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Assessment of residues from Mariavilla, Maynooth

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Abstract

The submitted material comprised small collections of iron smelting residues from the fills of two cut features, interpreted as the basal pits of non-slag tapping iron smelting furnaces.

The two pits were truncated, one much more severely than the other, and the slag they contain was not the entire residue from their last smelts. 14C determinations suggest both date from the end of the Developed Iron Age or the start of the Late Iron Age. This interval has dominated evidence for iron smelting from the Iron Age, with later Iron Age sites being rare.

The evidence from other sites is very imperfect, but this general period of evidence for high production of iron is also one of high diversity within furnace construction. Understanding of the precise significance of this diversity is currently hindered by inadequate dating evidence, so the new evidence providing dates from both furnaces at Mariavilla is particularly welcome.

The Mariavilla furnaces are examples of the relatively narrow furnaces that came to dominate iron making in Ireland from the first century BC and through the Late Iron Age. Such furnaces may show evidence for a furnace arch, although no such evidence appears to have been present at Mariavilla.

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Methods

All materials were examined visually, using a low-powered binocular microscope where required. As an assessment, the materials were not subjected to any high-magnification optical inspection, not to any form of instrumental analysis.

The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

This assessment was conducted in June 2020 and was commissioned by Paul Stephens of IAC Ltd.

Description of the assemblage

The submitted material (Table 1) comprised 3 collections:

Context 106, s#<2>, 505g (42 pieces)
The assemblage comprises prilly flow slags. The individual prills are commonly inflated, forming broad, low horizontal flow lobes (up to 25mm wide and 12mm high). The upper faces of the lobes are rounded, the lower faces variable – some with small fuel dimples, some with moulds of larger fuel fragments and some with a rough appearance, possibly from flow over sand or silt. The largest fragment is fractured but appears to represent a birdsfoot-like structure. Many of the fragments show fractures that appear fresh, and it is possible, even likely, that all the fragments are parts of a single whole slag flow from the base of a slagpit.

Context 120, s#<7>, 5.456kg (250 pieces)
This collection includes a range of slag morphologies typical of those from the basal slag of slag-pit style non-tapping iron smelting furnace with a wood packing. No records of the slag as it had been *in situ* were available, but the collection appears to be an incomplete slagpit assemblage. There is a single significant fragment (768g) from the upper part of a 'furnace bottom' slag cake, together with a further approximately 390g (24 pieces) of probably similar material. The lower part of the slag mass is represented by 1015g (3 pieces) of amalgamated flow slag with a wall contact and 642g of amalgamated flow slags with a wall contact (4 pieces). There were 2395g (215 pieces) of flow slags that might have derived either from the lower part of the slag mass or as prills descending below the slag mass into the lower pit fill.

Context 126, s#<12>, 145g (33 pieces)
The 33 pieces of flow slag were rather blebby, dark, dull-surfaced prills with a typical prill diameter of 8mm or less. The prills anastomose, but do not amalgamate into blocks. Wood/charcoal imprints were present but were all very small; there was no evidence for large wood contacts.

Distribution of the assemblage

The materials described in this report all derive from two features – the basal pits of two shaft furnaces of the slagpit type. The key contexts (* with slags) are:
furnace C105 (fill c106*)
furnace C119 (fills c121, c120*, c126*, c127)

The site also included numerous other 'hearths'. Although some appear to have the dimensions of cut hearths (whether metallurgical or for other purposes), the lack of slag evidence and the presence of a significant degree of truncation, it is unknown whether many of these areas of heat alteration formed below true hearths or below other furnaces:
C138 (area 1b)
C116 (area 2b)
C117 (area 2b)
C122 (area 2b) (fills c123, c124, c125)
C110 (area 3b) (fill c111)
C113 (area 3b) (fills c114, c115)

Interpretation

Two smelting furnaces were identified during excavation:

Furnace [119] (in Area 2B) – Furnace [119] is described as being 0.4m in diameter and 0.25m deep, but the main slag fill is described as 0.33m by 0.25m and 0.2m deep. The furnace appears to have had basal fill (126) followed by main slag-rich fill (127) (although the major slag collection was all bagged as context (120) not (127)). The middle fill of the furnace was a grey sandy silt (121), overlain by a brown silty clay (120). The archaeometallurgical residues are labelled (120) <7> (5.5kg) and a smaller collection (145g) labelled (126) <12>. Context (126) was dated using alder charcoal from sample <11> to cal. 50 BC – cal. AD70.

Furnace [105] (in Area 3A) – this was heavily truncated, being 0.35m in diameter with a surviving depth of only 90mm; it was filled with (106). It was associated with a shallow second feature [103], interpreted as a hearth and an area of scorching (107). Given the shallow surviving depth, if any, of these features, care should be taken not to over-interpret them. The archaeometallurgical residues from fill (106) comprise 505g of small pieces of flow slags, typical of the basal fills of some slagpit furnaces and very similar to the equivalent-sized components from the fills of Furnace [119]. Context (106) was dated using alder charcoal from sample <1> to cal. AD1-130.

The two furnaces thus appear to be of a similar modest size, the slag assemblages from the two furnaces appear very similar in morphology, colour and texture (differing in detail in morphology because of their origin at different locations with the slag pit) and they are also of similar age.

Each furnace formed part of a cluster of heat-affected features and each was the deepest of the nearby cuts.

Discussion

Summary of the Mariavilla data

The slag assemblages derive from two furnaces – 505g of horizontal flows from the basal layers of the fill of the highly-truncated Furnace [119] and 5.6kg from the fills of the better preserved (but probably also truncated) Furnace [105].

The assemblage from Furnace [105] represents perhaps 25-30% of the total slag that might be expected to accumulate within the basal pit of a furnace of this type during one smelt and most of the main slag cake is missing. It is unclear whether this is solely as a result of truncation or whether the slag assemblage was fragmented during bloom extraction and the collection present in the pit was at least partially redeposited following its final smelt.

The nature of the comparative data

Any discussion of the context of the Mariavilla furnaces needs to offer some critical re-appraisal of current understanding of Iron Age iron smelting. Some synethesis of the Iron Age data has already been undertaken by Dolan (2016), but much remains to be done. The two key areas are the dates of previously excavated furnaces and the interpretation of their morphology.

Indeed, those two questions are interlinked, because even a cursory understanding of the technology reveals a fundamental issue concerning the dating. The last 15 years or so has seen the almost complete abandonment of previous interpretations of Iron Age furnaces in Ireland (and indeed elsewhere in NW Europe) as bowl furnaces (*ie* furnaces wider than they are in total height in which a smelting reaction is controlled by manipulation) and a realisation that they are probably all shaft furnaces (*ie* furnaces taller than they are wide, with a reaction controlled by gravity). The furnaces in use in the Irish Iron Age were forms in which the shaft overlies a basal pit, into which the slag descends during the smelt, separating from the iron bloom, which forms at a level just below the air blast, approximately at original ground level. These furnaces would be mostly intended to be multi-use. In many varieties of this furnace style as used in Ireland, if not most, the furnace wall contained an arch, often below ground level, to facilitate removal of slag and bloom. In some varieties the basal chamber may actually have been close to or above the original ground surface, but in Ireland this is mainly seen in examples of slightly later date.

Furnaces of this type are known from a wide area of Europe and may be known as slagpit furnaces or slag drain furnaces.

Part of the method of use of these furnaces requires that the basal pit to be packed with a material that can combust, but which provides space for the descending slag (as opposed to a base of dense wood ash, which would prevent the down flow of the slag). The basal pit packing is usually of one of two types – either a packing of wood (either split or roundwood, or a mixture) or a packing of cereal /grass. Furnaces in Ireland with a cereal packing are so far only known from the Early Medieval; where the packing has been identified, it is wood in Iron Age examples. The descent of the slag between the pieces of wood produces slag prills of very characteristic, apparently contorted form, which may amalgamate into larger masses and preserve the imprint of the large wood pieces in the form of moulds. The purpose of the packing may, in part, be to provide a support for the early stage of the reaction which may later combust to provide space for slag to accumulate. Perhaps even more important, may be that the wood moulds provide weakness along which the slag mass will break to ease extraction of the slag from the pit after a smelt.

This means that charcoal in the base of the furnace pit may result from the charring of the wood packing. Charcoal remains from the actual charcoal fuel of the furnace may not necessarily be able to descend into the lower part of the pit. Thus, charcoal in the pit may be different to the charcoal fuel. The textural attributes of the wood moulds are suggestive of oak in many cases and oak is the dominant charcoal species recorded from the slagpits. This does not mean, necessarily, that oak was the main fuel.

There are a few sites from which multiple dates are available. The following list (Table 2) is biased towards (but not limited to) sites for which the author provided the archaeometallurgical reporting and for which therefore has a better working knowledge. The dataset is very small but is suggestive of a systematic problem of dates on oak being older than closely-related dates on other woods (notwithstanding that in none of these examples is the pairs of determinations on wood from the same context).

There might be two explanations for such a pattern – firstly that the selection of charcoal substrates for 14C determinations did not correctly locate examples showing sapwood or bark (used charcoal fuel will be consumed from the margin of the fragment so these characteristic zones may be lost first), but used heartwood and the large oak fragments included older wood than the twigs utilised as a substrate for the other species, and secondly, it is possible that the oak used for the pit packing was not fresh wood at all, but old wood, perhaps extracted from the bog alongside the ore. Either of these explanations would permit the wood of the pit packing to be, on average, older than the wood employed for charcoal making (potentially young coppice or pollard wood). As a subsidiary note, this may also mean that not only are dates on oak from slagpit furnaces to be considered potentially suspect, but so are the multitude of comments from archaeobotanists that oak was the preferred fuel for smelting – it may have been for the pit packing ,but we may not always have even analysed the fuel at all!

If the dates and archaeobotany of described examples should be treated with caution, so should field descriptions of the features themselves. Very few field archaeologists have sufficient experience or training to make suitably detailed or nuanced observations on the furnace remains. In particular, especially during the boom days of motorway development, inexperienced field crews may have been confused by the recording of the burnt clay that may surround the slagpit. The heat affected, commonly oxidised, halo around the pit

may be confused with a clay lining to a pit. In some cases, a clay lining was certainly present, but in many cases the line of the pit cut may have been erroneously interpreted. The key figure, often unrecorded in feature descriptions, is the size of the working pit (the space available during the smelt) – which may be much smaller than either a lined construction cut, or a limit of oxidation erroneously interpreted as a cut. This figure is rarely, if ever, quoted in the body of existing final reports.

Another problem with their recording, is that the pits are truncated in all but a very few exceptional cases. An understanding of the extent and significance of truncation is not demonstrated in many excavation reports. The assumption that the level of preservation has a direct relevance to the level of the contemporaneous ground surface is implicit; a cut feature with a heat-altered halo may be treated as a furnace or hearth, but an area of heat alteration without an associated cut is rarely considered as a potential location of a deeply truncated furnace or hearth. Thus, the profile is very important and consideration of size needs to take allowance of the measured dimensions compared with the likely original ones.

The processes of excavation and sampling also impact on the potential quality of the eventual interpretation. In Ireland, the continued heavy emphasis on the interpretation of burnt cut features as 'bowl hearths' or 'bowl furnaces' well into the 2000s has often held back development of understanding. The non-recognition of furnaces with basal arches means that it is now very difficult to understand how many paired furnaces excavated in the motorway boom were actually furnace/working pit pairs, divided not by natural ground, but by a collapsed furnace arch. In general, a preoccupation in field archaeology with half-sectioning cut features means that the distribution of slag within the basal pit of a smelting furnace is very rarely recorded adequately and after the event it may often be impossible to determine whether the assemblage was in-situ or represented smelting waste dumped into an abandoned furnace pit.

Sampling of charcoal for archaeobotanical and dating purposes has been touched on above, but problems also exist through a lack of sampling for archaeometallurgical microresidues. In some jurisdictions and within some contracting companies such work is routine and expected, but within the Republic it is the exception rather than the rule. The almost total lack of microresidue data impacts particularly through the loss of one of the key lines of evidence surrounding the smithing of iron and thus also the recognition of dumped waste accumulations as opposed to in-situ assemblages. It also reduces the evidence available which might have enabled features lacking visible heat alteration to be identified as metallurgical features. Dolan (2016) has commented on the paucity of smithing sites from the Irish Iron Age, but a lack of sampling for microresidues probably carries some degree of responsibility for this state of affaris.

Mariavilla in context

Mariavilla produced two bloomery iron smelting furnaces of apparently similar morphology, slag and date.

The best estimate of working size can be derived from furnace [119] (at approximately 0.35 x 0.30m); furnace [106] is compatible with being a similar size but is heavily truncated.

Furnace [105] was dated to cal. AD1-130 and Furnace [119] to cal. 50 BC – cal. AD70, each on the basis of alder charcoal from their basal fills. It is not known whether the alder formed part of the fuel or the pit packing. The lack of any oak in the charcoal samples may suggest that alder formed the pit packing (although it may have been present as fuel as well), however, it is possible that in the very basal parts of pits there may be insufficient charring of the pit packing to ensure its preservation. However, taken at face value, these dates suggest that the smelting was undertaken at a period close to the boundary of the Developed and Late Iron Age (Becker *et al*. 2008).

Notwithstanding the issues with dating discussed above, previous studies have suggested that the furnaces of the Developed Iron Age in Ireland are relatively large and previous review (Young 2009b) identified a group of sites with furnaces having diameters of around or greater than 0.45m:
Leap 1, Co Laois (Young 2009a)
Cloncollig, Co Offaly (Young 2008b)
Cherryville 12, Co. Kildare (Young 2008a)
Newrath 35, Co. Kilkenny (Eogan pers.comm. 2006)
Morrett D, Co. Laois (Young 2005)
Adamstown 1, Co. Waterford (Young 2006b)
Tullyallen 6, Co. Louth (Young 2003d)
Clonrud 4, Co. Laois (Young 2008h)
Derryvorrigan 1, Co. Laois (Young 2008f).

Re-examination of the reporting for these sites suggests that in several cases the reported furnace dimensions were significantly larger than the actual working volume. This group is amended in Table 2 to include only Ballydavid, Cherryville and Cloncollog (Group A), with the doubtful examples listed separately as 'uncertain'.

The two best-preserved in-situ slag assemblages from these larger furnaces derive, unfortunately, from undated furnaces (at Tullyallen 6 and Adamstown 1; Young 2003d, 2006b).

In contrast, a second group of sites (Group B), mostly of later date than those of Group A, have produced evidence for slightly smaller furnaces. These include:
Carrickmines (Young 2003a, Ó Drisceoil 2005, 2007)
Derrinsallagh 4 (Young 2008d,i; Lennon 2009a)
Derrinsallagh 5 (Young 2008e; Lennon 2009b)
Derrivorrigan 1 (Young 2008f; Lennon & Kane 2009b)

Alongside which are listed two sites from the very late Iron Age or early medieval period:
Grange 2 (Kelly 2011)
Knockbrack (Hull & Taylor 2006)

This group is best represented by Derrinsallagh 4, where approximately 47 furnaces were recorded. The likely working volume of 40 out of these 47 furnaces can be reconstructed from documentation present in the final report and calculated as an effective working diameter (from the root mean square of the maxima and minima). For two examples this is less than 250mm, 10 from 250mm to 300mm, 7 from 300-350mm, 16 from 350-400mm, 3 from 400-450mm and just 2 where the effective working diameter is over 450mm (and thus overlapping with the typical size of the Group A furnaces).

Morphological similar furnaces occur on other undated smelting sites, for instance Celbridge Interchange 5 (Young 2003b) and Derrrinsallagh 3 (Young 2008c; Lennon & Kane 2009b), which may also belong in this group.

The detailed morphology of the smaller terminal Developed Iron Age/early Late Iron Age furnaces is slightly problematic. The examination of one block-lifted furnace in great detail (Derrinsallagh 4, F397, Furnace 35; Young 2008i) revealed a form with a frontal arch that had not been recognised during excavation. Based on the site records, it is likely that at least 4 of the other furnaces on this site were also arched, also unrecognised during their excavation. Other furnaces at Derrinsallagh 4 appeared to have simple basal pits (although this does not preclude them from having had arches above ground surface).

An unusual variant on the arched design is presented by the furnace from Grange 2 (probably dated to the Late Iron Age; Kelly 2011), which was constructed with a clay block (furnace setting) in one end of a pit (the other end contained evidence suggesting it too may have housed a furnace but the lay setting had been removed. The base of the furnace possessed an arch into the containing pit. This method of construction is widespread amongst furnaces of Roman Britain. The furnace appears to have been small, although the final report contains no details on the size of the basal chamber, it appears to have been wider than the shaft above (possibly as narrow as 120mm diameter on the basis of the report photographs).

On-going use of small furnaces through the Late Iron Age and into the start of the Early Medieval is also suggested by the site at Knockbrack (Co. Kerry; Hull & Taylor 2006). Here a pair of slagpits, each 0.36m in diameter, with centres approximately 0.70m apart, faced external burnt working hollows to their NW and had shallow pits about 0,5m in diameter centred approximately 0.90m to their SE. The furnaces and their working hollows were set at the SE end of a broader depression, some 2m across, with heat alteration at its centre. This level of detail of observation of a furnace/feature cluster is unusual, but it is unclear whether this careful distribution of features at Knockbrack has been brought to light through a better level of preservation (lower degree of truncation) than the Midlands sites, or whether it represents a genuinely higher level of sophistication of the setup of furnaces at the very end of the Iron Age. It is unclear whether this setting was part of a building (and thus somewhat resembling the much later smelting structure at South Hook, on the Irish-facing SW coast of Wales.

The 47 or so furnaces at Derrinsallagh 4 showed clustering into perhaps 9 clusters (e.g. Dolan 2016, Fig. 4), with clusters sometimes forming a linear arrays of cut features. These include furnaces 13/14/15/16 and '16b' (forming a very slightly arcuate array), 32/28/26/29 (forming an array of irregular spacing) and furnaces 35/36/44 (an array of arched furnaces with external working hollows). Some of the smaller sites in the same area of the M7 in Co. Laois as Derrinsallagh 4, for instance Leap 1, produced a single cluster of furnaces and probable waste pits. A very similar linear array of features has been recorded at Ballinamona 2 (Johnston & Kiely 2019; Young 2009d) in Co. Cork, although the interpretation in detail of the metallurgical features there is problematic.

Some furnaces at Derrinsallagh 4, for instance furnaces 8/9 and 45/46, were very closely related with what appeared to be a second furnace (rather than an external working hollow as in F397). These 'paired furnaces' can also be recognised at Derrrivorrigan 1 (possibly 4 pairs) and at Clonrud 4 (1 pair). Clonrud may be rather earlier than Mariavilla, but Derrivorrigan appears to be of similar age.

What the current level of dating does not permit, is any understanding on the relative dating of the use of paired furnaces and of furnaces with frontal arches (either those below ground (e.g. Derrrinsdallagh 4 c397) or largely above ground (e.g. Knockbrack).

The evidence from Mariavilla fits closely with these patterns observed elesewhere. The two furnaces at Mariavilla each lies within a cluster of features (areas 2B and 3A), of mostly indeterminate nature because of truncation. The simple, small, slagpits present at Mariavilla are preserved to depths of just 250mm and 90mm, so definite interpretation of both slagpit size and shape is not possible, but it is likely that they would have been similar size to the smaller furnaces on the sites of Group B.

The phenomenon of isolated clusters of features associated with iron-making from the late Developed Iron Age/early Late Iron Age has been discussed by Dolan (2016). It most likely represents repeated exploitation of an area's resources at intervals over long periods of time. Repeated exploitation on slightly different locations are a feature in other times and cultures of smelting following coppice rotations, but there is no evidence as to whether that is the controlling influence here.

Further work

The slags are, as described above, are a rather small assemblage, and not represent of the complete suite of residues likely to have been produced in the furnaces. They are thus only capable of yielding very limited further evidence if they were to be subjected to detailed analysis.

On this basis, no further work is recommended at this time. The material is however important (such slags might in the future be worthy of detailed analysis to contribute to regional studies or to provenancing programmes) and thus should be deposited in a suitable repository with the site archive.

References

Becker, K., Ó Néill, J. and O'Flynn. L. 2008 Iron Age Ireland: Finding an Invisible people. Final Report to the Heritage Council Project 16365 2008 Archaeology Grant Scheme

Breen, T.C. 2005. Final report on archaeological excavation at Cherryville (Site 12), Kildare Bypass, Co. Kildare, 01E0955. Unpublished report for Valerie J. Keeley Ltd.

Crane, P. & Murphy, K., 2010, Early medieval settlement, iron smelting and crop processing at South Hook, Herbranston, Pembrokeshire, 2004–05. *Archaeologia Cambrensis*, 159, 117-196.

Dolan, B. 2016. Making iron in the Irish midlands: the social and symbolic role of Iron Age ironworkers. *The Journal of Irish Archaeology* 25, 31-48.

Hardy, C., Green B. & Stevens P. 2010. Site AR 26, Ballydavid Townland, Co Tipperary, M8/N8 Cullahill to

Cashel Road Improvement Scheme, Final Report. Unpublished report for Valerie J Keeley Ltd.

Hull, G & Taylor, K. 2006. Archaeological sites on the route of the N21 Castleisland to Abbeyfeale road improvement scheme, Co. Kerry. *Journal of the Kerry Archaeological and Historical Society*,Series 2, 6, 5-59.

Johnston, P. & Kiely, J. 2019, *Hidden Voices: The Archaeology of the M8 Fermoy–Mitchelstown motorway*, TII Heritage 7.

Kane, E. 2009a. Clonrud 4, Contract 3, M7 Portlaoise to Castletown/M8 Portlaoise to Cullahill Motorway Scheme, Final report. Unpublished report for ACS Ltd.

Kane, E. 2009b. Leap 1, Contract 1, M7 Portlaoise to Castletown/M8 Portlaoise to Cullahill Motorway Scheme, Final report. Unpublished report for ACS Ltd.

Kelly, A. 2011. Grange 2, E3124. M3 Clonee – North of Kells, Contract 4. Final Report. Unpublished report for IAC Ltd.

Lennon, A.-M. 2009a. Derrinsallagh 4, Contract 2, M7 Portlaoise Castletown/M8 Portlaoise-Cullahill Motorway Scheme, Final report. Unpublished report for ACS Ltd.

Lennon, A.-M. 2009b. Derrinsallagh 5, Contract 2, M7 Portlaoise Castletown/M8 Portlaoise-Cullahill Motorway Scheme, Final report. Unpublished report for ACS Ltd.

Lennon, A.-M. and Kane, E., 2009a. Derrinsallagh 3, Contract 2, M7 Portlaoise to Castletown/M8 Portlaoise to Cullahill Motorway Scheme, Final Report. Unpublished report for ACS Ltd.

Lennon, A.-M. and Kane, E., 2009b. Derryvorrigan 1, Contract 2, M7 Portlaoise Castletown/M8 Portlaoise-Cullahill Motorway Scheme, Final Report. Unpublished report for ACS Ltd.

Nunan, J, 2009. Derrygarriff 2, E3711, N18 Gort to Crusheen Road Scheme, Final report. Unpublished report for IAC Ltd.

Ó Drisceoil, C 2005. Draft final report, archaeological excavation Carrickmines Great Site 59-62 South Eastern Motorway, Co. Dublin 02E272. Unpublished report for Valerie J Keeley Ltd.

Ó Drisceoil, C 2007. Life and death in the Iron Age at Carrickmines Great, County Dublin. *Journal of the Royal Society of Antiquaries of Ireland* 137, 5-28.

Wiggins, K. and Kane, E., 2009. Bushfield/Lismore 1, Contract 2, M7 Portlaoise Castletown/M8 Portlaoise-Cullahill Motorway Scheme, Final Report. Unpublished report for ACS Ltd.

Young, T.P. 2003a. Evaluation of slag from the SE Motorway, Co. Dublin (02E0428, 02E0272, 02E0074 and 02E0076). 3pp. *Geoarch Report 2003/02*.

Young, T.P. 2003b. Evaluation of slag from Celbridge Site 5, County Kildare (01E0306). *Geoarch Report 2003/07*. 5pp.

Young, T.P. 2003c. Is the Irish iron-smelting bowl furnace a myth? A discussion of new evidence for Irish bloomery iron making. 4pp. *Geoarch Report 2003/09*.

Young, T.P. 2003d. Evaluation of slag from Tullyallen 6, Co. Louth (00E00944). *Geoarch Report 2003/10*. 2pp. + 2 figs.

Young, T.P. 2005. Evaluation of archaeometallurgical residues from the Heath-Mayfield N7 development (03E0151, 03E0966, 03E0461, 03E0603, 03E0633, 03E0679, 03E0602, 03E0635). *GeoArch Report 2005/12*. 28pp.

Young, T.P. 2006a. Evaluation of archaeometallurgical residues from the Kildare town By-pass; Loughlion Site 8 and Cherryville Site 12 (01E0846 ad 01E0955). *GeoArch Report 2005/16*. 8pp.

Young, T.P. 2006b. Evaluation of archaeometallurgical residues from sites on the N25, Co. Waterford (Woodstown 6, Adamstown 1,2,3). *GeoArch Report 2006/15*. 38pp.

Young, T.P. 2008a. Archaeometallurgical residues from Cherryville Site 12, Kildare Bypass. 01E0955 *GeoArch Report 2007/24*. 33pp.

Young, T.P. 2008b. Evaluation of metallurgical residues from Cloncollig 2, Co. Offaly, NTB06, A033/E2850137. *GeoArch Report 2008/09*. 4pp

Young, T.P. 2008c. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Derrinsallagh 3 (E2179). *GeoArch Report 2008/22*. 11pp.

Young, T.P. 2008d. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Derrinsallagh 4 (E2180). *GeoArch Report 2008/23*.

Young, T.P. 2008e. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Derrinsallagh 5 (E2181). *GeoArch Report 2008/24*.

Young, T.P. 2008f. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Derryvorrigan 1 (E2193). *GeoArch Report 2008/26*.

Young, T.P. 2008g. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Lismore-Bushfield 1 (E2220). *GeoArch Report 2008/27*.

Young, T.P. 2008h. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 3: Clonrud 4 (E2167). *GeoArch Report 2008/30*.

Young, T.P. 2008i. Detailed recording of furnace C397, Derrinsallagh 4 (E2180), M7/M8 Contract 2. *GeoArch Report 2008/34*, 10pp.

Young T.P. 2009a. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 1: Leap 1 (E2131). *GeoArch Report 2009/03,* 3pp.

Young, T.P. 2009b. Evaluation of Archaeometallurgical Residues from the M8/N8 Cullahill-Cashel: AR26 (E2370), *GeoArch Report 2009/30*, 7 pp.

Young, T.P. 2009c. Evaluation of archaeometallurgical residues from the N9/N10 Waterford-Kilcullen, Site 3-5, Milltown/ Ballynamorohan, Co. Kilkenny (E2499), *GeoArch Report 2009/38*, 12 pp.

Young, T.P. 2009d. Evaluation of archaeometallurgical residues from the N8 Fermoy-Mitchelstown, Ballynamona 2, Co. Cork, (E2429). *GeoArch Report 2009/43*, 8 pp.

*Table 1: summary catalogue of submitted macroscopic materials. Weights in g. * = sample may be from 3004.*

Context	Sample	Item wt	Item no	Notes
106	2	505	42	Horizontally prilly flow slags, includes a birdsfoot structure and many fragments may represent a single basal flow
120	7	768	1	Plano-convex lump of open-textured furnace bottom material rich in fine fuel moulds. Upper surface granular, possibly original upper surface of cake.
		1015	3	Burr-like contact of heat-altered grey ceramic and coarsely-prilly furnace bottom material, not intense burr, but definite interaction between the amalgamated flow slags and the pit wall. The flow slags contain moulds of roundwood.
		2395	215	Flow slags
		222	21	Rough-surfaced, granular slag
		642	4	Large amalgamated flow slag pieces, show moulds of moderately large wood pieces, but no exceptionally large moulds
		164	3	Rough-surfaced, granular slag in larger pieces, possibly material similar to that forming the upper surface of the plano-convex block
		250		Debris and dust
126	12	145	33	Flow slag, in fairly narrow flows, fuel contacts but no large wood moulds.

Table 2. Selected comparative sites and radiocarbon evidence.

Site	Dimensions of working volume in m	Dates on oak		Dates on other species			Comments
GROUP A							
Ballydavid AR26	[c142]: 0.52 x 0.50 x 0.21 [c157]: 0.46 x 0.42 x 0.29 [c161]: 0.30 x 0.46 x 0.48 [c172]: 0.69 x 0.63 x 0.31 [c167]: 0.45 x 0.40 x 0.30 [c169]: 0.62 x 0.44 x 0.19	380–190BC	UBA-10363	770 - 410BC	UBA-10360	*Pomoideae*	[c156] (lower fill of "furnace" c157): 765 - 416BC [c171] (lower fill of "furnace" c172): 374BC – 191BC [c168] (dump in ditch c60): 32BC – AD127 UBA-10362
Cherryville 12	0.46 diameter F2 0.54 x 0.4 F6 0.48 diameter F7 0.45 diameter F8			400-340/320-200BC	Wk-12861	Alder	Date from F8 which is not certainly a furnace.
Cloncollog 2	0.57 x 0.6 x 0.32 deep	360 – 270/260 – 90 BC	UB 8278				2158+/-34
UNCERTAIN							
Clonrud 4	0.41 x 0.39 0.46 x 0.41	790 BC – 490 BC	SUERC- 6967	360 BC – 90 BC	SUERC-16968	Willow	Willow date from furnace 1 [003] 3160+/-35 Oak date from furnace 2 [005]. 2495+/- 35
Leap 1	0.40 x 0.40 (F007) 0.25 x 0.25 (F011)	390 BC – 180 BC	SUERC-16945	BC50 – AD90 BC200 – AD10	SUERC-16941 SUERC-16940	Alder Alder	Alder date from F011, second alder date from probable waste pit F008, oak from probable waste pit F009.
Derrygarriff 2				350–100 BC	UBA 12716	Alder/hazel	Possible arched furnace, up to 0.68 maximum width?
Ballinamona	Assoc with 0.55m x 0.55m x 0.25m deep			90 – 70 BC/60BC – AD60	UBA-14151	Ash	2017+/-21, (23) fill of [25] multiple paired furnaces? Cuts 'deliberately lined with clay' – working volume uncertain
Lismore-Bushfield 1	0.44 x 0.38 0.50 x 0.45 0.42 x 0.38 0.60 x 0.49 0.54 x 0.50			90BC to AD80			Furnace pits poorly preserved
Newrath 35	0.30 diameter 0.40x0.30 0.42x0.40 0.50x0.43	400 BC – 200BC	UB-6317	350BC – 40 BC	UB-6316	Hazel	
GROUP B							
Carrickmines Great	0.37 diameter	360 – 110 BC	Poz-11607				2165+/-30
Derrinsallagh 5	0.25 x 0.25 x 0.25 deep	540 – 350/280 – 250 BC	SUERC-17283 (C81)	160 – 140 BC/ 120 BC – AD 70	SUERC-17282 (C9)	Ash and Hazel	Furnace [070] produced the oak analysis. Second date is from associated pit
Derryvorrigan 1	0.29 x 0.37 x 0.22 deep	370 – 150/140 – 110 BC	SUERC-17599 (F155)	50 BC – AD 90/ AD100 - 120	SUERC-17595 (F121)	Alder and Hazel	Alder/hazel the fill of posthole C016 associated with Structure 3 oak 2175+/-35, alder & hazel 1975+/-35
Derrinsallagh 4	0.25 to 0.40 diameter			100BC-AD260 50BC-AD240 100BC-AD80	Beta-218649 Beta-218645 SUERC-17011	? ? ash	
Grange 2	Shaft <0.15 diameter	AD 250–410	UBA 12077	AD 420–560	UB13957	Barley	
Knockbrack AR02	0.36 x 0.36 x 0.15	AD 90 – 100/120 – 390 AD 240 – 430/490 – 510	Beta-202182 Beta-210880	AD 560 – 670	Beta-207372	Hazel	Oak from both of the pair of furnaces, hazel just from fill of [3], 1790+/-50, 1680+/-40, 1420+/-40

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