# Late Mousterian lithic technology: its implications for the pace of the emergence of behavioural modernity and the relationship between behavioural modernity and biological modernity

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## Abstract

An analysis is presented of several Mousterian industries of Acheulian tradition from Western Europe dated to the first half of IOS 3 and manufactured by Neanderthals before the arrival of anatomically modern humans in Europe. It is shown that some behaviours previously thought to be characteristic of recent behaviours associated with anatomically modern humans were in fact shared with another species. Among those are: the variability of Mousterian technologies across time and space; the use of Upper Palaeolithic methods of production immediately prior to the arrival of anatomically modern humans in Europe; and the long-term planning of knapping activities across the territory.

This paper also demonstrates that some of these specific behaviours (the scheduling of lithic tool production within the territory) might eventually have been abandoned by Neanderthals, while others (the use of a volumetric method of producing blanks) were kept alive by them.

These results show that models of the development of behavioural 'modernity' have to take into consideration every line of evidence, including the testimony of the behaviour of anatomically non-modern humans. We do not have to consider *a priori* that anatomically modern humans were better suited or were the only ones capable of behavioural 'modernity'. On the contrary, it is necessary to demonstrate how they were better adapted than Neanderthals. Evolutionary trajectories might be punctuated, and resulting from a combination of biological and contingent events which created a patchwork of changes.

## Résumé

Le lien causal entre la 'modernité' culturelle, synthèse des changements comportementaux qui deviendront la norme à la fin du Pléistocène, et la modernité biologique doit être discuté à partir de l'ensemble des documents dont nous disposons. L'étude des comportements des Néandertaliens avant l'arrivée des hommes anatomiquement modernes en Europe, en s'appuyant sur les industries lithique MTA de la première moitié du stade isotopique 3, montre que des comportements d'abord jugés spécifiques de notre espèce ont en fait été partagés avec les Néandertaliens. Elle montre également que certains de ces comportements, comme l'organisation à long terme de l'activité de taille dans le territoire, ont été finalement abandonnés par les Néandertaliens, tandis que d'autres, comme l'utilisation d'une méthode de taille volumétrique, ont été conservés par les mêmes Néandertaliens.

Nous ne devons pas a priori exclure les Néandertaliens d'une 'modernité' comportementale. Au contraire, nous devons rechercher, par une analyse comparée précise des comportements des Néandertaliens et des premiers hommes anatomiquement modernes en Europe, la nature des avantages de ce dernier groupe. L'évolution humaine pourrait bien être ponctuée et résulter d'une combinaison d'évènements biologiques et contingents qui ont créé un patchwork de changements.


## Introduction

By 30 000 years ago, almost all humanity had adopted a set of new behaviours generally defined as 'modern'. These behaviours are qualified as 'modern'[1] because there is clear continuity between them and the set of behaviours of historic hunter-gatherers, and because of the apparent coincidence in Europe of these behavioural innovations with the expansion of anatomically modern human populations, while Neanderthals were in the process of disappearing (Klein, 2000).

Behavioural modernity is a key question regarding the behavioural differences between us, anatomically modern humans, and our earlier ancestors. It is tackling the relationship between behavioural modernity and anatomical modernity (McBrearty & Brooks, 2000; Klein, 1998, 2000; Mellars, 1989, 1998). Yet, speaking of behavioural modernity certainly does not imply that behaviourally modern people have to be anatomically modern ones (see Chase & Dibble, 1990; Zilhão, 2001; d'Errico, 2003). We have to consider biological evolution and behavioural evolution separately, at least at the initial stage. At a later stage, we should progress towards interpreting the relationship between them. Then, is behavioural modernity linked to modern biology, or could it have arisen within the Neanderthal lineage? Furthermore, does it mean that 'behavioural modernity' is a dead concept if it is not specific to our species?

Three main models have been proposed to reconstruct the development of behavioural modernity.

1. After a selectively advantageous genetic mutation within anatomically modern humans (Klein, 1998, 2000), 'modern' behaviours would have developed rapidly

and then dispersed from Africa to Asia and Europe at around 50–40 Ky BP (Klein, 1998, 2000; Ambrose, 1998). Characterised by the use of symbols and a fully elaborated language, the sudden development of behavioural modernity can be considered a 'revolution' (Klein, 1989, 1994, 1995, 2000; Mellars & Stringer, 1989; Diamond, 1992; Mellars, 1996a, b; Noble & Davidson, 1991; Bar-Yosef, 1998; Wadley, 2001; Henshilwood & Marean, 2003).

2. Others support an earlier development of modern human behaviours (Deacon, 1989; Brooks *et al.*, 1995; Knight *et al.*, 1995; Barham, 1998; Watts, 1999; Henshilwood *et al.*, 2002). The development of behavioural modernity would have been gradual, as the gradual appearance of several distinct modern behaviours between 250 Ky and 40 Ky BP demonstrates (Deacon & Deacon, 1999; McBrearty & Brooks, 2000; Deacon & Wurz, 2001; Barham, 2001).

   Both of these models imply that behavioural modernity arose only within anatomically modern humans. Indeed genetic and fossil evidence seems to favour a single origin – or an 'Out of Africa' model – over the continuity model for the appearance of modern humans in Europe and Asia (e.g. Stringer, 2003). The Out-of-Africa model is thought to imply that there were behavioural differences between the expanding modern humans and the indigenous population outside of Europe and Asia. This consequently suggests that European Neanderthals were not behaviourally modern – or at least less so than the incoming behaviourally modern humans. This idea must not be accepted without precise knowledge of the behavioural differences between the colonisers and the local populations.

3. The third model has been recently put forward by d'Errico and his colleagues (d'Errico, 2003; d'Errico *et al.*, 2003). Extensive review of available data on Neanderthal behaviours would not support the single-species origin of behavioural modernity. Neanderthals would have contributed to the development of behavioural modernity, as well as anatomically modern humans.

Analyses of European Neanderthal behaviour then provides a point of comparison of the behaviour of yet another species. It aids in defining species-specific behaviours, and in testing the tempo of acquisition of new behavioural traits that became the norm after 30 Kya.

This paper focuses on two of the traits defining behavioural modernity according to the synthesis made by McBrearty and Brooks (2000): technological innovativeness and planning depth. It provides data on the archaeological signature of those traits within the Mousterian of Acheulian tradition (MTA) from the south-west of France. No anatomically modern human remains have ever been found associated with this industry, only the remains of Neanderthals (Maureille & Soressi, 2000). MTA assemblages have a precise geographic location, centred on the south-west of France

(Bordes, 1984; Mellars, 1973; and see a recent synthesis in Soressi, 2002: 6–7), and a precise time duration, enduring briefly either side of 50 Ky BP (Figs 1, 2). MTA is characterised by small and finely retouched cordiform bifaces and by backed elongated flakes as well as well formed end-scrapers and borers (Bordes, 1984; Fig. 3). The assemblages used for this analysis were the eponymous assemblages: Le Moustier layers G and H, Pech-de-l'Azé layers 4 to 7, as well as two others – La Rochette layer 7 and La Grotte XVI layer C. These were all dated by radiometric methods (see references for the dating in the legend of Fig. 2).

## Stability of Mousterian technology?

According to some authors, among them several who defend the Revolution model of the development of behavioural modernity, Mousterian lithic technology would be internally static and consistent through the Middle and the Late Pleistocene compared

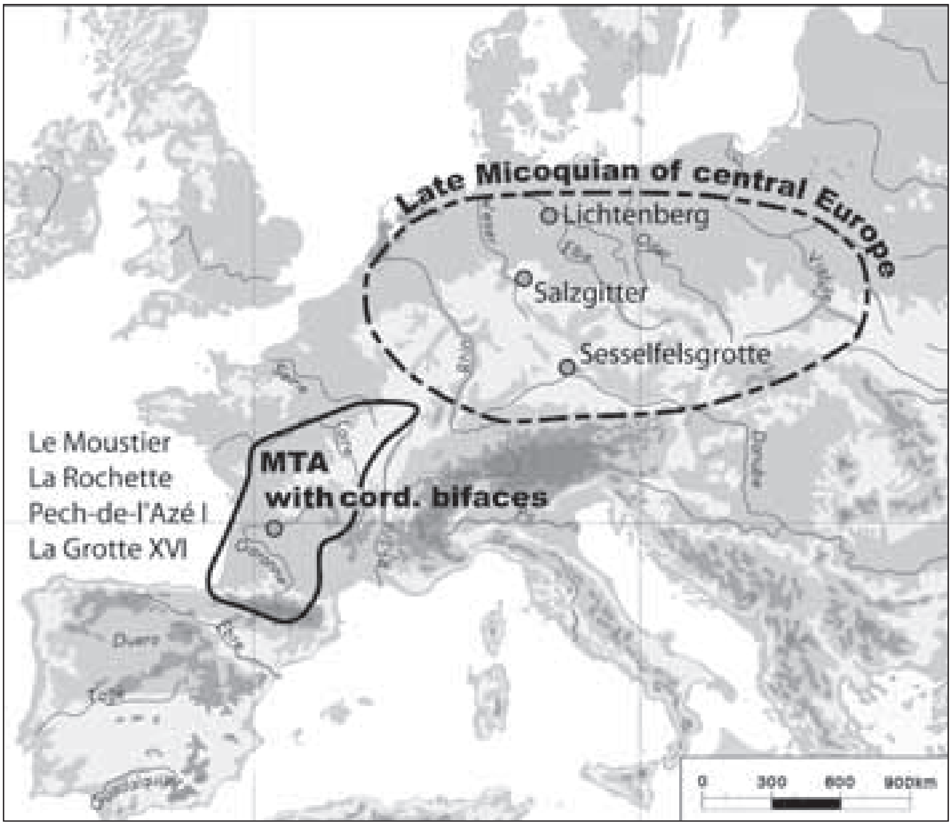



Figure 1 Geographic spread of the Mousterian of Acheulian tradition with cordiform bifaces of the late Micoquian of Central Europe, and location of sites mentioned in the text.

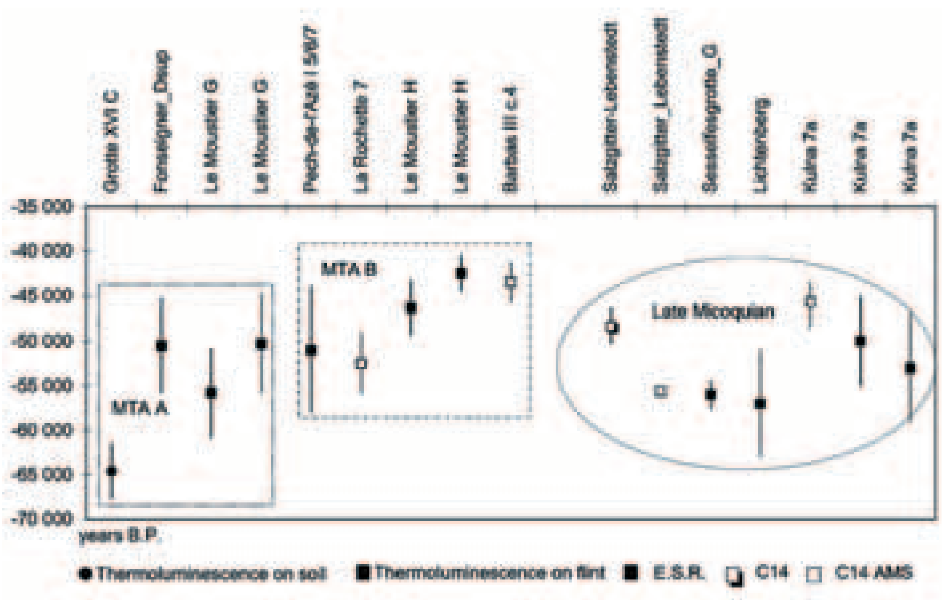



Figure 2 Dating on the MTA from south-west of France and Late Micoquian sites from Central Europe (after Guibert *et al.*, 1999; Valladas *et al.*, 1987; Soressi, 2002: 30–32, 36, and Soressi *et al.*, in preparation; Boëda *et al.*, 1996; Vogel & Zagwijn, 1967; Richter *et al.*, 2000; Veil *et al.*, 1994; Mook, 1988; and Rink et al., 1996). ESR dates are means of ages given by EU (early uptake) and LU (linear uptake) age models.

with the succeeding Upper Palaeolithic (e.g. Binford, 1989; Foley, 1997). Then, frequent technological changes would be characteristic of behavioural modernity as shown by the ethnography. Also, frequent technological changes are related to a high degree of innovation and only anatomically modern populations would have been sufficiently organised in social structures and mental capacity to allow a high degree of innovation (e.g. Wynn & Coolidge, 2004)

The stability of Mousterian technology is spectacularly exemplified by the Levallois technology known in Europe since at least IOS 8 and used continuously until IOS 3. The other method frequently used in the European Mousterian, the discoid method (Boëda, 1993; Peresani, 2003), is not specific to Mousterian industries, and would have been used in Western Europe since IOS 6 at least (Jaubert & Mourre, 1996; Texier, 1996), if not since more than 780 Ky (Vaquero & Carbonell, 2003). The Quina technology (Turq, 1989; Bourguignon, 1996, 1997) occurs more frequently in Europe during IOS 4/3 and would have been present since IOS 5 (Bourguignon, 1997: 37). Yet some technologies were used in Europe for shorter periods: for instance, a volumetric

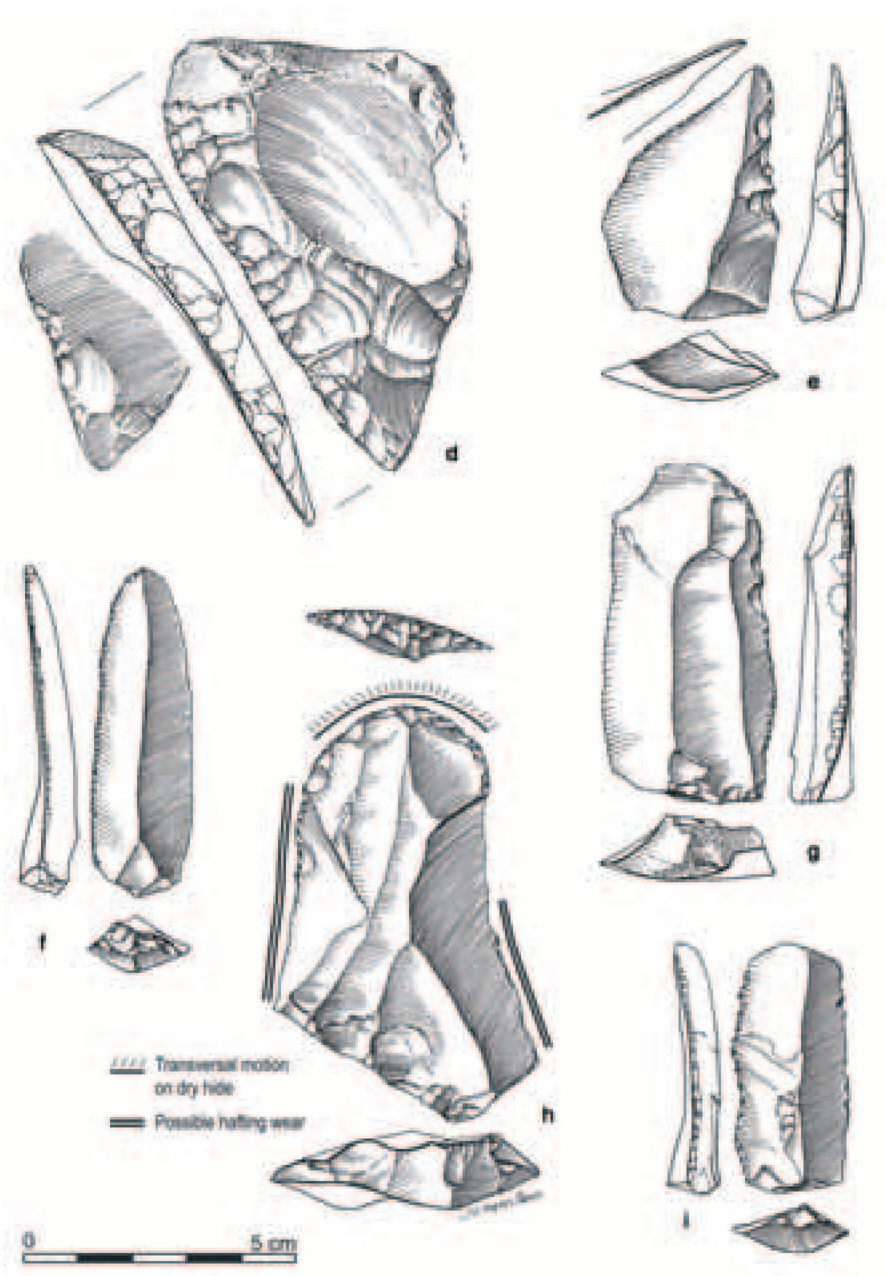
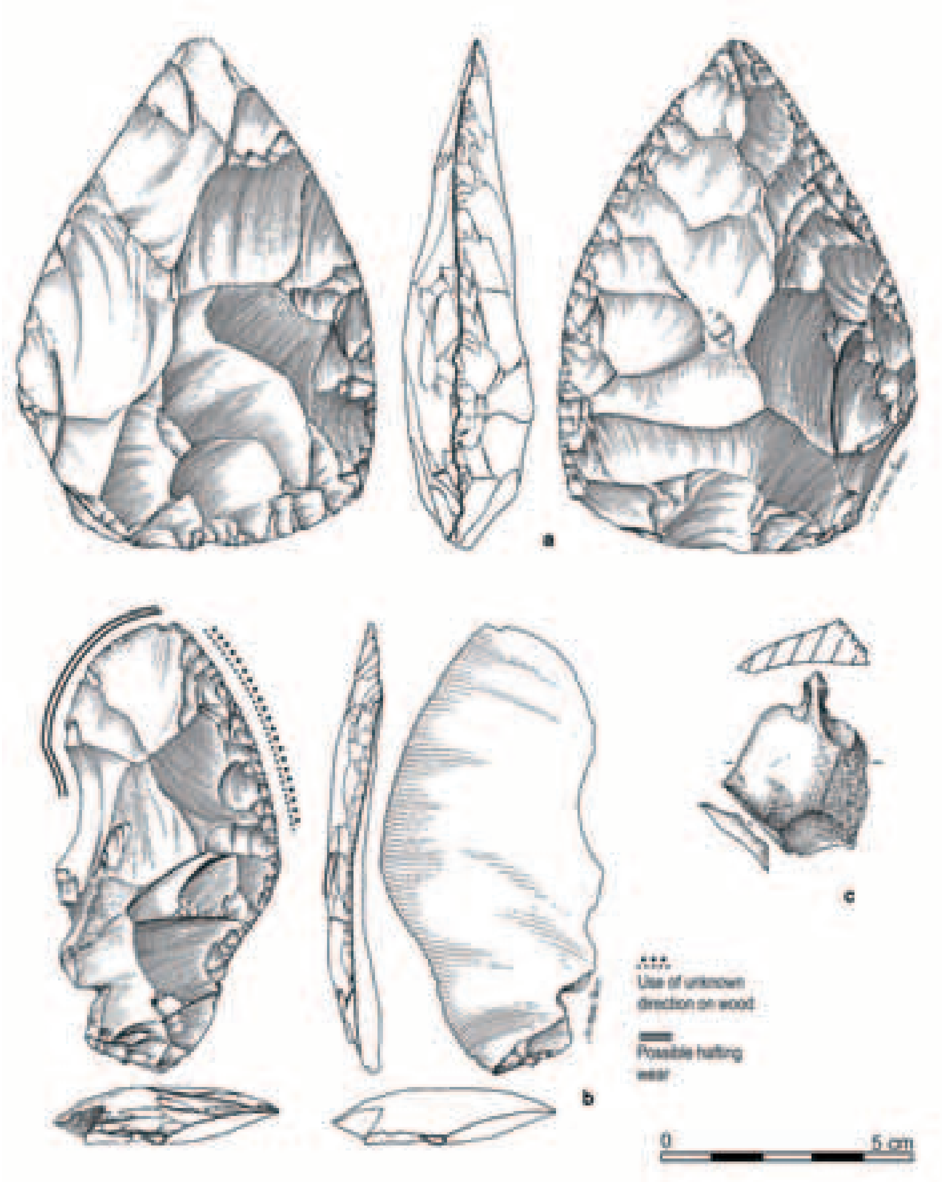



Figure 3 MTA industry: (a) small and finely retouched bifaces, (f, g, i) backed elongated flakes, (h) end-scrapers, (c) borers, (b,d) convex side-scrapers, a, b, d: Pech-de-l'Azé I, layer 4 MTA A; c: La Rochette layer 7 MTA B; e, f, g, h, i: Pech-de-l'Azé I, layer 6 or 7, MTA B (drawings by J.G. Marcillaud except (c) by S. Pasty; use-wear analysis after Anderson-Gerfaud, 1981: 112).


a
b
c
Use of unknown
direction on wood
Possible hafting
wear
0
5 cm

blade production was in fashion around stage 5c in the north of France/Germany (Révillion & Tuffreau, 1994; Delagnes, 2000; and see Delagnes & Meignen, in press for a recent synthesis).[2]

To address the stability across time and uniformity across space of Mousterian technology, I compared the methods used to shape bifaces within the MTA and those of a contemporaneous and neighbouring industry: the late Micoquian of Central Europe (also named the industry of the *Keilmesser* group). The MTA and the late Micoquian are both characterised by their bifaces and both these industries show use of other technologies such as that of the Levallois or discoid (Richter, 1997; Soressi, 2002: 240–241). The late Micoquian of Central Europe is centred on Germany. The late Micoquian industry is radiometrically dated to about 50 Ky BP (Fig. 2).[3]

The MTA method of shaping bifaces is characterised by the shaping of a bi-convex transverse section (Table 1), which progressively becomes plano-convex by retouching and resharpening of the edges (Table 2). The removals used to create this volume are generally struck from the lateral sides of the bifaces (Soressi, 2002: 113). Although the late Micoquian (LM) method of shaping bifaces is more variable, it never matches the MTA method. The transverse section of the LM bifaces often appears flat (Fig. 4a). These bifaces are manufactured with a special technique involving removals with a flat profile instead of the MTA convex removals. The transverse section may also involve a combination of flat and convex removals (Fig. 4b). Another LM method involves convex removals highly inclined on a flat or even concave surface (Fig. 4c). The biface longitudinal section is generally flat and convex, while the MTA one is bi-convex. Removals are frequently struck from the point (Fig. 5c), which is almost never the case on MTA bifaces.

Table 1 Position of the mean plane of intersection of the two faces at the biface point relative to the volume of the transverse section of the bifaces abandoned during production stage at Le Moustier and La Rochette.

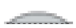
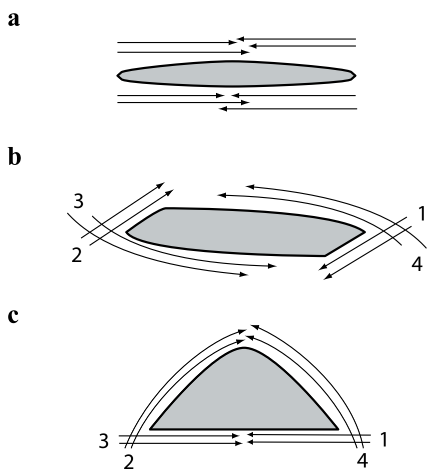
| | Moustier, G<br>*n* = 22<br>% | Rochette, MAT<br>*n* = 18<br>% |
|---|---|---|
| **Central**  | 68 | 61 |
| **Low**  | 32 | 39 |
| **Total** | 100 | 100 |

Table 2 Position of the mean plane of intersection of the two faces at the biface point relative to the volume of the transverse section on bifaces abandoned during retouch stage at Pech-de-l'Azé I (layer 4).

| | | **Pech-de-l'Azé I,4** ***n* = 70** **%** |
|---|---|---|
| **Low** |  | 61 |
| **Central** |  | 6 |
| **Central inclined** |  | 31 |
| **Foliate** |  | 1 |
| **Total** | | 100 |

Figure 4 Method of shaping bifaces used within the Late Micoquian of Central Europe, view in section (after Boëda, 1995 and Bosinski, 1967).




Might those differences between MTA and late Micoquian methods be related to the manufacture of tools designed for different uses? Available use-wear analysis shows that the MTA bifaces were used to perform variable tasks on variable materials, such as scraping wood, butchering or scraping hide (Anderson-Gerfaud, 1981: 85, Soressi & Hays, 2003), and there are examples of an MTA biface used to perform several different tasks (Fig. 6). Use-wear analyses of Micoquian bifaces are rare, but when available they show that some of them were used as meat knives (Veil *et al.*, 1994).

As use-wear analyses of MTA and Micoquian bifaces are still not common, another useful way to extract information on the functionality of the bifaces is to study their

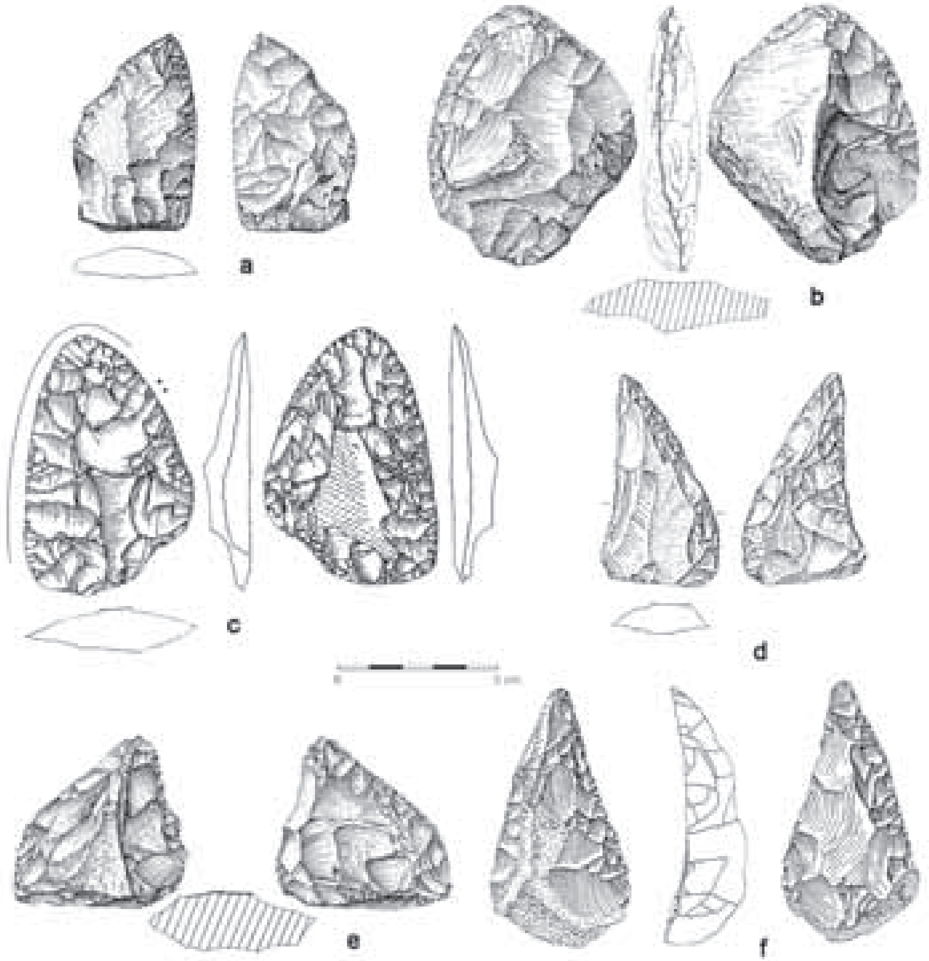



Figure 5 Late Micoquian of Central Europe industry. (a) *Keilmesser* from Klausennische (Bavière, Germany: after Debenath & Dibble, 1994: 158); (b) *Keilmesser* from Sesselfelsgrotte (Saxe-Anhalt, Germany; Richter, 1997: 383); (c) *Keilmesser* from Lichtenberg (Basse-Saxe, Germany; Veil *et al.*, 1994); (d) *Faustkeilblätter* from Klausennische (Bavière, Germany: after Debenath & Dibble, 1994: 157; (e) *Faustkeilblätter* from Sesselfelsgrotte (Saxe-Anhalt, Germany; Richter, 1997: 301); (f) *Halbkeile* from Bockstein (Rhénanie, Germany: after Debenath & Dibble, 1994: 155).

morphology. As some specialised tasks require tools of specialised morphology, studying the morphology of the bifaces would help to understand if these bifaces were specialised tools (like sharp knives or efficient scrapers) or if they were multifunctional tools.

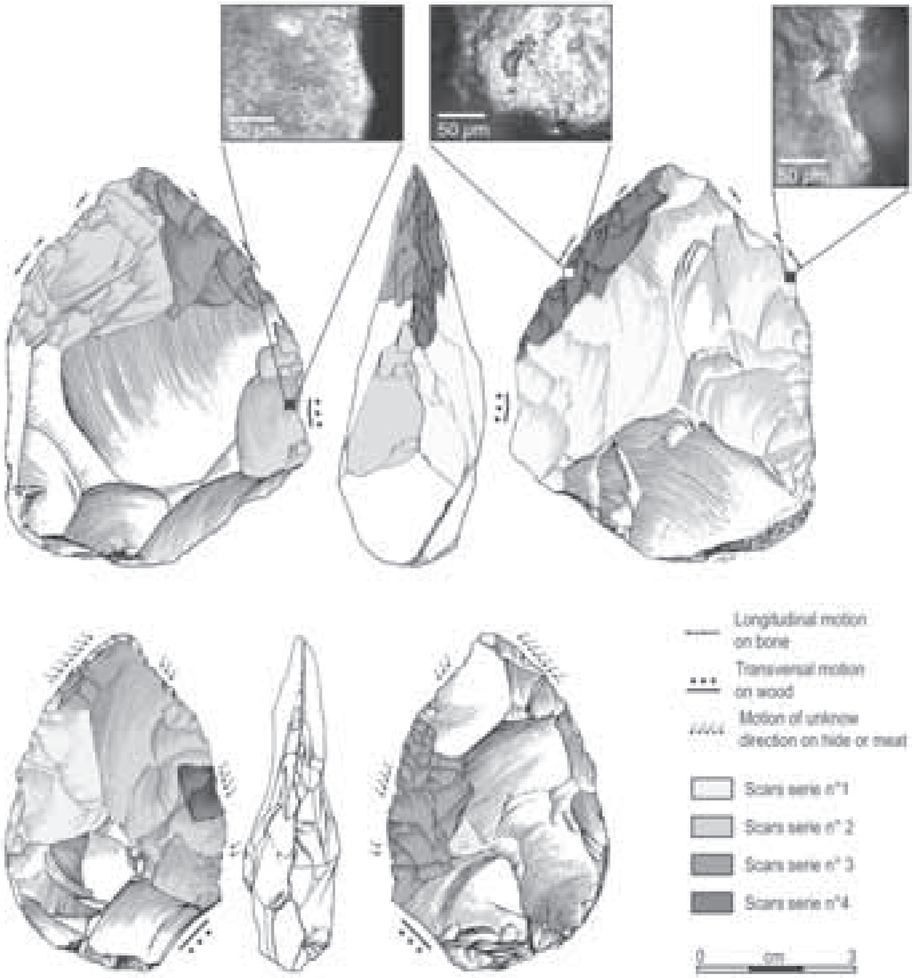



Figure 6 Bifaces from Grotte XVI layer C used on two different materials. On the smaller one, use on hide or meat probably came after the use on wood, according to the chronology of removals shaping the biface (after Soressi & Hays, 2003).

The angulation and the delineation of edges situated on both sides of the point are different from the ones of the biface bases. Point edges are acute and regular while basal edges are blunt, often abraded and irregular. The contrast between the angulation and delineation of those edges as well as the geometric opposition between them allow the inference that the edges on both sides of the point are the active edge

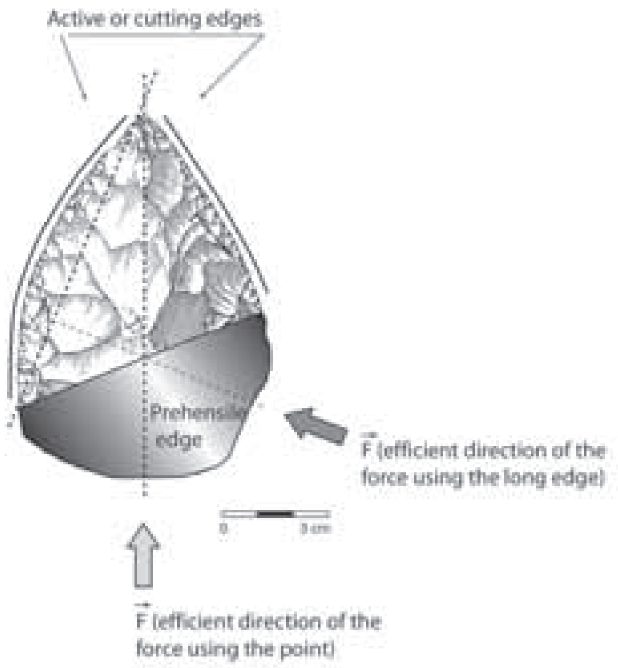



Figure 7 Position of active and prehensile edge on MTA bifaces, and possible multiple uses, implying the point or the long edge, according to the direction of the force applied to the biface.

while the basal edge is the passive – or prehensile – one. This hypothesis is verified by the available use-wear analyses (Anderson-Gerfaud, 1981: 85; Soressi & Hays, 2003). André Leroi-Gourhan's (1943: 47–64) ethnographic referential demonstrates that for a tool to be utilised in a punctiform way (e.g. to bore), it merely needs a polyhedral point and a prehensile edge opposed to this point. It also shows that to be used in a linear movement (e.g. to cut or to whittle down), a tool needs a prehensile edge allowing a prehension perpendicular to the long axis of the active edge. Actually, the MTA bifaces, with their initially symmetrical active edges, allow a punctiform action. Simultaneously their morphology also permits a linear action, because the longest active edge here is sufficiently extended to allow prehension perpendicular to its long axis (Fig. 7).

As many ethnographic studies have shown, the possibility of using tools to cut-in material (i.e. a vertical incision), or to cut-out (i.e. a horizontal incision), or to do both is related to the angulation of the edges. Edges close to 35° and more acute than 35°

would be useful mainly for in-cutting, wider edges exceeding 65° would be useful for out-cutting only, while intermediate angulation would allow both directions of cutting (Soressi, 2002: 61–62 and references therein). In fact, the intermediate angulation of biface active edges, about 53°, allows both directions of cutting. Furthermore, the continuity of this angle toward the centre of the piece allows deep as well as superficial cuts while an abrupt change of angle toward the centre of the tool would allow only a superficial cut (continuity of the angle is present on 85 per cent of the bifaces at Pech-de-l'Azé I, $n = 55$). So each of the available lines of evidence, use-wear analyses and analyses of their morphology, shows the multifunctionality of MTA bifaces.

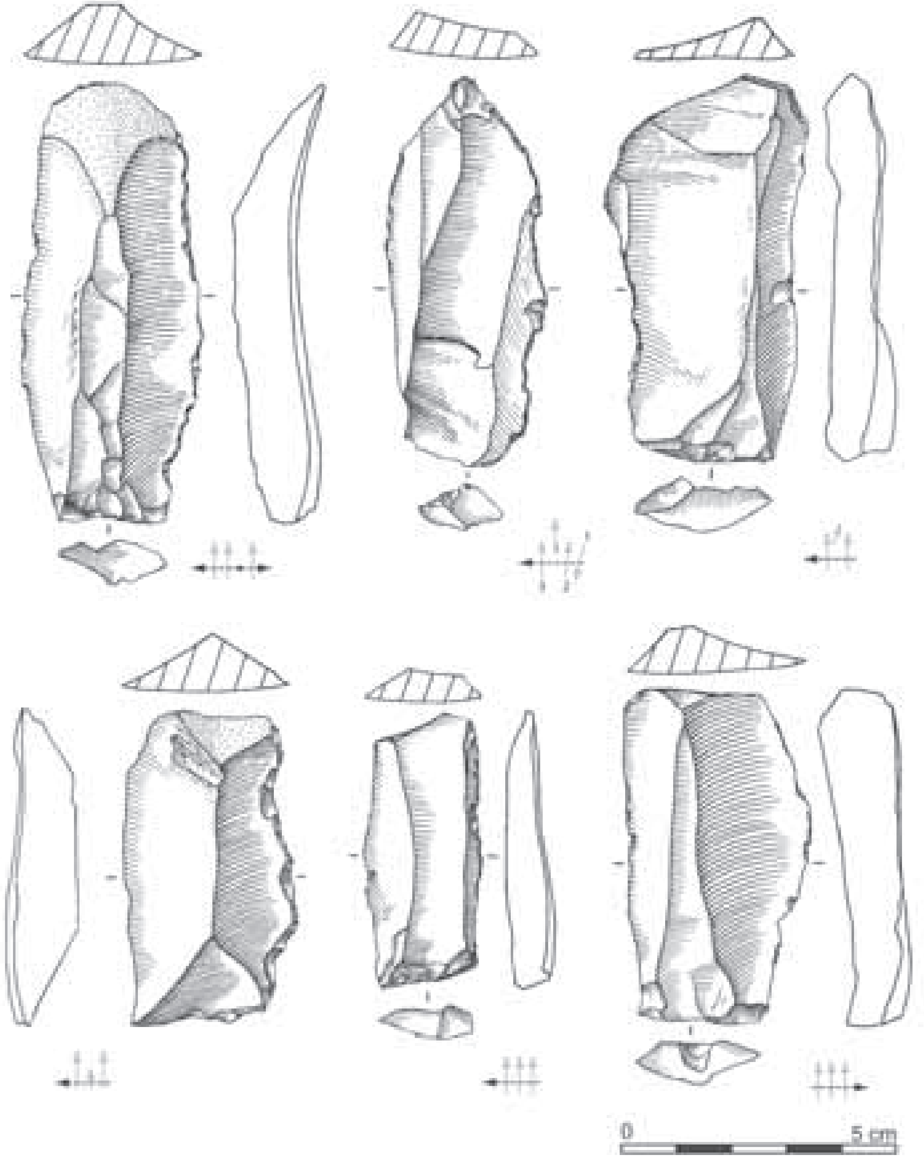
The variety of shape and the angulation along the acute edges of the Micoquian bifaces, ranging from very acute edges to more open edges, would probably have allowed a variety of uses (Fig. 5). So, the MTA bifaces as well as the late Micoquian bifaces were probably used in the same way: to perform a variety of tasks.

These neighbouring groups were using two different technologies to produce tools used to satisfy equivalent needs during contemporaneous time, according to the time resolution given. These technologies were used for a restricted period of time relative to the duration of the Middle Palaeolithic (less than one tenth of its duration). To conclude on this point, the MTA provides one archaeological signature of innovation within the European Mousterian.

## Acculturation responsible for innovation by the end of the Mousterian?

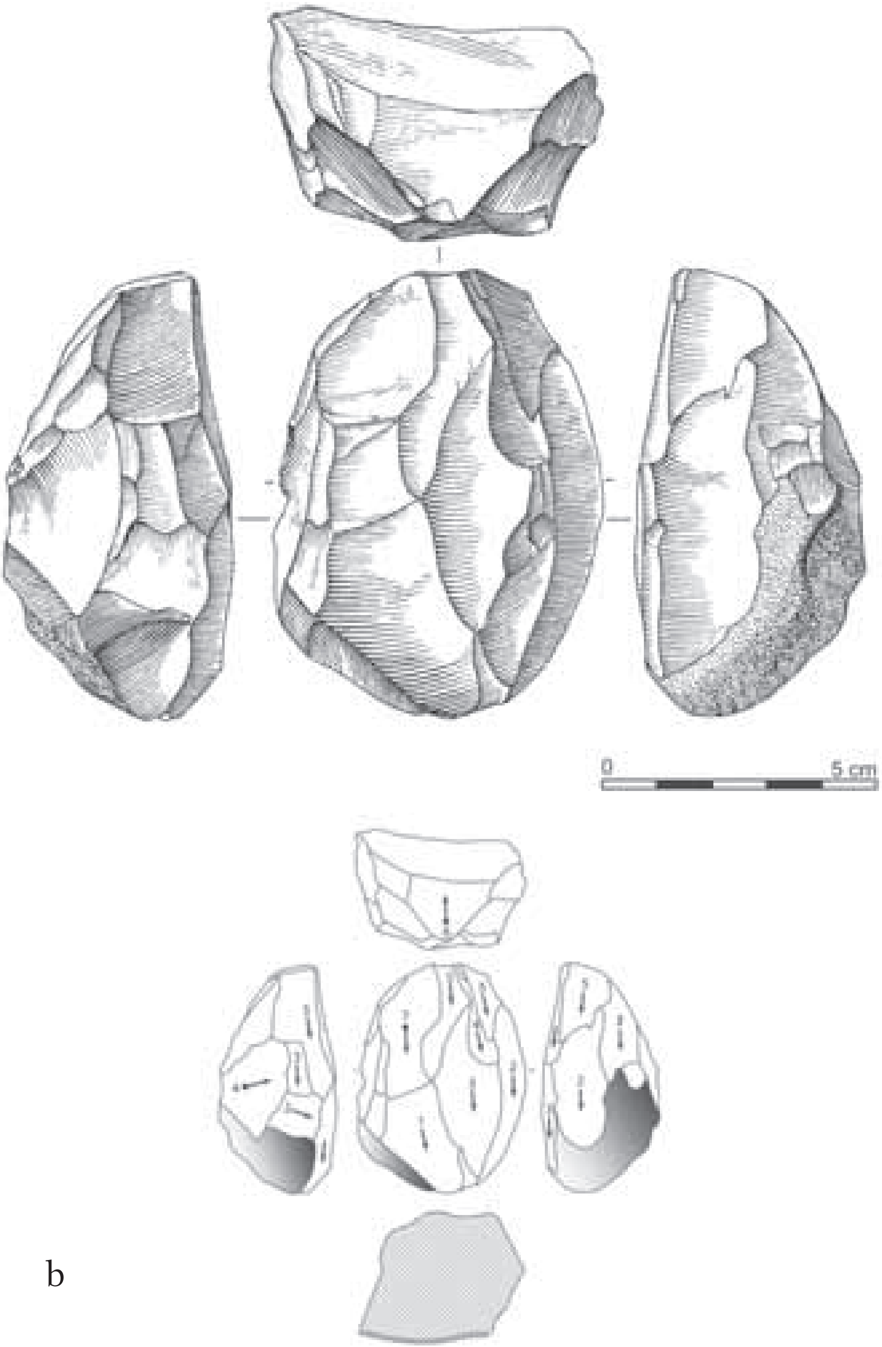
The use of an Upper Palaeolithic volumetric method of debitage by the last Neanderthals in South-western Europe is considered by some to be a result of acculturation from contact with anatomically modern humans (AMH) after 40 Ky (Demars & Hublin, 1989; Mellars, 1989a, 1989b; Graves, 1991; Wynn & Coolidge, 2004). Châtelperronian blade production would be one example of this acculturation. In fact, as mentioned earlier, volumetric methods of debitage are known in the north of France during ISO stage 5 (Révillion & Tuffreau, 1994; Delagnes, 2000). Yet none had previously been described within the period of IOS 4 and IOS 3, which precede the Châtelperronian, and this volumetric method of producing blanks is thought to have disappeared until the influence of anatomically modern humans in Western Europe.

Several methods of debitage had been used within the MTA. One of them was used to produce elongated blanks, of a 1,76 ± 0,53 elongation ratio (mean calculated on three assemblages, n total = 505; Fig. 8a). Actually, my analysis of MTA from Pech-de-l'Azé layer 5–7 and La Rochette layer 7 shows that this method is of Upper Palaeolithic type because the debitage (i.e. the flaking of the end-products) occurs not only on the broad faces of the core but also on the narrow ones. It actually rotates around part of the volume of the core (Table 3; Fig. 8b). The direction of the removals shaping




a

Figure 8 Flakes (a) and core (b) from MTA type B of La Rochette layer 7 (drawings S. Pasty, chronology of removals is indicated).




b

the platform also indicates that the platform is more often prepared for a lateral flake removal instead of an axial flake, which in turn indicates that the debitage has systematically been removed in a circular fashion around part of the circumference of the core (Table 4).

Table 3 Position of the mean plane of intersection of the two faces at the biface point relative to the volume of the transverse section of the bifaces abandoned during production stage at Le Moustier and La Rochette.

| | **Rochette, 7**<br>***n* = 38**<br>**%** | **Pech-de-l'Azé I, 7**<br>***n* = 34**<br>**%** | **Pech-de-l'Azé I, 6**<br>***n* = 37**<br>**%** |
|---|---|---|---|
| **Debitage on the narrow side(s) of the core** | 73 | 81 | 57 |
| **Debitage only on broad side(s) of the core** | 27 | 19 | 43 |
| **Total** | 100 | 100 | 100 |

Table 4 Position of the mean plane of intersection of the two faces at the biface point relative to the volume of the transverse section on bifaces abandoned during retouch stage at Pech-de-l'Azé I (layer 4).

| | **Rochette, 7**<br>***n* = 43**<br>**%** | **Pech-de-l'Azé I, 6**<br>***n* = 36**<br>**%** |
|---|---|---|
| **Lateral** | 81 | 87 |
| **Axial** | 19 | 13 |
| **Total** | 100 | 100 |

Conclusively, MTA people were using the volumetric Upper Palaeolithic method of producing blanks shortly before the arrival of anatomically modern humans in Europe. MTA is the only Mousterian industry within south-western Europe with an emphasis on elongated backed artefacts (cortical backing, retouch backing or backing produced during the debitage process) as important as the one characterising the Châtelperronian (Soressi, 2002: 277–284; Fig. 9). Considering that Pelegrin (1995: 260–265) has already demonstrated that the Châtelperronian does not mimic Aurignacian technology, there is no reason to believe that the Châtelperronian Upper Palaeolithic method of producing blades is derived from acculturation whilst in contact with anatomically modern humans. These were actually modifying habits that were already in use before the arrival of anatomically modern humans. Once again Mousterian innovativeness is demonstrated.

## Lack of planning of Mousterian technology?

McBreartry and Brooks (2000) define planning depth as the ability to formulate strategies based on past experience and to act upon them in a group context. Tangible traces of this could be seen, for example, in the scheduling of resource exploitation (McBreatry & Brooks, 2000: 402). One way of interrogating the planning of Mousterian technology is by looking at the different location(s) used during the production process of stone tools. It would be exclusively in the context of raw material scarcity that Mousterian tools and blanks would be transported far away from their place of manufacture, but no planning of the knapping process would be seen in context of abundant raw material. The entire manufacture process would then have taken place at the site whereas Upper Palaeolithic anatomically modern humans would use sites with local abundant raw material as workshops. They would only have processed the initial stages of the manufacture at those sites, and the unfinished blanks would have been exported out of those sites to a further destination (Feblot-Augustins, 1997: 223–228).

The MTA assemblages I studied revealed that only the first stages of the reduction sequence were done *in situ* at sites like Le Moustier and La Rochette, and bifaces were in most cases abandoned at the production stage (Fig. 10a). At other sites like Pech-de-l'Azé I, abandoned retouched bifaces were the norm and the reduction sequence would have been entirely completed at the site (Fig. 10b). Finally, at sites like the Grotte XVI, only imported retouched bifaces are found (Fig. 10c). Yet the sites of Le Moustier, La Rochette and Pech-de-l'Azé I rest directly on the rich source of good flint which was used to make the bifaces. Le Moustier and La Rochette have to be considered as biface workshops, where tools were manufactured in advance to be brought eventually to other sites, e.g. Grotte XVI.

The massive retouch seen at Pech-de-l'Azé I cannot be due to a lack of local raw material compared to Le Moustier or La Rochette, as the size of the archaeological assemblage at Pech is its testimony. At Pech-de-l'Azé I, more than 30 000 lithic artefacts larger than 3 cm had been manufactured from the local flint during the MTA. Acquiring raw material, then, presented no problem, without even considering the thousands of contemporaneous artefacts produced at Pech-de-l'Azé IV eighty metres from Pech-de-l'Azé I (McPherron & Dibble, 2000).

Then, even in the context of abundant raw material, which is true of the Périgord area where these four sites are located, a scheduling of the knapping process is observed. This is one example of long-term planning of knapping activities, not driven by raw-material scarcity, previously thought to have been used in Europe only by anatomically modern humans.

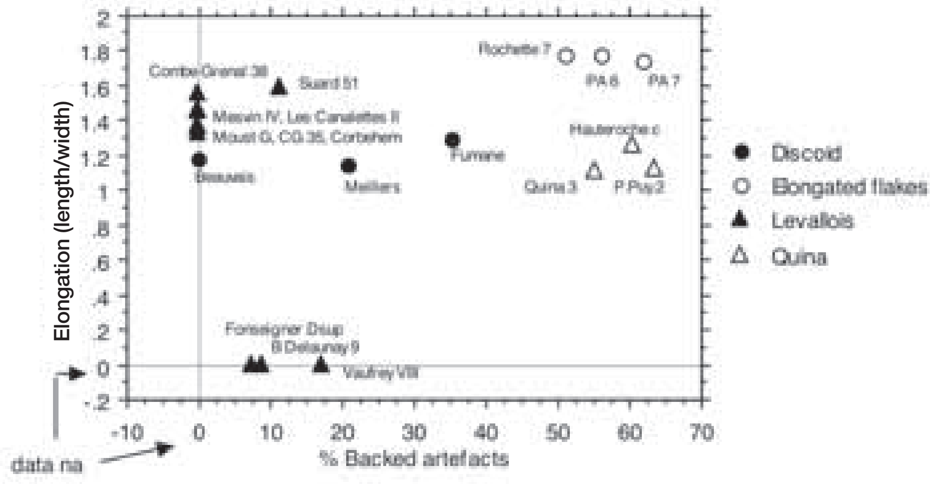



Figure 9 Percentage of backed flakes (pseudo-Levallois points, flakes with a cortical back, *débordants* flakes) and elongation of production flakes within MTA type B assemblages (Rochette layer 7, Pech-de-l'Azé 6 & 7: Soressi, 2002: 218–230) and within other Mousterian assemblages (Beauvais: Locht & Swinnen, 1993; Locht *et al.*, 1995; Fumane: Peresani, 1998; Meillers: Pasty, 2000; Corbehem, Combe-Greanl 35 & 38, Suard 51, Bourgeois-Delaunay 9, Mesvin IV: Delagnes, 1992; Les Canalettes: Meignen, 1993; Vaufrey VIII, Fonseigner Dsup: Geneste, 1985; Hauteroche C, La Quina 3, Petit Puymoyen 2: Bourguignon, 1997; Le Moustier G: Soressi, 1999).

### *A progressive improvement of Mousterian behaviours?*

Two successive episodes can be distinguished within the MTA. MTA Type A is characterised by the production and use mainly of bifaces, MTA type B by the production and use mainly of backed knives and elongated flakes. The chronology of these episodes is based on their relative stratigraphic position at key sites (Bordes, 1984: 149; Delporte, 1970), as the resolution of radiometric dating has not yet allowed the determination of the precise duration of each event (Fig. 2).

The later stage of the MTA, MTA type B, is characterised by:

- the less frequent use of bifaces, knowing that MTA bifaces were long-lasting tools, resharpened (Soressi, 2002: 127–134, 2004) and transported from site to site (Soressi, 2002: 80, 163; Soressi, 2004).
- the less frequent hafting of tools, indicated by use-wear analysis on Pech-de-l'Azé I stone tools. Denticulates, the more frequent MTA B tool, are significantly less hafted than scrapers and end-scrapers, more frequently found in the MTA A (Soressi, 2002: 262, 2004 after Anderson-Gerfaud, 1981:77–85).

- the less elaborate planning of the production of stone tools. The organisation within the territory mentioned above is used only during the first stage of the MTA: MTA type A. Analyses of MTA type B assemblages at the same sites (Pech-de-l'Azé I layer 6 and 7, La Rochette layer 7) indicate that, contrary to what is seen in MTA type A, entire reduction sequences are completed at the sites (Soressi, 2002: 205–206, 2004).

The production of MTA type B was not constrained by a sudden lack of raw material. At Le Moustier and La Rochette, several other assemblages were produced after the MTA, still using the same raw material (there are three successive layers above the MTA at Le Moustier and at La Rochette – Peyrony, 1930; Delporte & David, 1966).

Scheduling of resource exploitation in respect of lithic raw material was practised during the MTA type A, but was later abandoned. It is one example of a diachronic behavioural change towards less planning.

## Discussion

This paper provides new elements to show that some behaviours, earlier thought to be characteristic of recent behaviours associated with anatomically modern humans, were in fact shared with another biological species. This paper also demonstrates that some of these behaviours (the scheduling of lithic tool production within a territory) were eventually abandoned by Neanderthals, while others (the use of a volumetric method of producing blanks) were kept alive by the same Neanderthals.

Should we refuse to qualify these behaviours as 'modern' because they were performed by Neanderthals? It is not necessary to do so if we accept that biological and behavioural changes occur autonomously, or if we accept that some behavioural changes included within the 'modernity' package might have occurred without

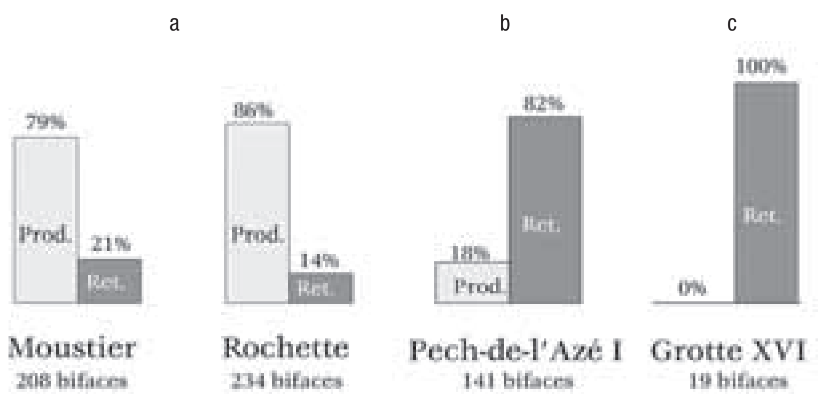



Figure 10 Proportion of the two main stages of the reduction sequence of bifaces at different MTA sites.

biological change. Transmitted by imitation or teaching, behavioural changes do not necessarily require biological changes, as the (often used) example of the Neolithic revolution has demonstrated.

This leads me to conclude that:

1. We have to accept that Neanderthals did behave in ways that would have been the norm after their disappearance. The dominance over the last years of the Revolution model of the emergence of behavioural 'modernity' might have induced the transformation of its initial assumption of the behavioural advantages of the last surviving species to the new assumption that Neanderthals must have always behaved in a peculiar and different way (see Chase & Dibble, 1990). We need to be aware that teleological or goal-direct explanations are opening the way to circular arguments (Renfrew, 1996). There is general agreement that anatomically modern humans represent the last species of hominid, and that our species emerged some 40–200 Kya – according to the different settings of the molecular clock and to the observed phenotype of the human fossil remains. But it is still hotly debated whether or not this genetic change gave rise to a quick, massive and permanent behavioural change. One has to then demonstrate and not to assume (cf. Gould, 1989: 304–306) that the last surviving hominid species, our species, did acquire some new, rapidly expanding and persistent behavioural changes after their speciation. Only this procedure would establish a firm link between biological changes and behavioural changes for this period of time. Consequently, the behaviour of Neanderthals has to be as accurately and thoroughly investigated as that of early anatomically modern humans.

We also know that depending on historical contingencies, actual or sub-actual societies developed in different ways. Sub-actual groups were living in Stone Age times, whereas others were living in the time of the industrial age. So to distinguish between biologically, environmentally or historically induced changes, we would probably have to check for the universality and the persistence of those changes. Would symbolism fulfil those conditions? Symbolic behaviour would certainly be recognised as a universal and persistent change after 40 Ky. But then the question still remains about the link between the adoption of this behaviour and biology. Symbolic behaviour by Neanderthals has been demonstrated in the Châtelperronian of South-western Europe (d'Errico *et al*., 1998; Granger & Lévêque, 1997). Furthermore, some of the potentially critical evidence of interaction or acculturation of Neanderthals by Aurignacian groups has recently been withdrawn (e.g. by the invalidation of technical influence between those two groups – Pelegrin, 1995: 261–262 ; d'Errico *et al*., 1998, and by the refutation of interstratifications between Châtelperronian and Aurignacian layers – Bordes, 2002, 2003). Yet, at the same time, evidence for contemporaneity from radiometric dating is increasing, at least on a broad geographic scale (e.g. Conard &

Bolus, 2003), while noting that other authors regard it as controversial (e.g. Zilhão & d'Errico, 2003).

2. The other conclusion that I am driven to is that behaviours that became the norm or that were eventually generalised after 40 or 30 Ky would have developed in a patchy way with regard to time and space (see d'Errico, 2003 for the development of a similar idea). This implies that according to the historical and environmental circumstances, some groups might have adopted, at an early date, behaviour that would have been generalised later. They might have then abandoned this behaviour (as exemplified by the MTA type B). Later the same group or another one would have re-invented and re-adopted it, and eventually it would become generalised.

In the end, the picture of the emergence of behavioural 'modernity' we get now is probably over-simplified because it was obtained mainly by considering AMH behaviours and not always using comparable data about Neanderthals, and because it over-emphasises either the revolutionary idea or a gradual progression toward 'modernity', though actually this trajectory might be multi-punctuated, and even reversing from time to time. Finally, the actual picture is also not enough considering that behavioural changes might be related not to a single cause, but to a combination of biological and contingent events which created a patchwork of changes.

## Notes

1 Jean-Jacques Hublin argued at the conference that the term 'modern' should be avoided when referring to Palaeolithic biology or behaviour. He and other discussants proposed that 'recent' and 'earlier' *Homo sapiens* would better suit the reality of the fossils remains we are dealing with (Morris, 2003). Concerning behavioural modernity, it is true that using this term to define a way of life which disappeared more than 7 Kya in Europe is probably not appropriate, especially when addressing the general public. Nonetheless, I will for now continue to use the term 'behavioural modernity', until a more appropriate word is established in the literature.

2 Yet, the low resolution of dating techniques of sites older than 35 Ky (with a very large sigma error) does not allow knowing the precise duration of the blade production or of the MTA episode.

3 Since the writing of this paper, Joris (2004) published a synthesis of the chronostratigraphy of the late Middle Palaeolithic assemblages in Central Europe.

## Acknowledgements

I am very grateful to Lucinda Backwell and Francesco d'Errico for their kind invitation to the meeting, as well as for their comments on an early draft of this paper.

C. Henshilwood gave me the opportunity to enter the 'network' of collaborations between France and South Africa by inviting me to analyse Blombos lithic industries. Data presented here were collected while I was working on my PhD dissertation which benefited from many discussions with J-M. Geneste, P. Villa and H. Dibble. Nikki Berington helped me to write this paper in better English. My gratitude extends to the CNRS/ECLIPSE project lead by M. Sanchez-Goñi for funding the AMS 14C dating of La Rochette, to the French Minister of Culture, the Conseil General de la Dordogne and the IPGQ for their support toward the ESR dating of Pech-de-l'Aze I. This paper was prepared while I was financially supported by the Fyssen Foundation. The IZIKO South African Museum provided working space and was a place of stimulating discussions while working in Cape Town.

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