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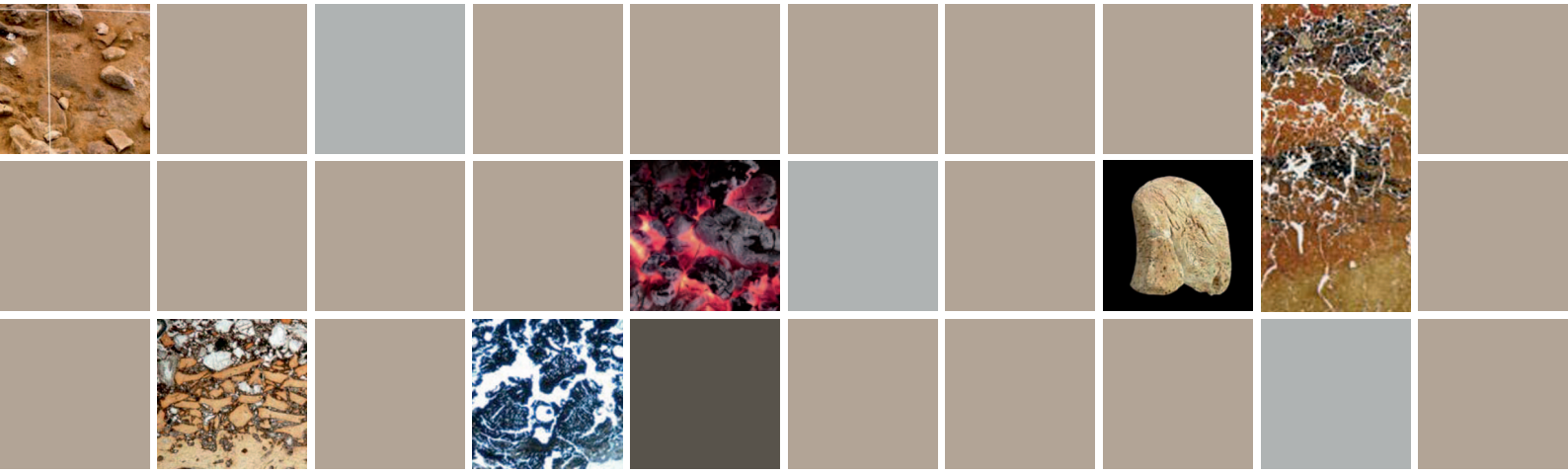
# THE TAPHONOMY OF BURNED ORGANIC RESIDUES AND COMBUSTION FEATURES IN ARCHAEOLOGICAL CONTEXTS



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## Translation
Magen O'FARRELL

## Layout
Yann BELIEZ

## Cover
Fabien TESSIER

***The contributions should be addressed to:***

REVUE P@LETHNOLOGIE
Vanessa LEA, Research associates

TRACES - UMR 5608 of the CNRS
Maison de la recherche
5 allées Antonio Machado
31058 Toulouse cedex 9, FRANCE

Phone: +33 (0)5 61 50 36 98
Fax: +33 (0)5 61 50 49 59
Email: vanessa.lea@univ-tlse2.fr

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# CHRONOLOGICAL SIGNIFICATION OF LBK WASTE ASSEMBLAGES: THE CONTRIBUTION OF ANTHRACOLOGICAL, TYPOLOGICAL AND STRATIGRAPHIC DATA FROM THREE LBK SITES IN THE HESBAYE (LIÈGE PROVINCE, BELGIUM)

Dominique BOSQUET, Aurélie SALAVERT & Mark GOLITKO



**Abstract**

Considerations on the chronological signification of Linearbandkeramik (LBK) waste assemblages are presented in this study based on data from anthracology, ceramic seriation and vertical distribution of pottery in pits. Interesting evidence concerning the occupation chronology is provided and a more complex vision of LBK refuse disposal is proposed than that generally accepted. In particular, it is argued that pits, as they appear today to archaeologists, represent no more than a few years of use. It is likely that refuse was first dumped in surface middens, and gradually displaced afterwards to the pits we excavate today.

**Keywords :** LBK in the Hesbaye (Liège, Belgium), chronology, anthracology, pottery analysis, taphonomy, waste disposal

## Introduction

This article presents some thoughts on the crucial question of the chronological significance of Linearbandkeramik (LBK) waste assemblages. It is mainly based on the ongoing study of the pottery and charcoal at several LBK sites in the Hesbaye area (Belgium), but the questions considered and the lines of thought suggested far exceed this regional context. It follows a recently published work on the dynamics of the establishment of the first Neolithic groups in this region of Belgium, which led to the discovery of a pioneer phase during its settlement around 5000 BC (Bosquet *et al.,* 2008; Salavert, 2008). These results were themselves based on a comparison of typological and anthracological data, the latter appearing to be an element able to reliably support the relative chronology since observations were repeated on several sites presenting a similar spatial organisation (Salavert, 2008). During the presentation of these works at the Naumur Conference in November 2006, an important question was raised concerning the ceramic corpus: decorated vessels originating from a single pit covered virtually all of the styles recognised for the Belgian LBK and the Dutch Limbourg, or the equivalent, according to I. Jadin (2003), of 150 to 200 years of occupation (cf. § 2). How can we explain this fact, which is, moreover, repeated in other structures and at other sites, given that it is difficult to imagine pits in continuous use for such a duration?

In Belgium, all of the material used in absolute or relative dating originates from hollow structures—mainly pits, but also ditches and, very rarely, postholes—whether or not they are associated with houses and with the exception of burials, which are practically absent from the area. Strangely, even though the chronology is based on the study of their content, questions such as those related to the duration of the use of these pits, the stratigraphic distribution of the material they contain and the general organisation and taphonomy of the waste, are very rarely discussed, if at all. In the same manner, questions related to the management of waste by Neolithic people have been infrequently raised up to now. Some authors have nonetheless examined these issues (David and David-Hennig, 1971; Rulf, 1986; Pavlu, 1986; Kreuz, 1990a, 1990b; Staüble, 1990, 1997; Pavlu, 1998; Last, 1998; Pavlu, 2000; Birkenhagen, 2003; Staüble, 2005; Kreuz, 2007), and highlight various methods of disposal of pottery containers (Last, 1998) or a link between various types of fill and their content in vessels (Rulf, 1986; Last, 1998). Others conclude that the pits were in short-term use (Staüble, 1990, 1997, 2005) or that they were used prior to and alongside the construction phase of houses without continuing throughout their occupation (Birkenhagen, 2003; Kreuz, 2007). Concerning waste management and the use-life of pits in the LBK, it generally seems that the situation is quite variable from one site to another and certainly complex (Last, 1998). Yet within the scientific community, the idea persists that as soon as everyday objects became useless they were immediately and casually thrown into the pits bordering the dwellings, to the extent that one assumes that the duration of use of these structures corresponds more or less to the duration of occupation.

The study presented here agrees with the previous results, which tend to show that the management of waste by Neolithic people was more complex. In particular, we can argue that the assemblages as they come to us today correspond to a relatively short period of occupation (a few years at most) of the houses on these sites. If such is the case, the reconstructed assemblages correspond not to the duration of the occupation, but rather to the state of the corpus at the moment of disposal.

## LBK chronology: basic principles

The chronology of the LBK is based on two types of data:

- 1. Radiometric dating, which provides absolute dates with very approximate accuracy, in particular for the period corresponding to the Hesbayen LBK,

for which the calibration curve is affected by a marked plateau (Jadin, 2003, fig. 1).

- 2. The analysis of part of the archaeological material, mainly the decorated pottery, leading to the division of the LBK period into a certain number of successive phases of which the number varies depending on the author and the region. An equal duration is arbitrarily attributed to each of the phases, since the lack of precision of C14 prevents the reliable determination of their duration as an absolute value. The scientific community admits the imperfection of the system but has none better to suggest at present. The Hesbayen LBK period thus covers approximately 200 years, between 5150 and 4950 BC (Jadin, 2003) and divides, according to Modderman's (1970) typology, completed by Jadin (2003), into two periods of three and five phases respectively, or eight in total, each phase assumed to last around 25 years.

The decorative repertoire on which Modderman's chronology is based includes 33 principal or secondary patterns, which, according to their position on the containers, are also considered as discriminating factors in chronological terms. Nearly all of these patterns cover several of the eight identified phases, so the presence of one single pattern only rarely permits the attribution of the vessel to a single phase. Most often, only associations of pattern and form permit the narrowing of the typo-chronological window to a few phases, or even to one phase in some cases.

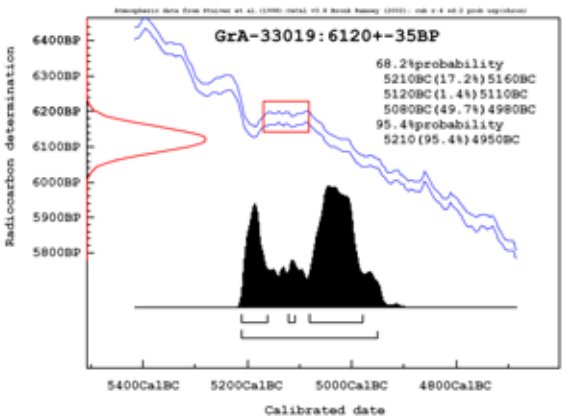


**Fig. 1** - Fexhe-le-Haut-Clocher «Podrî l'Cortri». Radiocarbon date obtained on hazelnut tree bark, showing the plateau effect on the calibration curve (red box).

## Context of the study

The study presented here is based on the analysis of nine pits divided between the sites of Remicourt «En Bia Flo» II (seven pits) and Fexhe-le-Haut-Clocher «Podrî l'Cortri» (two pits), excavated by the Walloon Region in collaboration with the Belgian Royal Institute of Natural Sciences along the TGV route 25 km to the west of Liège (Bosquet *et al.*, 2004) and a ditch excavated at the site of Waremme "Longchamps" on several occasions between 1988 and 2005 (Keeley *et al.*, 2005). The common feature of these structures is their production of both charcoal and decorated pottery, which is not always the case for pits. This contribution constitutes part of the publication of these sites in the form of multidisciplinary monographs.

## Field methods

After drawing a plan at 1:50, the pits are excavated in squares in arbitrary levels of 10 cm. The archaeological material is labelled and packaged as it is discovered. During this operation, if concentrations of charcoal are encountered, they are removed immediately, like the other objects. Once the base of the structure is reached, the sections are carefully cleaned and photographed. The layers that comprise the fill are then highlighted with a stroke of the trowel and the section is drawn at 1:10 on graph paper.

The layers to be sampled are then selected according to various criteria, most often in collaboration with palaeoenvironmental specialists and are removed almost in their entirety in plastic bags for laboratory analysis. Each sample is indicated on the site plan at 1:10 and photographs of details are taken if necessary.

This method permits an excavation that is both rapid—a fundamental criterion in the rescue context—and that presents a sufficient degree of precision when situating the objects and samples stratigraphically (cf. § 7.4.3).

## Laboratory methods

### *Pottery*

After cleaning, each pottery sherd is marked (Site/pit/square/depth). The fragments are then attributed to a particular vessel on the basis of reconstructions, but also, when this is not possible, on the basis of technological criteria: decoration, clay, rim form etc. Thus, for each pit, a variable number of sherds cannot be reliably attributed to one or other vessel and are excluded from the final count. Next, the sherds of each vessel are numbered. The list by sherd notes, in addition to the provenance (Site/pit/square/depth/layer/vessel), the size of the fragment in cm² (cf. § 6).

It is important to make clear that the excavation method using arbitrary 10 cm levels does not allow the immediate attribution, in the field, of each sherd to one of the stratigraphic units representing successive waste episodes. The sherds are thus associated *a posteriori* with one of these layers by positioning them on the section drawings according to the excavation square and depth of discovery noted on the sherd. Clearly, this method implies a certain degree of inaccuracy, particularly for the non-horizontal layers covering all or part of the depth of the pit, but it appears that this case is quite rare and that it is more often possible to attribute the fragments accurately to a particular waste layer.

### *Charcoal*

As the sediments removed during excavation were very clayey, samples were placed in an oven for 24 hours at 50 °C in order to dry the sediment and thus to facilitate its dispersion. They were then dispersed in a basin of water and sieved, also in water, with a 250 µm mesh. As a result, fragmentation of the material due to manual pressure is eliminated, since the charcoal is released easily from its silty matrix.

The charcoal was then fractured along three planes (transverse, longitudinal-tangential and longitudinal-radial) observed under a reflecting microscope and identified with the help of an identification atlas (Schweingruber, 1990) and reference collections from the IRNSB (Brussels) and the UMR 7041 (MAE, Nanterre, France).

## Questions related to the taphonomy and stratigraphic distribution of the archaeological material

An initial question is related to taphonomy: are there vertical displacements of objects preserved in the pits according to their size? One could imagine, for example, that a sherd of 1 or 2 cm² is more likely to fall down through a hole than a sherd of 20 cm², which would lead to a possible vertical distribution according to size, with a higher proportion of small objects found at greater depth. If this is the case, we must conclude that the disturbances of all sorts that occurred over thousands of years have introduced a serious bias in a stratigraphic interpretation based on the position of sherds or lithic objects implicated in the reconstructions.

Two other questions are centred on the stratigraphic and planimetric distribution of the archaeological material, which have been examined according to two criteria. Firstly, how are the components of reconstructed lithic objects, or the sherds belonging to reconstructed vessels, distributed between the pits and within each of them? Next, is there a vertical distribution of the pottery that is consistent with the typology? If, as one tends to think, the pits were gradually filled throughout occupation, one might expect some sort of logic in the content in terms of vessels in the layers that make up the fill: the sherds that comprise the identified vessels should be distributed somewhat horizontally, according to the arrangement of the waste layers, and one should find the older vessels more towards the bottom of the pit, while the more recent ones should be concentrated further up.

It should be noted at the outset that, no matter which site is considered, the pits in question here have all suffered an average erosion of 70 cm, a value that represents at least a quarter of the fill of the original structure, and up to two-thirds. It is therefore important to remember that the layers of the final period and of the abandonment of

the structures, together with the archaeological material that they perhaps contained, are today completely absent. There is also often, though not always, a link between the depth of the pits and the quantity of material collected during an excavation. That said, since all of the pits on all of the sites in the region have suffered this type of damage to a relatively constant degree (between 60 and 80 cm of erosion), one could reasonably consider that the contents of the pits of equivalent depth may be studied and compared without risk of introducing a major taphonomic bias into the results. All the more so because, as we shall see later, the waste management method seems to have been relatively constant from one site to another. Nevertheless, this erosion must of course be taken into account as a potential gap in our estimation of the duration of activities and occupations.

## The Remicourt «En Bia Flo» II site

### *Pits selected and quantity of material analysed*

This site, excavated on several occasions between 1997 and 1998, is located 25 km west of Liège, along the E40 Brussels-Liège motorway (Bosquet *et al*., 2004).
Pits 10 and 141, associated with the external house, and 90, 113, 160, 234 and 235, situated within the enclosure, were selected for this study (fig. 2). These structures produced 594 sherds belonging to 135 vessels, of which 116, decorated, could be situated in Modderman's (1970) chronology. A total of 1376 pieces of charcoal were collected. Whether external or internal to the village, the material analysed - sherds, lithic objects and charcoals - originate from two very different layer types.

### *Description of type 1 and 2 layers*

Type 1 layers (fig. 3, n° 1 to 6), present in six of the seven pits studied, share the following characteristics:
- these are layers with concentrated charcoal, around ten centimetres thick;
- they always lie near to or at the bottom of the pits;
- the only material present is charcoal with, in some cases, a few carpological remains and sparse fragments of burned earth;
- they most often contain a reduced number of taxa.

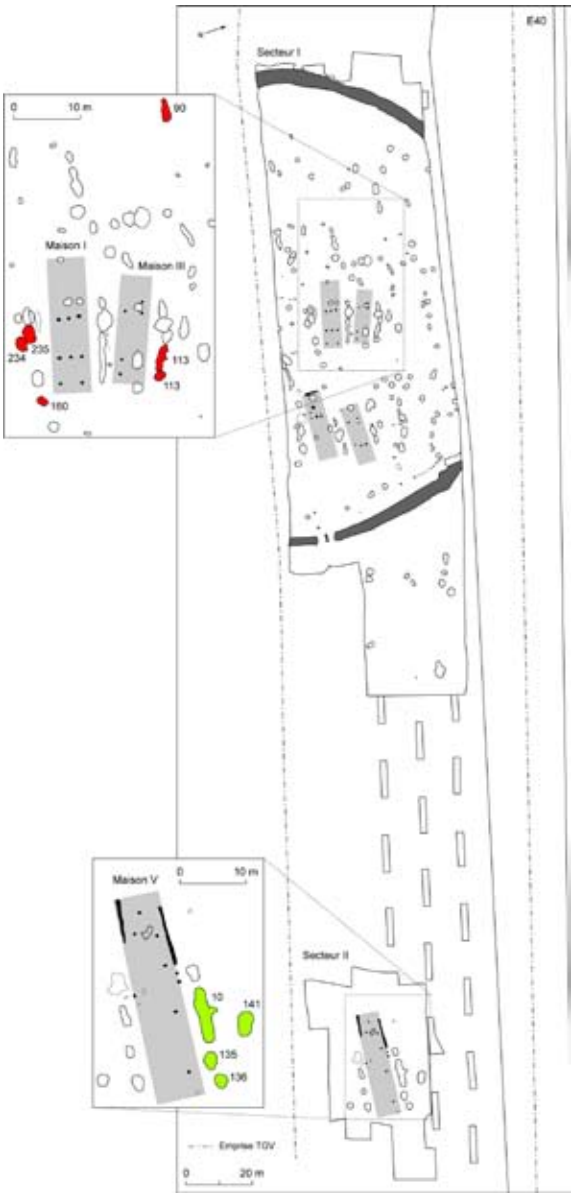


**Fig. 2** - Remicourt «En Bia Flo» II. Location of the studied pits on the excavation plan (pits 135, 136, see chapter 7.2.2).

Type 2 layers (fig. 3, n° 1 to 6), present in six of the seven pits studied, share the following characteristics:
- they contain all types of everyday waste (carbonised vegetable remains, pottery, lithics, fragments of reddened earth, etc.), present in highly-variable proportions and accumulated in thicknesses of between 20 and 60 cm. In certain cases it is possible to discern several sub-layers within type 2 layers (fig. 4), each probably corresponding to a waste episode;
- charcoals is found dispersed in the sediment;

- type 2 layers often occupy the upper half or two-thirds of the pit, sometimes more, not including the thickness truncated by erosion;
- they contain a relatively high number of taxa.

### *Stratigraphic relationship between type 1 and 2 layers*

In pits 10, 90, 160 and 234, where the two types of layer are present, two scenarios have been noted. Either a type 2 layer rests directly on the type 1 layer (fig. 3, n° 3 and 4), or there is a sterile fill layer between the two (fig. 3, n° 1, 2, 5 and 6).

Given the extent of erosive processes in a temperate climate on bare surfaces, Neolithic pits and ditches become filled naturally by collecting runoff mud or after the erosion and/or collapse of their walls as a result of weathering. A night of violent showers is sometimes sufficient to fill an excavation significantly (fig. 5); once again, this is a rapid phenomenon. An experiment recently carried out (Broes et Bosquet, 2007) showed that in one year a ditch became half-filled without any human intervention.

On the basis of these observations, we can say that where anthropogenic waste layers are in direct contact with each other, this means that the layers have quickly succeeded each other leaving no time for the natural filling process to develop. In the same way, given the rapidity of erosive phenomena, the presence of a sterile layer between two anthropogenic waste layers cannot be advanced as an argument to suggest a significant extension of the duration of use of the pits whose fill includes this type of layer. This is also true—and *a fortiori*—if the sterile layer indicates intentional filling carried out by Neolithic people with the aim, for example, of covering organic rubbish, probably regularly mixed with object debris.

### *Pottery*

#### Stratigraphic distribution of sherds according to their size

Given the numerous bioturbations present in Neolithic pits—resulting from several millennia of biological activity—it is reasonable to imagine that a certain number of objects, particularly the smallest, will have been affected by these essentially vertical movements. In order to test the hypothesis of a vertical classification of sherds according to their size, induced by natural phenomena, a diagram showing the relationship between sherd size and their discovery depth has been drawn up for each pit (fig. 6). These diagrams show without doubt that there is no link between the two parameters: sherds of all sizes are spread from top to bottom in the pit, in no particular order.

#### Reconstructions between pits

For the pioneer house, although the reconstructions between pits are still at a preliminary stage, three individual pottery vessels link pits 10 and 141 and five lithic reconstructions link these same structures and pits 135 and 136 (Allard, pers. com.). It is therefore reasonable to suppose that, at least in part, these pits were jointly utilized. The presence of fragments of an individual pottery vessel in several pits is also an indication that the vessel, once broken or judged unusable, was disposed of in different places and thus very probably at different times, without here prejudging the lapse of time between each of these disposals.

For the village, the reconstructions between pits have not yet been carried out.

#### Reconstructions by pit

For both the exterior and interior of the village, the analysis of the reconstructions from each pit clearly show that the sherds comprising an individual vessel are distributed throughout the whole depth of the fill, very often in several layers (fig. 7). This is also true for the lithic reconstructions carried out for the pits belonging to the external house. If, for reasons linked to the excavation technique, doubts may persist as to the attribution of certain sherds to one or another layer (cf. § 5.1), there is little room for discussion regarding the reconstructions linking objects originating from the top and the bottom of pits.

We thus realize that the question concerning the existence of a stratigraphic logic according to typology, with the oldest objects at the bottom of the fill and the most recent at the top, becomes irrelevant.

As with the vessels present in several pits, it seems that those present in one pit were also disposed of at several different times.


**Fig. 3** - - Types 1 (a) and 2 (b) layers and their organisation in some pits from Remicourt, with or without sterile layers (c).


**Fig. 4** - Remicourt «En Bia Flo» II. Type 2 layer (b) containing sub-layers (underlined in white) indicating several waste dumping episodes.


**Fig. 5** -Remicourt «En Bia Flo» II. The effects of one night of rainfall on an excavation square comparable to LBK pits: collapse of the vertical wall (a), erosion of the oblique wall and of the surface around the pit (colluvium).

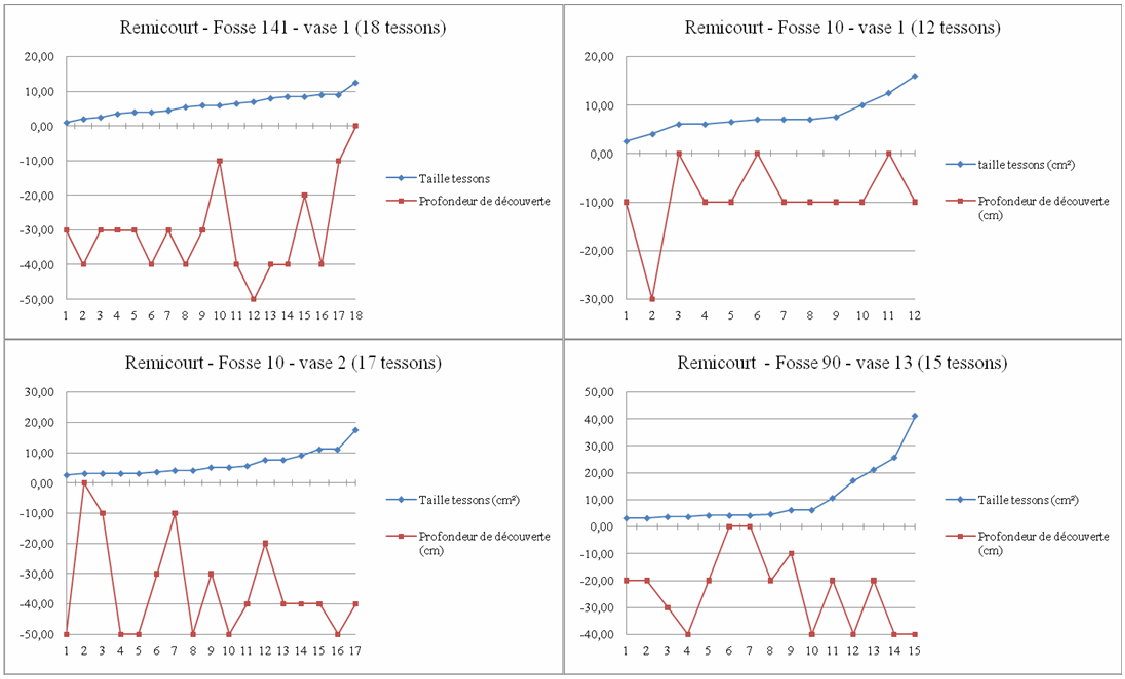


**Fig. 6** - Graphics showing the absence of correlation between sherd size and discovery depth (pits 10, 141 and 90 from Remicourt).

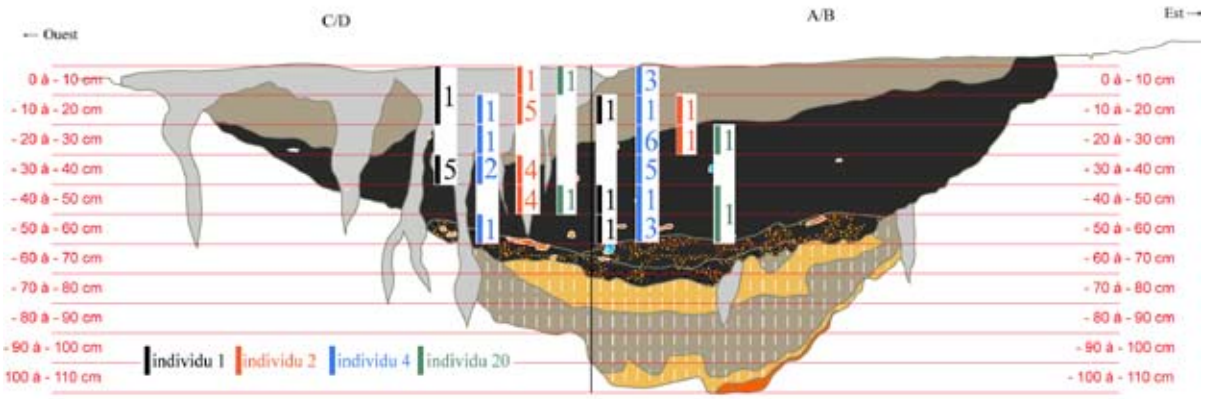


**Fig. 7** - Remicourt «En Bia Flo» II, pit 141. Vertical distribution of ceramic sherds from 4 vessels (the number of sherds is indicated beside the coloured rectangles). All the vessels are distributed across the two major waste layers (type 2 layers), over 60 cm maximum. Light beige, grey and orange layers at the bottom of the pit are sterile, while the brown layer with orange dots corresponds to one or several layers of hearth cleaning waste (type 1 layer). It should be recalled that the pit is affected by erosion of 40 to 60 cm.

## *Chronology*

### The pioneer house

Pits 10 and 141 produced respectively 35 and 25 decorated vessels likely attributable to Modderman's (1970) phases and periods. The summary table of the typological attributions for the two pits (fig. 8) shows above all that no individual vessel can be attributed to only one of the eight phases, each vessel covering at least two (2 cases out of 60) of them, or at most six (6 cases out of 60), and the majority covering five (32 cases out of 60).

In addition, the two pits present a very similar image: the individual vessels that one could consider as the oldest—two of which are located exclusively in period I—are considerably fewer in number than the more recent vessels. Amongst these latter, 29 vessels are located between Id and IId, and

| Fosses 10 et 141 - 60 individus (i) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Individus | Période I | | | Période II | | | | |
| | Ib | Ic | Id | IIa | IIb | IIc | IId | IId+ |
| i1 | x | x | x | | | | | |
| i2 | x | x | x | | | | | |
| i3 | x | x | x | x | | | | |
| i4 | x | x | x | x | x | x | | |
| i5 | x | x | x | x | x | x | | |
| i6 | x | x | x | x | x | x | | |
| i7 | x | x | x | x | x | x | | |
| i8 | x | x | x | x | x | x | | |
| i9 | x | x | x | x | x | x | | |
| i10 | | x | x | x | x | x | | |
| i11 | | x | x | x | x | x | | |
| i12 | | x | x | x | x | x | | |
| i13 | | x | x | x | x | x | | |
| i14 | | | x | x | x | x | x | |
| i15 | | | x | x | x | x | x | |
| i16 | | | x | x | x | x | x | |
| i17 | | | x | x | x | x | x | |
| i18 | | | x | x | x | x | x | |
| i19 | | | x | x | x | x | x | |
| i20 | | | x | x | x | x | x | |
| i21 | | | x | x | x | x | x | |
| i22 | | | x | x | x | x | x | |
| i23 | | | x | x | x | x | x | |
| i24 | | | x | x | x | x | x | |
| i25 | | | x | x | x | x | x | |
| i26 | | | x | x | x | x | x | |
| i27 | | | x | x | x | x | x | |
| i28 | | | x | x | x | x | x | |
| i29 | | | x | x | x | x | x | |
| i30 | | | x | x | x | x | x | |
| i31 | | | x | x | x | x | x | |
| i32 | | | x | x | x | x | x | |
| i33 | | | x | x | x | x | x | |
| i34 | | | x | x | x | x | x | |
| i35 | | | x | x | x | x | x | |
| i36 | | | x | x | x | x | x | |
| i37 | | | x | x | x | x | x | |
| i38 | | | x | x | x | x | x | |
| i39 | | | x | x | x | x | x | |
| i40 | | | x | x | x | x | x | |
| i41 | | | x | x | x | x | x | |
| i42 | | | x | x | x | x | x | |
| i43 | | | x | x | x | x | x | |
| i44 | | | | x | x | x | | |
| i45 | | | | x | x | x | | |
| i46 | | | | x | x | x | | |
| i47 | | | | x | x | x | | |
| i48 | | | | x | x | x | | |
| i49 | | | | x | x | x | | |
| i50 | | | | x | x | x | | |
| i51 | | | | x | x | x | | |
| i52 | | | | x | x | x | x | |
| i53 | | | | x | x | x | x | |
| i54 | | | | x | x | x | x | |
| i55 | | | | x | x | x | x | |
| i56 | | | | x | x | x | x | |
| i57 | | | | x | x | x | x | |
| i58 | | | | x | x | x | x | |
| i59 | | | | | | x | x | |
| i60 | | | | | | x | x | |

**Fig. 8** - Remicourt «En Bia Flo» II. Extra muros pits: decorated ware seriation.

17 others exclusively in period II, between IIa and IIc or d. For the two pits, we also note the total absence of phase IId+, characterised by pivoted comb patterns.

These typological characteristics permit the association of these pits with a transitional phase between the regional Middle and Late LBK.

### The village

The same table was created for the pits located inside the enclosure (fig. 9), comprising between 25 and 5 decorated vessels suitable for this purpose, out of a total of 56. Contrary to the observations for the pioneer pits, a majority of vessels may be attributed to a single phase (40 cases) while those covering from two to six phases are more rare (16 cases).

Once again, the oldest vessels are very clearly fewer in number than those attributed to later phases. As has already been indicated (Bosquet *et al.*, 2008), these pits correspond to the Late LBK period of the Hesbaye (IId), with a minor but clear presence of the final phase, IId+. The presence of a few vessels covering the same periods as those from the external pits allows for the possibility that, at least for a period, the two areas of habitation were jointly occupied.

| Fosses 90, 113, 160, 234 et 235 - 56 individus (i) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| individus | Période I | | | Période II | | | | |
| | Ib | Ic | Id | IIa | IIb | IIc | IId | IId+ |
| i1 | x | x | x | x | | | | |
| i2 | x | x | x | x | | | | |
| i3 | x | x | x | x | | | | |
| i4 | x | x | x | x | | | | |
| i5 | x | x | x | x | x | x | | |
| i6 | x | x | x | x | x | x | | |
| i7 | | x | x | x | x | x | | |
| i8 | | | x | x | | | | |
| i9 | | | x | x | x | x | | |
| i10 | | | x | x | x | x | x | |
| i11 | | | | x | x | x | x | |
| i12 | | | | | x | x | x | |
| i13 | | | | | x | x | x | |
| i14 | | | | | | x | x | |
| i15 | | | | | | x | x | |
| i16 | | | | | | x | x | |
| i17 | | | | | | | x | |
| i18 | | | | | | | x | |
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| i36 | | | | | | | x | |
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| i38 | | | | | | | x | |
| i39 | | | | | | | x | |
| i40 | | | | | | | x | |
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| i46 | | | | | | | x | |
| i47 | | | | | | | x | |
| i48 | | | | | | | x | |
| i49 | | | | | | | x | |
| i50 | | | | | | | x | |
| i51 | | | | | | | x | |
| i52 | | | | | | | | x |
| i53 | | | | | | | | x |
| i54 | | | | | | | | x |
| i55 | | | | | | | | x |
| i56 | | | | | | | | x |

**Fig. 9** - Remicourt «En Bia Flo» II. Intra- muros pits: decorated ware seriation.

### Duration of use of vessels and temporal inequality of typological phases

The typological analysis provides a decisive element in the context of the problem addressed: whichever pit or habitation zone is considered, the number of older vessels is always considerably less than that of those decorated with later patterns. This cannot be due to chance only since it is equally true for two pits analysed in the same way at the site of Fexhe-le-Haut-Clocher (Bosquet and Van Driessche, 2008).

Two possibly complementary phenomena explain this particularity in the typological composition of the assemblages: the use-life of the vessels and the unequal duration of the typological phases.

Various studies have been dedicated to the question of the use-life of pottery vessels in diverse ethnographic contexts (Mayor, 1994; Shott, 1996; Varien and Mills, 1997; Shott and Sillitoe, 2004), of which some (David and David-Hennig, 1971) were taken up by Last (1998) during his works on Miskovice. According to these studies, the use-life of vessels is very clearly linked to their size and thus often to their use. The oldest vessels are therefore large storage vessels, which are less mobile and thus less likely to be broken than cooking and serving vessels. For other vessel categories, the use-life varies in most cases between a few months and 15 years (Mayor, 1994; Shott, 1996, 476, table 5; Varien and Mills, 1997, 174-177, table A1), but small and medium vessels that are comparable in this respect to those studied here may sometimes significantly surpass these figures, being preserved for up to 50 years or more (Mayor, 1994, 192). In this context, we should recall that at the site of Fexhe-le-Haut-Clocher, some decorated vessels that had been entirely broken were repaired with birch bark tar by the Neolithic inhabitants (Bosquet *et al*., 2001).

The other element that may have an impact on the smaller number of older vessels is the unequal duration of the stylistic phases, the older phases having lasted for a shorter time. In support of this idea, one could consider the chronology of the sites of Darion "Colia" and Waremme "Longchamps" whose several phases of construction indicate the length of their occupation, but which have yielded only vessels attributed to period II, the vast majority being from IId and IId+ (Jadin, 2003).

## *Charcoal*

### Analysis of the taxa abundance in the type 1 and 2 layers of the pioneer house and the ditched village

In the pioneer pits (pits 10 and 141), two type 1 deposits and one type 2 deposit were considered (figs. 10, 11 and 12). They are each characterised by a low number of taxa and the exclusive presence of ash (*Fraxinus excelsior*), hazel (*Corylus avellana*) and oak (*Quercus* sp.). Only the latter is absent from the dispersed deposit in pit 10. Across the site, twelve taxa have been identified (Salavert, 2008), emphasizing the particularity of these taxa-poor *extra muros* deposits. Given the reproducibility of the results from one deposit type to another and from one pit to another, this cannot be due to the amount of charcoal analysed, nor caused by sampling bias (fig. 13).

In the village, the anthracological assemblage is much more diversified (fig. 14) than in the *extra muros* context. Ash, hazel and oak are included, together with Pomoideae (apple, pear, hawthorn and rowan family), elm(*Ulmus* sp.), willow/poplar (*Salix-Populus*), cherry/sloe (*Prunus* sp.), elder (*Sambucus* sp.), lime (*Tilia* sp.), buckthorn (cf. *Frangula* sp.) and maple (*Acer* sp.). The analysis is based on four type 1 layers and five type 2 layers. Among the type 1 deposits (fig. 10), three (pits 90, 160 and 235) are relatively poor in tree species, (three or four taxa) while another (pit 113) yielded a higher number of species (seven taxa). The type 2 deposits (fig. 11) generally contain five or more taxa. Only the deposit in pit 90 contains just two tree species, but the low number of charcoal pieces identified (N=16) explains this result. If we now compare all of the tree species identified in the type 1 layers with those of type 2 (fig. 12), we see that elm, buckthorn and maple are represented only in type 2 assemblages. However, the two latter taxa are rare at Remicourt and elm is not one of the dominant taxa. While each type 2 layer generally contains a higher number of tree species than each

COUCHES DE TYPE 1

| Structure | 10 | 141 | 90 | 113 | 160 | 235 |
|---|---|---|---|---|---|---|
| **Couche** | **1** | **4** | **2b** | **2** | **3** | **2** |
| **Profondeur en cm** | **40-60** | **70** | **60** | | | |
| Carré | A1B1 | B | | B2/1 | | A2/B2 et D/A1 |
| Poids non tamisé en kg | 2 | 4,4 | 0,52 | 1,252 | 0,651 | 1 |
| Poids charbons après tamisage en g. | 4,94 | 4,0698 | | 2,585 | 0,8569 | 0,349 |
| N° Inventaire | A1753 A1756 | A1807 | | A1788 | A 1769 | A1779 |
| Localisation des structures | *extra muros* | | *intra muros* | | | |
| **TAXONS** | | | | | | |
| *Quercus* sp. (fc) - Chêne | 11,4 | 3 | 79,54 | 53,78 | 64 | 84,61 |
| Pomoideae - Pomoïdées | - | - | 13,63 | 19,69 | - | 5,77 |
| *Fraxinus excelsior* - Frêne | 71 | 75 | 2,27 | - | - | 9,61 |
| *Corylus avellana* - Noisetier | 17,5 | 22,50 | 4,54 | 17,42 | - | - |
| *Ulmus* sp. - Orme | - | - | - | - | - | - |
| *Salix/Populus* sp. - Saule/peuplier | - | - | - | 3,03 | - | - |
| *Prunus* sp. - Merisier/prunellier | - | - | - | 0,75 | - | - |
| *Sambucus* sp. - Sureau | - | - | - | 0,75 | 36 | - |
| *Tilia* sp. - Tilleul | - | - | - | 4,54 | - | - |
| *Cf. Frangula* sp. - Bourdaine | - | - | - | - | - | - |
| *Acer* sp. - Erable | - | - | - | - | - | - |
| **Nombre de charbons** | **114** | **80** | **44** | **132** | **50** | **52** |

**Fig. 10** - Remicourt «En Bio Flo» II. Anthracological results (%) for type 1 layers (concentrated).

COUCHES DE TYPE 2

| Structure | 10 | 90 | 113 | 160 | 234 | 235 |
|---|---|---|---|---|---|---|
| **Couche** | **5** | **3** | **3** | **5** | **2** | **3** |
| **Profondeur en cm** | **20-30** | **30-40** | | | **couche sup.** | |
| Carré | A2 | A2/B2 | B2/1 | | A2/A3 | A2/B2 et D/A1 |
| Poids non tamisé en kg | 2 | 0,43 | 1,272 | 1,352 | 0,298 | 3 |
| Poids charbons après tamisage en g. | 6,104 | 0,9297 | 1,272 | 1,093 | 0,9386 | 1,17 |
| N° Inventaire | A1755 A1757 | A1805 | A1789 | A1768 | A1782 | A 1780 A 1781 |
| Localisation des structures | *extra muros* | | *intra muros* | | | |
| **TAXONS** | | | | | | |
| *Quercus* sp. (fc) - Chêne | - | 93,75 | 35,63 | 45,11 | 61,90 | 77,06 |
| Pomoideae - Pomoïdées | - | 6,25 | 14,94 | 49,62 | 23,80 | 8,71 |
| *Fraxinus excelsior* - Frêne | 72,27 | - | 2,29 | - | 8,33 | 0,46 |
| *Corylus avellana* - Noisetier | 27,72 | - | 10,34 | - | 4,76 | - |
| *Ulmus* sp. - Orme | - | - | 27,58 | 0,75 | - | - |
| *Salix/Populus* sp. - Saule/peuplier | - | - | 1,14 | - | - | 6,42 |
| *Prunus* sp. - Merisier/prunellier | - | - | 8,04 | 2,25 | 1,19 | 4,59 |
| *Sambucus* sp. - Sureau | - | - | - | 0,75 | - | 0,46 |
| *Tilia* sp. - Tilleul | - | - | - | - | - | 0,92 |
| *Cf. Frangula* sp. - Bourdaine | - | - | - | 0,75 | - | 1,38 |
| *Acer* sp. - Erable | - | - | - | 0,75 | - | - |
| **Nombre de charbons** | **101** | **16** | **87** | **133** | **84** | **218** |

**Fig. 11** - Remicourt «En Bia Flo» II. Anthracological results (%) for type 2 layers (dispersed).

| Localisation des stuctures | *Extra muros* | | *Intra muros* | |
|---|---|---|---|---|
| **Types de couches** | **TYPE 1 (concentrées)** | **TYPE 2 (dispersées)** | **TYPE 1 (concentrées)** | **TYPE 2 (dispersées)** |
| **Nombre de structures** | **2** | **1** | **4** | **5** |
| Poids non tamisé en kg | 6,4 | 2,4 | 3,4 | 6,4 |
| Poids charbons après tamisage en g. | 9 | 6,1 | 3,79 | 5,4 |
| **TAXONS** | | | | |
| *Quercus* sp. (fc) - Chêne | X | - | X | X |
| Pomoideae - Pomoïdées | - | - | X | X |
| *Fraxinus excelsior* - Frêne | X | X | X | X |
| *Corylus avellana* - Noisetier | X | X | X | X |
| *Ulmus* sp. - Orme | - | - | - | X |
| *Salix/Populus* sp. - Saule/peuplier | - | - | X | X |
| *Prunus* sp. - Merisier/prunellier | - | - | X | X |
| *Sambucus* sp. - Sureau | - | - | X | X |
| *Tilia* sp. - Tilleul | - | - | X | X |
| *Cf. Frangula* sp. - Bourdaine | - | - | - | X |
| *Acer* sp. - Erable | - | - | - | X |
| **Nombre de charbons** | **194** | **101** | **278** | **538** |

**Fig. 12** -Remicourt «En Bia Flo» II. Comparison of taxonomic lists (X = presence, - = absence) between the two layers types in the two zones (extra and intra muros).

type 1 layer, the list of taxa identified for each type is fairly homogenous. It therefore appears, at this stage of analysis, that the determining factor in the abundance in taxa in the samples is their *intra muros* or *extra muros* location, once sample size has been accounted for. The deposit type is of only secondary significance in explaining taxa abundance. Based on this analysis, it is possible to consider the possible causes for the number of taxa, their nature and proportions in the samples.

### *What time-span, what environment type and what activities can the intra and extra muros pits indicate?*

#### Basic principles

When an anthracological assemblage contains a low number of taxa, the deposit may potentially correspond to one or two collections of firewood, particularly if the sample originates from contexts rich in charcoal. On the contrary, waste deposits accumulated over time are more appropriate contexts for suggesting palaeoenvironmental interpretations since they are likely to represent several collections of firewood (Chabal, 1994, 1997). Starting from these basic principles, several questions arise: what information in terms of occupation duration can be extricated from the analysis of the taxonomic abundance of type 1 (concentrated in charcoal) and type 2 layers (dispersed) and—in terms of the differences observed in the anthracological assemblages of the pioneer house and the ditched village—what were the woodland types exploited, how did they develop and which activities do they indicate?

#### Waste duration

The type 1 layers, whether *intra* or *extra muros* and characterised by a major concentration of charcoals have, in four cases (*intra muros* pits 10 and 141; *extra muros* pits 160 and 235), low or somewhat low taxonomic diversity in terms of the number of charcoal pieces analysed (fig. 13). For the *extra muros* pits, we have seen the link between this lack

of diversity and their situation in the pioneer house, whatever the deposit type (cf § 7.5.1). For the pits in the village, their concentrated nature is involved. We can estimate that deposits of type 1 in pits 160 and 235 (*extra muros*) represent a rapid waste episode with a very short timescale, particularly as the waste is fine, regular and there is no archaeological material. However, the type 1 waste of pits 90 and 113 (*intra muros*) have an increased taxa abundance when compared with the amount of charcoal analysed (fig. 13). Not all of the concentrated deposits are taxa-poor. This demonstrates a classic anthracological observation: it is highly likely that concentrated charcoal deposits (such as hearths) reflect a short activity duration (with few taxa represented),but they may also prove to be abundant, and thus represent a certain number of collections, sufficient to result in reasonable representation of the firewood used over time.

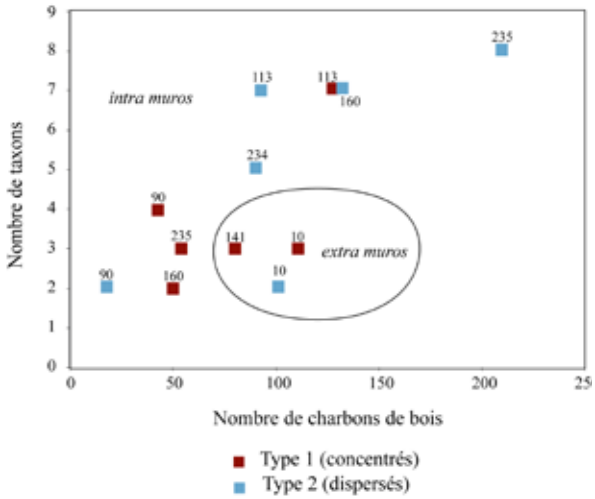


**Fig. 13** - Remicourt «En Bia Flo» II. Number of taxa in comparison with the number of pieces of charcoal analysed for each sample. We note that in the extra muros pits, the low number of identified taxa is not linked to a methodological problem as the phenomenon appears in the three features and, in addition, for a comparable amount of charcoal analysed in the intra muros pits, the number of taxa is higher. Finally, the type 1 layers (in red) are in general poorer in taxa (up to 4) than those of type 2 (in blue).

Being characterised by a dispersion of charcoal, the type 2 layers in the village have a high taxonomic diversity. It is thus possible to estimate based on anthracological analysis that these deposits represent a longer time-span than the type 1 layers, particularly as the waste is thick and contains a varied archaeological material. In addition, spatial analysis of the pottery indicates that it is likely that a few years were required to accumulate these detritus layers.

As we saw in § 7.5.1, if the spatial analysis of the pottery and lithic material is to be believed, a diffuse *extra muros* deposit (pit 10), while representing the same use-duration as in the interior of the village, presents a dearth of taxa comparable to that of the concentrated layers.

This taxonomic difference between the diffuse *extra* and *intra muros* layers cannot be explained by the duration of the waste episodes, but by the close link between certain activities carried out by the LBK people and the diversity of the environment and its development. This link is a function either of the spaces occupied or of the occupation phases, whether pioneer or principal.

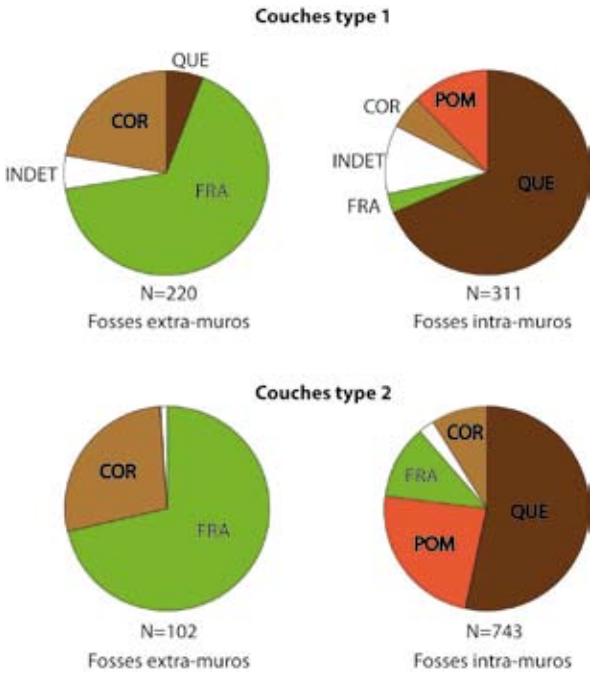


**Fig. 14** - Remicourt «En Bia Flo» II. Anthracological spectra: on the left results from the two extra muros pits, on the right spectrum from intra muros pits. In the latter case, only major taxa present in the village are represented (Salavert, 2008), in order to illustrate the transition from ash, which dominates in the extra muros area, to oak dominating intra muros.

### Ecology and development of the environment

In the three deposits studied in the extra muros pits, ash dominates significantly (more than 70%), followed by hazel (between 17 and 27%) and oak (between 3 and 11%), present only in the two deposits concentrated in charcoal. Ash is a heliophilous taxon adapted to humid edaphic conditions. At Remicourt, the village was established at the base of the slope, immediately adjacent to the bottom of the «valley of Bia Flo». It is difficult to know with certainty whether at that time a watercourse ran at the bottom of the valley in question, but it is very possible that the «pioneers» would have exploited the banks of the watercourse in order to bring the future village closer, as well as providing accessibility to the banks for the creation of fields and pastures for domestic animals. The presence of hazel, which is adapted to the shade of underbrush and also develops in hedges and the edges of woods on fertile soils, indicates the presence of woodland openings, perhaps maintained by the Neolithic people.

In the village, oak and the Pomoideae also dominate the assemblages by some margin. These are two heliophilous tree species that tolerate half-shade (Rameau *et al.*, 1989). Oak develops in copses on flat land and Pomoideae prefer woodland margins and hedges. In these formations, they can be accompanied by a great number of tree species (Bissardon *et al.*, 1997) such as Prunoideae, elder, elm, maple and hazel, all present in the *intra muros* assemblages. It thus seems that the inhabitants of the village exploited the mature woodlands as much as their margins, but were not particularly limited by watercourses and diversified their collections compared to the inhabitants of the first occupation.

### Woodland resource management

In general, we should consider two activity types that are linked to the occupation period:

1. Clearance: deforestation is aimed both at creating open spaces and obtaining tree-trunks in the first phases of an occupation. It provides:

- timber comprising high forest species used for construction and rope (bark), or other carpentry elements;
- wood suitable for wattle, particularly taxa such as hazel;
- waste wood for use as fuel.

2. The everyday exploitation of fuel for use in various hearths linked to daily and craft activities, having taken place before, during, and after, the clearances and the construction of buildings.

While some selection of species is probable for construction purposes, it is generally recognize that for the supply of domestic hearths, most collection is more of an opportunistic nature. In collections specifically for fuel, the material «on hand» is used, or failing that, material that is available closer to home. For craft hearths, some selection is conceivable, though, at least from a strictly technical viewpoint, it is not really necessary, based on the ethnographic data and experiments devoted mainly to pottery firing.

If we apply these principles to the results obtained from Remicourt, it is tempting to see in the type 1 layers (concentrated charcoal) the waste from hearths fed to a large extent with construction waste, since the tree species usable for this purpose dominate significantly (ash and oak), whether outside or inside the village. The fact that these layers are consistently found close to the bottom of the pits, i.e., associated with the start of digging, reinforces this hypothesis. The *intra muros* presence, in two concentrated deposits, of Pomoideae, a taxa *a priori* inappropriate for construction, particularly in the case of hawthorn (although possible if rowan), does not contradict this idea; it simply illustrates the fact that hearths maintained during the construction of the houses were not exclusively fed with waste products.

The composition of the *intra muros* type 2 diffuse layers that contain a diversified number of taxa corresponds well to the idea we have of opportunistic collections carried out over a certain period. However, this is not the case with the only *extra muros* diffuse layer (pit 10), which does not show any taxonomic development in comparison with type 1 layers, even though it accumulated during a time span equal to that of the *intra muros* diffuse layers (cf. § 7). At least two explanations are possible. This may also be an opportunistic collection, but in an environment that was still little modified since

the construction of the first house, so that, whatever the use—fuel or construction—the species are the same, and the wood is taken from the dominant species. This is not to say that other species, including Pomoideae, are not already present, but rather that they do not dominate sufficiently to be included in opportunistic collections. According to another hypothesis, this may indicate collection linked to a specific activity. Clearances immediately come to mind, which one can easily imagine to be one of the main tasks of the first colonists. While ash is not very resistant to insect attack (Bakels, 1978), both it and oak do have trunks of the size and diameter suitable for the construction of LBK houses. Due to its suppleness, hazel can be used in wattle. Thus by carrying out woodland clearance, the LBK builders also provided themselves with construction timber and fuel. The very obvious predominance and recurrence of these taxa in the pits analysed illustrates their abundance near the site during the first stage of colonisation. In addition, it is entirely possible that during clearances certain species judged useful for food were spared or even favoured. This may particularly be the case for the Pomoideae, whose appearance in the anthracological assemblages of the village shows that at this point in the occupation these taxa dominated sufficiently around the habitation to be gathered during opportunistic collections. The abundance of these species may be due to a natural development because of the previously created openings. In the Pomoideae group, several types such as rowan or hawthorn are heliophilous and linked to woodland margins, clearings or light woodland. These environments may exist naturally but their particular abundance, as is the case here, can be hypothetically linked to the recolonisation by these taxa of deforested spaces, and thus to previous thinnings or clearances. We see no other explanation, either technological or in terms of fuel, for their abundance. This thus demonstrates the anthropogenic impact on the area around Remicourt between the pioneer and secondary occupations. This is all the more probable since this situation is repeated across several villages where the pioneer settlement combines, in each case, a reduced assemblage that is free from Pomoideae, with an older pottery assemblage than that of the secondary settlement, but also with a noticeably different method of supply in terms of ceramic and lithic raw materials (Bosquet *et al*., 2008; Salavert, 2008; Golitko *et al*., 2009). This is the case at the two sites presented in the following section: Fexhe-le-Haut-Clocher "Podrî l'Cortri" and Waremme "Longchamps".

## Fexhe-le-Haut-Clocher «Podrî l'Cortri», and Waremme «Longchamps»

### *Stratigraphic distribution and typology of individual pottery vessels*

For the Fexhe site, only two pits have been analysed according to the same methods, but the two structures concentrate 60% of the pottery collected, i.e., 1045 sherds forming 192 individual vessels (Bosquet et Van Driessche, 2008).

In both pits, the sherds of a few vessels are grouped by layer. These are fragments of containers composed of eight sherds at most, of which some were clearly broken after burial, judging by the presence of fresh breaks. The other vessels are composed of sherds distributed throughout the depth of the pits, as at Remicourt (fig. 15).

At Waremme, a section of the enclosure ditch has been studied. It yielded 66 decorated vessels whose sherds are once again vertically distributed over more than 1 metre and between several waste layers.

From a typological point of view, the situation at Fexhe is comparable with that of Remicourt: in the pioneer pits, some old vessels are associated with more recent ones, with no combed patterns, while in the village combed patterns appear—stroked in this case. At Waremme, the pioneer house is attributed to IIc, while the village develops in IId. In this case, the comb is omnipresent, but in very different proportions: between 5 and 10% in the pioneer house and 68% for the village (Bosquet *et al*., 2008). We must add to this the fact that a very clear difference is consistently observed between the pioneer and

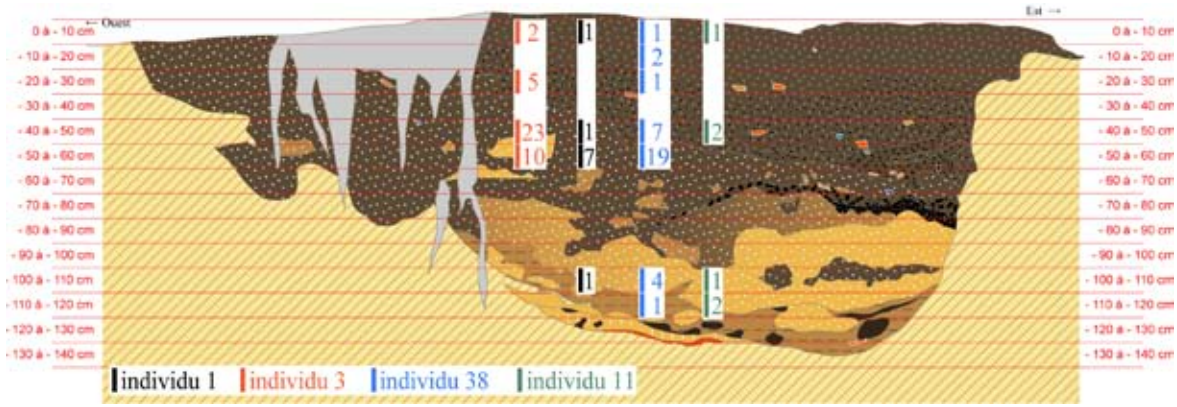


**Fig. 15** - Fexhe-le-Haut-Clocher «Podrî l'Cortri», pit 314. Vertical distribution of ceramic sherds from 4 pots (the number of sherds is indicated beside the coloured rectangles). As at Remicourt, the vessels are distributed over a considerable depth (60 to 120 cm), corresponding to at least two waste episodes. Here again the pit is affected by 40 to 60 cm of erosion.

principal establishments in terms of the supply of lithic and ceramic raw materials (Bosquet *et al*., 2008; Golitko *et al*., 2009).

The observations made for these two sites during their study thus clearly confirm the results obtained at Remicourt and tend to show that the use duration of vessels, the method of waste management and the periodicity of disposal are relatively constant from one village to another.

### *Composition of the anthracological assemblages*

At both Fexhe and Waremme, the assemblages from the pioneer settlements are characterised by a small number of taxa always consisting of oak, ash, hazel and elm. Lime is also present, particularly at Fexhe. This occurrence supports the age of the occupation since lime characterises the forests that developed at the time of the arrival of LBK people in Middle Belgium (Bakels, 1992). Pomoideae are represented by only one piece of charcoal out of the 560 identified in the pioneer house at Waremme. However, in the villages, the collection of firewood diversifies. Pomoideae, although not reaching the percentage attained at Remicourt (Salavert, 2008), are well represented (between 7 and 8%) given that the rate of cherry/sloe, which also prefers woodland margins, reaches 15% at Waremme. Therefore, the same observations may be proposed for the three sites at which at least two occupation phases have been identified. Pomoideae characterise the secondary occupations, suggesting that these tree species are favoured by human activities.

## Discussion/conclusion: waste management, periodicity of disposal and occupation duration documented by the LBK pits

The type 1 *intra* and *extra muros* layers, exclusively composed of charcoals, correspond to a few disposals probably made during construction of the houses, that is during a very short or rather short period. In four cases out of six they are composed of a low number of tree species, and in two cases out of six—but only in the village—of a number of taxa equal to that of the type 2 layers (the abundance being reflected in the amount of charcoal analysed). These two cases do not bring into question the shortness of the fill period since in anthracology we see the same type of ambiguity in hearth abandonments, for example. This indicates that a short activity duration generally produces few taxa, but may, given the randomness of wood collection, produce a higher number of tree species.

In the type 2 layers (mainly present in the LBK pit fill), though they are sometimes composed of superimposed sub-layers, it seems that the majority of the pottery, used lithic material and hearth waste that they contain was not immediately disposed of upon breakage, wear or successive uses. The objects were first moved elsewhere, probably in the open-air and perhaps

to be used, with other materials and over some time, in recycling contexts such as we still see in ethnographic cases (Beck and Hill, 2004). When the mass of waste was considered too intrusive and/or the remaining fragments were unusable, all or part of the midden was removed to the available pits and/or to pits dug for this purpose. After some period of additional accumulation, the next disposal into a pit or pits occurred, forming the following layer and so on until the abandonment of the site. This is the method of waste management that can best explain the mixture observed here. The numerous associations between sherds and flint flakes originating from layers sometimes located at the bottom and the top of the pits, also show that these layers would have accumulated quite rapidly since it is difficult to imagine that several fragments of a single vessel or a lithic reconstruction would have been consistently disposed of tens of years apart. However, if this waste was disposed of over a few years at most, this would indicate that the material originating from the pits does not reflect the total duration of occupation, but rather the state of the corpus over the duration of the accumulation of waste; at most a few years. It seems rather unlikely that the occupation duration of an LBK house does not exceed a few years. If this is indeed the case, we must admit that only a small proportion of the waste material is accessible to us through excavation, the rest having been washed away by erosion after the abandonment of the site, whether from the upper part of the pits or the residual middens.

Consequently, as we might expect, the presence in these pits of containers covering nearly the entire regional chronology is not due to the fact that the houses were occupied for 150 or 200 years, but rather to the durability of a small number of old vessels and to the unequal duration of the typological phases, the oldest probably having been shorter than the more recent, at least in the Hesbaye.

Regarding the positioning of the waste heap(s) in the villages, we can hypothesise that they occupied some of the zones surrounded by waste pits and without post holes present in all the habitations, such as in the village *Dalupa* analysed by Beck and Hill (2004, 304, fig. 2) during their study of the management of middens in the Philippines. These are generally explained as the locations of houses whose foundations have been entirely destroyed by erosion. While this possibility remains valid, it is not unreasonable to consider that at least some of these areas were open-air rubbish zones.

In terms of the archaeobotanical aspect of this study, we must accept the evidence that type 1 layers are not able to provide certain information on the state of forest coverage during the LBK occupation. On the other hand, the type 2 waste layers more consistently represent a long timescale and thus contexts more appropriate for palaeoecology (Chabal, 1997; Asouti et Austin, 2005). In addition, the clearest difference that appears is not between the type 1 and 2 layers, but between the pits of the pioneer house and those of the village. It is clear that the charcoal from the pioneer house, whether concentrated or dispersed, originates from specific supplies, which we have attributed to a phase of clearance, both of short duration and of local character (exclusive representation of ash, hazel and oak).

Therefore, at the three sites presented, the development of the forest cover between the pioneer phases and the main occupations has been revealed through analysis of the layers that accumulated over a time span estimated at a few years based on the results of spatial analysis of the pottery and, in one case, the lithic evidence. According to these results, if the main occupation phase quickly followed the pioneer phase—which is not yet proven—we can conclude that the impact of human activities on the original forest environment was rapid. We thus once again raise here the question of the chronological relationship between the two occupations, which is directly linked to that of the minimum time necessary to induce the modifications of the forest cover observed at the three sites between the two occupations; this is information that we do not currently possess.

This recognition of a more complex waste management method than that generally envisaged and the resulting chronological interpretation of the waste assemblages could not have been achieved without integration of the archaeological and anthracological data from several sites. These latter are often limited to strictly palaeoenvironmental interpretations, though in this case they contribute elements for the determination of occupation duration represented by the different types of waste materials present in the LBK pits, as well as for the wood supply specific to an activity and/or a habitation phase.

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## Authors

### Dominique Bosquet

Service public de Wallonie (DG04),
Service de l'Archéologie de la province de Brabant, Avenue Vésale, 15, 1301 Bierges. Belgique
dominique.bosquet@spw.wallonie.be

### Mark Golitko

University of Illinois,
West Harrison Street, 1007 - 60607 Chicago - United States of America.
mgolitko@yahoo.com

### Aurélie Salavert

Muséum national d'Histoire naturelle
UMR 7209 du CNRS
Archéozoologie, Archéobotanique : sociétés, pratiques et environnements / case postale 56, 55 rue Buffon 75005 Paris - France
salavert@mnhn.fr

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