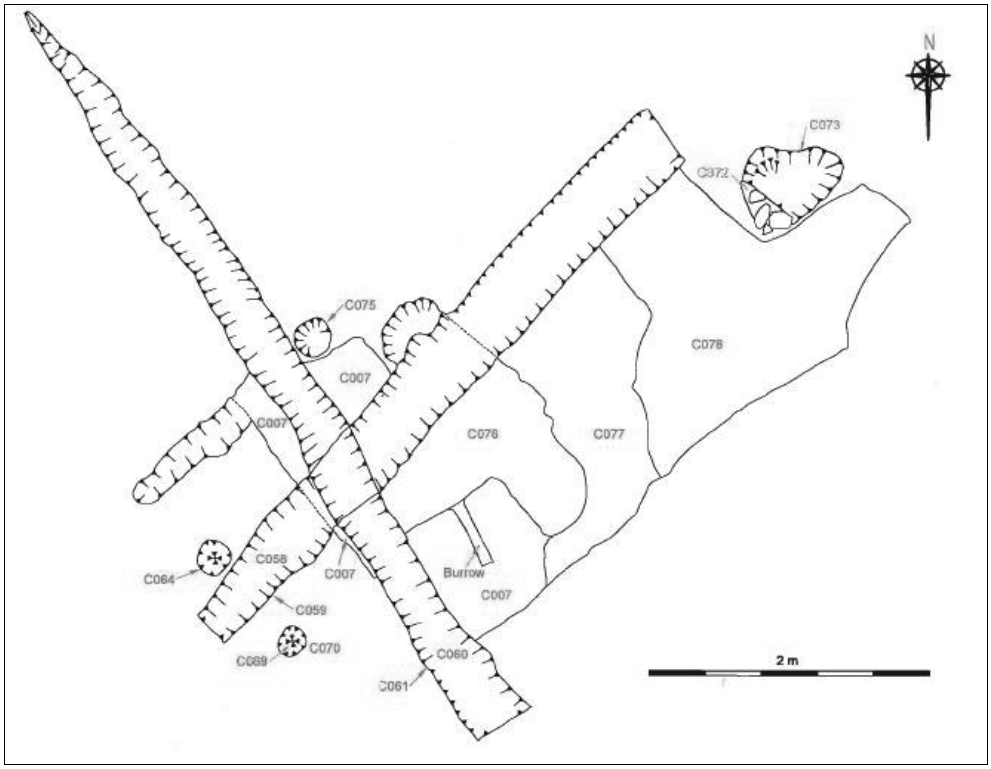

Fig. S.17 Cuffsborough 5, Co. Laois. Plan of the ironworking area (after Cotter 2009a: 90)

Curragh 2, Co. Laois

Site no. 41

Townland: Curragh
Civil Parish: Bordwell
Coordinates (ITM): E634308, N680821

Licence: E2249
Director: Eamonn Cotter (ACS)
Excavated between March and April 2006

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Partial excavation		
Ironworking features: None					
Dating evidence: C14, pottery			Sample size: 770g		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic		Iron artefacts

Description

At the site of Curragh 2, Co. Laois, a sub-rectangular enclosure was uncovered with limited evidence of metalworking (Cotter 2009b). The enclosure included a possible post-built structure, with an associated slot-trench and hearths, and scattered pits (ibid.: 18–19). An isolated pit or posthole contained a single piece of slag (30g), a rectangular pit revealed nine pieces (353g), while a larger piece (361g) was recovered from one of the ditches (Young 2009f). The slag from all three contexts showed limited flow-structure, but it remained unclear if the material originated from smelting or smithing.

A probable piece of tuyere material was recovered from the topsoil. Radiocarbon analysis of a fragment of blackthorn charcoal from the basal fill of the same ditch containing the slag returned a date of AD 1157–1272 (2σ) or AD 1187–1199 (15.3%) and 1206–1258 (84.7%) (1σ) (Cotter 2009b: 28), Radiocarbon analysis on material from one of the postholes of the structure gave a date of AD 1284–1333 (42.5%) and 1336–1398 (57.5%) (2σ) or AD 1293–1318 (39.8%) and 1352–1390 (60.2%) (1σ), while material from another gave AD 1260–1317 (72.0%) and 1353–1389 (28.0%) (2σ) or AD 1272–1299 (79.6%) and 1369–1380 (20.4%) (1σ). Two pieces of locally made pottery were found, one from topsoil, the other from one of the ditches (McCutcheon 2009d). A date range not more precise than the thirteenth to fourteenth centuries for the deposition of the metalworking residues at this site can be proposed.

Curragh Upper, Co. Cork

Site no. 42

Townland: Curragh Upper
Civil Parish: Clondulane
Coordinates (ITM): E586585, N598075

Licence: 09E0209
Dir.: Bernice Molloy (Margaret Gowan Ltd.)
Excavated in April 2009

Site summary:

Ironworking activity: Smithing			Significance: High	
Site deposition condition: Disturbed			Investigation level: Complete excavation	
Ironworking features: Forge building, hearth				
Dating evidence: C14			Sample size: 2.7kg	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale	✓	Other ceramic	Iron artefacts

Description

Excavations at the site of Curragh Upper, Co. Cork revealed an area containing ironworking residues (Molloy 2010). A deposit measuring 3.60 by 2.33 by 0.03m with frequent charcoal contained a large amount of metalworking residues (ibid.: 5). This charcoal consisted exclusively of oak (O'Donnell 2010: 17). The slag from this deposit, consisting of 45 pieces and weighing 2.7kg in total[138], was described as amorphous lumps (Scully 2010: 21). The residues consisted of undiagnostic slag and both spheroidal and flake hammerscale. This spread was enclosed on two sides by a curving gully (See Fig. 8.1d), oak charcoal from which returned a radiocarbon date of AD 1175–1260 (2σ) or AD 1209–1255 (1σ) (Molloy 2010: 23). Although no hearth was recorded, the section through the spread shows a dip where the spread was truncated by a field drain (ibid.: 34). The visible length of this probable hearth is about 0.82m, the other dimension is not re-constructable. Three nearby stakeholes were seen as connected (ibid.: 5). The gully, which respects the area of metalworking had no recorded slag and could be either a foundation trench for a building or a drain on the outside of its clay walls. A pit was located just past one of the termini of the gully. This site represents late twelfth- to early thirteenth-, and likely early thirteenth-century, smithing carried out in a mud-walled forge.

138 This limited amount of material seems to suggest that either not all the residues were collected or that they were not made available to the specialist.

Danesfort, Co. Kilkenny

Site no. 43

Townland: Danesfort
Civil Parish: Danesfort
Coordinates (ITM): E651874, N647600

Licence: E3539
Director: Richard Jennings
(Irish Archaeological Consultancy Ltd.)

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Danesfort, Co. Kilkenny a stone-built structure measuring 3 by 3.2m was uncovered (Jennings 2010).[139] A demolition fill, above a likely compacted natural clay floor with a hearth, included finds of bone, slag, metal and Leinster Cooking Ware. This was sealed by a deposit containing post-medieval pottery.

139 This information is based on an entry in the Excavations Bulletin. A full report of these excavations was not available by the time of writing.

Derrinsallagh 1, Co. Laois

Site no. 44

Townland: Derrinsallagh
Civil Parish: Aghabor
Coordinates (ITM): E624875, N686005

Licence: E2177
Director: Anne-Marie Lennon (ACS)
Excavated in 2005

Site summary:

Ironworking activity: Smelting			Significance: High	
Site deposition condition: Primary			Investigation level: Complete excavation	
Ironworking features: Furnace				
Dating evidence: C14			Sample size: 12.1kg	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	✓ Iron artefacts

Description

During excavations at site 1 in Derrinsallagh, Co. Laois, a complex feature (C.025) connected to ironworking was unearthed (Lennon 2009).

It consisted of two parallel strips of natural bedrock on top of which an arc-shaped structure of limestone blocks with an external diameter of c. 1.2 by c. 1.2m[140] was constructed (Fig. S.18 and see Fig. 6.4). The enclosed hollow, measuring c. 0.7m diameter[141], was filled with four layers, the three uppermost of which contained slag (ibid.: 9). The residues from the lowest of these layers consisted of 45 pieces of flow slag, a thick curved crust of slag with adhering clay and two pieces of vitrified lining (730g in total) (Young 2009b: 151). The debris from the middle fill consisted of two blocks of very dense crust, flow slag, other slag and vitrified lining (1230g in total). The material from the upper fill was made up of three small slag fragments (16g).

Radiocarbon analysis on unspecified organic material from the middle fill gave a date of AD 1316–1355 (22.0%) and 1388–1447 (98.2%) (2σ) or AD 1333–1336 (3.8%) and 1398–1439 (96.2%) (1σ) (Lennon 2009: 49). Immediately in front of the opening of

140 Calculated from Fig. 8 (Lennon 2009a: 81).
141 Idem. The measurements given, that is to say 3.8 by 2.4m (Lennon 2009a: 9) are obviously erroneous.

the arc-shaped structure was a circular pit measuring 1.27m diameter and which was 80mm deep (ibid.: 9). Its single fill was highly charcoal-rich and contained 6829g of slag. This included furnace-floor material, slag crust, pieces of slag with flow-structure, two of which showed impressions of large wood fragments, and small amounts of furnace lining (Young 2009d: 69).

Fig. S.18 Derrinsallagh 1, Co. Laois. Post-excavation photograph of furnace C.025 (Lennon 2009a: 84)

Interesting is the occurrence of a small fragment of bright blue, glassy slag in the assemblage, testifying to the varying conditions which can occur inside a furnace. Radiocarbon analysis on a fragment of hazel from this fill returned a date of AD 1330–1339 (1.7%) and 1397–1454 (98.2%) (2σ) or AD 1416–1441 (1σ) (Lennon 2009a: 15, 51). A second pit, either earlier or later than the former[142], also had frequent slag in its lower, charcoal-rich fill. This is described as flow slag and/or slag crust (2118g) and other slag types (778g) (Young 2009d: 151). Two pieces of slag, one from each pit, were seen as possible smithing hearth cakes, indicating that some post-reduction smithing had taken place. The structure from Derrinsallagh 1 is an iron-smelting furnace, dated to the early fifteenth century. While the pieces showing wood impressions indicate an organic fill under the charge, reminiscent of the slag-pit furnace, it is clear that there was no pit under the furnace.

142 In the text this feature (C011) is described as truncating former (C003) (Lennon 2009a: 13), while in the context description the relation is the other way round (ibid.: 9). The description of the upper fill and the one below of C011 are both described as below the other (ibid.: 10). The accompanying plates also give no conclusion (ibid.: 84).

Dooneen AR025, Co. Kerry

Site no. 45

Townland: Dooneen
Civil Parish: Castleisland
Coordinates (ITM): E499888, N612966

Licence: 07E0478
Dir.: Michael Tierney (The Archaeology Company)
Excavated in 2007

Site summary:

Ironworking activity: Smelting			Significance: Medium		
Site deposition condition: Disturbed			Investigation level: Complete excavation		
Ironworking features: Furnace					
Dating evidence: C14			Sample size: 5.78kg		
Material present:	Slag	✓	Tuyeres		Tools
	Hammerscale		Other ceramic	✓	Iron artefacts

Description

At Dooneen, Co. Kerry site AR025 several features containing slag were uncovered (Tierney et al. 2009b). One of these, C.1/2, consisted of a charcoal-rich spread containing slag and measuring 1.01 by 0.44 by 0.12m surrounded by a band of heavily burnt clay (ibid.: 9). Although it was stated that no cut was present, from another plate the feature seems to have consisted of two adjoining hollows (ibid.: 9, 38). At one end of this feature a lump of slag interpreted as a furnace bottom weighing 3159g was found, while the other material was described as undiagnostic, but probably smelting slag, dribbles and fired clay (Keys 2009b: 60).

Radiocarbon analysis on a fragment of porous diffuse wood from the fill of this feature returned a date of AD 1220–1272 (2σ) or AD 1226–1234 (19.3%) and 1238–1248 (27.5%) and 1251–1266 (53.2%) (1σ) (Tierney et al. 2009b: 57). The rest of the charcoal from this feature consisted of oak (Dillon 2009b: 55). A similar feature, C.29,

was located about 30 metres east of C.1/2. It measured c. 0.7m by c. 0.38m by 0.11m[143] and was filled with charcoal-rich material overlaying heavily burnt clay (ibid.: 14). The limited amount of metallurgical material from this feature (101g) was described as slag runs, magnetic fragments and fired clay which was interpreted as left-over *in situ* iron-smelting debris (Keys 2009b: 60). No dates were retrieved for this feature, while the charcoal consisted exclusively of oak (Dillon 2009b: 56). Smithing activity dated to the early medieval period was also uncovered at the same site (Tierney et al. 2009b: 11–12). The feature with the *in situ* furnace bottom is consistent with a base of a shaft furnace, and would have operated around the mid-thirteenth century. The other feature is likely a heavily truncated base of the same and possibly contemporary.

Fig. S.19 Dooneen AR025, Co. Kerry. Mid-excavation photograph of furnace C.1/2 (Tierney et al. 2009b: 38)

143 These measurements are taken from the plan (Tierney et al. 2009b: 34), the text gives 0.4 by 0.16m.

Dublin, Back Lane/Lamb Alley

Site no. 46

Townland: St. Audoens
Civil Parish: Dublin City
Coordinates (ITM): E714925, N733893
SMR: DU018:123

Licence: 96E0300
Director: Tim Coughlan
(Margaret Gowan Ltd.)
Excavated between Oct. 1996 and Mar. 1997

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Documentary		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Slag was also found associated with medieval stone houses at the site of Back Alley/Lamb Lane further south and also just inside the city walls (Coughlan 1998). Stone houses dating to AD 1260 are recorded here and this was seen as probably the beginning of the phase of activity that included the residues.

Dublin, Bride Street

Site no. 47

Townland: St. Bridget's
Civil Parish: Dublin City
Coordinates (ITM): E715233, N733733
SMR: DU018:313

Licence: 93E0153
Director: Mary McMahon
Excavated between Oct. and Dec. 1993

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Primary			Investigation level: Urban		
Ironworking features: Hearth					
Dating evidence: Pottery			Sample size: > 21.75kg		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic		Iron artefacts ✓

Description

During excavations at Bride Street evidence for intensive activity, including late medieval metalworking, was uncovered (McMahon 2002). After an earlier graveyard went out of use, sometime in the twelfth century, small-scale ironworking was carried out in the north-western section of the site (ibid.: 86–87). As one of the pieces is recorded as the remains of a possible "furnace bottom", it is likely that the activity was smithing.

At the same location, a further series of features connected to ironworking were created at a later date (Fig. S.20). A D-shaped setting of stones, hearth (C.31) (c. 0.8m square), was uncovered in the north-west of the excavations (ibid.: 89). This feature was constructed on a charcoal-rich layer (C.27) which had frequent slag inclusions (5.5kg in total) (ibid.: 89–90). The same deposit was found in a linear depression (C.27B), which held a further 1kg of slag. Both these features yielded two unspecified sherds of medieval pottery. Two small, shallow pits (C.42 and C.47) containing more slag were

found directly in front of the hearth (ibid.: 90). Several deposits (C.18, C.25 and C.88) in the vicinity of these features held further slag, the former yielding 9kg and the latter described as having frequent inclusions of the material (ibid.: 88–89). To the south of this, a pit (C.45) contained a further 5.5kg of slag, one piece of which was described as the remains of a "furnace bottom", together with a sherd of unspecified Ham Green Ware (ibid.: 91, 95). Beneath this, a hollow (C.70) held a large piece of slag, possible a "furnace bottom", which crumbled on removal (ibid.: 91). Two deposits (C.53 and C.73) in this south-westerly corner yielded further slag, the latter 0.75kg. In the eastern half of the site a pit (C.17, 0.92 by 0.9 by 0.29m) held 1kg of slag together with a sherd of Dublin glazed ware (ibid.: 88).

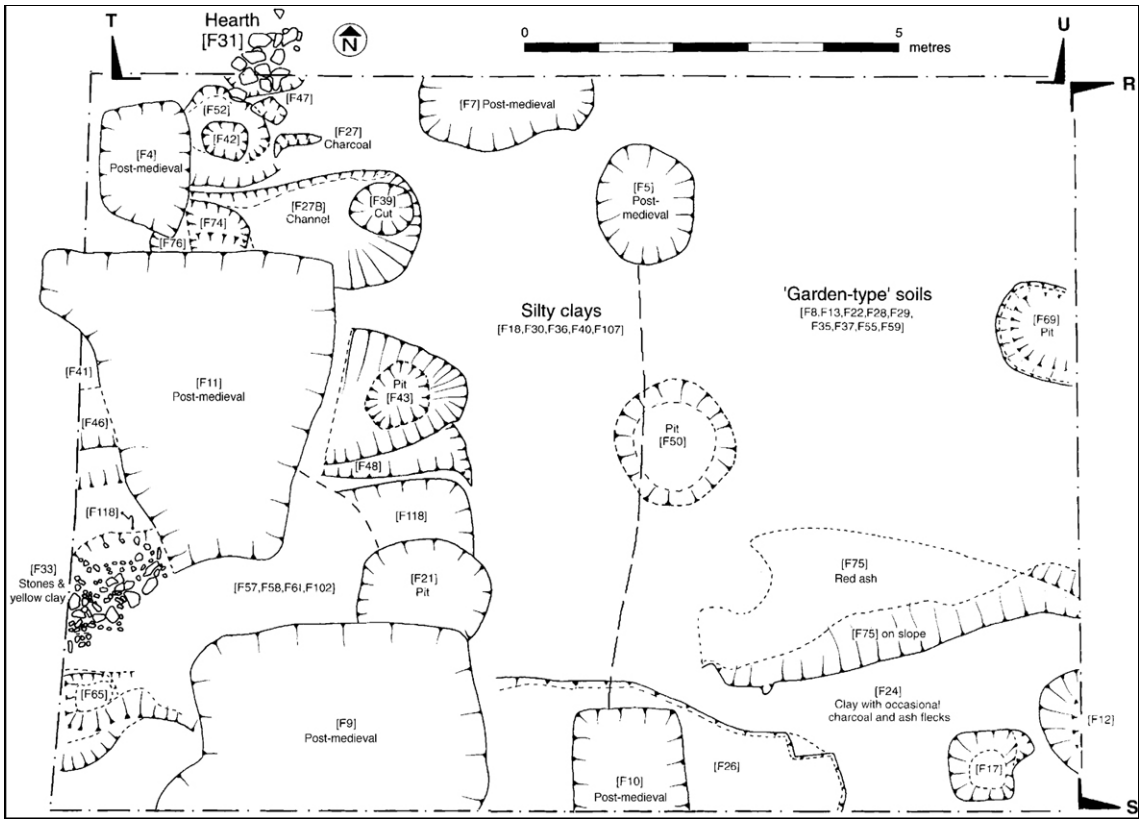

Fig. S.20 Dublin, Bride Street. Post-excavation plan of Phase IV and V features (McMahon 2002: 127)

A relatively arge amount of slag (10.5kg) was retrieved from a deposit of garden-type soils (C.22) in the same area which also contained Ham Green A and Dublin hand-built ware (ibid.: 87, 95, 97). Another deposit (C.28) of a similar nature held a piece of tuyere (ibid.: 103). Although few pieces of pottery were found in the same features containing metalworking residues, the latter were seen as belonging to a phase of activity in the thirteenth century (ibid.: 92). Iron objects found in the above features include several

nails, a hook and a ringed pin. The reference to “furnace bottoms” probably suggests smithing activities taking place here and the report mentions the occurrence of copper staining on some of the slag pieces (ibid.: 91). Some of the features, for example hearth (C.31) and possibly pit (C.17), are probably the remains of *in situ* metalworking operations, but no structures seem to have been present.

Dublin, Bridge Street Lower

Site no. 48

Townland: St. Audoens
Civil Parish: Dublin City
Coordinates (ITM): E714766, N734108
SMR: DU018:020(578)

Director: Mary McMahon
Excavated between September and November 1989

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Bridge Street Lower, just inside the north-western corner of the town walls, some slag was recovered from a wicker mat functioning as a foundation for a post-and-wattle structure (McMahon et al. 1991: 47, 65). French imported pottery and Minety-type Ware dated this feature to the late twelfth to early thirteenth centuries (ibid.: 47, 60).

Dublin, Christ Church Place

Site no. 49

Townland: St. Nicholas Within
Civil Parish: Dublin City
Coordinates (ITM): E715091, N733904
SMR: DU018:020

Director: Breandán Ó Ríordáin
(National Museum of Ireland)
Excavated between 1972 and 1976

Site summary:

Objects subjected to metallographic examination and chemical analysis

Description

Two knives, dated to the thirteenth century and recovered during the excavations at Christ Church Place in Dublin, were chemically analysed and metallographically examined as part of Brian Scott's doctoral research (Scott 1976: 275–284) (Table S.19). The results of these excavations remain unpublished (Ó Ríordáin 1975).

	C	P	Al	Mn	Ni	Ti	Cu
1	0–0.89	0.02	0.2	tr.	0.004	tr.	0.004
2	0–0.9	0.006	0	tr.	0.001	tr.	0.003

Table S.19 Analyses results for iron objects from Christ Church Place, Dublin (Scott 1976: 275–284)

1 Knife. Ferrite/pearlite/martensite/troostite, back: very low C, edges: high C steel, fork-welded, quenched (CCP.E22: 1219)
2 Knife. Ferrite/pearlite/cementite, piled structure, centre: high C, edges: low C, likely carburized (CCP.E22: 1311)

Dublin, Francis Street/Lamb Alley

Site no. 50

Townland: St. Nicholas Without
Civil Parish: Dublin City
Coordinates (ITM): E714805, N733927

Excavation licence: 92E0109
Director: Alan Hayden
Excavated between August and November 1992

Site summary:

Ironworking activity: Smithing		Significance: High	
Site deposition condition: Primary		Investigation level: Urban	
Ironworking features: Hearth, trough, anvil?, associated hut			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At the site of Francis Street/Lamb Alley, which would have been located just outside the New Gate, one of the western gates of medieval Dublin, *in situ* late medieval ironworking was found (Hayden 2000). Here, a rectangular post-and-wattle structure was uncovered with associated mercury droplets and early to mid-thirteenth-century pottery (ibid.: 103–105). The mercury was seen as indicating non-ferrous metalworking and both finds and historical documentation suggest that buckles were produced here.

After the abandonment of this structure, a small, round post-and-wattle building (3.4m diameter) was erected on the same spot (ibid.: 106) (Fig. S.21). Just in front of a gap in the double post structure, an elongated pit interpreted as an "iron furnace", measuring c. 1.10 by c. 0.45m[144] was uncovered (ibid.: 106, 108). At one end of this feature a large hollow containing the remains of a wooden trough (c. 1.75m square) was

144 Values deduced from the plan.

found, which contained large amounts of charcoal (ibid.: 106). A large stone, visible on the plan, could have functioned as an anvil (ibid.: 108). Fragments of slag were found in the vicinity (ibid.: 106). Pottery relating to this phase consisted of unspecified early to mid-thirteenth-century types (ibid.: 105). Next, a large timber building dated to the mid- to late thirteenth century was built on the same place (ibid.: 108–109) An earlier notice regarding this site mentions tuyere fragments being found associated with this phase (Hayden 1993), which are not recorded in the publication.

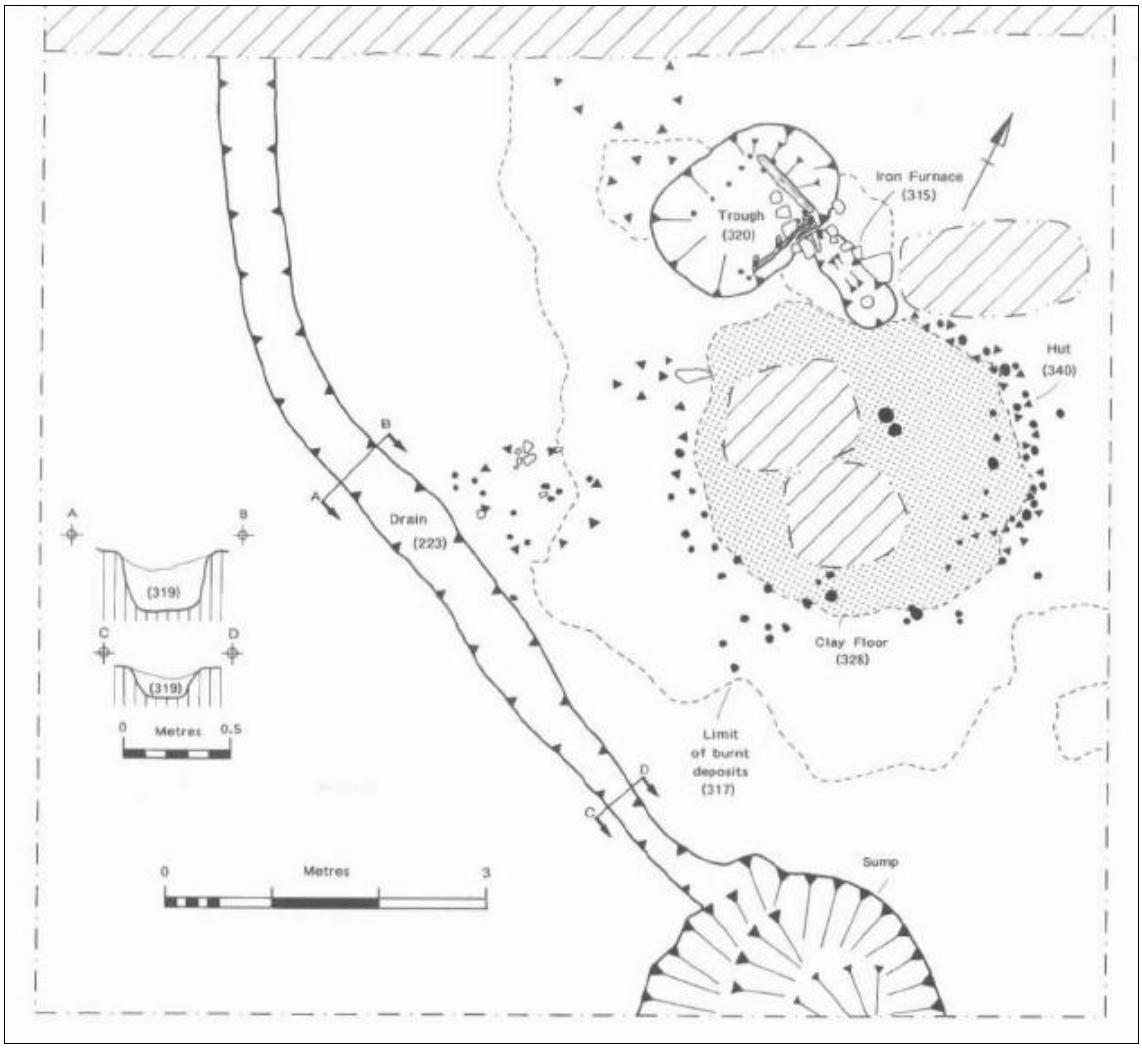

Fig. S.21 Dublin, Francis Street/Lamb Alley. Post-excavation plan of the ironworking area (Hayden 2000: 108)

Dublin, 3–15 Hammond Lane/161–168 Church Street

Site no. 51

Townland: St. Michan's
Civil Parish: Dublin City
Coordinates (ITM): E714815, N734335

Licence: 05E0765
Dir.: Sinead Phelan (Margaret Gowan Ltd.)
Excavated between Oct. 2005 and Feb. 2006

Site summary:

Ironworking activity: Smithing		Significance: Medium	
Site deposition condition: Primary?		Investigation level: Urban	
Ironworking features: Hearth?			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations of a large tract of land were carried out north of the river Liffey, in what would have been medieval Oxmantown, at 3–15 Hammond Lane and 161–168 Church Street (Phelan 2010). The site was regarded as continuously inhabited from the twelfth to the twentieth centuries (ibid.: 188). On one of the (medieval?) plots, a "smelting furnace … with a number of clench bolts in its flue" was uncovered. These bolts were similar to those used in shipbuilding and were "in the process of being re-smelted". No further information was available[145] and the feature is not represented on the accompanying plans. The information is too scant to allow for an interpretation of the activity represented here.

145 No contact information for the director of this site was found, so no permission to consult the unpublished report could be obtained.

Dublin, High Street

Site no. 52

Townland: St. Michael's
Civil Parish: Dublin City
Coordinates (ITM): E715005, N733917
SMR: DU018:203(263B)

Director: Breandán Ó Ríordáin
(National Museum of Ireland)
Excavated between 1967 and 1972

Site summary:

Objects subjected to metallographic examination and chemical analysis

Description

Four knives from High Street, Dublin were chemically analysed and metallographically examined as part of Brian Scott's doctoral dissertation (Scott 1976: 275–284). Two were dated to the late tenth to early eleventh centuries and two to the late twelfth century. The first two were not included in the current study. The results for the last two, a knife and scramasax knife, are given below (Table S.20). These excavations were carried out several years previously by Ó Ríordáin (1971).

	C	P	Al	Mn	Ni	Ti	Cu
1	0	0.013	0.01	0.007	0.01	tr.	0.004
2	0.05–0.15	0.213	0.005	0.04	0.02	tr.	0.02

Table S.20 Analyses results for iron objects from High Street, Dublin (Scott 1976: 275–284)

1 Knife. Ferrite, even grain-size, some slag (H.St. E71: 16019)
2. Scramasax knife. Ferrite. Pattern-welded with high and low P layers, one low C steel layer, slag-rich welding seams (H.St.: 16919)

Dublin, 2–6 Longford Street Little

Site no. 53

Townland: St. Stephen's
Civil Parish: Dublin City
Coordinates (ITM): E715549, N733681
SMR: DU018:203(089)

Licence: 00E0137ext.
Dir.: John O'Neill (Margaret Gowan Ltd.)
Excavated in 2001

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Primary?		Investigation level: Urban	
Ironworking features: Hearth?			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	Tuyeres	✓ Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations at 2–6 Longford Street Little, to the south of the medieval city of Dublin, uncovered near-continuous activity from the eleventh to twelfth centuries till modern times (Ó Néill 2003). Phase 3, dated to the fourteenth century, included a "furnace" and the find of a tuyere together with Dublin-type Ware pottery.[146]

146 No permission was obtained to consult the original unpublished report on this site.

Dublin, 48 New Street South

Site no. 54

Townland: St. Nicholas Without
Civil Parish: Dublin City
Coordinates (ITM): E715026, N733251

Excavation licence: 04E1286
Dir.: Antoine Giacometti (Arch-Tech Ltd.)
Excavated between Sep. and Dec. 2004

Site summary:

Ironworking activity: Smithing

Significance: Low

Site deposition condition: Secondary

Investigation level: Urban

Ironworking features: None

Dating evidence: Pottery, artefacts

Sample size: 1090g

Material present:				
	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

To the south of the city, at 48 New Street South, small amounts of slag were recovered from two late medieval features in an area with numerous tanning pits (Giacometti 2008). The first feature, a possible plot boundary or drainage ditch (C27), contained seven pieces of slag, four of which showed copper staining (760g in total) (ibid. vol. 1: 37; Rico Rey and Giacometti 2008: 135). The second feature, a layer (C439/442/1522) yielded a compact slag fragment (330g) (ibid.: 136). A large ditch (C78) on the one hand cut the above layer and on the other was potentially contemporary with ditch C27 (Giacometti 2008 vol. 1: 26, 37). This large ditch was probably constructed in the mid-thirteenth to fourteenth centuries and contained fifteenth- to sixteenth-century artefacts in its upper fills (ibid. vol. 1: 58).

Dublin, 58–59 Thomas Street

Site no. 55

Townland: St. Catherine's
Civil Parish: Dublin City
Coordinates (ITM): E714674, N733876
SMR: DU018:020(970)

Excavation licence: 97E0380
Director: Judith Carroll

Site summary:

Ironworking activity: Smithing			Significance: Medium	
Site deposition condition: Primary?			Investigation level: Urban	
Ironworking features: Hearths?				
Dating evidence: Pottery			Sample size: Unknown	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	✓ Iron artefacts

Description

At 58–59 Thomas Street, along the road leaving Dublin through the New Gate and on a plot situated across from St. John the Baptist's Hospital, quite extensive remains of late medieval ironworking were uncovered (Carroll 1999a). The features containing slag were concentrated in a cutting on the north side of the site, close to the current Thomas Street.

Features with slag belonging to the upper levels in this area consisted of a hollow feature (C.5, c. 0.6 by c. 0.35m) with burnt clay and smithing waste in the northern half of the cutting and two deposits (C.27 and C.28) in its south-eastern corner (ibid.: 12–13, 17, 23). Pit C.5 included a sherd of Dublin-type Coarseware, while thirteen sherds of Dublin-type Ware were recovered from deposit C.27 (McCutcheon 1999: 42, 44). On a lower level, three deposits (C.14, C.25 and C.26) containing slag were found in the north of the cutting (Carroll 1999a: 12–13, 18). In the south-eastern section, three adjoining pits containing slag were found. The most northerly (C.62) had

a heat-affected clay base and measured c. 1.45 by 0.9m (ibid.: 9).[147] A ceramic plug, a very large quantity of iron slag and a great deal of pottery were recorded from its fill (C.43), but none of the latter is mentioned in the specialist report (ibid.; McCutcheon 1999: 40).

The next pit (C.61) measured 1.06m square and was 0.25m deeper than the previous pit (Carroll 1999a: 9). Both these pits were separated by a narrow organic baulk. The third pit (C.63) measured just over a metre north/south, and more than 0.7m east/west (ibid.: 22). This pit was covered (filled?) with a deposit (C.33) containing both slag and a sherd of Dublin-type Ware (ibid.: 23; McCutcheon 1999: 45). Nearby, a shallow cut (C.56, c. 0.6 by c. 0.4 by 0.1m) contained two layers of "ferruginous material" (Carroll 1999a: 14, 22).

To the west, a north/south-orientated linear feature was interpreted as a boundary structure[148], while a row of post was interpreted as part of a possible structure covering the metalworking area (ibid.: 8, 10). No dimensions for these postholes are given, but most would seem to be around 0.1m diameter (ibid.: 22), which, together with the length of c. 6m for the row of postholes, would more probably suggest that these represent part of a fence rather than having a structural function. Part of a large cesspit uncovered in another cutting further south also contained slag this time accompanied by various kinds of Dublin-type Wares, Saintonge and Ham Green B sherds (ibid.: 10; McCutcheon 1999: 43).

This site is difficult to interpret, but probably represents smithing activities on a relatively large scale. It is unclear if the material was dumped in this area or if the activity was *in situ*, as both the smaller pits C.5 and C.56 as well as the larger C.62 could be smithing hearths. The function of the dividing wall between pits C.61 and C.62 is wholly unclear. The cesspit in the southern cutting is datable to the late twelfth to early thirteenth centuries, while the main activity in the northern cutting is only definable as late medieval.

147 Its depth from the top of upstanding division C.46 (see below) is given as 0.65m. The levels on the plan and the picture show the actual depth of the feature to have been about 0.15 to 0.2m (Carroll 1999a: 22, 31).

148 Its fill, shown on one plan as 21, could also have contained slag, but the same number was given to a deposit on the highest level (Carroll 1999a: 18, 22).

Dublin, 119–121 Thomas Street

Site no. 56

Townland: St. Catherine's
Civil Parish: Dublin City
Coordinates (ITM): E714518, N733975
SMR: DU018:020(621)

Excavation licence: 96E0280
Director: Edmond O'Donovan
(Margaret Gowan Ltd.)
Excavated between Nov. and Dec. 1996

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At 119–121 Thomas Street, on a plot on the northern side of the road, a concentration of late medieval rubbish pits were excavated (O'Donovan 2003). Small amounts of ironworking slag were retrieved from some of these features (unspecified) and the activity was placed, based on pottery finds, between the late twelfth and the fourteenth centuries (ibid.: 165).

Duleek, Abbeyland, Co. Meath

Site no. 57

Townland: Abbeyland
Civil Parish: Duleek
Coordinates (ITM): E705187, N768560
SMR: ME027:038

Excavation licence: 97E0165
Dir.: Cormack McSparron (Office of Public Works)
Excavated in 1997

Site summary:

Ironworking activity: Smithing

Significance: Low

Site deposition condition: Secondary

Investigation level: Partial excavation

Ironworking features: None

Dating evidence: Pottery

Sample size: Unknown

Material present:				
	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

Excavations in the townland of Abbeyland, Co. Meath, near Duleek, uncovered several late medieval buildings together with evidence for metalworking (McSparron 2009a). In the northern-most trench, area 1, slag-rich deposits were found on the exterior of, and contemporary with, the partially preserved stone footing of a building (ibid.: 141). A similar deposit was encountered in the southern-most trench, area 3, which was stratigraphically younger than a second building located here (ibid.: 142). The absence of Saintonge Ware from the latter deposit, and the assumption that both deposits were contemporary, led to the suggestion of a late fourteenth- or fifteenth-century date for the metalworking (ibid.: 145). Both iron and non-ferrous slag were observed (ibid.: 142). As no features are recorded in connection with the metallurgical activity and no examination of the residues was carried out, little can be said about this site. The suggestion that the first building could have been a forge (ibid.: 141), however, cannot be upheld as the material was located outside the building.

Dunamase Castle, Co. Laois

Site no. 58

Townland: Park or Dunamase
Civil Parish: Dysartenos
Coordinates (ITM): E652936, N698203
SMR: LA013:052

Excavation licence: 93E0150
Dir.: Brian Hodkinson (Office of Public Works)
Excavated between 1994 and 1995

Site summary:

Ironworking activity: Smithing		Significance: Medium	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: Waist-high forge?			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Dunamase Castle, Co. Laois, during excavations around the gatehouse, slag was recovered from numerous deposits (Hodkinson 1994: 59–60; 1995: 65–66)[149] A charcoal-rich layer with metalworking debris was uncovered on the floor inside the gate tower, which was interpreted as the result of this building being converted into a smithy (Hodkinson 1994: 23, 41). No hearth was found, but a square pit (C.321, 1.8m square by 0.5m deep), cut through the floor in the north-west corner of the room, was seen as a possible robbed-out hearth-base (ibid.: 23, 40). This activity was dated to the thirteenth century based on pottery (ibid.: 41). Although the pit would be around the expected size for the base of waist-high smithing hearth, it is unclear why it would need to be so deep. An alternative explanation could be that the material is the result of smithing operations connected with a building phase of the castle.

149 The reports only contain sample numbers of slag, without providing quantitative information.

Dundalk, Rampart Road, Co. Louth

Site no. 59

Townland: Townparks
Civil Parish: Dundalk
Coordinates (ITM): E704677, N807034
SMR: LH007:119

Excavation licence: 96E0093
Director: Kieran Campbell
Excavated in 1996

Site summary:

Ironworking activity: Smithing?

Significance: Low

Site deposition condition: Secondary

Investigation level: Urban

Ironworking features: None

Dating evidence: Pottery

Sample size: Unknown

Material present:				
	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

Test trenches were excavated at Rampart Road, Dundalk, Co. Louth (Campbell 1996). The site is located relatively close to the place where the medieval marketplace would have been situated. A layer extending across three of these trenches contained iron slag together with medieval glazed pottery.

Dysart, Co. Kilkenny

Site no. 60

Townland: Dysart
Civil Parish: Pleberstown
Coordinates (ITM): E659586, N639302
SMR: KK032:004

Director: Ben Murtagh
Excavated between 1989 and 1991

Site summary:

Ironworking activity: Smelting?, smithing			Significance: High			
Site deposition condition: Primary			Investigation level: Partial excavation			
Ironworking features: Hearth, anvil						
Dating evidence: Pottery			Sample size: 4.9kg			
Material present:	Slag	✓	Tuyeres	✓	Tools	
	Hammerscale	✓	Other ceramic	✓	Iron artefacts	✓

Description

The site at Dysart, Co. Kilkenny consists of a twelfth-century, or earlier, church with associated cemetery, a fifteenth-century tower house and a large seventeenth-century house (Murtagh 1994: 31–33; Clyne 2007). During the late medieval period, Dysart was an outlying grange forming part of the monastic estate of Kells Priory [75].[150] The material from Dysart was visually examined as part of this PhD research (Table S.21).

The ironworking remains, dated to the twelfth to fourteenth centuries based on finds of Leinster Cooking Ware, consisted of an *in situ* smithing hearth but also small quantities of likely smelting slag with clear flow-structure found dispersed over a wide area (See Fig. 6.8). 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) (Fig. S.22). The Trench J revealed 446g of possible smelting slag and about 140g of copper-alloy material, including tubular and semi-circular waste pieces. Material from the western end of the church consisted of slag with flow-structure (898g), possibly

150 All relevant context and dating information was provided, together with material itself, by the site director, Ben Murtagh.

fused smithing hearth cakes (396g) and indeterminate slag (698g). This material was recovered from deposits (C.714 and C.718) and grave fills (C.710 and C.1147) dated to the late twelfth to thirteenth centuries, from seventeenth-century contexts (C.813a, C.1101 and C.1125B) and from nineteenth-century treasure hunting pits (C.706, C.717, C.721, C.727, C.818, C.829 and C.834). Two pieces of tuyere were also found in this area, one of which came from the late medieval deposit C.714, as did several smaller pieces of copper-alloy material (92g).

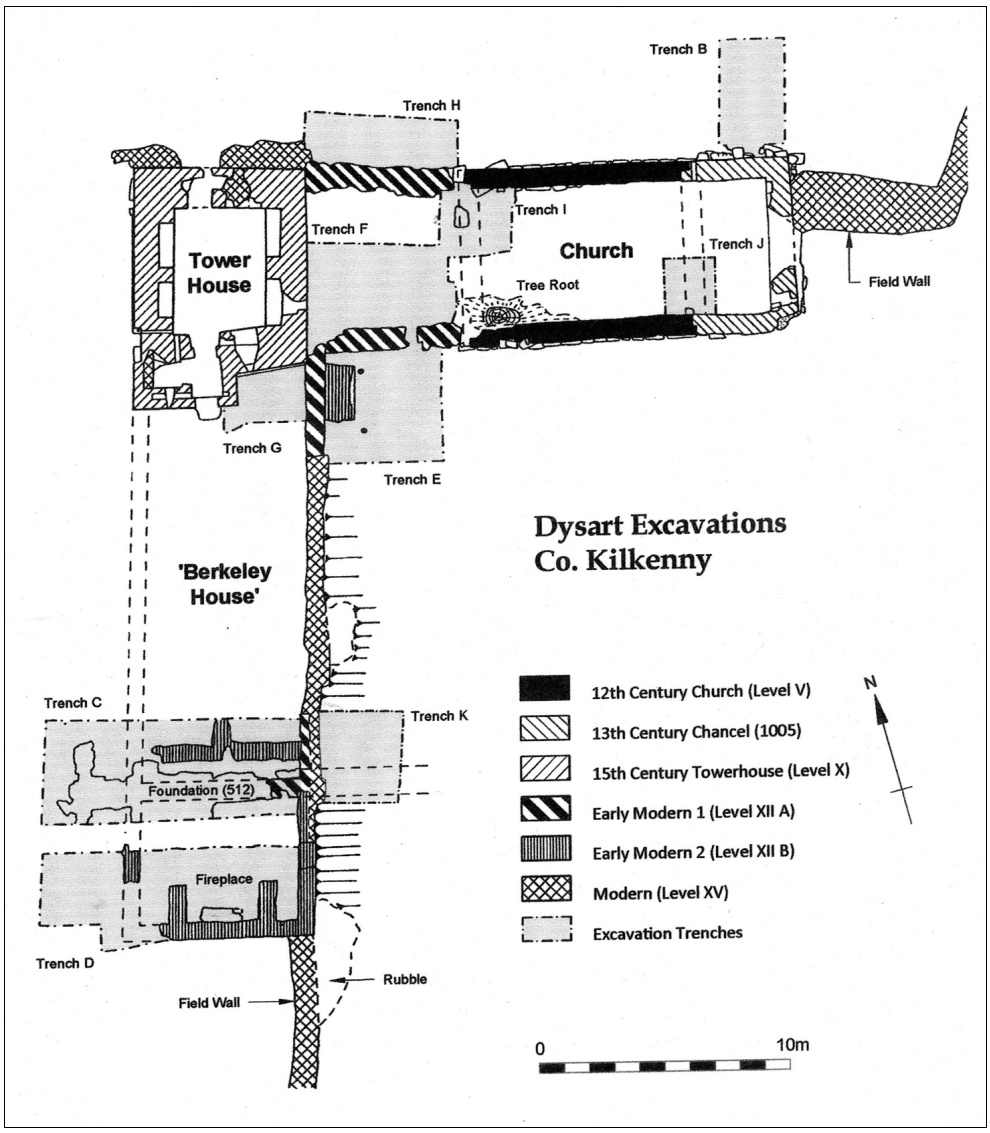

Fig. S.22 Dysart, Co. Kilkenny. Site plan (Courtesy of Ben Murtagh)

From Trench D came 995g of potential smelting slag, 383g of smithing hearth cakes, 174g of unclassifiable slag and 602g of smithing pan. All the smithing pan, and various other slag fragments, were recovered from the fill of probable hearth (C.557),

suggesting that this was a smithing hearth (See Fig. 8.6c). This feature was stratigraphically earlier than the construction of the nearby tower house in the early to mid-fifteenth century. It measured 1.1 by 0.44m and was c. 0.2m deep. In the middle of its northern edge a large flat stone was embedded, partially overlying the fills. The stone was sub-circular (0.49 by 0.39m), was fractured in the middle and likely functioned as a stone anvil. The same feature also contained three pieces of heavily heat-affected clay covered in a thin slag film (See Fig. 8.11b). Two of these showed teardrop-shaped sections (50mm long axis, 35mm short axis) and mushroom-cap-shaped termini. One of these pieces had a small portion of smithing pan adhering to it. An associated layer (C.556) contained a small amount of copper-working residue, while the layer overlaying this activity (C.550B) had more slag, both potentially smithing and smelting. Further trenches revealed small amounts of both possible smelting slag and copper-alloy material.

Most of the slag from Dysart has a more or less convincing drippy structure resulting from the solidification of fluid slag. This is normally seen as the result of smelting, that is to say 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, however, are very likely the result of smelting, with the rest only potentially so. No impressions of organic material (wood) were observed in this slag. Some of these pieces with flow-structure show patches of greenish vitrification, which suggests direct contact with oxygen. This is rarely seen on smelting slag from traditional slag-pit furnaces, but is common on smithing slag and can be expected when smelting slag leaves the furnace either laterally or below the hearth in an oxygen-rich environment. This site represents, next to likely iron smelting, *in situ* smithing activities with indications of associated copper-working dated to the late twelfth to fourteenth centuries.

Context	Type	Date	Description	Weight (g)
504	Topsoil	Modern	Light, very shiny slag. Smelting?	5
504	Topsoil	Modern	Piece of heavily weathered and oxidized drippy slag. Possibly smelting	14
507	Disturbed grave soil	Medieval	Two tiny pieces of drippy slag	2
514	Disturbed grave soil	Medieval	Five small pieces of weathered rather light slag, some drippy. Possible smelting slag	20
515	Disturbed grave soil	Medieval	Two small pieces of rather light slag, one very drippy. Possible smelting	8

522	Disturbed grave soil	Medieval	Five small pieces of slag, the largest is drippy. Potentially smelting	6
523	Disturbed grave soil	Medieval	Four small pieces of drippy slag. Potentially smelting	16
550B	Soil layer	Late medieval	Three lumps of slag, of which two are fractured, likely smithing hearth cakes	383
550B	Soil layer	Late medieval	Three lumps of rather dense slag, two fractured, with flow-pattern. Possible smelting slag	387
550B	Soil layer	Late medieval	Lump of weathered dense flowed slag with impression of large charcoal particle. Probably smelting slag	267
556	Occupation layer	Anglo-Norman	Small lump of copper-alloy containing material	2
575	Redeposited late medieval soil	Post-medieval	Three heavily weathered lumps of slag. Two showing flow-structure. Possible smelting	208
587	Fill of smithing hearth C.557	Anglo-Norman	Two irregular lumps of rather dense slag	174
587	Fill of smithing hearth C.557	Anglo-Norman	Multiple fragments of smithing-pan	602
587	Fill of smithing hearth C.557	Anglo-Norman	Three pieces of vitrified “clay-plugs”	61
587	Fill of smithing hearth C.557	Anglo-Norman	Three pieces of flowed slag. One example is very fresh and has slight vitrification on the upper surface	17
706	Fill of TH pit	c. E19th C	Flat, squarish lump of dense slag. The upper surface has greenish vitrification at one edge	251
706	Fill of TH pit	c. E19th C	Flat piece of heavily oxidized slag	20
706	Fill of TH pit	c. E19th C	Small drippy piece of rather light slag. Could be smelting	18
710	Grave fill	c. L12th/13th C	Two small slag fragments	4
710	Grave fill	c. L12th/13th C	Flat, light shiny black slag with clear flow-structure, likely smelting	6
714	Layer	c. 12th/13th C	Roundish lump of heavily weathered rather dense slag	198
714	Layer	c. 12th/13th C	Five small pieces and fragments of slag	19
714	Layer	c. 12th/13th C	Three pieces of rather dense drippy slag. Possibly smelting	95
714	Layer	c. 12th/13th C	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	16
717	Fill of TH pit	c. E19th C	Four pieces of weathered, rather dense slag. The largest piece is very likely smelting slag	179
718	Layer	c. L12th/13th C	Two small pieces of heavily weathered drippy slag. Possible smelting	17
721	Fill of TH pit	c. E19th C	Three heavily weathered lumps of slag	132
721	Fill of TH pit	c. E19th C	Bun-shaped lump of rather dense slag. Smithing hearth cake. Could be two smaller smithing hearth cakes fused together	396

721	Fill of TH pit	c. E19th C	Elongated drippy piece of slag. Possibly smelting slag	49
727	Fill of TH pit	c. E19th C	Small piece of weathered potentially drippy slag	13
813a	Foundation layer	c. L17th C	Two rounded lumps of copper-alloy	24
813a	Foundation layer	c. L17th C	Piece of heat affected clay. A smooth hollow surface on one side could indicate this is tuyere material	11
818	Fill of TH pit	c. E19th C	Two thin pieces of copper-alloy	1
818	Fill of TH pit	c. E19th C	Three lumps of copper-alloy	18
829	Fill of TH pit	c. E19th C	Fragment of iron working slag with flow-structure and heavy glazing	86
833	Fire layer	c. 14th C	Concretion of oxidized iron and charcoal fragments, no hammerscale	21
834	Fill of TH pit	c. E19th C	Squarish, rather dense piece of weathered ironworking slag. The upper surface has flow-structure. Possibly smelting slag.	254
1058	Fill of TH pit	c. E19th C	Concave piece of rather dense, oxidized slag. The lower surface shows flow-structure, no vitrification. Possible smelting slag.	409
1060	Fill of TH pit	c. E19th C	Small piece of somewhat drippy slag with charcoal impressions	2
1061	Fill of TH pit	c. E19th C	Broadly semi-circular lump of copper-alloy material	83
1061	Fill of TH pit	c. E19th C	Tubular piece of copper alloy	45
1061	Fill of TH pit	c. E19th C	Two pieces of light drippy slag with highly shiny black patches. Smelting?	28
1062	Fill of TH pit	c. E19th C	Small piece of probable copper slag	2
1063	Fill of TH pit	c. E19th C	Small flat droplet of copper alloy	7
1066	Fill of TH pit	c. E19th C	Clearly drippy, but heavily weathered piece of light slag	7
1101	Layer	c. L17th C	Five small pieces of copper-alloy containing material, one piece has charcoal inclusions	5
1107	Layer	Late medieval	Flat piece of copper-alloy material	29
1107	Layer	Late medieval	Elongated drippy piece of slag. Possibly smelting slag	33
1125	?	c. L17th C	Thick, flattish lump of copper-alloy	15
1125B	?	c. L17th C	Rather dense lump of slag in two fragments. Shows flow-structure and has greenish vitrification	148
1135	Grave fill	c. L12th/13th C	Irregular, rather dense piece of slag with frequent charcoal impressions	53
1213	Layer	Anglo-Norman	Tiny piece of copper-alloy material	1
?	Small oval pit	Anglo-Norman	Small shiny drippy piece of slag	2
Total				4869

Table S.21 Description of the material related to metalworking from Dysart, Co. Kilkenny (TH pit = treasure hunting pit)

Farranastack, Co. Kerry

Site no. 61

Townland: Farranastack
Civil Parish: Lisselton
Coordinates (ITM): E493104, N641221
SMR: KE005:098

Excavation licence: 03E0171
Director: Marion Dowd
(Eachtra Archaeological Projects Ltd.)
Excavated in 2003

Site summary:

Ironworking activity: Smelting		Significance: Medium	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: C14		Sample size: 1276g	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Farranastack, Co. Kerry, six pieces of slag were found in a shallow feature (Dowd and Fairburn 2005). This feature was over 1.6m long, continued under the edge of excavation and measured 1.54m wide and 0.12m deep. Two pieces of slag, weighing 36 and 42g, were classified as undiagnostic. Two other pieces, weighing 44 and 248g, were described as tap slag, while the last two, weighing 412 and 494g, were classed as furnace slag (ibid.: 116). The latter was interpreted as probably formed at the bottom of a furnace. Oak charcoal from twigs and roots from the fill of the pit was dated by radiocarbon analysis to AD 1027–1252 (2σ) or AD 1045–1094 (35.2%) and 1120–1141 (14.6%) and 1147–1214 (50.1%) (1σ). The assemblage was interpreted as originating from a shaft furnace, which would have been situated outside the excavated area. From the description above, the residues would seem very likely to have originated from iron smelting, but could have originated either in a shaft furnace or a slag-pit furnace. The deposition of the material cannot be more closely dated than to the eleventh to early thirteenth centuries.

Ferrycarrig Castle, Co. Wexford

Site no. 62

Townland: Newtown
Civil Parish: Carrick
Coordinates (ITM): E701270, N623165
SMR: WX037:028(02)

Director: Claire Cotter
Excavated between June and July 1987

Site summary:

Ironworking activity: Smithing?		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: c. 2kg	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Ironworking residues were recovered during excavations at Ferrycarrig Castle, Co. Wexford, an Anglo-Norman ring-work castle (Cotter 1992). Two kilograms of material, first identified as slag, was recovered from several features, but later analysis concluded that only a small part of this material constituted slag (ibid.: 44). The residues were found together with late medieval pottery.

Galway, Courthouse Lane

Site no. 63

Townland: Galway city
Civil Parish: Galway City
Coordinates (ITM): E529711, N725025

Excavation licence: 97E0082
Director: Dominic Delaney
Excavated between 1997 and 1999

Site summary:

Ironworking activity: Smithing			Significance: High		
Site deposition condition: Primary			Investigation level: Urban		
Ironworking features: Hearths, anvil					
Dating evidence: Pottery, architectural			Sample size: Unknown		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale	✓	Other ceramic	Iron artefacts	✓

Description

At the site of Courthouse Lane (now Druid Lane), less than 50 metres from the location of the quays of medieval Galway, extensive remains of ironworking were uncovered inside a late medieval building (Delaney 2004).[151] The building, measuring more than 14m by just under 10m, consisted of buttressed long walls, each with a doorway, and a row of three central columns (ibid.: 168). Documentary evidence could suggest that the hall was un-roofed by AD 1333, but punch-dressing on the columns indicated a fourteenth- to fifteenth-century date, implying that they replaced earlier roof supports (ibid.: 168, 177).

The ironworking inside the hall was carried out in at least two phases. The first phase was evidenced by two pits, C.347 and C.348, measuring respectively 0.7 by 0.6 by 0.05m and 0.8 by 0.55 by 0.05m, which were located in the area of the central column. The first of these included iron filings (presumably hammerscale) and occasional slag inclusions, while the second had a slag deposit at its upper western edge. These two pits were covered by a 0.2 to 0.4m thick deposit (C.116) of black silty clay containing frequent slag and charcoal. One piece of this slag was described as a concave mass (102 by 79 by 28 mm) with a bubbly surface and interpreted as a possible furnace bottom (Scully 2004: 492). This layer also yielded a stirrup and two horseshoes. Two

151 The information in the publications is supplemented with context descriptions provided by the site director, Dominic Delaney.

further pits were seen as related to the same phase and activity (Delaney 2004: 170–171), but their context descriptions give no evidence for ironworking.

The most impressive feature associated with the second phase of ironworking was a large cruciform anvil-setting (Fig. S.23 and see Fig. 8.8). The head and arms of this anvil were of broadly equal dimensions (0.9 by 0.55m), while the shaft was longer (1.75m) (Delaney 2004: 174), giving a total length of 4.2m. A pit, C.112, which was cut into C.116 and located south of the central column, measured 1.2 by 0.95m and was 0.18 to 0.38m deep. It contained significant quantities of slag. Another smaller pit, C.113, measuring 0.65 by 0.55 by 0.3m and also later than C.116, was located east of the same column and held a heavy concentration of slag. These pits, and most of the hall interior, were covered by a subsequent deposit, C.50, consisting of similar material, again with frequent slag and several nails. Two pieces of this slag which are described as bubbled and two sherds of Late Saintonge Ware, were respectively dated to the mid-sixteenth to late seventeenth centuries and to the sixteenth century (Scully 2004: 493; Meenan 2004: 387, 391).

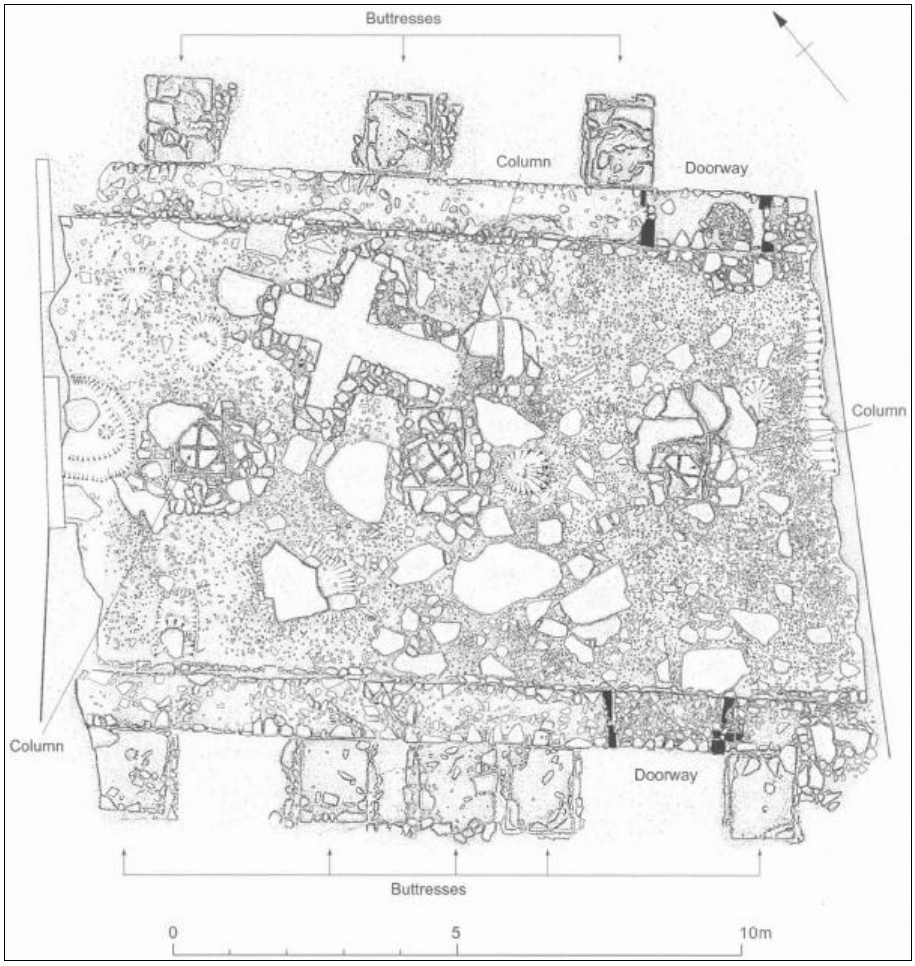

Fig. S.23 Galway, Courthouse Lane. Plan of Phase 2 (Delaney 2004: 169)

A roughly circular setting (0.8 by 0.7m) of stones and cobbles near the north-western wall of the hall was associated with substantial quantities of iron filings (likely hammerscale) (Delaney 2004: 173). A collapsed stone structure, overlaying a wall foundation (0.9m long by 0.3m wide and 0.45m high), was located near the south door of the hall (ibid.: 174). This wall foundation was heavily stained by iron and a fine powder of iron filings was present among the stones. Next to it was a deposit with further iron filings and slag. More features containing slag were present on the site (Scully 2004: 492), for which no further data was available.

The site represents a complex iron-smithing setting, with activity in the late sixteenth century and earlier. The significance and possible function of the anvil has been elaborated upon in the relevant chapter (8.2.2). The collapsed stone structure in the south of the hall is potentially the remains of a waist-high forge, but is probably too far removed from the anvil to have been used together. Either one or more of the floor-level hearths or another, completely removed, waist-high forge were used in conjunction with the anvil.

Garadice 11, Co. Meath

Site no. 64

Townland: Garadice
Civil Parish: Gallow
Coordinates (ITM): E685840, N744743

Excavation licence: 07E0295
Director: Ellinor Larsson (CRDS)
Excavated between April and May 2007

Site summary:

Ironworking activity: Smithing			Significance: Low	
Site deposition condition: Secondary			Investigation level: Partial excavation	
Ironworking features: None				
Dating evidence: C14, pottery			Sample size: Unknown	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts ✓

Description

Excavation of Site 11 at Garadice, Co. Meath uncovered various features dated to the late medieval period (Larsson 2009). The features consisted of two large pits, interpreted as water-pits, fed by various channels, a possible structure, scattered pits and many undiagnostic features, making a full interpretation of the site difficult (ibid.: 94). Considerable amounts of slag were recovered from one of the water-pits (17.65l[152] from 6 fills) and the channels feeding it (29.15l from 9 features) in the southern part of the excavation (ibid.: 89, 129–134).

Two ditches close to the same water-pit also contained substantial volumes of slag, that is to say 18.55l from 4 fills and 17l from 3 fills, respectively (ibid.: 90, 129–134). Most other features in the vicinity also contained slag, that is to say six pits (14.70l in total), four gullies (15.05l) and two furrows (5.35l). The other water-pit, located in the north-west of the excavated area, contained substantially less slag (2.25l from two fills and 3.50l from one of its channels). Slag was recovered from three further

152 There is no weight information available for the slag, the amounts are given in litres which refer to the contents of the bags in which they are kept.

pits (7.85l in total) and one gully (2.50l) in the northern section. In the north-western corner of the site a pit contained a further 4.5l of slag, 3l of which were recovered from its top fill and described as the base of possible hearth measuring 0.5m diameter (ibid.: 37, 202). Close-by, three spreads of material revealed another 3.75l of slag (ibid.: 38, 129–134). Over 1000 sherds of pottery were recovered from the site, 98.33% of which were late medieval in date, consisting of Leinster Cooking Ware, Dublin-type Ware, Dublin-type Fineware and Trim-type Ware (McCutcheon 2009c).

Five radiocarbon dates were retrieved from material from the site. A fragment of *Pomoideae* charcoal from a lens in the basal fill of the water-pit with the least amount of slag returned a date of AD 1269–1317 (62.8%) and 1353–1390 (37.2%) (2σ) or AD 1278–1301 (68.2%) and 1367–1382 (31.7%) (1σ), while a fragment of the same species from the basal fill of the other pit returned a Bronze-Age date (Larsson 2009: 78, 216). A date on a wheat grain from a stratigraphically early pit, which contained slag, gave AD 1279–1325 (46.8%) and 1344–1394 (53.2%) (2σ) or AD 1287–1309 (44.8%) and 1361–1386 (55.2%) (1σ). Similar analysis on bread/club wheat from the potential structure returned a date of AD 1285–1331 (41.6%) and 1338–1397 (58.3%) (2σ) or AD 1295–1317 (38.5%) and 1354–1389 (61.5%) (1σ), while hazel from a hearth feature/fire pit probably unconnected with metallurgical activity gave AD 1280–1327 (45.4%) and 1342–1395 (54.6%) (2σ) or AD 1288–1311 (43.8%) and 1359–1387 (56.2%) (1σ).

The site seems to represent a dump area for metallurgical residues rather than a production area, although the hearth base at the top of the pit associated with several spreads containing slag could be related to ironworking. The radiocarbon dates are very consistent and cover two periods, that is to say late thirteenth to early fourteenth and mid- to late fourteenth centuries. Although the earlier date range was suggested based on the pottery (McCutcheon 2009c: 248), the acceptance of later dates for the types found means that both periods are likely.

Garraun, Co. Tipperary

Site no. 65

Townland: Garraun
Civil Parish: Kilnarath
Coordinates (ITM): E574661, N669820

Excavation licence: E2494
Director: Patricia Long
(Headland Archaeology (Ireland) Ltd.)
Excavated between Dec. 2006 and Jan. 2007

Site summary:

Ironworking activity: Smelting			Significance: High		
Site deposition condition: Primary			Investigation level: Complete excavation		
Ironworking features: Furnace					
Dating evidence: C14			Sample size: 2865g		
Material present:	Slag	✓	Tuyeres		Tools
	Hammerscale		Other ceramic	✓	Iron artefacts

Description

Further features related to ironworking were unearthed during excavations at Site 1 Garraun, Co. Tipperary (Long 2009). A sub-circular pit (C.2025), measuring 0.47 by 0.39 by 0.11m, had a single fill containing slag inclusions (ibid.: 12). The cut of this feature is described as having gradual breaks of slope, concave sides and an uneven base. The debris was identified as general furnace material (2865g), including pieces with flow-structure, slag spheres, one furnace base and furnace-lining fragments (Cosham 2009a: 71). Eighty fragments of charcoal from the fill of this feature were identified as predominantly oak (74 frag.), hazel/alder (4 frag.), alder and willow (1 frag. each) (Gannon 2009: 69). The oak consisted mainly of large pieces of slow-grown wood (ibid.: 67).

Six metres to the north of the latter, and separated by a small stream, a deposit (C.2019) of metalworking waste was uncovered, measuring 5 by 4.5 metres and containing frequent charcoal and metalworking waste inclusions (Long 2009: 12). The

amount of material was substantial (31239g) and included several furnace bases, pieces showing flow-structure, probable bog ore fragments (1170g) and furnace-lining (Cosham 2009a: 71–72). Slag spheres, measuring between 2 and 4 mm were also present and were interpreted as probable spheroidal hammerscale, implying primary smithing activities. Bloom smithing, however, would be expected to lead to the production of at least some flake hammerscale, and it is possible that the material found represents slag spheres or fines connected to smelting. Radiocarbon analysis of a fragment of hazel charcoal from this deposit returned a date of AD 1216–1278 (2σ) or AD 1225–1234 (22.3%) and 1237–1249 (29.7%) and 1251–1268 (48.0%) (1σ) (Long 2009: 77).

Nearby, two features, measuring 1.33 by 0.95 by 0.17m and 0.58 by 0.46 by 0.08m, were interpreted as smithing hearths, although they contained no slag, except two pieces of fuel-ash slag in the latter (ibid.12–13), which is not necessarily connected to metalworking. Although separated by a stream, which could have been absent when the ironworking was taking place, the pit and the deposit are probably contemporary. The shape of the pit, however, seems somewhat irregular for a basal pit of a slag-pit furnace and could represent a tapping-pit in front of an otherwise destroyed furnace. This would also conform with the furnace bases reported from the deposit. The ironworking activity would have taken place around the mid-thirteenth century.

Garryleagh, Co. Cork

Site no. 66

Townland: Garryleagh
Civil Parish: Garryleagh
Coordinates (ITM): E584520, N614301

Excavation licence: E2433
Director: Simon Ó Faolain
(Eachtra Archaeological Projects Ltd.)
Excavated in 2007

Site summary:

Ironworking activity: Smithing			Significance: High		
Site deposition condition: Primary			Investigation level: Complete excavation		
Ironworking features: Hearth					
Dating evidence: C14			Sample size: 18.2kg		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale	✓	Other ceramic		Iron artefacts

Description

Excavations at Garryleagh, Co. Cork revealed an isolated smithing hearth, a short ditch section and various minor features (Ó Faolain 2011). The circular hearth measured 0.9 by 0.87 by 0.15m, had concave sides and four fills (ibid.: 31) (Fig. S.24 and see Fig. 8.6d). The basal fill contained 21 pieces of amorphous slag (350g), 18 pieces showing flow-structure (266g), 6 fragments of glassy slag (46g), a concretion of slag and hammerscale (38g) and 23 sherds of vitrified tuyere (Young 2011a: 47). The layer above produced nine pieces of blebby slag (58g), 4 pieces of lining slag (44g), a piece of hammerscale accretion (6g) and two tuyere sherds.

The stratigraphically next layer contained three pieces of dense flow-slag (30g), two undiagnostic pieces (8g) and a lining-influenced fragment (4g). The uppermost fill yielded 15 amorphous pieces of slag (74g), a piece of dense slag with flow-structure (52g), two lining slag fragments (16g) and a piece of tuyere. The short section of ditch, located about ten metres away from the hearth, had three fills (Ó Faolain 2011: 29–30).

This ditch contained just under 17kg of slag, mostly from its basal fill and much less so from the middle fill, and was considered contemporary with the hearth (Young 2011a: 37). This included 25 reconstructable smithing hearth cakes, multiple tuyere fragments, three of which allow a tentative calculation of original diameter and various other fragments, including several contorted and twisted pieces (ibid.: 42–47). No iron artefact are recorded. Radiocarbon analysis on hazel/alder charcoal from the upper fill of the smithing hearth resulted in a date of AD 1283–1318 (45.9%) and 1352–1390 (54.1%) (2σ) or AD 1289–1306 (43.1%) and 1363–1385 (56.9%) (1σ) (Ó Faolain 2011: 19). No information was available on other wood species. The smithing activity at Garryleagh took place in the fourteenth century.

Fig. S.24 Garryleagh, Co. Cork. Post-excavation photograph of smithing hearth C.13 (Ó Faolain 2011:13)

Glendalough, Co. Wicklow

Site no. 67

Townland: Brockagh
Civil Parish: Derrylossary
Coordinates (ITM): E712537, N696912
SMR: WI023:012

Excavation licence: E178
Director: Conleth Manning (National Parks and Monuments)
Excavated in 1979

Site summary:

Ironworking activity: Smithing?

Significance: Medium

Site deposition condition: Primary

Investigation level: Partial excavation

Ironworking features: Hearths

Dating evidence: Pottery

Sample size: Unknown

Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

Excavations carried out about 120m east of the monastic settlement at Glendalough, Co. Wicklow revealed remnants of late medieval ironworking (Manning 1983). These consisted of a thick charcoal-rich layer containing slag which covered and filled three pits (ibid.: 344). They measured respectively 0.8 by 0.6 by 0.22m, 0.88 by 0.48 by 0.1m and 0.6m in diameter by 0.1m deep (ibid: 344–346). The slag-rich material contained sherds of medieval pottery described as crude cooking ware and green-glazed thirteenth-century pottery. Although the information is too scant to conclude positively that the above features are smithing hearths, this would nevertheless seem likely. The activity can only be dated to the late medieval period.

Greencastle, Co. Donegal

Site no. 68

Townland: Eleven Ballyboes
Civil Parish: Moville Lower
Coordinates (ITM): E665391, N940390
SMR: DG022:003

Excavation licence: 96E0051
Director: Ruairi Ó Baoill
Excavated between April and May 1996

Site summary:

Ironworking activity: Smithing?

Significance: Low

Site deposition condition: Secondary

Investigation level: Partial excavation

Ironworking features: None

Dating evidence: Pottery

Sample size: Unknown

Material present:			
Slag	✓ Tuyeres	Tools
Hammerscale	Other ceramic	Iron artefacts

Description

Excavations of a ditch section at Greencastle, Co. Donegal revealed ironworking residues (Ó Baoill and Halpin 1997). Slag was found in this ditch together with pottery dated to the thirteenth to fourteenth centuries, while the castle was built in the early fourteenth century.

Greencastle, Co. Down

Site no. 69

Townland: Greencastle
Civil Parish: Kilkeel
Coordinates (ITM): E724603, N811869
SMR: DOW057:003

Excavation licence: various
Director: various
Excavated between 1971 and 2001

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Secondary			Investigation level: Partial excavation		
Ironworking features: None					
Dating evidence: Pottery			Sample size: Unknown		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

Early excavations of several cuttings in the interior of Greencastle, Castle revealed limited amounts of ironworking remains (Waterman and Collins 1952). The bedrock forming the base of the interior of the north-eastern tower was covered by a layer of mortar, on top of which a layer with a considerable amount of iron slag was deposited (ibid.: 92–93). The construction of the castle is dated to around the middle of the thirteenth century (ibid.: 96).

Subsequent excavation of the defensive ditch on the eastern side of the castle revealed further ironworking residues (Lynn 1971). A quarry, sealed by the bank of the ditch, was backfilled with substantial amounts of slag and other material, including thirteenth-century pottery. This was, probably correctly, interpreted as connected to the construction of the castle. More recently, an area excavated in front of the same castle revealed a succession of structures with associated metalworking debris (Ó Baoill 2007). Two partially exposed circular structures, represented by postholes and slots, belonged to Phase 1, were dated to the thirteenth century based on coin and pottery finds and seen as connected to work undertaken on the castle gate (ibid.: 14–16). A

small fragment of possible brazing shroud was unearthed from pit C.166, while more of this material, a smithing hearth cake, hearth-lining and more undiagnostic slag (717g in total) were recovered from an occupation-level (context 30/117/128/138) associated with the structures (ibid.: 14–15; Young 2010e: 9).

A further 125g of metalworking waste, comprising vitrified lining and undiagnostic slag, was retrieved from various deposits (C.11, C.58, C.59, C.68 and C.69) belonging to Phase 2, interpreted as build up after abandonment of the previous phase (Ó Baoill 2007: 17–18; Young 2010e: 9). Phase 3 was represented by a stone-built structure dated by pottery and a coin to the fourteenth century (Ó Baoill 2007: 21–22). Various layers inside the building (contexts 36 to 39 and 43) contained 554g of metalworking waste, including a smithing hearth cake, vitrified lining and undiagnostic slag (ibid.; Young 2010e: 9).

Unlocalized contexts 145 (irregular cut) and 169 (deposit) yielded respectively 20g of undiagnostic slag and a crucible fragment (Ó Baoill 2007: 21–22, 36–37; Young 2010e: 9). Although no *in situ* evidence for metalworking was uncovered, this site did possibly produce rare evidence for brazing of iron artefacts. Ten nails, eleven knives and seven other objects, dated to between the thirteenth and sixteenth centuries from the earlier excavations at Greencastle, were metallographically examined and chemically analysed as part of Brian Scott's doctoral thesis (Scott 1976: 261–266) (Table S.22). The same results were subsequently published (Scott and Lynn 1976).

	C	P	Al	Mn	Ni	Ti	Cu
1	0	0.004	0.005	0	0.02	0.002	0.01
2	0.05–0.6	0.004	0.4	0.004	0.02	tr.	0.008
3	0.1–0.89	0.004	0.4	0.005	0.01	0.011	0.02
4	0	0.093	0.4	0	0.02	tr.	0.02
5	0.05–0.7	0.003	0.01	0.017	-	tr.	0.003
6	0–0.89	0.14	0.007	0	0.009	0.01	0.005
7	0.05–0.1	0.003	0.01	0	0.01	0.011	0.004
8	0.05–0.89	0.006	-	tr.	0.008	0.008	0.01
9	0.05–089	tr.	0.01	0.031	0.01	0.003	0.05
10	0.05–0.2	0.004	-	0.042	-	tr.	-
11	0.6–0.8	0.003	0.004	tr.	0.005	tr.	0.003
12	0	0.004	0.01	0.003	0.005	0.008	0.003
13	0	0.103	0	0	0.02	tr.	0.1
14	0.05–0.8	0.007	0.01	0.007	0.01	tr.	0.03
15	0.05–1	0.066	0.03	tr.	-	tr.	0.017

16	0.05–1	0.003	-	0.007	0.007	0.026	0.002
17	0	0.063	0.008	0.007	0.01	0.01	0.05
18	0.4–0.6	0.007	0.01	0.005	0.03	0.006	0.5
19	0–0.6	0.012	0.03	0.036	0.008	0.008	0.008
20	0.05–0.1	tr.	0.01	0.007	0.02	tr.	0.17
21	0–0.89	0.27	0.003	0.007	0.007	tr.	0.007
22	0.05–0.89	0.003	0.007	tr.	0.01	tr.	0.3
23	0.05–0.15	tr.	0.01	tr.	0.006	tr.	0.02
24	0.05–0.89	tr.	0	0.021	0.003	0.003	0.008
25	0–0.89	-	-	-	-	-	-
26	0–0.89	-	-	-	-	-	-
27	0–0.89	0.19	0.02	tr.	0.01	0.04	0.002
28	0	0.004	0.02	0.003	0.05	0.003	0.006

Table S.22 Analyses results for iron objects from Greencastle, Co. Down (Scott 1977: 261–266)

1 Nail. Ferrite, slag-rich (GC/1)
2 Nail. Ferrite/pearlite, highly uneven carburization, grain deformation in head (GC/2)
3 Nail. Ferrite/pearlite, pronounced carbon banding, ferrite deformation at head/shank junction (GC/3a)
4 Nail. Ferrite, nitride precipitation and P segmentation on shank (GC/4)
5 Nail. Ferrite/pearlite, highly variable grain size and C content, much slag (GC/5)
6 Nail. Ferrite/pearlite, Strong C banding, also P bands, variable grain size, slag-rich (GC/6)
7 Nail. Ferrite/pearlite, even grains and C distribution (GC/7)
8 Nail. Ferrite/pearlite, heavy distortion in head (GC/8)
9 Large spike. Ferrite/pearlite, needle-like ferrite, pearlite started to spheroidise (GC/9)
10 Nail shank? Ferrite/pearlite, even C distribution, pearlite started to spheroidise (GC/10)
11 Bar. Ferrite/pearlite, fairly even C distribution (GC/UD/1)
12 Bar. Ferrite, much slag (GC/UD/2)
13 Sheet iron. Ferrite, high phosphorus (GC/E2)
14 U-shaped bar. Ferrite/pearlite, very uneven C distribution, fairly slag-rich (GC/31)
15 Ornate key. Ferrite/pearlite, two areas: high P, pure Fe and low P, low C (GC/67/40)
16 Hooked bar. Ferrite/pearlite, uneven P distribution, pearlite spheroidising (GC/UD/6)
17 Fiddle key nail. Ferrite, even grains, much slag (GC/f5)
18 Knife. Ferrite/pearlite/sorbite, central area with sorbite, Widmanstätten on side plate (GC/3b)
19 Knife. Ferrite/martensite, edge-welded, back: pure ferrite, edge: quenched high-C steel (GC/13)
20 Large knife. Ferrite/pearlite, very low and uneven C, welded (GC/14)
21 Knife blade. Ferrite/martensite, edge-welded, back: pure ferrite, edge: quenched high-C steel (GC/39a)
22 Knife. Ferrite/martensite/troostite, edge and back welded, central: pure Fe, edges: high C steel (GC/39b)
23 Knife. Ferrite/pearlite, quenched, even C distribution, slag-rich (GC/57/42)
24 Knife. Ferrite/pearlite/martensite/troostite, piled structure with high C edge, latter quenched (GC/E44/67)
25 Knife. Ferrite/martensite, edge-welded, back: pure Fe, edge: high C steel, quenched (GC/70)
26 Knife. Ferrite/pearlite/martensite, edge-welded, back: ferrite, edge: high C steel, quenched (GC/UD/3)
27 Ornate knife. Ferrite/pearlite/martensite, edge- and pattern? welded, back: 3 layers of high P iron, edge: uneven high C steel, quenched, some areas unhardened, much slag (GC/X)
28 Large knife/sword. Ferrite, pure Fe, much slag, fairly even grains (GC/Y)

Hallahoise, Co. Kildare

Site no. 70

Townland: Hallahoise
Civil Parish: Killelan
Coordinates (ITM): E676294, N685717

Excavation licence: E2949
Director: Lisa Doyle (Headland Archaeology (Ireland) Ltd.)
Excavated between July and August 2007

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Partial excavation		
Ironworking features: None?					
Dating evidence: C14, pottery			Sample size: 4871g		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

A multi-period site, with at least two phases of ironworking, was excavated at Hallahoise, Co. Kildare (Doyle 2010). A group of postholes, stakeholes and associated features at the centre of the site were interpreted as a possible structure (ibid.: 11–15). One of the postholes (C.121) contained three slag fragments (4g) of undiagnostic nature (Doyle 2010: 14; Cosham 2010b: 420). A gully (C.079) near this concentration of postholes contained a mammal vertebra radiocarbon dated to broadly the tenth century AD (Doyle 2010: 11–12). A pit (C.081) closer to the posthole concentration included three sherds of Leinster Cooking Ware (McCutcheon 2010a: 395). Further south, a large square pit (C.095), measuring 4.5 by 4.4 by 0.44m, contained six fills and was originally interpreted as a smithing hearth (ibid.: 18).

Visual analysis of the residues concluded that only small amounts of undiagnostic slag were present in two of the layers (27 and 32g respectively) (Cosham 2010b: 421, 424). Radiocarbon analysis of a fragment of hazel charcoal from the first of

these fills returned a date of AD 1025–1225 (99.5%) and 1235–1236 (0.2%) and 1249–1250 (0.2%) (2σ) or AD 1046–1091 (36.5%) and 1121–1140 (14.8%) and 1148–1210 (48.7%) (1σ) (Doyle 2010: 376). To the immediate north and north-east of this feature a cluster of pits was uncovered, three of which contained slag. One oval pit (C.113), measuring 0.78 by 0.6 by 0.2m, yielded 637g of metalworking residues, including a probable base of a smithing hearth cake, possible vitrified ceramic material and undiagnostic pieces (Doyle 2010: 18; Cosham 2010b: 423).

The two other pits (C.127 and C.157) revealed minor amounts of undiagnostic slag (respectively 6 and 4g) (ibid.: 420, 421). Another nearby pit (C.162) returned a radiocarbon date on an undetermined grain of AD 1484–1685 (72.6%) and 1732–1807 (21.7%) (2σ) or AD 1521–1575 (32.6%) and 1583–1590 (2.8%) and 1625–1673 (43.1%) and 1778–1799 (16.7%) (1σ) (Doyle 2010: 26–27). Two other pits (C.117 and C.134) forming part of this cluster contained late medieval local pottery (Leinster Cooking Ware and Dublin-type Ware) (McCutcheon 2010a: 395). Further west a second cluster of pits, in three of which metallurgical waste was found. An oval pit (C.29), measuring 1 by 0.55 by 0.23m, had two fills, each containing two small fragments of undiagnostic slag (16 and 45g in total) (Doyle 2010: 15; Cosham 2010b: 419). The fill with the larger amount also included charred bread wheat grains which returned a radiocarbon date of AD 1024–1215 (2σ) or AD 1040–1110 (59.3%) and 1115–1164 (40.7%) (1σ) (Doyle 2010: 376).

A nearby pit (C.031), measuring 0.8 by 0.58 by 0.17m, held two likely fragments of smithing hearth cakes (Doyle 2010: 16; Cosham 2010b: 419). The remaining pit (C.035) of this cluster, with an irregular linear cut, yielded small amounts of undiagnostic slag (11g) (Doyle 2010: 17; Cosham 2010b: 419). A complex series of ditches were constructed on the site, representing at least three phases. One of the fills (C.321/328) of an irregular curvilinear ditch (C.104), described as an upper fill, contained a near-complete small smithing hearth cake (310g), while another (C.329/354), a middle fill, had a piece of slagged vitrified ceramic material (Doyle 2010: 9–10, 123; Cosham 2010b: 423). A piece of mammal vertebra from the basal fill (C.008) of this ditch returned a late eighth- to ninth-century radiocarbon date (Doyle 2010: 376), while another upper fill (C.150) held three sherds of Leinster Cooking Ware (McCutcheon 2010a: 395), suggesting that the ditch was in use over a long period of time.

Another ditch (C.366), at broadly right angles to the latter and re-cut by a

townland boundary ditch, contained a likely smithing hearth cake and an amorphous lump of slag (312g in total) (Doyle 2010: 24; Cosham 2010b: 422). A fill of another ditch (C.004), forming a rectangular enclosure around the southern pit cluster, yielded part of a likely smithing hearth cake (209g) (Doyle 2010: 22–23; Cosham 2010b: 423). This, and various other fills of the same ditch, revealed many sherds of late medieval local pottery (Leinster Cooking Ware, Dublin-type Wares) (McCutcheon 2010a: 395). In summary we have:

- No ironworking residues dating to the early medieval period were recovered. A posthole with small amounts of slag is located near a gully with an early medieval radiocarbon date, but closer to a pit with late medieval pottery. The basal fill of the curvilinear ditch gave an early medieval carbon date, but the metalworking waste, from a middle layer and one of the upper layers, is probably contemporary with the late medieval pottery from another upper layer.
- Ironworking dating to the eleventh to twelfth centuries is established in two features, one in the southern pit cluster, the other in the cluster to its west.
- Contexts which contained both ironworking residues and late medieval pottery are the curvilinear ditch and the rectangular ditch, enclosing the southern pit cluster. Two pits within this cluster also had similar pottery, while another returned a broadly sixteenth century radiocarbon date and three others again had ironworking residues.

A secure chronology for this site is not possible because of the many phases of activity. The one radiocarbon date within the research period could be contemporary with the features containing the local pottery, which would then date to the sixteenth century. No smithing hearths were positively identified for the latter period, but several of the pits could have functioned as such.

Inch Abbey, Co. Down

Site no. 71

Townland: Inch
Civil Parish: Inch
Coordinates (ITM): E747688, N845596
SMR: DOW037:005

Dir.: Declan Hurl (Dept. of the Environment)

Site summary:

Ironworking activity: Smithing?		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations to the north of Inch Abbey, Co. Down uncovered structural gullies, charcoal spreads and slag, dated by pottery and a silver coin to the thirteenth century (Nenk et al. 1994: 267). No further information on this site was found.

Jerpoint Abbey, Co. Kilkenny

Site no. 72

Townland: Jerpointabbey
Civil Parish: Jerpointabbey
Coordinates (ITM): E657178, N640301
SMR: KK028:062

Excavation licence: 04E1512ext.
Director: Patrick Neary
Excavated in 2005

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Primary			Investigation level: Partial excavation		
Ironworking features: Hearth					
Dating evidence: Pottery			Sample size: 1712g		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic		Iron artefacts

Description

A small scale excavation inside the chapter house of Jerpoint Abbey, Co. Kilkenny revealed a limited amount of metalworking debris (Neary 2010a). This material was the subject of visual evaluation as part of the current research (Table S.23). Only a small amount of the material (40g) examined was retrieved from early contexts, that is to say a probable fragment of a smithing hearth cake and a small undiagnostic piece from pit (C.32). This pit measured 1.36 by 1.02m and is described as related to metalworking. Several pits (C.17, C.34 and C.39) and a deposit (C.31) are recorded as related to metalworking and large amounts of slag are mentioned at the base of walls (C.13 and C.27). No metallurgical samples were seen from these features and it seems likely that only part of the material was available for study. A further 1740g of material was recovered from modern rubble layers (C.1 to C.5) and a treasure-hunting pit (C.24). This material was remarkably homogeneous and included smithing hearth cakes (Fig. S.25) and multiple pieces of vitrified ceramic material, one of which showed a slightly

curved outer surface with adhering slag, very likely a tuyere fragment. Two small copper blobs were also retrieved. The metalworking contexts were stratigraphically contemporary with vaults being built in the chapter house in the fourteenth or fifteenth centuries, but while it is likely that the residues examined are related to this event, this remains unsure.

Fig. S.25 Jerpoint Abbey, Co. Kilkenny. Smithing hearth cake

Cut	Fill	Type	Description	Weight (g)
NA	NA	Spoil	Possible fragment of small smithing hearth cake, with charcoal impressions at the base and rusty patches throughout	48
NA	NA	Spoil	Two pieces of black shiny vitreous material, one a complete “drip”	34
NA	NA	Spoil	Two small pieces of probable oxidized iron	1
NA	NA	Spoil	Three fragments of reddish black shiny vitreous material, one containing a flat piece of vitrified stone-like material	24
NA	NA	Spoil	Rather dense probable fragment of a smithing hearth cake, charcoal impressions on the base and relatively smooth upper surface	146
NA	NA	Spoil	Fragment of shiny black vitreous slag with an inclusion of vitrified stone fragment	9
NA	NA	Spoil	Large fragment of dense slag. Heavily rusted upper part and grey tongue shaped lower part protruding on one side	111
NA	NA	Spoil	Piece of relatively dense iron-rich slag with some protruding shiny black lobes	70
NA	NA	Spoil	Two pieces of probable iron	15
NA	1	Deposit	Fragment of relatively dense slag. Dark grey lobes on the upper surface, shiny black vitreous material on the base	25
NA	2	Deposit	Two relatively dense smithing hearth cakes, one with a shiny black upper	209

			surface	
NA	2	Deposit	Three fragments of reddish to black shiny vitreous material, one containing a flat piece of vitrified stone-like material	40
NA	2	Deposit	Four fragments of ceramic material. All have homogeneous orange to red clay without inclusions and are vitrified on the outside. One piece has some unvitrified outer area surviving	39
NA	2	Deposit	Two small fragmets of brown iron-rich slag	5
NA	2	Deposit	Small fragment of brown dull slag with flow structure	5
NA	2	Deposit	Nine fragments of relatively dense grey-brown slag with occasional rusty patches. Some pieces possible fragments of smithing hearth cakes	230
NA	2	Deposit	Twelve fragments of reddish, black shiny, sometimes metallic, vitreous material	127
NA	2	Deposit	Seven pieces of ceramic material, all with adhering vitreous slag. Some pieces consist of oxidized (orange) clay, others of reduced (grey) clay, with one piece showing both (oxidized on the inside). The clay is homogeneous with very occasional inclusions of angular quartz	220
NA	3	Deposit	Five fragments of iron-rich slag, some with straw-like impressions	31
NA	4	Deposit	Two pieces of reddish black shiny vitreous material	38
NA	4	Deposit	Several fragments of copperoxides	8
NA	4	Deposit	Piece of relatively dense slag with impressions of organic material (charcoal?, but also longer straw-like ones)	21
NA	4	Deposit	Small piece of homogeneous orange clay without inclusions, with vitrified outer side	2
NA	5	Deposit	A fragment of reddish black lobed vitreous slag	20
NA	5	Deposit	Four pieces of vitreous material with shiny reddish, black and somewhat metallic patches on the surface	122
NA	5	Deposit	Lobed piece of black, shiny vitreous material	13
NA	7	Deposit	Elongated piece of iron rich slag, rusty on the base	22
24	24	Pit	Two pieces of relatively dense slag, together forming one lobe, brownish black on the upper surface and grey on the base	10
24	24	Pit	Two fragments of relatively dense slag, both with dull brown to black upper surfaces and shiny black, more vitreous bases	27
32	32	Pit	Fragment of rusty iron-rich slag, probable part of an smithing hearth cake	38
32	32	Pit	Small piece of vitreous material	2
Total				1712

Table S.23 Description of the material related to metalworking from Jerpoint Abbey, Co. Kilkenny

Johnstown 1, Co. Meath

Site no. 73

Townland: Johnstown
Civil Parish: Rathcore
Coordinates (ITM): E676805, N740460
SMR: ME048:031

Excavation licence: 02E0462
Director: Linda Clarke (ACS)
Excavated between April and October 2002

Site summary:

Ironworking activity: Smelting?, smithing			Significance: Medium		
Site deposition condition: Primary?			Investigation level: Complete excavation		
Ironworking features: None					
Dating evidence: C14, pottery			Sample size: > 200 kg		
Material present:	Slag	✓	Tuyeres	Tools	✓
	Hammerscale		Other ceramic ✓	Iron artefacts	✓

Description

At Johnstown 1, Co. Meath a large multi-period site yielded about two tons of slag (Clarke 2008). Extensive ironworking took place inside a sub-circular enclosure during the early medieval period, with well over 200kg of slag recovered from one of the ditch phases (C.4) (ibid. vol. 1: 10). Inside the enclosure and located towards the western corner was an area of burials dating from the early to late medieval period, with a concentration in the thirteenth and fourteenth centuries for the later period, but no structures were found (ibid.: 38–106, 273).

The most recent enclosure ditch (C.124), more sub-rectangular and so only partially covering the latter enclosure, contained just under 300kg of slag (ibid.: 16). The finds from the same ditch included a square-sectioned possible awl or punch (ibid.: 11, 238). Most of the metalworking waste was recovered from its western corner and consisted mainly of cake-shaped pieces and vitrified ceramic material (Photos-Jones 2008d: 243). A piece of slag from this feature, described as unusual, was chemically analysed (Table S.24). Radiocarbon analysis of a piece of bone from a burial (C.269) at

the base of this ditch in the same corner, returned a date of AD 1039–1277 (2σ) or AD 1055–1076 (11.8%) and 1154–1265 (88.2%) (1σ) (Clarke 2008 vol. 1: 13; vol. 7: 144). A sample of animal bone from the same ditch returned a date of AD 1446–1661 (2σ) or AD 1492–1602 (82.0%) and 1612–1637 AD (18.0%) (1σ) (ibid. vol. 1: 13; vol. 7: 145).[153] A sherd of fourteenth- to fifteenth-century pottery[154] and three sherds of North Leinster Cooking Ware were also recovered from the same ditch (ibid. vol. 1: 13).

Further to the north, a pit (C.553) cut into the base of this ditch yielded a further 16.75kg of slag (ibid. vol. 1: 116). This slag consisted mostly of porous material, dense slag and plano-convex smithing hearth cakes (Photos-Jones 2008d: 245). A fragment of unspecified charcoal from this pit was radiocarbon dated to AD 1045–1095 (8.9%) and 1119–1141 (3.2%) and 1147–1288 (87.8%) (2σ) or AD 1177–1270 (1σ) (Clarke 2008 vol. 7: 152). Near the latter pit, on the inside of the enclosure, an elongated linear feature (C.278) contained a further 4.2kg of slag together with a sherd of North Leinster Cooking Ware (ibid. vol. 1: 137). This material contained two pieces of vitrified ceramic material (Photos-Jones 2008d: 241).[155]

To the west, a shorter linear feature (C.808), located amidst several burials, contained 5.71kg of slag (not examined), a sherd of North Leinster Cooking Ware and a square-sectioned iron tool, possibly a chisel or awl (Clarke 2008: 140, 238). Several other features, dispersed within the enclosure, contained more ironworking residues. Two sherds of North Leinster Cooking Ware and one piece of slag (50g) were recovered from isolated pit (C.5), located in the east of the enclosure (ibid.: 118–119), while 400g of metallurgical residues were found together with a piece of the same type of pottery in a linear feature with adjacent pit (C.123/C.348) further north (ibid. vol. 1: 135). The material consisted entirely of vitrified ceramic material (Photos-Jones 2008d).

At the northern corner of the enclosure, an irregular pit (C.194) contained 7.75kg of slag and one sherd of North Leinster Cooking Ware (Clarke 2008 vol. 1: 120). This material included dense and porous pieces as well as two slag cakes (Photos-Jones 2008d: 243). Near the southern "corner", a deposit (C.17/550) contained 6.55kg of slag and a sherd of possible Souterrain Ware. A sample of alder and *Prunus* charcoal returned a radiocarbon date of AD 1297–1466 (2σ) or AD 1323–1347 (25.3%) and 1392–1443 (74.7%) (1σ) (Clarke 2008 vol. 1: 292; vol. 7: 143).[156] A nearby small hearth

153 The excavation report contains no information on fills of the different features.

154 The type of pottery is not specified and the report does not contain a specialist report on the pottery.

155 The two pieces are the material mentioned and unless these are exceptionally heavy pieces, not all the material was seen by the specialist.

156 In the specialist report, this material is described as three pieces of dense and porous slag (Photos-Jones 2008d: 250), which likely does not represent the full assemblage.

(C.55) measuring 0.66 by 0.5 by 0.16m contained no metallurgical residues. There are surprisingly few features near the concentration of ironworking debris in the western corner.

A hearth (C.1035) measuring 1.7 by 0.8 by 0.12m and a circular pit (C.1036) measuring 0.92m diameter and 0.2m deep, containing respectively 200 and 1150g of slag, could be related to the late medieval smithing activities, but they are also close to a layer with large amounts of slag (over 400kg), which was dated to the early medieval period (ibid. vol. 1: 118, 129, 131). It is possible that the ironworking activity producing the late medieval slag concentration was actually carried out in the ditch itself, as was the case at the site of Lisanisk in Co. Monaghan (Coughlan 2011), and was not recognized as such during excavation. If this was the case, then the later fifteenth- and/or sixteenth-century dates could apply to this activity.

The frequent occurrence of slag cakes in the assemblages would imply that the main, if not the sole, activity on the site during late medieval times was iron smithing. The high manganese content of the one piece of slag analysed, on the other hand, could point towards smelting. However, slag inclusions inside a knife from the same site showed even more elevated manganese contents (average 27.37%) (Photos-Jones 2008e: 264). The knife, which showed no signs of being welded, was found in a linear feature containing slag, but which had no dating information (ibid.; Clarke 2008: 241). The use of manganese-rich sand in the welding of an early medieval sax has been convincingly argued (Joosten et al. 1996). The occurrence, however, of very high levels of that same metal in slag inclusions in the Johnstown knife, which was not welded, suggests other uses for manganese-rich material in smithing.

The chronology of this ironworking activity is difficult to establish, partly because of the lack of stratigraphic information regarding the main assemblage of material in ditch C.124, but the span of dates would indicate activity spread out over the whole of the late medieval period if not continuous. Burials would appear to have taken place at the same time as the ironworking.

Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
n.d.	0.49	3.59	35.34	4.08	2.19	5.47	n.d.	9.13	35.99

Table S.24 Results of chemical analyses of slag from Johnstown, Co. Meath (Photos-Jones 2008d: 224, 227)

Unusual piece. Johnstown 1, Co. Meath, SASAA JONS5 [SEM-EDAX, area analysis].

Kells, Church Street, Co. Meath

Site no. 74

Townland: Townparks
Civil Parish: Kells
Coordinates (ITM): E674000, N775873
SMR: ME017:044

Excavation licence: 10E0405
Director: Fintan Walsh
(Irish Archaeological Consultancy)
Excavated in September 2010

Site summary:

Ironworking activity: Smithing

Significance: Low

Site deposition condition: Secondary

Investigation level: Urban

Ironworking features: None

Dating evidence: Pottery

Sample size: Unknown

Material present:			
Slag	✓ Tuyeres	Tools
Hammerscale	Other ceramic	Iron artefacts

Description

Excavation of two test trenches in Church Street, Kells, Co. Meath, close to the medieval center of that place, revealed evidence for late medieval metalworking (Walsh and Bailey 2013). Large lumps of slag were found together with sherds of medieval pottery, animal bone and antler fragments.

Kells Priory, Co. Kilkenny

Site no. 75

Townland: Rathduff
Civil Parish: Kells
Coordinates (ITM): E649752, N643318
SMR: KK027:030

Excavation licence: 96E0092
Dir.: Thomas Fanning (University College Galway) and Myriam Clyne (Office of Public Works)
Excavated between 1972 and 1996

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Complete excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

During extensive excavations at the Augustinian Kells Priory, Co. Kilkenny only limited evidence of ironworking was uncovered (Clyne 2007). On top of a cobbled surface next to one of the priory towers, a "substantial iron slag deposit (C44), a furnace bottom, relating to smelting" was found (ibid.: 111). Charcoal and roofing slates were found together with the slag, while iron fragments and food waste were retrieved nearby. No dating evidence was available, but the later fourteenth century was tentatively proposed as a minimum date. It is unclear from the above if the furnace bottom refers to a feature (hearth?) in or around which the deposit was found, or if it is related to the shape of the slag discovered.

Kilcoe Castle, Co. Cork

Site no. 76

Townland: Kilcoe
Civil Parish: Kilcoe
Coordinates (ITM): E501878, N532898
SMR: CO140:032(01)

Excavation licence: 98E0133
Director: Eamonn Cotter
Excavated after March 1998

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Partial excavation		
Ironworking features: None					
Dating evidence: Pottery, stratigraphy			Sample size: 390g		
Material present:	Slag	✓	Tuyeres		Tools
	Hammerscale		Other ceramic	✓	Iron artefacts

Description

A small amount of ironworking waste was found during excavations at Kilcoe Castle, Co. Cork (Cotter 2011, 2012). This material was visually examined as part of this doctoral research (Table S.25). All the material (390g) was found inside a pit with a connected channel (C02), which was found inside, and going under the walls of a stone building adjacent to a late medieval tower house (Cotter 2011: 8). None of the above features are directly datable but a nearby stakehole yielded a sherd of North Devon Temper Free Ware (Cotter 2012: 15).

Other stratified finds on the site were sixteenth to seventeenth centuries (ibid.: 19). The slag consisted of a tongue-shaped smithing hearth cake (Fig. S.26), a possible fragment of the same and a small drip of slag. Also three pieces (one of which was broken in two) of vitrified ceramic material were recovered (Fig. S.27). The occurrence of quartz-tempering suggests that these are likely tuyere fragments.

Fig. S.26 Kilcoe Castle, Co. Cork. Smithing hearth cake

Fig. S.267Kilcoe Castle, Co. Cork. Tuyere fragment

Context	Type	Description	Weight (g)
C.02	Pit with channel	Elongated, “tongue-shaped” smithing hearth cake, upper surface is mid grey and shows slight flow-structure, underside is mid-grey with patches of oxydization, no fractures except at the back of the piece where several small fragments of stone are embedded	256
C.02	Pit with channel	Roughly rectangular shaped piece with a frature on one side. Could be the end part of an elongated smithing hearth cake	62
C.02	Pit with channel	Low density slag drip without fractures	10
C.02	Pit with channel	Vitrified tuyere fragment broken in two fragments. The grey to light pink clay contains frequent angular stone inclusions, predominantly (exclusively?) quartz. The entire piece is covered with a dull grey-black crust of slag	37
C.02	Pit with channel	Vitrified tuyere fragment consistong of orange fired clay with frequent angular quartz fragments and a crust of dull grey slag. The slag is protruding slightly away from the ceramic body	23
C.02	Pit with channel	Small piece of vitrified tuyere material. The ceramic body is yellowy pink with a few angular quartz inclusions, the vitrification dull brownish grey	2
Total			390

Table S.25 Description of the material related to metalworking from Kilcoe Castle, Co. Cork

Kilcolman Castle, Co. Cork

Site no. 77

Townland: Kilcolman Middle
Civil Parish: Doneraile
Coordinates (ITM): E557820, N611929
SMR: CO017:041(01)

Excavation licence: 94E0108
Director: Eric Klingelhöfer
(Mercer University, USA)
Excavated between July and August 1996

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Stratigraphy		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

A sump in a turret belonging to the bawn wall of Kilcolman Castle, Co. Cork included lumps of slag (Klingelhöfer 2005: 142). The fill of this sump was seen as the result of cleaning up after one of the various building episodes at the end of the sixteenth century.

Kilcoole, Co. Wicklow

Site no. 78

Townland: Kilcoole
Civil Parish: Kilcoole
Coordinates (ITM): E729687, N708083
SMR: WI013:029

Excavation licence: 98E0244
Dir.: Emmet Byrnes (Archaeological Development Services Ltd.)
Excavated in June 1998

Site summary:

Ironworking activity: Smithing		Significance: Medium	
Site deposition condition: Primary		Investigation level: Partial excavation	
Ironworking features: Hearth			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

A small-scale excavation at Kilcoole, Co. Wicklow revealed two features with metalworking waste (Byrnes 1998). One of the features was pear-shaped, measured 1.52 by 0.56 by 0.26m and had charcoal-rich basal layers (ibid.: 4). Next to fifteen pieces of slag it also contained a sherd of glazed medieval pottery. The other feature measuring 2.3 by 0.48 by 0.4m yielded two small pieces of slag (ibid.: 3). Only the first feature is a possible smithing hearth of unspecified late medieval date.

Kilferagh, Co. Kilkenny

Site no. 79

Townland: Kilferagh
Civil Parish: Kilferagh
Coordinates (ITM): E653417, N652049
SMR: KK023:024(03)

Director: Maurice Hurley (University College Cork)
Excavated in 1982

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations at Kilferagh, Co. Kilkenny revealed the remains of a corn-drying kiln with a nearby working area, ditches, part of a building tentatively interpreted as a barn and a possible stone house (Hurley 1987). An unspecified quantity ("several") fragments of slag were recovered, including from the backfill of the kiln and in the foundation trench of the barn (ibid.: 96). Two fragments described as "furnace bottoms" probably refer to smithing hearth cakes. None of the features excavated appear connected to metallurgical activity. The majority of the abundantly present pottery, including Saintong Ware and various local wares, was dated to the late thirteenth to early fourteenth centuries (ibid.: 93). This was seen as the date of occupation of the site and its abandonment was put shortly at after the mid-fourteenth century (ibid.: 97).

Kilkenny Castle

Site no. 80

Townland: Dukesmeadows
Civil Parish: St. Patrick's
Coordinates (ITM): E650776, N655730
SMR: KK019:026

Director: Ben Murtagh
Excavated between June 1992 and January 1993

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavation of twelve trenches inside Kilkenny Castle revealed late medieval ironworking residues from two of them (Murtagh s.d.). Sixteen pieces of slag were retrieved from cutting 3, some provisionally dated to the twelfth to thirteenth centuries, some to the thirteenth to fourteenth centuries and some broadly to the late medieval period (ibid.: 192). Additionally, over 230 pieces of slag were recovered from cutting 12, located in the courtyard of the castle and all generally dated to the late medieval period (ibid.: 196).

Kilkenny, 1 Irishtown

Site no. 81

Townland: St. Mary's
Civil Parish: St. Mary's
Coordinates (ITM): E650341, N656259
SMR: KK019:026

Excavation licence: 02E1592
Dir.: Ian Doyle (Margaret Gowan Ltd.)
Excavated between November 2002 and April 2003

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Stratigraphy		Sample size: Unknown	
Material present:	Slag	Tuyeres	✓ Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

During excavations at 1 Irishtown, in the south of the northern part of medieval Kilkenny, an unusual find related to ironworking was unearthed (Doyle 2004). A large fragment of a tuyere (See Fig. 8.10a) was recovered from a gravelly deposit built up around a post-and-wattle structure tentatively dated to the late twelfth century based on the lack of pottery (ibid.: 19, 20, 103). No slag was found on the site. The tuyere measured 149 mm, but was possibly originally larger. This tuyere was interpreted a disc tuyere, but the uneven nature of the back of the object suggests that this more probably represents the vitrified front of a larger cylindrical tuyere.

Kilkenny, The Parade

Site no. 82

Townland: Dukesmeadows
Civil Parish: St. Patrick's
Coordinates (ITM): E650767, N655692
SMR: KK019:026

Excavation licence: E3463
Director: Patrick Neary
Excavated between July and October 2007

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Secondary			Investigation level: Urban		
Ironworking features: None					
Dating evidence: Pottery			Sample size: 33.5kg		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

Extensive trenching in central Kilkenny, at the Parade and Canal Square/Walk, was accompanied with archaeological excavation which revealed substantial remains of late medieval metalworking (Neary 2010b).[157] The material was made available for visual analysis as part of this research (Table S.26). In total, just over 33.5kg of material was found *in situ*, the vast majority at the Parade. The material from the latter area was divided chronologically, based on the available evidence from pottery determinations[158], and plotted per weight.

The residues show three concentrations: one between AD 1200 and 1400 (13.7kg), in the 1680s (11.5kg) and nineteenth- and twentieth-century material (3.7kg). The remaining residues were found distributed in smaller amounts over varying phases situated between these three main groups. Twelve complete smithing hearth cakes were

157 This preliminary excavation report was supplemented by an updated stratigraphic sequence supplied by the director of the site, P. Neary.
158 This analysis was preliminary at the time of writing.

found, nine of which were dated between AD 1200 and 1400. Only eleven pieces of vitrified ceramic material were included in the assemblage, none of which could be positively recognized as being tuyere material. Seven of these pieces belonged to the same early chronological phase. Surprisingly, this same AD 1200 to 1400 period held a large proportion of residues containing coal (See Fig. 8.13). Tiny fragments of the same type of fuel were also found embedded in one of the pieces of vitrified ceramic material. Small amounts of copper droplets and copper-containing slag were found distributed over all phases. The bulk of the material dated to the late medieval period was recovered from ditch fills, but the retrieval of ironworking debris from two postholes and a pit (C.147, C.156 and C.140) in the proximity (at Purcell's surgery, Parade Middle) potentially indicates *in situ* smithing nearby.

Context	Type	Date	Description	Weight (g)	Fuel
101	Pit	1200–1400	Small slag fragment	1	
12/94/107	Garden soil	1200–1400	Grey, light brown smithing hearth cake	437	coal
12/94/107	Garden soil	1200–1400	Grey, light brown, probable part of smithing hearth cake	418	coal
12/94/107	Garden soil	1200–1400	Full and partial small smithing hearth cake	206	
12/94/107	Garden soil	1200–1400	Piece of copper slag	28	
12/94/107	Garden soil	1200–1400	Piece of copper slag	25	
124/297/312/314/379/394	Surface	1200–1400	Slag fragment	23	coal
124/297/312/314/379/394	Surface	1200–1400	15 small pieces of grey and rusty slag	126	
124/297/312/314/379/394	Surface	1200–1400	Tiny piece of slag	4	
125/132	Surface	1200–1400	Dense, dark grey slag fragment	155	charcoal
125/132	Surface	1200–1400	Fragment of dark grey runny slag	30	charcoal
125/132	Surface	1200–1400	Dense grey slag piece	38	
135	Ditch	1200–1400	3 pieces of dense slag	191	charcoal
135	Ditch	1200–1400	Dense smithing hearth cake	563	coal
135	Ditch	1200–1400	Dense smitihng hearth cake	865	coal
135	Ditch	1200–1400	5 pieces of dense slag	271	coal
135	Ditch	1200–1400	Two lumps of dense grey slag	350	coal
135	Ditch	1200–1400	3 pieces of dense slag	146	coal/

					charcoal
135	Ditch	1200–1400	Large dense smithing hearth cake	1115	coal/ charcoal
135	Ditch	1200–1400	Large dense smithing hearth cake	669	coal/ charcoal
135	Ditch	1200–1400	Piece of slag with ceramic (tuyere or hearth lining) material, broken in two	74	
135	Ditch	1200–1400	7 lumps of dense rusty slag	217	
136	Ditch	1200–1400	3 pieces of dense rusty slag	697	coal
136	Ditch	1200–1400	3 pieces of dense rusty slag	390	
136	Ditch	1200–1400	Lump of dense rusty coloured slag	58	charcoal
136	Ditch	1200–1400	Piece of dense rusty slag	39	coal
136	Ditch	1200–1400	Lump of dense rusty coloured slag	313	coal/ charcoal
136	Ditch	1200–1400	4 pieces of dense rusty slag	119	
137	Ditch	1200–1400	Dense lump of slag with frequent stone inclusions	425	coal
137	Ditch	1200–1400	Dense lump of slag with sulphur in cavities	236	coal
137	Ditch	1200–1400	Fragment of dense dark grey slag with frequent cavities	216	coal
137	Ditch	1200–1400	7 fragments of dense slag	744	
137	Ditch	1200–1400	Small lump of slag	8	
140	Pit	1200–1400	Large lump of dense slag	761	coal
146	Ditch	1200–1400	Small fragment of slag lobes	9	
147	Posthole	1200–1400	Two lumps of dense grey slag	166	
151	Ditch	1200–1400	Piece of dark grey slag	78	coal
154	Pit	1200–1400	Small fragment of rusty slag	2	coal
156	Posthole	1200–1400	Four fragments of slag	244	coal
167	Ditch	1200–1400	Dense, dark grey slag fragment	114	coal
167	Ditch	1200–1400	12 pieces of rather dense rusty slag	951	coal
167	Ditch	1200–1400	Rusty rather dense smithing hearth cake with adhering tuyere/hearth lining material	430	coal
167	Ditch	1200–1400	4 pieces of vitrified clay material, hearth lining or tuyere, with tiny coal inclusions in the ceramic body	59	coal
167	Ditch	1200–1400	Piece of relatively light rusty slag	45	coal/ charcoal
167	Ditch	1200–1400	2 pieces of light fuel ash slag	16	
167	Ditch	1200–1400	2 pieces of vitrified clay material, most likely tuyere	11	
169	Ditch	1200–1400	3 pieces of dense rusty slag	364	coal
183/184	Ditch	1200–1400	Dense grey SHC with rusty exterior	386	charcoal
192	Layer	1200–1400	Lump of dense dark grey slag	218	coal
192	Layer	1200–1400	Small fragment of vitrified ceramic material, hearth lining or tuyere	11	
2//200	Layer	1200–1400	Two pieces of slag	54	coal

2//200	Layer	1200–1400	Smallish rusty smithing hearth cake	189	coal
2//200	Layer	1200–1400	Piece of light purpley grey slag	23	coal
2//200	Layer	1200–1400	Piece of dense grey slag	31	
496	Middle of road junction	1200–1400	Piece of dense grey slag	20	charcoal
496	Middle of road junction	1200–1400	3 small pieces of shiny black slag	19	charcoal
496	Middle of road junction	1200–1400	Two small pieces of slag	10	coal
496	Middle of road junction	1200–1400	Flat fragment of vitrified ceramic material, tuyere or hearth lining	18	
496	Middle of road junction	1200–1400	4 pieces of dense dark grey slag with lobe	80	
496	Middle of road junction	1200–1400	Multiple pieces of copper	7	
496	Middle of road junction	1200–1400	Multiple small fragments of slag	44	
496	Middle of road junction	1200–1400	Flat piece of vitrified ceramic material, tuyere or hearth lining, with drop of copper embedded in ceramic matrix	24	
496	Middle of road junction	1200–1400	3 small pieces of copper	1	
375	Ditch	1200–1650	Piece of dark grey, relatively dense slag	137	coal
61	Mansory	1223–1351	Small lump of slag	20	charcoal
452/461	Layer	1250–1650	Bag of small Cu droplets	46	
452/461	Layer	1250–1650	Small piece of copper slag	1	
519	Layer	1250–1650	Two parts of a large smithing hearth cake	870	charcoal
519	Layer	1250–1650	Piece of light slag	20	charcoal
534	Layer	1250–1650	Multiple small fragments of copper	2	
166/216	Ditch	1300–1650	Small fragment of rusty slag	11	coal
166/216	Ditch	1300–1650	Tiny piece of slag	2	
337	Pit	1300–1650	2 pieces of dense rusty slag	413	coal
501	Pit	1300–1650	Small piece of copper	1	
501	Pit	1300–1650	Multiple tiny fragments of slag	5	
501	Pit	1300–1650	Tiny piece of copper	1	
501	Pit	1300–1650	Two small pieces of copper slag	1	
286/408	Layer	1350–1749	Small piece of copper	1	
395	Ditch	1350–1749	Part of a relatively dense smithing hearth cake	92	charcoal

395	Ditch	1350–1749	Rather flat fragment of vitrified ceramic material, tuyere or hearth lining	23	
196	Pit	1400–1675	Two small pieces of slag	13	charcoal
232/301	Pit	1500–1680	Piece of copper dripping	3	
325	Pit	1500–1680	Small piece of dark grey slag	2	charcoal
56	Layer	1540–1900	Rusty brown slag piece with layer of fuel particles at the base	239	coal
56	Layer	1540–1900	Grey glassy slag	64	coal
56	Layer	1540–1900	Small piece of rusty slag	7	coal
56	Layer	1540–1900	5 small fragments of rusty slag material	52	
56	Layer	1540–1900	Light piece of fuel ash slag	32	
17	Masonry	1560–1680	3 dense rusty slag lumps	687	charcoal
17	Masonry	1560–1680	Dense rusty slag lump	386	coal
17	Masonry	1560–1680	Dense rusty slag with tuyere material	158	
17	Masonry	1560–1680	Rusty slag with blue glassy slag inclusions	154	
17	Masonry	1560–1680	7 lumps of dense rusty slag	1030	
23	Ditch	1560–1680	Tiny piece of frothy slag	2	coal
269	Ditch	1675–1680	Small piece of copper	1	
108	Layer	1680–1680	Black dense slag fragment with frequent cavities	53	coal
97/109	Surface	1680–1680	Small piece of slag	112	charcoal
97/109	Surface	1680–1680	22 lumps of dense rusty slag	1614	charcoal
97/109	Surface	1680–1680	4 dense, rusty slag pieces	289	coal
97/109	Surface	1680–1680	Small dense, iron-rich piece of slag	135	coal
97/109	Surface	1680–1680	2 lumps of dense grey slag	401	coal
97/109	Surface	1680–1680	Dense lump of rusty slag	223	coal
97/109	Surface	1680–1680	Lump of dense rusty slag	447	coal/ charcoal
97/109	Surface	1680–1680	10 pieces of dense rusty slag	215	
97/109	Surface	1680–1680	Small dense, iron-rich piece of slag	118	
97/109	Surface	1680–1680	Small dense, iron-rich piece of slag	43	
97/109	Surface	1680–1680	Small piece of slag	30	
97/109	Surface	1680–1680	13 pieces of dense grey to black slag	1862	
97/109	Surface	1680–1680	Small dense piece of slag with Cu staining and red patches on outer surface	15	
97/109	Surface	1680–1680	30 lumps of dense rusty slag	3600	
300/308/ 370/ 373/542	Surface	1682–1682	Piece of quartz-rich rock attached to slag	30	coal
300/308/ 370/ 373/542	Surface	1682–1682	Two pieces of lead	15	

15	Area of buning	1682–1770	5 pieces of light clinkery slag	65	
15	Area of buning	1682–1770	Two pieces of light glassy black slag	100	
25	Masonry	1682–1770	Lump of rusty slag with frequent cavities	66	
264	Layer	1682–1770	Rusty dense smithing hearth cake	288	coal
55/115/120/ 264/465	Layer	1682–1770	Probable corroded iron object	354	
141/190/ 321/ 398	Surface	1682–1830	Two lumps of rusty slag	88	coal
141/190/ 321/ 398	Surface	1682–1830	Piece of mid grey, light slag	28	
409	Layer	1683–1853	Fragment of dense dark grey slag	38	coal
138	Masonry	1700–1700	Small lump of dense grey to rusty slag	89	coal
486	Layer	1749–1830	Three small pieces of copper	1	
13	Area of burning	1749–1870	Crust of slag formed around an elongated round object	66	charcoal
13	Area of burning	1749–1870	Crust of slag formed around an elongated round object	13	coal
165	Layer	1749–1870	Dense, rusty lump of slag	193	coal
554	Pit	1749–1870	Bag of small Cu fragments	2	
555	Layer	1749–1870	Tiny piece of slag	1	charcoal
7/35/36/ 37	Drain	1749–1870	Small irregular shapes slag fragment with secondary sulphur growth	40	
145	Masonry	1749–1870	Lump of rusty slag with frequent fuel inclusions	154	coal
79	Layer	1760–1780	10 lumps of rusty slag	335	coal
88	Layer	1760–1780	Piece of light but solid light grey slag	100	
413	Layer	1801–1999	Lump of dense rusty slag	120	coal
1	Drain	1830–1914	Small slag fragment	4	charcoal
1	Drain	1830–1914	Kindey-shaped smithing hearth cake with sulphur	251	coal
1	Drain	1830–1914	4 lumps of rusty slag	123	coal
1	Drain	1830–1914	Piece of relatively light slag	97	coal
1	Drain	1830–1914	2 lumps of dense rusty slag	311	coal/ charcoal
1	Drain	1830–1914	Two small slag fragments	3	
1	Drain	1830–1914	Piece of light glassy dark grey slag	100	
1	Drain	1830–1914	Piece of light slag with blue blast furnace slag-like part	24	
1	Drain	1830–1914	Piece of rusty slag	52	
1//490	Drain	1830–1914	6 pieces of dense grey to rusty slag	181	

163	Drain	1830–1914	Piece of dense grey slag with flowing lobes	229	coal
163	Drain	1830–1914	2 small pieces of slag	27	coal
163	Drain	1830–1914	15 fragments of dark rusty slag of varying density	849	coal
163	Drain	1830–1914	Piece of copper slag	13	coal
163	Drain	1830–1914	2 pieces of dense grey slag	48	
163	Drain	1830–1914	Light slag run	12	
186/195	Surface	1830–1914	12 pieces of rusty slag	164	coal
186/195	Surface	1830–1914	11 lumps of rusty slag	625	coal
186/195	Surface	1830–1914	11 tiny pieces of slag	15	coal
186/195	Surface	1830–1914	10 pieces of rusty slag	305	
186/195	Surface	1830–1914	3 lumps of rusty slag	161	
188	Cable trench	1830–1914	Piece of vitrified clay material, tuyere or hearth lining	13	
424	Well	1850–1870	Small piece of slag	14	coal
Total				33022	

Table S.26 Description of the material related to metalworking from The Parade, Kilkenny

Kilkenny, 11 Patrick Street

Site no. 83

Townland: Gardens
Civil Parish: St. Patrick's
Coordinates (ITM): E650642, N655639
SMR: KK019:026

Excavation licence: 99E0757ext.
Director: Bruce Sutton
(Eachtra Archaeological Projects Ltd.)
Excavated between January and February 2005

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At 11 Patrick Street, multiple pits were uncovered, some of which contained late medieval material together with metalworking debris (Sutton and Johnston 2012). The pits containing slag, C.113, C.133, C.223, C.259 and C.380, were interpreted as rubbish pits and all contained Kilkenny-type Ware and Kilkenny-type Cooking Ware (ibid.: passim). C.113 also contained a crucible fragment, Ham Green B Ware and Green-Glazed Saintonge pottery (ibid.: 93). Pits C.133 and C.259 additionally had Leinster Cooking Ware and Kilkenny-type Coarseware, while the former also had Green-Glazed Saintonge Ware (ibid.: 95, 102–103). Pit C.223 further yielded Leinster Cooking Ware and possible Redcliffe Ware. This site represents slag, presumably smithing residues, together with a crucible fragment, dumped over several phases during the late medieval period.

Kilkenny, 27–33 Patrick Street

Site no. 84

Townland: St. Mary's
Civil Parish: St. Mary's
Coordinates (ITM): E650606, N655709
SMR: KK019:026

Excavation licence: various
Director: various
Excavated between March 1998 and 1999

Site summary:

Ironworking activity: Smithing			Significance: High		
Site deposition condition: Primary			Investigation level: Urban		
Ironworking features: Hearth					
Dating evidence: Pottery			Sample size: > 3541g		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

The large-scale excavations at 27 to 33 Patrick Street in Kilkenny were carried out in several phases and by two different companies. Between March and November 1998 five areas were excavated by Judith Carroll Ltd., four (areas 1 to 4) under licence number 97E0468 and a fifth (area 7) under licence number 98E0092. The results of these excavations are available in a report in the National Monuments Service (Carroll 2002). This report includes both a specialist report on the medieval pottery (McCutcheon 2002a, 2002b) and the post-medieval pottery (Meenan 2002).

The report on the medieval pottery gave the corresponding context for each piece of pottery, while the report on the post-medieval material only mentioned the context of several pieces in the accompanying text (none of these came from features containing metalworking residues). The plans included in the report did not include all context numbers, but several could additionally be located using the information in the context description, both using the measurements and/or related features. A few contexts

remain unlocalized. Between September and November another area, behind 33 Patrick Street, was excavated by the same company, this time under excavation licence 98E0402. A report for this excavation is also finalized (Carroll 1999b), this time without a specialist report on the pottery. Both features with slag could be located using the plans included.

The metalworking residues from these excavations were not preserved (pers. comm. Judith Carroll). In 1999, Eachtra Ltd. excavated part of area 7 (under licence 99E0165), area 6 (under licence number 97E0468 ext.) and a newly opened up area to the east of the 33 Patrick Street excavation (under licence number 98E0402 ext.). The report for the latter two of these excavations is not yet finished, but Jacinta Kiely of Eachtra Archaeological Projects Ltd. made available a preliminary report (mostly the context descriptions), a specialist report on the pottery (McCutcheon 2000), lists both of the finds (including slag) and the missing finds. No location information for the features was available, but the report did allow the features to be grouped in north (N) and south (S) of the excavated area. The metalworking residues from this excavation were visually analysed as part of this research (Table S.27). The area 7 excavation report was put online as part of the Eachtra Journal (Kiely 2012) and included a specialist report on the pottery (McCutcheon 2012a). All the spacial information from the above excavations was collated into an overview plan.

Unlocalized features

Several features had no information permitting closer localization. Stony layer C.564 containing slag and Kilkenny-type Ware was located above pit C.566 with fills C.559 and C.606 (Carroll 2002: 68; McCutcheon 2002b: 26). A fill, C.567, without cut information, contained some slag and medieval pottery (Kilkenny-type Ware, Kilkenny-type Cooking Ware, Saintonge Unglazed Ware). Another pit C.689 (fill C.688), partially covered by concrete, also had medieval pottery and slag (Kilkenny-type Ware, Leinster Cooking Ware) (Carroll 2002: 74–75; McCutcheon 2002b: 28). The fills of two cuts, C.665 and C.669 yielded medieval and modern material together with some slag, while shallow pit C.671 contained post-medieval pottery with slag (Carroll 2002: 73). All these features were located in area 1, and possibly, based on number sequence, in the southern part of that area.

A stone-lined pit C.716 held both medieval and post-medieval material together

with slag (ibid.: 76). A hearth, C.723, contained several layers, the basal one of which not only held slag, but also medieval pottery (Kilkenny-type Ware and Kilkenny-type Coarseware) (ibid.; McCutcheon 2002b: 29). Irregular cut C.799, partially outside of the excavation area, yielded post-medieval material as well as some slag (Carroll 2002: 79). Deposit C.910 consisted of what was interpreted as possible granulated slag (ibid.: 83). It was very loose and lay below C.909 and above a lower clay level C.931. Based on number sequence these features could belong to area 1N. Pit C.865 had both medieval pottery (Kilkenny-type Ware, Kilkenny-type Cooking Ware) and slag in its fill, and can probably be situated in area 1W based on number sequence (Carroll 2002: 81; McCutcheon 2002b: 31).

Area 1

Area 1 had the largest concentration of features containing metalworking residues. In the western part of area 1, three pits held slag. Pits C.867 and C.875 were rather shallow (2.4 by 1.2 by 0.3m and 2.1 by 1.4 by 0.2m respectively), while the larger pit C.927 was 0.7m deep at its western end (Carroll 2002: 82–84). All three had, next to slag, animal bone and medieval pottery in their fills. The pottery from the first pit is not recorded in the specialist report, the second contained Kilkenny-type Ware, Kilkenny-type Coarseware and Kilkenny-type Cooking Ware and the third yielded Kilkenny-type Ware, Kilkenny-type Cooking Ware and Saintonge Green Glazed pottery (McCutcheon 2002b: 31–32). Further east, three more pits with slag were uncovered. The largest of these, C.841, also yielded large amounts of charcoal, fired clay and ash (Carroll 2002: 80). It was not excavated deeper than 0.5m.

Also feature C.843, with oyster shells and animal bone, was deeper than the 0.65m depth excavated. Linear cut C.838 was 0.25m deep and contained fired clay, charcoal and animal bone. All three of these features had Kilkenny-type Ware, the latter two Kilkenny-type Cooking Ware in their fills, and pit C.838 also included Kilkenny-type Coarseware (McCutcheon 2002b: 31). A large concentration of features was situated about halfway along the eastern edge of the excavated area. At the centre of this concentration were two adjacent areas of burnt material containing ashy deposits (C.710/741 and C.714) with slag and medieval pottery (Kilkenny-type Ware, Kilkenny-type Coarseware and Kilkenny-type Cooking Ware) (Carroll 2002: 75–77; McCutcheon 2002b: 28). At its south-western end, the former covered a posthole (C.794) which also

held slag (Carroll 2002: 79). Further south another posthole (C.760) had slag and medieval pottery (Kilkenny-type Ware and Kilkenny-type Cooking Ware) inclusions (Carroll 1999a: 77; McCutcheon 2002b: 28).

Other post- and stakeholes occured in the area, but did not have metalworking residues. To the south-east of this a multi-layered pit (C.557) was uncovered, the upper fill of which yielded metalworking residues, bone, shell, iron and medieval pottery (Kilkenny-type Ware, Kilkenny-type Coarseware, Kilkenny-type Cooking Ware and Saintonge Green-Glazed) (Carroll 1999a: 68; McCutcheon 2002b: 26). Below this, the pit contained two layers of charcoal, while the base was interpreted as a "smelting pit". This contained round nodules of slag and three sherds of pottery not listed in the specialist report. Pit C.557 was circular and had a diameter of about 1.65m. To the north-west of the areas with burnt material were two very similar sized, stone-lined pits, C.717 and C.719 (the depths varied though, respectively 1.05 and 0.42m) (Carroll 1999a: 76). These both yielded bone, charcoal, medieval pottery (Kilkenny-type Ware, Kilkenny-type Coarseware, Kilkenny-type Cooking Ware and Leinster Cooking Ware) and slag (ibid.; McCutcheon 2002b: 28, 29). A third pit, C.713, unlined, contained nuggets of slag, this time the pottery consisting of Kilkenny-type Ware, Saintonge Green-Glazed Ware and one sherd of Ham Green B pottery (Carroll 1999a: 76; McCutcheon 2002b: 28).

Area of burning C.714 was cut by two adjacent pits (C.701 and C.707), the former having a mixture of medieval and post-medieval material, while the latter had only later material (Carroll 1999a: 75). At the western end of this concentration a large pit (C.771), which continued beyond the edge of excavation, contained charcoal, coal, bone, post-medieval pottery and small fragments of slag (ibid.: 78). South of the strip of unexcavated ground were more features with metalworking debris. North of, and parallel with the triple row of stakeholes, was linear feature C.405 with slag and a mixture of medieval material (Kilkenny-type Ware, Kilkenny-type Coarseware, Kilkenny-type Cooking Ware, Leinster Cooking Ware, medieval glass and tile fragments) (Carroll 1999a: 61; McCutcheon 2002b: 25). At the western end of this feature was pit C.603, which was stone-lined and nearly 2m deep (Carroll 1999a: 70). Its lower fill (C.679) contained bone, shell, slag and burnt material, next to medieval pottery (Kilkenny-type Ware, Kilkenny-type Coarseware, Kilkenny-type Cooking Ware, Saintonge Green-Glazed and Saintonge Green-Painted Ware) (ibid.; McCutcheon 2002b: 28).

Further west a smaller pit (C.687) yielded slag, burnt bone, shell and medieval pottery (Kilkenny-type Coarseware) (Carroll 1999a: 74; McCutcheon 2002b: 28). A large pit, C.385, south of the stakeholes contained post-medieval building material together with slag, but no pottery (Carroll 1999a: 60). To the east of this, a multi-layered, stone-lined linear pit (C.647) contained both medieval and post-medieval material, shell and slag (ibid.: 72). North of this, another pit (C.637) had exclusively post-medieval material. Finally, a pit (C.371) north of linear C.405 also yielded iron slag, oyster shell and bone, together with medieval (lower fill, Kilkenny-type Ware and Leinster Cooking Ware) and post-medieval (upper fill) ceramics (ibid.: 60; McCutcheon 2002b: 24).

Areas 2, 4 and 7

The south-western corner of the excavation, comprising areas 2, 4 and 7 had a more dispersed occurrence of features with metalworking debris. A long linear feature skirted the eastern and northern limits of excavation. Two of its fills, C.207 and C.308 (cut numbers C.209 and C.309), contained slag together with medieval pottery (Carroll 1999a: 53, 57; McCutcheon 2002b: 20, 23). Both held Kilkenny-type Ware, Kilkenny-type Coarseware and Kilkenny-type Cooking Ware, fill C.207 additionally had Kilkenny-type Fine Ware and Redcliffe Ware, while fill C.308 had Saintonge Green-Glazed Ware and Ham Green B Ware. A third fill (C.222), upper fill of possible re-cut (C.223) contained both medieval and post-medieval material together with slag (Carroll 1999a: 54). Close-by, possible drain C.219 held post-medieval building rubble and pottery, while pit C.267 had animal bone, shell, clay pipe and both medieval and post-medieval pottery (ibid.: 54, 55).

Pit C.304, at the junction between the N/S and E/W part of this linear, had steep sides and a flat bottom (0.62m deep) and held a mixture of medieval and post-medieval material (ibid.: 57). Another linear (C.129/261), towards the west, yielded slag, medieval ceramics (Kilkenny-type Ware and Kilkenny-type Coarseware) and iron nails (ibid.: 50, 55; McCutcheon 2002b: 18, 22). A large pit (C.127) west of this linear had large amounts of animal bone, slag and medieval pottery (Kilkenny-type Ware, Kilkenny-type Coarseware and Leinster Cooking Ware) (Carroll 1999a: 50; McCutcheon 2002b: 18).[159] Pit C.65, further east, had burning at its base and contained

159 The excavation report mentions one sherd found in this pit (fill 126), while the specialist report records five sherds found in it.

animal bone, shell, slag, coal and charcoal as well as medieval and post medieval pottery (Carroll 1999a: 47).

Pit 61, further east again, had burning at the edges and two large lumps of slag with medieval pottery (Kilkenny-type Ware and Kilkenny-type Coarseware) from its fill (ibid.; McCutcheon 2002b: 17). Further south, in area 7, two pits (C.142 and C.277) held animal bone, slag and medieval pottery (both had Kilkenny-type Ware, pit C.142 also Kilkenny-type Coarseware and Leinster Cooking Ware and pit C.277 Kilkenny-type Cooking Ware and possible Minety-type Ware) (Carroll 1999a: 34, 37; McCutcheon 2002a: 41, 44). During the next phase of excavation of area 7, under licence 99E0165, slag was only found in a single pit (C3) which contained plentiful butchery waste and medieval pottery (Kilkenny-type Ware, Kilkenny-type Cooking Ware, Leinster Cooking Ware and Saintonge Green Glazed Ware (Kiely 2012: 11; McCutcheon 2012a: 23).

Areas 3, 6, 98E0402 and 98E0402 ext.

In area 3, the north-western corner of excavation, three features containing metalworking residues were uncovered. Pit C.413 yielded large pieces of bone, post-medieval material and slag while shallow linear features C.556 and C.623 also had bone with small amounts of slag ("one piece" and "some small pieces" respectively) (Carroll 2002: 61, 68, 71). C.556 only had glass in its fill and C.623 had no datable material.

In area 6, slag was only found in possible drainage gully C.13, which had no datable material (Elder and Richardson 2001: 86).

The area excavated under licence number 98E0402 yielded slag from two substantial pits (C.37 and C.100). The former pit, which was stone-lined, was excavated up to 1.95m deep, the latter up to 0.5m. Both had unspecified medieval pottery, animal bone and slag (Carroll 1999b: 10, 19, 26–27).

In the area to the east of this, excavated under licence 98E0402ext., some thirteen contexts were found to include slag (Elder and Richardson 2001). This material was visually examined for this PhD research (Table S.27). In the southern half of the area a large wood-lined pit (C.336) had two layers containing slag (68g). The material

included smithing hearth cake fragments and a piece of possible crucible material. The former had coal inclusions in its matrix. Neither of these layers yielded pottery or other datable material, but another layer (C.105) of the same pit held Kilkenny-type Ware (Elder and Richardson 2001: 21–22; McCutcheon 2000b: 9). Another context, C.284, yielded leather, slag (676g) and Kilkenny-type Ware and Kilkenny-type Cooking Ware.[160] The metallurgical debris consisted of amorphous lumps of slag and three flatter pieces with a distinctive red coating.

In the northern half, three pits had medieval material next to slag. The first (C.84) was a funnel-shaped pit and contained Kilkenny-type Ware.[161] The second pit (C.272) was fairly substantial (2.7 by 1.22m and over 1.1m deep), interpreted as a soaking-pit, and contained amorphous slag, some with embedded coal fragments, and Kilkenny-type Ware (Elder and Richardson 2001: 65; McCutcheon 2000b: 9). The third pit (C.288) had a large weathered lump of slag (948g) and Kilkenny-type Ware sherds in its fill and was interpreted as a rubbish pit (Elder and Richardson 2001: 49; McCutcheon 2000b: 10). A further pit (C.50), measuring 1.06 by 0.98 by 0.41m, yielded, next to animal bone, charcoal and slag, also a fragment of Seville Coarse Ware (Elder and Richardson 2001: 51; McCutcheon 2000b: 46). One layer with slag, C.35, also had post-medieval pottery and another, 319, more a mixture of contexts, had both medieval and post-medieval material. Four contexts, a layer (C.161), a pit (C.183), a drainage feature later used as rubbish pit (C.328) and an unlocated context (C.173), had slag but no datable artefacts.

The western part of area 1, adjacent to Pudding Lane, has the largest concentration of features containing slag, which would indicate that metalworking was carried out nearby. The layers with burnt material, ash and slag would further suggest nearby *in situ* ironworking, and pit C.557 in Area 1 seems to have been used, at least initially, as a smithing hearth. At least one of the unlocated features, potentially located in area 1, is a hearth with slag in its basal fill. All the features with exclusively late medieval pottery are enclosed by a triple row of stakeholes on the south and by linear feature C.809 to the north. It is unclear if the latter feature was fully excavated, but no slag was recorded from it, while it contained only six sherds of pottery (Kilkenny-type Ware, Kilkenny-type Coarseware and Saintonge Green-Glazed Ware) (Carroll 2002: 79, 108, 128; McCutcheon 2002b: 30). Several internal post- and stakeholes are indicative of a

160 No further information was available about this context.
161 The slag from this context was missing.

structure inside these enclosing elements, but definite evidence is lacking. The dumping activity was extensive and potentially covered most of the late medieval period and probably beyond. Some other pits, such as C.867 and C.875 in area 1, or pit C.61 with burnt edges in area 2 could also have functioned as smithing hearths.

Cut	Fill	Type	Description	Weight (g)
13	8	Drain	Dense fragment of slag with impressions of charcoal in its matrix	61
50	46	Pit	2 lumps of slag with calcium-rich coating	169
NA	161	Pit	3 lumps of relatively dense slag	379
?	173	?	Small lump of slag with encrustation	43
183	149	Pit	2 small pieces of slag, one drippy	7
?	234	?	Flat piece of slag with purple-reddish coating	11
272	225	Pit	Irregular lump of rather dense slag	246
?	284	Pit	7 lumps of oxidized slag, one piece elongated rectangular	434
?	284	Pit	3 pieces of flat dense slag with distinctive reddish coating	239
?	284	Pit	Small bean-shaped droplet of slag	3
288	269	Pit	Large lump of dense slag, heavily encrusted	948
NA	319	Deposit	5 pieces of drippy, bubbly slag	93
328	318	Pit	10 lumps of rather dense slag, the larger ones are probably irregular smithing hearth cakes	840
336	70	Timber lined pit	Small piece of vitrified ceramic material, hearth lining or tuyere	4
336	70	Timber lined pit	Small lump of dense smithing hearth cake, with hammerscale embedded in the encrustation	64
Total				3541

Table S.27 Description of the material related to metalworking from Kilkenny, 33 Patrick Street

Kilkenny, Robing Room

Site no. 85

Townland: Gardens
Civil Parish: St. Canice
Coordinates (ITM): E650233, N656466
SMR: KK019:026

Excavation licence: 11E0157
Director: Cóilín Ó Drisceoil (Kilkenny Archaeology)
Excavated between June and July 2012

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Urban		
Ironworking features: None					
Dating evidence: Pottery			Sample size: 2420g		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic	✓	Iron artefacts

Description

To the north of Kilkenny Cathedral at the Robing Room, the former Bishop's residence, evidence for late medieval ironworking was found (Ó Drisceoil 2012). Visual examination was carried out on these residues and included in this thesis (Table S.28). About 1300g of metalworking debris were recovered from this site, most of it from various fills of a lime kiln chamber [103] dated by pottery to the late twelfth to thirteenth centuries (ibid.;Ó Drisceoil 2012: 43). The material consisted of smithing hearth cakes, fragments thereof, vitrified ceramic material, with one piece identifiable as tuyere material, and brick-like material with tubular hollows. The latter material is interpreted as unrelated to metalworking and possibly part of the air-supply system of the kiln. Examination of the residues of the sieving process revealed no hammerscale, indicating that the metalworking residues were highly probably produced elsewhere and dumped after the kiln went out of use.

Cut	Fill	Type	Description	Weight (g)
NA	1	Topsoil	Small irregular piece of vitrified ceramic material. Some rounded quartz-like inclusions	4
77	76	Garden feature	Piece of sandstone with strong vitrification on one side.	167
77	76	Garden feature	Small lump of vitrified slag	9
77	76	Garden feature	Rather dense piece of slag, probably part of small smithing hearth cake	13
77	76	Garden feature	Small lump of vitrified slag	19
77	76	Garden feature	Fragment of brick-like material	11
NA	86	Deposit	Roughly triangular smithing hearth cake with charcoal impressions. A specimen of globular hammerscale is embedded on the lower side	571
NA	86	Deposit	Small fragment of reddish vitrified ceramic material. Many small stones In the clay matrix, mostly angular quartz	11
NA	86	Deposit	Piece of slightly reddish vitrified ceramic material with adhering slag. A convex outer surface is visible. Tuyere material	19
NA	86	Deposit	Small rather flat piece of slag. Some charcoal impressions	40
91	90	Garden feature	Small piece of reddish vitrified ceramic material with some quartz inclusions	3
91	90	Garden feature	Small piece of rather dense slag	13
91	90	Garden feature	Tiny lump of slag	5
NA	98	Deposit	Small piece of slag with minor charcoal inclusions. One part of this piece has a light-grey matrix, potentially showing influence of tuyere material	11
NA	98	Deposit	Small irregular piece of slag with multiple charcoal impressions	6
NA	98	Deposit	Small fragment of slag with charcoal impressions	9
NA	98	Deposit	Small piece of rather dense slag with multiple charcoal impressions	20
100	87	Pit	Piece of brick like material with strong vitrification on one side. Seems to be have three sides at straight angles from each other	23
100	105	Pit	Small dense irregular smithing hearth cake with some charcoal impressions.	222
100	106	Pit	Small fragment of flat vitrified ceramic material. A small piece of slag is embedded in the reddish oxidized clay matrix. No other obvious tempering	11
103	102	Lime kiln	Fragment of brick-like material with circular linear hollow. Two small smoothed patches could be the remnants of a second parallel hollow. Some calcium-rich inclusions in the fabric	131
103	102	Lime kiln	Small piece of slag with many charcoal inclusions	8
103	102	Lime kiln	Lump of dense slag with some charcoal impressions. Part of a smithing hearth cake	269
103	102	Lime kiln	Partial smithing hearth cake with crystaline upper part and heavily oxidized lower part	180

103	102	Lime kiln	4 pieces of relatively dense slag. Fragments of smithing hearth cakes	256
103	102	Lime kiln	17 small pieces of relatively dense slag. Some with charcoal inclusions and/or impressions	140
103	102	Lime kiln	Two small pieces of drippy slag	8
103	102	Lime kiln	Fragment of vitrified ceramic material.	9
103	102	Lime kiln	Two small pieces of slag encrusted by yellowish clay material	7
103	102	Lime kiln	Fragment of brick-like material	28
103	102	Lime kiln	Irregular lump of rather dense, oxidized slag with charcoal impressions	182
103	102	Lime kiln	Small piece of reddish vitrified ceramic material	2
103	102	Lime kiln	Small fragment of slag	2
103	110	Lime kiln	Small piece of slag with minor charcoal inclusions	11
Total				2420

Table S.28 Description of the material related to metalworking from Kilkenny, Robing Room

Kilkenny, Talbot's Tower

Site no. 86

Townland: Gardens
Civil Parish: St. Patrick's
Coordinates (ITM): E650571, N655456
SMR: KK019:026

Excavation licence: E3646
Director: Cóilín Ó Drisceoil (Kilkenny Archaeology)
Excavated between August and Dec. 2012

Site summary:

Ironworking activity: Smithing

Significance: Low

Site deposition condition: Secondary

Investigation level: Urban

Ironworking features: None

Dating evidence: Pottery

Sample size: 722g

Material present:				
	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

The southern-most site in Kilkenny where ironworking residues were found is at Talbot's Tower (Ó Drisceoil 2008). Visual examination of the material as part of this thesis showed that the material related to smithing activities (Table S.29). Some of the material was found in early medieval as well as modern deposits, while small amounts were retrieved from late medieval layers of the town ditch.

Cut	Fill	Type	Description	Weight (g)
8	19	Ditch	Small smithing hearth cake, covered on two sides by iron stained lime/mortar	114
8	19	Ditch	Small fragment of dark rather dense slag	16
8	72	Ditch	Small piece of rather light dark shiny slag with reddish discolouration on one surface	7
8	72	Ditch	Small fragment of brick, vitrified on one side	2
8	350	Ditch	Fragment of dark, rather dense slag	24

8	356	Ditch	Lump of heavily corroded, rather dense slag	111
24	68	Robber pit	Large fragment of black rather dense slag, irregular shape	238
NA	75	Deposit	Small dense rounded fragment of oxidized slag	37
NA	170	Sod	Small, rather light fragment of dark shiny slag with regular quartz-like inclusions	5
NA	170	Sod	Small piece of dark grey irregular shaped slag with lime encrustation	5
NA	170	Sod	Rather dense fragment of dark slag	18
NA	189	Garden mound	Fragment of dense dark grey slag with vitrification on one surface	145
Total				722

Table S.29 Description of the material related to metalworking from Kilkenny, Talbot's Tower

Kilkenny, Troy's Gate/Vicar Street

Site no. 87

Townland: Gardens
Civil Parish: St. Canice
Coordinates (ITM): E650256, N656559
SMR: KK019:026

Excavation licence: 02E0593
Director: Theresa Bolger
(Margaret Gowan Ltd.)
Excavated in 2002

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Troy's Gate/Vicar Street, further remains of late medieval ironworking were uncovered (Bolger 2004). In one of the test trenches a slot through a large pit was excavated and revealed “possible furnace bottoms” and two sherds of unspecified medieval pottery. In an adjacent trench a deposit with *in situ* burning contained pieces of “furnace bloom” and a sherd of coarse medieval pottery. This site does not seem to have been excavated and the available information is too limited to allow interpretations beyond that the area was probably the location of late medieval smithing activity.

Killaspy, Co. Kilkenny

Site no. 88

Townland: Killaspy
Civil Parish: Dunkitt
Coordinates (ITM): E661288, N615680
SMR: KK043:079

Excavation licence: 03E0619
Dir.: David Pollock (Archaeological Development Services Ltd.)
Excavated between May and Sep. 2003

Site summary:

Ironworking activity: Smithing			Significance: High		
Site deposition condition: Primary			Investigation level: Complete excavation		
Ironworking features: Hearths, anvil supports					
Dating evidence: C14			Sample size: 91.8kg		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale	✓	Other ceramic	✓	Iron artefacts ✓

Description

At the site of Killaspy, Co. Kilkenny, a concentration of intensive late medieval ironworking was excavated, located at the edge of a Bronze Age burnt mound (Pollock 2009). The largest feature in this concentration was a large pit (C.231) measuring 2.2 by 1.2 by 0.25m (ibid.: 20). Its basal layer consisted of a crust of hammerscale and charcoal (NI)[162], followed by a layer with further residues and sealed by a fill including iron waste (NI). The material from the middle layer, in total 89g, yielded dense slag and undiagnostic slag, but more might have been recovered as the text refers to this fill as containing layers of material similar to the basal fill (ibid.; Keys 2009c: 43). To the south of this pit, two features described as postholes were uncovered.

The first (C.080) abutted the southern end of the pit and measured c. 0.3m[163] in diameter and was 0.2m deep (Pollock 2009). It contained a smithing hearth cake,

162 Several contexts included ironworking residues, but were not included in the specialist report. These will be indicated by (NI) or Not Investigated.
163 Dimensions taken from drawings and in the context register 080 refers to a "blob" (ibid.: 34).

undiagnostic slag and vitrified hearth-lining, in total 427g (Keys 2009c: 44). Further south-west, a second feature (C.043) interpreted as a posthole, was c. 0.4 by c. 0.3m and 0.2m deep[164] and held ironworking waste (NI) (Pollock 2009: 21). To the west of the large pit, a smaller circular pit (C.229) was excavated, measuring 1m in diameter and 0.25m in depth (ibid.: 21). Its basal fill consisted of hammerscale (more than 2.5kg!), run slag, vitrified lining and undiagnostic slag, in total 4584g (Keys 2009c: 43–44). Radiocarbon analysis of a fragment of oak charcoal from this fill returned a date of AD 1223–1280 (2σ) or AD 1229–1231 (1.7%) and 1242–1246 (7.0%) and 1251–1278 (91.2%) (1σ) (Pollock 2009: 61). All wood identified from this feature consisted of oak (Austin 2009). The upper fill of the same feature included three smithing hearth cakes, slag runs, vitrified lining, hammerscale and undiagnostic slag (4061g) (Keys 2009c: 43).

Just north of this, a smaller pit (0.5m diam. by 0.15m deep) had further ironworking waste (NI) (Pollock 2009: 21). All these features described up to now were covered by an extensive layer (C.006/039) of ironworking waste (NI) (ibid.: 20, 79). At the western edge of this deposit another large pit (C.264) was located, measuring 1.5 by 0.8 by 0.25m (ibid.: 22). Its primary fill included one smithing hearth cake, vitrified lining, hammerscale and other slag types (2056g in total), while the upper fill contained further ironworking waste (NI) (ibid.; Keys 2009c: 43). Two features further away, both shallow hollows (C.064 and C.177), yielded respectively slag (NI) and a smithing hearth cake together with undiagnostic material (Pollock 2009: 16, 23; Keys 2009c: 44–45). Nearly 79.2kg of smithing debris, including 33 smithing hearth cakes, were recovered from the lower topsoil layer (C.005/024) in the metalworking area (ibid.: 45–47). Several pieces of iron were recovered from the site, but none could be positively identified.

Although the report is incomplete, it can be concluded that the site represents rather intensive thirteenth-century, likely late thirteenth-century, iron smithing. Due to the nature of their basal fills, pits 229, 231 and 264 are accepted as smithing hearths, both “postholes” 043 and 080 are then likely settings for anvil-blocks. There is no evidence to suggest if this took place inside a building or not. It is unclear if the many references to vitrified hearth-lining are correct identifications or if this could indicate tuyere material.

164 Dimensions taken from drawings.

Killegland, Co. Meath

Site no. 89

Townland: Killegland
Civil Parish: Killegland
Coordinates (ITM): E705719, N752024

Excavation licence: 06E0871
Dir.: John Kavanagh (Icon Archaeology Ltd.)
Excavated in 2006

Site summary:

Ironworking activity: Smithing

Significance: Low

Site deposition condition: Secondary

Investigation level: Partial excavation

Ironworking features: None

Dating evidence: Pottery

Sample size: Unknown

Material present:				
	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

Excavations at Killegland, Co. Meath, while mostly revealing features dated to the early medieval period, also had evidence for late medieval ironworking (Kavanagh 2009). This consisted of pottery fragments and slag recovered from fire-spots over some of the silted-up older ditches.

Kiltotan and Collinstown, Co. Westmeath

Site no. 90

Townland: Kiltotan and Collinstown
Civil Parish: Castlelost
Coordinates (ITM): E644709, N738729

Excavation licence: 03E0619
Director: Áine Richardson
(Eachtra Archaeological Projects Ltd.)
Excavated between June and July 2004

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Primary			Investigation level: Complete excavation		
Ironworking features: Hearth					
Dating evidence: C14			Sample size: 1.1kg		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic		Iron artefacts

Description

Two features related to ironworking were uncovered in the townland of Kiltotan and Collinstown, Co. Westmeath (Richardson 2009). One was a possible furnace dated to the late tenth to early eleventh centuries (ibid.: 6, see Chapter 6.2.2). The other feature, an oval feature measuring 0.7 by 0.6 by 0.24m, had a heavily heat-affected base, irregular sides and a charcoal-rich basal layer (ibid.: 7).[165] The metalworking residues it contained were identified as amorphous slag (145g), fluid slag (50g), vitrified lining and a tuyere fragment (Fairburn 2009b: 32). Radiocarbon analysis of a fragment of possible oak charcoal from this feature returned a date of AD 1420–1492 (98.0%) and 1603–1611 (2.0%) (2σ) or AD 1435–1463 (1σ) (Richardson 2009: 29). Charcoal analysis showed a predominance of oak, but also occurrence of non-oak species (Johnston 2009). The tuyere fragment would suggest forging activities and the feature is accepted as a fifteenth-, likely mid-fifteenth-century, smithing hearth.

165 According to the text this feature was cut by a later ditch, but on the section drawing it is set in its upper fill (ibid.: 18).

Limerick, Charlotte's Quay/Broad Street

Site no. 91

Townland: Irishtown
Civil Parish: St. John's
Coordinates (ITM): E558012, N657337
SMR: LI005:017

Director: Ann Lynch (OPW)
Excavated in 1981

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

During excavations at Charlotte's Quay/Broad Street in the Irish Town part of Limerick, a small amount of slag (2.25kg/5lb) was recovered (Lynch 1984: 316). Most of the material was found in a deposit (C.103) together with local and imported thirteenth-century pottery and an Edward I penny minted between AD 1272 and 1278 (ibid.: 297). Close-by, further slag was found in late thirteenth- to early fourteenth-century deposits, which contained Saintonge, Ham Green and local pottery (ibid.: 299).

Limerick, Charlotte's Quay/Castle Site

Site no. 92

Townland: Irishtown
Civil Parish: St. John's
Coordinates (ITM): E558033, N657371
SMR: LI005:017

Director: Christine Tarbett
(Limerick Corporation)
Excavated in 1989

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Just north of the last site, at Charlotte's Quay/Castle Site, slag was recovered from an ashy layer sealing several pits with unspecified thirteenth- to fourteenth-century pottery sherds (Tarbett and Wiggins 1990).

Limerick, 48–50 Mary Street

Site no. 93

Townland: St. Francis Abbey
Civil Parish: St. Mary's
Coordinates (ITM): E558037, N657518
SMR: LI005:017(142)

Excavation licence: 00E0635
Dir.: Tracy Collins (Aegis Archaeology Ltd.)
Excavated between Oct. and Dec. 2000

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At 48–50 Mary Street, outside of the medieval city walls, a fragment of vitreous slag was recovered from a drain which was tentatively interpreted as a drain inside a late medieval house (Collins 2002: 73, 77).

Limerick, The Parade/Broad Lane

Site no. 94

Townland: King's Island
Civil Parish: St. Munchin's
Coordinates (ITM): E557741, N657894
SMR: LI005:017

Director: Brian Hodkinson
Excavated between 1989 and 1990

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

North-east of St. John's Castle, at The Parade/Broad Lane, several pits and a layer are recorded as yielding iron slag (Hodkinson 1999: 17). The date of this material could only be narrowed down to the late medieval period.

Lismahon Motte, Co. Down

Site no. 95

Townland: Ballykinler Lower
Civil Parish: Ballykinler
Coordinates (ITM): E742835, N838918
SMR: DOW044:003

Dir.: David M. Waterman (Archaeological Service of Northern Ireland)
Excavated June and July 1958

Site summary:

Ironworking activity: Smithing		Significance: Medium	
Site deposition condition: Primary		Investigation level: Complete excavation	
Ironworking features: Hearths, anvil-supports?			
Dating evidence: Artefacts, stratigraphy		Sample size: > 16kg	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations at Lismahon Motte, Co. Down uncovered an area of metalworking on top of the mound (Waterman 1959). The area of metallurgical activity was located on the western edge of the mound and consisted of pits, an area of paved stone and post- and stakeholes (ibid.: 152) (Fig. S.28). More than 16kg (36lb) of slag was found in the area, concentrated around the pits, but also in (some of?) the postholes. The western-most of the pits (C.2, c. 0.4 by c. 0.3[166] by 0.08 to 0.1m deep) was heavily affected by heat. Of the other two pits, one was larger (c. 0.55m diameter) and the other smaller (c. 0.3 by c. 0.2m). Three of the postholes, including two double ones were located between these pits and the paved area, but also appear on the plan of the next phase (ibid.: 154). A post and stone wall was constructed over pit C.2 during this later phase (ibid.: 152). A wide variety of pottery was recovered from the site, but it is unclear which material came from the ironworking area (ibid.: 156–161). Based on the find of a coin and

166 Measurements deduced from the plan.

stratigraphic considerations the phase with the ironworking was tentatively dated to c. AD 1200 (ibid.: 166–167). All three pits might represent smithing hearths, but the evidence for a structure covering the activity is unconvincing. Some of these postholes might represent anvil-block supports.

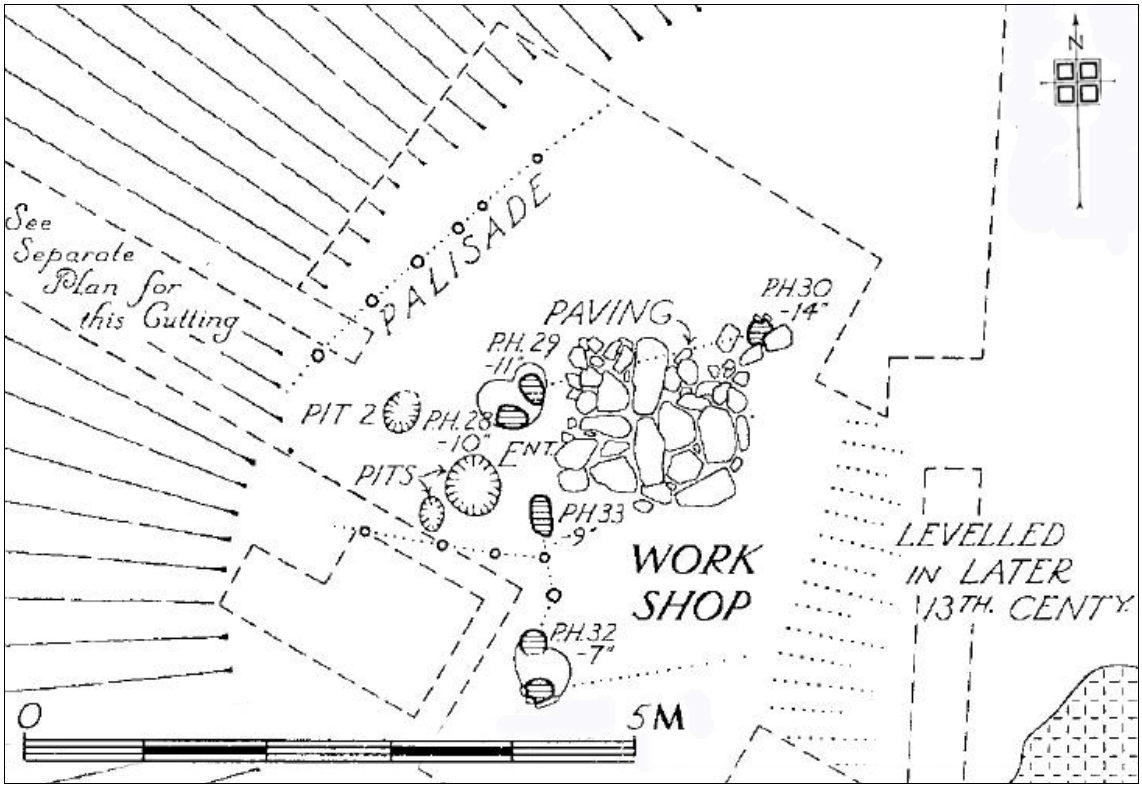

Fig. S.28 Lismahon Motte, Co. Down. Post-excavation plan of the ironworking area (after Waterman 1959: 154)

Loughbown 1, Co. Galway

Site no. 96

Townland: Loughbown
Civil Parish: Loughbown
Coordinates (ITM): E582165, N728165
SMR: GA087:178

Excavation licence: E2442
Director: Nick Bower (Eachtra Archaeological Projects Ltd.)
Excavated in 2006

Site summary:

Ironworking activity: Smithing			Significance: High		
Site deposition condition: Primary			Investigation level: Complete excavation		
Ironworking features: Hearths					
Dating evidence: C14			Sample size: 130 kg		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale	✓	Other ceramic	Iron artefacts	✓

Description

At Loughbown 1, Co. Galway, the excavation of an early medieval ringfort also uncovered later ironworking (Bower 2009). The focus of this metalworking was an area outside of the entrance of the ringfort and as its residues were present in only the uppermost fills of the ditch the ringfort would have been out of use by the time of the metalworking (ibid.: 23) (Fig. S.29). Several deposits lining the metalworking area contained a total of 49kg of slag (ibid.; Kearns 2009: 197). This material contained several smithing hearth cakes, the largest weighed 1100g, undiagnostic lumps and hammerscale.

Three features, interpreted as bowl furnaces or smithing hearth, were located broadly in the middle of these deposits (Bower 2009: 23; Kearns 2009: 198). One of these, C.89, measured c. 0.7 by 0.62 by 0.2m[167] and was broadly circular with sloping edges (Bower 2009: 83). It contained over 2kg of slag which is described as very porous and drippy (Kearns 2009: 196). A fragment of hazel/alder charcoal from this feature returned a radiocarbon date of AD 1047–1088 (13.6%) and 1122–1139 (4.0%) and

167 The measurements in the report are 0.62 by 0.39 by 0.2m (Bower 2009: 83), which seem to be the values taken of the plan without considering the part of the feature cut by the later furrow (ibid.51). The recalculated values are based on the available section drawing (ibid.).

1149–1257 (82.5%) (2σ) or AD 1156–1219 (1σ) (Bower 2009: 252). The other wood from this hearth was predominantly oak with some *Pomoideae* (Dillon 2009a: 231). The other two features, C.94 and C.95, measured respectively 0.35 by 0.3 by 0.2m and c. 0.9 by 0.65 by 0.12m (Bower 2009: 84).[168] Both contained slag, the text mentions at least 25 smithing hearth cakes from the three above features, but this was not available for specialist study (ibid.: 23; Kearns 2009: 196).

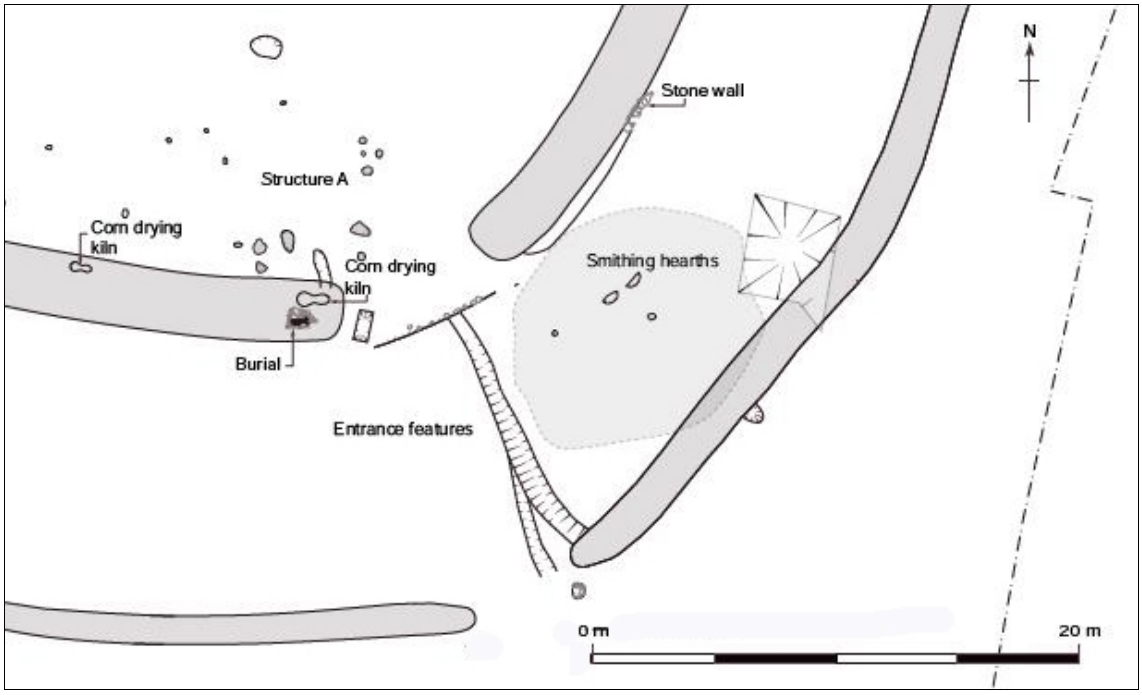

Fig. S.29 Loughbown 1, Co. Galway. Site plan (after Bower 2009: 42)

A large pit C.64 nearby was used as a rubbish pit and contained further metallurgical residues (Bower 2009: 23). This material, which weighed more than several kilograms, included smithing hearth cakes, light slag with a high ceramic content and a piece of slag with embedded hammerscale (Kearns 2009: 196). Smaller amounts of slag, not described, are recorded from other nearby features including a corn-drying kiln, material from which was radiocarbon dated to AD 1282–1327 (43.7%) and 1342–1395 (56.3%) (2σ) or AD 1291–1312 (41.6%) and 1358–1387 (58.4%) (1σ) (Bower 2009: 18, 252). The bulk of the ironworking at Loughbown dates to the late twelfth to early thirteenth centuries and consists of smithing activities without evidence of domestic structures. Some later, fourteenth-century, activity might also be present. Only C.89 and C.95 can be reasonably confidently assigned as smithing hearths.

168 The report gives 0.5 by 0.5 by 0.12m, but the plan clearly shows the feature to be larger (ibid.: 51). No section drawing was available.

Loughgur, Car Park Area II, Co. Limerick

Site no. 97

Townland: Loughgur
Civil Parish: Knockainy
Coordinates (ITM): E564798, N641205
SMR: LI032:036

Director: Rose Cleary
(University College Cork)
Excavated between May and August 1978

Site summary:

Ironworking activity: Smithing		Significance: High		
Site deposition condition: Primary		Investigation level: Partial excavation		
Ironworking features: Hearths, anvil-supports?				
Dating evidence: Pottery		Sample size: Unknown		
Material present:	Slag ✓	Tuyeres	Tools	✓
	Hammerscale	Other ceramic	Iron artefacts	✓

Description

Excavations at the site known as Car Park Area II at Loughgur, Co. Limerick revealed evidence of late medieval settlement, including two rectangular houses, several circular hut structures, ditches and various pits (Cleary 1982, 1983). The site is located close to Bouchier Castle, a fifteenth-century tower house. The first part of the area excavated included one of the houses, the foundation trench of which revealed three "furnace bottom" fragments and another one at the junction of the trench and an earlier pit (Cleary 1982: 80, 94). The pottery associated with this house consisted of local wares (ibid.: 80, 85). More slag, together with thirteenth- to seventeenth-century pottery and a hone stone fragment (See Fig. 8.12a), was recovered from two nearby paved areas (ibid.86–87). A large ditch to the east of the house contained iron slag, "pit lining" and thirteenth- to eighteenth-century pottery (ibid.: 89).

At the south-west edge of the site an area with more intensive metallurgical activity was uncovered. In total 6.44kg of residues were found, including "furnace

bottoms", "pit lining" and a tuyere fragment, the majority of which came from a partially excavated rectangular pit (0.85 by more than 0.35m) (ibid.: 90). On its western side, this feature had a stone-built hearth showing intensive use. In the same area a chisel-like object and a large whetstone were found (ibid.: 92). A nearby shallow pit (c. 4m length, width unknown)[169] contained further significant amounts of slag, including "furnace bottoms" (ibid.: 90). Two postholes (or possibly anvil-block supports?) were set in its base. Pottery, dated from the thirteenth to seventeenth centuries, was found in this area but none in direct proximity to the features containing metallurgical residues (ibid.: 92). The area post-dates the fourteenth-century yard (ibid.: 97).

The second part of the same area was the location of the second rectangular house, where fifteen fragments of slag were recovered, including three "furnace bottoms" (Cleary 1983: 55). Based on both stratigraphy and pottery finds, this house was considered slightly later than the one mentioned earlier (ibid.: 64). Five kilograms of slag, including 17 "furnace bottoms", were recovered from the fills of two trenches which were contemporary with the second house, but could have been associated with a later, undated pit around which more slag was found (2 by 1.3m) (ibid.: 65, 68). A single piece of iron slag was recovered from a corn-drying kiln which also yielded a sherd of local pottery and a twelfth- to thirteenth-century key (ibid.: 68), while two "furnace bottoms" were found in a stone-built hearth (c. 2.4 by 1.9m) together with a fragment of local pottery (ibid.: 70). Two pieces of slag came from a ditch without datable material (ibid.: 72). The occurrence of multiple "furnace bottoms" and tuyere material would suggest that most, if not all, the material is derived from smithing activities. Any of the two hearths or the two pits could be related to ironworking, although clear evidence for this is lacking. The metallurgical activity seems to have been rather small-scale and likely spread out over several phases during the late medieval period.

169 Dimension taken from plan (ibid.: 79).

Mallow, Quartertown, Co. Cork

Site no. 98

Townland: Quartertown
Civil Parish: Mourneabbey
Coordinates (ITM): E554694, N598025
SMR: CO033:111

Excavation licence: 11E0142
Director: Dan Noonan
(Dan Noonan Archaeology)
Excavated between July and August 2011

Site summary:

Ironworking activity: Fining		Significance: Medium	
Site deposition condition: Secondary		Investigation level: Surface finds	
Ironworking features: None			
Dating evidence: Documentary		Sample size: 1635g	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Quartertown, Mallow, Co. Cork, excavations took place in the vicinity of the location of the blast furnace and finery owned by Sir Thomas Norris, Lord President of Munster, between AD 1593 and 1598 (Noonan et al. 2013: 3) (See Chapter 5.3). Previously, the author of this thesis had found three pieces of dense slag, one of which had adhering clay-luted stone-work (Table S.30, Fig. S.30 and see Fig. 6.11) at the suspected location of this ironworks. This was interpreted as probable debris of the above-mentioned finery (Rondelez 2013: 18). An excavation of features filled with slag-like material at the same location revealed this to probably be the dumped waste from the nearby coal-fired nineteenth-century flour-drying kilns (ibid.: 19). During this excavation, additional pieces of the dense finery slag were found and it was assumed that this sixteenth-century finery was situated nearby, its exact location as yet undiscovered and possibly destroyed by the construction of the later flour-mills.

Fig. S.30 Mallow, Quartertown, Co. Cork. Finery slag with adhering stone-work

Description	Weight (g)
Piece of dense grey slag with stoney inclusions and adhering luted stonework	717
Lump of dense grey slag with stoney inclusions	597
Smaller piece of dense grey slag	321

Table S.30 Description of the material from Mallow, Quartertown, Co. Cork (surface finds)

Mannan Castle, Co. Monaghan

Site no. 99

Townland: Donaghmoyne
Civil Parish: Donaghmoyne
Coordinates (ITM): E685288, N807414
SMR: MON028:118

Excavation licence: 99E0044
Director: Eoghan Moore
Excavated in 1999

Site summary:

Ironworking activity: Smithing		Significance: High		
Site deposition condition: Primary		Investigation level: Partial excavation		
Ironworking features: Forge building, hearth				
Dating evidence: Pottery		Sample size: Unknown		
Material present:	Slag ✓	Tuyeres	Tools	✓
	Hammerscale	Other ceramic	Iron artefacts	✓

Description

Excavations carried out at a motte known as Mannan Castle, Co. Monaghan revealed extensive ironworking remains in the southern part of the bailey area (Moore 2001). The focus was a building defined on three sides by a slot-trench (C.17/38 east wall, C.23/37 west wall and C.63 south wall) enclosing an area of 8 by 5m (ibid.: 14) (See Fig. 8.1h). An iron chisel was recovered from slot-trench C.17/38 (ibid.: 49). On the northern, open side a posthole (C.56) was located which was surrounded by a deposit of burnt material (C.58) (ibid.: 14, 30). About a third of the length of the building inwards, a hearth (C.39) measuring 0.8 by 0.55 by 0.05–0.08m was uncovered (ibid.: 14, 27). A deposit (C.27/28) containing burnt material was found in the southern half of the building (ibid.: 26). To the south of the building, part of the boundary ditch was uncovered (C.12) (ibid.: 23). All the above features contained slag[170] and nearly all (the hearth and deposit excepted) together with sherds of unspecified medieval pottery (ibid.: 36–51).[171] To the

170 It is unclear if the entries represent single or multiple pieces, so quantification is not possible.
171 In several instances glass is recorded from these features, but as it described in some cases as glass

west of the building, a further slot-trench section (context 70) and a hearth (context 77) containing slag were uncovered, none of which held pottery (ibid.: 20, 32–33). The main building was correctly identified as a forge, and a late twelfth- to early thirteenth-century date can be proposed due to the relation with the motte and bailey (McNeill 1997: 71–72).

fused to iron slag (ibid.: 48) the material might represent highly vitrified metallurgical waste.

Merrion Road, Co. Dublin

Site no. 100

Townland: Merrion
Civil Parish: Donnybrook
Coordinates (ITM): E719625, N730735

Excavation licence: 04E0272
Dir.: Christine Baker (Margaret Gowan Ltd.)
Excavated between April and May 2004

Site summary:

Ironworking activity: Smithing			Significance: Low	
Site deposition condition: Primary?			Investigation level: Partial excavation	
Ironworking features: Hearths?				
Dating evidence: C14, pottery			Sample size: Unknown	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts ✓

Description

Excavations at Merrion Road, Co. Dublin uncovered a series of late medieval pits and drains, several of which contained metalworking waste (Baker 2008). Three of these inter-cutting pits (C.52, C.53 and C.54) in the north-east of the site contained slag and showed evidence of burning (ibid.: 243). These pits measured approximately and respectively, 1.6 by 0.8m, 0.8 by 0.6m and 1.8 by 1.2m.[172] Slag, together with medieval pottery, was also recovered from unspecified drains and deposits (ibid.: 240, 242). Radiocarbon analysis was carried out on material from two pits without metalworking residues, one of which returned a date of AD 1285–1330 (42.2%) and 1338–1397 (57.8%) (2σ) or AD 1294–1316 (38.8%) and 1355–1389 (61.2%) (1σ), while the other gave a date of AD 1326–1343 (7.3%) and 1394–1443 (92.7%) (2σ) or AD 1408–1433 (1σ) (ibid.: 238, 240).

The pottery from the site consisted of Leinster Cooking Ware, Dublin-type Ware and Dublin-type Fineware (McCutcheon 2008: 253). Eleven awls or punches were

172 Measurements taken from plan, no depths available (ibid.: 237).

recovered from the site, which were assumed not to be related to leather-working, but for which no context information was available (Baker 2008: 244, 260). If all the features are broadly contemporary, which is not sure, a fourteenth to early fifteenth, and likely late fourteenth to early fifteenth, centuries date can be assumed for the assemblage. The burning in the pits probably indicates *in situ* smithing, but the evidence is too scant to be certain.

Merrywell 1, Co. Meath

Site no. 101

Townland: Merrywell
Civil Parish: Knockmark
Coordinates (ITM): E693294, N750992

Excavation licence: E3051
Director: Aidan O'Connell (Archaeological Consultancy Services Ltd.)
Excavated between Aug. and Nov. 2005

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: C14, pottery		Sample size: 225g	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations at Merrywell 1, Co. Meath revealed a series of field boundary ditches, some of which were late medieval in date and contained small amounts of slag (O'Connell and Ginn 2009). One piece (120g) was recovered from the secondary fill of a ditch (C.6) which also contained Leinster Cooking Ware, Dublin-type Cooking Ware, Dublin-type Coarseware and Dublin-type Ware (ibid.: 5; Wallace 2009a: 89; McCutcheon 2009e: 76). Radiocarbon analysis on hazel charcoal from the same fill returned a date of AD 1174–1281 (2σ) or AD 1219–1268 (1σ) (O'Connell and Ginn 2009: 44). The single fill of a ditch cutting the former contained a further small piece of slag (105g) and similar pottery (ibid.: 5). The slag was interpreted as smithing slag (Wallace 2009a: 89). The site represents small amounts of smithing material probably dumped in the mid-thirteenth century.

Moigh Upper (Hill of the Smith), Co. Roscommon

Site no. 102

Townland: Moigh Upper
Civil Parish: Kiltullagh
Coordinates (ITM): E552477, N773103

Fiona Grant (University of Manchester)

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Surface find	
Ironworking features: None			
Dating evidence: C14		Sample size: Unknown	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Moigh Upper, Co. Roscommon, at a place known as “the Hill of the Smith” a small fragment of a smithing hearth cake was recovered during drainage works (Grant 2004: 160–161, 171). Unidentified charcoal retrieved from within the slag returned a radiocarbon date of AD 1410–1519 (93.2%) and 1593–1619 (6.7%) (2σ) or AD 1424–1473 (1σ) (ibid.: 172).

Moigh Upper (Kiltullagh Hill), Co. Roscommon

Site no. 103

Townland: Moigh Upper
Civil Parish: Kiltullagh
Coordinates (ITM): E552477, N773103

Fiona Grant (University of Manchester)

Site summary:

Ironworking activity: Bloomsmithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Surface finds	
Ironworking features: None			
Dating evidence: C14		Sample size: 16.1kg	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

In the same townland, on Kiltullagh Hill just over a kilometre to the north-east, eight fragments of large smithing hearth cakes (weights from 939 to 3595g, average weight 2016g) were found during field-walking (ibid.: 194–195). Radiocarbon analysis on charcoal inclusions in a ninth, amorphous, piece from the same locality returned a date of AD 1040–1112 (28.5%) and 1115–1257 (71.5%) (2σ) or AD 1049–1084 (24.5%) and 1124–1137 (8.0%) and 1151–1222 (67.4%) (1σ) (ibid.: 196).

Moneygall, Co. Offaly

Site no. 104

Townland: Moneygall Excavation licence: 06E0321
Civil Parish: Cullenwaine Dir.: Colm Moloney (Headland Archaeology (Ireland) Ltd.)
Coordinates (ITM): E602855, N681169 Excavated between Aug. and Nov. 2005

Site summary:

Ironworking activity: Smithing			Significance: High		
Site deposition condition: Primary			Investigation level: Partial excavation		
Ironworking features: Hearth					
Dating evidence: C14			Sample size: 36.5kg		
Material present:	Slag	✓	Tuyeres	✓	Tools ✓
	Hammerscale	✓	Other ceramic		Iron artefacts ✓

Description

Excavations at Moneygall, Co. Offaly unearthed a sub-circular enclosure together with evidence for both early and late medieval ironworking (Moloney 2009). The later ironworking activity was located around the northern part of the enclosure, which was early medieval in date. Two penannular ditches, both of which cut ditches associated with the enclosure, had ironworking residues.[173] The first, C892, enclosing an area with a diameter of 3.8m, had 10g of undiagnostic slag (ibid.: 42–43; Young 2009g: 201, 206). Radiocarbon analysis on a charred oat grain[174] from the fill of this ditch returned a date of AD 1487–1604 (75.7%) and 1608–1648 (24.3%) (2σ) or AD 1521–1578 (66.2%) and 1581–1591 (8.8%) and 1620–1642 (24.9%) (1σ) (Moloney 2009: 50).

The other penannular ditch, C.890, 4m east of the latter and enclosing an area with an identical diameter of 3.8m, contained just over 6kg of metalworking residues

173 The stratigraphic relation between the penannular ditches and the early medieval features is not recorded in the text, but is visible on one of the plans (ibid.: 21) and is mentioned in the specialist report on the metallurgical residues (Young 2009g: 195).

174 Additional information on the species of the samples subjected to radiocarbon analysis was provided by Jonathan Millar (Rubicon Heritage Services Ltd. formerly Headland Archaeology (Ireland) Ltd).

(ibid.: 41; Young 2009e: 200–201). The material included smithing hearth cake and tuyere fragments, but also several pieces with characteristics indicating that they represented smelting slag. Radiocarbon analysis on a charred hazelnut shell returned an Iron Age date (Moloney 2009: 50). About 20m south of the penannular ditches a smithing hearth and an associated pit were uncovered.

The hearth C.905, measuring 1.6 by 0.7 by 0.17m, contained just under 2.5kg of slag and had a fractured stone at its base (ibid.: 37; Young 2009e: 202). The material consisted mostly of smithing hearth cake material, with other pieces giving indications of smelting together with hammerscale and several droplets of copper alloy. The pit, C.901, contained around 1400g of metalworking debris consisting of smithing hearth cake and tuyere fragments, hammerscale and several hollow pieces interpreted as slag solidified around a poker (ibid.: 201). A linear feature C.903[175] extending from this pit yielded a further 448g of metalworking debris including a piece of slag solidified around a poker. One of a series of burials returned a radiocarbon date comparable to the late medieval one obtained from the penannular ditch, while others were earlier (ibid.54). The similarity of the penannular ditches and the fact that they are stratigraphically younger than the early medieval enclosure indicates that the Iron Age date is erroneous and that both are of a late fifteenth- to early seventeenth-century date.

175 This context information is only contained in the specialist report (ibid.: 194).

Mullaghmarky AR016, Co. Kerry

Site no. 105

Townland: Mullaghmarky
Civil Parish: Castleisland
Coordinates (ITM): E499013, N611655

Excavation licence: 07E0474
Dir.: Michael Tierney (The Archaeology Company)
Excavated in 2007

Site summary:

Ironworking activity: Smelting, smithing?			Significance: High		
Site deposition condition: Primary			Investigation level: Partial excavation		
Ironworking features: Furnace(s?)					
Dating evidence: C14			Sample size: 15.3kg		
Material present:	Slag	✓	Tuyeres		Tools
	Hammerscale		Other ceramic	✓	Iron artefacts

Description

At the site of Mullaghmarky AR016, Co. Kerry, ironworking and other activity was located around a former ringfort (Tierney and Leiniger 2011). The site is located in the townland adjoining Dooneen where more evidence for late medieval iron smelting was uncovered. A pit, C.90, was cut into the filled-in terminus of the ringfort ditch (Fig. S.31). It measured 59 by 0.39m (truncated), was 0.33m deep and its lower fill contained slag (ibid.: 12). The slag was described as run slags and furnace slags (192g) together with pieces of fired clay (Tierney 2011: 212–213).[176] The feature was interpreted as a furnace. The fill of the pit above the one containing the ironworking debris was dated by radiocarbon analysis on alder charcoal to AD 1298–1370 (68.5%) and 1379–1416 (31.5%) (2σ) or AD 1314–1356 (71.7%) and 1388–1406 (28.3%) (1σ) (Tierney and Leiniger 2011: 195).

Three layers, interpreted as redeposited bank material and overlaying this feature

176 In this case, the site director wrote the specialist report, based on the categories used by Lynne Keys for other sites on the project (see Dooneen [45] and Mullaghmarky AR024 [106]).

contained further similar slag, as did a peaty layer interpreted as organic growth before the demolition of the bank (ibid.: 131, 133, 136). Radiocarbon analysis of a sample of hazel charcoal from the layer immediately above the pit returned a date of AD 1297–1372 (79.2%) and 1377–1399 (20.8%) (2σ) or AD 1303–1325 (41.6%) and 1344–1366 (39.9%) and 1383–1394 (18.4%) (1σ) (ibid.: 195). Close to the pit, two layers, one charcoal-rich and the other sandy and ashy, contained further similar slag (ibid.: 136, 138).

Fig. S.31 Mullaghmarky AR016, Co. Kerry. Photograph of section of pit C.90 (Tierney and Leiniger 2011: 99)

Another feature, measuring 0.54 by 0.45 by 0.05m, consisted of heat-affected clay with inclusions of fragments of quartz pebbles (ibid.: 139). As the latter material was similar to that adhering to some of the pieces of slag, it was concluded this might have been the base of a truncated furnace. If this is correct, which would seem plausible, then the aforementioned pit probably represents a rubbish pit rather than a furnace.

An additional feature connected to ironworking was unearthed near the centre of the ringfort. It consisted of a teardrop-shaped cut, measuring 0.78 by 0.49 by 0.1m, which was filled with a charcoal-rich layer and a lower one with slag and “a high concentration of mineral elements” (ibid.: 131, 145). The slag from this feature was identified as eleven (fragments of?) smithing hearth bottoms (982g), run slag and

dribbles (1841g) and undiagnostic slag (180g) (Tierney 2011: 213). This feature was interpreted as a smithing hearth, although the large amount of what sounds like smelting slag could indicate that this was (also?) used as a furnace.

Three pieces of slag interpreted as furnace bottoms (4229g), were recovered from the upper fill of a corn-drying kiln dug into the northern terminus of the ringfort ditch (ibid.: 212, Tierney and Leiniger 2011: 145). Two radiocarbon analyses were carried out on material from the same layer, the one on holly charcoal returning a date of AD 1220–1272 (2σ) or AD 1226–1234 (22.3%) and 1238–1248 (27.9%) and 1251–1266 (49.7%) (1σ), while the other on willow charcoal gave AD 1217–1267 (2σ) or 1225–1249 (73.9%) and 1251–1258 (26.1%) (1σ) (ibid.: 195). A third radiocarbon analysis, on alder charcoal from a charcoal-rich layer within the flue of the same kiln, gave a date of AD 1219–1269 (2σ) or AD 1225–1235 (30.5%) and 1238–1248 (33.6%) and 1251–1261 (35.9%) (1σ).

Further material identified as furnace bottoms, one large and another three from the same specimen (together 5521g), were recovered from the linear feature cutting the southern ringfort ditch terminus (Tierney 2011: 212). Birch charcoal from the parallel and more northerly linear feature gave a radiocarbon date of AD 1275–1300 (87.1%) and 1368–1381 (12.9%) (2σ) or AD 1280–1294 (1σ) (Tierney and Leiniger 2011: 195). Although inconclusive, it would seem likely that the furnace used at this site consisted of a shaft-furnace with lateral slag-tapping. The slag cakes from the deposit would then possibly be furnace bottom material. It would seem that the iron smelting took place in the fourteenth, likely early fourteenth, century, while the smithing on the same site more probably dated to the mid-thirteenth century.

Mullaghmarky AR024, Co. Kerry

Site no. 106

Townland: Mullaghmarky
Civil Parish: Castleisland
Coordinates (ITM): E499685, N612800

Excavation licence: 07E0473
Dir.: Michael Tierney (The Archaeology Company)
Excavated in 2007

Site summary:

Ironworking activity: Smelting			Significance: High		
Site deposition condition: Primary			Investigation level: Complete excavation		
Ironworking features: Furnace					
Dating evidence: None			Sample size: 4435g		
Material present:	Slag	✓	Tuyeres		Tools
	Hammerscale		Other ceramic	✓	Iron artefacts

Description

At the site of Mullaghmarky AR024, Co. Kerry, further ironworking remains were uncovered (Tierney et al. 2009a). One feature, a figure-of-eight depression, C.27, measuring 1.16 by 0.7 by 0.26m, had a steep-edged hollow on one side, a heat-affected base and was filled with charcoal-rich material containing slag and fired clay (ibid.: 11–12) (Figs. S.32 and S.33). The slag (4435g) was composed of dense slag, dribbles, furnace slag, run slag and thick runs similar to tap slag and interpreted as resulting from iron smelting (Keys 2009a). Another feature, C.32, about six metres removed, was sub-rectangular, measured 1.6 by 1.05 by 0.1m and contained similar slag (2673g) (ibid., Tierney et al. 2009a: 12–13). This was interpreted as a "furnace pit", but judging from the plates (ibid.: 25–26) could well have been a charcoal-production pit used to dump the slag.

About 50m away, a third feature, C.40, was uncovered yielding ironworking debris. Here a sub-circular cut, measuring 0.76 by 0.42 by 0.11m with steep sides and a sloping base, was unearthed (ibid.: 18–19). It had a heat-affected base and was filled by a deposit containing slag and another mainly made up of angular stones. The slag consisted of 139g of run slag and dribbles, suggesting that the feature was the base of a

furnace (Keys 2009a). None of the above features were dated, while a nearby charcoal-production pit returned a radiocarbon date of the fifteenth to seventeenth centuries. The figure-of-eight-shaped feature is a good example of a shaft furnace with lateral slag-tapping, while feature C.40 could represent the severely truncated base of another.

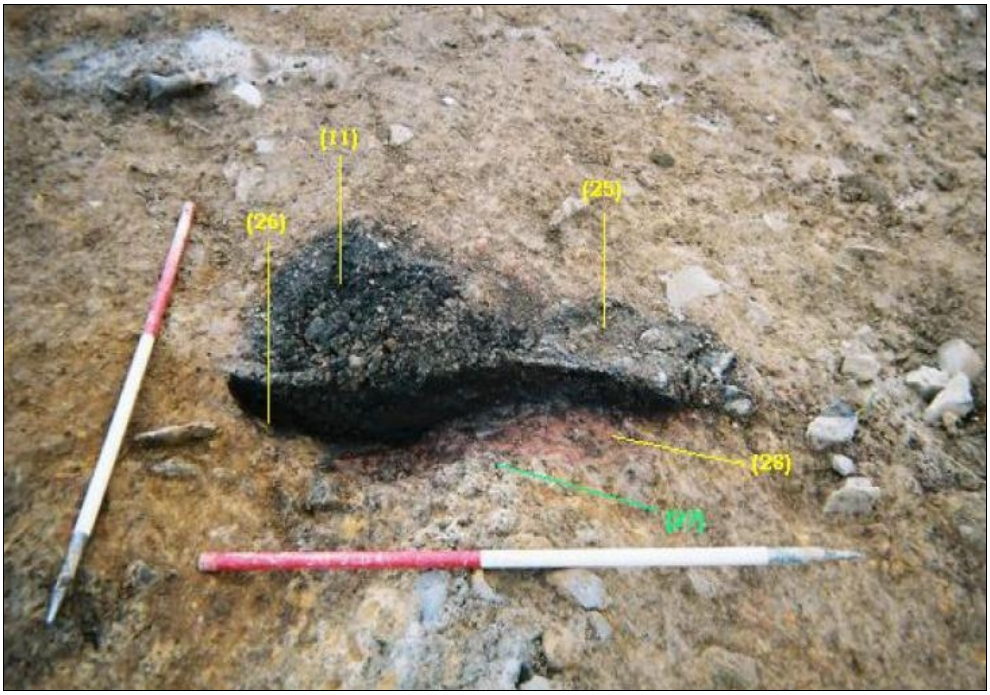

Fig. S.32 Mullaghmarky AR024, Co. Kerry. Mid-excavation photograph of furnace C.27 (Tierney et al. 2009a: 52)

Fig. S.33 Mullaghmarky AR024, Co. Kerry. Post-excavation photograph of furnace C.27 (Tierney et al. 2009a: 53)

Mullamast, Co. Kildare

Site no. 107

Townland: Mullamast
Civil Parish: Narraghmore
Coordinates (ITM): E678130, N695837

Excavation licence: E2856
Director: Angus Stephenson
(Headland Archaeology (Ireland) Ltd.)
Excavated between April and Dec. 2007

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: 1988g	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Mullamast, Co. Kildare part of a manorial Anglo-Norman village was excavated which consisted of both domestic and utilitarian buildings, corn-drying kilns and a complex system of ditches (Bolger and Lenihan 2010). Two of the ditches revealed one piece of slag each (1102 and 885g) and one pit contained less than 1g of slag (ibid.: 55, 65, 90). Each of these slag occurrences was found together with Dublin-type Cooking Ware, Dublin-type Fineware, Dublin-type Ware, Kildare-type Ware, Leinster Cooking Ware, but also Dublin-type Coarseware from one of the ditches and the pit. The slag from the ditches was identified as smithing slag, while that from the pit was undiagnostic (Cosham 2010c). This assemblage is dated, based on the pottery types, to the thirteenth century.

Mullingar, Blackhall Place, Co. Westmeath

Site no. 108

Townland: Mullingar
Civil Parish: Mullingar
Coordinates (ITM): E643644, N752832
SMR: WM019:089

Excavation licence: E2497
Dir.: Thaddeus Breen (Valerie J. Keeley Ltd.)
Excavated between Feb. 2006 and Mar. 2007

Site summary:

Ironworking activity: Smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Urban		
Ironworking features: None					
Dating evidence: Pottery			Sample size: 46.9kg		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

A large area was excavated ahead of construction work at the location of the former Dominican priory in the western part of Blackhall Place, Mullingar, Co. Westmeath (Breen 2007b). The material classified as related to metalworking was visually examined as part of this thesis (Table S.31). Just under 47kg of this material was recorded, with nearly half of this (21.8kg) retrieved from the modern fills of an earlier feature. Several kilograms of material belonged to the late medieval period and comprized iron, copper- and lead-working residues.

The ironworking residues are readily recognizable as resulting from smithing and consist largely of smithing hearth cakes and fragments thereof. 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, indicating that this is a fragment of a clay tuyere. The curvature allows the calculation

of the original circumference of the piece to around 0.16m. It is assumed that the other vitrified clay material also represents tuyere fragments. The iron smithing slag is fairly spread out, but one concentration (or possibly two) could 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 that 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 was 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 (C.333) listed in the finds register, but not included with the study material, could indicate that some non-ferrous metalworking also took place in the central concentration area(s).

The main lead-working hearth (C.24) 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 finds suggests the non-ferrous metalworking in this area also to be late medieval. Just over 3kg of the lead residues were recovered from the hearth which measured 0.35 by 0.23m and was 0.35m 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, that is to say (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 trenches has been clarified, the distribution of the material will be better delineated and might, for example, make clear if the material in the centre of the excavation area consists of one or more concentrations.

Lead-working hearth (C.24) was interpreted as related to another nearby hearth (C.29) (Breen 2007: 46–47), while another hearth (C.257) was located on the border between the areas A3c and A3f. The latter contained medieval material, and although it held 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, that the material was

imported from elsewhere (unlikely due to the distribution and nature of that the material, that is to say 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 21.8kg) of the cindery material (total 28.3kg), by weight, was recovered from two fills (C.105 and C.123) of the large stone-lined feature (C.113). These layers contained both medieval and later finds. Further cindery residues were recovered from various garden soils and organic layers (3.24kg), rubble layers and deposits (1.09kg), a wall (C.12; 59g), a kiln (C.59; 24g), a pit (C.1446; 141g) and a ditch (C.642; 471g). Three deposits with medieval material (C.631, C.633 and C.635) contained a combined 1.45kg 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 smithing hearth cake, it also had some of the cindery material, which is either intrusive or dates this feature to a later period.

Fill	Feature number	Type	Date	Description	Weight (g)
4	NA	Garden soil	19th–20th C	Two pieces of shiny cindery material with stoney inclusions (quartz)	114
4	NA	Garden soil	19th–20th C	Heavily corroded iron object	16
4	NA	Garden soil	19th–20th C	Small lump of cindery material	16
4	NA	Garden soil	19th–20th C	Piece of dark rather dense, vitrified material with protruding shiny lobe. Burnt limestone inclusion	63
4	NA	Garden soil	19th–20th C	5 fragments of cindery material	195
4	NA	Garden soil	19th–20th C	6 pieces of rather dense slag with rusty patches. Charcoal inclusions/impressions	333
4	NA	Garden soil	19th–20th C	Small piece of cindery material with burnt limestone inclusion	10
4	NA	Garden soil	19th–20th C	Three pieces of light cindery vitrified material. Burnt limestone	84
5	NA	Sandy spread	19th–20th C	Large piece of light cindery material	367
12	193	Wall	19th–20th C	Four pieces of cindery material, limestone inclusions	51
12	193	Wall	19th–20th C	Fragment of shiny cindery material	8
15	NA	Garden soil	19th–20th C	Piece of cindery material	104
15	NA	Garden soil	19th–20th C	c. 40 pieces of light cindery material, some	1322

				with burnt limestone inclusions	
16	NA	Garden soil	19th–20th C	Dark grey clayey material with compacted ashy layers with copper inclusions	91
16	NA	Garden soil	19th–20th C	Small piece of cindery material	1
29	127	Wall footing	18th–19th C	Large bun-shaped smithing hearth cake	1787
42	NA	Organic layer	19th–20th C	Two pieces of cindery material with stoney inclusions (quartz)	54
51	NA	Garden soil	19th–20th C	Elongated piece of cindery material	19
58	NA	Garden soil	18th C	24 pieces of light cindery material, some with burnt limestone inclusions	1270
98	NA	Clay deposit	Med?	7 pieces of cindery vitrified material, some with stoney (quartz) inclusions	242
105	113	Fill of pit	19th–20th C	Two pieces of cindery material with stoney inclusions (quartz)	92
105	113	Fill of pit	19th–20th C	27 pieces of light cindery material. Burnt limestone inclusions	795
105	113	Fill of pit	19th–20th C	c. 50 pieces of light cindery material. Burnt limestone inclusions	1277
105	113	Fill of pit	19th–20th C	62 pieces of cindery vitrified material Inclusions of burnt limestone	699
105	113	Fill of pit	19th–20th C	100+ pieces of cindery vitrified material. Stoney (quartz/limestone) inclusions	4018
105	113	Fill of pit	19th–20th C	100+ pieces of cindery vitrified material. Stoney (quartz/limestone) inclusions	2391
123	113	Fillof pit	18th C	100+ pieces of cindery vitrified material. Stoney (quartz/limestone) inclusions	2830
123	113	Fillof pit	18th C	28 pieces of light shiny cindery material. Burnt limestone inclusions	255
123	113	Fillof pit	18th C	5 pieces of shiny material with stoney (quartz) inclusions	79
123	113	Fillof pit	18th C	c. 40 pieces of light cindery material. Burnt limestone inclusions	761
123	113	Fillof pit	18th C	32 pieces of light cindery material. Burnt limestone inclusions	1349
123	113	Fillof pit	18th C	14 pieces of light heavily vitrified material. Quartz inclusions	184
123	113	Fillof pit	18th C	c. 40 pieces of light cindery material, some with burnt limestone inclusions	598
123	113	Fillof pit	18th C	5 pieces of shiny vitrified material with stoney (quartz) inclusions	322
123	113	Fillof pit	18th C	18 pieces of cindery material and vitrified brick	427
123	113	Fillof pit	18th C	100+ pieces of cindery vitrified material, some with stoney (quartz/limestone) inclusions	2832
123	113	Fillof pit	18th C	100+ pieces of cindery vitrified material, stoney (quartz/limestone) inclusions	2927
146	NA	Deposit	Medieval	Fragment of vitrified ceramics (tuyere) with	377

				adhering slag. Diameter c. 0.15m. Finely sorted clay with calcium rich inclusions. Charcoal inclusions.	
148	135	Deposit	?	7 pieces of dark grey clay impregnated with copper	37
191	155	Fill of kiln	Med?/18th C?	Piece of cindery material with quartz inclusions	24
195	135	Wall	Medieval	Irregular rusty smithing hearth cake with adhering lump of dense grey slag. Charcoal and burnt bone inclusion	345
197	150	Fill of ditch	Medieval	1 smallish well shaped round SHC, oxidized. Charcoal inclusions	231
197	150	Fill of ditch	Medieval	8 pieces of light cindery material. Stoney (quartz/limestone) inclusions	220
213	NA	Deposit	18th–19th C	Piece of light cindery material	105
218	NA	Garden soil	18th–19th C	Small fragment of cindery material	7
269	NA		Medieval	Fragment of shiny rather dense slag	36
314	231		Medieval	Piece of heavily vitrified white material, with shiny outer surface. Probably heavily burnt stone	67
333	144	Bedding for cobbles	Medieval	Small fragment of rather dense slag with slight flow structure	20
333	144	Bedding for cobbles	Medieval	Two pieces of relatively dense oxidized slag, charcoal impressions	117
333	144	Bedding for cobbles	Medieval	Vitrified ceramic material (likely tuyere) with adhering slag. Ceramic material is finely sorted and slightly oxidized	81
333	144	Bedding for cobbles	Medieval	Fragment of flat, oxidized smithing hearth cake, charcoal impressions.	433
365	NA	Deposit	Medieval	8 pieces of very dense homogeneous slag, one piece showing flow structure	516
365	NA	Deposit	Medieval	One piece of heath affected stone with adhering vitrified material. Some droplets of copper containing material attached to the surface	80
365	NA	Deposit	Medieval	Two pieces of rather dense slaggy material with one piece having been attached to a vertical surface	96
509	NA	Deposit	19th C	Roughly half of a flat smithing hearth cake with a blob of lighter material adhering on the upper surface	180
510	NA	Rubble layer	19th C	Vitrified ceramic material (likely tuyere) with adhering slag. Ceramic material is finely sorted and oxidized	29
510	NA	Rubble layer	19th C	14 pieces of cindery material, some with limestone inclusions	138
511	109	Fill of pit	17th C	Small piece of cindery material.	6
522	NA	Deposit	18th C	Piece of rather dense slag with greenish glaze on one end	30
523	109	Fill of pit	18th C	5 pieces of shiny vitrified material. Burnt	141

				limestone inclusions	
527	NA	Deposit	18th C	One piece of light cindery material	7
555	201	Stone surface	18th–19th C	Piece of light cindery material	189
598	204	Wall	19th C	Dense rounded smithing hearth cake with oxidized upper part, charcoal inclusions	431
631	NA	Deposit	Medieval	c. 40 pieces of light cindery material, some with burnt limestone inclusions	1235
633	NA	Deposit	Medieval	Three pieces of cindery material, one rather dense one adhering to vitrified (sand?) stone	205
635	NA	Deposit	Medieval	Four small fragments of cindery material	11
649	69	Fill of ditch	19th C	Large piece of light cindery material	471
666	63	Burnt spread	Medieval	Elongated piece of solidified lead	298
666	63	Burnt spread	Medieval	Small piece of copper stained material	2
715	117	Bedding for cobbles	Medieval	Fragment of dense slag with iron oxide encrustations	50
790	NA	Deposit	Medieval	Rather dense piece of slag with green copper coating	13
803	NA	Deposit	Medieval	Fragment of very dense homogenous slag	184
933	24	Fill of hearth	Medieval	Multiple flat pieces of solidified lead, with charcoal impressions	3099
946	276	Fill of ditch	Earliest	Fragment of dense, nearly homogenous slag with charcoal impressions	205
1021	NA	Deposit	Medieval	Elongated, dense smithing hearth cake with rusty encrustation on both sides, charcoal inclusions and impressions. Patch of calcium rich material at one end	373
1021	NA	Deposit	Medieval	Rounded smithing hearth cake with extension on one side, generally rusty with denser rust on lower side. Charcoal inclusions/impressions	443
1131	NA	Rubble layer	Med?	Large droplet of copper (alloy)	35
1192	NA	Deposit	Medieval	Small droplet of light shiny slag	6
1206	NA	Rubble layer	Medieval	Elongated dense smithing hearth cake with iron rich upper crust, charcoal impressions	538
1231	NA	Deposit	?	Two pieces of very light shiny cindery material	20
1291	91	Gravel layer	Medieval	Roughly half of a bun shaped smithing hearth cake with a thin oxidized layer on the upper surface	216
1623	250	Fill of linear	Medieval	Large rather irregular, dense smithing hearth cake (potentially two fused smithing hearth cakes) with oxidized upper layer. Charcoal inclusions/impressions	1003
?	NA	NA	NA	4 pieces of light vitrified material with stoney (quartz/limestone) inclusions	394
12	NA	NA	NA	Two pieces of light cindery material	18
NA	NA	NA	NA	7 fragments of compacted ashy and heavily copper stained material	41

NA	NA	NA	NA	Fragment of shiny rather light cindery material with some limestone inclusion	52
NA	NA	NA	NA	Three shiny lobes of vitrified material	41
NA	NA	NA	NA	Elongated rather dense smiting hearth cake charcoal inclusions	219
NA	NA	NA	NA	Small piece of cindery material	26
NA	NA	NA	NA	Three pieces of cindery material, quartz inclusions	41
NA	NA	NA	NA	Large piece of light cindery material	1549
NA	NA	NA	NA	Large fragment of dense homogenous slag, charcoal inclusions	354
NA	NA	NA	NA	c. 40 pieces of light cindery material, some with burnt limestone inclusions	1934
NA	NA	NA	NA	c. 50 pieces of light cindery material. Burnt limestone inclusions	1302
NA	NA	NA	NA	Small, rather dense smithing hearth cake with oxidized upper surface. Some charcoal inclusions	168
NA	NA	NA	NA	12 pieces of light cindery material, some with stoney inclusions	415
Total					46887

Table S.31 Description of the material related to metalworking from Mullingar, Blackhall Place, Co. Westmeath

Mulphedder, Co. Meath

Site no. 109

Townland: Mulphedder
Civil Parish: Clonard
Coordinates (ITM): E655639, N744888
SMR: ME047:005

Prospector: Niall Kenny
(Archaeological Consultancy Services Ltd.
Prospected in 2007

Site summary:

Ironworking activity: Smithing?			Significance: Low	
Site deposition condition: Secondary			Investigation level: Field-walking	
Ironworking features: None				
Dating evidence: Pottery, site-type			Sample size: > 45kg	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

Field-walking on the site of a ploughed-out ring-work at Mulphedder, Co. Meath revealed evidence for ironworking (Kenny 2007). Over 45kg of slag was encountered, mostly in the area within the ramparts of the ring-work (ibid.: 63). The debris included plano-convex cakes and was probably the result of smithing activities. Pottery recovered from the same area was dated to the thirteenth to fourteenth centuries (ibid.: 62).

Newtown Little, Co. Dublin

Site no. 110

Townland: Newtown Little
Civil Parish: Kilgobbin
Coordinates (ITM): E718575, N724807

Excavation licences: 05E0089 and 05E0333
Director: Kara Ward (Margaret Gowan Ltd.)
Excavated between April and May 2005

Site summary:

Ironworking activity: Smithing

Significance: Medium

Site deposition condition: Primary?

Investigation level: Complete excavation

Ironworking features: Hearths?

Dating evidence: Pottery

Sample size: Unknown

Material present:			
Slag	✓ Tuyeres	Tools	
Hammerscale	Other ceramic	Iron artefacts	

Description

An excavation at Newtown Little, Co. Dublin uncovered a group of three pits containing slag (Ward 2005). The first was a circular pit (1.25m diameter by 0.35m deep) which contained frequent large pieces of slag and six sherds of Dublin Type Cooking Ware (ibid.: 77). A second pit (0.6m diameter by 0.1m deep) was rich in slag, while a third (1.05 by 0.83 by 0.13m) contained less slag. All three features possibly represent smithing hearths, although the dimensions of the second are a-typical, with an unspecified late medieval date.

Nobber, Bridge Park, Co. Meath

Site no. 111

Townland: Nobber
Civil Parish: Nobber
Coordinates (ITM): E682411, N786365
SMR: ME005:071

Excavation licence: 07E0345
Director: Matt Seaver (CRDS)
Excavated between May and Nov. 2007

Site summary:

Ironworking activity: Smithing			Significance: High		
Site deposition condition: Primary			Investigation level: Partial excavation		
Ironworking features: Hearth					
Dating evidence: C14, pottery			Sample size: 25.76kg		
Material present:	Slag	✓	Tuyeres	Tools	✓
	Hammerscale		Other ceramic ✓	Iron artefacts	✓

Description

Excavations consisting of two larger areas and several trenches at Bridge Park in Nobber, Co. Meath uncovered remains belonging to the medieval borough of the same place (Seaver 2010). The oldest phase of activity on the site, dated to the late twelfth to thirteenth centuries, consisted of two post-built structures and a metalworking hearth situated along a metalled roadway (ibid. vol. 1: 22–32). Radiocarbon analysis on unspecified material from a hearth associated with one of the buildings returned a date of AD 1218–1303 (93.7%) and 1365–1383 (6.3%) (2σ) or AD 1252–1294 (1σ) (ibid. vol. 2: 140).

The metalworking hearth, C.1083, located in the trench next to the two larger areas, measured 1.2 by 1 by 0.2m, had a charcoal-rich fill but no scorching at its base (ibid. vol. 1: 32) (Fig. S.34).[177] It contained seven smithing hearth cakes (3430g in total), over 200 pieces of irregular slag (7970g) and over 53 pieces of vitrified ceramics

177 Judging from the photograph the feature was somewhat longer than the dimensions given.

(Wallace 2010: 173–174). It was assumed that at least some of the latter were parts of tuyeres, but this could not be confirmed (ibid.: 171). Further south in the same trench a spread of material contained a further smithing hearth cake (800g) and 46 fragments of irregular slag (1360g) (Seaver 2010 vol. 1: 32; Wallace 2010: 174). A small nodule of slag (10g) was recovered from a deposit near the eastern-most of the two structures (Seaver 2010 vol. 1: 143; Wallace 2010: 173).[178]

Fig. S.34 Nobber, Bridge Park, Co. Meath. Smithing hearth C.1083 (Seaver 2010: 32)

During the next phase, dated to the thirteenth/fourteenth centuries, a stone building was constructed on the site (Seaver 2010 vol. 1: 33–36). Two pieces of slag (480g together), one of which might have been a half of a smithing hearth cake, were recovered from one of the wall sections and multiple tiny fragment of slag (5g) were found incorporated into a nearby metalled surface (Seaver 2010 vol. 1: 148–149, 168; Wallace 2010: 173). In phase 3, dated to the fifteenth century, a boundary ditch flanked by pits was constructed along the old roadway, which also filled up during this phase (Seaver 2010 vol. 1: 36–42). A smithing hearth cake (1800g) was recovered from one of the fills, while more slag was found in another fill, organic material from which was radiocarbon

178 The specialist report mentions a further two large smithing hearth cakes (1120 and 2300g) from phase one (ibid.: 173). The associated feature (C.327), however, is a stakehole (Seaver 2010 vol. 1: 156), while the sample (270) is recorded as soil from a different feature (ibid.: 73).

dated to AD 1420–1523 (82.3%) and 1560–1561 (0.1%) and 1572–1629 (17.6%) (2σ) or AD 1433–1491 (92.6%) and 1603–1611 (7.4%) (1σ) (Seaver 2010 vol. 1: 74, 136, vol. 2: 140; Wallace 2010: 173–174).[179]

Several pieces of slag were also recovered from the parallel pits, that is to say two smithing hearth cakes (400 and 550g), a nodule (60g) and two irregular fragments (10g) (Seaver 2010 vol. 1: 138–140, 144; Wallace 2010: 173). A further half of a smithing hearth cake (270g) was found in natural silt around one of the walls from the previous phase and six irregular pieces (total 300g) from two layers of bank material associated with the new boundary ditch (Seaver 2010 vol. 1: 142, 146, 148; Wallace 2010: 173). During phase 4, dated to between the fifteenth and seventeenth centuries, the pits were regularly re-cut, stone structures built and a corn-drying kiln constructed (Seaver 2010: 42–48). Slag was found in a deposit sealing the ditch from the previous phase (a smithing hearth cake, 870g), on a stone surface (two smithing hearth cakes, 600 and 1800g) and in a deposit of garden soil (a 10g nodule) (ibid.: 136–137, 139; Wallace 2010: 173).

A deposit belonging to the final medieval phase (5), contained slag (medium bag), twenty-one sherds of medieval pottery and a small iron chisel or awl (Seaver 2010: 50, 54, 69). The site represents *in situ* thirteenth-, likely late thirteenth-century, ironworking, but the designation as a possible smithy in the report (Seaver 2010: 32, 58) could not be accepted as there is no clear evidence that the smithing activities were undertaken inside a building. Although it is possible that the residues from phases 3 and 4 are residual, it is more likely that they represent continued smithing in the same general area over a longer period.

179 The slag from the radiocarbon dated fill is not recorded in the specialist report.

Portmarnock, Co. Dublin

Site no. 112

Townland: Portmarnock
Civil Parish: Portmarnock
Coordinates (ITM): E722988, N742416

Excavation licence: 08E0376
Dir.: Colm Moriarty (Margaret Gowan Ltd.
Excavated between Sep. and Dec. 2008

Site summary:

Ironworking activity: Smithing			Significance: Medium	
Site deposition condition: Primary?			Investigation level: Partial excavation	
Ironworking features: Hearths?				
Dating evidence: C14, pottery			Sample size: 10.4kg	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts ✓

Description

At Portmarnock, Co. Dublin, six parallel, near-complete late medieval village plots were excavated (Moriarty 2011). One of the plots, which had two broadly square structures, contained 10.4kg of slag (ibid.: 250). All the residues were recovered from the yard, which was located east of one of the buildings and north of the other and fronted on to the street side.[180] Substantial amounts of pottery, mostly local wares, and a hone stone were recovered from features associated with this plot. Radiocarbon analysis of oak charcoal from the floor of one of the buildings returned a date of AD 1491–1641 (2σ) (ibid.: 247).[181] Three additional radiocarbon dates from features from the other plots gave very similar date spans. The published interpretation as this plot as belonging to a sixteenth-century village blacksmith would seem correct (ibid.: 265), although it is unclear if the activities took place inside one of the buildings, both of which had hearths, or in the open on the yard.

180 Confusingly, the location is described as south of Structure C, but should read north of Structure B.
181 Not recalibrated, BP dates not published.

Rathglass, Co. Galway

Site no. 113

Townland: Rathglass
Civil Parish: Killaan
Coordinates (ITM): E567909, N726909

Excavation licence: 07E0345
Director: Tamás Péterváry (CRDS)
Excavated between May and June 2006

Site summary:

Ironworking activity: Smelting			Significance: High	
Site deposition condition: Primary			Investigation level: Complete excavation	
Ironworking features: Furnaces				
Dating evidence: C14			Sample size: 18.5kg	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

The remains of several features containing material connected to ironworking were excavated at Rathglass, County Galway (Péterváry 2009). The late medieval component of the site was interpreted as probably connected to a nearby rectangular enclosure, which may have been a moated site (ibid.: 30).

The first feature consisted of a keyhole-shaped hollow, C.334, measuring 1.2 by 0.6 by 0.2m cut into an earlier pit and containing five fills (ibid.: 27) (See Fig. 6.6). Two of these contained frequent slag, "five litres" and 3367g, and a further large piece was recovered from the second oldest fill. A fragment of oak charcoal from the fill above this was radiocarbon-dated to AD 1274–1330 (49.6%) and 1339–1397 (50.4%) (2σ) or AD 1283–1311 (50.4%) and 1359–1387 (49.5%) (1σ) (ibid.: 107). One of the upper fills of the pit cut by this feature also contained a relatively large amount of slag (4284g) (ibid.: 26, 99–102), which might mean that this layer was actually connected to an ironworking feature.

A second feature, C.78, about ten metres north-west of the latter, consisted of a sub-oval bowl measuring 1.2 by 0.8 by 0.42m and showed heavy scorching at its base (ibid.: 27–28) (Fig. S.35). All of its three fills had slag inclusions according to the text, while the sample register only records a large amount of material (9614g) from the basal

fill (ibid.: 102). Radiocarbon analysis on a piece of alder charcoal from the basal fill gave a date of AD 1297–1373 (65.1%) and 1377–1422 (34.9%) (2σ) or AD 1313–1357 (67.0%) and 1388–1410 (33.0%) (1σ) (ibid.107).

Fig. S.35 Rathglass, Co. Galway. Post-excavation photograph of furnace C.78 (Péterváry 2009: 198)

A nearby corn-drying kiln, radiocarbon dated on carbonized seeds to AD 1284–1329 (42.6%) and 1340–1396 (57.4%) (2σ) or AD 1293–1315 (39.4%) and 1355–1388 (60.6%) (1σ), also contained a small amount (10g) of slag (ibid.: 28–29, 107). More slag (1287g) was recovered from the fill of a nearby ditch (ibid.: 26, 99). Pending visual analysis of the material, the features at Rathglass seem to represent two shaft furnaces with adjoining hollows to receive the laterally tapped slag. The larger furnace dates to the late thirteenth to fourteenth centuries, while the activity of the smaller one was more narrowly confined to the fourteenth century.

Rossan 4, Co. Meath

Site no. 114

Townland: Rossan
Civil Parish: Donaghmore
Coordinates (ITM): E659359, N744780
SMR: ME046:024

Excavation licence: 02E1066
Director: Deirdre Murphy
(Archaeological Consultancy Services Ltd.
Excavated after November 2002

Site summary:

Ironworking activity: Smelting?			Significance: Medium	
Site deposition condition: Secondary			Investigation level: Partial excavation	
Ironworking features: None				
Dating evidence: C14			Sample size: 331g	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

At the site of Rossan 4, Co. Meath several features were excavated, one of which was related to late medieval ironworking (Murphy 2008). An isolated sub-rectangular pit (C.003), measuring 2.08 by 1.3 by 0.2m and close to the edge of excavation, had a charcoal-rich fill and contained a small amount of metallurgical residues (331g) (ibid.: 3; Photos-Jones 2008c: 19). The material consisted of drippy slag, fines and vitrified ceramic material. A piece of the slag was chemically analysed (Table S.32) and interpreted as smelting slag derived from bog ore, based on the elevated manganese level, while the feature was seen as a (bloom) smithing hearth. A fragment of unspecified charcoal was subjected to radiocarbon analysis and returned a date of AD 1040–1110 (22.2%) and 1115–1271 (77.8%) (σ). The feature is very similar to a nearby feature (C.001) which was interpreted as a possible charcoal-production pit (Murphy 2008: 6, 33). If this is correct, then the metallurgical material is then residual, potentially from nearby smelting. The report mentions that charcoal from the site,

without specifying which contexts, consisted of oak (Murphy 2008: 6), but in the specialist report referred to, it was not included.

Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3
nm	1.53	0.61	26.72	0.34	0.84	6.19	n.d.	5.45	58.02

Table S.32 Results of chemical analyses of slag from Rossan 4, Co. Meath (Photos-Jones 2008c: 22)

Drippy slag. Rossan 4, Co. Meath, SASAA ROS2 [SEM-EDAX, average of two area analyses]

Shandon, Co. Waterford

Site no. 115

Townland: Shandon
Civil Parish: Dungarvan
Coordinates (ITM): E625467, N594409
SMR: WA031:072

Excavation licence: 01E0327
Director: Emer Dennehy
(Eachtra Archaeological Projects Ltd.)
Excavated between 2000 and 2002

Site summary:

Ironworking activity: Smelting, (bloom?)smithing			Significance: High		
Site deposition condition: Primary			Investigation level: Partial excavation		
Ironworking features: Furnaces, hearths?					
Dating evidence: C14, pottery			Sample size: 12.7kg		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

The site at Shandon, Co. Waterford, where the main feature consisted of a rectangular or square enclosing ditch, was excavated over several campaigns between 2000 and 2002 (Elder et al. 2012). Radiocarbon analysis of hazel and birch charcoal fragments from this ditch returned a date of AD 1080–1150 (2σ) (ibid.: 12)[182], while locally produced pottery (Dungarvan-type Cooking Ware) recovered from internal and outlying features was tentatively dated, based on its shape, to the twelfth to thirteenth centuries (McCutcheon 2012b: 36). The site was interpreted as either a moated site or, less likely, an earlier Hiberno-Norse site (Elder et al. 2012: 11–12). Metalworking residues, both ferrous and non-ferrous, were found in several areas, most of them outside of the enclosure itself.

A specialist report (Fairburn 2012a) was included in the final excavation findings and the same material, complemented with material not seen by Fairburn, was

182 No BP dates available.

examined as part of this thesis (Table S.33). Limited excavation of the features located inside the enclosure uncovered a pit containing bone, shell, twelfth- to thirteenth-century local pottery and two pieces of slag, one of which showed slight flow-structure. A crucible fragment, a copper ingot, some undiagnostic slag and a hammerscale particle adhering to a stone were recorded from unexcavated features, one of which also contained similarly dated pottery. The enclosing ditch itself produced only two tiny pieces of slag.

The features containing metallurgical residues in the area immediately to the south of the enclosure, consisted of various deposits and two pits. Apart from a small but convincing smithing hearth cake, some of the material might have represented weathered smelting slag. The most convincing of this material (170g) was recovered from deposit C.121 inside the enclosure, which was not fully excavated and yielded no pottery (ibid.: 5). One of the pits also contained twelfth- to thirteenth-century pottery and an eleventh-century Hiberno-Norse coin was retrieved from one of the deposits. Other features with metallurgical remains, found about 75m removed, included a large rubbish pit (C.2211) which contained smithing hearth cakes, vitrified ceramic material and at least 249g of possible smelting slag (ibid.: 6). This pit also had possible Dungarvan-type Ware in some of its fills.

About 6 metres away from this pit, the first concentration of metalworking remains was uncovered. A first pit, C.2008, in this area measured 0.28 by 0.23 by 0.24m[183] and had undercut edges (See Fig. 6.3a). This feature contained 2090g of slag which included over a hundred pieces of dense drippy slag (See Fig. 6.3b), frothy furnace cake and small fragments of furnace wall.[184] Immediately north-east of this feature, two conjoined pits, C.2018 and C.2019, had gradual sides and measured respectively 0.26 by 0.23 by 0.15m and 0.36 by 0.31 by 0.1m (ibid.: 19). These pits yielded a further 435g of dense drippy smelting slag, frothy furnace cake and furnace-wall fragments. Two metres to the north, another pit, C.2005, measuring 0.46 by 0.4 by 0.11m and with vertical sides held 807g of slag (ibid.: 9). This included dense slag with flow-structure and clear impressions of large wood fragments, pieces of a furnace-wall (Fig. S.36) and tuyere fragments (Fig. S.37).

To the west of the latter, a concentration a group of stakeholes and a slot-trench

183 Different values (0.24 by 0.14 by 0.11m) are given in the feature list (ibid.: 19), but the photograph of this feature, with scale, shows the first measurements to be correct (ibid.: 108, Plate 14).

184 In the feature listing this context is mentioned as the fill of three stakeholes (ibid.: 18–19). The same number, and C.2077, is also found as the fill of pit C.2090 (ibid.: 22). It is suggested here that C.2007 represents the fill of C.2008.

possibly formed a circular structure (ibid.: 9). To the south of this more features contained ironworking residues. The first pit, C.2090, measured 0.46 by 0.4 by 0.18m, had vertical sides and contained 2294g of slag, consisting exclusively of dense drippy slag, often with impressions of large wood fragments (ibid.: 6). Nearby, another pit, C.2093, measuring 0.98 by 0.69 by 0.07m contained a further 594g of slag, mostly weathered but with indications of smelting, and vitrified clay fragments. Because of their shape and the slag contained in them, features C.2005 and C.2008 are considered to be slag-pit furnaces. The other features around these furnaces were possibly refuse pits or connected to further processing of the blooms, as evidenced by the tuyere fragments. No dated material was recovered from the furnaces or their associated features, but the occurrence of possible smelting slag in the rubbish pit together with the local pottery could indicate a late medieval, possibly twelfth- to thirteenth-century, date. The same tentative dating can be proposed for the smithing activities.

Fig. S.36 Shandon, Co. Waterford. Furnace wall fragments

Fig. S.37 Shandon, Co. Waterford. Tuyere fragment

Cut	Fill	Type	Description	Weight (g)
123	116	Pit	Piece of dense slag with slight flow structure	29
123	116	Pit	Small piece of vitrified slag	1
NA	120	Unexcavated	Small piece of drippy slag	2
NA	121	Unexcavated	2 fitting pieces of a small crucible	2
NA	121	Unexcavated	23 pieces of relatively dense slag, some pieces could be weathered smelting slag	170
156	157	Ditch	2 tiny pieces of slag	1
NA	1152	Deposit	Lump of rather dense slag with rust adhering on several sides	75
NA	1152	Deposit	Fragment of small round disc of slag	12
NA	1158	Deposit	Piece of drippy vitrified slag	6

NA	1196	Deposit	7 small pieces of rounded rather light slag	20
1203	1202	Pit	Small rounded lump of rusty slag	6
1239	1232	Pit	Small vitrified smithing hearth cake with rust adhering to both sides	116
2005	2004	Pit	Two large and three small pieces of dense drippy slag, some with impressions of large wood/charcoal fragments. Smelting	382
2005	2004	Pit	6 pieces of heat affected clay material with some vitrification	79
2005	2004	Pit	9 pieces of vitrified clay with adhering slag. One piece with protruding blow hole slagged on the exterior, tuyere fragment	74
2005	2004	Pit	16 pieces of heat affected clay, some with a smoothened side. Furnace wall	42
2005	NA	Cut of pit (?)	Multiple fragments of hardened clay, one side smoothened, thickness about 10mm	230
2018/ 2019	2006	Pit	17 pieces of dense drippy slag. Smelting	207
2018/ 2019	2006	Pit	11 pieces of light frothy slag. Furnace cake material	43
2018/ 2019	2006	Pit	39 pieces of heat affected clay, some showing a smoothened side. Furnace wall	185
2008?	2007	Pit	100+ pieces of dense drippy lobed shiny slag, some with impressions of wood/charcoal. Smelting	1849
2008?	2007	Pit	Multiple pieces of frothy slag, most very small. Furnace cake	216
2008?	2007	Pit	17 small pieces of heat affected clay and stone, one with possible decoration in the form of an incized curving line	25
2090	2077	Pit	100+ fragments of shiny drippy lobed slag with impressions of large wood/charcoal pieces	1997
2090	2077	Pit	24 fragments of shiny drippy lobed slag with impressions of large wood/charcoal pieces	297
2093	2089	Pit	Lump of rather dense slag	160
2093	2089	Pit	Lump of rather dense rusty coloured slag	64
2093	2089	Pit	Lump of rather dense slag	160
2093	2089	Pit	9 pieces of relatively light slag	65
2093	2089	Pit	15 pieces of vitrified clay with adhering slag film, tuyere or hearth lining	142
2093	2089	Pit	Small piece of shiny lobed slag, poss. Smelting	3
2211	2200	Pit	Dense semi-circular smithing hearth cake	478
2211	2200	Pit	Fragment of very dense thick smithing hearth cake	541
2211	2200	Pit	10 pieces of relatively light slag lumps	359
2211	2200	Pit	Relatively dense lump of slag with adhering burnt clay on a flat side	152
2211	2200	Pit	Fragment of vitrified slag droplet	1
2211	2200	Pit	Piece of relatively dense slag	19
2211	2205	Pit	Relatively light elongated smithing hearth cake with flow structure on the base	288
2211	2205	Pit	Relatively dense smithing hearth cake lump	419
2211	2205	Pit	Small relatively dense smithing hearth cake	154

2211	2205	Pit	Relatively light piece of slag showing clear flow structure	147
2211	2205	Pit	2 pieces of relatively dense slag with rusty patches	116
2211	2205	Pit	25 pieces of light slag, some vitrified	261
2211	2205	Pit	3 small pieces of vitrified clay with adhering slag, tuyere or hearth lining	13
2211	2207	Pit	Large dense, well formed SHC	634
2211	2207	Pit	Large dense, relatively thick SHC	629
2211	2207	Pit	Dense, thin SHC	356
2211	2207	Pit	Dense elongated SHC	273
2211	2207	Pit	Dense mass of heavily lobed slag with small patch of burnt clay adhering (smelting?)	249
2211	2207	Pit	5 pieces of dense rusty coloured slag	405
2211	2207	Pit	8 small pieces of rather light slag	40
2211	2207	Pit	Small flat piece of vitrified clay with adhering slag	7
2211	2207	Pit	4 fitting fragments of piece of vitrified clay, probably tuyere or hearth lining	9
Sondage 3			Small fractured piece of rusty slag	10
Sondage 5			4 small pieces of slag	13
Sondage 5			8 pieces of relatively light slag, some possibly smelting	59
Stray			Piece of vitrified clay and adhering slag, probable tuyere or hearth lining	1
Stray			Small piece highly shiny slag with fayalite crystals	7
Stray			3 small pieces of rather light slag, one piece could be weathered smelting slag	20
Stray			2 small pieces of vitrified slag	1
Stray			25 small pieces of rusty slag. Some could be weathered smelting slag	166
Stray			2 small pieces of drippy shiny slag, possibly smelting	7
Stray			Piece of rather dense, flowed slag, smelting?	14
Stray			Tiny piece of drippy slag	1
Stray			Piece of irregular shaped, vitrified slag	24
Stray			Piece of drippy slag, rather dense	23
Stray			Three pieces (one tiny) of drippy, irregular rather dense slag	58
Stray			9 pieces of relatively light slag, some vitrified	95
Total				12709

Table S.33 Description of the material related to metalworking from Shandon, Co. Waterford

St. Mary's Abbey, Co. Fermanagh

Site no. 116

Townland: Devenish
Civil Parish: Devenish
Coordinates (ITM): E622407, N846935
SMR: FER211:021

Director: David M. Waterman
Excavated between 1972 and 1974

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations of the east range of the Augustinian St. Mary's Abbey, Co. Fermanagh on Devenish Island revealed several features which included metalworking debris (Waterman et al. 1979). The building is recorded as constructed around the middle of the fifteenth century (ibid.: 34). The first, apparently unfinished, building phase was probably not much earlier, and slag was recovered from one of its foundation trenches (FD) (ibid.: 38, 47). A layer (C.14) connected with the completion of the final building contained further slag, including a likely smithing hearth cake ("furnace bottom") and probable fifteenth- to sixteenth-century pottery (ibid.: 39, 43). Inside the range, two pits (C.25 and C.37) yielding slag and a "bronze smelting furnace" were uncovered, which could have been contemporary or older than the building phases (ibid.: 39). A large part of the range was subsequently covered in debris related to a fire, which was dated to c. 1500 AD, both by artefacts and seven radiocarbon dates from this layer (ibid.: 48). Although the information is limited, it is suggested here that the ironworking on the site represents smithing connected to the building activities from around the middle of the fifteenth century.

Taduff East 2, Co. Roscommon

Site no. 117

Townland: Taduff East
Civil Parish: Drum
Coordinates (ITM): E597947, N739441
SMR: RO051:111

Excavation licence: E3272
Dir.: Gary Conboy (Valerie J. Keeley Ltd.)
Excavated in May 2007

Site summary:

Ironworking activity: Smelting		Significance: Medium	
Site deposition condition: Secondary?		Investigation level: Partial excavation	
Ironworking features: Furnace?			
Dating evidence: C14		Sample size: 3.8kg	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

During excavations at the site of Taduff East 2, County Roscommon, a series of pits containing ironworking residues were uncovered (Conboy 2010) (Fig. S.38). The first of the four pits, C.9, measured 1.39 by 1.26m and was 0.22m deep (ibid.: 31, 33). It contained five fills, the lowest of which was a thin layer of orangey-red sandy clay. Above this was a charcoal-rich layer containing one piece of furnace slag (557g), followed by a layer of ashy silt with charcoal fragments, but without slag (Keys 2010b). Radiocarbon analysis of a fragment of oak charcoal from the charcoal-rich layer produced a date of AD 1296–1401 (2σ) or AD 1301–1327 (40.2%) and 1342–1367 (39.9%) and 1382–1394 (19.9%) (1σ) (Conboy 2010: 30).

Above this was a clayey silt layer with charcoal fragments and thirteen pieces of slag (1140g), all described as furnace slag (some probable), two of which were runny, while another two were part of a slag block showing wood impressions. The upper fill, consisting of silty clay with charcoal inclusions, had a further twelve pieces of slag

(565g), half of which were described as tap slag which had collected in a hollow (Keys 2010b). The second pit, C.7, measured 1.27 by 1.17m and was 0.22m deep. The lower fill was pale grey sandy silt described as including small pieces of slag, although none are recorded in the specialist report (Conboy 2010: 31; Keys 2010b: 28). The next layer, clayey silt with large fragments of charcoal, included seven pieces of runny slag (125g).

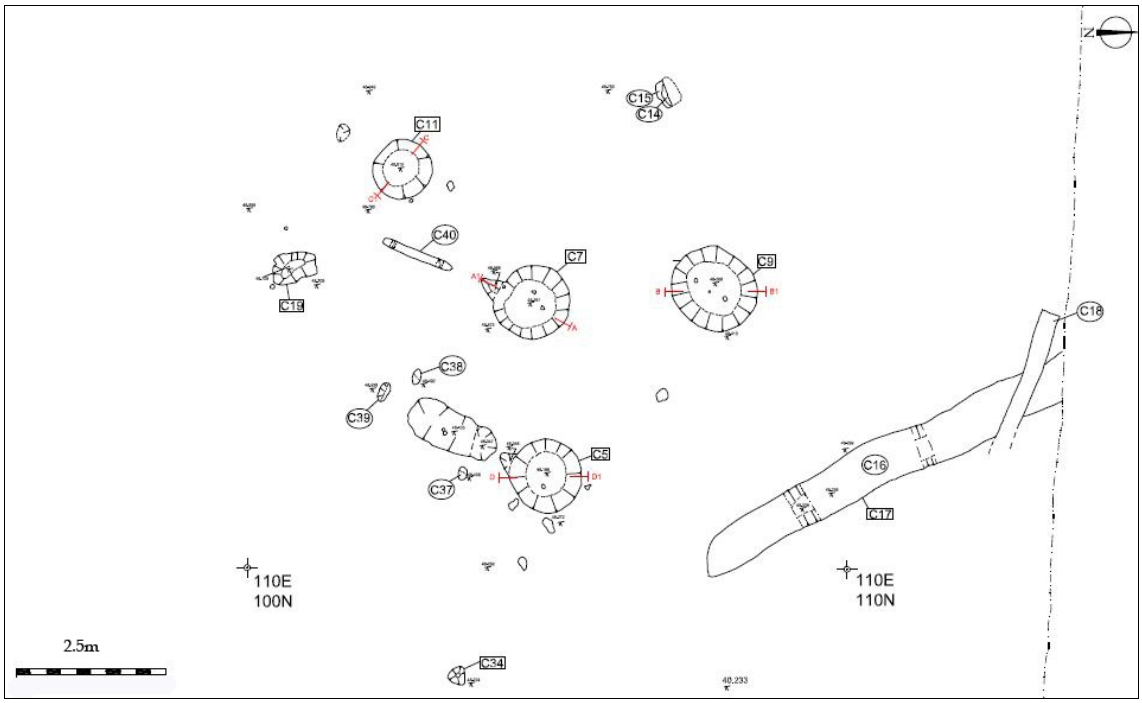

Fig. S.38 Taduff East, Co. Roscommon. Site plan (after Conboy 2010: 53)

Ten centimetres (?) to the south of this feature was a spread measuring 1.59 by 0.57 by 0.06m and consisting of pale grey sandy clay with occasional charcoal, burnt clay and thirty-nine pieces of furnace and run slag (1412g) (Conboy 2010: 10, 33; Keys 2010b: 28). Part of the latter spread consisted of thirteen pieces weighing 190g. Two further pits, of similar dimensions and each with charcoal-rich layers above a burnt layer at their bases, did not yield any slag. These pits were dated by radiocarbon analysis to respectively the fourteenth and between the late fifteenth and early seventeenth centuries (Conboy 2010: 30). These four pits, although interpreted as shaft furnaces in the report, would more probably represent charcoal-production pits in which smelting slag was dumped. No features, however, could be convincingly interpreted as furnaces.

Pit C.7 had a semi-circular depression, V-shaped in section at its edge, which could represent a truncated furnace base, but a similar feature was recorded at the edge of one of the pits holding no slag. Another possibility, is that the spread next to C.7 was

the very basal layer of a heavily damaged shaft furnace. Although interpreted as raked-out material, the dimensions would be representative of a furnace and tapping area, while the occurrence of multiple small fragments might indicate the material was not transported over a long distance. Alternatively, the furnace(s) might have been located outside the excavated area. If the assertion in the specialist report that the assemblage represents a single event (Keys 2010b: 29) is correct, then, as some of the slag was mixed in with the radiocarbon dated charcoal-rich layer, the ironworking activity is broadly contemporary with this fourteenth-, likely early to mid-fourteenth-century, date.

Thomastown, Chapel Lane, Co. Kilkenny

Site no. 118

Townland: Cloghabrody
Civil Parish: Thomastown
Coordinates (ITM): E658504, N642055
SMR: KK028:040

Excavation licence: 95E0233
Director: Ben Murtagh
(Archaeological Works)
Excavated in 2002

Site summary:

Ironworking activity: (Bloom?) smithing			Significance: Low		
Site deposition condition: Secondary			Investigation level: Urban		
Ironworking features: None					
Dating evidence: Pottery			Sample size: 10.8kg		
Material present:	Slag	✓	Tuyeres	✓	Tools
	Hammerscale		Other ceramic		Iron artefacts

Description

During an excavation at Chapel Lane, Thomastown, Co. Kilkenny, in an area which would have been situated outside the medieval town walls of that place, metalworking waste was recovered from several late medieval features (Murtagh 1998). The ironworking residues were recovered from three pits, that is to say C.60, C.90 and C.96, and a layer C.29 (ibid.: 4–5). These contained respectively 2484g, 1056g, 3457g and 3826g of residues. The layer was stratigraphically earlier than the upper fill of one of the pits C.60, while the pits themselves were interpreted as cesspits used for discarding rubbish. Pottery from these features consisted of South Leinster Cooking Ware and local wares (ibid.: 16–19). The material from this site was subjected to visual examination as part of this doctoral research (Table S.34).

Most of the material consisted of smithing hearth cakes or fragments thereof. Several of these were well formed, one example showing a “blowing hollow” created by the the air from the bellows and forming a dip in the still semi-liquid slag which then

solidified (See Fig. 8.15c). Other smithing hearth cakes were more irregular and all were rather dense. The weight of these varied between around 400g and 1150g. Of particular interest is a pie-shaped piece of vitrified clay with adhering slag which represents the remnants of the front of a large-diameter tuyere (See Fig. 8.10b). The original diameter would have been just under 0.25m.

While nearly all the evidence for the fuel used in the metalworking at Thomastown consists of pieces and impressions of charcoal in the slag, one piece, from pit C.60, exclusively contains clearly recognizable coal inclusions. Striking was the fact that a large proportion of the slag material from pit C.60 was heavily weathered as opposed to that from the other contexts, suggesting that this material was only deposited after it had been exposed to the elements for a certain time. Also, the absence of smaller fragments, if not the result of selective sampling, would point to the material being redeposited from elsewhere.

Cut	Fill	Type	Description	Weight (g)
NA	29	Layer	Well formed, dense bun-shaped smithing hearth cake	463
NA	29	Layer	Dense lumpy smithing hearth cake	506
NA	29	Layer	Flat smithing hearth cake with oxidized exterior	348
NA	29	Layer	Squarish fragment of dense smithing hearth cake	291
NA	29	Layer	Piece of light vitrified slag	112
NA	29	Layer	Roughly wedge-shaped piece of highly vitrified ceramic material (L: 105mm), piece of large tuyere	165
NA	29	Layer	27 fragments of dense smithing hearth cake material	1941
NA	29	Layer	Three pieces of oxidized iron, one possible knife blade	
60	61	Pit	Weathered, rounded dense smithing hearth cake	759
60	61	Pit	Weathered, rounded dense smithing hearth cake	475
60	61	Pit	Roughly rectangular, oxidized partial smithing hearth cake	401
60	61	Pit	Lump of weathered dense slag	315
60	61	Pit	Two fragments of dense smithing hearth cakes	348
60	61	Pit	Piece of light vitrified slag	99
60	61	Pit	Slag with adhering clay which contains frequent coal inclusions	87
90	108	Pit	Two small smithing hearth cakes fused together, both dense, one with crust of oxidization	379
90	108	Pit	Small smithing hearth cake, dense with a crust of oxidization	130
90	108	Pit	Partial dense smithing hearth cake	300
90	108	Pit	Triangular dense slag piece, the small area of lighter slag on one of the corners could suggest this is a “pro-tuyere tongue”	68
90	108	Pit	Two fragments of dense smithing hearth cakes	179

96	109	Pit	Well formed, dense squarish smithing hearth cake with blowing hollow visible on upper side	1150
96	109	Pit	Partial, rather dense smithing hearth cake	688
96	109	Pit	Rather dense smithing hearth cake with porous bottom half and oxidized upper part	532
96	109	Pit	Dense, irregular smithing hearth cake with more oxidized upper part, could represent two working phases	297
96	109	Pit	Rather dense, irregular smithing hearth cake with more oxidized upper part	261
96	109	Pit	Eight fragments of dense smithing hearth cakes	529
Total				10823

Table S.34 Description of the material related to metalworking from Thomastown, Chapel Lane, Co. Kilkenny

Tintern Abbey, Co. Wexford

Site no. 119

Townland: Tintern
Civil Parish: Tintern
Coordinates (ITM): E679366, N610063
SMR: WX045:027C.01)

Dir.: Ann Lynch (Office of Public Works)
Excavated between 1980 and 1984

Site summary:

Ironworking activity: Smithing			Significance: Medium		
Site deposition condition: Primary			Investigation level: Partial excavation		
Ironworking features: Hearths					
Dating evidence: Pottery			Sample size: > 725g		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

Excavations at Tintern Abbey, Co. Wexford revealed evidence of both iron and copper-working concentrated in the ambulatory or the covered walkway around the cloister (Lynch 2010). An earlier "furnace bottom"[185] (plano-convex, 134mm diameter and 42mm thick, 725g), undoubtedly a smithing hearth cake, was recovered from a drain of late thirteenth-century date (ibid.: 170–171). The features in the ambulatory consisted of a series of pits and layers in its north-western corner (ibid.: 79–80). The largest of these, and most easterly, (C.638) was sub-rectangular in shape, measured c. 1 by c. 0.65m[186] and was between 0.33 and 0.4m deep (ibid.: 80). It was lined on three sides by roofing slates and all three fills contained slag and vitrified ceramic material.

To the north-west of this feature, a deposit containing a large amount of iron slag was uncovered. South of it, two smaller pits without slag were located. Further west, were two large pits (C.652 and C.653), both measuring c. 1 by c. 0.6m and respectively 0.16 to 0.34m deep and 0.21m deep (ibid.: 79). The first contained fragments of molten copper and copper slag, while the second, which was stratigraphically earlier, contained

185 This early, and the later, waste was seen as the result of smelting based on these "furnace bottoms" and on the false assumption that high iron and calcium content of slag indicate smelting (ibid.: 169).
186 Dimensions taken from the plan (ibid.: 79)

slag and “furnace bottom” fragments inside a circular setting of stones C.0.62m diameter). Two small postholes south of the former might be anvil-block supports. These pits were surrounded by a layer rich in slag, some containing copper (ibid.: 80).

Both the “furnace bottom” (E273: 1036) and some of the later iron slag was chemically analysed (Table S.35). The results, however, only given for oxides of four elements, Al, Si, Ca and Fe, are represented in columns and the values below should be seen as approximate. The metalworking activity was regarded as post-dating the dissolution of the abbey in AD 1536 and potentially connected either to demolition work related to this event and/or to construction work connected with a historically attested building phase in AD 1560 (ibid.: 169). The extent of the activity, at least two phases and large volumes of waste (although unquantified), would seem to indicate longer-term metalworking.

It is here suggested that the site possibly represents the activities of a smith taking up residence in the monastery in the period between its abandonment and the renovation, that is to say around the mid-sixteenth century. All three hearths are considered possibly used for metalworking activities, one seemingly (exclusively?) for copper-working, but is unclear if the whole feature can be seen as the hearth or, for example, only the stone-setting within it.

	Al_2O_3	SiO_2	CaO	Fe_2O_3
1	12	8	3	70
2	10	31	39	12
3	11	28	4	48
4	12	26	3	53
5	14	55	3	16
6	6	15	4	68
7	17	52	3	18
8	7	19	5	62
9	13	33	3	43

Table S.35 Results of chemical analyses of slag from Tintern Abbey, Co. Wexford (Lynch 2010: 170)

1 Furnace bottom. Tintern Abbey, Co. Wexford, E273: 1036 [Unspecified analysis method]
2 Slag. Tintern Abbey, Co. Wexford, N00F0005-Sample 3 [id.]
3 Slag. Id., N00F0012-Sample 3 [id.]
4 Slag. Id., N00F0007-Sample 10 [id.]
5 Slag. Id., N00F0014-Sample 12 [id.]
6 Slag. Id., N00F0009-Sample 15 [id.]
7 Slag. Id., N00F0015-Sample 17 [id.]
8 Slag. Id., N00F0010-Sample 18 [id.]
9 Slag. Id., N00F0011-Sample 41 [id.]

Trevet 1, Co. Meath

Site no. 120

Townland: Trevet
Civil Parish: Trevet
Coordinates (ITM): E695768, N756602

Excavation licence: E3607
Director: Stuart Rathbone
(Archaeological Consultancy Services Ltd.)
Excavated between July and December 2006

Site summary:

Ironworking activity: Smithing			Significance: High	
Site deposition condition: Primary			Investigation level: Complete excavation	
Ironworking features: Hearth				
Dating evidence: Pottery			Sample size: 4932g	
Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale	✓	Other ceramic	Iron artefacts

Description

At Trevet 1, Co. Meath a late medieval long-house enclosed by a ditch was excavated (Rathbone 2009). A clayey layer (C.13) that covered most of the site, which was interpreted as the remains of the demolished walls of the structure, contained 3667g of slag including two smithing hearth cakes (262 and 1130g) (ibid.: 7; Wallace 2009b: 2–3). A third smithing hearth cake (523g) was recovered from a possibly contemporary stone surface (Rathbone 2009: 6; Wallace 2009b: 5). Nodules of slag were found in a post-medieval drainage ditch (C.18) (ten with a total weight of 279g), in a deposit at the entrance to the building (22g) and in three of the ditches (C.24, C.36 and C.38) (total 441g) (Rathbone 2009: 21–23; Wallace 2009b: 4). Samples of both fills of a possible hearth (C.68) with burnt base, located outside of the north-eastern corner of the building, contained small amounts of hammerscale or metal dust (Rathbone 2009: 5; Anonymous

2009: 158).[187] This feature measured 2.1 by 0.6m[188] and yielded a sherd of local medieval Fineware (Doyle 2009: 88). More than three thousand sherds of late medieval pottery were found at Trevet 1, exclusively consisting of local types, most of which were from context C.13. Next to this, a substantial amount of iron objects was recovered, mostly nails and parts of knives. The site represents *in situ* ironworking activity of a general late medieval date.

187 Some caution is necessary as similar material was recovered from two pits (C.52 and C.70) related to burnt mound activity and a fourth pit (C.142) for which no further information was available.

188 Measurements taken from plan.

Trim Castle, Co. Meath

Site no. 121

Townland: Manorland
Civil Parish: Trim
Coordinates (ITM): E680195, N756727
SMR: ME036:048C.04)

Excavation licence: 95E0077
Dir.: Alan Hayden (Office of Public Works)
Excavated between 1995 and 1998

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Complete excavation	
Ironworking features: None			
Dating evidence: Pottery		Sample size: 87kg	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

During extensive excavations at Trim Castle, Co. Meath, 87kg of "iron slag and furnace bottoms" were found (Hayden 2011: 368). The furnace bottoms ranged from 80 to 160 mm in diameter. No further information is available in the publication, and according to the site director none of this material was found *in situ* (A. Hayden, pers. comm.).

Trim, High Street, Co. Meath

Site no. 122

Townland: Townparks North
Civil Parish: Trim
Coordinates (ITM): E680172, N756999
SMR: ME036:048

Excavation licence: 01E1146ext.
Dir.: Alan Hayden
(Archaeological Projects Ltd.)
Excavated in February 2002

Site summary:

Ironworking activity: Smithing		Significance: High	
Site deposition condition: Primary		Investigation level: Urban	
Ironworking features: Hearths			
Dating evidence: Pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

Excavations on the south side of High Street in Trim, Co. Meath uncovered extensive remains related to metalworking belonging to the late medieval period (Hayden 2009). The plot was situated at the street-front on the south side of the main artery of medieval Trim. During the first level of the late medieval phase of ironworking, a ditch was constructed between this street and the activity to the south (ibid.: 259). This activity consisted of several shallow hearths[189], interpreted as used for metalworking, set in a burnt clay floor (ibid.: 259–260).

At the end of this level a stone building, and possibly a post-built one, were constructed in the area (ibid: 261–262). This level was dated to the later thirteenth or early fourteenth centuries, based on the occurrence of Saintonge Green-Glazed Ware and Dublin Temper Free Ware (ibid.: 262). The next level of activity began with the construction of a building with wooden sill-beam walls with an internal hearth. No

189 The numbers of these are not specified and are hard to make out on the accompanying plan (ibid.: 259).

associated metalworking was recorded. Next, a clay floor was put down which contained a hearth (1m diameter) with several large lumps of slag. This smithing was seen as carried out in open air. The next level saw the construction of a large stone building on the western side of the excavations, while a smaller stone building was erected to the east (ibid.: 262–263).

A clay floor outside the latter building had three hearths cut into it, each measuring 0.7 to 0.8m diameter (ibid.: 264). These hearths were also seen as related to metalworking. During a final medieval level, a new floor level was introduced which had a hearth C.0.7m diameter) again associated with metalworking (ibid.: 265). This was overlaid with further burnt deposits and a one metre diameter hearth (ibid.: 265–266). The backfill of the demolition of the western stone building contained a fourteenth-century floor tile fragment and thirteenth- to fifteenth-century Irish pottery (ibid.: 266). This demolition was seen as taking place before the mid-sixteenth century. If all the hearths are indeed related to metalworking, and slag is only specifically mentioned in relation to one of them, then the site represents long-lived metalworking activity, spanning the thirteenth and fourteenth centuries and possibly beyond, but with potential gaps.

Tullykane, Co. Meath

Site no. 123

Townland: Tullykane
Civil Parish: Kilmessan
Coordinates (ITM): E690126, N757466
SMR: ME037:036

Excavation licence: 00E0264
Dir.: Christine Baker (Arch-Tech Ltd.)
Excavated in 2000

Site summary:

Ironworking activity: Smithing		Significance: Medium	
Site deposition condition: Primary?		Investigation level: Partial excavation	
Ironworking features: Hearth?			
Dating evidence: Pottery		Sample size: 18.8kg	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts ✓

Description

Excavations at Tullykane, Co. Meath revealed late medieval possible house structures and connected features containing metalworking waste (Baker 2002) (Fig. S.39). One possible structure consisted of two parallel and curving gullies connected to a larger ditch enclosing an area containing several postholes. A similar curved gully (C.43) was located to the east of the eastern-most of the former (C.19), potentially indicating an expansion or contraction of the structure. The latter contained 130g of slag while the former had 300g (ibid.: 32–33). The ditch (F 41) forming the northern side of the structure, a gully (C.42) parallel and to the north of it and a nearby depression (C.46) contained respectively 555g, 230g and 170g of slag (ibid.: 30–31, 39–40).

About 5m to the east of this structure, a shallow L-shaped feature (C.25) with a deeper western end was uncovered. This western end, which had an irregular figure-of-eight shape, measured 1.5 by c. 0.8m and contained most of the ironworking residues

(295g) (ibid.: 29).[190] Some slag, located lower down in the feature is described as adhering to lumps of clay, but it is unclear if this implies *in situ* smithing or the occurrence of vitrified ceramic material. A nearby pit (C.24, 2.6 by 1.25 by 0.25m) held another 5305g of slag, while a larger pit (C.23, 3.6 by 2 by 0.25m) south of this contained 60g (ibid.: 28–29).

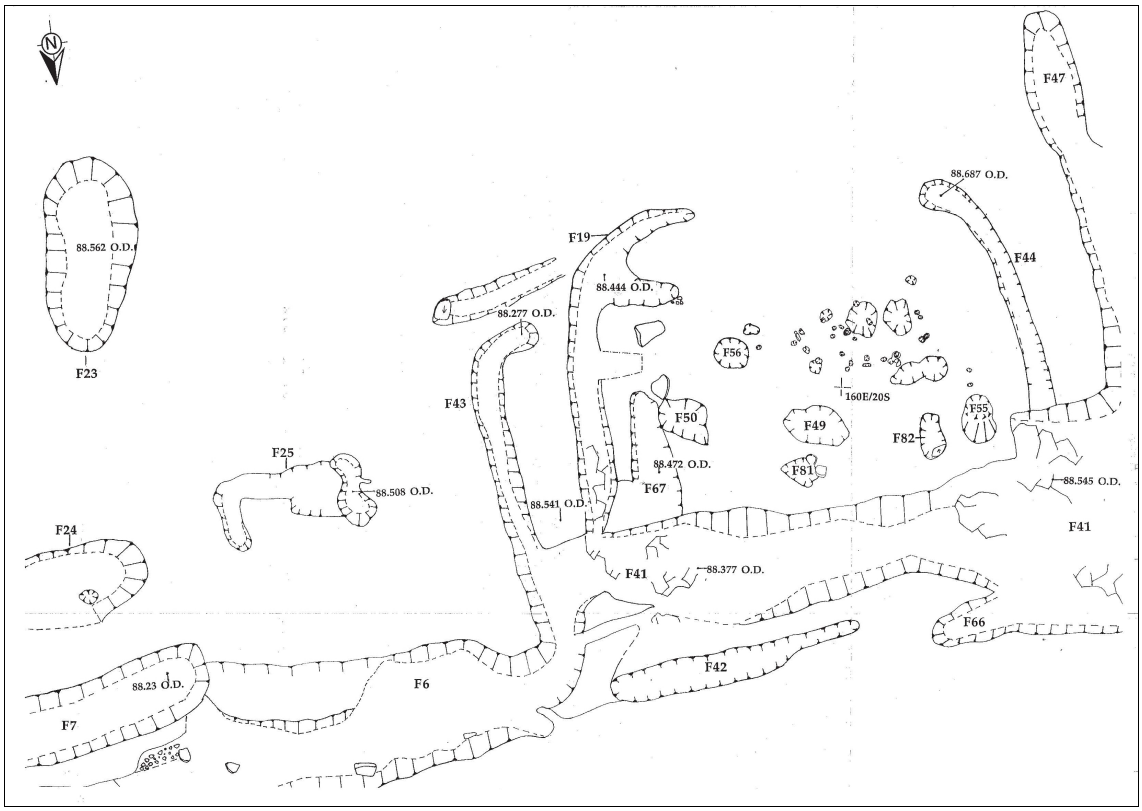

Fig. S.39 Tullykane, Co. Meath. Site plan (after Baker 2002: 98)

To the north of these pits, two ditches (C.6 and C.7) forming the continuation of the northern boundary ditch of the structure contained respectively 6030g and 4455g, while an additional 735g was labelled C.6/C.7 (ibid.: 27–28). About 15 metres north of this structure, further small amounts of slag were recovered from a ditch section (C.28, 115g), an irregular feature (C.37, 395g) and three deposits (L4, 140g, L16, 75g and L34, 30g) (ibid.: 11, 12, 26, 27, 52). All the above features, except deposits L4 and L16, contained substantial amounts of pottery sherds consisting of four types, that is to say local ware, Leinster Cooking Ware, Dublin-type Fineware and possible imports (ibid.: 55). The decoration on the local ware showed strong influence from Ham Green B Ware, while occupation of the site was deemed short and was situated in the second half

190 This value might be incorrect as C.25 is elsewhere described as having a high concentration of slag (ibid.: 8, 60).

of the thirteenth to the fourteenth centuries. The metallurgical residues were concentrated in the area to the east of the structure, with the deeper, western part of feature C.25 being the best candidate as a potential smithing hearth.

Tullylish, Co. Down

Site no. 124

Townland: Tullylish
Civil Parish: Tullylish
Coordinates (ITM): E708148, N848645
SMR: DOW026:005

Dir.: Richard Ivens
(Department of the Environment)

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Partial excavation	
Ironworking features: None			
Dating evidence: C14, pottery		Sample size: Unknown	
Material present:	Slag	✓ Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

At Tullylish, Co. Down at least two phases of metalworking were uncovered (Ivens et al. 1987). The early medieval metalworking phase, with evidence for both iron- and copper-working, was related to an enclosure around an early medieval monastic church and consisted primarily of a large hearth set into the top of an earlier ditch (ibid.: 61, 114). During the late medieval phase the enclosure went out of use, after which the site was interpreted as being either secular in nature or as a possible rectorial farm (ibid.: 118).

On the interior of the former enclosure, in Trench 1, a large corn-drying kiln was excavated. Nine of its fills contained slag, some of which was found together with Everted Rim Ware and wheel-thrown glazed pottery (ibid.: mf5, mf10).[191] Radiocarbon analysis from material related to the latest firing of this kiln returned a date of AD 1438–1641 (2σ) or AD 1447–1522 (61.4%) and 1574–1626 (38.5%) (1σ) (ibid.: 62,

191 The notation mf refers to the paginated microfiche accompanying the publication.

119).[192] Additional slag was recovered from a nearby gully containing two postholes (C.1.25), a possible gully (C.1.31), a deposit (C.1.35) and a shallow hollow (C.1.50) (ibid.:mf10). The first of these features also contained Everted Rim Ware (ibid.:mf5). About 15m to the north of the kiln, in Trench 6, slag was recovered from several of the top fills (C.6.10, C.6.11 and C.6.12) of the outer ditch, which also contained Everted Rim Ware and glazed wheel-thrown pottery (ibid.:mf6,mf11). Three fragments of crucibles were also found in these fills (ibid.: 104). There is no evidence for *in situ* late medieval ironworking at Tullylish, but the waste of the activity dumped in the abandoned kiln probably dates to the late fifteenth to early seventeenth centuries.

192 Confusingly, the radiocarbon analysis is recorded as taken from sample 1.76 (ibid.: 119), while this context is described as a final fill of the inner ditch (ibid.:mf18).

Walterstown, Co. Louth

Site no. 125

Townland: Walterstown
Civil Parish: Dromiskin
Coordinates (ITM): E702118, N800862

Excavation licence: 06E0307
Director: Dee Malone
Excavated in 2006

Site summary:

Ironworking activity: Smithing

Significance: Low

Site deposition condition: Secondary

Investigation level: Partial excavation

Ironworking features: None

Dating evidence: Pottery

Sample size: Unknown

Material present:	Slag	✓	Tuyeres	Tools
	Hammerscale		Other ceramic	Iron artefacts

Description

Excavations at Walterstown, Co. Louth uncovered extensive remains of late medieval activity (Malone and Halpin 2009).[193] The site included a complex of ditches, three corn-drying kilns and multiple pits. One of the latter contained iron slag, a spindle whorl and many sherds of medieval pottery. Pending specialist analysis and scientific dating, the site could not be dated closer than the late medieval period.

193 Information on this site is only available as a brief entry in the *Excavations Bulletin*.

Waterford, Little Patrick Street

Site no. 126

Townland: St. Patrick's
Civil Parish: Waterford City
Coordinates (ITM): E660578, N612447
SMR: WA009:005

Excavation licence: 92E0210
Director: Joanna Wren
Excavated between January and February 1993

Site summary:

Ironworking activity: Smithing
Significance: High

Site deposition condition: Primary
Investigation level: Urban

Ironworking features: Hearths, anvil-supports

Dating evidence: Pottery
Sample size: Unknown

Material present:					
	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	Iron artefacts	✓

Description

At the site of Little Patrick Street, located in an area which is seen as potentially occupied by the Ostmen of Waterford after the Anglo-Norman invasion, successive phases of medieval activity were uncovered (Wren 1994: 3). One of these phases, dated to the early thirteenth century based on unspecified pottery, consisted primarily of activity related to ironworking (ibid.: 25–26). An oval pit ("furnace" 79), measured 1m diameter by 0.49m deep, but it was remarked that the feature might have been shallower originally (ibid.: 25).

The upper levels of the cut are described as coated in slag and "furnace bottom", the latter presumably vitrified clay as the lack of this at the base of the feature was the argument for it potentially being shallower. Covering this was a large deposit C.77) of charcoal-rich material containing frequent slag inclusions (ibid.: 26). Further to the north and east, a further deposit (C.15) containing slag was uncovered (ibid.: 26, 29). A patch of clay (C.18) also included ironworking waste and had two adjoining features

identified as postholes at its edge (ibid.: 25, 27). The latter were interpreted as possibly part of a structure covering the metalworking activity, but as no other postholes were uncovered, these more probably represent anvil-block supports. All these features were located close to the southern edge of the cutting and more features, for example a hearth related to these “postholes”, could have been present to the south. The site represents *in situ* ironworking, presumably smithing, dated to the early thirteenth century.

Waterford, Peter Street

Site no. 127

Townland: St. Peter's
Civil Parish: Waterford City
Coordinates (ITM): E660714, N612377
SMR: WA009:005

Director: Alan Hayden
Excavated in 1987

Site summary:

Ironworking activity: Smithing		Significance: High		
Site deposition condition: Primary		Investigation level: Urban		
Ironworking features: Hearths, anvil-support				
Dating evidence: Pottery		Sample size: Unknown		
Material present:	Slag ✓	Tuyeres	Tools	
	Hammerscale	Other ceramic	Iron artefacts	✓

Description

Excavations at Peter Street, located in the eastern part of the Waterford pre-Norman triangle, uncovered the remains of successive levels of occupation (Hurley and Scully 1997). During a phase dated to the mid-twelfth century, an irregular row of seven wattle-walled houses was present within the excavated area (ibid.: 100–104). The most easterly of these, which was already present in the previous phase, was now used for metalworking (ibid.: 104) (See Fig. 8.1i). Apart from a central domestic hearth, four hearths were present within the floor. The first hearth, measuring 0.7 by more than 0.39 by 0.17m, had an oxidized base and a high iron content. The second hearth, measuring 1.7 by 1 by 0.25m, was heavily oxidized. The third hearth, measuring 1.8 by 0.7 by 0.16m, cut the central hearth and had a very high slag and hammerscale content. A concentration of stones to its south-west was interpreted as a possible post pad. It might have been a support for an anvil. The final hearth, 0.8 by 0.6m by 5mm, had a charcoal-rich fill. Three features interpreted as possible postholes were located about a metre away from this hearth. These might represent anvil-block supports. The floor area was covered with cinder, ash, charcoal and slag. The evidence for this site indicates *in situ* ironworking inside a house, with at least one convincing smithing hearth and three potential ones.

Wexford, 56–60 South Main Street

Site no. 128

Townland: St. Patrick's
Civil Parish: Wexford
Coordinates (ITM): E704888, N621698
SMR: WX037:016

Excavation licence: 02E1167
Director: Jacinta Kiely (Eachtra Archaeological Projects Ltd.)
Excavated in 2002

Site summary:

Ironworking activity: Smithing		Significance: Low	
Site deposition condition: Secondary		Investigation level: Urban	
Ironworking features: None			
Dating evidence: Pottery		Sample size: 4.71kg	
Material present:	Slag ✓	Tuyeres	Tools
	Hammerscale	Other ceramic	Iron artefacts

Description

During an excavation at 56–60 South Main Street in Wexford town several features, interpreted as rubbish pits were uncovered, three of which included ironworking waste (Lyttleton and Kiely 2012). The first pit C.6 containing slag also yielded local pottery and imported English wares (Ham Green B and Redcliffe) (ibid: 7; McCutcheon 2012d: 28). Pit C.22 had the same pottery supplemented with French wares and Minety Ware together with slag, while the last pit C.23 containing slag only had local wares with Redcliffe sherds (Lyttleton and Kiely 2012: 7; McCutcheon 2012d: 28–29). The slag amounted to 4.71kg and consisted solely of fragments of smithing hearth cakes (Fairburn 2012b: 42–43). The material is probably dumped smithing debris and the pottery potentially spans the whole medieval period.

Woodlands West, Co. Kildare

Site no. 129

Townland: Woodlands West
Civil Parish: Castledermot
Coordinates (ITM): E676442, N684748
SMR: KIL040:001

Excavation licence: E2960
Dir.: Nial O'Neill (Headland Archaeology (Ireland) Ltd.
Excavated between Mar. and Dec. 2007

Site summary:

Ironworking activity: (Bloom)smithing			Significance: Medium		
Site deposition condition: Secondary			Investigation level: Partial excavation		
Ironworking features: None					
Dating evidence: Pottery			Sample size: 36.1kg		
Material present:	Slag	✓	Tuyeres	Tools	
	Hammerscale		Other ceramic	✓	Iron artefacts ✓

Description

Excavations at Woodlands West, Co. Kildare revealed part of a late medieval circular enclosure with associated ironworking debris (O'Neill 2010). The site is interpreted as a rare example of a ring-work site which was not subsequently transformed into a masonry castle (ibid.: 27). About 40m to the south of the enclosure, a pit contained a small amount of undiagnostic slag while a corn-drying kiln held a fragment of a smithing hearth cake (Cosham 2010a: 500, 502). Organic material from these features returned a third- to sixth-century and a ninth- to eleventh-century date respectively (O'Neill 2010: 512).

Another 40m further south-east of the kiln, a slag-pit furnace was excavated containing over 3.7kg of smelting slag (ibid.: 21; Cosham 2010a: 498). No dating information for this furnace was available. One of the basal fills of the primary enclosing ditch (C.006) yielded a single piece of dense smelting slag with clear flow structure (O'Neill 2010: 12, Cosham 2010a: 499). The same fill also contained two

sherds of Dublin-type Ware (McCutcheon 2010b: 483). Five more fills of the same ditch contained just under 8.4kg of slag in total, mostly fragments of smithing hearth cakes (O'Neill 2010: 13–14; Cosham 2010a: passim).

Further metalworking debris was found in fills of two sections of a re-cut of the enclosing circular ditch. The first section (C.191), located in the south of the excavated part of this ditch, yielded nearly 13kg of slag spread over four of its seven fills (O'Neill 2010: 15; Cosham 2010a: passim). Of this slag, 2840g was identified as smelting slag from two separate fills (ibid.: 504, 506), with the rest consisting of smithing hearth cake, undiagnostic material and 43g of vitrified ceramic material. The second section of the re-cut (C.060) had over 8.6kg of slag in four of its seven fills, mostly smithing hearth cakes and undiagnostic material, but also one piece (125g) of likely slagged furnace lining and a single slag fine droplet from two different fills (O'Neill 2010: 14; Cosham 2010a: passim). The latter two fills also yielded Dublin-type Cooking Ware and Dublin-type Ware together with Saintonge Green-Glazed Ware respectively (McCutcheon 2010b: 483).

A smaller ditch, preserved in several sections, was located on the outside of the larger enclosing ditch. Two sections of this (C.035 and C.108), in the southern area of the enclosure and relatively close to the western edge of excavation, yielded respectively 16g and 851g more slag, with 88g of the latter possibly representing smelting slag (O'Neill 2010: 15–16; Cosham 2010a: 501, 503). A shallow ditch (C.110), at right angles to (C.108) contained nearly 1.5kg of slag, nearly all smithing hearth cake material (ibid.: 501). On the interior of the enclosure, a further 1.5kg of slag was recovered from both fills of a large pit (C.347), measuring 2.4 by 1.9 by 0.3m (O'Neill 2010: 119; Cosham 2010a: 507). All the material consisted of small fragments without diagnostic characteristics. A large pit (C.325) was cut into the enclosing ditch where its northern part disappeared under the edge of excavation (O'Neill 2010: 22). Three of its fills contained 1320g of slag, both smithing hearth cake and undiagnostic material (Cosham 2010a: 505, 508).

It would appear that both smithing and smelting activities were carried out over a substantially long period of time within the late medieval period. The pottery indicates activity in the thirteenth to fourteenth centuries. No features identifiable as either furnaces or hearths were uncovered, suggesting that the activity lay outside the excavated area (ibid.: 509). Of interest is the apparent absence of tuyere material.

Appendix 1

"Mines of iron stone" in Co. Limerick listed in the Desmond Survey (1586)

Desmond Survey placename[194]	*Modern townland (parish)*
Ballyferris alias Pierce Town	Ballypierce (Newcastle)
Bally Inge	Ballyine (Ardagh)
Bally Loghan	Ballinloughane (Ardagh)
Ballylondyrryg	Ballylin (Rathronan) (see Logainm)
BallymcKerry	Ballymakeery (Rathronan)
Ballymorrogho	Ballymurragh East/West (Monagay)
Ballynenaghe	Ballinena (Newcastle)
Ballywoghan	Ballyvoghan (Rathronan)
Bellabehee alias Birchewood	Ballaghbehy (Abbeyfeale)
Canmoye	Cahermoyle (Rathronan)
Clenlesse Mountain	Cleanglass North/South (Killeedy)
Doacatten	Doocatteen (Newcastle)
Dromen Mc Tirrelaghe	Dromin (Macturlogh) (Newcastle)
Droometrasna	Dromtrasna North/South/(Collins)/(Hartnett) (Abbeyfeale)
Droom Roo	Dromroe (Monagay)
Garranekevan	Garranekeevan (Newcastle)
Garreduffe	Garryduff (Monagay)
Glannegowen	Glennagowan (Newcastle)
Glanowhym	Glenquin (Monagay)
Glenestary	Glenastar (Newcastle)
Glenmaggin	Glenmaggeen in Ballymurragh East (Monagay)

194 From the online version of the relevant documents (Purcell 2009).

Knockbrackmoynetredale	Knockbrack (Abbeyfeale)
Knocknedohee	Knocknadiha (Killeedy)
Knocknegorna	Knocknagornagh (Kilmoylan)
Kylleyndroomelarra	Killenig is located in Dromtrasna North (Abbeyfeale) (Begley 1906: 326)
Kylleyneigh	Killeany More/Beg (Kilfergus)
Kyllheylaghe	Mountplummer (Cill Aidhleach) (Monagay)
Kyllquolleye	Killaculleen (Killeedy)
Lyskordan	Lisgordan (Rathronan)
Rathekaell	Rathcahill East/West (Monagay)
Ruskagh parish	Rooskagh East/West (Ardagh)
Templeclee	Athea, Templeathea West (Rathronan)
Templeglantan	Templeglentan East/West (Monagay)
Tullagh Leigh	Tullyleague (Kilfergus)
Tullygolyne	Tulligoline North/South (Monagay)

Appendix 2

References to smiths in the Fiants relating to Ireland

Year	Smith	Place	Source
1549	William Smith	Ballinaclode [= Ballymaclode, Co. Waterford]	(Fiants Edw. VI: 58)
1552	Patrick Ennose	Kildroghte [= Kildrought/Cellbridge, Co. Kildare]	(ibid.: 135)
1561	William Dallane	Maspole, Co. Wexford [= Masspool, Co.Meath?]	(Fiants Eliz. 1558–1570: 70)
1563	Thomas Chartan	Munkeneton [= Monknewtown], Co. Meath	(ibid.: 91)
1563	William McGillysaghtie	Killocia, [= Kilmallock?], Co. Limerick	(ibid.: 96)
1566	Thady O'Dowlyn	Leskyn [= Lushkinnagh?], Co. Kilkenny	(ibid.: 138)
1569	Richard Murrogho	Luckan [= Lucan], Co. Dublin	(ibid.: 205)
1572	Derby O'Hiegheren	Clonemell [= Clonmel, Co. Tipperary]	(Fiants Eliz. 1570–1576: 70)
1577	Eugenius More O'Fahee	Kahirmenayn [= Cahirminnaun, Co. Clare]	(Fiants Eliz. 1576–1583: 39)
1583	John Gowe	Dongarvan [= Dungarvan, Co. Waterford]	(ibid.: 200)
1585	Thomas O Ryodda	Liscollan [= Liscullane, Co. Kerry]	(Fiants Eliz. 1583–1586: 109)
1585	Donogh O Skabaie	Killeynan [= Killinane, Co. Tipperary]	(ibid.: 115)
1585	Donogho mcShane Y Dashowne	Killnyhomyny [= Killumney], Co. Cork	(ibid.: 132)
1585	Gillegrome O Flyn	Lougheskure [= Lough Scur, Keshcarrigan, Co. Leitrim]	(ibid.: 136)
1585	Chall O Flynn	Lougheskure [= Lough Scur, Keshcarrigan, Co. Leitrim]	(ibid.)
1585	Toole O Fenane	Lougheskure [= Lough Scur, Keshcarrigan, Co. Leitrim][195]	(ibid.)
1586	Teige O Nealan	Cahererelan [= Cahererillan, Co. Galway]	(ibid.: 156)
1586	Malaghlin mcConor Gowe	Dromrada [= Dromad, Co. Cavan?]	(ibid.: 159)
1586	Patrick Magargan	Moybologe [= Moybolgue par.], Co. Cavan	(ibid.: 160)
1586	Connor McWilliam O Multube	Banegh [= Banagher, Co. Cavan]	(ibid.: 162)
1587	Teig McRory oge	Cahirkenlis [= Caherconlish], Co. Limerick	(Fiants Eliz. 1586–1596: 30)
1588	Moroghe O Ryada	Ballymvoneany [near Lisnagoneeny, Co. Kerry]	(ibid.: 77)

Table A.1 References to smiths in the Fiants relating to Ireland

195 The same pardon also includes two tinkers, Teige oge O Fonan and Qwyn O Finan, of the same locality.

Appendix 3

References to smiths in late medieval Dublin

Source	c. AD 1200–1225	AD 1225–1250	AD 1250–1275	c. AD 1275–1300
Dublin Roll of Names (1216) (Connolly and Martin 1992)	Willelmus Faber (1) Hugo le Loramer (3) Robertus le Lorimer (9) Johannes le Lorimer (9) Willelmus Faber de Corc (13) Rogerus Faber (16) Gervasius Lorimer (17) Ailwardus Faber (17) Absolon Lorimerus (18) Adam Faber ad Pontem Ostmannorum (19) Stephanus Faber (22) Stephanus Faber (23) Robertus Faber (23) Ricardus Faber (27) Galfridus Faber (27) Ricardus Faber (30) Robertus Albus Faber (30) Nicholaus Faber (31) Ricardus Faber (36) Radulfus Faber (36) Osbertus Faber (36) Willelmus Faber de Crofergus [= Carrickfergus] (36) Arnaldus Faber (37) Arnaldus Faber (38) Warinus Faber (40) Willelmus Sparthax [Swordmaker] (41) Brun le Locsmith (47) Willelmus Albus Faber (48) Ricardus Wade le Lorimer (48) Walterus Lorimer de Kilmainham (49) Johannis Faber (50) Robertus Smethe (51)	Johannis Loksmith filius Simonis (52) Rudulfis Faber (54) Germain Faber (54) Ricardus le Lokismith de Tickehille [= Tickhill, Yorkshire] (54) Willelmus Faber qui facit sagittas [= arrows] (57) Willelmus le Lorimer (59) Galfridus Faber (65) Petrus Faber de Bealveis [= Bavais, Fr.] (66) Henricus Faber (69) Henricus Faber (71) Robertus Faber de Villa Ostmannorum (71) Gilebertus le Locker [probably locksmith] de Cestris [= Chester] (71) David Faber de Glovenia [= Gloucester] (71) Willelmus Albus Faber (71) Ricardus Juvenis Faber (74) Martinus Faber de Villa Ostmannorum (74) Thursteinus Faber de Villa Ostmannorum (74) Ricardus Faber (75) Thomas Lorimarius (75) Ricardus Palmerus [= pilgrim to the Holy Land] Lorimarius (75) Johannes Faber	Stephanus Faber de Sancto Thoma (89) Nicolaus Faber de Kildroth [Kildrought/ Celbridge, Co. Kildare] (90) Johannis le Wyse Loksmyth (91) Robertus le Lorimer (93) Gilebertus de Norhampton [= Northampton, Hampshire] Faber (94) Henricus filius fabri de Catheleston' [Two Caddelstowns in Co. Meath] (95) Ricardus le Locsmith filius Thome le Locsmith (95) Petrus le Locsmyth (95) Radulphus de Bedewind [= Bedwyn, Wiltshire] Faber (95) Stephanus Albus Faber de Esconia [likely Exeter (*Exonia*)] (96) Ada le Locsmyth filius Rig' de Bermingham (96) Gervasius Walensis Faber de Kardigan [Cardigan, Wales] (100) Johannes Faber de Finglas (101) Gilbertus Faber de Are [= Ayre, Scotland] (101) Patricius Faber de Ar' [= Ayr, Scotland] (107) Walhinius Faber de	

		Parisiensis (75) Nicholas Faber (75) Nicholaus Loremarius de Tristledermot (75) Patricius Faber de Clontarf (80) Willelmus le Locsmith (81) Rathenaldus Faber de Villa Ostmannorum (81) Adam Loksmiht (84) Rogerus Faber de Drohed' [= Drogheda] (89) Willelmus Faber de Drohed' [id.] (89)	Doune [= Down/ Downpatrick] (108) Ricardus Faber de Nova Villa de Ar' [= Newton, Scotland] (108)	
Christ Church deeds (CCCD Vol. 2)	(CCCD Vol. 1) Adam the artisan (38) Jordan the artisan [Oxmantown] (39)	(CCCD Vol. 2) Richard the smith [South Great George Street] (80)	Richard the smith (formerly held) (85)	
Register of the Hospital of St. John Baptist (St John Brooks 1936)	Randulph faber (7) Philippo filio Willelmi fabri (174) Robert Blund the smith (223)[196]	Willelmi fabri de Castro Dublinie [Dublin Castle] (17) Bridim fabri [Ostmantown] (86)	Ricardo filio fabri (237) Waltero faber (244)	Adam fabro (159) Abraham fabro (243) Willelmi fabri [Cook Street/Corn Market](124) Petro fabro (166)
St. Mary's Abbey chartulary (Gilbert 1884)	Willelmi le Lorimer (HMDI: 474)	Callach Fabri [Ostmantown] (237, 503) Henrico Fabro (445) Augustini Fabri [outside St. Audoen's Gate] (id.) Gilberto de Norhampton, fabro (462, 465) Ricardo de Lorimer (id., 469)	Benedicto Fabro (48) Robert le Lorimer (434–435) Stephano Fabro (454) Johannis Albi Fabri [Outside the New Gate, St. Katherine's], son of Roberti Fabri [Outside New Gate, Hospital of St. John's](see below) Radulphus Fabri [Outside New Gate, Hospital of St. John's] (455–456) Thurstani/Gurwani Fabri [Ostmantown] (474, 482, 484)	
Free citizens of Dublin		Raulinus Faber (114) Thomas Faber (114)		

196 This might be the Robertus blundus de Villa Ostmannorum mentioned in the list of free citizens of Dublin (HMDI: 121).

(1225–1250) (Connolly and Martin 1992)		Henricus Oeyn factor armorum (114) Walterus Lorimarius de Kilmain[ham] (114) Willelmus le Lorimer (114) Robertus Faber (116) Augustinus Faber (117)		
St. John's deeds (Robinson and Armstrong 1916)		Jordan the smith [next to Mill of the Church of the Holy Trinity] (179)		
Divers Rolls (BTR)			Richard le Lorymarii (59)	
Exchequer payments (CDRI 1252–1284)				Peter the smith (261, 288)
Justiciary Rolls (CJR 1295–1303)				Robert le Feure (107)

Table A.2a References to smiths thirteenth-century Dublin

Source	AD 1300–1325	AD 1325–1350	AD 1350–1375	AD 1375–1400
St. Mary's Abbey chartulary (Gilbert 1884)	Ade/Adam Faber [suburbio Dublin] (457–459)			
Christ Church deeds (CCCD Vol. 2)	William the Smith [Ostmantown] (92)	Richard the smith [Bridge Street] (108)		
Ormond Deeds (COD 1172–1350)	William the smith (Ostmantown] (222)			
Justiciary Rolls (CJR 1308–1314)	Adam le Fevere (220)			
Dublin White Book (CARD I)			Nicholas de Hodderode, armourer [Scarlettislane = Upper Exchange Street] (120)	

Table A.2b References to smiths in fourteenth-century Dublin

Source	AD 1400–1425	AD 1425–1450	AD 1450–1475	AD 1475–1500
Patent Rolls (RCH)	John Norreys, smyth (185)	Patrick Nicholl, smyth (260)	John Walsh, smith [Bray] (Berry 1914: 228–230)	

St. Werburgh's deeds (Berry 1919a)	John Reynald, smith [St. Werburgh Street] (287)		William Cornell, armourer (288, 290, 304)	
St. Catherine's/St. James' deeds (Berry 1919b)		Maurice Segyn, smith [St. Thomas Street] (274)		
Dublin Assembly Roll (CARD I)			Maurice Flemyng, smith [Nicholas Street] (296) John Brown, smith (297) William Cornell, armorer (320)	
Dublin Franchise Rolls (Lennon and Murray 1998)			(See Appendix 4)	(See Appendix 4)
Dublin wills and inventories (Berry 1898)			Richard Corbet, smith (79)	Patrick Gerrot, smith (141)
St. Werburgh proctor accounts (Empey 2009)				Denyse Smyth (42–45) William Cornell, armourer (passim) Christopher Armigerer/armorer (passim) Henry Smythe (60) Harry Cogan, smyth (75) Jenet Cornell, armorer (60–62, 65, 71) Thomas Walsh, smyth (62, 73)
Christ Church deeds (CCCD Vol. 3)				Christopher Cornell, armourer [Shipstreet] (118–119)
St. John's deeds (Robinson and Armstrong 1916)				Henry Bogane, smith [Skinners Row = Christ Church Place] (204)

Table A.2c References to smiths in fifteenth-century Dublin

Source	AD 1500–1525	AD 1525–1550	AD 1550–1575	AD 1575–1600
Dublin Franchise Rolls (Lennon and Murray 1998)	(See Appendix 4)			
St. Werburgh	Thomas		Thomas Basell,	John Miles, smith

proctor accounts (Empey 2009)	Flamyner, smyth (86) John armourer (83, 84, 95)		smyth (108, 110)	[Skinner's Row = Christ Church Place] (passim) William Staynes, [smith] (120–121)
St. Anne's Guild deeds (Berry 1904)		Richard Whyt, smith (Finglass) [Back Lane] (77)		
Monasticon Hibernicum (Archdall and Moran 1876)		Walter Smith [precinct of St. John's Hospital] (63)[197]		Patrick Cardif, smith [precinct of St. John's Hospital] (66)
St. John's deeds (Robinson and Armstrong 1916)		Murtaghe Marte, smith [Mary Lane, Oxmantown] (208)		John Morgan, smith and proctor (212)
Peter Lewis' proctor accounts (Gillespie 1996)			Thomas Frencheman, smith (passim) Mr. Barane, smith (106)	
Fiants			Thomas Pynock, smith [adjoining Dublin castle] (Fiants Eliz. 1570–1576: 26–27)	Patrick Lacy, smith, (Fiants Eliz. 1583–1586: 35) Edward Herford, smith (id.,Fiants Eliz. 1596–1601: 53)
Christ Church deeds (CCCD Vol. 3)			Donald Coskely alias Nangle, smith [Nicholas Street] (165)	John Myles, smith [Skinner's Row = Christ Church Place] (181)
Dublin Assembly Roll (CARD II)			John Bellewe, smith (83)	Walter Elyotch, smith (107) Walter Robens, armourer (110) Thomas Ogane, smith (119) Thomas Daly, smith (122) John Morgane (see below) John Maghry, smith (155) James Kees, smith (165) Fargus Dowdall, smith (182) Hugh Conwey, smith (187) John Lalor, smith (215) Walter Hykey, smith (237) John Belen, smith (239) James Bowdwyn, smith (252) Anthony Hues, smith (253)

197 Smith could be just a surname not denoting a trade, but the person mentioned before Walter in the same inquisition is Richard Workman.

				David Manning, smith (264) Maurice Nolan, smith (275) Daniel Morcho, smith (300) Patrick Nolan, smith (303) John Vince, smith (310) Patrick Kerney, smith (319) Walter Cawell, smith (324) John Dignam, smith (327) Edmond Byrn, smith (334) Dorby Hicky, smith (348) Robert Langan, smith (id.)
Court Book of St. Sepulchre (Wood 1930)				Johannem Quoyle, smith [Tallagh] (17) Donald Qusley, smith [Nicholas Street] (62)
Werburgh deeds (Berry 1919a)				William Stayne, smith [Castle Street] (309)

Table A.2d References to smiths in sixteenth-century Dublin

Appendix 4

Smiths in the Dublin Franchise Rolls, AD 1468–1511

	Master smiths	Apprentices	Appointed by special grace
1468/69	Maurice Segyn	Geoffrey Lange	
	Maurice Segyn	John Herforde	
	John Bron	John Lange	
	John Bron	John Ryan	
	John Griffyn	Matthew Logan (coiner)	
	John Griffyn	Patrick Loghan	
	Maurice Flemyng	Richard Gavane	
	John Flemmyng	Nicholas Ketyng	
	Reginald Walshe	Nicholas Fernes	
1470–79	Maurice Segyn*	John Herford	John Hill, fletcher
	John Herford	Thomas Herford (son), fletcher	
	John Bron	Richard Bron (son), merchant	
	John Griffyn*	Patrick Gerrot	
	John Griffyn*	John Dalway	
	Thomas Flemyng	Thomas Flemyng	
	John Flemyng*	Thomas Boll	
	John Flemyng*	Patrick Hunylow	
	John Flemyng*	Thomas Herford	
	John Flemyng*	Thomas Walche	
	Patrick Ley	Jeneta Ley (daughter)	
	Patrick Ley	William White	
	Richard Ley	Alexander Ley (son)	
	William Wiseman*	Thomas Walche	
	John Barry	Thomas Brengan	
	William Cornell, armourer	Richard West	
	William Cornell, armourer	Isabel Brun	
1480–89	Maurice Segyn	David Sogyn	John Davey, fletcher
	Philip Herford	David Walshe	
	John Griffyn	Richard Russell	
	John Griffyn	William Rocheford	
	John Griffyn	William Knowde	
	John Flemyng	Anastasia Flemyng	
	Patrick Hunylow	John Bron	

	Richard Ley	John Ley	
	Alexander Ley	Alexander Hamounde	
	Denis White	Cornelius White	
	Denis White	Henry Bagar	
	Dermot Lange	Geoffrey Colgagh	
1490–99	John Griffyn	Nicholas Nolan	William Mole
	Simon White, armourer	Alice White	John Talor, armourer
1500–09	John Griffyn	David Kelly	John Spencer, fletcher
	Thomas Walshe	Nicholas Cwrag	
	Nicholas Cwrag	Peter Kelly	
1510/11	Patrick Hunylow	Cornelius Lorcan	

Table A.3 Smiths in the Dublin Franchise Rolls, AD 1468–1511. Smiths with * were founding members of the smith's guild of St. Eligius in AD 1473 (Le Fanu 1930: 155).

Appendix 5

Dimensions of late medieval smithing hearths in Ireland

Site	Length (m)	Width (m)	Date	Setting	Confidence
Aghmanister, Co. Cork [Site1]	0.65	0.49	13th C?	Monastic	Very high
Aghmanister, Co. Cork [1]	0.55	0.55	13th C?	Monastic	Very high
Ballykeoghan, C. Kilkenny [6]	1	0.7	15th–E17th C	Rural	Very high
Ballykeoghan, C. Kilkenny [6]	1	0.9	15th–E17th C	Rural	Very high
Ballykeoghan, C. Kilkenny [6]	0.8	0.6	15th–E17th C	Rural	High
Ballykilmore, Co. Westmeath [7]	1.02	0.7	14th C	Rural	High
Ballyloughan, Co. Carlow [8]	0.65	0.65	LME	Military	High
Blackcastle, Co. Tipperary [12]	0.8	0.7	13th C	Rural	Very high
Borris, Co. Tipperary [13]	0.7	0.5	16th C?	Rural	Medium
Borris, Co. Tipperary [13]	0.87	0.62	16th C	Rural	Very high
Carnmeen, Co. Down [18]	1.04	0.89	L12th–E13th C	Monastic	High
Cashel, Bank Place, Co. Tipperary [23]	0.8	0.6	LME	Urban	Very High
Cashel, Bank Place, Co. Tipperary [23]	1.70?	0.85	LME	Urban	High
Cashel, Bank Place, Co. Tipperary [23]	0.6	0.5	LME	Urban	Medium
Cashel, Bank Place, Co. Tipperary [23]	0.75	0.45	LME	Urban	High
Cashel, Bank Place, Co. Tipperary [23]	1	0.7	LME	Urban	High
Cashel, Bank Place, Co. Tipperary [23]	0.66	0.44	LME	Urban	High
Coney Island, Co. Armagh [29]	1	0.9	LME	Military?	High
Cookstown, Co. Meath [30]	1.02	0.6	13th C	Rural	High
Cookstown, Co. Meath [30]	0.9	0.8	13th C	Rural	High
Coolamurry, Co. Wexford [31]	1	0.9	L12th–E13th C	Rural	Very high
Coolamurry, Co. Wexford [31]	0.92	0.82	L12th–E13th C	Rural	Very high
Coolamurry, Co. Wexford [31]	1.2	0.8	L12th–E13th C	Rural	Very high
Cork, Barrack Street [32]	1.45	1.3	M13th C	Urban	High
Cork, Barrack Street [32]	0.86	0.82	M13th C	Urban	High
Cork, Barrack Street [32]	1.28	1.02	M13th C	Urban	High
Cork, Tuckey Street [39]	0.73	0.48	L12th–E13th C	Urban	Medium
Cork, Tuckey Street [39]	0.58	0.48	L12th–E13th C	Urban	Medium
Cork, Tuckey Street [39]	0.64	0.5	L12th–E13th C	Urban	Medium
Cuffsborough, Co. Laois [40]	1.40	0.79	L15th–E16th C	Rural	High
Cuffsborough, Co. Laois [40]	0.9	0.9	L15th–E16th C	Rural	Medium
Curragh Upper, Co. Cork [42]	0.85	?	L12th–E13th C	Rural	Very high
Dublin, Bride Street [47]	0.8	0.8	13th C	Urban	High

Dublin, Bride Street [47]	0.92	0.9	13th C	Urban	Medium
Dublin, Francis Street/Lamb Alley [50]	1.10	0.45	E–M13th C	Urban	High
Dublin, 58–59 Thomas Street [55]	0.6	0.35	LME	Urban	Medium
Dublin, 58–59 Thomas Street [55]	0.6	0.4	LME	Urban	Medium
Dublin, 58–59 Thomas Street [55]	1.45	0.9	LME	Urban	Medium
Dysart, Co. Kilkenny [60]	1.10	0.4	L12th–E13th C	Rural	Very high
Galway, Courthouse Lane [63]	0.7	0.6	15th ?–16th C	Urban	High
Galway, Courthouse Lane [63]	0.8	0.55	15th ?–16th C	Urban	Medium
Galway, Courthouse Lane [63]	1.2	0.95	L16th C	Urban	Medium
Galway, Courthouse Lane [63]	0.65	0.55	L16th C	Urban	Medium
Garryleagh, Co. Cork [66]	0.9	0.87	14th C	Rural	Very high
Glendalough, Co. Wicklow [67]	0.8	0.6	LME	Urban	High
Glendalough, Co. Wicklow [67]	0.88	0.48	LME	Urban	High
Glendalough, Co. Wicklow [67]	0.6	0.6	LME	Urban	High
Kilcoole, Co. Wicklow [78]	1.52	0.56	LME	Rural	Medium
Kilkenny, 26–33 Patrick Street [84]	1.65	1.65	LME	Urban	High
Killaspy, Co. Kilkenny [88]	2.2	1.2	13th C	Rural	Very high
Killaspy, Co. Kilkenny [88]	1	1	Id.	Rural	Very high
Killaspy, Co. Kilkenny [88]	1.5	0.8	Id.	Rural	Very high
Kiltotan and Collinstown, Co. Westmeath [90]	0.7	0.6	15th C	Rural	High
Lismahon, Co. Down [95]	0.4	0.3	L12th–E13th C	Military	High
Lismahon, Co. Down [95]	0.55	0.55	L12th–E13th C	Military	Medium
Lismahon, Co. Down [95]	0.3	0.2	L12th–E13th C	Military	Medium
Loughbown, Co. Galway [96]	0.7	0.62	L12th–E13th C	Rural	High
Loughbown, Co. Galway [96]	0.9	0.65	L12th–E13th C	Rural	High
Loughgur, Co. Limerick [97]	0.85	>0.35	LME	Rural	Medium
Loughgur, Co. Limerick [97]	4	?	LME	Rural	Medium
Loughgur, Co. Limerick [97]	2	1.3	?	Rural	Medium
Loughgur, Co. Limerick [97]	2.4	1.9	LME	Rural	Medium
Mannan Castle, Co. Monaghan [99]	0.8	0.55	L12th–E13th C	Military	Very high
Merrion Road, Co. Dublin [100]	1.6	0.8	13th–E14th C?	Rural	High
Merrion Road, Co. Dublin [100]	0.8	0.6	13th–E14th C?	Rural	High
Merrion Road, Co. Dublin [100]	1.8	1.2	13th–E14th C?	Rural	High
Moneygall, Co. Offaly [104]	1.6	0.7	L15th–E17thC	Rural	Very high
Newtown Little, Co. Dublin [110]	1.25	1.25	LME	Rural	Medium
Newtown Little, Co. Dublin [110]	0.6	0.6	LME	Rural	Medium
Newtown Little, Co. Dublin [110]	1.05	0.83	LME	Rural	Medium
Nobber, Bridge Park, Co. Meath [111]	1.2	1	13th C	Urban	High
Tintern Abbey, Co. Wexford [119]	1	0.65	M16th C	Rural	Medium
Tintern Abbey, Co. Wexford [119]	1	0.6	M16th C	Rural	Medium
Trevet, Co. Meath [120]	2.1	0.6	LME	Rural	High

Trim, High Street, Co. Meath [122]	1	1	LME	Urban	High
Trim, High Street, Co. Meath [122]	0.7	0.7	LME	Urban	Medium
Trim, High Street, Co. Meath [122]	0.75	0.75	LME	Urban	Medium
Trim, High Street, Co. Meath [122]	0.8	0.8	LME	Urban	Medium
Trim, High Street, Co. Meath [122]	1	1	LME	Urban	Medium
Tullykane, Co. Meath [123]	1.5	0.8	E13th C	Rural	High
Waterford, Little Patrick Street [126]	1	1	E13th C	Urban	High

Table A.4 Dimensions of Irish late medieval smithing hearths. Site numbers in square brackets.

Appendix 6

References to iron in the Irish murage grants

Year	Place	Iron	Source
1221	Dublin	None	(CDRI 1171–1251: 154)
1224	Waterford	Weigh, 3d	(ibid.: 177)
1233	Dublin	None	(ibid.: 308)
1234	Waterford	Weigh, 1d Hundredweight, ½d	(ibid.: 316)
1234	Drogheda	Band, ½d	(ibid.: 316–317)
1237	Limerick	Wey, 2d	(ibid.: 358–359)
1243	Waterford	Weigh, 1d Hundredweight, ½d	(ibid.: 389–390)
1250	Dublin	Band, ½d Horseload, ½d	(ibid.: 455–456)
1252	Dublin	Stone, 1d Hundredweight, 1d	(CARD I: 138–140)
1275	Youghal	Except iron	(CDRI 1252–1284: 199–200)
1278	Drogheda	Except iron	(ibid.: 297)
1282	Kilkenny	Garb of steel, ¼d	(ibid.: 430)
1283	Kilkenny	Garb of steel, ¼d	(ibid.: 494–495)
1284	Dublin	Band, ½d	(ibid.: 505)
1284	Cork	None	(ibid.: 520–521)
1285	Bennet's Bridge	Weigh, 1d Hundredweight, ½d 100 sheaves of steel, ¼d	(CDRI 1285–1292: 35)
1286	Tralee, Mallow and Ard	Cartload, 1d	(ibid.: 107)
1290	Trim	Cartload, 1d	(ibid.: 277–278)
1291	Kilkenny	Cartload, 1d Seam, ½d 100 gads of steel, ½d	(ibid.: 409–410)
1291	Waterford	Hundredweight, ½d Seam, ½d 100 gads of steel, ½d	(ibid.: 410–411)
1292	Fethard	Cartload, 1d	(ibid.: 454)
1295	Dublin	Cartload, 1d	(CDRI 1293–1301: 105–106)
1295	Drogheda (Louth)	Cartload, 1d	(ibid.: 106)
1295	Castledermot	Cartload, 1d Horseload, ½d 100 gads of steel, ½d	(ibid.: 106–107)
1296	Drogheda (Meath)	Cartload, 1d Band, ½d 100 gads of steel, ½d	(ibid.: 145–146)

1297	Dublin	Band, 1d	(ibid.: 206–207)
1298	Clonmel	Band, ½d	(ibid.: 235–236)
1300	Tipperary	Band, ½d	(ibid.: 353)
1303	Dublin	Band, ½d Load, ½d	(HMDI: 219–221)
1303	Emly	(damaged) 100 sheaves of steel, 2d	(CPI: 40)
1303	Newcastle McKinnegan	(damaged) 100 sheaves of steel, 2d	(ibid.: 41)
1306	Kilkenny	None	(CDRI 1302–1307: 158)
1308	Trim	Cartload, 1d	(CPR 1307–1313: 70–71)
1308	Dublin	Cartload, 1d	(HMDI: 270–273)
1310	Adare	Hundredweight, 4d Hundred of steel, ½d	(CPI: 42)
1310	Croom	Hundredweight, 4d Hundred of steel, ½d	(ibid.)
1310	Athoul (?)	Hundredweight, 4d	(ibid.)
1310	Tipperary	Hundredweight, 4d	(ibid.: 43)
1310	Athenry	Hundredweight, 4d	(RCH: 16)
1311	Leighlin	Band, ½d Sheaf of steel, ¼d	(CPI: 43–44)
1311	Waterford	Band, ½d Sheaf of steel, ¼d	(ibid.: 44)
1312	Dublin	Cartload, 1d Two garbs of steel, ¼d	(HMDI: 308–312)
1313	New Ross	Horseload, ½d 100 gads of steel, ½d	(Dryburgh and Smith 2005: 49–50)
1316	Dublin	Cartload, 1d Two garbs of steel, ¼d	(Gale 1834: ccxi–ccxiv)
1318	Drogheda (Meath)	Band, ½d Cartload, ½d 100 gads of steel, ½d	(HMDI: 413–417)
1318	Cork	Horseload, ½d 100 bars of steel, ½d	(Dryburgh and Smith 2005: 51–52)
1323	Drogheda	Band, ¼d Sheaf of steel, ¼d	(CARD I: 12–13)
1327	Dublin	Band, ¼d Garb of steel, ¼d	DCA RC18
1336	Dublin	Band, ¼d 100 pieces of Spanish iron, ¼d	(CARD I: 14–16)
1337	Dublin	Band, ¼d 100 pieces of Bristol iron, 1d Quintal of Spanish iron, ¼d	DCA RC24
1339	Callan	Cartload, 1d Horseload, ½d 100 bars of steel, ½d	(Dryburgh and Smith 2005: 52–54)
1343	Dublin	Band, ¼d	DCA RC25

		100 pieces of Bristol iron, 2d Quintal of Spanish iron, ¼d	
1346	Dublin	Band, ¼d Bundle of steel, ¼d	(CARD I: 17–18)
1356	Drogheda (Louth)	Band of pieces, 1d Hundredweight, 2d 100 stone of Spanish iron, 4d	(CPI: 82)
1358	Dublin	Band, ¼d 100 pieces of Bristol iron, 3d Quintal of Spanish iron, ½d 100 pieces of Spanish iron, ¼d	(CARD I: 20–21)
1358	Youghal	Bundle of rod iron, ½d 100 gads of steel, ½d	(Caulfield 1878: xxv–xxvi)
1358	Caherconlish	Hundredweight, 4d Hundred of steel, ½d	(CPI: 61)
1361	Galway	Bundle, ½d 100 gads of steel, ½d	(Hardiman 1820: 58)
1364	Clonmel	Hundred pieces, 2d Band of pieces, 1d 100 stone of Spanish iron, 4d	(CPI: 64)
1375	New Ross	Hundred pieces, 2d Band of pieces, 1d 100 stone of Spanish iron, 4d	(ibid.: 67)
1375	Youghal	Band, ½d 100 gads of steel, ½d	(ibid.)
1375	Kilmallock	None	(ibid.: 68)
1375	Thomastown	Band, 1d Stone, ¼d Mass, 1d	(ibid.)
1375	Jerpoint	Hundredweight, 4d	(ibid.: 69)
1375	Kilkenny	Band, ½d 100 gads of steel, ½d	(Vallency 1786: 550–553)
1376	Ardee	None	(CPI: 73)
1380	Drogheda	Band of pieces, 1d Hundredweight, 2d 100 stone of Spanish iron, 4d	(ibid.: 78)
1382	Kilkenny	Band, ½d 100 gads of steel, ½d	(ibid.: 79)
1385	Drogheda	Band of pieces, 1d Hundredweight, 2d 100 stone of Spanish iron, 4d	(ibid.: 82)
1390	Clane	Band, ½d 100 stone of Spanish iron, 4d 100 gads of steel, ½d	(ibid.: 87)
1390	Ardee	None	(ibid.)
1393	Trim	Band, ½d 100 gads of steel, ½d	(ibid.: 89)
1394	Kilkenny	Band, ½d 100 gads of steel, ½d	(ibid.)

1395	Galway	Band of pieces, 1d Hundredweight, 2d 100 stone of Spanish iron, 4d 100 gads of steel, ½d	(Hardiman 1820: vii–viii)
1396	Galway	Band of pieces, 1d Hundredweight, 2d 100 stone of Spanish iron, 4d 100 gads of steel, ½d	(ibid.: xiii–xiv)
1396	Callan	12 measures, 1d 100 spits of Spanish iron, 4d	(CIRCLE: 19-richard-ii/7)
1404	Drogheda (Louth)	Hundred pieces, 2d Band of pieces, 1d 100 stone of Spanish iron, 4d	(CChR 1226–1257: 424–426)
1408	Athboy	Horseload, 1d	(CPCRI II: 454–455)
1412	Dundalk	Band, ½d Hundred pieces, 2d 100 stone of Spanish iron, 4d	(House of Commons 1835: 900)
1420	Kilkenny	Band, ½d 100 gads of steel, ½d	(Munby and Tyler 2005: 201)
1437	Ardee	None	(House of Commons 1835: 668)
1441	Kilkenny	Band, ½d 100 gads of steel, ½d	(Munby and Tyler 2005: 201)
1446	Athboy	Horseload, 1d	(CPCRI II: 454–455)
1468	Kells	None	(CIRCLE: 8-edward-iv/7)
1475	Malahide	Bundle, ½d Hundred stone, 2d 100 stone of Spanish iron, 4d 100 gads of steel, ½d	(House of Commons 1855: 8)
1480	Clonmel	100 pieces, 2d Bundle, 1d Hundred of Spanish iron, 4d	(CPCRI II: 210–211)
1549	Galway	Bundle of rod iron, 1d Hundredweight, 2d 100 stone of Spanish iron, 4d	(CPCRI I: 196–197)
1572	Waterford	Cask, 10d Pipe, 10d	(Byrne 2007: 56)
1578	Galway	Band of pieces, 1d Hundredweight, 2d 100 stone of Spanish iron, 4d	(Hardiman 1820: xviii–xix)
1585	Kilmallock	Horseload, 1d	(Fiants Eliz. 1583–1586: 71–72)

Table A.5 References to iron in the Irish murage grants

Appendix 7

Sites not included in the research

Several sites were not included in this thesis because of various reasons. For some, the dating evidence was unconvincing, on others the identification of ironworking was doubtful and for others, late medieval ironworking was recorded, but later retracted. In some cases, not all information was yet available.

Aghavea, Co. Fermanagh

Excavations at an ecclesiastical site in use during both the early and late medieval period at Aghavea, Co. Fermanagh, revealed substantial amounts of ironworking debris (Ó Baoill 2000). Some of this material was found together with late medieval pottery, but could have been residual from early medieval ironworking in the same areas (ibid.: 19, 21, 23).

Ahanaglogh, Co. Waterford

At Ahanaglogh, Co. Waterford, an area of ironworking was uncovered (Tierney 2009: 273–358). One pit contained both late medieval pottery (Waterford b Ware) and slag, but this pit cut an older feature with a large quantity of slag, so the ironworking activity was potentially older than the pottery.

Ardree, Co. Kildare

During excavations at Ardree in Co. Kildare about 67kg of ironworking residues were recovered. A full excavation report has not been finalized by the time of writing, but the specialist report on the residues is available (Young 2012d). The majority of the material is dated to the “medieval period”. This term is used in contrast to early medieval (ibid.: 2), and therefore probably indicates the residues are late medieval. It was thought prudent, however, to await the full availability of the data before incorporating it into larger overviews.

Ballyhanna, Co. Donegal

At Ballyhanna, in Co. Donegal several graves belonging to a cemetery in use from the twelfth to the late thirteenth/early fourteenth centuries yielded particles of hammerscale (Ó Donnchadha 2006: 50; Johnson 2006: 154). This was interpreted as meaning that the individuals buried with the hammerscale might have been smiths, but the graves could have been dug on the location of former smithing activity and the hammerscale deposited during the backfilling of the graves.

Ballyman, Co. Dublin

Excavations at Ballyman, Co. Dublin, carried out over several years between 1979 and 1986 uncovered many phases of activity (O'Brien 2000). Substantial amounts of ironworking residues were recovered and were regarded as late medieval (ibid.: 20). This, however was based on a radiocarbon date, and finds, from the upper levels of a thick deposit. The lower levels of this deposit, which sealed the largest concentrations of slag, including an *in situ* hearth, returned radiocarbon dates between the eighth and tenth centuries.[198] There is therefore a possibility that the slag from the upper layers of this deposit represents redeposited earlier material.

Carrowreagh, Co. Wexford

Several pieces of possible slag were recovered from the moat of a late medieval enclosure at Carrowreagh, Co. Wexford (Tierney and Johnston 2009: 8).

Doras, Co. Tyrone

Limited evidence for ironworking was found in proximity to a circular house structure at Doras, Co. Tyrone, but the pottery found was both early medieval (Souterrain Ware) and late medieval (Everted Rim Ware) (McDowell 1987: 142, 145).

198 The preserved metalworking assemblage from Ballyman was subjected to visual analysis for inclusion in this thesis. The report (Rondelez 2011) used the late medieval date suggested in the excavation report, which now needs to be revized.

Dowdstown, Co. Meath

Extensive settlement remains were unearthed close to the ruins of a twelfth century church established by the Cistercian monastic order (McGowan 2008). Slag was recovered from several features and while others nearby produced late medieval pottery, no direct dating evidence was recorded for the metalworking. The site was not excavated and preserved *in situ*.

Downpatrick, Scotch Street/Church Street, Co. Down

A small-scale intervention at Scotch Street/Church Street, Downpatrick, revealed evidence of ironworking (Gahan 1997). Although the published account appears to suggest this is late medieval in date, the evidence provided is inconclusive.

Dublin, 10 Exchange Street Upper

Excavation at 10 Exchange Street Upper in Dublin uncovered several hearths dated to the twelfth to thirteenth centuries (Scally 1999). One of these hearths had a large stone across its middle and was interpreted as having been used for unspecified metalworking.

Dublin, Phoenix Street North

According to the notice on the excavations at Phoenix Street North in Dublin, iron slag and late medieval material was recovered from one of the areas excavated (Cosgrave 2000). The final report at the National Monuments Service in Dublin, however, does not mention any metalworking remains.

Duiske Abbey, Graiguenamanch, Co. Kilkenny

About 8lbs of slag was recovered during excavations at Duiske Abbey in Co. Kilkenny (Bradley et al. 1981: 420), but no context or dating information was provided.

Dunshaughlin, Co. Meath

During excavations at an ecclesiastical enclosure at Dunshaughlin, Co. Meath, a "furnace bottom" was found in a context dated to the Anglo-Norman period, but could have been residual from former activity demonstrated in the same area (Simpson 2005: 229, 236).

Farrest, Co. Tyrone

During the excavation of an oval enclosure at Farrest, Co. Tyrone, "furnace bottoms" and a bloom were found together with fragments of Everted Rim Ware (Lynn 1983: 157). The slag itself, however, could not be confidently dated (ibid.: 158).

Finglass, 4–8 Church Street, Co. Dublin

Evidence for small-scale ironworking was recorded in the notice on an excavation carried out at 4–8 Church Street in Finglass, Co. Dublin (Kavanagh 2007), but subsequent information received from the director[199] made it clear that none was actually present.

Glebe, Co. Meath

Excavations on a terrain near the village of Rathmoylon, Co. Meath unearthed three "bowl-furnaces and a possible quenching trough" (Shine 2009: 22). These were seen as possibly late medieval, but firm dating evidence was lacking.

Holy Trinity Abbey, Trinity Island, Co. Roscommon

None of the more than 7kg of slag recovered during the excavations at Holy Trinity Abbey in Co. Roscommon was retrieved from dated contexts (Clyne 2005: 48, 55, 59).

Inishcaltra, Co. Clare

Excavations on the island of Inishcaltra or Holy Island in Co. Clare revealed the

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remains of iron-, copper- and boneworking which was dated between the eleventh and the thirteenth centuries (de Paor 1997: 78). The excavation report, however, is very incomplete, for example having no context information connected to the finds register.

Kilkenny, 63 High Street

At 63 High Street in the centre of Kilkenny, a feature relating to ironworking was uncovered and interpreted as a furnace (Ó Drisceoil 2005a). On the south side of the western-most cutting, a pit (114) was visible in one of the section faces and not fully excavated (ibid.: 54). Its basal fill is variably described as containing 50g of slag and large lumps of the same. A layer containing frequent charcoal, but without recorded slag, was interpreted as a rake-out deposit from this furnace. This layer, however, was situated on top of the pit (ibid.: 52). A deposit over the previous one contained local wares, Saintonge and Redcliffe pottery (ibid.: 54). Both the dating and the nature of the ironworking on this site are thus unclear.

Laracor, Co. Meath

Excavations at the multi-period site at Laracor, Co. Meath uncovered a pit with iron slag which was sealed by a layer containing thirteenth-century pottery (Breen 2004: 44). Although the metalworking was said to have been carried out between the thirteenth and seventeenth centuries (ibid.: 43), this could not be confirmed by the information in the report.

Mellifont Abbey, Co. Louth

Furnace bottoms or iron blooms, that is to say likely smithing hearth cakes, were recovered from the crypt and cloister during excavations at Mellifont Abbey, Co. Louth. No further information was provided, so no indications of the date of the residues (de Paor et al. 1969: 140).

Moore Abbey, Co. Kildare

During excavations at Moore Abbey, a late medieval Cistercian foundation, near

Monasterevin, Co. Kildare, large amounts of industrial residues interpreted as iron slag were uncovered (Mullins 2001: 18). A sample of the material sent by the director of the excavation was studied as part of this PhD research and identified as clinker which was probably derived from the boilers of a nearby nineteenth century distillery (Rondelez 2012).

Movilla Abbey, Co. Down

At Movilla Abbey, Co. Down, slag was recovered from late medieval layers, but could have been residual from underlying early medieval activity (Ivens et al. 1984: 106).

Mungret Abbey, Dromdarrig, Co. Limerick

The notice on the excavations at Mungret Abbey in Co. Limerick mentioned iron slag and medieval pottery found in several features (Kavanagh and Quine 2010). Subsequent information received from the director[200] made clear none was actually present

Nevinstown, Co. Meath

Large quantities of slag were found around a paved area associated with a flat-topped mound enclosed by three concentric ditches (Cahill 1988). A late twelfth- to thirteenth-century date was proposed for the structure, but a later re-assessment of the site suggested a possible earlier date (Kerr et al. 2012: cmxix).

Newry Abbey, Ballynacriag, Co. Down

At Newry Abbey, slag was found in the upper layers of a ditch together with thirteenth-century artefacts, but sixteenth-century pottery was retrieved from older strata in the same ditch (Crothers and Gahan 2000: 73, 75).

Thurles, Cathedral Street, Co. Tipperary

The notice on the excavation at the Munster Hotel in Thurles, Co. Tipperary mentions a truncated medieval ironworking furnace which was uncovered (Stevens 2000). The

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report on the excavation, consulted at the National Monuments Service in Dublin, has no record of metalworking activity on this site.

Wexford Town, Bride Street

Evidence for ironworking was uncovered during the excavation at Bride Street in Wexford Town (Bourke 1989). The settlement activity ranged from the eleventh to the thirteenth centuries and, from the limited information available on the excavation results, it was unclear to which period the metalworking belonged.

Wexford Town, Cornmarket

Possible, but unconfirmed, remains of ironworking were uncovered during excavations at Cornmarket in Wexford Town (Wren 2002).

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BmR	Bibliothèque municipale de Rouen
Bodl.	Bodleian Library, Oxford University, Oxford
BnF	Bibliothèque nationale de France, Paris
DCA	Dublin City Archives, Dublin
NLI	National Library of Ireland, Dublin
Nott. Arch.	Nottinghamshire Archive, Nottingham
NUL	Nottingham University Library, Nottingham
PRO	Public Records Office, London
PRONI	Public Records Office of Northern Ireland, Belfast
WAM	Walters Art Museum, Baltimore, USA

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