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# DISCOID DEBITAGE *STRICTO SENSU*:

## a method adapted to highly mobile Middle Paleolithic groups?

**Céline THIÉBAUT**

**Abstract**

*Over the past ten years, descriptions of the Discoid debitage concept have become increasingly precise, resulting in the distinction of at least two methods. In addition, increasingly systematic petroarchaeological studies since the latter half of the 1980's have contributed to our knowledge of the mobility patterns of human groups. At the same time, increasing numbers of multidisciplinary and functional studies have enabled Paleolithic researchers to better understand the role of environmental and functional factors in the technical choices made by human groups. Discoid debitage is currently perceived as an adaptive response to mediocre raw materials. In this paper, I propose a new interpretation of the Discoid debitage stricto sensu method, not as a simple adaption of technical traditions to environmental constraints, but as a reflection of the technical traditions of human groups. The chronological longevity (from at least OIS 5 to 3) and the multiplication of assemblages attributed to this method at the end of the Middle Paleolithic could reflect a concordance between the increasing mobility of human groups and the environments that they occupied, enabling them to have more freedom in their movements.*

**Keywords**

*Middle Paleolithic, Discoid debitage, mobility, technical traditions.*

## Introduction

Over the past decades, many studies have focused on obtaining a better understanding of the economic and social organization of Neandertal groups. The movements of human groups across a territory have long been approached through petroarchaeological studies of the raw materials used to manufacture stone tools. Today, an increasing number of zooarchaeological analyses and techno-economic analyses of lithic industries contribute further to our knowledge of the economic organization of human groups through an understanding of site functions[1]. In a recent article, Delagnes and Rendu (2011) addressed the economic organization of Neandertal groups based on a well-known, but perhaps outdated, aspect of their lithic industries, the typological facies of F. Bordes (1953). They proposed that there is a relationship between the dominant flaking method (shaping, Levallois or Discoid debitage) and organization and mobility strategies. Technical and behavioral differences would therefore reflect different procurement strategies in association with different animal species: the hunting of gregarious migratory species would be associated with greater mobility, and the hunting of more solitary, non-migratory species with less mobility (Delagnes, Rendu, 2011).

1. It is indeed rare for this period to find in situ levels and archaeological assemblages that have not been modified by taphonomic processes.

In this paper, I discuss this point of view and address the question of Neandertal mobility by focusing on those who used the Discoid *sensu stricto* debitage method; we will see that the approach developed here reveals a few nuances and suggests directions for reflection on the models proposed.

Discoid debitage *sensu stricto*, whose main objective was to obtain pseudo-Levallois points, is one of the debitage methods included in the Discoid concept. Since it was first defined, the development of techno-economic and typological approaches has enabled researchers to more clearly define the objectives of its authors and the technical features of the assemblages in which it is present. Multidisciplinary approaches now also allow us to better define the composition of faunal assemblages and thus the animal resource procurement and processing strategies associated with lithic assemblages. After a brief historic review of the definition of this method, I will present the available petroarchaeological, faunal and functional data in order to better apprehend the occupation and mobility patterns of the human groups with which it is associated. I will then explore the relationship that may have existed between human mobility patterns and the adoption and development of this debitage method in western Europe during the later phases of the Middle Paleolithic.

## 1 - Discoid debitage *stricto sensu*: technical features of the assemblages

The term "discoid" was employed by F. Bordes (1950) to describe disk-shaped cores associating what would later be perceived as different debitage methods (recurrent centripetal Levallois, Discoid and recurrent centripetal). In the 1990's, it was more precisely defined by É. Boëda (1993, 1994), while many authors emphasized the significant variability observed in the core reduction strategies and end-products associated with this concept (Meignen, 1988; Boëda, 1993; Locht, Swinnen, 1994; Mourre, 1994, 2003; Peresani, 1998; Slimak, 1998-1999, 2003).

According to these authors, this variability or technical diversity arises from different factors. In the case of the Discoid debitage present at the sites of Coudoulous and Mauran, "the influence of the environment, the technical tradition, the economic function of a human occupation and the regional identity" all contributed to this variability (Jaubert, Mourre, 1996: 337). J.-L. Locht and C. Swinnen argue that the different debitage modalities observed at the site of Beauvais are linked to the initial morphology of the cores (Locht, Swinnen, 1994: 92).

The hierarchisation of the core surfaces can be correlated with the notions of productivity and raw material economy (Peresani, 1998). A core can thus be reduced on one or two surfaces, with or without a hierarchy, forming bifacial or partially unifacial cores (Collina-Girard, 1975; Jaubert *et al.*, 1990)

Similarly, the orientation of the fracture planes is linked to both to the initial form of the raw nodule and the stage of core exhaustion, contributing to a gradual increase in the debitage surface convexities (Jaubert, Mourre, 1996; Peresani, 1998).

The debitage method employed (centripetal and/or parallel) could be linked to the qualitative and/or quantitative objectives of the authors (Locht, Swinnen, 1994; Peresani, 1998).

Like Levallois debitage, Discoid debitage can be realized through different methods depending on the production objectives, the materials employed and the morphology of the initial blocks. J. Jaubert and V. Mourre emphasize that it can be difficult to distinguish between the Discoid method and the recurrent centripetal Levallois method based on core analysis alone. They argue that all of the technological products must be studied in order to identify the debitage concept and method employed (Jaubert, 1993; Mourre, 2003).

The products obtained using the Discoid debitage method have been described by many researchers:

- *éclats à dos débordant* (core-edge flake) (Boëda, 1993);
- pseudo-Levallois points (Bordes, 1953; Boëda, 1993) or *éclat à dos débordant limité* (Meignen, 1993);
- centripetal flakes, either wider than they are long, or nearly as wide as they are long (Boëda, 1993). In this category, we include flakes with a "*talon débordant*", which are flakes that are usually wider than they are long, and whose naturally backed edge is located on the platform (Thiébaut, 2005);
- and, flakes with an axial or transverse crest that participate in the creation of a new striking platform used for the production of long flakes (Slimak, 2003).

Discoid debitage and the diversity of its production objectives were thus identified several decades ago. Nonetheless, with a few exceptions (Locht, Swinnen, 1994; Bourguignon, Turq, 2003), the production objectives have rarely been described in publications of assemblages and the distinction between Discoid debitage *sensu lato* and *stricto lato* proposed by V. Mourre (2003) has only recently been integrated in technological studies and publications. In Discoid debitage *sensu lato*, the production objectives are varied, while in Discoid debitage *sensu stricto*, the main objective is to obtain pseudo-Levallois points and core-edge flakes (Mourre, 2003).

Due to the nature of its objectives, the second method is easier to identify, describe and distinguish from the other recurrent centripetal debitage methods (Discoid, Levallois, or other). The goal of core reduction is to produce a relatively standardized product, reflecting a capicity to employ methods enabling predetermination (Mourre, 2003; Bourguignon *et al.*, 2006; Thiébaut, 2007; figure 1).

It is currently difficult to determine the chronological and geographical extension of this method because it still has not been clearly named or identified in early publications. It is nonetheless present in OIS 5 at the site of Les Forêts (Brenet, Folgado, 2003), and until the end of the Middle Paleolithic at around 40 000 BP in several regions in Europe (figure 2), including the Micoquian levels at Kûlna in Moravia (Czech Republic), for the easternmost site, and especially in northern France at the site of Beauvais (Oise), attributed to OIS 4 (Locht, Swinnen, 1994; Locht, 2004), and at many sites in the southwest (for a list, cf. Brenet, Folgado 2003), as well as in the Pyrenees at the site of Mauran and Noisetier Cave, both attributed to OIS 3 (Farizy *et al.*, 1994; Mourre *et al.*, 2008). Discoid debitage *stricto sensu* is also known in northern Spain in Catalonia, in different layers at Abri Romani (Thiébaut, 2007; Thiébaut *et al.*, 2012), dated from 57 000 BP (layer K) to 41 000 BP (layer E) (Bischoff *et al.*, 1988; Carbonell *et al.*, 1994).

A recent techno-economic analysis of several lithic assemblages in which this debitage method is present show that it is generally exclusive or dominant. We can cite the examples of Mauran (Farizy *et al.*, 1994), Beauvais (Locht, Swinnen, 1994), Champ de Bossuet (Bourguignon *et al.*, 2000), Les Fieux, layer K-denticulés (Thiébaut *et al.*; Gerbe *et al.*, in press), and several layers at Abri Romani (Thiébaut, 2007; Thiébaut *et al.*, 2012). This method can nonetheless be accompanied by Discoid debitage *sensu lato*, as in layer Egpf at Saint-Césaire (Thiébaut, 2005; Thiébaut *et al.*, 2009). Some assemblages also include a bifacial component, such as at Les Forêts (Brenet, Folgado, 2003) and Külna (Boëda, 1995), or another debitage concept such as Levallois (preferential Levallois and recurrent centripetal Levallois) at Bois de Reymondeau (Detrain *et al.*, 1999). The association of different flaking concepts within a single archaeological layer can result from a mixture of distinct occupations or the use of the shaping method by distinct human groups with different technical traditions. As it is not our aim here to discuss these two hypotheses, we will consider only those assemblages created solely by Discoid flaking.

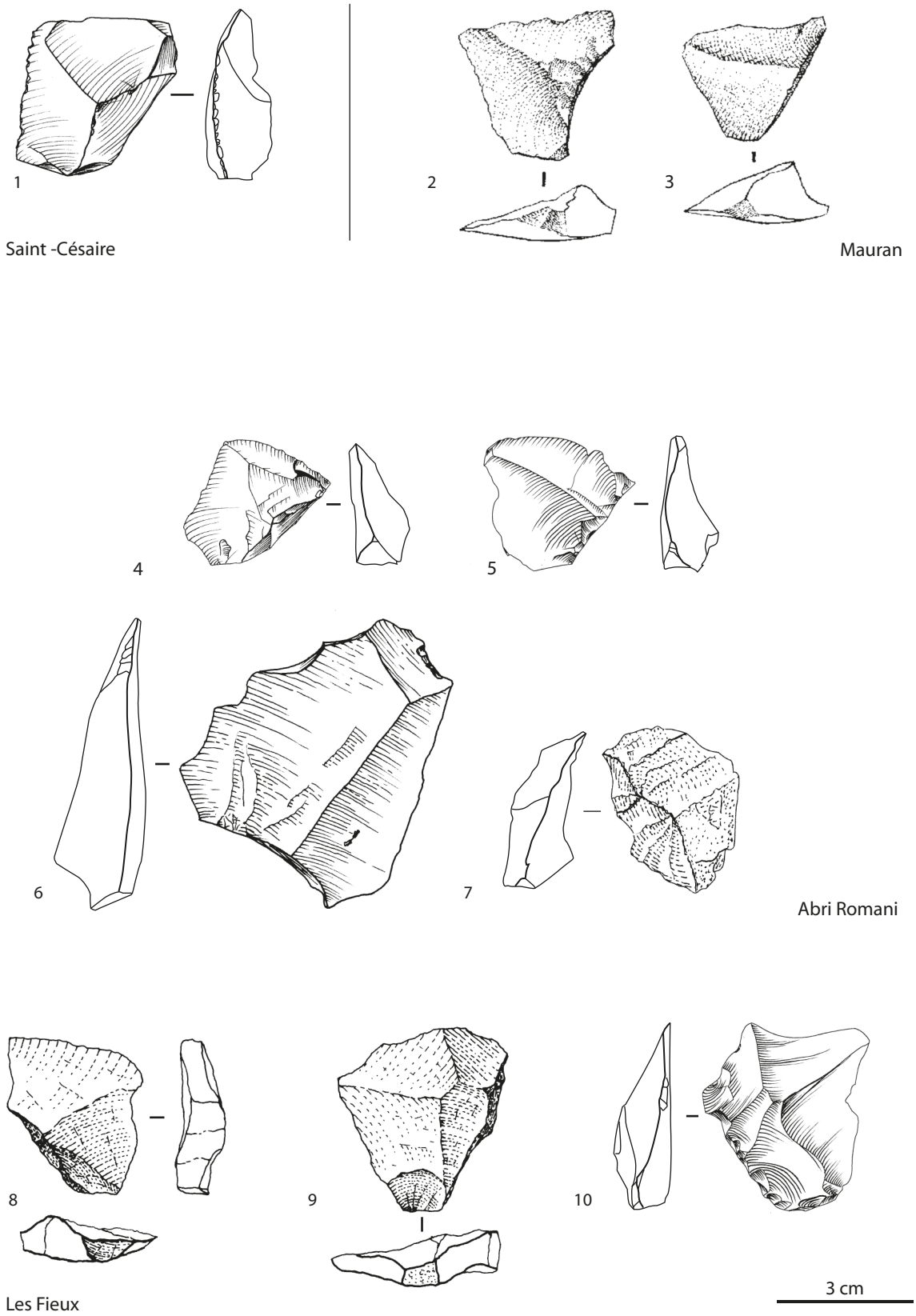


**Figure 1** - Pseudo-Levallois points: 1, 4, 5, 10 in flint ; 2, 3, 8, 9 in quartzite ; 6 in limestone ; 7 in quartz (drawn by the author except 2 and 3 by Jacques Jaubert *in* Farizy *et al.,* 1994 and 8 and 9 by Vincent Mourre).

This debitage method has a clear technical advantage relative to bifacial productions or the Levallois debitage method, even the recurrent one, which is the capacity to produce a high quantity of predetermined blanks with little preparation. It is thus advantageous in terms of productivity (Bourguignon *et al.*, 2006). It also facilitates the manufacturing of relatively standardized blanks that are adapted to diverse activities, as we will see below.

From a typological perspective, since the main objective of this debitage method was to manufacture pseudo-Levallois points and core-edge flakes, it is associated with very few retouched tools, rarely exceeding 10 % of the flakes longer than 20 mm. The most frequent tools are notched pieces (Mauran, Saint-Césaire, Romani, Champ de Bossuet and Les Fieux level Kdenticulés) and scrapers (Beauvais, les Forêts, Külna). The low proportions of both of these tool types indicate that they were not the main objective of the *chaîne opératoire*, in contrast to pseudo-Levallois points and core-edge flakes. The variability of the proportions of these retouched tools could thus be correlated with the functional objectives of the blanks. From this perspective, it appears that the "Discoid with denticulates" techno-complex defined by some authors (Delagnes, Rendu, 2011; Discamps *et al.*, 2011) is very limited and does not constitute a true technical group, but rather part of a broader technical group including the Discoid productions associated with scrapers. I believe that isolating "Discoid with denticulates" assemblages from other Discoid assemblages creates a methodological bias when attempting to identify groups with similar technical traditions and in the reconstruction of occupation patterns across a territory or the animal resource procurement strategies of Neandertal groups.


**Figure 2** - Location of the mentionned sites.

Pseudo Levallois flakes and core edge flakes have morpho-functional features that are adapted to different actions. The presence of a point serves to perforate or incise semi-hard or soft materials, while the edges can cut or scrape all types of soft, semi-hard or hard materials and the back opposite the edge makes the tool easier to hold in the hand. It is thus difficult to determine their function based only on their morphological features, and usewear analyses are therefore required to provide more reliable information. Unfortunately, very few analyses of this type have been performed. Currently, only three assemblages have been the subject of global usewear analyses and detailed publications: Champ de Bossuet (Astruc *in* Bourguignon *et al.*, 2001), Les Fieux (Coudenneau, Thiébaut *in* Gerbe *et al.*, in press) and Mauran (Coudenneau, Thiébaut *in* Thiébaut *et al.*, 2012). In addition, most of the assemblages are poorly preserved. Therefore, no functional data has been recorded for tools in the lithic assemblage from Champ de Bossuet. They were modified by sediment polish that might hide any possible micropolish (Astruc *in* Bourguignon *et al.*, 2000: 102). Despite these issues, the few available usewear data obtained show that pseudo-Levallois points were used in the context of different activities at Les Fieux and Mauran: the scraping of semi-hard and hard materials (wood or bone), perforation of skin and a semi-hard material, as well as cutting in the context of butchery activities. A certain number of pseudo-Levallois points showing little or no modification do not have macrotraces (n = 8) and could thus have been used for activities that are either less intensive or produce fewer traces, such as animal skinning (Claud, Thiébaut *in* Thiébaut *et al.*, 2011).

Very few core-edge flakes and unretouched edges display macrotraces: one in flint from Les Fieux was used to scrape a hard material; another one from Mauran, also in flint, was used to scrape a semi-hard or soft material.

Despite the small number of pseudo-Levallois points and core-edge flakes analyzed and displaying usewear, all of these pieces attest to varied activities. The intensive scraping of dry skin was the only activity not identified on these artifact categories, but it is rarely possible to identify this activity on unretouched blanks.

Another point that should be emphasized is the great diversity of materials exploited with this method. The debitage of pseudo-Levallois points was realized on flint blocks (Champ de Bossuet, Beauvais, Külna, Saint-Césaire, Abri Romani) quartz (Les Fieux) and quartzite pebbles (Mauran, Les Fieux, Noisetier Cave), and even limestone (Romani). When diverse materials were exploited, at sites such as Abri Romani, Mauran and Les Fieux, no raw material economy was observed (Perlès, 1991). All the materials were exploited in the same manner.

## 2 - Neandertal mobility, from the general to the particular

The reconstruction of the mobility patterns of Neandertals is a transdisciplinary endeavor. Petrographs, technologists and zooarchaeologists all search for evidence that can enable them to identify the territories covered by Neandertals and their strategies for exploiting them.

Analysis of the raw materials present in lithic assemblages is one of the most precise methods for determining the distances travelled by human groups. The question of exchanges between groups can sometimes be addressed, as well as the mobility of a single group within a defined territory. The integration of petrographic and technological analyses has been largely developed and systematized over the past 30 years. In some regions, this approach now enables researchers to observe territorial occupation strategies from a diachronic perspective (Chalard *et al.*, 2007).

The mobility of objects across long distances (100 km) has been demonstrated for the Middle Paleolithic in the Aquitaine region (cf. Geneste, 1985; Féblot-Augustins, 1997, for example), though this phenomenon concerns only some object categories (scrapers, bifaces and Levallois flakes). For these latter, the question of the modalities of their movements (exchanges between groups or group mobility) can be raised. The results accumulated over the past 30 years have shown that human groups sometimes transported pre-formed cores, as well as raw or retouched blanks (Bourguignon *et al.*, 2006; Chalard *et al.*, 2007). Following the landmark study by J.-M. Geneste (1985 and 1988), all research has shown a close link between the distance from the raw material source and the degree of reduction or resharpening / reworking of a transported object. Nonetheless, a diachronic analysis of the mobility patterns of objects in assemblages from the Quercy region (France) during the Middle Paleolithic has shown an increase in the proportions of allochthonous flint in the most recent assemblages, as well as a diversification of the objects transported. A significant change thus occurred in the mobility patterns of lithic objects through time, which is seen in the greater quantity of allochthonous materials in more varied forms at the end of the Middle Paleolithic during OIS 4 and 3 (Chalard *et al.*, 2007).

These studies must not be lead us to forget that there are significant differences in the transportation modalities of allochthonous materials depending on the knapping methods and tool types that characterize lithic industries. In effect, the changes observed at the end of the Middle Paleolithic do not apply to all industries. The assemblages analyzed in the studies cited above show that the most mobile objects were associated with three production schemes: Levallois debitage, biface production and the manufacturing or retouching of Quina scrapers.

These three production schemes generally require a greater quantity of raw material and, especially, nodules or blocks of greater dimensions. This factor has been reiterated by several researchers (e.g. Bourguignon *et al.*, 2006). Several assemblages show that when the quality of the local raw material is adequate, even if it is not flint, Levallois debitage and the manufacturing of bifaces and Quina scrapers can be realized. This is the case in the assemblages of the level with bears in the caves of Tournal and Noisetier, where Levallois debitage was realized on fine-grained quartzite blocks (Tavoso, 1987; Mourre, Thiébaut, 2008; Thiébaut *et al.*, 2012). At Noisetier Cave, a biface was manufactured from a schist block and at Les Fieux, a biface on a quartzite flake was also found. In level XI of Esquilleu Cave, the Quina scrapers were made from quartzite (Carrión Santafé, Baena Preysler, 2003). Therefore, the long distance transportation of specific objects – such as Levallois cores, Levallois flakes, Quina scrapers or scraper blanks and bifaces – represents an adaptive response to the absence of high quality local materials in quantities that are sufficient for the manufacturing of these objects. Some authors argue that this behavior reflects *"a very organized territorial exploitation system: the context of the site that we will occupy is known and an expedition is thus planned."* (Chalard *et al.*, 2007: 229). This vision of the occupation patterns and exploitation of a territory can be close to the prehistoric reality, as is shown by the existence of sites occupied seasonally and repeatedly through time, such as Coudoulous (Jaubert *et al.*, 2005). It is also possible that the act of transporting a diversified technical kit over long distances allowed these groups to have greater liberty in their movements: in parallel to a planned expedition, we could also interpret this type of behavior as an anticipation of possible needs. The groups would have transported the minimum equipment necessary for an expedition of a short duration (e.g. for exploration or animal resource procurement), anticipating a destination where the richness and diversity of lithic materials was unknown. In both cases, this is a *"provisioning of individuals"* strategy according to the definition of S. Kuhn (1995).

Some assemblages in the Quercy region (La Borde, Les Fieux level Kbase) include a few objects in a non-local flint attributed to a Levallois debitage concept (Jaubert *et al.*, 1990; Thiébaut, 2005). These sites have a particular topography (sinkhole-trap) that resulted in the natural or anthropogenic trapping of animal carcasses. At Les Fieux, the presence of a small number of Levallois pieces (n = 9) associated with fauna that fell naturally into the trap indicate a scavenging strategy. The technical and faunal elements in this level (Gerbe *et al.* in press) attest either to an anticipated expedition with the objective of collecting meat from the fallen carcasses (the individuals would have known of the natural trap, cf. Brugal, Jaubert, 1991), or a more opportunistic or exploratory presence of human groups on the Causse de Gramat (Gramat plateau).

To return to the results obtained by P. Chalard and collaborators in the Quercy region, the observation of an increase in the distances traveled and a diversification of the blanks made from allochthonous materials in the late phases of the Middle Paleolithic appear to indicate an increasingly high mobility among Neandertal groups. To my knowledge, however, the transportation of Discoid cores or pseudo-Levallois points over distances greater than 30 km has never been observed, though some assemblages containing them are attributed to the end of the Middle Paleolithic (Mauran, Saint-Césaire, Romani, Les Fieux and Noisetier Cave).

There is still little direct evidence for the transportation of pieces associated with the Discoid debitage *sensu stricto* method. At Saint-Césaire, the imported Discoid cores and blanks originate from 10 km away (Thiébaut, 2005, t. 2: 239). Similarly, at the site of Combemenue, the allochthonous raw materials imported and used for part of the Discoid debitage originates from a site 10 to 15 km away (Brenet, Cretin, 2008). At Les Fieux, in level Kdenticulés (Gerbe *et al.*, in press), three pieces, including one denticulate on a core-edge flake and one pseudo-Levallois point in Senonian flint, made using a Discoid concept, have been identified. This flint originates from Coniacian formations, the closest of which are located around twenty kilometers away (Thiébaut *et al.*, 2009b).

If we associate these data with the fact that in many Quercy assemblages, local quartz and quartzite were used mainly for Discoid debitage, while the allochthonous flint was used for the realization of bifaces, Levallois flakes and Quina scrapers, it is possible that the Discoid debitage method was used only as a substitute for the other methods in contexts in which the raw materials were of a lesser quality. Its use would thus be an adaptive response to the exploitation of poorer quality raw materials and / or smaller raw blocks or nodules, a hypothesis that was recently proposed by Delagnes and Rendu (2011).

However, as I already mentioned, Discoid debitage has absolutely no association with a particular raw material. We find it in the Charente region where there is an abundance of good quality flint in the form of blocks of varying dimensions, such as in level Egpf of Saint-Césaire (Thiébaut, 2005; Thiébaut *et al.*, 2009a), in Gironde in the assemblage of Champ de Bossuet, in Dordogne in some levels of Combe-Grenal (Bourguignon, Turq, 2003) and at the site of Les Forêts (Brenet, Folgado, 2003). Discoid debitage, whether *sensu stricto* or *lato*, is in fact found in very diverse geological contexts in which the most abundant materials vary greatly (good quality flint, small or large blocks of flint, limestone, quartz and quartzite).

The use of this concept therefore cannot be attributed to a simple adaptation of debitage methods to mediocre quality materials.

Based on petrographic, technological, zooarchaeological and functional analyses my colleagues and I recently proposed that the different debitage methods employed in southwestern France could reflect the technical traditions of distinct Neandertal groups (Thiébaut *et al.*, in press), thus supporting the hypothesis proposed by F. Bordes (1961). As we observed, the diversity of methods is in effect not directly linked with the diversity of materials employed. Similarly, the functional

objectives of the tools manufactured using the different debitage methods cannot explain the technical diversity of Middle Paleolithic lithic assemblages since bifaces, denticulates, scrapers, Levallois flakes and core-edge flakes *sensu lato* were all used mainly for butchery activities. The same is true for the environment or the species hunted, which are different for each method (Thiébaut *et al.*, in press). Therefore, if we retain the idea that Discoid debitage reflects the technical traditions of one or several cultural groups, meaning that it was not determined by environmental, economic or functional constraints, but rather that it represents a production method chosen from several possible ones, and thus a technical choice that was known and transmitted among one or several human groups, we could imagine not only human groups with different technical traditions, but ones on which different territorial occupation strategies would also be superimposed.

According to technological and petrographic data, we would thus have a coexistence of human groups that moved over long distances (greater than 30 km), and who manufactured Quina scrapers and Levallois flakes, with other human groups that moved over a smaller territory territory (less than 30 km), and who would have employed the Discoid debitage *sensu stricto* method. The zooarchaeological data nonetheless tends to nuance this scenario.

## 3 - Human groups with low mobility?

Based on petroarchaeological analyses, it indeed appears that the groups who oriented most of their lithic production activities toward the manufacturing of pseudo-Levallois points seldom transported their products, and when they did, it was across only short distances. Does this necessarily mean that these groups moved over short distances or within a more limited territory?

An identification of the functions of some sites with Discoid assemblages with points indicates the contrary.

The increasing number of analyses integrating lithic technology and zooarchaeology over the past fifteen years has contributed to our knowledge of the function of some sites and therefore to the construction of models of Neandertal organization. Largely based on the models proposed by L. R. Binford (1980), albeit in a simplified manner, different types of economic organization and various territorial occupation strategies have thus been proposed for the Middle Paleolithic. While for some authors these different forms of organization – residential or logistical mobility – are closely linked to the environment and climate (Depaepe, 2010), since they are largely determined by the strategies employed to procure animal carcasses, which depend on hunting, which in turn depends on the environment, for others they are more closely related to distinct techno-economic traditions (Delagnes, Rendu, 2011). In the first case, the favored hunting strategies and the species hunted are not related to the production schemes, but to specific environments. According to this scenario, bison or reindeer hunters could use any flaking method. In the second case, it is the technical traditions, and the associated mental templates (considered to be more or less complex in each case), of the groups that would have determined the carcass procurement strategies and the species hunted. There would therefore be a very clear difference between the organization of groups with Levallois products or blades and those who manufactured more Quina scrapers and denticulates using the Discoid concept. In their conclusion, they state that "*The Levallois and laminar technologies, which prevailed during the early stages of the Middle Paleolithic, prior to OIS4, were related to a forager-related mobility system with no selective hunting strategies*." (Delagnes, Rendu, 2011: 9). These two technical groups (Levallois and laminar) would therefore be more closely related to a residential mobility strategy, as seems to be indicated in their model. The Quina and Discoid with denticulate groups, on the other hand, would be associated with a logistical mobility strategy involving planned and diversified activities throughout the year. According to them, the difference

between the Quina and Discoid with denticulates technical groups would lie in more opportunistic movements for the Discoid with denticulates groups and more planned movements for the Quina groups. This hypothesis is based on the greater predictability of the seasonal migrations of reindeer, compared with those of bison (Delagnes, Rendu, 2011).

This model, though it is very seductive, is tempered by the existence of some Levallois assemblages that are dominated by bison. Among these assemblages, we can cite that of La Roquette à Puycelci. According to L. Bourguignon, who studied this assemblage, the debitage methods employed are recurrent unipolar Levallois and recurrent centripetal Levallois on flint and Discoid (method not given) on quartz / quartzite. The tools are also rather diverse (scrapers = 19.6 %; denticulates = 23 %; notches = 19.8 %; flakes with short retouch = 23 %; after Bourguignon *et al.*, 2001). The technical characteristics of this industry appear to be somewhat similar to those of the assemblage of level 4 at Coudoulous (Jaubert *et al.*, 2005), whose fauna is dominated by bison, at 95 %, despite the absence of denticulated pieces.

Moreover, reindeer represents 90 % of the fauna associated with a dominant Levallois debitage method (after the data of Park, 2007) in level 8 at La Quina (Debénath, Jelinek, 1990; Rendu, Armand, 2009). Levallois debitage can thus be associated with the selective hunting of a single species such as bison or reindeer. In addition, a certain number of lithic assemblages associated with bison remains in significant proportions (> 19 %) are characterized by a dominant Levallois debitage concept, such as in levels 11 and 29-30 at Combe-Grenal, level 4b at La Quina, and US 8 and 6-7 at Jonzac. It therefore appears that groups employing the Levallois method sometimes oriented their hunting toward a single species, but also that they hunted species considered to be gregarious and migratory, such as reindeer and bison, which would require a certain degree of activity planning (*cf.* Rendu, 2007).

At the same time, some Quina levels in northern Spain are associated with faunal assemblages dominated by red deer and ibex, such as at Cueva de Prado Varga (Navazo *et al.*, 2005; Navazo, Diez, 2008) and Peña Miel level g (Montes Ramirez,1988; Montes *et al.*, 2001). Similarly, some assemblages characterized by the Discoid debitage *stricto sensu* method, such as those of levels E and K at Abri Romani and Noisetier Cave, are more closely associated with a temperate climate and wooded environment (Allue *et al.*, 1996; Mourre *et al.*, 2008). Finally, at the site of Beauvais, the assemblage with Discoid *sensu stricto* debitage is associated with a faunal assemblage dominated by reindeer (Locht, 2004).

Therefore, the groups with Discoid and denticulate technologies did not hunt only bison, not any more than the Quina knapping groups hunted only reindeer.

Like P. Depaepe, I believe that the environment, in the broad sense, including the climate and vegetal and animal biomass influenced the animal procurement strategies employed, and therefore the occupation strategies within a territory, more than the technical traditions of a group.

Concerning the Discoid *sensu stricto* assemblages, if we retain some of the sites already mentioned, we observe a particular territorial organization, even if a synchronic approach is impossible, and some sites have distinct functions: a seasonal kill site with monospecific fauna and primary butchery (Mauran: Farizy *et al.*, 1994; Rendu, 2007), seasonal bison kill site with butchery and consumption (Les Fieux cKdenticulés: Gerbe *et al.* in preparation), a knapping workshop and diverse fauna consumption site (Saint-Césaire: Thiébaut *et al.*, 2009), and a seasonal occupation site and diverse fauna consumption site (Romani: Thiébaut *et al.*, 2012) and Noisetier Cave (Mourre *et al.*, 2008).

Numerous ethnographic data show that the organization of hunter-gatherer societies, and by extension the territorial occupation and management strategies employed, are largely dependent on climatic, or even seasonal, fluctuations (*e.g.* Kropotkine, 1902; Mauss, 1950; Testart, 1982; Cashdan, 2001; Collard, Folley, 2002), as well as the ethology of the hunted species, especially their possible

migrations (Burch, 1972; Kelly, 1995; Kenyon, 1997). Depending on the topography and demography of the territories occupied, the distances covered by human groups would be greater and the occupied sites would have a greater diversity of activities during rigorous climatic periods, especially since the vegetal biomass would be reduced and the animal species gregarious and migratory (bison, reindeer and horse). Inversely, during temperate phases, the animal and vegetal biomass could be abundantly available within a smaller territory throughout the year and human groups would thus have lower mobility strategies within the area occupied. This is the model proposed by P. Depaepe and presented above.

The Discoid *sensu stricto* assemblages are associated with diverse faunal species, which are associated with climates and physical environments that are also diverse. It is thus possible that the long distances could have been covered, especially in the case of bison and reindeer hunters. It is thus in these assemblages that we would expect to find evidence for an importation of raw materials from distant sources. However, regardless of the site function considered, such economic behaviors have not yet been observed in Discoid *stricto sensu* assemblages.

Why did these human groups, who probably moved across long distances, neglect to carry with them the equipment necessary to meet their basic needs, as appears to be a general practice among modern hunter-gatherers (cf. Khun, 1995)?

The response probably lies in their technical choices, and especially the use of a debitage method that allowed them to manufacture a large range of tools adapted to different activities, using varied raw materials.

The absence of evidence for long distance movements of Discoid products is therefore not a clear indication that the authors of these productions were not very mobile.

## Conclusion

The diverse approaches applied in studies of human groups who employed the Discoid *sensu stricto* debitage method show that their lithic artifacts (end-products and / or by-products) were much less mobile than those associated with the Levallois debitage concept or with the manufacturing and retouching of Quina scrapers or bifaces.

The size of the territories covered by these groups is thus impossible to estimate. The archaeological evidence nonetheless indicates that during cold climatic phases and in intensive steppe environments, these Discoid groups, like other Neandertal groups, planned their activities in space and time. They occupied sites, at which they carried out the specialized activity of carcass procurement and butchery (Mauran and Les Fieux), seasonally and for short durations. In parallel, the manufacturing of pseudo-Levallois points and core edge flakes by the Discoid debitage method allowed them to produce a high number of predetermined blanks from a small number of stone blocks. In addition, this method could be employed with petrographically and morphometrically diverse raw materials.

Therefore, based on these data, the use of the Discoid *sensu stricto* method cannot be considered as a simple adaptive response to environmental constraints, but can rather be perceived as a reflection of the technical traditions of one or several human groups employing the best strategy to overcome all material, economic and environmental constraints. In the end, it thus appears to have been the strategy best adapted to a nomadic organization of hunter-gatherer groups. Because this method could be used with a wide range of raw materials and the blanks produced could be used for diverse activities, the human groups who employed it would have been able to move freely within a relatively vast territory because they were not constrained by the types of

raw materials available to them; alluvial formations could have provided them with the different materials adapted to knapping in diverse environments, and even during periods with heavy snow cover.

Therefore, rather than two models of mobility patterns or territorial occupation strategies dictated by the technical traditions of human groups, as proposed by A. Delagnes and W. Rendu (2011), I propose that these data reflect different strategies, between the transportation of implements and that of human groups depending on the flaking methods employed (for the transportation of products), and depending on the environment in the broad sense (for the socio-economic organization of the group within a territory). The groups that favored the Levallois debitage method, or those that manufactured Quina scrapers or bifaces, would have been constrained by their technical traditions. In response to possible shortages of local, high quality raw materials in sufficient quantities (anticipated or not), they would have carried with them the minimal equipment necessary for short expeditions and seasonal movements. Because their knapping method was more dependent on the quality and dimensions of available raw material volumes, these groups opted to transport part of their necessary equipment. At the other end of the spectrum, the groups who used the Discoid *sensu stricto* method were less dependent on the quality and dimensions of available raw materials, and thus did not encumber themselves with such equipment when they moved across long distances. The flexibility of this debitage method thus freed these groups from the technical constraints imposed by the raw materials available to them. The multiplication of late Middle Paleolithic assemblages attributed to this method, regardless of the environment and the mobility strategy (logistical or residential), may be the result of an increasing mobility of human groups over longer distances, coupled with the adoption of this method by an increasing number of human groups benefitting from the technical and economic advantages that it offered.

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