Production in deposition

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Production in deposition: structured deposition of Iron Age ironworking elements (The Netherlands)

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1. Introduction

During one of many excavation campaigns targeting the Iron Age habitation of Oss-Schalkskamp between 1990 and 1992, a ditch system surrounding a Late Iron Age settlement cluster was excavated (Brusgaard *et al.* in prep.; Fokkens *et al.* in prep.). Surprisingly, whilst the ditch had already been filling-in to some extent, a large 3.8 by 1.6 m and 0.5 m deep oval structure was constructed within it. The remains of this feature consisted of a layer of reddish sand covered by a thick layer of charcoal and has been interpreted as an iron-forging hearth (Brusgaard *et al.* in prep: fig. 3). In this hearth and the ditch it was constructed in, ample evidence for local iron production was recovered (*op. cit.*: tab. 4). It comprised 203 slag fragments (15.4 kg), 54.5 kg of (partly sintered; used as furnace lining?) pottery, a fragment of a *tuyere* and part of a bronze-working crucible and various chunks of burnt loam (1.5 kg; possibly hearth or furnace lining). Additionally, forged iron products as well as half-products and hammerscale were found in and around the hearth (*ibid.*).

This remarkable find of Oss-Schalkskamp unfortunately appears to be somewhat of a one-off. In general, the evidence for Iron Age metalworking is rather scarce (Serneels & Perret 2003: 472). Notwithstanding that there are plausible explanations as to why metallurgic activities are difficult to discover (for example (1) recyclable materials, (2) pyrotechnical activities being presumably located off-site due to fire hazards and (3) heritage management focus on settlement nuclei rather than peripheries, where such sites may be situated, *cf.* Kuijpers 2008: 16-17; 25), the sheer numbers of Iron Age settlements excavated in the Netherlands and the extensive areas of the contemporaneous cultural landscapes uncovered in the process may intuitively warrant a higher number of ironworking sites. Moreover, as the well-argued case of Oss-Schalkskamp suggests ironworking during the Late Iron Age, one wonders how to conceptualize the start of local iron working from the Early Iron Age – the period that takes its name from it.

Each phase in the iron production process creates its own unique debris, of which the slags are the most archaeologically visible (fig. 1). The slag formed during the smelting process can be grouped into four categories based on where in the furnace they are formed (Joosten 2004). Their shape and composition may also vary according to the raw materials and the type of furnace that is used and the efficiency of the process (Joosten 2004; Blakelock *et al*. 2005). For example, the slag formed when using a tap furnace tends to have a stalactite-like flowing structure, making it easily recognizable (De Rijk 2007). Slag from primary smithing is less easily identifiable as it varies in shape, although it is generally larger than secondary smithing slags (De Rijk 2007). The debris created during the final phase, secondary smithing, consists of hammerscale – produced by the hammering on the iron – and slags formed in the hearth. Of the latter, the smithing slags are easily recognisable with their plano-convex shape in cross-section.

Unfortunately, the data-set on the various steps of iron working, *i.e.* extraction (prospecting and amassing ore), smelting (converting ore to bloom, creating smelting slags in the process), primary smithing (converting bloom to bars/billets, creating primary slags), and secondary smithing (commonly known as forging or blacksmithing; converting bars/billets into iron objects, creating smithing slags and hammerscale in the process) is limited for the Dutch Iron Age.

Thus far, scholars studying the history of iron production in the Low Countries had to base themselves primarily on Roman Period and Medieval data. For example, the earliest well-dated (bowl) smelting furnaces date to the Roman period (Joosten 2004: 30). Recently, another Roman Period iron working site with smelting furnaces was excavated at Apeldoorn (De Rijk 2014, *cf.* Koopstra 2003: 99). Yet for the Iron Age proper, evidence for local production is much rarer. In this contribution, we will briefly discuss the *status questionis* of Dutch prehistoric iron production, followed by a presentation of the remarkable finds of slag fragments at Hijken and Oss. Furthermore, the composition of the slag fragments is studied to reconstruct the smithing process in more detail. We will also discuss the possibility that remains of iron working activities were intentionally left behind – and thus represent more than simple discard. But first, let us take a look at what is presently known about prehistoric iron working.

2. Evidence for Iron Age iron working

Whereas on a European scale, iron artefacts dating to the mid-third millennium are known (*e.g.* Collis 1984: 30-31) and smelted iron is attested from the 13th century BC onwards in the eastern Mediterranean (Butler 1984: 59), iron artefacts predating the traditional Iron Age period in the Low Countries (*c.* 800- 12 cal. BC) are very rare (Joosten 2004: 30). A noteworthy exception is the iron pin found during the exca-

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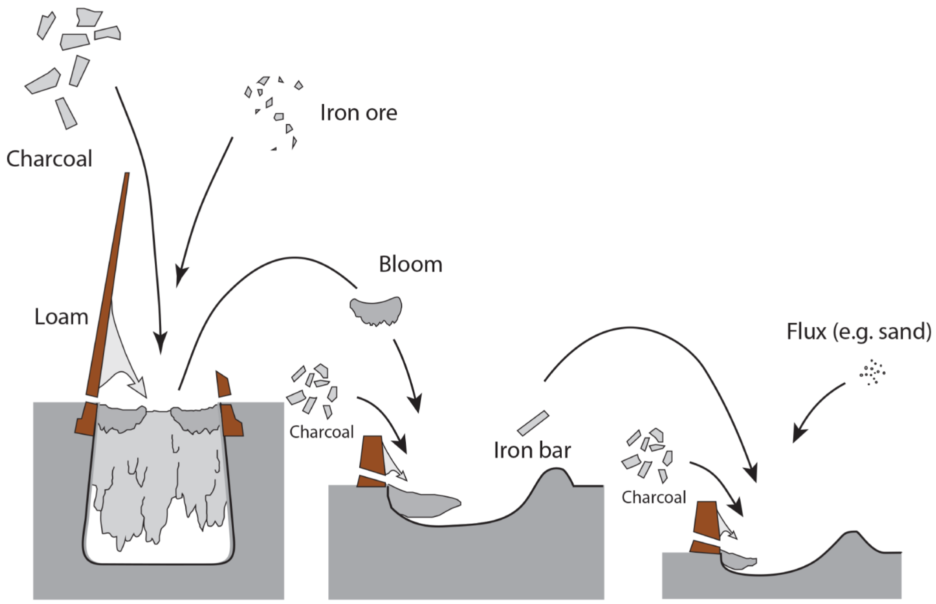

	Step 1	Step 2	Step 3	Step 4
	Extraction	Smelting	Primary smithing	Secondary smithing
Setting	Iron ore source	Furnace	Direct from the furnace or Hearth	Smithing hearth
Raw materials	-	Iron ore Charcoal	Bloom Charcoal	Iron bar Charcoal Flux (sand)
Product	Iron ore	Bloom	Iron bar/billet	Iron product
Possible archaeo-logical debris	-	Smelting slags Charcoal Furnace lining (e.g. clay) Tuyere (Bellows)	Primary smithing slags Charcoal Hearth lining (e.g. clay or loam) Tuyere (Bellows)	Secondary smithing slags Charcoal Hearth lining (e.g. clay or loam) Tuyere (Bellows) Hearth stone Anvil

Fig. 1. The four steps of iron working: 1 (extraction), 2 (smelting), 3 (primary smithing), and 4 (secondary smithing or forging) of the iron, with the involved raw materials and resulting products as well as the possible archaeological correlates listed. Top figure after De Rijk 2003: 32 fig. 19.

vation of a wooden bog trackway (Bou XVII) in March 1961 (Casparie 1984: 62 fig. 13). Underneath a tuft of cotton grass (*Eriophorum vaginatum*), a *c.* 3.8 cm long nail, punch or awl of 2-3 mm square cross-section was uncovered (*ibid.*). Compositional and metallurgical analysis indicated that the item was most likely cold-worked by hammering down a piece of high-grade bog ore (limonite or siderite) of originally half the length but twice the thickness (Charles 1984: 97; 99). Dendrochronological dating of the planks underlying the iron object resulted in an age of 1345-1350 cal BC for the trackway. Assuming that the iron object was placed or dropped onto the trackway not long after construction, it suggests a Middle

Bronze Age cold-working precursor to later Iron Age smelting technologies of iron working.

The start of our Early Iron Age can be seen as a transitional period, in which object types previously executed in bronze were now also available in iron forms. The two most notable examples are swords (of Gündlingen and Mindelheim types; Fontijn & Fokkens 2007: 367) and iron socketed axes (Fontijn 2003: 164-165). Their incorporation, just like their bronze counterparts, into the graves and depositions in wet places suggest that the transition in material may not have implied an equally distinct transition in conceptualization of the objects (and their intended life-histories) involved *(loc. cit.*; Fontijn & Fokkens 2007: 364-365). More important, however, is that fact that while such iron objects were *available* and apparently seamlessly integrated into running traditions, evidence for local *production* from the start of the Iron Age is rare. This could imply that such items of novel materials were initially mostly imported, raising the questions (1) in what form they were imported and (2) when local production *did* start.

There is some evidence for the forging of iron in the Early Iron Age (Table 1). For example, at Oss-Ussen, six pits dating to the EIA were found that contained slag fragments (Schinkel 1998: 55-56). However, this is one of only a few finds of metalworking debris for this period. A second example might be the 5th century pit-cluster of Geleen, in which a single slag fragment – rich in wüstite – was recovered (Van den Broeke 1980: 108). For the Middle Iron Age, finds such as the *c*. 600 gram of slag and *tuyere* fragments from Velsen-Santpoort Spanjaardsberg (Van Heeringen 1992: 73(157); 75(159)) have been dated to 412 cal. BC at the oldest (2315 ± 30 BP; *op. cit:* 181(265). At Velsen-Hoogovens, *c.* 1 kg of slag fragments were dated to *c.* 390-250 cal. BC (2280 ± 35 BP; *ibid.*). The crucible from Maasland-Aalkeet Buitenpolder is dated by pottery to from the 3rd century BC onwards (345-235 cal BC; 2220 ± 30 BP: Van Heeringen 1992: 171(255); 218(302)). After 100 cal BC, iron slags occur more commonly in settlement contexts (Joosten 2004: 30). It is important to stress that these younger slags still predominantly represent smithing slags, debris which originates from the last phase of the iron production process (*loc. cit.*). This more general presence, along with the occasional finds of general-purpose hearths and items relating to forging (*cf.* Cunliffe 1997: 115 fig. 86), points to the more widespread forging of iron during the Middle and Late Iron Age. Nevertheless, the amount of slags found per site generally points to small-scale domestic production that would have catered to one or perhaps two settlements (Brusgaard *et al.* in prep; De Rijk in prep.).

Indications for the preceding phases in the iron production process are still lacking for the Iron Age. This has led to the general consensus that until the Roman Period, iron was not smelted in the Netherlands, but instead pre-fabricates were imported and only the final stage of forging took place in the Netherlands (Joosten 2004: Van den Broeke 2009). To prove local iron smelting, smelting slags are required, but these have not been identified beyond doubt. The charcoal-filled MIA/LIA pits of Anlo can only speculatively be related to charcoal production for smelting (Lanting & van der Plicht 2006: 340). A case has been argued that a large pit-complex at Maastricht-Randwijck (measuring c. 3 by 4 m) may represent a location where iron smelting took place (Dijkman 1989: 38-39). This interpretation is, however, primarily based on an observed intercalation of charcoal-rich layers and layers with slag fragments in the pit-clusters, which according to Dijkman resembled iron smelting furnaces known from Germany (*loc. cit.*). Additionally, several tens of slag fragments were recovered and identified as smelting slags (Dijkman 1989: 38-9). They could – through associated pottery – be dated to the Middle Iron Age (*c.* 450-400 cal. BC; Dijkman 1989: 12; 26). To our mind, the large size of the pit-cluster argues for an iron-forging workshop rather than a production (furnace) setting. A re-analysis of the slag fragments from this site could provide a definitive answer on whether here primary (smelting) or secondary (smithing) ironworking took place. For the site of St. Oedenrode – unfortunately not published in full, nor more precisely dated than ‘ Iron Age’ – the excavator lists the slag fragment as ore/slag, but without first-hand study of these fragments it

Site	Evidence	Dating	References
Maasland-Foppenpolder	several tens of slag fragments	3rd-1st BC	Abbink 1989: 362; Van Heeringen 1992: 237(321)
Velsen-Hoogovens	*c.* 1kg of slag	390-250 cal BC	Van Heeringen 1992: 181(265); 237(321)
Velsen-Santpoort	364 gr of slag, tuyere fragment	410-380 cal BC	Van Heeringen 1992: 73(157); 75(159); 181(265)
Hijken-Hijkerveld	168 gr of slag in two posts of LIA house	360-110 cal BC	Arnoldussen & De Vries 2014: 99
Oss-Schalkskamp	203 secondary smithing slags, hearth, tuyere from large oval workshop in ditch	2nd century BC	Brusgaard et al. 2014
Maastrick-Randwijck	possible iron bar	Iron Age	Dijkman et al. 1986; Dijkman 1989: 39
Maastrick-Randwijck	large pit cluster with tens of slag fragments and ample pottery	450 - 400 BC	Dijkman et al. 1986; Dijkman 1989: 39
Best-Aarle	19 fragments of bog iron ore, 207 slag fragments and possible remnants of the hearth	Iron Age	De Rijk in prep.
Horst	six spike-type iron bars	Iron Age	Verhart 2006: 103
St. Oedenrode	postholes and pits with many slag fragments, possible smithy?	Iron Age	Beex 1967: 119
Geleen-Haesserderveld	slag fragment from large (7 x 4, figure-of-eight-shaped) pit with ample pottery	725-575 BC	Van den Broeke 1980: 108; 2012: 287
Oss-Ussen	slag from 6 EIA pits	8th-7th BC	Schinkel 1998: 55-56
Oss-Ussen	slag from 18 MIA pits (one with 4 kg), fragments of 3 crucibles and possible tuyere	6th-4th BC	Schinkel 1998: 91-93; 123
Oss-Ussen	slag from25 LIA pits	3rd-1st BC	Schinkel 1998: 132-139
Oss-Mettegeupel	c. 6 kg of slag; from posts of house, granary, from pits and well	Iron Age/LIA	Fokkens et al. in prep.
Oss-Mikkeldonk	62 slag fragments, from pits, unknown locations and a well	500 - 400 cal BC	Fokkens et al. in prep.
Oss-Horzak	tentative iron bar (concave, 1,2 kg) from LIA well	3rd-1st BC	Van As et al. 2014
Kesteren-de Woerd	12 secondary smithing slags and hearth debris from MIA findslayer and pit	Iron Age	Joosten 2001: 202; 204
Anlo-Bosweg	choarcoal-rich pits, possible for choarcoal production from smelting	MIA/LIA	Lanting & van der Plicht 2006: 340

Table 1. Evidence for iron working from Dutch Iron Age contexts.

remains too speculative to assume step 2 processing of iron there (Table 1).

If iron was generally imported rather than locally smelted, it would have been transported in the form of iron bars or billets (pre-fabricates). Iron bars were usually produced at the same location as the iron blooms, being formed straight from the bloom (De Rijk 2007: 164). They were easier to handle than blooms due to their shape and weight and were more cost-efficient to transport (blooms still contain a large number of impurities to be removed during primary smithing; De Rijk 2007: 164). Although occurring abundantly in Great Britain and less frequently in Germany (*e.g.* Hingley 1990; Crew 1995; Cunliffe 1999: 307; De Rijk 2003: 82-83), few Iron Age bars have been found in the Netherlands. A possible (Late Iron Age?) iron bar was found at Maastricht - Randwijck (Dijkman *et al.* 1986; Dijkman 1989: 39) and at Oss - Horzak (Van As *et al*. 2014: 26). However, the latter object proved to be concave in cross-section so its status as an iron bar is ambiguous. It is possible that it represents the blade-part of a gauge-type tool (with the handle-side missing), but alternatively the flanging of the sides could be some sort of quality indicator (as has been suggested for the tangs of later Iron Age sword-type and double-pyramidal ingots (*cf.* Cunliffe 1999: 115; Crew 1995: 1). Less disputable is a deposit comprising six spike-type iron bars, which was recovered at Horst (Jos Schatorje pers. comm. 2013; Verhart 2006: 103). Despite such remarkable finds, the problem remains that they prove the *presence* of iron bars in Iron Age Netherlands, but not whether they were imported or locally produced.

3. Two cold cases: Oss and Hijken

As mentioned earlier, secondary smithing slags are frequently found in Late Iron Age settlement contexts. However, the exact distribution and scale of iron forging in the Late Iron Age is not known. Most finds are described only briefly in hard-to-access archaeological reports, or come from old excavations where the number and composition of the slag fragments were not always recorded in detail. The excavations at Oss, in the province of Brabant in the southern Netherlands, and Hijken, in the province of Drenthe in the northeastern Netherlands, are two interesting examples of the latter type.

At Oss-Mettegeupel, Oss-Mikkeldonk, and the aforementioned Oss-Schalkskamp and Oss-Ussen (fig. 2), slag debris has been found. By far the largest number was found at Schalkskamp where the remains totalled 203 slag fragments, all originating from secondary smithing and found in Late Iron Age contexts (Brusgaard *et al.* in prep.). The slags found at Oss-Mettegeupel were associated with Late Iron Age features and features more broadly dated to the Iron Age, yet the exact number of slags is unknown (the excavation database records 12 slags spread across a number of features and 11 find complexes for which only the total weight of the slags is recorded). It is also unknown what types of slags were present at Mettegeupel. However, one of the slags, found in an Iron Age pit, is recorded as having a weight of 3 kg. If this was accurately recorded (*i.e.* it is indeed *one* slag of 3 kg rath-

Fig. 2. Map of Oss-North and the excavations that have been carried out there. Inset: Map of the Netherlands with Oss indicated (Brusgaard et al. in prep.).

er than a number of slags totalling 3 kg) than it is possible that it is a (step 2) smelting slag. As a general rule, smithing slags weigh under 250 g and never more than 1 kg; heavy slags are usually from the smelting process (De Rijk 2003: 30; 2007).

The excavation database of Mikkeldonk lists 62 slags, of which 19 were found in one dated feature and 37 cannot be traced-back to a feature. The 19 slags were found in a well dated by the associated pottery to the Middle Iron Age, *c.* 500-400 cal BC (Fokkens *et al.* in prep.). At Oss-Ussen, slags were found in the aforementioned Early Iron Age contexts as well as Middle Iron Age and Late Iron Age features. Eighteen pits dating to the Middle Iron Age contained slags; in one of these 4 kg of slag was found and the remains of what is possibly hearth lining (Schinkel 1998: 91-3). Three crucibles for bronze working and possible fragments of *tuyeres* were also found in the pits (Schinkel 1998). Slag fragments were moreover found in 25 features dating to the Late Iron Age (Schinkel 1998: 132-9). The total number of slags from this settlement is not known. Only the slags from Schalkskamp have been looked at in detail and therefore it is unknown whether the slag remains from the other Oss settlements are smelting, primary smithing, or secondary smithing slags. The abundance of smithing slags in the Netherlands and the scarcity (or possibly lack of) smelting and primary smithing slags suggests that the odds are great that the other Oss slags are debris from the forging process as well. Nevertheless, it is clear that at least iron smithing took place throughout the Oss area on a domestic scale in the Iron Age (*cf.* Brusgaard *et al.* in prep.). Presumably, this applies to the Northern Netherlands as well, as will be clear from a discussion of the Hijken evidence.

Between 1969 and 1973 an area of 3 ha of a later prehistoric cultural landscape was excavated near the village of Hijken

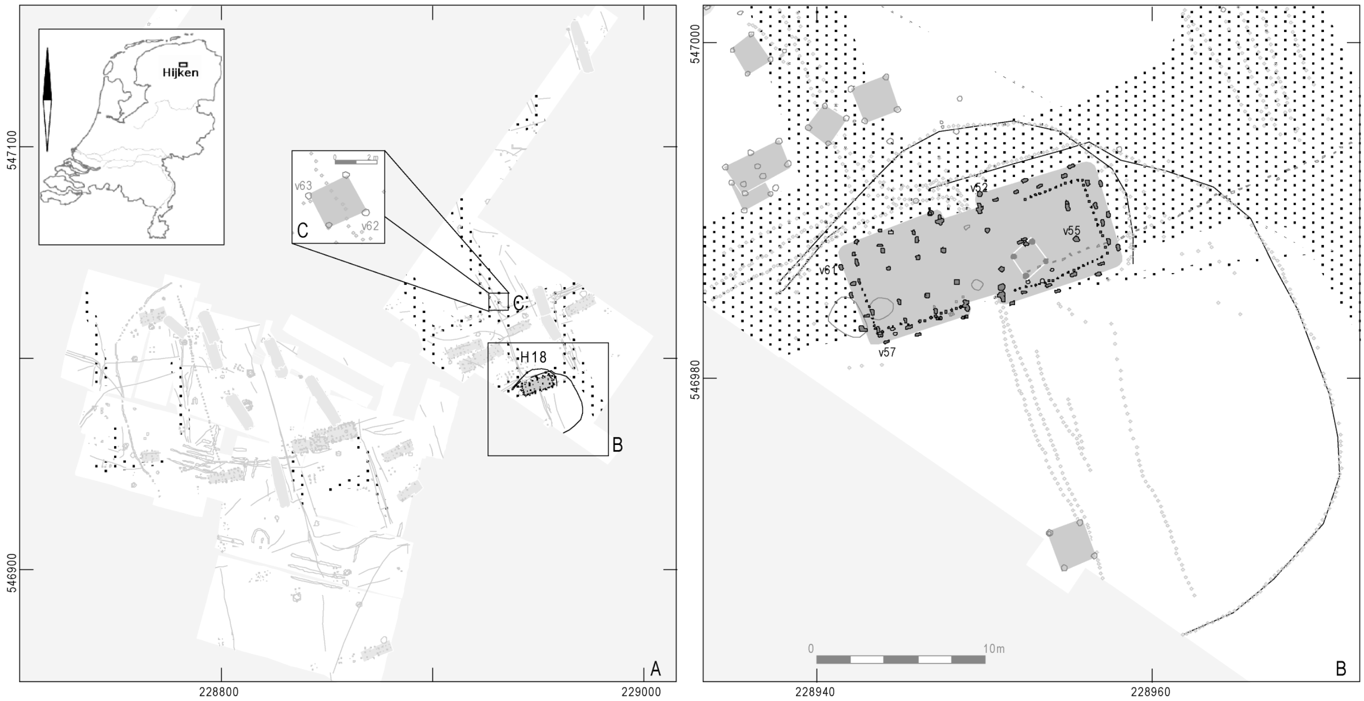

Fig. 3. Overview (A, left. Inset: Map of the Netherlands with Hijken indicated) and details (B, right) of Late Iron Age house 18 at Hijken. The locations of the slag fragments (v.52 and v.57) are indicated. The dotted areas denote the location of Celtic field banks as mapped during fieldwork.

(Arnoldussen & De Vries 2014). The excavations targeted funerary monuments, Bronze Age and Iron Age settlement features, and uncovered a substantial area of a much wider Celtic field. Whereas most of the Iron Age habitation involved houses and outbuildings datable to the Early and Middle Iron Age, a farmstead datable to the Late Iron Age was also uncovered (*op. cit.*). Centrally located on an intersection of Celtic field banks, house 18 (fig. 3) is surrounded by two curvilinear fences and several outbuildings.

The dating of house 18 is based on both pottery (a large fragment of a RW3 / G3-type pot was recovered from a posthole; Waterbolk 1962: 33-45; Taayke 1995; 54-55; 1996: 173; Fig. 3, no. 55)) and several radiocarbon dates that span the period of 360-109 cal BC (from three postholes; Lanting & van der Plicht 2006: 343). In one of the short-side roof-supports (fig. 3, no. 61) fragments of a tephrite object (quern?) were discovered. In the posthole of a roof-support directly north of the northern long-side entrance (fig. 3, no. 52), a small ferrous slag fragment was uncovered (14,1 gr; fig. 4, top-left). Additionally, the southernmost outer roof-support yielded yet another, larger, ferrous slag fragment (154,3 gr: fig. 3, no. 57; fig. 4, right).

The morphology of both Hijken slags is consistent with that of secondary smithing planoconvex (hearth) bottom slags (Crew 1996; Serneels & Perret 2003; Joosten 2004; De Rijk 2007; Brusgaard *et al*. in prep.). These are formed in the hottest part of the hearth, under the air inlet (*cf.* Fig. 1, step 4; Crew 1996; De Rijk 2003: 104). With only two slags being recovered, it is impossible to make any statements on the scale of ironworking that took place at Hijken and where exactly the ironworking took place. However, an analysis of the composition of the slags does reveal some other interesting facts.

Both Hijken slag fragments were cut into two halves in order to allow for an X-Ray Fluorescence (XRF) analysis of their composition and visual inspection of the slag composition (our gratitude is expressed here towards B. van Os (RCE), who helped in obtaining and explaining the XRF-data). Both fragments comprised a core of 61-80% iron (see Table 2) within a crust of much lower iron content. Using a hand-held magnet, the presence of magnetite (Fe_3O_4) could be confirmed (*cf.* De Rijk 2003: 53). Their composition, as well as the small size and morphology of particularly slag fragment v.52 suggests that this is ironworking debris. Furthermore, the two slag fragments from house 18 suggest *local* iron working. We would not expect the debris to be found far from the ironworking area where it was created as the slags would have had no further functional significance - despite them having retained a minimal amount of pure metallic iron.

Some additional details of the process of local iron working may be inferred from the presence of tin (Sn; 0,13% max.) and copper (Cu; 0,24% max.) in both Hijken slags. These metals are not native to the iron ores or to the raw materials used for iron production. They could only have become incorporated in the slag fragments through contamination during forging. The relatively higher values for calcium and potassium could indicate that ashes from the furnace were incorporated into the slag fragment (pers. comm. B. van Os; *cf.* De Rijk 2003: 59; Serneels & Perret 2003: 473). Similarly, silicium from ash, flux or hearth lining may become incorporated into slags, albeit generally in variable amounts (Serneels & Perret 2003: 473; Blakelock *et al*. 2009: 1745-1746; Brusgaard *et al.*, in prep). The presence of tin and copper, albeit in small amounts, in the Hijken slag fragments not only suggest local *iron* working, but that locally also the

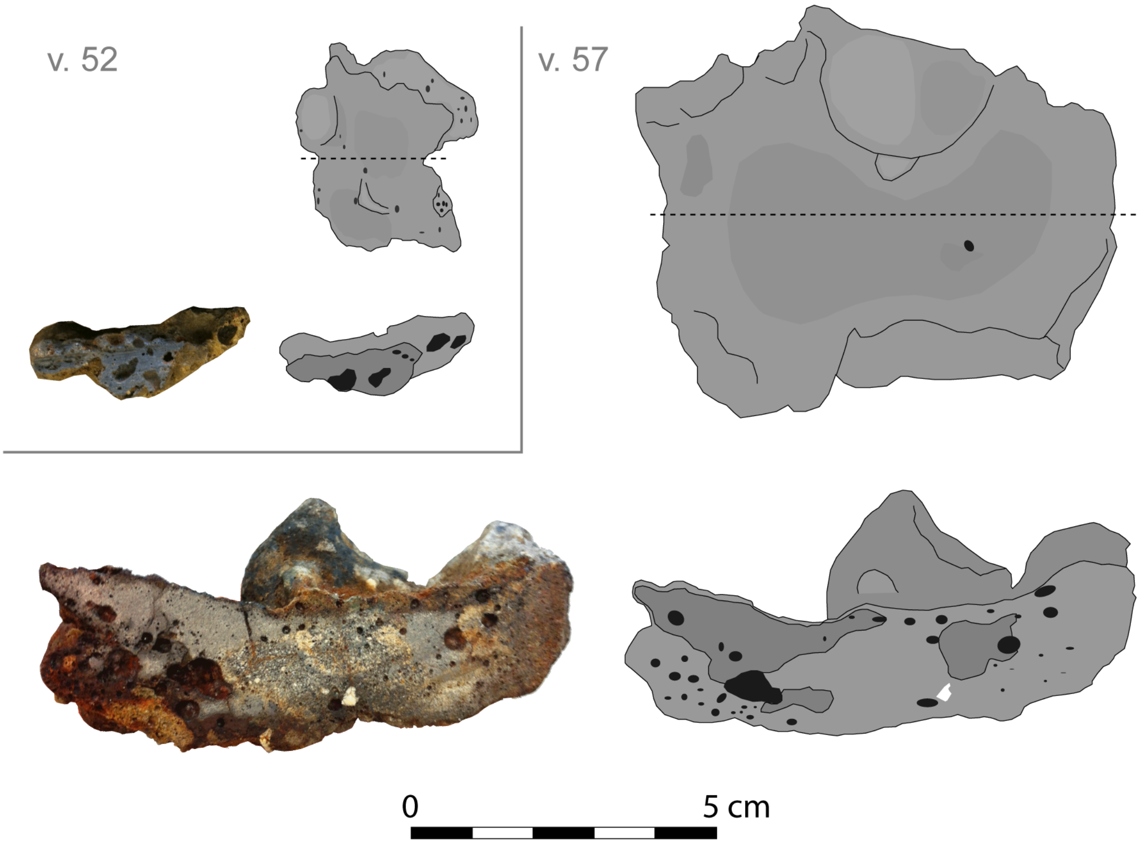

Fig. 4. Late Iron Age iron working slag from Hijken, v.52 (top left) and v.57 (right). The photographs show the cross-sections after cutting of the fragments, black areas denote pores.

know-how and materials were present to work *bronze* as well. This means that diverse (and possibly more specialized) metalworking activities, involving both the smithing of iron and bronze were feasible even in small-scale agricultural hamlets.

This diversity in metalworking skills in primarily agricultural villages is supported by the find from Oss-Schalkskamp, where near the hearth a fragment of a crucible was found together with a fragment of bronze, which were originally stuck together (Brusgaard *et al.* in prep.). Clearly, there is evidence for bronze working in the same context as ironworking at both Oss-Schalkskamp and Hijken. Interestingly, the chemical composition of the Schalkskamp slags as revealed by an XRF analysis did not include tin or copper (Table 2; see Brusgaard *et al.* in prep.). This could suggest that bronze working took place here after ironworking had ceased. Other

		Fe2O3		Sn		Cu		CaO		K2O		SiO2	
		%wt	stand.dev.	%wt	stand.dev.	%wt	stand.dev.	%wt	stand.dev.	%wt	stand.dev.	%wt	stand.dev.
Hijken	V57 (mean of max. 4 measurements)	71,47	8,44	0,01	0,0012	0,02	0,0049	2,36	0,44	1,60	0,33	19,00	4,43
Hijken	V52 (mean of two measurements)	76,49	3,69	0,08	0,0558	0,23	0,0149	1,83	0,32	1,20	0,04	17,85	0,32
Oss	V90 (mean of two measurements)	62,82	13,63	0,01	-	0,01	-	0,67	0,12	0,68	0,42	36,82	9,99
Oss	V123 (mean of two measurements)	63,67	9,14	0,01	-	-	-	2,04	1,13	0,71	0,48	17,38	5,76
Oss	V43 (one measurement)	66,97	-	-	-	-	-	1,76	-	0,84	-	16,28	-
Oss	V121 (one measurement)	80,94	-	0,01	-	-	-	2,69	-	-	-	18,05	-
Oss	V4 (one measurement)	52,45	-	0,01	-	0,01	-	1,91	-	0,79	-	10,84	-
Oss	V19 (one measurement)	73,79	-	-	-	0,01	-	1,03	-	0,95	-	28,26	-

Table 2. Selection of elements of the Hijken & Oss slags as determined by XRF analysis (by B. van Os, RCE), not yet compensated for oxides.

elements were present in comparable amounts to the Hijken slags, such as a 49-81 % metallic iron content (see Brusgaard *et al.* in prep.).

4. Deposition of Iron Age metalworking debris: the Dutch data

The above discussion has indicated that in various (Late) Iron Age hamlets, iron working took place. Yet only in the case of Oss-Schalkskamp, could the context in which the fragments were recovered be interpreted as a smithy. For the larger Hijken slag, its substantial size compared to the posthole from which it was recovered, renders it unlikely that it had become incorporated into that feature unintentionally. Could finds such as that of Hijken suggest a pattern of Iron Age intentional object deposition in which metalwork debris figured?

This is not a completely novel topic. Research in Britain has focused not only on the presence of metalworking debris at Iron Age sites, but also on the depositional contexts and patterns at hand. For example, Hingley's (2006) study of iron bars in Britain shows that from the 3rd and 2nd century BC onwards, hoards containing iron bars and single finds of iron bars occur increasingly frequent. Such hoards are found predominantly in enclosure boundaries of settlements, such as ditches or banks, whereas from the 2nd century AD onwards, wells become a common context for the deposition of these objects (Hingley 2006: 214). Hingley dismisses the traditional viewpoint that these hoards and depositions were of a practical nature and instead sees them as representing 'one part of a broader tradition of hoarding various types of objects as offerings to the supernatural or to ancestors' (Hingley 2006: 215). Occasionally, these iron bars are found in association with slag and hearth debris, which has been interpreted as the deposition of an object manufactured specifically for deposition along with the by-products of its production (Giles 2007: 107-108). Indeed, Hingley (1997; 2006) has argued that not only finished objects, but also slag, could have been deposited with an intended (ritual) significance.

The above examples seem to provide more straightforward evidence of intentional deposition of metalworking debris than the Dutch finds. Yet they may also be used to argue that a change of perspective – away from a tradition in which such remains are customarily described solely in terms of evidence for metalworking and towards one in which they are seen informative on patterns of object deposition as well – is much needed. It is therefore of importance to re-evaluate the contexts of the Oss, Hijken and other Dutch ironworking remains.

The Schalkskamp slags appear to be a cut-and-dry case of discarding the debris from an ironworking activity area rather than the intentional deposition of metalworking debris. The slags were discarded within the partially filled-up ditch during the regularly clearing out of the hearth and the last debris was left in the hearth when it was abandoned (*cf.* Brusgaard *et al.* in prep: especially fig. 9). At Oss-Ussen, the depositional practice appears to have changed during the Iron Age. The Early Iron Age pits containing slags are concentrated in two areas of the settlement, in the northeast and the southwest (*cf.* Schinkel 1998: fig. 42). In the subsequent Middle Iron Age, the pits in which the slags were found are distributed throughout the settlement (*cf.* Schinkel 1998: fig. 86). The pit containing 4 kg of slag and possible hearth fragments may have held the remains of a hearth, but the pattern of distribution of slags is not consistent with the clearing-out of an ironworking activity area. In that case, one would expect the slags to be discarded relatively close to one another near the activity area, like at Schalkskamp. In the Late Iron Age, the slag debris is concentrated in one area in the northeast of the settlement (*cf.* Schinkel 1998: fig. 131). The distribution patterns of slag fragments do not correspond entirely with the distribution patterns of other artefacts during the three periods. Therefore, it is unlikely that the former is a result of the general discard distribution of material and we must seek alternative explanations.

At Mettegeupel, the few slag fragments were also found distributed throughout the settlement, but all between or around house plans. For six of the slag finds or find complexes, the feature types were recorded; these were one posthole of a granary, one posthole of a house, three pits, and one well. In contrast, the well in which the majority of the Mikkeldonk slags were found was situated in the east of the excavation site, presumably outside of the Middle Iron Age settlement. This could indicate that there was an iron production area outside of the settlement, of which the debris was discarded in the well. However, this view may be biased because the area around this well was not excavated and therefore we do not know if other house plans were situated here (*cf.* Fokkens *et al.* in prep.).

For the Hijken fragments, unfortunately, no details on the position of the slag fragments within the postholes were noted at the time of excavation. The fact that the smallest slag (v.52) was found together with several sherds, suggests that occupational debris became incorporated into the posthole. The much larger size of the other (v.57) slag and the absence of debris from most postholes of house 18 could, however, suggest intentional placement in the posthole. Early Iron Age deliberate depositions on the Hijken site could be characterized by patterns of object fragmentation, with often recovering only single fragments of individual pots in pottery depositions (Arnoldussen & De Vries 2014: 97). This could suggest we should be cautious in dismissing the option of intentional deposition simply because small pottery sherds accompanied the smaller slag fragment. In the case of Horst (the spike-type ingot hoard) and Oss-Horzak (the possible ingot from a well), object association and context respectively argue against casual discard.

Reviewing the available evidence, a series of patterns come to the fore. First, sites like Oss-Schalkskamp and Maastricht, and tentatively also Geleen, all show a combination of large pit-complexes and metalworking debris, which could suggest workshop contexts. For the Velsen, Kesteren and Maasland sites, as well as those of St. Oedenrode, Best and Middle Iron Age Oss-Ussen, the nature (*i.e.* diversity, presence of *tuyeres*) of the objects recovered indicate the presence of a local smithy, albeit that the material is no longer at the workshop location (*e.g.* incorporated into finds-layers or pits). For Oss-Mikkeldonk, Oss-Mettegeupel, Oss-Horzak, Hijken and Horst, deliberate deposition of ironworking material can be argued for. The fact that metalworking debris was put into postholes of houses (Hijken, Oss-Mettegeupel), granaries (Oss-Mettegeupel) and wells (Oss-Horzak, Oss-Mettegeupel), suggests that Iron Age settlements were suitable arenas for such depositional acts. If one looks at the position of such depositions *within* the settlements as a whole, some support for Hingley's (2006: 114) observation that such depositions are frequently situated at the margins of the settlement domain can be found. In Oss-Ussen there is spatial disassociation between the other settlement debris and the contexts with ironworking debris and in Oss-Mettegeupel the Middle Iron Age well containing the slag was situated at the settlement margin. Speculatively, one could argue that as only a single Late Iron Age house-plan was uncovered within the Hijken excavations (Arnoldussen & De Vries 2004: 99), this house too was situated near, or formed, the Late Iron Age settlement margin.

5. Outlook

The scarcity of evidence for iron production during the Dutch Iron Age is noteworthy when we look at the archaeological record abroad. Not only production debris, but also production places are more well-known from Germany and the Alpine area (e.g. Jöns 1997; 2010), Denmark (Lyngstrøm 2008), and Britain (Jones 2001). As mentioned in the introduction, there are a number of plausible explanations for this, yet the limited evidence for iron production still seems disproportionate to the ample number of excavated Iron Age settlements. A few possible explanations come to mind.

First, the collecting of data in the field and post-excavation analysis strategies have certainly had an impact. For many years, the object category 'slag' attracted little attention from scholars, which impeded post-excavation processing, but also the way this material was collected (or even *not* collected) in the field. In Denmark, it was not until the 1960s that iron production debris received any attention during and after fieldwork (Lyngstrøm 2008). Similarly, Tylecote's 1962 study of the technology of iron production introduced archaeometallurgy as an archaeological sub-discipline in Britain. In the Netherlands, it was not until the 1980s that this area of interest attracted widespread interest (Joosten 2004: 1).

Second, the limited accessibility of data poses a problem for estimating the scale of iron production during the Dutch Iron Age. As mentioned earlier, many finds are described in hard-to-access archaeological reports or were uncovered in not-yet published older excavations. However, reviewing the results from the cold cases Oss and Hijken, it is evident that much can be gained from looking into older excavations. The finds from both Oss and Hijken corroborate the notion that small-scale ironworking became widespread in the Late Iron Age. Additionally, both sites indicate that this was primarily a domestic metalworking tradition, with iron smithing and bronze working taking place in the same activity area within small agricultural hamlets. The finds from Oss-Ussen are moreover indicative of small-scale ironworking in this area during the Early and Middle Iron Age. For these earlier phases of the Iron Age, the scale, locations, and methods of ironworking remain still unclear. Nevertheless, Early Iron Age slags such as those of Geleen and Oss-Ussen suggest that the forging of iron may have been more common in this early period than previously thought, even if merely for the crafting and repairing of small objects. On the other hand, the scarcity of Early and Middle Iron Age ironworking remains may reflect a past reality. This brings us to the third point, that the amount of evidence may be low because forging only took place sporadically until the Middle Iron Age and smelting only sporadically until the Roman Period. To determine whether this was the case or whether this conclusion is the result of research biases, we need to gather more evidence, both in the field and in the labs (where compositional analysis of ironworking remains provides much needed insight into the various stages of iron working).

The same holds true for understanding the context and deposition of iron production remains. Our review has shown that while part of the ironworking debris may indicate *in-situ* workshops or general refuse disposal, the presence of slag fragments placed in postholes and wells may be part of a wider Iron Age tradition of deliberate object deposition. In these deposits, tentatively related to the abandonment of settlement structures such as houses and outbuildings (Gerritsen 2003: 97-102), often a wide-range of domestic activities (cooking, grinding, spinning, weaving) are represented (in a *pars-pro-toto* fashion; Arnoldussen & De Vries 2014: 97, *cf.* Van Hoof 2002: 84-87). Incorporation of slag fragments in such contexts at Maastricht and Geleen (both interpreted as abandonment deposits by Gerritsen (2003: 98 tab. 3.14)) shows that ironworking was considered a 'household task' of equal importance and suitability to be incorporated in deposition. Notwithstanding this integration of ironworking remains within multiple object hoards, the placing of slags in postholes at Oss-Mettegeupel and Hijken indicates that these objects (and the skills, contacts, and processes that they represented) had a significance in their own right. In irretrievable ways, materials related to the production of iron and ironworking, held a significance expressed through deposition.

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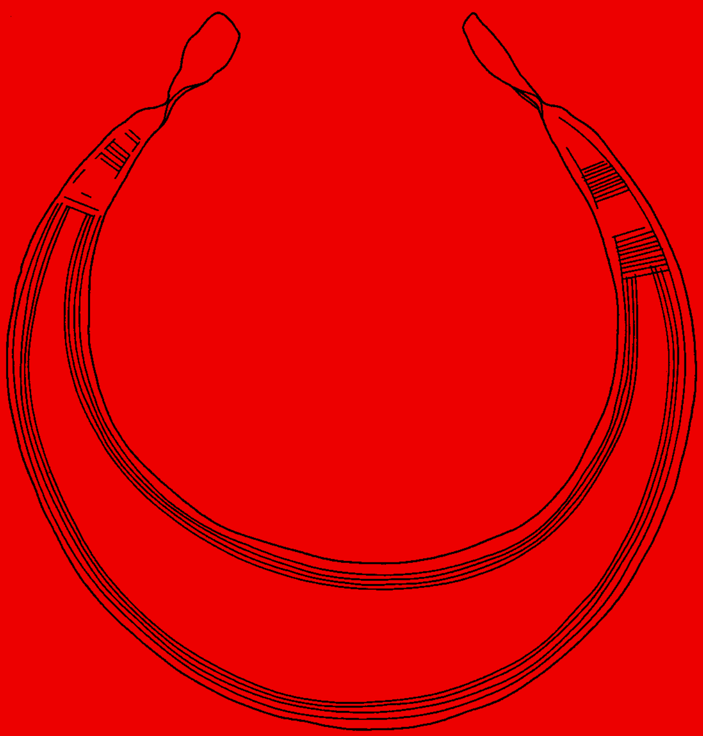

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