CONTRIBUTION TO THE UNDERSTANDING OF NEANDERTHAL TECHNICAL BEHAVIOR DURING END OF OIS 6 AND LATE INTERGLACIAL (OIS 5) IN SOUTHERN EUROPE: THE LITHIC ASSEMBLAGE OF UPPER LEVEL IN THE SITE OF PAYRE (RHÔNE VALLEY, SOUTHEASTERN FRANCE)

Marie-Hélène Moncel\(^1\) and María Gema Chacón\(^2\)

\( ^1 \)Département de Préhistoire-CNRS, Muséum national d’Histoire Naturelle, Paris (France); moncel@mnhn.fr

\( ^2 \)Área de Prehistòria Universitat Rovira i Virgili, IPHES (Institut Català de Paleoeologia Humana i Evolució Social), Tarragona (Spain); gchacon@prehistoria.urv.cat

Abstract

The Middle Paleolithic site of Payre is one of the rare sites in the Middle Rhône valley dated from oxygen isotopic stages (OIS) 7–5. Payre yielded several archeological units with human remains. Humans occupied one or several rock shelters. The upper D level, one of the Neanderthal occupations, is dated to the end of OIS 6 or beginning of OIS 5. This period is poorly documented in southern France – a period when Neanderthal populations spread through Europe. Seasonal occupations took place during winter. Based on the crushing marks, multiple-use tools were used for subsistence activities such as consuming animals that had been brought in quarters. The diversity of products reflects various activities that may have been linked with cynegetic external actions oriented toward the hunt of Cervus elaphus. Other domestic activities were documented, such as pebble gathering, tool-making from large flakes in basalt, quartz, limestone and quartzite, and flint scrapers and points produced by the discoid débitage method. The characteristics of the lithic assemblage are compared with the patterns observed all over Europe.

INTRODUCTION

At the end of the Middle Pleistocene, Neanderthal populations expanded throughout Europe and their anatomic features reached a balance. The OIS 5 period shows the development of Classic Neanderthal features (Condemi, 1998; Courture and Hublin, 2005). The spread of Neanderthal populations over Europe is shown by the large number of sites of that period which cannot be explained only by a better sediment preservation. In the state of our knowledge, northern Europe was not really abandoned during colder periods, but less inhabited. On the contrary, a large number of sites is dated to OIS 5 (Foltyn et al., 2005). The scarcity of sites in northern Europe during glacial phases (OIS 8, 6 and 4) suggests that some populations found a refugee in southern territories. During the interstadial periods (OIS 7 and OIS 5), human groups expanded probably into previously abandoned territories. At the same time, southern Europe, including the south of Central Europe, was inhabited continuously. Southern plateaus, valleys and basins, separated or not by geographic barriers, offered a mosaic of possibilities.

Their technical behavior raises interesting issues concerning the Neanderthals’ abilities to colonize and tolerate their environments during Middle Pleistocene (Gamble and Roebroeks, 1999). Archaeological studies have revealed more
complex and organized hunting practices during OIS 5 than during older periods (Gaudzinsky, 2002). Since OIS 9–8, the lithic processing systems became longer and more complex. Sites of that age show a large technical variability in time and space, related with traditions, activities and stone availability. Some new traditions, such as the laminar method, appear during OIS 8 and develop during OIS 5 (Réвillion, 1995). In northern Europe, these changes have been explained by discontinuity. In southern Europe, continuous occupation did not favor breaks in the technical tradition, except for the laminar method, which appeared at the beginning of OIS 4, and likely the Quina tradition (Moncel, 2003).

The Rhône Valley (France) sites, dated from 350,000 years to the occurrence of Modern Humans ca. 35,000 years ago, are testimonies of these continuous occupations. In this area, abundant lithic assemblages were excavated, providing valuable information about Neanderthal populations. All over Europe, Levallois technique assemblages appeared, as the Mammoth-steppe developed (Moncel, 2003). In the Middle Rhône valley, Middle Paleolithic behavior is recognized in Orgnac 3, dated from OIS 9 to the beginning of OIS 8. Among the Paleolithic sites found along the Ardèche River, a tributary of the Rhône River, the site of Payre is an example of a cave occupation that became progressively a shelter. It has been dated to OIS 7–5. The upper part of the sequence, level D, dated from the end of OIS 6 to the beginning of OIS 5, recorded several human occupations. We studied the level D assemblages to test its similarities and differences with older and later ones. Through this study, we intend to contribute to the understanding of Neanderthal behavior, especially during the end of OIS 6 and beginning of the Late Interglacial OIS 5.
Neanderthal technical behavior during end of OIS and late interglacial

ARCHAEOLOGICAL CONTEXT

The site of Payre

The site of Payre is located at the edge of the Rhône valley. It opens to the southeast on a cliff, 60 m above the Payre River, a small tributary of the Rhône River. The site is a flat surface of 80 m², 15 m long, 12 m wide. It has been regularly excavated since 1990 (Combier, 1967; Moncel, 1993; Moncel et al., 1993) (Fig. 1). The site belongs to a karstic complex of the Jurassic and Cretaceous formations, which cover a large part of the right edge of the middle Rhône Valley (Debard, 1988). The sequence, 5 m thick, is made of five main levels (G, F, E, D-C and B-A from bottom to top), each of them including sub-layers (Fig. 2).

The study of the sequence indicates that humans first inhabited a cave, and then shelters, after the cave collapsed due to erosion. As cave morphology and surrounding landscapes kept changing, recurrent human occupations took place under the 2 m limestone vault, or in front of it, during the deposition of unit D. This unit, excavated over 70 m², is 20 to 60 cm thick. Data obtained from pollen analyses indicate a semi-open environment. Quercus t. ilex was found at the base of unit D and was replaced toward the summit by Buxus. The presence of Quercus t. ilex, Buxus, Pistacia and Cistus emphasizes the Mediterranean influence (Kalai et al., 2001). Large forest surfaces area, composed of Quercus and Carpinus, are known to have spread over high latitudes during OIS 5 in Western and Central Europe (Andrieu et al., 1998; Caspers et al., 2002). At the same period, Mediterranean vegetation persisted in southern Europe (Beaulieu and Reille; 1989; Woillard, 1978). The sequences in Central Europe suggest a closer forest in a warm and humid context (Taubach, Gasovce, Bojnice, Tata; Vertcs, 1964; Svoboda, 2002).

Biostratigraphical patterns

The three main occupation phases (units G, F, and D) deposited during interstadial or interglacial phases when the climate was temperate and humid. The environment was composed of highly developed forestall areas and open spaces which favoured a great diversity of taxa in several ecological compartments. The mammal species...
are Dicerorhinus hemitoechus, Stephanorinus kirchbergensis, Equus cf. mosbachensis, Bos primigenius, Bison sp., Cervus elaphus ssp., Capreolus capreolus ssp., Megaloceros sp., Capra ibex, cf. Hemitragus sp., Rupicrurus sp., Sus scrofa ssp., Ursus deningeri-speleus, Ursus arctos, Canis lupus ssp., Vulpes vulpes, Panthera (Leo), Panthera pardus, Crocuta crocuta ssp., Meles meles, Martes arctes, Castor fiber, Lepus sp., and unspecified herbivores (Elephas) (Moncel et al., 2002) There are few variations among the different levels. Since Equus cf. Mosbachensis, frequent in biozone 21, is present in unit F, together with Hemitragus, an animal which seems to have disappeared before the end of the penultimate glaciation, and an ursid with mixed characteristics between Ursus deningeri and Ursus spelaeus (evolutional stage frequent in biozone 23). This leads us to propose that units G and F belong to stage 7.

Twenty-three micro-mammal species were found in the sequence. Pliomys lenki and Microtus brecciensis (Iberomys) are observed in both levels G and D. They belong to Middle Pleistocene, but were found to extend to the beginning of Upper Pleistocene in southern France. This attribution is backed up by the thick enamel of Arvicola teeth in levels F and D. In Unit D, the association of four species of rodents (Pliomys lenki, Microtus brecciensis (Iberomys), Arvicola terrestris and Arvicola sapidus) suggests an open humid environment that belongs to the end of Middle Pleistocene and the beginning of Upper Pleistocene. The avian remains evoke a temperate climate with a rather open and rocky landscape (El Hazzazi, 1998; Moncel et al., 2002).

Large mammal associations and palynological results, which indicate a semi-open to open landscape, lead us to assign unit D to a sub-stage of the OIS 5, probably OIS 5d. The micro-mammal association tends to suggest that unit D corresponds rather to the end of OIS 6 and the beginning of OIS 5, deposited during a milder climatic phase.

**Dating**

Bones and large mammal teeth were dated by U-Th and ESR, and burned flint was dated by TL and were sampled throughout the whole sequence and on the stalagmitic floor located at its base (Moncel, 1993; Masaoudi et al., 1997; Moncel et al., 2002; et al., in press) (Fig. 3). The TL datings are still unpublished. The dates suggest that the stalagmitic floor was formed on both sides of the cave during OIS 8–7. It is overlaid by orange clay with numerous stones and slabs, which yielded most of the scattered human remains of two occupations. Eight teeth and a fragment of a left parietal bone belong to three or four individuals, children, youth, and adults (Moncel and Condémi, 1996, 1997). TL dates correspond to OIS 7, as for the second deposit, level F. Made of seven stages of gray sediment and beds of rubble and clay, it corresponds to alternating human and animal occupations, especially occupation by Ursus. Rare pollens indicate a semi-forest environment with Mediterranean trends (Kalaï et al., 2001). This slightly disagrees with the cold and dry climate reflected by the micro-faunal patterns, which may however be the result of selection by birds or bone injection inside sediments. The cave ceiling collapsed at the end of OIS 6 or beginning of OIS 5 (U/Th and ESR datings). The cavity opened. Pollen indicate a temperate environment. Then Payre cave was progressively shrank and became a shelter for human occupations.

According to the new radiometric ESR and U/Th dates obtained on bones and teeth of large mammals, the deposits of unit D are attributed to the end of the OIS 6 or the beginning of OIS 5 (Masaoudi et al., 1997; Moncel et al., in press). New dating of two teeth gives balance ages of 141 ± 11 ka, older than those (116 ± 9 ka) calculated previously (Masaoudi et al., 1996). These ages correspond to Eemian (OIS 5e), a short stable climatic period, which took place at the end of OIS 6 (Imbrie et al., 1984; Lowe and Walker, 1997; Andrieu et al., 1998; Bosch et al., 1998; Litt, 1998; Shackelton et al., 2002). Eemian is considered as a more temperate phase, according to isotopic sea curves and pollinic sequences within the Last Interglacial (OIS 5). It was followed by several phases of gradual climatic worsening (OIS 5d to OIS 5a), forecasting the return of the cold, characterized at Saint-Germain I and II and Melisey I and II (Lowe and Walter, 1997; Shackelton et al., 2002). This is good agreement with the temperate climate suggested by micro-fauna.
Neanderthal technical behavior during end of OIS and late interglacial

Fig. 3. Synthesis of the Payre sequence: Stratigraphic, palynologic, mammal and radiometric data; type of human occupation
Unit D lithic assemblage. Values in parentheses are percentages

<table>
<thead>
<tr>
<th></th>
<th>Basalt</th>
<th>Quartz</th>
<th>Limestone</th>
<th>Quartzite</th>
<th>Others</th>
<th>Flint</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unworked nodules</td>
<td>87</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>90 (3.0)</td>
</tr>
<tr>
<td>Broken nodules</td>
<td>43</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>46 (1.6)</td>
</tr>
<tr>
<td>Pebble tools</td>
<td>20</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>23 (0.7)</td>
</tr>
<tr>
<td>Flakes and flake fragments</td>
<td>202</td>
<td>221</td>
<td>22</td>
<td>38</td>
<td>1</td>
<td>-</td>
<td>1,847 (433 × 20 mm)</td>
</tr>
<tr>
<td>Retouched artifacts</td>
<td>3</td>
<td>21</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>437 (15.2)</td>
</tr>
<tr>
<td>Cores and core fragments</td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>84 (2.9)</td>
</tr>
<tr>
<td>Total</td>
<td>355 (11.6)</td>
<td>249 (8.2)</td>
<td>25 (0.8)</td>
<td>45 (1.5)</td>
<td>2 (.06)</td>
<td>2,368 (77.8)</td>
<td>3,044</td>
</tr>
</tbody>
</table>
Table 2

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Origin</th>
<th>Form</th>
<th>Type of treatment</th>
<th>Place of treatment</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flint in nodules (&lt;50%)</td>
<td>less than 10 km south on a plateau (Barremian, Bedoulian)</td>
<td>whole or tested nodules</td>
<td>knapping</td>
<td>in the site</td>
<td>different kinds of flakes</td>
</tr>
<tr>
<td>Flint in pebbles</td>
<td>Rhône banks less than 1 km</td>
<td>unworked nodules</td>
<td>knapping rare shaping on little pebbles</td>
<td>in the site</td>
<td>different kinds of flakes</td>
</tr>
<tr>
<td>Flint in nodules (some pieces)</td>
<td>Tithonian-Portlandian limestone of the cave</td>
<td>reprocessing of some natural fragments</td>
<td>none</td>
<td>on the spot in the site</td>
<td>use of the edges</td>
</tr>
<tr>
<td>Basalt</td>
<td>river near the site</td>
<td>unworked nodules big flakes</td>
<td>shaping to choppers unworked nodules hammers</td>
<td>in and out of the site (Payre terraces?)</td>
<td>heavy tools with cutting edge</td>
</tr>
<tr>
<td>Quartz</td>
<td>river near the site</td>
<td>unworked nodules or knapping flakes</td>
<td>knapping exceptional shaping</td>
<td>in and out of the site</td>
<td>thick flakes used rough</td>
</tr>
<tr>
<td>Quartzite</td>
<td>Rhône valley less than 1 km</td>
<td>tools shaping big flakes</td>
<td>shaping exceptional knapping</td>
<td>out of the site tools resharpenering in the site</td>
<td>heavy tools or tools with a long sharp edge</td>
</tr>
<tr>
<td>Limestone</td>
<td>Local rivers or wall-rock</td>
<td>unworked nodules and flakes fragments</td>
<td>knapping and shaping?</td>
<td>in and out of the site</td>
<td>flakes and nodules with cutting edges</td>
</tr>
</tbody>
</table>

Flint cores were preferentially (57.1%) with two-secant-surfaces (Table 3). One of these surfaces is cortical. The debitage is mainly unifacial, centripetal, rarely uni-bipolar. As a final phase, some cores show that the pyramidal flaking surface was truncated by an invasive removal (Figs. 9–10). Most of the cores are on flakes, a feature common to many Middle Paleolithic series (Bourguignon and Turq, 2003). The chaîne opératoire stages took place at different convenient localities, carrying flakes being more comfortable than transporting large blocks. Some habits, such as splitting up the production or making reserves, may also explain this trend. Knapping of most artifacts follows the debitage rules of discoidal type (Boëda, 1993).

Most flakes are unretouched debitage products, smaller than 40 mm (Table 4). Flakes less than 20 mm are numerous. They were probably produced during knapping on both the set of cores and flake-cores. Some large flakes were obtained by knapping outside. Flakes are found with or without cortex. Their shapes are diverse: short and rectangular, elongated parallel or with convergent edges, with a large and thick base or with reduced bases (pseudo-Levallois points). A part of the flakes are backed flakes.

There are 244 flakes (27.3%) that show crushing marks, visible macroscopically, as adjacent micro-removals. These use marks are located on the cutting edges and near the tip of triangular flakes (n = 70, 30.04%). These flakes are mostly less than 50 mm long. They are thinner (5–20 mm) and generally backed (26.8%).

The number of retouched artifacts is 437 (18.4%). Entire flakes are the most common supports, but broken flakes and some cores were used also (n = 14). Whatever their size, all products were considered as potential supports. However tools were rather made out of non-cortical flakes, and on the largest and thickest ones (Moncel, 2003; Chacón and Moncel, 2004; Moncel et al., in press). Scrapers (45.8%) and convergent tools (41%) are the most frequent (Table 5, Fig. 8).

Side scrapers were made preferentially on cortical flakes. The retouch is marginal, slightly scaled or ordinary, and does not alter the product morphology. The proximal part of the support
was sometimes thinned (32 scrapers – 26.4 %). Crushing marks have been found on 20 to 30% of the side scrapers.

Convergent tools are artifacts with two convergent edges, whatever the position of the tool on the flake and the type of flake (the Bordian tool type was not employed) (Table 6). The most frequent convergent tools are bilateral (40.4%), parallel to the technical axe. Others are “dejetée” points. The unretouched points used are also often parallel to the technical axis. Most ends are pointed. The retouch is unifacial and direct. When it is marginal to very marginal (77%), the retouch does not modify the artifact morphology. Scaled (26.2%) and scalariform retouches (6.7%) are frequent too. Points are divided into two groups: short thick ones (length < width) and elongated ones (length > 1 or 2 widths). These two groups and the variety of retouches indicate a great diversity of convergent tools inside the assemblage that can be related to unspecialized flaking. These tools are not thin (< 15 mm) (Fig. 11). When

Fig. 4. Processing system of the basalt and the quartz (level D): From raw material collection to the shaping, débitage and retouch
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Fig. 5. Processing system of the calcareous and the quartzite (level D) from raw material collection to the shaping, debitage and retouch

thinned (8.9%, n = 16), thinning took place on the proximal part. Edges and the convergent tip show significant alterations or macro-signs of crushing, which indicates that they were used. Other marks are linked with the type of retouch and its location: most of the retouched convergent tools display signs of a thin micro-removal, often inverse, on their tip. Seventy-one fragments of convergent tools (29%) and some points have broken tips, over 3–4 mm. Edges with scalariform retouch are crushed on their total length, and scars sometimes involve the tip. Entire edges are more used when the retouch is ordinary. Points with a peripheral retouch show crushing marks on several areas (Fig. 12).

In summary, Neanderthals produced a whole range of flint flakes: thick, short, backed, elongated or triangular. Small flakes were amply used without retouch. The largest and thickest were retouched to become scrapers or points (18%). Hu-
Quartz : discoid cores

Fig. 6. Quartz discoid cores (level D)

Table 3

<table>
<thead>
<tr>
<th>Types of flint cores of Unit D</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire nodules or broken nodules</td>
<td>5</td>
<td>5.9</td>
</tr>
<tr>
<td>Cores with two secant flaked surfaces (discoidal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cortex on 2 surfaces</td>
<td>3</td>
<td>3.6</td>
</tr>
<tr>
<td>Cortex on 1 surfaces – invasive</td>
<td>26 (4 tools)</td>
<td>30.9</td>
</tr>
<tr>
<td>Cortex on 1 surfaces – residual</td>
<td>11 (1 tool)</td>
<td>13.1</td>
</tr>
<tr>
<td>Without cortex</td>
<td>8 (1 tool)</td>
<td>9.5</td>
</tr>
<tr>
<td>Total discoidal cores</td>
<td>48</td>
<td>57.1</td>
</tr>
<tr>
<td>Unipolar removals cores</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td>Double or multiple flaked surface cores</td>
<td>10 (3 tools)</td>
<td>11.9</td>
</tr>
<tr>
<td>Core fragments</td>
<td>17 (5 tools)</td>
<td>20.2</td>
</tr>
<tr>
<td>Total</td>
<td>84 (including 14 tools)</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Table 4

<table>
<thead>
<tr>
<th>Unit D flint debitage products</th>
<th>Unit D</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flakes &lt; 10 mm</td>
<td>154</td>
<td>–</td>
</tr>
<tr>
<td>Flakes 10–15 mm</td>
<td>279</td>
<td>–</td>
</tr>
<tr>
<td>Cortical flakes</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>&lt;1/2 cortical flakes</td>
<td>225</td>
<td>136</td>
</tr>
<tr>
<td>Cortical platform flakes</td>
<td>106</td>
<td>–</td>
</tr>
<tr>
<td>Back cortical flakes</td>
<td>86</td>
<td>33</td>
</tr>
<tr>
<td>Noncortical flakes</td>
<td>485</td>
<td>199</td>
</tr>
<tr>
<td>Backed flakes</td>
<td>108</td>
<td>–</td>
</tr>
<tr>
<td>Kombewa flakes</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Chunks + fragment flakes</td>
<td>400</td>
<td>65</td>
</tr>
<tr>
<td>Total</td>
<td>1,847</td>
<td>437 (18.4%)</td>
</tr>
<tr>
<td>Number of flakes &gt; 15 mm/cores</td>
<td>16.8</td>
<td>–</td>
</tr>
</tbody>
</table>

Mans took advantage of numerous basalt pebbles, sometimes shaped into choppers. Some of them (4.5% with marks) show a severe crushing of the cutting edge, i.e., signs of actions on the axis and perpendicular to the edge. Their cutting edge was used as a wedge, for longitudinal or transversal scraping actions. These tools were worked on the spot and resharpened. Artifacts made on large
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Fig. 8. Flint sidescrapers and points (level D): 1 – double sidescraper; 2, 5 – "dejeté" convergent tool; 3 – end-scraper; 4 – transversal sidescraper and notch; 6 – sidescraper or "dejeté" lateral convergent tool. Drawings by P. Giunti

quartzite flakes are retouched unifacially and severely crushed on a large part of their periphery (disarticulation wedge?). Flakes were obtained by knapping large pebbles outside the site for quartz and limestone as well. Quartz flake cutting edges were used unretouched or retouched as sidescrapers and convergent tools. Fine limestone flakes were also brought from outside.

DISCUSSION

What contribution does the site of Payre and its lithic assemblage make to the understanding of Neanderthal behavior at the end of OIS 6 and beginning of the Late Interglacial OIS 5?

First it corresponds to a type of human settlement, a cave, which was common in southern Europe only, Sclayn (Belgium; Moncel et al., 1998) and Külna (Czech Republic; Valoch, 1988) excepted. Shelter occupations were also recognized in Spain (cave of Bolomor, Valencia; Fernández, 2003) and in Italy (Liguria, Cauche et al., 2004). But the Rhône River valley and its surroundings is the richest area which allow the study of continuous records: the Moula shelter, La Borde, les Cèdres, the Saint-Marcel cave and the Abri des Pêcheurs, Bau de l’Aubesier, Artenac, Baume Vallée and Pech de l’Azé II (Debard, 1988; Fernandez et al., 1998; Defleur 2000, 2001; Masaoudi et al., 1996; Crégut-Bonnoure, 2002; Jaubert, 2002; Monnier et al., 2002; Antoine et al., 2003).

In northern Europe, the large plain, which was less occupied by human populations during the coldest periods (OIS 8, 6 and 4), was reoccupied during OIS 5d to 5a. Most excavated sites of
Fig. 9. Flint flakes and discoid cores (level D): 1, 6 – bifacial discoidal cores; 4 – unifacial core on flake; 2, 3, 7 – unretouched flakes; 5 – backed flake. Drawings by P. Giunti

| Table 5 |
|-----------------|------|---------|--------|--------|--------|--------|
| Flint retouched débitage products and unretouched débitage products with use traces |
| Sidescrapers | Points | Denticulates | Endscrapers | Notches | Drills | Retouched Cores |
| 200 (39.6%) | 250 (49.5%) + 83 used traces = (56.6%) | 34 | 10 | 6 | 5 | 14 |

that age are open air sites (Zwolen, in Poland Lehringen, Tönchesberg and Taubach in Germany, Villiers Adam Riencourt-les-Bapaume, Mont-Dol, Bettencourt and Seclin in France (Roebroeks et al., 1992; Conard, 2001, Callow and Cornford, 1986; Roebroeks and Tuffreau, 1999; Tuffreau, 2001, 2002; Gaudzinski, 2002; Roebroeks and Spellers, 2002) Paleoenvironmental studies suggest a dense forest at the beginning of OIS 5 (Eemian). Sylvosteppe represented a better context for human occupation but may have prevented mobility and induced discontinuous traditions (Antoine et al., 2003; Tuffreau, 2001, 2002; Woillard, 1978; Schreve, 2001; Svoboda, 2002). Among the southern sites inhabited continuously, the site of Payre represents a good example of Neanderthal traditions in southern Europe from OIS 7 to OIS 5.
Table 6

Total number of flint points. Values in parentheses are percentages

<table>
<thead>
<tr>
<th>Type of point</th>
<th>Retouched points</th>
<th>Triangular flakes with use marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilateral points</td>
<td>46 (18.4)</td>
<td>26 (31.3)</td>
</tr>
<tr>
<td>Bilateral points</td>
<td>101 (40.4)</td>
<td>47 (56.6)</td>
</tr>
<tr>
<td>Points with a total retouch</td>
<td>32 (12.8)</td>
<td>10 (12.1)</td>
</tr>
<tr>
<td>Broken points</td>
<td>proximal part</td>
<td>27 (16.8)</td>
</tr>
<tr>
<td></td>
<td>distal part (extremity)</td>
<td>44 (17.6)</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>83</td>
</tr>
</tbody>
</table>

Type of environmental management through raw material gathering and fauna remains

Identifying a site function and the type of environmental management through the lithic assemblage may seem impossible, considering that all of the other materials (wood, for instance) have disappeared, and the use signs are badly or only partially preserved. In the Neanderthal world, evidence of specialized sites and specific stopping places is given by the accumulation of bone remains belonging to only one species (La Borde, Mauzan, La Combette in France, Lehringen, Neumark-Nord I in Germany, Swolen in Poland, Sclayn in Belgium) (Thieme and Viel, 1985; Jaubert, 1990; Farizy et al., 1994, Texier et al., 1996; Moncel et al., 1998; Boyle, 2000; Schild et al., 2000). Such assemblages also suggest settlements in places where the species selected was hunted seasonally, and several species if the occupation persisted.

Payre units G and F dated to OIS 7 suggest recurrent year-round seasonal occupations for hunting cervids (Cervus elaphus), bovids (Bos) and equids (Equus), associated with rhinocerotidae (Dicerorhinus) and proboscideans (elephants). As far as unit D assemblage is concerned, hunting was rather oriented toward Cervus elaphus, most probably during the winter season. This selective seasonal hunting was also combined with an opportunist predation of other herbivores (Moncel, 1997; Moncel et al., 2002; Bouteaux 2003; Julien, 2003). This has been observed in other sites in southern France and in Europe (Boyle, 2000). Ursus spelaeus settled in the cave longer and more frequently than human populations that used the site of Payre as a resting spot for hunters and a place for short occupations.

Our findings on the right bank of the Rhône Valley fit well in the scenario presently proposed for most European sites. More complex and organized hunting has been suggested for younger periods since OIS 5 (Gaudzinski, 2002). At the site of Payre, prey was treated similarly during three main occupation phases. Moreover, the patterns based on ethnologic observation cannot be applied to this part of southeastern France where the model of centrifugal living structures cannot be observed in cave sites (Binford, 1978, 1983, 1987; Bourguignon and Turq, 2003).

Mammal remains reflect the use of local lithic raw materials that were gathered along the Payre and Rhône rivers as well as the plateau and its slopes near the site. These lithic raw materials were collected further away in various directions, usually less than 10 km from the site. This distance is identical to that observed in most sites in southern France (Moncel, 2003; Moncel et al., in press) that show the use of lithic resources of the local and semi-local surroundings from OIS 9 to OIS 3. Flint was most likely used because it is easily available in the limestone formations bordering the Massif Central mountains and other stones, such as quartz at the Abri des Pechers, are rare. Like other sites, different flint outcrops were visited, but one outcrop was always more exploited. Flint nodules, pebbles or cubic fragments were collected in the nearest available outcrops. The discovery of raw materials brought from a long distance (60 km south) in a base level of the Payre sequence may modify the assumption that Neanderthal groups covered only restricted territories for (Moncel et al., in press) and new investigations must be conducted to propose more precise limits for these territories.
Tool kit, functional marks and subsistence activities

The tool kit did not show a high degree of specialization in Neanderthal lifeways. To the best of our knowledge at present, Neanderthal lithic products were multifunctional implements displaying distinct active portions that imply different stages of specialization characterized by the angle and form (Beyries, 1988; Lemorini, 2000; Márquez et al., 2001). Portions of tools may have been resharpened and their use may have changed. Some products, like unretouched blades, suggest more specific uses (Riencourt-les-Bapaume, Tuffreau et al., 1993). In Abric Romani, Spain, intense work on wood is attested by the preservation of numerous wooden objects. Micro-wear analyses also revealed intense butchery activities on unretouched and retouched arti-
Fig. 11. Size of the flint unretouched and the retouched points according to their technological and morphological axes (level D): Evidence of short and large points
Fig. 12. Crushing marks on the flint sidescrapers and the tip of the points (level D): Evidence of various marks related to a large diversity of tool function

facts (Martínez et al., 2003). Use wear was not always found on the retouched areas and cutting edges may have proved to be very efficient.

In the two lower levels of Unit D of Payre, the large blanks brought from outside suggest the Neanderthal’s ability anticipate the materials needed to make tools as well as technical expertise, as attested in earlier populations as well the Acheulians (Madsen and Goren-Inbar, 2003). Most of the cutting edges of the pebble tools and large flakes show macro-marks of deep crushing, but only débitage products larger than 15–25 mm, made of flint and quartz, display the same macro-signs. This indicates that the cutting edges of sidescrapers and convergent tools were used on materials hard enough to produce scars, even though these
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kinds of marks can appear rather quickly on a rough edge (Lemorini et al., 2003). The other uses are unknown, but the severe fragmentation of bones and the high diversity of tools of various sizes lead us to suppose that subsistence activities were diverse in Payre. The diversity of available products made by the discoid method in unit D may be linked with both cyangetic external actions and domestic activities. Different phases in the occupation have been identified for the treatment of carcasses that require different tools for disarticulation and bone crushing (for recovery of the bone marrow), such as thin as well as thick heavy tools or thin cutting tools. Bone compressors have been identified, certainly related to the retouch of the flakes.

In levels G and F of Payre, the percentage of convergent tools is very high, 49.5% for tools and 56.6% with flint and quartz unretouched points with use scars included. This percentage is usually lower in other French series: 15% in layer 35 of Combe Grenal; 14% in layer CA of Rincourt-Bapaume; 23% in layer Ila of Biache; and 30% in layer VIII of Vaufrey (Turq, 1992; Tuffreau and Somme, 1988; Tuffreau et al., 1993; Rigaud et al., 1988). Data from Payre suggests that point production is not necessarily associated with specialized resource procurement, highly specialized production method or specialized tools. These tools developed through selection among flakes produced using a generalization production method, such as for the sidescrapers.

In each unit of Payre, we examined the use macro-marks in relation to the type of tools; marks are located on unretouched or retouched cutting edges of points and sidescrapers, and on pointed tips of convergent tools, “becs” and borer.s They suggest a large variety of uses, even with only two types of tools. Wear analysis in progress will characterize the types of use.

Like most Middle Paleolithic sites, sidescrapers are one of the two main flake tool types. In the occupation, the angles of sidescrapers, bearing macro-signs, are diverse (Fig. 12). The type of retouch and its position depends on the section and the shape of the cutting edge and also suggest multiple potential uses. The flaking method was discoidal, and the various products obtained by this type of flaking are known to be polyvalent supports that can be used for occasional activities with no significant transformation (Martinez et al., 2003; Bourguignon and Turq, 2003). The products are retouched either to make or to maintain the angle and/or the line of a cutting edge efficient during longitudinal and transversal actions (Geneste and Jaubert, 1999; Tuffreau et al., 1993; Lemorini et al., 2003). The active part of the flake has no relation with the artifact morphology. The shape and section of the cutting edges are not designed for a specific use, which does not reflect strong anticipation capacities (Lemorini, 2000; Peresani et al., 2001; Lemorini et al., 2003). The products and cutting edges obtained through the chaîne opératoire are adjusted by retouch for some specific tasks, as observed on the unit D scrapers.

About points, macro-marks were preserved on: 1) the distal end of the convergent edges; 2) the edge length or both edges; and 3) the point end, whatever the type and location of the retouch. One artifact can display several distinct functional macro-marks. Tips are broken with clear-cut breaks or micro-breaks, about 3 mm or 4 mm in size. In most cases, fractures show a lip (Knetch, 1997; Ellis, 1997). According to Fischer et al. (1984), Shea (1997, 2001, 2002 and 2006) and Lombard (2005), this may result from the use of the point tip.

Micro-wear results suggest a great functional diversity of triangular implements. In European lithic series, there are still no triangular instruments that can be indisputably attributed to a projectile, whereas they are common in Modern Human assemblages (Shea, 1997; Geneste and Maury, 1997; Plisson and Beyries, 1998; Lombard, 2005). Some points were, however, hafted (for example in Kabara (OIS 4) or layer 5 of La Cotte-Saint-Brelade in Great-Britain (OIS 6, Shea, 1998; Callow and Cornford, 1986). Points, probably mounted on spear shafts, are attested during the Middle Stone Age in South Africa as early as OIS 5 by an artifact stuck in a vertebra (Milo, 1998), in the Near East by a Levallois flake stuck in an animal vertebra in Umm El Tel (Boëda et al., 1999) and at Königsaue (Grünberg, 2002). Signs of an impact have been observed on a rib of a Neanderthal man at Shanidar (Trinkaus, 1983). The discovery of wood spears in Schönigen, Lehringen and Clacton attests the practice of throwing or pushing (Thieme, 1997, 1998;
Schmitt and Churchil, 2003). Evidence of fitting a handle or hafting does not necessarily mean that the tool was used as a projectile: convergent tools used as manual wood borers in Kebara (Israel) and in Umm El Tell (Syria) or for butchery in Riencourt-les-Bapaume (north of France) (Tuffreau et al., 1993; Plisson and Beyries, 1998). The proportion of broken points or scars localized on active areas is sometimes considered a characteristic of the use of hafted points that have to be prepared in order to insert the point into an organic frame (bitumen in Um El Tell, Syria, Boëda et al., 1996; limes and plasters in Quneitra, Israel) (Geneste and Maury, 1997; Plisson and Beyries, 1998; Goren-Inbar, 1990; Lombard, 2005; Fischer, 1984). However, hafting processes are diverse which makes it difficult to interpret scars.

In Payre unit D, the location of crushing marks, thinning and bifacial retouches, fractures or micro-fractures of some points (about 10%) suggest that they may have been used both as hafted points or handy tools (Fig. 12). From a ballistic point of view, and according to Shea’s (1997, 2001) hypotheses on the site of Kebara in Israel and to Lombard’s (2005) hypotheses on the site of Sibidu Cave in South Africa, points used as “thrusted implements” must be short and thick, to resist breaking. This “thickset” morphology implies the practice of a “close-up hunting” in order to be efficient (Knecht, 1997; Ellis, 1997). Ethno-archaeological, experimental archaeological and micro-wear studies of the last few years dismiss the fact that a point must have a perfect triangular morphology and specific morphological characteristics (cf. Levalloisian or Mousterian points) (Nelson, 1997; Ellis, 1997; Greaves, 1997; Shea, 1997, 1998, 2001). Any flake with a small modification (retouch, change of axe, thinning down…) is potentially usable as a hafted tool (Nelson, 1997; Greaves, 1997).

In the series of unit D, only a few points have a support with a triangular morphology and an axi-dimensional symmetry. Convergent tools are often thick and short, with a large base (Fig. 11). Some macro-traces (impact or crushing) observed on the tips of the Payre convergent tools reveal that they certainly had several functions (Fig. 12): micro-removals on the tip of becs or borers, deep micro-crushing on edges with an invasive and stepped retouch, crushing marks on unretouched cutting edges. In other series, these traces are associated with wood working, butchery or to activities like stripping, cutting, or piercing of skins, as in the Near East (Ellis, 1997; Greaves, 1997; Shea, 1997; Plisson and Beyries, 1998).

Payre site and the variability of technical behavior in Europe

Major technical trends persisted from OIS 9 to 3 in Europe, independent from climatic changes. In the North, the occurrence of new traditions is explained by the discontinuity of occupations. It is the case of laminar débitage that spread at the end of the OIS 5, and disappeared afterward. In southern France and especially in southeastern France, technical traditions were not broken since the site was continuously and permanently occupied from OIS 7 to OIS 4. The only changes were the development of laminar débitage at the beginning of OIS 4, and the setting up of specific facies such the Quina facies. The technical behavior observed in Unit D is identical to that of the lower levels dated to OIS 7 and in the other OIS 5 sites of the Payre surroundings. The base levels of Abri Moula and Abri des Pêcheurs reveal specific activities (Table 7). Evidence of cannibalism was found on Homo neanderthalensis remains in Moula XV level (Defleur et al., 1999). The lithic material of the Abri des Pêcheurs is characterized by a supply of crystaline or sandstone pebbles, a discoid knapping of local quartz pebbles and some flint flakes brought inside the site from a larger farther away. It has been considered an example of opportunistic occupations, probably for the treatment of ibex carcasses, as another site further southwest, the Hortus site (Lumley et al., 1972).

It is difficult to show how population behavior during OIS 5 or OIS 7 was influenced by the forest environment in topographically isolated areas. Was this environment a factor limiting human group mobility? According to Finlayson, such habitat fragmentation is often a major source of demographic instability for large mammals and it is conceivable that it played a role in Neanderthal behavior, or why not in Neanderthal extinction (Finlayson, 2005). In various contexts, it has not been still possible to identify a link between technical and subsistence behaviors on the basis of hunting practices (Stiner, 1994; Gaudziński
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Payre and Moula shelters: Seasonal stops in cave sites along the Rhône valley

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(* Crégut-Bonnoure, in Defleur et al., 2001; Bouteaux, 2003; Patou-Mathis in Moncel et al., 2002)

and Turner, 1999; Boyle, 2000; Gaudzinski, 2002; Patou-Mathis, 2002). In northern Europe, small groups have developed different traditions and technical ways, which is not detectable in southern populations who were much less affected by the climatic changes during OIS 7, 6 and 5. In the Payre geographical perimeter, the Levallois method developed as early as OIS 9 in Orgnac 3. The discoidal method was in use in the site of Arago, and at the base levels of Payre (OIS 7), at Coudoulsous I (Lot, OIS 6), at Coupe-Gorge 3R (Haute-Garonne, OIS 6), at Saint-Anne (Haute-Loire, OIS 6-5d) (Gagnepain and Gaillard, 1996; Jaubert and Mourre, 1996; Peresani, 2003; Raynal, et al. 2005). Diverse core reduction methods cannot be considered as breaks in the history of technical behaviors during OIS 7, OIS 6 and OIS 5.

The Middle Paleolithic is often characterized by long-term technological stability, even breaks are observed in northern Europe (Gamble and Roebroeks, 1999). While Neanderthal subsistence behaviors are considered to have been fully organized since OIS 5 (Stiner, 1994; Gaudzinski, 2002), southern lithic assemblages, and some of the northern ones attest to an equally organized technical behavior already set up before, as observed in the lower levels of Payre attributed to OIS 7. Work on bones is always rare, except in some sites in Latium (Italy), dated from the OIS 9 to OIS 5 (Anzidei, 2001). Site studies have shown that cultural clusters existed at a regional scale rather than at a continental scale on the basis of a variety of processing systems: production of microlithic (Taubach in Germany; Tata in Hungary; Külna c.11 in Czech Republic–OIS 5; Valoch, 1988) or macrolithic artifacts, diversified or standardized such as elongated products (Bettencourt, Villiers-Adam, Saint-Germain-des-Vaux, Riencourt-les-Bapaume in France, Rheindahlen–OIS 6–5 in Germany), persistence of some bifacial series of Acheulian type (Pech de l’Aze II c.7–8, Combe Grenal c. 64-56-65 OIS 6, Lazarat unit III, OIS 6, in France), presence of Micoquian bifacial tools (Pietraszyn 49–OIS 6 and Zwolen–OIS 5c in Poland), a variety of retouch types (the Quina sites, Les Tares, in France–OIS 6; Beyries and Walter, 1996), or local and semi-local raw materials. The site of Payre fits well into the variability of the Middle Paleolithic in southeastern France and Europe and could be related to the Charentian Mousterian family.
CONCLUSION

The study of the unit D lithic assemblage of Payre provides information on the needs of Neanderthal groups at the end of OIS 6 and beginning of OIS 5. These groups have seasonally inhabited the site, especially hunted Cervus elaphus, secondary bovids and equids, practiced domestic activities. The sources of raw materials are local, controlled by the topographical context of the eastern fringe of Massif Central and the Rhône Valley, composed of basins, valleys and plateaus. The territory, linked to the occupation, seems to be rather small, including the Rhône valley and the surrounding plateaus. Flint is abundant, but some rare varieties of flint show that artifacts moved along a north-south axis. Flint is associated with various other stone types that offer different knapping qualities. The tool kit is composed of small flake tools, including numerous points, and large tools with severe crushing marks. Macrowear traces suggest diversified subsistence activities. Marks on the point tips and on edges may have been, in some cases, the result of hafting during the Middle Paleolithic in Europe. Data suggests that a small tool kit and point production were not necessarily associated with specialized resource procurement.

The analysis of the technological strategies of the unit D contributes to understanding better how Neanderthal populations lived during this temperate period in southern Europe. This type of Middle Paleolithic industry illustrates well the technological and typological variability of the human groups tool kits observed in the same geographical area. Behavior have not changed in southern Europe between OIS 9 and the end of OIS 5, as confirmed by the entire sequence of the oldest occupations in the Payre site. Behavior stability does not seem to have been disturbed by the climatic variations, which occurred in the area at the beginning of OIS 4 (Moncel, 2003).

Acknowledgments

The excavations of the site were supported by the French Ministry of Culture and the regional district (Rhône-Alpes area). They took place between 1990 and 2002 with an interdisciplinary team and numerous students from the National Natural History Museum in Paris and from French and Foreign universities belonging to scientific exchange programs based on the study of Neanderthal behavior. We would like also to thank Brigitte Deniaux (CNRS, UMR 5198) for helping us restructure the manuscript. Thanks to Elvira Domínguez for helping for the English translation. The Fundación Atapuerca supports Maria Gema Chacón with a research fellowship.

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