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Tracing the small parts: the remains of a late Iron Age ironworking site at Ronse Pont West (prov. East Flanders, Belgium)

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1. Introduction

Ironworking sites in the Low Countries are virtually a blind spot in the archaeological records. Even though the application of the Malta Convention has resulted in large-scale rescue excavations in both Belgium and the Netherlands, many excavation reports only mention the presence of slags without paying further attention to the phenomenon (Brusgaard *et al*. 2015). Even scarcer than the presence of slags are the actual remains of forges. In the Netherlands there are some sites with evidence for on-site forging during the Iron Age, but in Belgium there is a complete blank in the present dataset (Arnoldussen & Brusgaard 2015: 117). The slags are found mainly in secondary waste deposit features, such as wells or pits, e.g. at Lier- Duwijck II or Meer-Zwaluwstraat (Cryns *et al*. 2012, 247; Delaruelle & Verbeek 2004: 170). These sites suggest blacksmith activities, but due to the small datasets, there is little further information about the different features of such working sites and there debris.

Two features at the excavation "Ronse Pont West", dated between ca. 240-175 calBC, clearly contain the debris of a blacksmith workshop. It is still uncertain whether the features themselves are part of the actual forge or not. Although there is no *in situ* burning of the soil, several arguments point out that the forging area was close by and the pits were probably part of the infrastructure of the blacksmith.

Through a detailed macroscopic examination of the iron slags and the other debris, the aim of this paper is to determine the nature of the slags and the nature of the features. Are the features part of a forging infrastructure, are they related to smelting operations, or are they just waste pits? And if there was on-site forging, which part of the smithing process was done here?

2. Find context

The site Ronse Pont West is situated southwest of the city centre of Ronse in the south of the province of East-Flandres, Belgium **(**fig. 1).

This region is known for its Tertiary hilly landscape covered by aeolic (sandy) loam. The site is surrounded by these hills: in the north by the inliers of the "Flemish Ardennes": Kluisberg, Muziekberg, Hotond, which reach to 145 m AMSL. The terrain itself is situated on a promontory between two streams that run off to the river Scheldt in the north, giving the terrain a dominant position in the landscape.

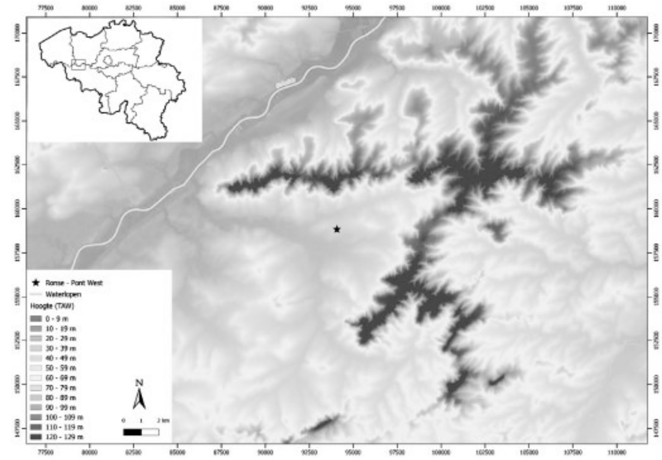

Fig. 1. Positioning of the excavation site at the digital terrain model.

The excavations were part of a rescue excavation carried out between 2011 and 2014 by the intermunicipal utility company SOLVA. An examination of 17 ha by trial trenching led to an actual excavation of 7, 2 ha. Notwithstanding evidence of a brief phase of activity during the upper Paleolithic, traces of more permanent occupation only start to emerge at the end of the middle Bronze Age A (De Graeve *et al.* 2014). During the late Iron Age/ early Roman period the occupation on the site is attested by many pits, ditches and graves. There is a gap in the occupation between the 2th century BC and the 9th century AD. Afterwards the site is uninterruptedly inhabited until the present day.

3. Features

There are two concentrations with debris form an ironworking site lying around 15 m apart from each other.

In the west, there is one circular-shaped pit with a lens-shaped bottom and a diameter of approximately 90 cm. The pit is filled with charcoal, iron slags and pieces of burned loam.

The other concentration consists of five different round-shaped pits with the same appearance as the aforementioned pit. Their diameters vary between 70 cm and 120 cm. One of the pits has a slightly different fill, having a grey layer at the bottom and a filing with charcoal just above that (fig. 2).

The pits are covered with a black layer containing charcoal and debris form ironworking. There are no indications for *in situ* burning of the soil (fig. 3).

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Fig. 2. Concentration of the pits

Fig. 3. Section on one of the pits.

It seems that all the pits have been used as waste deposits after their possible use as part of the ironworking infrastructure. In all the contexts, there are fragments of pottery, pieces of (grind) stone and fragments of burned bones.

All the contexts were collected in bulk per layer. These were then wet-sieved on 0,5 cm meshes and sorted out, using a handheld magnet for collecting the small metallic parts.

4. Dating

The dating of the features is based on the combination of four ^{14}C-datings and typological analysis of the pottery.

The table shows that one of the samples is clearly older than the others (table 1). This is probably due to "old wood effect", so this result is not withheld for the further analysis (fig. 4). The other results can be used to calculate an average dating of 2177 ± 17 BP (X2-Test: df=2 T=1.0 (5% 6.0)). The calibration reveals a chronological fork between 356 calBC (62,4 %) 285 calBC and 235 calBC (33 %) 173 calBC. The pottery sherds, especially the fragments of a bottle with smooth surface and vertical grooves, exclude the oldest fork, suggesting the peak between 235 calBC and 173 calBC is statistically the most plausible option.

5. Materials and methodology

We shall start with a short introduction about the different aspects of metalworking debris. There are three main types of iron slags that can be determined. Each of these slags represent a certain stage in the *chaîne opératoire* of the ironworking. The first type is the *smelting slag*. This type of slag is a by-product of the iron smelting in a bloomery. The second type, the so-called *refining slag*, is formed when the iron bloom (raw sintered iron particles from the bloomery furnace) is refined into an ingot (primary smithing). In this part of the process, the many impurities that are still present in the bloom are hammered out, resulting in a compacted and forgeable metal form. The last type of slags we discuss is a by-product of blacksmithing - or secondary smithing - which is called the *smithing slag*. In this stage of the *chaîne opératoire* the blacksmith shapes the iron using heat and an array of tools. The most common type of slag within this category is the *plano-convex bottom slag* (PCB). This slag is formed in the blacksmith's furnace and is mainly a conglomerate of oxidized iron, ash, sand/clay and furnace lining. As the name mentions, it has its own distinct morphological features.

Context	Name	Dating BP	Dating calBC (OxCal V4.3.2 Bronk Ramsey 2017)
I-A-8	RICH-22967	2367±29 BP	540 calBC (2σ) 380 calBC
I-A-8	RICH-22957	2157±28 BP	360 calBC (2σ) 100 calBC
I-A-41	RICH-22254	2197±30 BP	365 calBC (2σ) 184 calBC
I-A-41	RICH-22258	2179±30 BP	362 calBC (2σ) 167 calBC

Table 1. Overview of the radiocarbon datings.

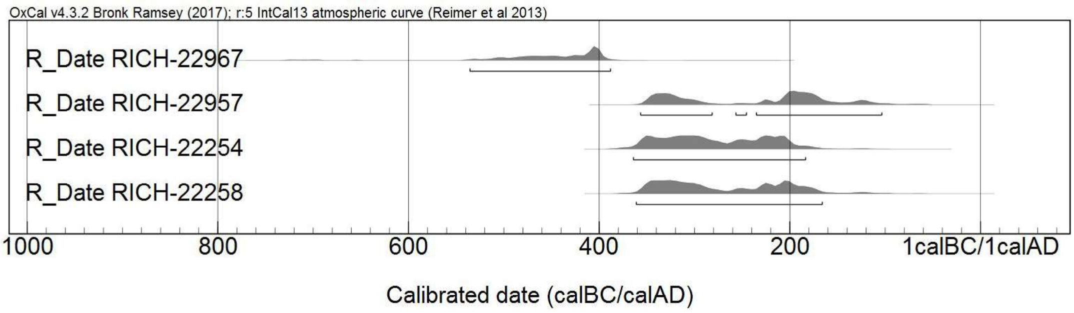

Fig. 4. Multiplot of the radiocarbon dating.

However, it is still difficult to make a distinction between the refining slag from the primary smithing and the plano-convex bottom slag formed during secondary smithing, even if these represent a different stage in the *chaîne opératoire*.

The slags that were analysed from Ronse – Pont West were all of the third type, i.e. debris from secondary smithing activities.

The collection was macroscopically examined (Windey 2017). Parts smaller than 3 cm were not taken into account since it is not possible to link these to a specific part in the *chaîne operératoire*. The diagnostic parts were weighed, measured and their magnetic conductivity tested using a small, hand-held magnet. Further attention was paid to color identification, morphology, presence of inclusions, glazing, etc. The non-diagnostic group contains parts smaller than 3 cm, glazed parts of the furnace lining and strongly fragmented parts of plano-convex bottom slags or amorphous slags.

The plano-convex bottom slags were categorised following Serneels and Perret (2003) into three subtypes: scorie *grise dense (SGD), scorie argilo-sableuse (SAS), and scorie ferreuse rouillée (SFR)*. The underlying thought for this subcategorization is that different actions by the blacksmith (e.g. fire welding, hammering, refining, etc.) form different types of PCB slags. As there is still much debate about this subcategorisation, we shall not touch upon this aspect in this article, but we will refer to Serneels & Perret (2003) and Windey (2017) for more information.

By studying the slags as one assemblage, the measurements and analyses of the different slags can tell us more about the smithing activities than the study of the individual slags ever could do because they remain invisible at the level of the individual slag (Windey 2017:4).

6. Analyses and results

The ironworking debris contains a total of 9,64 kg, including slags, furnace lining (i.e. burned parts of the furnace) and hammerscale (table 2). The level of fragmentation of the material was very high, leaving only 22 intact PCB slags in the study. The morphological variation within this group is striking yet not unusual, as these slags are mainly the result of the morphology of the hearth, size and purity of the used iron, the type of fuel, the forging temperature and the metal working techniques.

Category	Total weight (g)	Total amount	Total weight %
Hammerscale	212	-	2.2%
Non-diagnostic	6246	-	64.8%
PCB:	3182	22	33.0%
SGD	750	4	7.8%
undetermined	2432	18	25.2%
total	9640	22	100%

Table 2. Total weight and number of slags and other materials from the studied contexts.

	Weight (g)	Diameter (cm)	Thickness (cm)
Average	130	6.6	2.4
Median	112	6.5	2.0
Maximum	264	8.8	3.5
Minimum	57	4.8	1.0

Table 3. Measurements of the PCB slags (weight and diameter: n=22).

The dimensions of the slags fall within the expected range of ironworking slags from this period, with a maximum diameter of 8, 8 cm (Windey 2017: 5). Slags from secondary smithing are rarely bigger than 15 cm in diameter (de Rijk 2003: 25).

Although it is hard to draw conclusions from this part of the study due to the limited dataset of PCB's (n=22), there are nevertheless some interesting obeservations to be made. The weight of the PCB slags, with an average of 130 g per slag, points in the direction of secondary smithing (table 3). This corresponds with other Iron Age iron working sites in the Netherlands and in France (e.g. Brusgaard *et al.* 2015, Mauvilly *et al*. 1998; Joosten 2001). There are four PCB slags that correspond with Serneel's and Perret's subcategory SGD (*Scorie grise dense*) (Serneels & Perret 2003). This subcategory of slags is linked to the forging and heating of the metal (fig 5).

Fig. 5. The cross-section on a SGD-PCB.

By having a closer look at the smallest parts of the dataset, i.e. the hammerscale, we can better understand the production process. There is a total of 222 g of hammerscale in the dataset.

The hammerscale is spread out over most of the context, with a clearly higher concentration in context I-A-41 (144 g = ca. 70% of the total amount). This is the south side of the concentration of five pits. The omnipresence of hammerscale has some important implications. Firstly, it proves that there has been on-site smithing activity, as parts that are this small are unlikely to be brought in by other means. Secondly, they can be used to determine the precise location of the forging, as the hammerscale is to be expected near the anvil and the hearth (Windey 2017: 6; Pleiner 2006: 112). Thirdly, the hammerscale can also provide more information on the smithing activity itself. Hammerscale can be divided in two groups. On the one hand there are flat 1 to 3 mm flakes, that are the result of the thermic shock between the hot iron and the oxygen in the air. On the other hand, there are the small, more spherical parts which are the result of the use of a flux. An additional advantage of the use of a flux, is that the metastable surface is suitable for fire welding (Dhaeze *et al.* 2015: 67). The study of the hammerscale illustrates that the last step in the ironworking process, which is secondary smithing, was carried out on-site. When we compare the amount of hammerscale with the well-known (and published), contemporary ironworking site at Oss-Schalkskamp, it is clear that amount of hammerscale at Ronse Pont West is higher than at Oss. From the latter site, a total of 15, 4 kg of slags was found, of which 59 pieces were determined as plano-convex bottom slags (Brusgaard *et al.* 2015: 351). They also found 85 g of hammerscale. At Ronse - Pont West there was a total of 9,6 kg of ironworking debris, of which 22 whole slags could be interpreted as plano-convex bottom slags. However, 222 g of hammerscale was retrieved at Ronse - Pont West, which is almost three times the amount of the scale found at Oss-Schalkskamp. This might be explained by different excavation methods or by the formation of the contexts.

Fig. 6. Fragment of a "tuyère" with a part of the furnace lining (photo Dirk Wollaert).

Most of the hammerscale was concentrated in the charcoal-rich layers of the pits, even if some fragments were also found in the underlying layers. Which indicates that the forging took place here.

The largest group of materials consists of small non-diagnostic parts of the smithing process (ca. 65% of the total weight). These are pieces of slag, furnace lining, conglomerate of hammerscale with clay and sand, charcoal and so on. Some pieces were part of the furnace lining that protected the bellows against the heath of the fire. The air from the bellows came through an opening in the side of the furnace lining, called a *tuyère*, which normally measures between 18 and 25 mm in diameter (Young 2012). Different fragments of *tuyères* were found in the assemblage, one of which had a diameter of ca. 22 mm (fig. 6).

In almost all the pits pieces of iron artefacts were found. Amoung the finds we recognized nails, possible knife fragments and other small corroded objects. These fragments or objects were probably too small to be used in the production process.

7. Discussion

The site of Ronse - Pont West yielded clear evidence of blacksmith activities. The identification of a smithing hearth is difficult, as there are no traces of *in situ* burning of the soil. Furthermore, the characteristic lay-out of a hearth could not be recognized in the excavated features. According to earlier research, a hearth which was dug into the ground, can measure between 20 – 200 cm in diameter with a rectangular, round or oval shape. The depth of the hearthpit varies between 15 and 60 cm (de Rijk 2003: 77). However, for normal blacksmith activities, a forge measuring 30 x 20 x 15 cm is more than sufficient. Such small features are easily destroyed by modern plowing activities, which might explain why so few forges have been discovered or recognized in the archaeological record. Keeping these dimensions in mind, we can prudently suggest that the pits at Ronse - Pont West must have been dug around 70 cm deep. Following the calculations by de Rijk (2003), this would be exceptionally deep for a hearth.

The remains of the furnace lining and the abundant amount of hammerscale prove that smithing has taken place in the close vicinity of the excavated features. A possible explanation for the conservation of the features is suggested by the reconstruction of a forge in Sévaz (Swiss) (Mauvilly *et al.* 1998). Here, not the hearth was dug into the ground, but rather the blacksmith's working level. This way the actual smithing hearth was at groundlevel and so the blacksmith could work standing up instead of continually kneeling down.

The absence of larger, strongly magnetic and metallic plano-convex bottom slags, is notable. These are often associated with primary smithing (i.e. forging the bloom into the iron ingot). The lack of this type of slag as well as other indicators from primary smithing, such as the bloom itselfs, seems to confirm that there was only secondary smithing activity on the site.

Notwithstanding the high level of fragmentation of the slags, it seems that the production at Ronse - Pont West was being carried out on the level of the household. The rather small dimensions and weight of the PCB slags are indicative for brief, small-scale and simple smithing activities that did not exceed local needs.

It seems that the iron was imported to the site, as there is no evidence for iron ore extraction or smelting on the site. The blacksmith started working from an iron ingot, since no evidence of primary smithing was discovered. The origin of the iron remains unclear as evidence for pre-Roman iron production in Belgium is very scarce. In the southern part of Belgium (region Sambre/Meuse/Lotharingen/Liège), there is growing evidence for iron ore extraction during the La Tène period (Cremers 2009). The only evidence of bloomery in the northern part of Belgium, comes from a mid- 20th-century find at Huise/Lozer-Zuid, approximately 20 km north of Ronse - Pont West, where slags were found together with parts from a bloomer (De Laet & Van Doorselaer 1969; De Laet 1974). This is the only evidence of possible bloomery during the La Tène-period in this region.

There are different explanations for the absence of primary smithing activity sites in the region. Most likely, the absence in the archaeological record can be linked to the state of the archaeological research. Brusgaard *et al.* (2015) suggest that the absence of evidence for iron smelting in the Netherlands is a direct result of the focus of modern-day excavations. Iron smelting is a typical peripheral activity (fire hazard, smoke, bad smell, use of a lot of resources), whereas secondary smithing is could be done in the settlement itself. Contemporary archaeological research focusses only on the settlements itself, neglecting marginal and peripheral activities (Brusgaard *et al.* 2015: 359). Another possibility is that the iron was imported as iron bars/billets from abroad, which leaves very few traces in the archaeological record.

8. Conclusion

At the site Ronse **-** Pont West there are six features containing iron working debris (slags, hammerscale, etc.). ^{14}C-dating shows that the activities most likely took place between 235 – 175 calBC. A macroscopic study of the iron slags and the associated debris such as hammerscale seems to point to secondary smithing activities on the level of the household. As there is no evidence for on-site bloomery, we suggest that the iron was imported as ingots, bars or billets.

The six different pits have no *in situ* burning of the soil, but the presence of hammerscale and furnace lining points out that the blacksmith's activities were carried out in the immediate proximity of the pits. By analogy with a contemporary site in Switzerland, we could reconstruct a type of forge in which the blacksmith's working area was dug into the ground while the actual heart was on the walking level.

Bibliography

ARNOLDUSSEN, S. & BRUSGAARD, N. Ø. 2015. Production in deposition: structured deposition of Iron Age ironworking elements (The Netherlands). *Lunula. Archaeologia protohistorica,* **XXIII**, pp. 115-124.

BRUSGAARD, N.Ø., FOKKENS, H., VAN AS, F.M. & HUISMAN, D.J. 2015. The potential of metal debris: a Late Iron Age ironworking site at Oss-Schalkskamp (Prov. Noord-Brabant/ NL). *Archäologisches Korrespondenzblatt,* ***45*****,** pp. 345-363.

CRYNS, J., LALOO, P., NOENS, G., REINE, S., CRUZ, F., MIKKELSEN, J., ALLEMEERSCH, L., TEETAERT, D., DE BRANDT, R., VAN GOIDSENHOVEN, W., VANDERMEER, W. & LANGE, S. 2014. *Lier Duwijck II: De geschiedenis van een bedrijventerrein. Eindrapportage van een meerfasige occupatie van het gebied Duwijck II*, GATE-rapportage 63.

DHAEZE, W. VERBRUGGE, A., COOREMANS, B., COSYNS, P., DEFORCE, K., DELRUE, P., DESCHIETER, J., HANECA, K., RENIERE, S., VAN STRYDONCK, M. & WILLEMS, S. 2015. Een inheems-Romeinse nederzetting in het zandlemige deel van de civitas Menapiorum (midden 1ste eeuw- eind 3de eeuw na Chr.) Archeologisch onderzoek op de site Menen-Kortewaagstraat. *Relicta,* **14**, pp. 9-118.

DE GRAEVE, A., DU RANG, E., VAN HECKE, C., VERBRUGGE, A. & CHERRETTÉ, B. 2014. Een kringgreppel en dassenburchten te Ronse Pont-West (prov. O.-VL., België). *Lunula. Archaeologia protohistorica*, **XXII**, pp. 37-40.

DE LAET, S.J. & VAN DOORSELAER, A. 1969. *Lokale ijzerwinning in westelijk België in de Romeinse tijd*. Brussel: Paleis der Academiën.

DE LAET, S. J. 1974. *Prehistorische kulturen in het zuiden der Lage Landen*. Wetteren: Universa.

DELARUELLE, S. & VERBEEK, C. 2004. De metaaltijden op het HSL-traject. *In:* C. VERBEEK, S. DELARUELLE & J. BUNGENEERS (EDS.). *Verloren voorwerpen, Archeologisch onderzoek op het HSL-traject in de provincie Antwerpen.* Antwerpen: Dienst Cultureel Erfgoed Provincie Antwerpen, pp. 115-174.

DELRUE, P. 2008. *Archaeometallurgical analyses of pre-Islamic artefacts fromed-Dur (Emirate of Umm al-Qaiwain, U.A.E).* Proefschrift voorgedragen tot het behalen van de graad van doctor in de Archeologie. Gent.

DE RIJK, P. T. A. 2003. *De scoriis. Eisenverhuttung und Eisenverarbeitung im nordwestlichen Elbe-Weser-Raum*. Wilhelmshaven: in eigen beheer.

JOOSTEN, I. 2001. Metaalslakken. In: A. A. A. VERHOEVEN & O. BRINKKEMPER (EDS), *Twaalf eeuwen bewoning langs de Linge bij De Stenen Kamer in Kerk-Avezaath. Archeologie in de Betuweroute 6*. Rapportage Archeologische Monumentenzorg, 85. Amersfoort. pp. 311-318.

PLEINER, R. 2006. *Iron in Archaeology: Early European Blacksmiths*. Praha: Archeologický Ústav AV ČR.

MAUVILLY, M., ANTENEN, I. & GARCIA CRISTOBAL, E. 1998. Sevaz "Tudinges": chronique d'un atelier de metallurgistes du debut de La Tene dans la Broye. *Archäologie der Schweiz,* **21-4**, pp. 144-154.

SERNEELS, V. & PERRET, S. 2003. Quantification of smithing activities based on the investigation of slag and other material remains. *Archaeometallurgy in Europe. Proceedings of the International Conference (Milano, 24-26 septembre 2003)*, Vol. 1, Milano: Associazione Italiana di Metallurgia, pp. 469-478.

WINDEY, S. 2017. *Ronse Pont West. Analyse metaalslakken*. Onuitgegeven rapport GATE bvba.

Internetbronnen

CREMERS G. 2009. Onderzoeksbalans Onroerend Erfgoed Vlaanderen. A. Onderzoeksbalans Archeologie. 4.6.2.2 Ateliers. *https://onderzoeksbalans.onroerenderfgoed.be/onderzoeksbalans/archeologie/metaaltijden/bronnen/archeologisch/ateliers* (09/01/2016)

YOUNG, T. 2012. Iron : hand blacksmithing. Archaeology datasheet 303. *http://hist-met.org/images/pdf/HMSdatasheet303.pdf* (19.12.2017)