Quaternary International xxx (2015) 1–19

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Technical diversity within the tanged-tool Gravettian: New results from Belgium

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A R T I C L E I N F O

Article history:
Available online xxx

Keywords:
Gravettian
Tanged tools
Lithic technology
Belgium
Maisières-Canal
Station de l'Hermitage

A B S T R A C T

Located at the interface between the Paris and the Rhine Basins and the more northern territories of Europe, Belgium contains several Gravettian occupations, both open-air and in caves. The available documentation is unfortunately limited by the earliness of the excavations conducted at most sites. Stratified records in karstic context, primarily excavated in the 19th century, are particularly affected by this situation. The analysis of Gravettian lithic technological behaviours can, however, rely on two open air sites excavated in the late 20th century which provide more rigorous data: Maisières-Canal and Station de l'Hermitage. These two sites have been the focus of comparisons that highlight their similarities, both in terms of the lithic industry and location. In fact, the former stands out for the presence of tanged tools, a typological marker which is usually associated with the Early Gravettian of Western Europe. In this article, we present a new study that evidences the differences in the lithic technical systems represented at these sites. After a presentation of the most recent data, we consider the causes that may be responsible for such diversity, highlighting the possible role of the chronological factor, but also of the existence of an original technical tradition in north-western Europe during the appearance and development of the Gravettian.

1. Introduction

In the last decade, research on the Early Upper Palaeolithic of Western Europe have developed a particular interest in the period comprised between the end of the Aurignacian and the beginning of the Gravettian (among others: Leoz, 2007; Pesesse, 2008a, 2010; Pesesse and Michel, 2006; Moreau, 2009, 2011; Michel, 2010). These works brought new data allowing discussion on the transition between these two subdivisions of the Upper Palaeolithic. In south-western France, progressive modification of the lithic industry, leading to the development of specific technical systems, was identified during this transition period (Pesesse, 2008a,b, 2010). This observation allows considering that the Gravettian developed from the Aurignacian in Western Europe. It implies consequently a technical continuity between Recent Aurignacian and Early Gravettian industries. This conclusion is also supported by lithic assemblages coming from German sites belonging to both periods (Moreau, 2011). However, the question of the development of original technical systems between the end of the Aurignacian and the beginning of the Gravettian still needs to be explored for other regions.

In north-western Europe, and more particularly in Belgium, the emergence of the Gravettian is difficult to tackle. In Belgium, Gravettian occupations are generally found in caves within complex stratified records excavated since the 19th century, such as Spy Cave and Goyet (Fig. 1). Unfortunately, this long history of research has major implications for the understanding of the Belgian Gravettian, particularly given the lack of stratigraphic and chronological context. Technological characterization of the assemblages is also affected because these cave assemblages are frequently mixed. Studies of technical behaviour during the Gravettian period can, however, rely on two open-air sites excavated in the late 20th century for which the archaeological contexts are much more rigorously documented and reliable: Maisières-Canal and Station de l'Hermitage. These two sites have yielded lithic industries marked by the presence of tanged tools, a feature associated with the Early Gravettian of Western Europe.

In this article we compare the industries at Maisières-Canal and Station de l'Hermitage on a technological and typological basis to

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http://dx.doi.org/10.1016/j.quaint.2015.11.034
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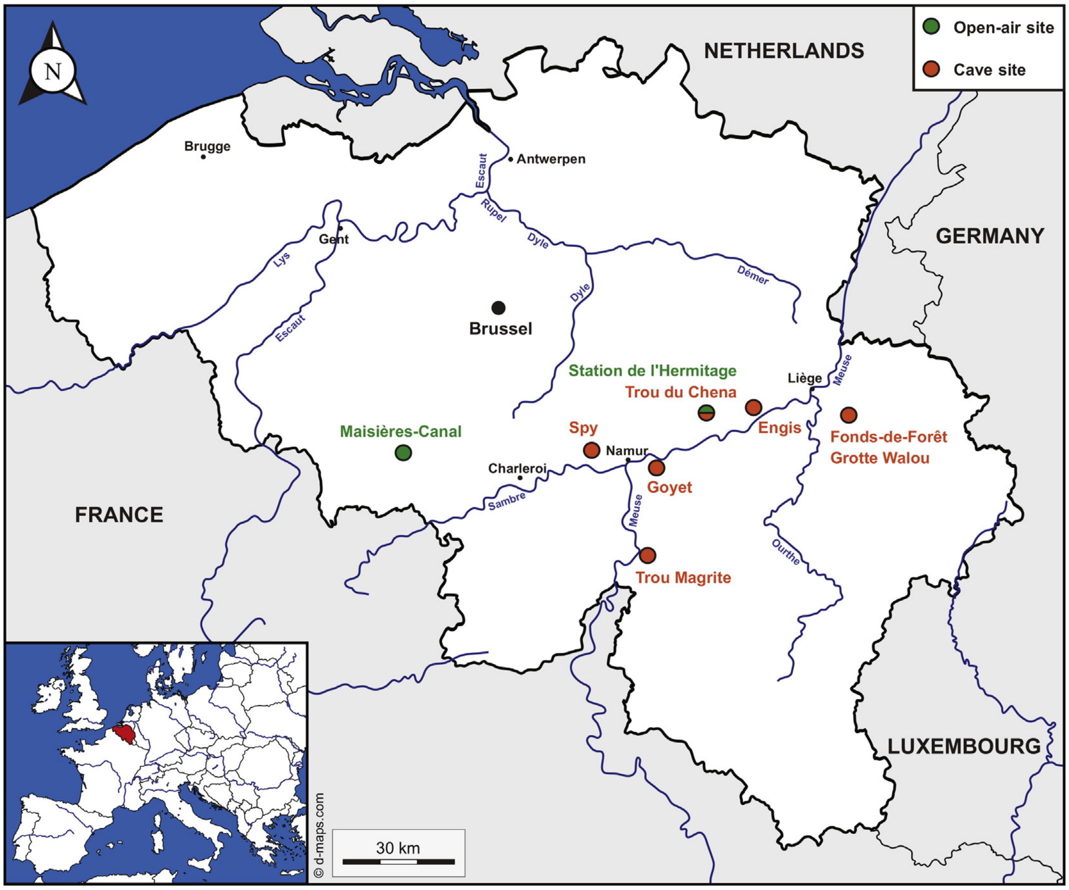

Fig. 1. Map of Gravettian sites in Belgium (CAD by O. Touzé).

evaluate the homogeneity of Early Gravettian industries in Belgium. This comparison highlights several differences, some of which have previously been identified (Miller, 2000), that indicate significant technical diversity between both sites. Based on the observations made, interpretative hypotheses are proposed providing new insights on the beginning of the Gravettian in north-western Europe.

2. Method

The analyses of lithic material coming from Maisières-Canal and Station de l'Hermitage were conducted using the "*chaîne opératoire*" methodology (Pelegrin et al., 1988; Karlin, 1991) commonly applied in modern lithic studies of the Gravettian (for exemple: Klaric, 2003; Pesesse, 2008a; Moreau, 2009; Simonet, 2009; De la Peña Alonso, 2011), and the classical typology established for the European Upper Palaeolithic (de Sonneville-Bordes and Perrot, 1954, 1955, 1956a,b).

The analysis of the Maisières-Canal material was undertaken by two of us (D. P. and D. F.). It focused mostly on the core reduction process as well as on the making process of the most emblematic tool types of the site (tanged points, tanged burins and Maisières points). This work is based on the study of material conserved at the Royal Belgian Institute of Natural Sciences (de Heinzelin and Bois d'Enghien collections). This material comes from the area known as the "*Champ de fouille*" which is the main excavated area of the site. The lithic material coming from "*Atelier de taille de la Berge Nord-Est*" has not been studied as it is quantitatively and qualitatively limited compared to the assemblage of the *Champ de fouille*. As the typo-technological data on Maisières-Canal used in this paper have already been published in detail (see Pesesse and Flas, 2012), only part of the information is presented here to allow comparison with new data collected on the Gravettian material from Station de l'Hermitage. Please refer to the publication mentioned above for more information.

The analysis of Station de l'Hermitage material was carried out by one of us (O. T.) and aimed to characterize the Gravettian lithic technical system. It is therefore based on the recognition of the different operational schemes and also on the characterization of their specific goals in terms of blank and tool production. This work also integrates identification of raw materials used at the site, even though study of the procurement area remains limited given the state of research on raw materials in the region (see section 3.2.1 for more information). Four of the five existing collections related to Station de l'Hermitage were examined during this study. These collections are conserved at the Royal Belgian Institute of Natural Sciences (Haesaerts collection), the Grand Curtius Museum (De Puydt and Lohest, and Tihon collections) and the University of Liège (Straus and Otte collection).

3. Material

3.1. *Maisières-Canal*

3.1.1. *Presentation of the site*

The archaeological site of Maisières-Canal is located on the Canal du Centre, in the Mons Basin. After enlargement work on the canal began in 1965, G. Bois d'Enghien found abundant archaeological material in the exposed deposits, around 28–29 m a.s.l., in

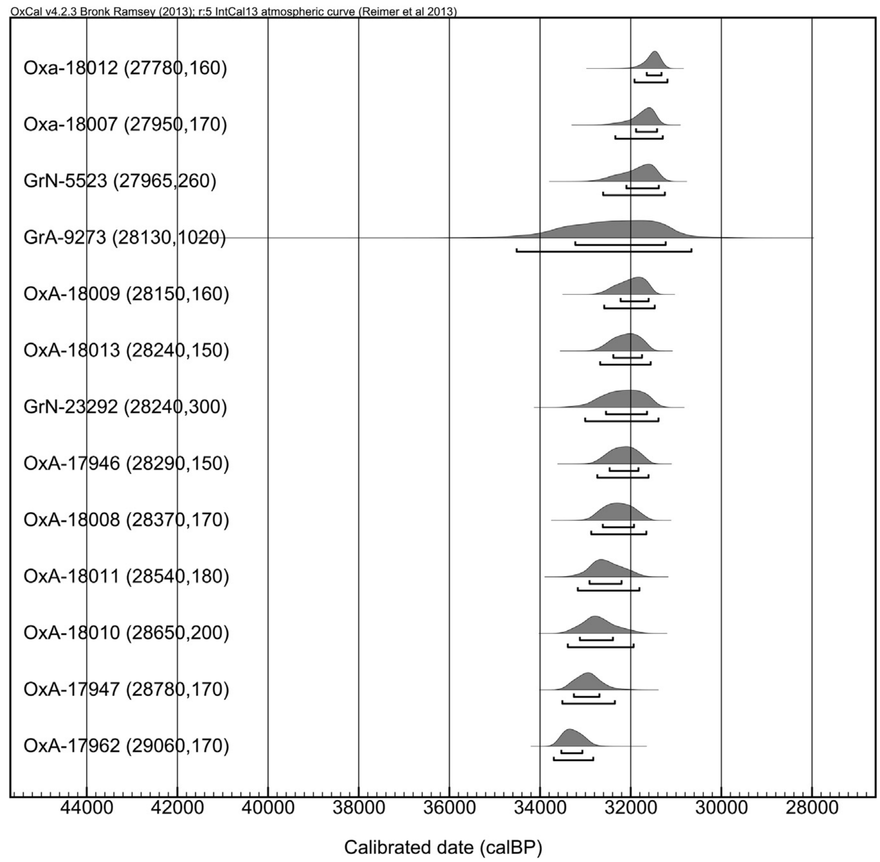

Fig. 2. Radiocarbon determinations at Maisières-Canal.

1966. This area, known as the "*Champ de Fouilles*", was subsequently excavated over an area of 95 m by the Royal Belgian Institute of Natural Sciences, yielding a Gravettian occupation including well preserved lithic artefacts in addition to faunal remains (Haesaerts and de Heinzelin, 1979). A second occupation, "*l'Atelier de Taille de la Berge Nord-Est*", yielding hundreds of artefacts, was also discovered by J. de Heinzelin on the north-eastern bank of the canal in 1966 and excavated by P. Haesaerts in 1967 (De Heinzelin, 1973). The artefacts from this second area come from a layer stratigraphically correlated with the Gravettian occupation of the "*Champ de Fouilles*" (Haesaerts and de Heinzelin, 1979). More recently, between 2000 and 2002, a team from the University of Liège undertook new excavations at this second area and discovered a previously unknown Aurignacian occupation as well as limited Gravettian material related to the occupation previously excavated (Miller et al., 2004a,b).

The Gravettian settlement of the "*Champ de Fouilles*" has a clear chronological position, as a result of precise stratigraphic analysis and a dozen radiocarbon dates that attribute it to around 32 000 cal BP (Fig. 2; Haesaerts and de Heinzelin, 1979; Haesaerts, 2004; Haesaerts and Damblon, 2004; Jacobi et al., 2010). Gravettian artefacts are present in layers M.G., M.H., M.I. and M.J. These layers correspond to a medium-cold oscillation (the Maisières interstadial), originally radiocarbon dated to 27 965 ± 260 uncal BP (on humic material, layer M.H., GrN-5523; De Heinzelin, 1973). This age has recently been confirmed by new radiocarbon dates on different bones from the same area. Two mammoth bones from the M.H. layer yielded radiocarbon ages of 28 240 ± 300 uncal BP (GrN-23292) and 28 130 +1.020/−900 uncal BP (GrA-9273) (Haesaerts and Damblon, 2004). Moreover, several dates were obtained on bones from the occupation layer (Jacobi et al. 2010), with results confirming an age of around 28 000 uncal BP; the most reliable date, on a cut-marked reindeer bone from unreworked deposits, was 27 950 ± 170 uncal BP (OxA-18007).

3.1.2. The Gravettian archaeological material

The Gravettian lithic assemblage from the "*Champ de Fouilles*" is particularly rich, with more than 34 000 artefacts including more than 900 tools. Table 1 gives an overall count of this material according to the work of De Heinzelin (1973). It must be noted, however, that the number of typological tools is lower than the one proposed by this author. We have indeed counted 961 tools while Marcel Otte has counted 937 tools in a previous study (Otte in Haesaerts and de Heinzelin (1979)). As was noted by Otte (in Haesaerts and de Heinzelin (1979), p. 69), this significative difference can be explained by the fact that de Heinzelin also classified as typological tools pieces with traces of use or accidental retouch linked to taphonomical processes. Furthermore, nearly 2000 pieces were not classified into a general technological category because of the modalities of the count realised by de Heinzelin. However, this limit does not affect the overall view of the industry that indicates, given especially the high number of cores and flakes, an important *in situ* reduction process oriented toward blade production.

Regarding the osseous material, an osseous industry is also present though clearly poorer (n = 68). It includes decorated ivory pieces, an ivory pin, ivory rods, bone tubes, bone points fragments, perforated reindeer phalanxes and lissoirs (Otte, 1979). The faunal spectrum is diverse, including mammoth, horse, red deer, reindeer, bison, aurochs and brown bear. Polar fox, hare and birds (willow grouse, Western capercaillie, harfang and crow) have also been identified (Gautier, 1979). These correspond to a moderately cold climate consistent with the Maisières interstadial.

Please cite this article in press as: Touzé, O., et al., Technical diversity within the tanged-tool Gravettian: New results from Belgium, Quaternary International (2015), http://dx.doi.org/10.1016/j.quaint.2015.11.034

Table 1
Count of the Gravettian lithic material from the *Champ de fouille* at Maisières-Canal by collection (after De Heinzelin, 1973, modified).

Collection	Blades	Bladelets	Flakes	Cores	Tools	Burin spalls	Chips and debris	Unclassified	Total
Bois d'Enghien	280	18	435	121	791	72	346	115	**2178**
RBINS	3701	563	13851	298	883	397	10941	1814	**32448**
Total	**3981**	**581**	**14286**	**419**	**1674**	**469**	**11287**	**1929**	**34626**

3.2. *Station de l'Hermitage*

3.2.1. *Presentation of the site*

The site of Station de l'Hermitage is located on a butte overlooking the eastern bank of a meander in the Méhaigne River, south of the village of Huccorgne in the Province of Liège. The archaeological material was found in the part of the butte between two cuts formed by the construction of a road and a railroad in the second half of the 19th century. These construction cuts allowed De Puydt and Lohest (1884–1885) to detect the presence of Palaeolithic material. Shortly after their discovery, Ferdinand Tihon conducted the first excavation on the site between 1886 and 1890. Tihon identified two Neolithic layers, though the initial attribution of the oldest one to the Early Neolithic (Dormal and Tihon, 1890–1891) was to be modified by subsequent research. In addition, around five meters deep, lithic remains including two handaxes associated with mammoth remains were also discovered (Tihon, 1895–1896), indicating the presence of a Mousterian or recent Acheulean layer (Ulrix-Closset, 1975, p. 96). From 1969 to 1971, Joseph Destexhe-Jamotte undertook new research at l'Hermitage. This important fieldwork concerned a total surface area of 148 m^2 and mostly focused on the second layer recognized by Tihon, which had been attributed to the Perigordian/Gravettian by Ulrix-Closset (1975, p. 95). Next, in 1976 and 1980, a team from the Royal Belgian Institute of Natural Sciences recorded the Pleistocene stratigraphy under the direction of Paul Haesaerts, and also recovered new Gravettian and Middle Palaeolithic material. The final fieldwork was conducted between 1991 and 1993 by the universities of New Mexico and Liège under the direction of Lawrence G. Straus and Marcel Otte. These excavations focused on the Gravettian occupation, but also revealed the presence of reworked Mousterian remains in peripheral areas of the site. After more than a century of research, the archaeostratigraphy of Station de l'Hermitage is understood to consist of at least three different chrono-cultural components, including an important Gravettian settlement and limited Middle Palaeolithic and Neolithic remains.

3.2.2. *The Gravettian archaeological material*

The Gravettian occupation of Station de l'Hermitage is characterized by an abundant lithic industry associated with faunal remains. Though little information is provided on the latter, the 1991–1993 excavations yielded a limited and poorly preserved faunal corpus including reindeer, horse and mammoth (Gautier, 2000). As far as the lithic industry is concerned, a significant loss of material should be noted. Although nearly 16 000 lithic artifacts were found during Destexhe-Jamotte's excavation (personal communication made to Paul Haesaerts, evoked in Haesaerts (2000), p. 18), most of this significant collection has now disappeared (Guy Destexhe, pers. comm.). Further, as Marcel Otte noted (2000, p. 35), it is also likely that what is preserved today of Tihon's collection does not represent the entirety of the material found during his fieldwork. In addition, a small set of tools belonging to the same collection was not studied because of its condition of curation at the Grand Curtius museum.

However, despite these constraints, the total lithic industry still accessible today consists of more than 3000 elements, chips and debris excluded (Table 2). This set includes tools, blanks, cores and production waste and thus constitutes an appreciable sample of the whole industry. Data presented below comes from the study of material stored at the Grand Curtius museum (both de Puydt and Lohest collections and Tihon excavations), the Royal Belgian Institute of Natural Sciences (RBINS excavations) and the University of Liège (excavations of the universities of New Mexico and Liège). Though we have not yet studied what is left of Destexhe-Jamotte's collection at the time of writing, preliminary observations indicate that the material is coherent with that of the other collections.

3.2.3. *The Gravettian occupation: long- or short-term palimpsest?*

Since the fieldwork realised at the beginning of the 1990s, a debate has arisen concerning the time-scale during which the site was occupied during the Gravettian period. This debate emerged because of lithic refitting that suggested that Station de l'Hermitage was visited at least twice during the Gravettian (Martinez and Guilbaud, 1993 [French version]; Martinez and Guilbaud, 2000 [English version]), a result that raises the question of the time-gap separating these visits: are we dealing with a long or a short time-gap? Interpretations of the chronological data unfortunately show contradiction in the monography (Straus et al., 2000) as was noted by Jacobi et al. (2010, p. 34). It is thus necessary to review the available data in order to determine how to interpret the archaeological assemblage and how the study of the lithic industry can be processed.

Radiocarbon dating of material from the Gravettian layer tends to support the long-term occupation hypothesis since results extend from circa 28 400 to 23 200 uncal BP (Straus, 2000, p. 77; Fig. 6). According to Haesaerts (2000, p. 32), however, it is likely that the 23 170 ± 160 BP (GrN-9234, conventional method on bone collagen) and 24 170 ± 250 BP (CAMS-5893 [NSRL-1044], AMS on bone collagen) dates are too young given the stratigraphic sequence. This is especially likely for the latter since the same bone also gave a much older date. In addition, stratigraphic analysis indicates that the Gravettian material is contained in a layer contemporaneous with the first silty deposits of the Early

Table 2
Count of the Gravettian lithic material from Station de l'Hermitage by collection.

Collection	Blades	Bladelets	Flakes	Cores	Tools	Burin spalls	Chips and debris	Others	Total
De Puydt and Lohest	28	9	25				5		**67**
Tihon	42	10	47		13	1	7		**120**
Haesaerts	781	607	1041	15	48	51	3866	4	**6413**
Straus and Otte	118	74	252	3	8	5	2025	4	**2489**
Total	**969**	**700**	**1365**	**18**	**69**	**57**	**5903**	**8**	**9089**

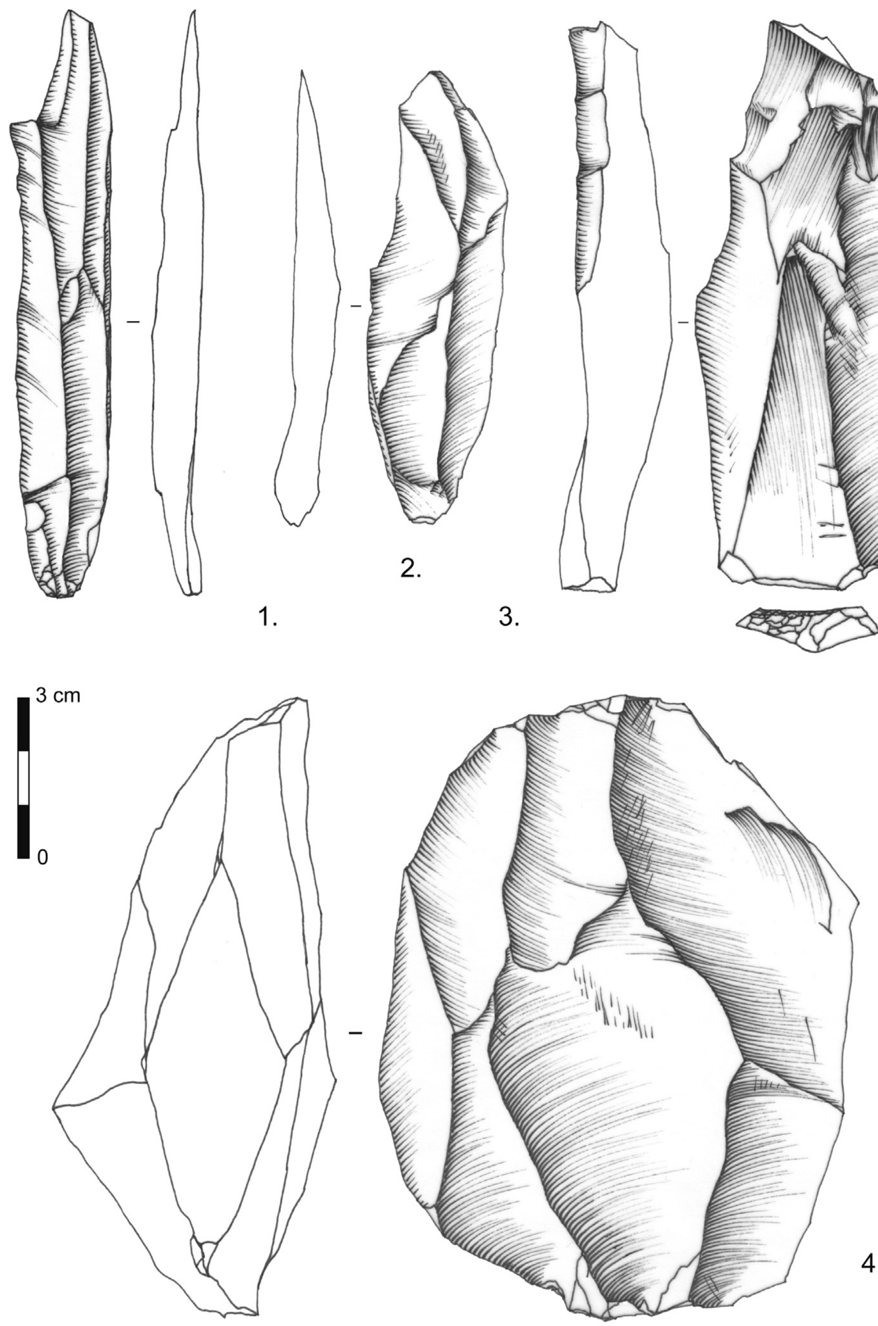

Fig. 3. Maisières-Canal – 1–3: blades, 4: core (drawings by D. Pesesse).

Pleniglacial (layer G1), situated just before the Les Wartons interstadial around 26 000 BP (Haesaerts, 2000, p. 32). The date of 26 300 ± 350 BP (OxA-3886, AMS on bone collagen) supports this chronological attribution. The bone used for this dating comes from what was defined as Stratum 4 during the 1991–1993 excavations which would correspond to layers G1 and G3 in the stratigraphy determined during previous excavations by the RBINS (Haesaerts, 2000, p. 28). However, the absence of clear correlations between stratigraphic subdivisions established in the 1976/1980 and 1991–1993 field seasons, prevents us from knowing exactly from which layer of Haesaerts's stratigraphic model this bone came. According to Jacobi et al. (2010, p. 35), it appears that the "*bone fragment most probably [comes] from Unit G1*". The last difficulty raised by radiocarbon dates comes from two determinations that yielded dates of 28 170 ± 430 BP (CAMS-6371 [NSRL-1045], AMS on bone aspartic acid) and 28 390 ± 430 BP (CAMS-5891 [NSRL-1044], AMS on bone gelatin). The mammoth ribs used come this time from a part of Stratum 4 that would correspond to a rock-flow (layer G3) overlying layer G1 (Straus, 2000, p. 76; Jacobi et al., 2010, p. 35). These dates indicate that at least some osseous material from the site of l'Hermitage has the same age as the Gravettian occupation of Maisières-Canal. The chronological attribution of the few tanged pieces present in the industry of l'Hermitage is then ambiguous as it has been suggested that they could possibly be contemporaneous with Maisières as well (Jacobi et al., 2010, p. 35). The fact that they were only found during Tihon and Destexhe-Jamotte's excavations – who dug exclusively at the top of the butte – also questions the possible

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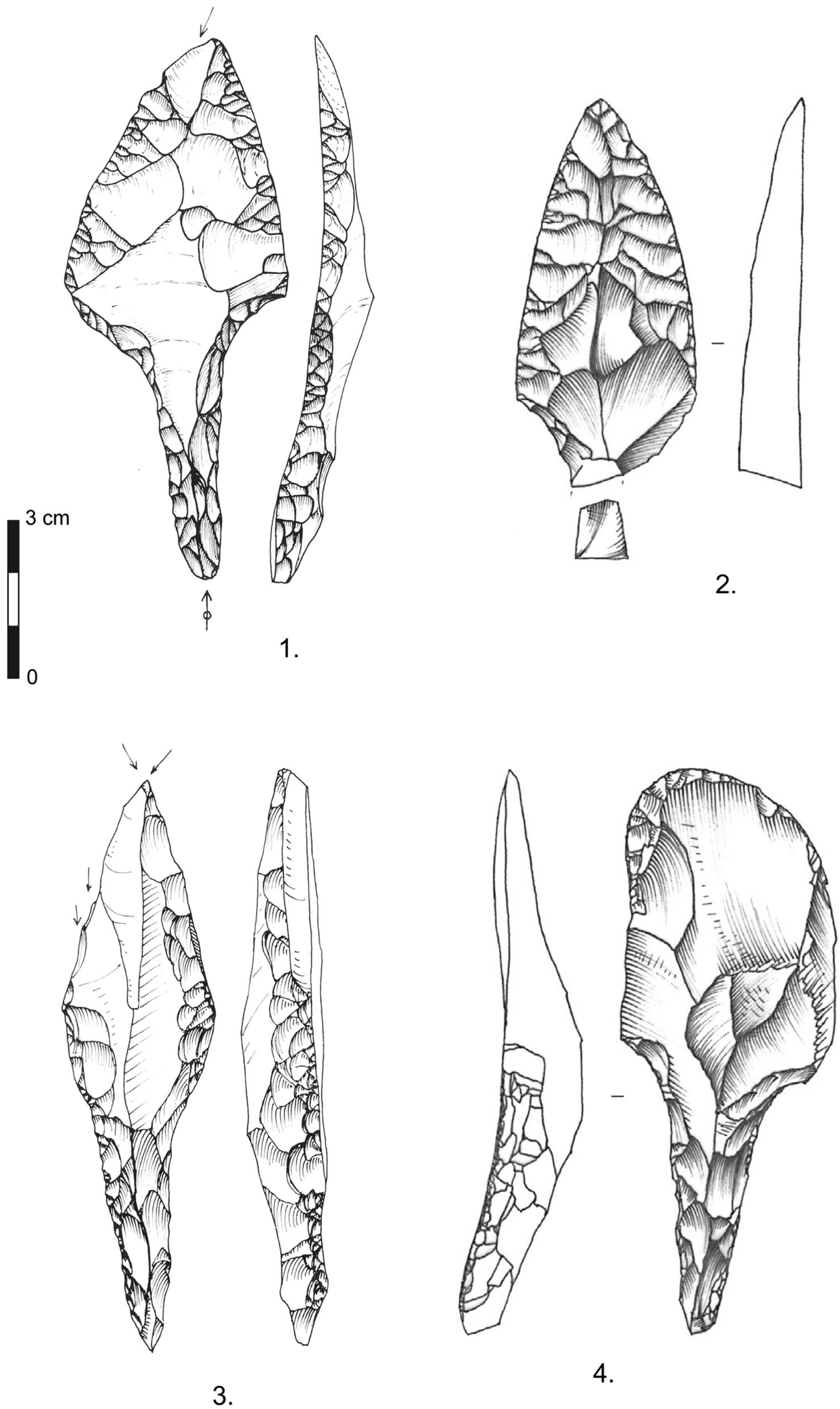

Fig. 4. Maisières-Canal — 1–2: tanged points, 3: tanged burin, 4: tanged end-scraper (1 & 3 by M. Otte, 2 & 4 by D. Pesesse).

presence of chronologically different Gravettian occupations which might have been located in different areas of the site.

Despite the obvious complexity of the data, several clues indicate that the lithic industry from Station de l'Hermitage likely belongs to only one phase of the Gravettian and, thus, may reflect a rather "short-term" occupation, even though it is impossible to determine the precise time-scale during which the site was visited during the Gravettian.

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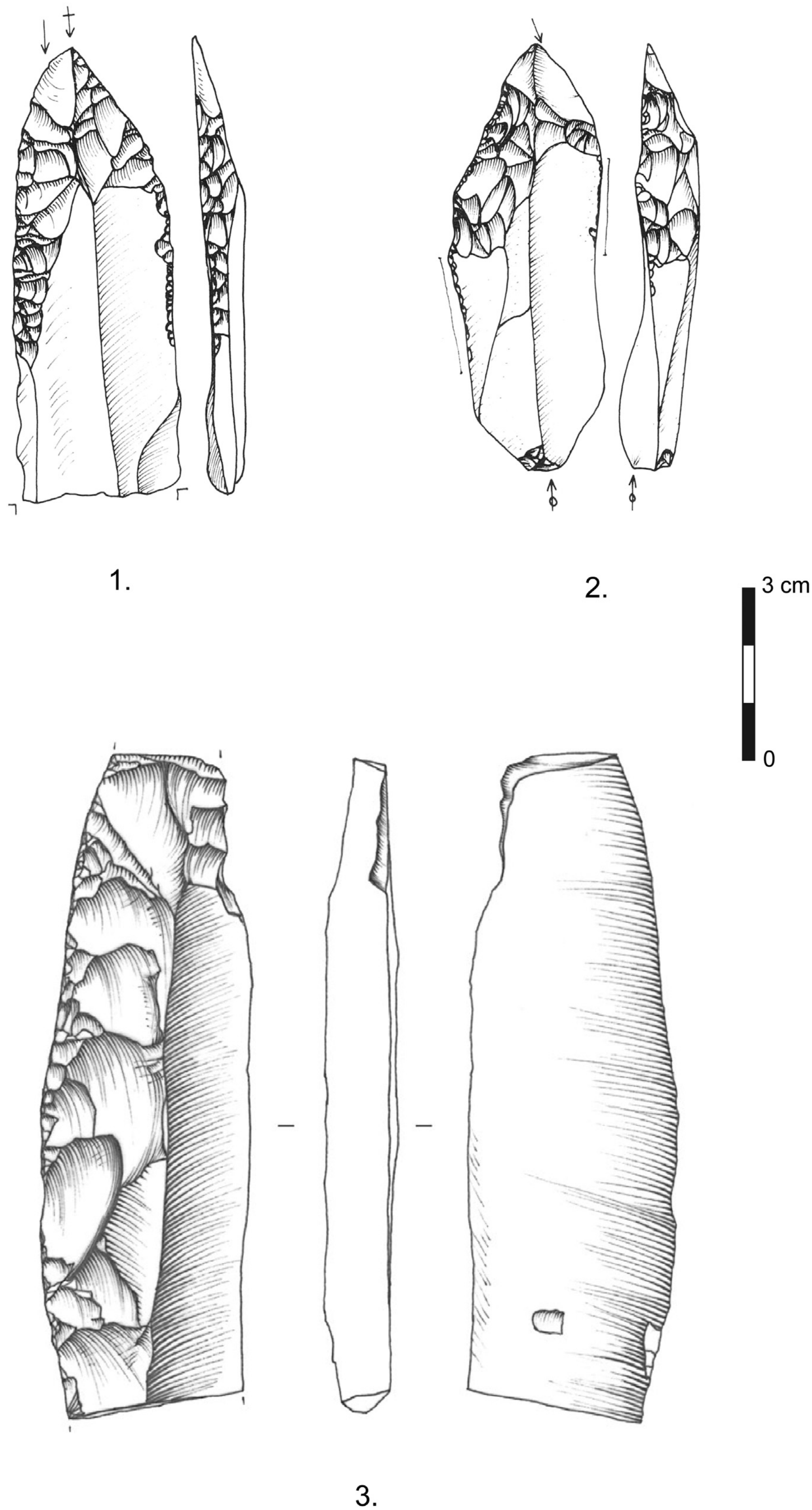

Fig. 5. Maisières-Canal – Maisières points (1–2 by M. Otte, 3 by D. Pesesse).

First, regarding the typo-technological characteristics of the industry, it is worth noting the lack of elements that would suggest the presence of multiple Gravettian phases. The industry is indeed remarkably coherent from a technological perspective as the same technical features are represented in each of the different collections and areas excavated on the site. For example, the same types

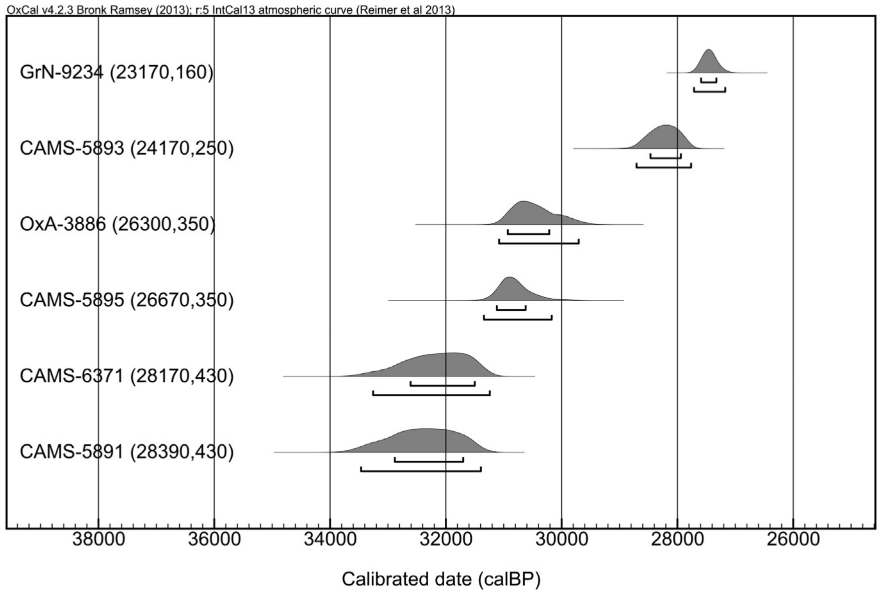

Fig. 6. Radiocarbon determinations at Station de l'Hermitage.

of raw material, each revealing a similar treatment in every collection, are encountered in different parts of the site. This aspect has also been verified for Destexhe-Jamotte's material during preliminary observations. Moreover, there are no typological markers, such as truncated backed pieces, well-known from the recent Gravettian of Belgium (Otte and Noiret, 2007), which would clearly indicate a long period of occupation.

Second, the vertical distribution of Gravettian material in some areas, in particular in Haesaerts' roadside trenches at the bottom of the butte, should be mainly interpreted as the result of reworking of the occupation layer. The very high proportion of splinters and small debris in these trenches and in a trench from the UNM/ULg excavations, located between the bottom of the butte and the central part of the site, strongly suggests sorting along the slope by water flow (and possibly solifluction), since these micro elements are much less common in the upslope trench realised in the 1990s. Also, the nature of layers G2 (colluvium), G3 (rock-flow) and G4 (loess deposit filling a small channel cutting into layer G3), all above layer G1 – which would have originally contained the Gravettian horizon – strengthens this hypothesis as they indicate potentially significant reworking processes (Haesaerts, 2000). This interpretation is archaeologically supported by refits across Unit G made by members of the UNM/ULg team (Straus and Martinez, 2000), and more recently by one of us, on material coming from Haesaerts' roadside trenches.

In conclusion, even if the data are unclear about the exact duration of the Gravettian presence at Station de l'Hermitage, there is no clear evidence of a long-term occupation that would have included several phases of the Gravettian. On the contrary, the limited indications available tend to support the idea of a single reworked occupation phase, situated around 26 000 uncal BP, during which one or several groups came to the site, primarily for knapping and possibly hunting activities. However, this hypothesis does not explain the two dates falling around 28 000 uncal BP. Indeed, these determinations still require interpretation. The presence of older bone material that became mixed with the Gravettian industry because of the disturbance processes evoked above could be an explanation, but there is no evidence supporting this possibility. New fieldwork on the site appears necessary to resolve this question. However, given the apparent technical homogeneity of the lithic material, it seems possible to study the industry of l'Hermitage as a coherent assemblage, though it is important to bear in mind that the assemblage resulted from at least two visits to the site, and that the exact time-gap between these visits (a season, year, decade, century?) is unknown even if we are certainly not facing an occupation to be measured on the very long term.

4. Results

4.1. Maisières-Canal

4.1.1. Core exploitation

The lithic technical system is primarily based on blade production (Fig. 3; Pesesse and Flas, 2012) using high quality local flints from different sources within the Mons Basin, all located less than 10 km from the site (Miller, 2001; Moreau et al., 2013). The closest flint source provides Obourg Maastrichtian flint. This flint, dark-blue in colour, is particularly fine-grained and is available less than 2 km from the site (De Heinzelin, 1973, pp. 42–43).

The degree of shaping of the cores varies according to the morphology of the flint blocks: it can be complete or very limited. Blade cores have a broad reduction surface that is created on the longest side of the block. The sides and sometimes the back of the core are shaped to manage the reduction surface.

Even if a lot of cores are defaced at the end of the production, therefore not permitting reconstruction of the reduction process, some of them are preserved enough to allow clear interpretation of this process. The blades are mainly extracted from two opposed striking platforms, but a rare unipolar core reduction cannot be excluded. According to dorsal scar lengths on blanks, there is no preferential striking platform since both striking platforms are used to produce blanks and to manage the volume of the core. The alternate use of the opposed striking platforms, as well as the knapping of *débordant* blanks (removing the core's edge), allows maintenance of the required convexities. These convexities are well marked, providing quite thick blanks. The alternate use of the striking platforms also shows different patterns depending on the cores or the knapping sequence. Indeed, some blanks show quick alternation (one blank per striking platform), while others show a slower rate of alternation and, in consequence, unidirectional dorsal scars. These changes in the use of the opposed platforms possibly correspond to precise intentions, leading to pre-determined blanks with certain characteristics like a thin, acute and axial distal tip, as a result of a ridge previously created by two removals from the opposed platform. Such a feature is in fact important for several tool types (see below).

The use of a broad reduction surface enables production of large and sturdy blades which are generally struck with stone hammers, hard or soft, and perhaps rarely with an organic hammer. Stone percussion often involves a preparation of the striking platform in order to strengthen the percussion area: many blanks have dihedral and sometimes facetted platforms with an angle close to 90°. Blades also show variability regarding their size and their regularity. However, small blades do not appear to have been a major intentional product, as they remain typically unretouched. It is finally important to stress the lack of bladelet production.

4.1.2. Tool-kit

The industry includes 961 tools that are dominated by burins, “Maisières points” (points with dorsal flat retouch) and tanged pieces. The latter category includes tanged points (also called “Font-Robert points”, Table 3, Fig. 4–5) and also other tool types, particularly tanged burins and few tanged end-scrapers. Retouched blanks are numerous whereas other tool types such as end-scrapers, splintered pieces, truncated pieces or backed pieces are rare. The latter category includes a mesial fragment, a distal fragment showing an irregular backing, and a piece with a proximal partial truncation. The fourth piece has a well-shaped rectilinear back made by abrupt crossed retouch. Opposite this backed edge is a sharp, convex edge that has been denticulated with 11 adjacent notches. None of these backed pieces corresponds with the typology of the Gravette point. In the following, discussion is focused on the three main diagnostic typological groups of the industry: Maisières points, tanged points and tanged burins.

The production of tanged points implies no strict selection of the blanks as regular and irregular blades, and also by-products (*sous crête* blades, laminar flakes, partially cortical blanks) have been chosen. One is then led to question the existence within the reduction process of a sequence whereby regular blades can be produced. The degree of blank standardisation during *débitage* is poor, and this has consequences on the way points are retouched.

Table 3
Count of the Gravettian lithic tools from Maisières-Canal.

Tools			N
Maisières points			145
Distal fragments of point with flat retouch			11
Tanged points			130
Burins	dihedral	simple	170
		double	8
	angle	on break	69
		on truncation	63
		double	14
	mixed		42
End-scrapers			25
Retouched blades			115
Retouched flakes			103
Notches, denticulates			4
Backed pieces			4
Truncated pieces			8
Splintered pieces			4
Retouched bladelets			4
Multiple tools			29
Miscellaneous			13
Total			961

Indeed, if regular blades with natural distal tip are often only slightly retouched, other blanks show, on the contrary, a complete or almost complete retouch of the dorsal face (Fig. 4, n° 1–2). In this latter case, the high degree of retouch may be considered as the way to configure irregular blanks in order to obtain certain functional characteristics. Ventral retouching of these points is rare and can appear on the tang as well as on the distal part of the point. The creation of the tang also shows some variability (Le Mené, 1999), with abrupt or semi-abrupt retouch, reducing the initial width of the blank to varying degrees. Sometimes, the angle of the retouch appears different on the two sides of the tang. In some cases, the tang is also asymmetrical with a difference in length between the two sides (Otte, 1979). A general asymmetry is also possible when the axis of the tang does not correspond to the axis of the point. Overall, the morphology of these tanged pieces is thus very variable. Their size also reflects this variability: if most tanged pieces have a length between 60 mm and 100 mm, the smallest is 35 mm in length and the longest complete example is 120 mm. Their width ranges from 11 mm to 55 mm, with a mean of 30 mm.

Maisières points and tanged pieces share several aspects. In both cases, retouch is generally found on both edges and is mainly concentrated on the distal part, and the selection of blanks, the importance of retouch and the size of the tools show similar variability. Some of the Maisières points are indeed regular, light and pointed, while others are irregular and extremely large (Fig. 5). Between these two extremes are numerous intermediate specimens. The definition of sub-types would thus often be arbitrary. This remark also applies to tanged pieces since a similar difficulty exists when attempts are made to group these artefacts into coherent sub-types with clear limits. Both types of points also share a very singular feature that is reminiscent of the tranchet blow technique known for the prondnik. This feature corresponds to a short flake extracted at the distal end of the tool, slightly overshooting laterally on the ventral face, that enables sharpening of its point and one of its edges (Otte, 1976). It is present on 54 Maisières points and on 26 tanged points (Fig. 4, n° 1; Fig. 5, n° 1–2).

Because these two types of points share a similar degree of variability regarding several features (size, extensiveness of retouch, regularity of the blanks), 11 distal fragments of points cannot be attributed to one type or the other. The only differences between the two types may therefore be in the way they were hafted and used. Judging by their respective morphology, these pieces could have been used in different ways to work different materials, as the shape and the sturdiness of the cutting-edge varies; but without micro-wear analysis precise functional data is lacking. However, some points belonging to both typological categories show morphological regularity as well as a pointed, axial tip, sharp edges and a regular proximal part. The combination of these features, as well as the presence of macroscopic breakages (Pesesse and Flas, 2012), might support the hypothesis of their use as projectile points.

Aside from the tanged points, the tanged pieces category comprises several types of tanged tools, among which burins are the most common. 14 tanged tools can be classified as dihedral burins. However, on their dorsal face these pieces display the scars of former flat, invasive retouch (Fig. 4, n° 3). In several cases, identification of the sequence of removals is possible and shows that burin spalls have always been struck both after this invasive retouch and after the shaping of the tang. In consequence, it appears that blanks were initially shaped before being transformed into burins afterwards. It is thus possible that the initial retouch had a precise goal in terms of functional characteristics that did not correspond to the creation of a burin. The latter would then represent a recycling of the former tool. Hafting traces on these tanged burins have been identified (Rots, 2002), but it is difficult to determine whether they had been used for another function before being transformed into burins. This recycling process of artefacts into burins is also seen on other tool types, and especially a large number of Maisières points (n = 46).

4.2. Station de l'Hermitage

4.2.1. Core exploitation

Lithic production at Station de l'Hermitage mostly relies on the exploitation of a fine-grain flint (Fig. 7) whose macroscopic traits are common in the Hesbaye region where the site is located. Cortex alteration suggests limited transport by water and it is likely that blocks were collected in the vicinity of the site, possibly in the Méhaigne alluvium. Other raw material types are also present in the industry (Table 4) but their exact procurement areas are unfortunately unknown in most cases. It appears highly probable, however, that some of these materials are extra-regional since they are poorly represented and were introduced at the site under the form of blanks and tools. A very fine-grain black flint (Fig. 8) was brought to the site as cores in a late stage of exploitation, thus indicating that the source of this raw material may not be local. The colour and the quality of this flint is fairly similar to Obourg flint found in the Mons basin in central western Belgium, but the characteristics of l'Hermitage's black flint do not seem to match those of Obourg flint. Another possibility could be a black flint that has been identified in a quarry between Liège and Maastricht, a region which is much closer to l'Hermitage than the Mons basin (Miller, 2001, p. 191 and pers. comm.). Gravettian knappers also used other types of raw materials than flint. Among these is especially a glazed sandstone which is often referred to as "Brussels sandstone" in the literature. This type of material is found in the Tertiary sand formations located in the central part of Belgium. As it remains poorly described in archaeological contexts, supply sources used by Palaeolithic groups are not generally known with certainty (Krupa, 1988, p. 95; Di Modica, 2010, pp. 172–174). It is possible that Gravettian occupants of Station de l'Hermitage collected glazed sandstone blocks nearby, since it could have been transported by the Méhaigne which cuts through Tertiary formations upstream (Di Modica, 2010, p. 174). The absence of sandstone cores in the industry is, however, intriguing and most certainly reflects spatially separated exploitation.

Stages of the operational chain represented at the site vary for each raw material because they were not transported to the site in the same way. For example, and as mentioned above, a very fine-grain black flint was brought to the site, but since the cores had already been greatly exploited elsewhere for blade production, they only yielded small blades and bladelets at the site. In addition, there are no cortical flakes and only a small number of semi-cortical flakes in black flint at Station de l'Hermitage, providing further support that most of the reduction process of black flint cores is not represented. It seems likely that the high quality of this material motivated its transport to several locations. For the purposes of this paper, we have chosen to present a description of the reduction sequence applied to the local fine-grain Hesbaye flint because this raw material is the most intensively exploited in the industry. Indeed, it represents 75.01% of the studied material (splinters and debris excluded), and is also the only raw material that shows an entire *in situ* reduction process that reflects all of the different production goals.

Cores are prepared to varying degrees depending on the morphology of the original volume. Preparation may be limited, leaving large cortical surfaces, or, conversely, entirely shape the block with the removal of carefully prepared two-sided crests. Based on the most complete cores and blades, it would appear that the collected blocks did not exceed 15 cm in length. Knappers looked for rather narrow surfaces on which to create the flaking surface. In the few cases where the state of the cores still allows localization of the initialisation, the reduction process is initiated on the narrow side of the block. Blanks are then extracted following a frontal scheme, or rather a symmetric progression according to a recent reappraisal of the terminology by Valentin et al. (2014, pp. 663–666), as reduction extends in the same manner on the initial flanks of the core. This scheme may not necessarily be systematic. Indeed, for the black flint, cores often have scars indicating dissymmetric progression. This kind of scheme could be a consequence of opportunistic and very intense core exploitation. Given that only the last stage of the black flint reduction process is represented at l'Hermitage, it is not possible to determine at which point in this process dissymmetric progression began. Flaking faces are managed with two opposed striking platforms, while latitudinal convexity is maintained throughout the operational chain by the extraction of blades between the flaking face and flanks. The role attributed to the opposed platforms seems to vary, whether used to extract blanks or to manage the core's volumetric parameters, depending on the situation faced by the knapper. Blanks are obtained using a soft stone hammer on a smooth platform after abrasion of the platform's edge although abrasion remains absent in many cases. The use of organic and hard stone hammers is very rare and remains a marginal phenomenon in the industry.

The reduction process produces blanks of several calibres that decrease progressively during core exploitation. At the beginning of

Table 4
Count of the Gravettian lithic material from Station de l'Hermitage by raw material types.

	Blades	Bladelets	Flakes	Cores	Tools	Burin spalls	Splinters and debris	Others	Total
Fine-grain Hesbaye flint	743	486	1062	10	54	33	4059	4	**6451**
Grainy Hesbaye flint	13	1	41				49		**104**
Medium-grain grey flint (Hesbaye?)	2								**2**
Black flint	36	81	44	4	1	3	226		**395**
Brown flint	10	3	24				18		**55**
Brown flint with yellow bands	3			1					**4**
Blond flint	7	3	1	1		1	5		**18**
Glazed sandstone	15	10	21		1		95		**142**
Glazed sandstone with blackish veins	21	12	6				20		**59**
Quartz			1	1			7	1	**10**
Siliceous limestone			2				12		**14**
Patinated flint	94	90	148		12	18	1202	1	**1565**
Undefined flint	25	14	15	1	1	2	210	2	**270**

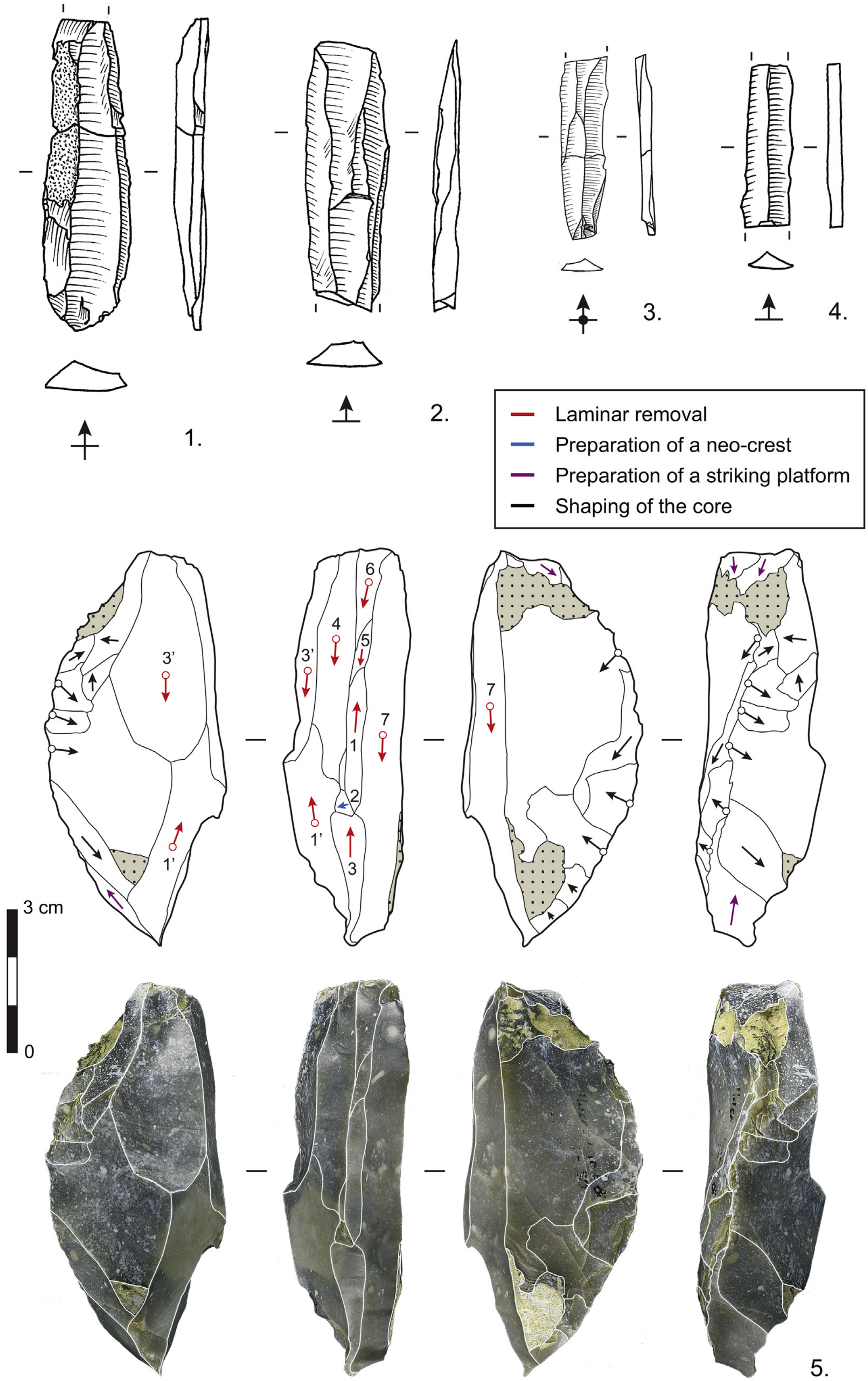

Fig. 7. Station de l'Hermitage, Hesbaye flint – 1–4: blanks, 5: core (drawings, pictures and CAD by O. Touzé).

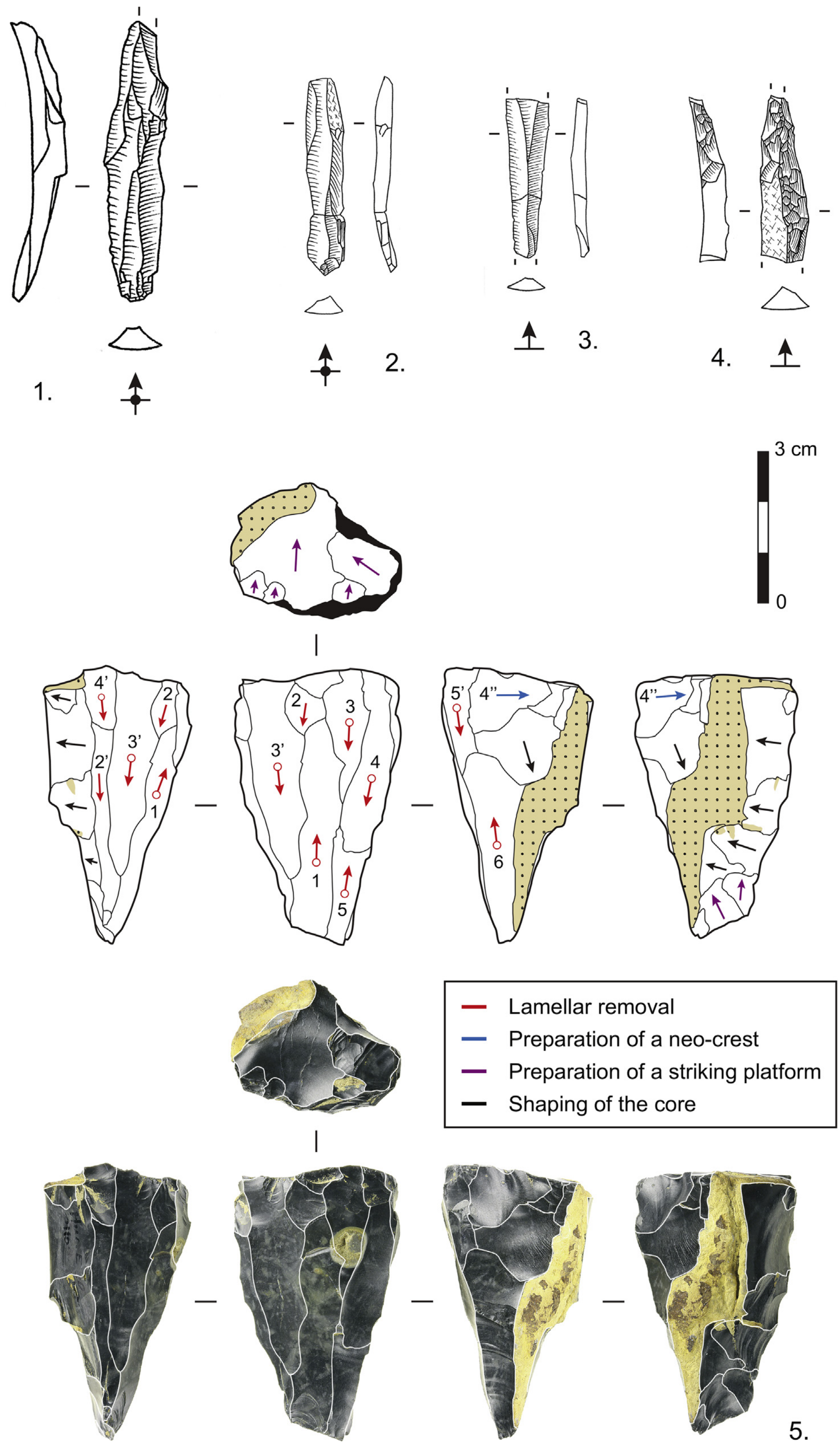

Fig. 8. Station de l'Hermitage, "Black flint" – 1–3: blanks, 4: crested bladelet, 5: core (drawings, pictures and CAD by O. Touzé).

the process, large and sturdy blades can be produced if the size of the block permits it. These blanks already have a tendency to regularity and often have cortical zones and/or traces of core preparation which indicate that their detachment occurred during the first stage of blank production. As the reduction process reduces the available material of the core, production then continues toward lighter and more regular blades. At this point of the operational chain, volumetric parameters of the core are carefully controlled and preparation of neo-crested blades is frequent. At the last stage of production, knappers finally extract small regular blades that match the calibre of bladelets.

Besides blade production, independent lamellar production is also documented at Station de l'Hermitage. Despite the limited number of bladelet cores (n = 4), these share similar features that allow identification of some production characteristics. In most cases, bladelets are extracted from two opposed striking platforms on the edge of laminar *débitage* by-products. Indeed, this burin-core scheme is applied on one *sous-crête* blade, one semi-cortical flake and two non-cortical flakes. In one case, unipolar lamellar production may have been realised on both sides of a dihedral angle. The burin-core made on the *sous-crête* blade (Fig. 9) is especially interesting because it is the longest blade of the industry (L = 10.6 cm) but also, and mainly, because it is made on a raw material represented by only four elements in the industry. This material is a fine-grain brown flint with regular semi-circular yellow bands. This original characteristic and the very marginal presence of this flint type in the assemblage strongly suggest that this raw material is extra-regional. Scars present on flaking surfaces and analysis of small blade calibres and morphology do not allow recognition of distinct subsets that could be associated specifically with burin-core production or blade production. Instead, these products cannot be isolated as similar traits were sought by the knappers, unless an unambiguous clue such as a *pan-revers* can be identified.

4.2.2. Tool-kit

At the time of writing access was available to a total set of 69 retouched tools. This count excludes Destexhe-Jamotte's collection and some of the tools found by Tihon in the 19th century. Among this unstudied material are four of the five tanged pieces uncovered at l'Hermitage. The studied sample is thus limited, even if the whole Gravettian tool-kit (Fig. 10) certainly doesn't exceed, however, 100 elements.

This studied tool-kit is dominated by burins (n = 21) and backed pieces (n = 18) (Table 5). Another quantitatively significant component is retouched blades, whereas end-scrapers are rare. This picture is completed by a single tanged tool made in glazed sandstone, a shouldered piece and a fragment of a leaf-shaped piece. The latter was found during the 1991–1993 excavations in layer 3 overlying the Gravettian horizon in layer 4. Its white patina significantly contrasts with the rest of the Gravettian industry and it is possible that this piece in fact belongs to a Neolithic occupation. The pattern described above is supported by the description of the 1969–1971 material provided by Otte and Destexhe-Jamotte (2000), which consists of a tool set also dominated by burins and that includes several microgravette points and backed pieces as well as pointed blades and rare tanged and shouldered pieces.

The backed pieces category includes distinct typological groups such as gravette and microgravette points. Other micro-backed pieces have been classified as “undefined” since these artefacts are broken at both ends, thus preventing determination of whether they were originally microgravette points or backed bladelets. Finally, a fourth sub-group may be isolated, consisting of four very small elements not exceeding 2 mm in thickness and 3 mm in width. These nano backed pieces were found only in Haesaerts's roadside trenches. One is from layer G1 while the others are of unknown stratigraphic provenance, although they probably originate from Unit G. Backed pieces are made on regular blades and bladelets produced during a *plein débitage* sequence. The longitudinal position of the point on the blank is difficult to address since the backed pieces set consists of a high number of mesial fragments. The few distal fragments available do not show clear orientation: the point can be created at the distal or proximal end of the blank. The positioning of the back, and consequently the cutting edge, is also flexible because they are located on the left or right edges of the blank in similar frequencies. The back is shaped starting from the ends of the edge toward the middle using direct or crossed retouch. Crossed retouch also appears to be used to correct bumps or to shape the point. Given the scarcity of distal fragments, marginal inverse retouch on the distal end has only been observed on two distal parts of microgravette points.

Other tool types are preferentially made on regular blades from *plein débitage*, but products such as *sous-crête* blades or, more rarely, neo-crested blades, can also be transformed into tools. From this perspective, burins are significantly diverse since different kinds of blanks, including a few flakes, of different calibres were exploited. For burins on truncation, burin spalls are struck equally from the distal and proximal ends of the blank. In contrast, dihedral burins are mostly prepared at the distal end of the blank. End-scrapers and blades with one or two retouched edges tend to be shaped on wide and sometimes thick blades, while pointed blades are made on blanks with greater calibre diversity.

Table 5
Count of the Gravettian lithic tools from Station de l'Hermitage.

Tools			N
Gravette points			1
Microgravette points			5
Undefined micro backed pieces			8
Undefined nano backed pieces			4
Tanged pieces			1
Shouldered pieces			1
Burins	dihedral		8
	on truncation	simple	11
		double	1
	undefined		1
End-scrapers			6
Side-scrapers			1
Pointed blades			4
Retouched blades			8
Retouched bladelets			1
Retouched flakes			2
Borers			1
Fragments of leaf-shaped piece			1
Multiple tools			3
Others			1
Total			69

4.3. Comparison of the results

Comparison of the Gravettian lithic industries at Maisières-Canal and Station de l'Hermitage show differences on several levels. First, regarding diagnostic tool categories, these sites indeed present distinct patterns. At Maisières-Canal, numerous tanged points and Maisières points are associated with other types of tanged tools (tanged burins, tanged end-scrapers) and a very limited number of backed pieces. Such a combination is remarkable as it is very rare for the Gravettian period, with only a very limited number of Gravettian sites, such as the “Clairière Est” sector of the Cirque de la Patrie in the Paris Basin (Cheynier, 1963; Touzé, 2013), showing a similar pattern. On the other hand, the association of typical microgravette and gravette points with a few tanged pieces at Station de l'Hermitage is not uncommon in the Early Gravettian of Western Europe, since it is observed at several other sites such as, for instance, Flagy – Belle Fontaine (Klaric et al., 2004), Höhle Fels (Conard and Moreau, 2004), La Vigne Brun (Pesesse, 2008a), Le Sire (Surmely et al., 2011) and Le Flageolet I (Lucas, 2000).

Beyond the tool-kits, the lithic technical systems at Maisières and l'Hermitage also differ with respect to blank production, as distinct strategies, responding to different objectives, were

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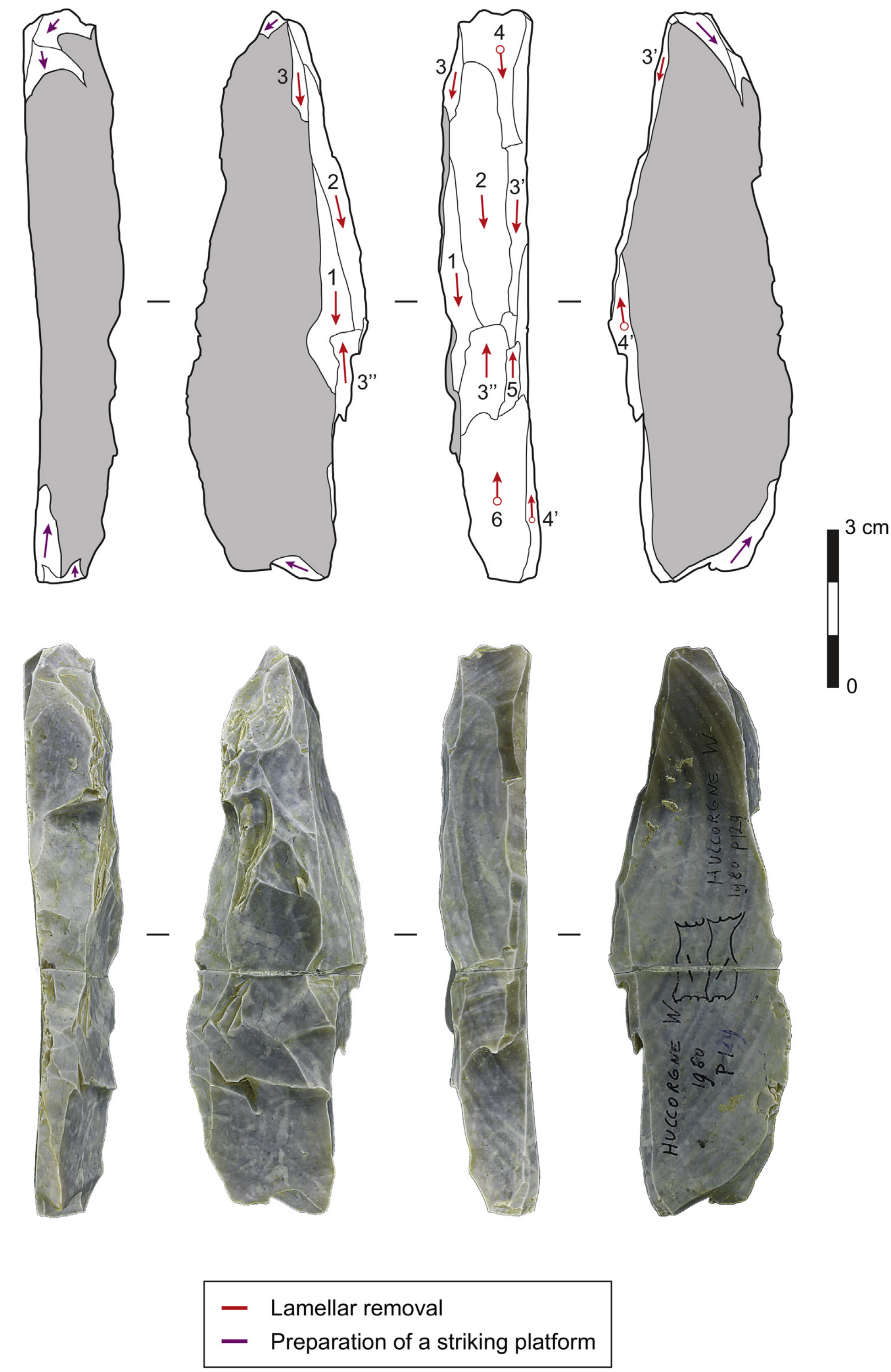


Fig. 9. Station de l'Hermitage, "Brown flint with yellow bands" — burin-core (pictures and CAD by O. Touzé).

employed to exploit the raw materials. Lithic production at the first site is oriented toward straight and sturdy blades with a variable degree of regularity. This intentional choice for massive blades could have been facilitated by the relative proximity of raw material sources. However, the positioning of the flaking surface on the broad side of the core instead of its narrow side, and the frequent use of a hard stone hammer, were possibly guided by specific techno-cultural norms structuring the production of these massive blanks. This hypothesis is further supported by the lack of lamellar production at Maisières-Canal, whether at the end of the laminar reduction process or by a dedicated operational scheme. In consequence, bladelets are nearly absent from the tool-kit at this site (Fig. 11). This absence is especially striking since bladelet production is a widespread technical phenomenon in the Early Upper Palaeolithic of Western Europe (Le Brun-Ricalens, 2005; Goutas et al., 2011; Roussel, 2011). One should also stress that the lack of

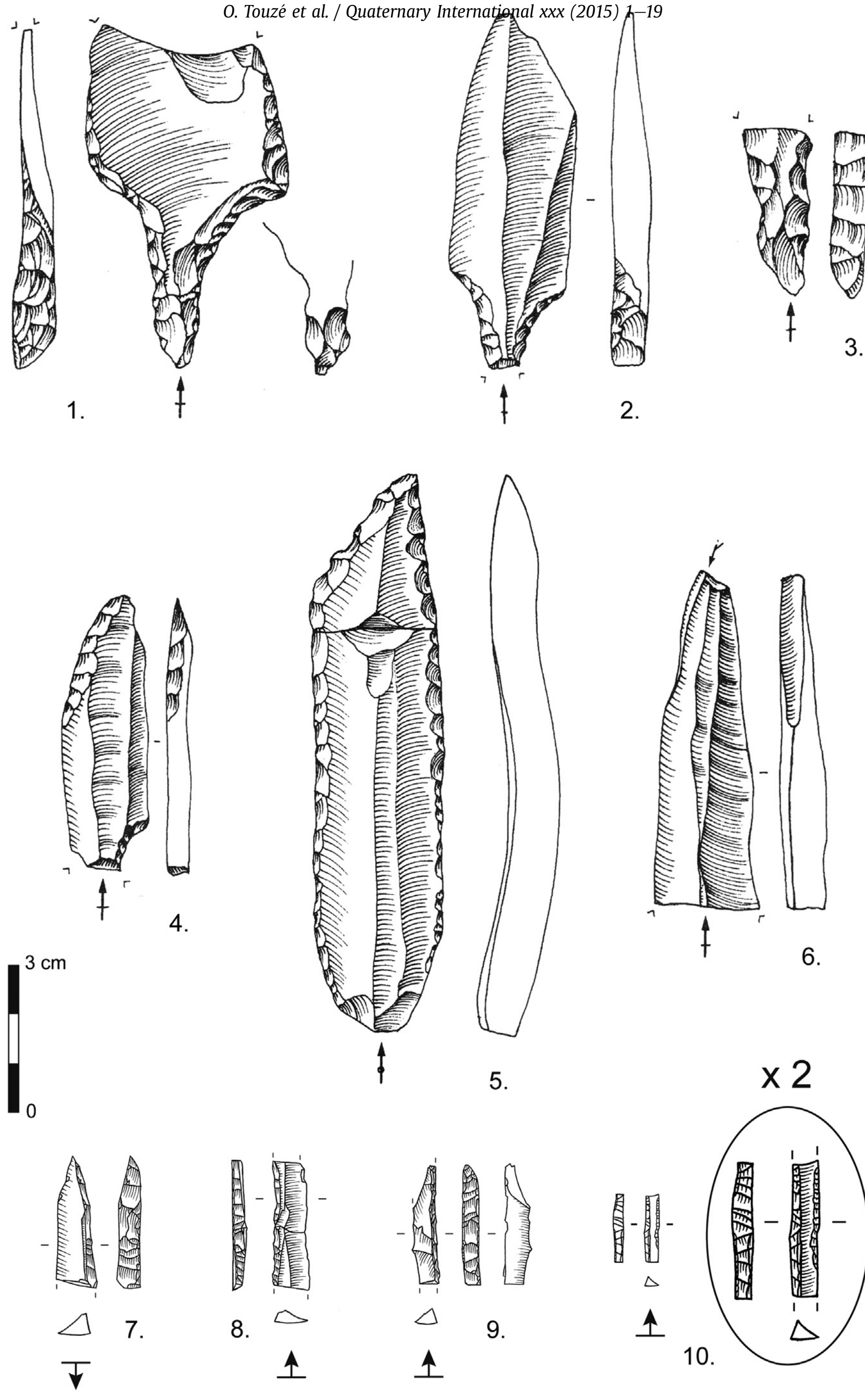


Fig. 10. Station de l'Hermitage — 1–2: tanged tools, 3: broken tang, 4: shouldered tool, 5: pointed blade, 6: burin, 7: microgravette point, 8–9: undefined micro-backed pieces, 10: undefined nano-backed piece (1–6 by M. Otte; 7–10 by O. Touzé).

lamellar production at Maisières-Canal does not result from a bias created by excavation methods, since micro-*débitage* is well attested in the industry by very numerous burin spalls. At Station de l'Hermitage in contrast, the intention focused on the production of lighter, narrower (Figs. 12–13) and regular blades, and also regular bladelets that were partly obtained by burin-core type production. Just as for the tool-kit, these technical choices seem to appear more typical of the Gravettian period.

One should, moreover, note the differential use of more discrete technical gestures, especially the *tranchet* blow technique which is attested at Maisières-Canal but has not been identified at Station de l'Hermitage. This very specific type of retouch is also almost unknown outside north-western Europe, where it may be found only at La Ferrassie in south-western France (Le Mené, 1999). This leads to questions regarding the variability of the “Font-Robert” type as tanged points can display technical as well as morphological differences from one Gravettian site to another. The extent of this variability remains to be assessed by new studies, and is part of doctoral research currently in progress by one of us (O. T.).

Finally, the raw material supplies appear difficult to compare, in particular because of the current state of research at Station de l'Hermitage. The available data show that this site has greater raw material diversity than Maisières-Canal. Also, the procurement area at Maisières is mostly concentrated in the Mons Basin, not more than 10 km maximum from the site itself (Moreau et al., 2013). At Station de l'Hermitage, some raw material types, such as the “black

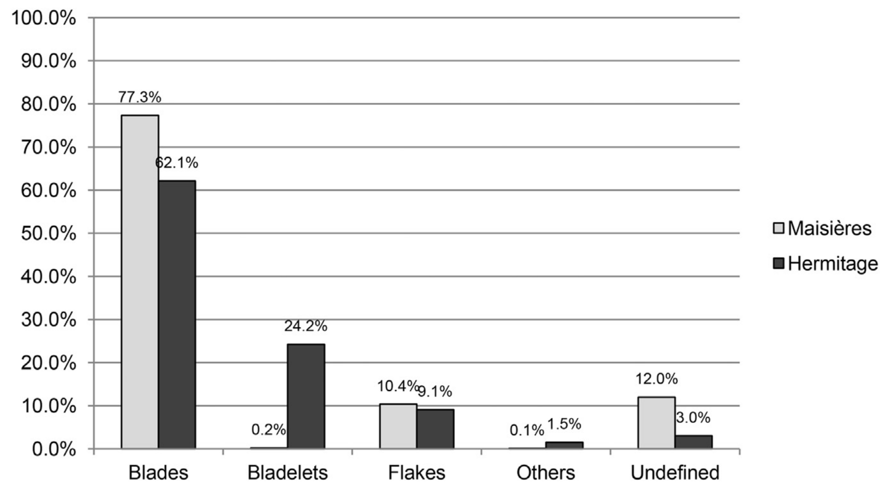
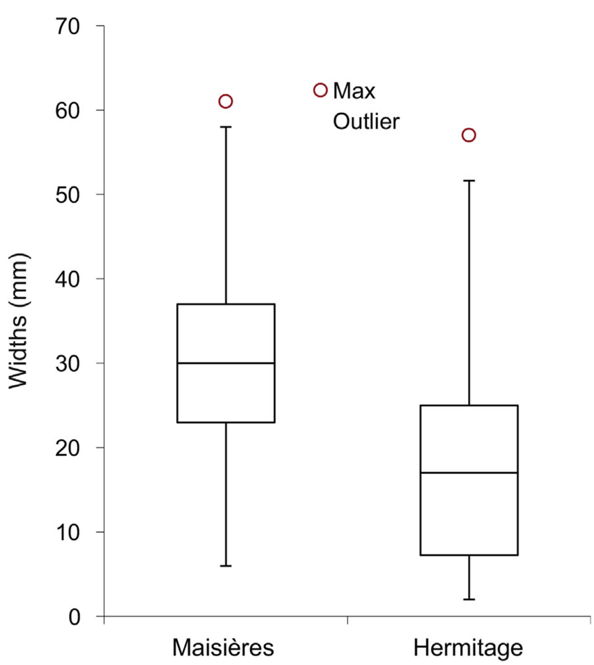
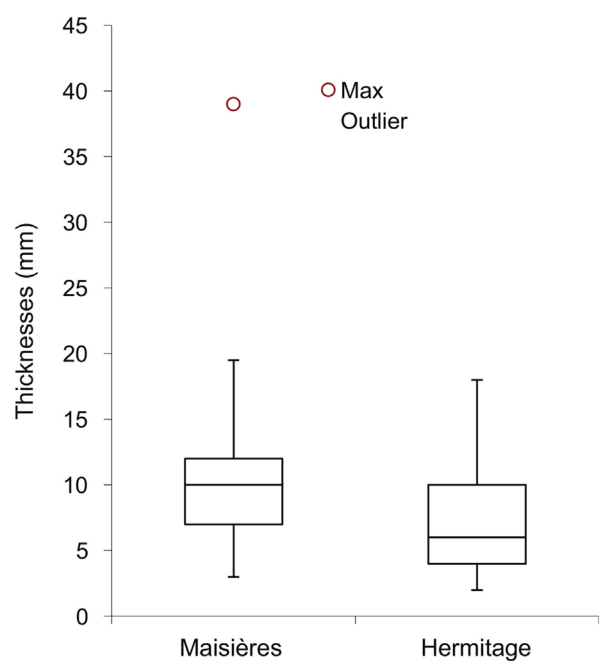


Fig. 11. Categories of blanks transformed into tools.



Labels	Maisières	Hermitage
Min	6	2
Q_1	23	7,25
Median	30	17
Q_3	37	25
Max	61	57
IQR	14	17,75
Upper Outliers	1	2
Lower Outliers	0	0

Fig. 12. Widths of blanks transformed into tools.



Labels	Maisières	Hermitage
Min	3	2
Q_1	7	4
Median	10	6
Q_3	12	10
Max	39	18
IQR	5	6
Upper Outliers	5	0
Lower Outliers	0	0

Fig. 13. Thicknesses of blanks transformed into tools.

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flint" and the "brown flint with yellow bands" are probably exogenous to the Hesbaye region. But new research remains to be undertaken in order to obtain a more comprehensive and comparative view of raw material procurements at both sites.

In conclusion, the lithic production strategies at these two sites show different norms and intentions regarding operational schemes and tool-kits. Given this divergence, it thus seems probable that the Gravettian lithic industries of Maisières-Canal and Station de l'Hermitage belong to two distinct lithic technical systems.

5. Discussion

At least two hypotheses can be proposed to explain such a difference in industries both belonging to an early phase of the Gravettian. The first addresses the chronological factor. As has been previously mentioned, the Maisières-Canal settlement is firmly dated around 28 000 uncal BP and correlated by Paul Haesaerts with the Maisières interstadial (GIS 5). According to his work, the Gravettian occupation at Station de l'Hermitage is likely to be more recent as it can be linked with the first silty deposits of the Upper Pleniglacial around 26 000 uncal BP. Although radiocarbon dating proves imprecise at l'Hermitage, the result of 26 300 ± 350 BP (OxA-3886) obtained on bone collagen could support this lithostratigraphic interpretation. A significant chronological gap thus separates the Gravettian settlements of both sites. One can therefore propose that the differences observed in the lithic technical systems may be the consequence of an evolution of technical norms and practices through time.

The second hypothesis proposed is also based on these two aspects – technical differences and the chronological gap separating Maisières-Canal and Station de l'Hermitage. The originality of Maisières-Canal industry in the Gravettian period has long been emphasized. De Heinzelin (1973) suggested that its singular characteristics allow recognition of a specific facies of the Gravettian. Though initially called "Périgordien hennuyer" by de Heinzelin, this facies was finally named "Maisierian" after a suggestion by Campbell (1980). Several authors have discussed the relationship between the Maisierian and the Gravettian. Some, like Campbell (1980, 1986) and Dewez (1989), see the Maisierian as a particular culture while others (Schmider, 1971; De Heinzelin, 1973; Otte, 1976, 1979) interpret it as a component of the Gravettian entity. However, differences reported between the lithic industry at Maisières-Canal and that at Station de l'Hermitage, which has typical Early Gravettian features, ultimately enhance the originality of the former. However, the particular features encountered at Maisières are not entirely specific to this site. Indeed, in recent years, Maisierian typological components have been identified in the mixed Gravettian assemblage of Spy Cave in Belgium (Pesesse and Flas, 2013), and also at Le Cirque de la Patrie in northern France (Touzé, 2013). England and Wales have yielded possible Maisierian markers as well (Jacobi et al., 2010), but find-spots, like the two previous sites, are unfortunately poorly documented. The existence of multiple sites concentrated in north-western Europe yielding traces of Maisierian industries suggest that the Maisierian is an original technical tradition rather than a simple epiphenomenon of the Early Gravettian. Based on data collected at the eponymous site, this tradition would be present around 28 000 uncal BP, after the Aurignacian – a fact demonstrated at Maisières-Canal (Miller et al., 2004a,b) – and prior to the Gravettian. The development of new technical systems between the end of the Aurignacian and the beginning of the Gravettian have already been established for southern France (Pesesse, 2008a,b, 2010). The Maisierian could then represent their northern counterpart, and would therefore reflect one of the many paths taken by post-Aurignacian societies during the developmental process of cultural traits that we label today as "Gravettian".

The relationship between the Maisierian and Early Gravettian industries is especially difficult to tackle, however, given the absence of a well-documented stratigraphic sequence yielding both kinds of assemblages. One should nonetheless emphasize the fact that tanged pieces were found both at Maisières-Canal and Station de l'Hermitage. This situation may be of some significance since this type of artefact is uncommon in the Gravettian and only appears within a particular spatiotemporal framework. Bipolar production, the use of soft stone hammers and the presence of backed pieces are also elements that are equally attested in these sites, even if the latter are rare and atypical at Maisières. In consequence, the Maisierian appears clearly closer to the Early Gravettian than to the Aurignacian. This observation is also confirmed by the analysis of the Aurignacian lithic set uncovered at Maisières-Canal (Flas, 2004; Flas and Jacobs, 2004; Miller et al., 2004a,b), which shows no similarities to the Maisierian material.

6. Conclusion

In conclusion, the Early Gravettian period (~28 000–26 000 uncal BP) in Belgium is characterized by an evolution of the lithic technical system, demonstrated by the analysis of lithic assemblages from Maisières-Canal and Station de l'Hermitage. This evolution affects both the tool-kit and operational schemes and highlights modifications of technical norms during the time-gap separating these sites. In addition, these modifications are sufficiently significant to hypothesize that Maisières and l'Hermitage produced lithic assemblages that did not belong to the same technical tradition. Indeed, while l'Hermitage shows common Early Gravettian features, Maisières, on the contrary, shows original characteristics that likely reflect an original tradition. The Maisierian thus appears as an entity defined on a specific lithic technical system which succeeded the Aurignacian in north-western Europe, and preceded the development of Gravettian type-industries. Due to the lack of well-documented occupations, the Maisierian is still poorly known even though it has been successfully identified in several deposits. The discovery of new stratigraphic sequences that include Maisierian and Early Gravettian occupations – a situation that might have existed at Spy Cave – could allow further investigations on the relationship between these traditions, and consequently on the genesis of the Gravettian in north-western Europe.

Acknowledgments

The authors thank Ivan Jadin and the staff of the Royal Belgian Institute of Natural Sciences for providing access to the material. Olivier Touzé also thanks Jean-Luc Schütz who provided access to the material of Station de l'Hermitage at the Grand Curtius Museum, and Paul Haesaerts and Guy Destexhe for very helpful discussions. Many thanks are due to Rebecca Miller and Carlotta Tavormina who helped to significantly improve the quality of the English. We also thank the two anonymous reviewers for their helpful comments. Finally, we thank György Lengyel and Jaroslaw Wilczyński for organizing the session « *The lithic issues of the Gravettian* » at the 17th UISPP congress.

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Please cite this article in press as: Touzé, O., et al., Technical diversity within the tanged-tool Gravettian: New results from Belgium, Quaternary International (2015), http://dx.doi.org/10.1016/j.quaint.2015.11.034