Many awls in our argument. Bone tool manufacture and use in the Châtelperronian and Aurignacian levels of the Grotte du Renne at Arcy-sur-Cure

ABSTRACT A comparative analysis of the bone awls from the Châtelperronian and Aurignacian levels of the Grotte du Renne at Arcy-sur-Cure is conducted with the aim of establishing the cultural affiliation of these tools and identifying distinctive technological and functional features for the two assemblages. The studied material consists of fifty Châtelperronian and nine Aurignacien awls presenting an excellent state of preservation. The largest collection of Châtelperronian awls comes from the lowest (level X) of the three levels attributed to this technocomplex, and the awls from Châtelperronian and Aurignacian horizons show a spatial distribution which is different and coherent with that observed for diagnostic Châtelperronian and Aurignacian finds. This contradicts the hypothesis that the presence of bone tools in the Châtelperronian levels is the result of a reworking of sediments. Awls are, in both assemblages, made out of the limb bones of horse, reindeer and carnivores. Common features in the choice of blanks include the use of naturally pointed bones, such as accessory horse metapodials, shaft fragments derived from limb bones broken for marrow extraction, as well as elongated proximal fragments probably obtained by longitudinally splitting metapodials and radii. Châtelperronian awls show a more diverse repertoire of blank types (e.g. use of carnivore fibulae and of massive epiphyseal fragments obtained by fracture) and variable degrees of shaping than Aurignacian ones. Nine Châtelperronian tools are marked with sets of notches or v-shaped motifs, while only one Aurignacian piece bears a decoration consisting of a set of crosses. Comparative microscopic analyses of archeological and experimental tools indicate that the awls of the Châtelperronian were intensively used and produced hundreds, more likely thousands, of perforations on a variety of soft materials, probably different types of skins. Worn tools were resharpened by rubbing the points on grinding stones and tiny awl fragments were reused until total exhaustion.

Introduction

Excavated in the late 1950s by André Leroi-Gourhan (Leroi-Gourhan and Leroi-Gourhan, 1965; Farizy, 1990a, 1990c, 1994; Schmider, 2002) the Grotte du Renne at Arcy-sur-Cure plays a major role in the debate on the Middle/Upper Paleolithic transition. This site has yielded rich Châtelperronian and Aurignacian assemblages, including a variety of bone tools, personal ornaments and human remains. However, the stratigraphic integrity and the dating of these layers as well as the interpretation of their archeological content has been repeatedly questioned.
Solving such contentious issues would help in gaining a better understanding of the chronology of the transition in western Europe and of the nature of cultural and biological interactions between the late Neandertals and the earliest anatomically modern humans (AMH) colonizing the region. Recent revival of researchers’ interest in the site was triggered by the attribution to a Neandertal child of a previously unpublished human temporal fragment found by Leroi-Gourhan in the Châtelperronian layers (Hublin et al., 1996). This came as a confirmation of the hypothesis already put forward after the discovery of the Saint-Césaire skeleton (Lévêque and Vandermeersch, 1980) that the Châtelperronian is to be considered as a late Neandertal material culture. In the same publication, the presence of personal ornaments in the Châtelperronian layers of the Grotte du Renne was interpreted as proof that Châtelperronian Neandertals did not produce all or a part of these objects by themselves but rather exchanged them with neighbouring Aurignacians and, as a consequence, that the Châtelperronian was the result of an acculturation of late Neandertal populations by invading AMHs.

This mode of reasoning was not new (see d’Errico et al., 1998; Zilhão and d’Errico, 1999a, 2000; Zilhão, 2001, for a synthesis). Several researchers believed then (e.g. White, 1989, 1992, 1995; Davidson and Noble, 1989, 1993; Stringer and Gamble, 1993; Mithen, 1996,1998), and some still believe today (e.g., Hublin, 1999; Mellars, 1999a-b; McBrearty and Brooks, 2000; Klein 2003), that Neandertals were incapable of developing symbolic behaviour or, at least, not independently and to the same degree as AMH. Others (Taborin, 1998) claim that the manufactured bone objects found in the Châtelperronian layers of the Grotte du Renne are Aurignacian items either percolated into lower levels or found in Aurignacian deposits wrongly attributed by Leroi-Gourhan to the Châtelperronian. Following the publication of the human remains some of us (d’Errico et al., 1998; see also Zilhão and d’Errico, 1999a-b) defended instead the viewpoint that the personal ornaments and the bone industry from the Châtelperronian layers should be attributed to this technocomplex for the most part if not entirely, and that they were manufactured and used by late Neandertals.

This is notably suggested by 1) the presence of an almost sterile layer (VIII) between the Aurignacian (VII) and the richest Châtelperronian ones (IX, X), 2) the absence of apparent mixing in the stone tool assemblages, 3) the abundance of worked bone in Châtelperronian layers compared to the Aurignacian, 4) the presence in the Châtelperronian layers of the manufacture waste from bone tools and decorated bone tubes, and 5) the coherent distribution of bone tools and ornaments within structures identified during excavation. The comparison of Châtelperronian and Aurignacian lithic technologies and a combined spatio-temporal analysis of the distribution of west European Aurignacian, Châtelperronian, Uluzzian and late Mousterian occupation sites have also led us to reject the traditional view of the Transitional technocomplexes as cultural entities developed in western Europe after the arrival, and under the influence of AMH, and to interpret the innovations observed in these technocomplexes as a result of an autonomous evolution to the Upper Paleolithic (Zilhão and d’Errico, 1999a, 1999b).

Supporters of the acculturation hypothesis (e.g., Mellars, 1996,1998, 1999; Hublin 1999a-b; Gamble, 1999) argue that a long contemporaneity between the Châtelperronian and the Aurignacian is demonstrated by the dates between 33 and 38 kyr BP for the Châtelperronian and the numerous dates from northern Spain between 38 and 40 kyr BP for the Aurignacian. Contemporaneity would also be demonstrated by the interstratifications between Aurignacian and Châtelperronian layers at the sites of Le Piage and Roc de Combe in southwestern France (Champagne and Espitalié, 1981; Bordes and Labrot, 1967), and of
El Pendo in northern Spain (González Echegaray, 1980). However, critical analysis of stratigraphic, radiometric and taphonomic data considering all available radiometric dates for the transitional period in Europe and the Near East shows that the very existence of an Aurignacian of that antiquity is not demonstrated (Zilhão and d’Errico, 1999, 2000, this volume). This hypothesis is based on the dating of samples of uncertain cultural attribution, either because they were collected in palimpsests containing remains of other technocomplexes, or because the assemblages associated with the samples are of doubtful Aurignacian affiliation. At occupation sites for which the archeological context of the sample is secure, the oldest Aurignacian seems to be no older than ca.36.5 kyr BP. In addition, recent refitting and spatial distribution analysis of the lithics from Roc de Combe and Le Piage (Bordes, 2001, this volume), confirm doubts expressed in the past (d’Errico et al., 1998; Zilhão and d’Errico, 1999; Rigaud, 2000) about the reality of these interstratifications and clearly demonstrate that they are the consequence of misinterpretations of the sites’ stratigraphy and formation process.

If the Châtelperronian and the other European technocomplexes stemmed from local Mousterian traditions before the arrival of Aurignacian moderns they must be interpreted as an autonomous evolution of Neandertal cultures towards cultural modernity, an evolution somehow obscured in the archeological record by the spread of the Aurignacian. This model does not rule out the possibility that biological and cultural contacts took place between these populations and played a role in shaping their cultures. It just approaches the issue without preconceptions on the biological inferiority of Neandertals. After all, AMH left little evidence of bone technology and even less evidence of personal ornament use before their arrival in Europe (Villa and d’Errico, 2001; d’Errico, 2003). Why should they be considered by definition as those who autonomously invented them? Three hypotheses can therefore be posited, that of an independent origin of these behaviors in both populations, that of their emergence in one of them with subsequent transfer to the other, and that of a simultaneous emergence in both as a result of contact (d’Errico et al., 1998).

Testing these hypotheses requires new excavations (e.g., David et al., 2001; Conard et al., this volume) and reappraisals of anciently discovered archeological material. It is for this reason that we have undertaken a comparative analysis of the bone industry from the Châtelperronian and Aurignacian layers of the Grotte du Renne. The aim of this study is to assess the coherence of Châtelperronian and Aurignacian bone tool assemblages, identify respective peculiar features, and use information on bone tools securely attributed to the Châtelperronian to gain a better understanding of the significance of bone tool manufacture and use in late Neandertal societies. In order to achieve this goal we will 1) document the techniques used to manufacture, decorate and resharpen the bone tools, 2) identify their function, 3) estimate their lifespan, and 4) combine these informations with available contextual data (stratigraphy, spatial distribution, provenance from features recorded during excavation). We will focus on awls as they are represented in both Châtelperronian (Baffier and Julien, 1990) and Aurignacian (Julien et al., 2002) layers by a relatively high number of specimens. They also present an excellent state of preservation, which generally allows microscopic surface analysis and meaningful comparison with experimentally produced traces.

**Materials and methods**

The inventory of bone awls from the Grotte du Renne includes 2 specimens from Mousterian layers XI and XII, 52 from Châtelperronian layers X, IX and VIII, and 21 from
Aurignacian layer VII. However, two pieces attributed to the Châtelperronian (RX-IX-VIII-sn; 59-Rxa-B6) and 13 attributed to the Aurignacian bore no anthropic modifications and were eliminated from further study. Two Aurignacian specimens consist of pointed fragments, 1.5 cm in length, with traces of chemical alteration typical of bone digested by hyenas and very similar in shape and size to pseudo-points from Pleistocene hyena dens (Villa and d’Errico, 2001). Three of the rejected specimens were identified as fragments of metatarsals and ulnae of reindeer (Fig. 1, no. 8, 10, 12). Seven are fragments of horse accessory metapodials (Fig. 1, no. 1-4, 6-7, 11); four of these may well have been bone awls originally, since they lack a large portion of their distal epiphysis, their surface is ochred, and
one of them bears a set of ten parallel cut marks (Fig. 1, no. 1). Since awls made out of this bone are present in the same layer, we cannot exclude that the missing portion of these pieces bore traces of manufacture and use. A last piece (Fig. 1, no. 12), erroneously identified as an awl by Leroi-Gourhan, is in fact a fragment of ulna carrying traces of manufacture by bifacial gouging.

As a consequence of this critical analysis of the evidence, the collection we studied comprises 2 awls from the Mousterian, 48 from the Châtelperronian and 9 from the Aurignacian. Also one Aurignacian piece is, typologically speaking, not really an awl (Fig. 2, no. 7), since it has a bevelled end. Except for three pieces, one per technocomplex, on display at the Avallon Museum, all the others are kept at the Laboratoire d’Ethnologie Préhistorique, Maison René Ginouvès, Nanterre.

Cultural attribution of the bone awls

If the awls attributed to the Châtelperronian were Aurignacian bone tools which percolated into the Châtelperronian layers we would expect to see their number gradually decreasing from the Aurignacian layer downward. We observe the opposite; Châtelperronian horizons (Fig. 3) yielded four times more awls than the Aurignacian one, and the Châtelperronian layer which yielded most of them, layer X, is the lowest of the three layers attributed to this technocomplex. Spatial distribution of these tools also contradicts the hypothesis of mixing (Fig. 4). Though scattered all over the excavated surface, Châtelperronian bone tools concentrate in the elliptical ashy area located in the center of the main feature identified by Leroi-Gourhan.
FIG. 4 – Spatial distribution of bone awls from Châtelperronian (X-VIII) and Aurignacian (VII) levels. Features in the Châtelperronian representations are those from level X.
(square A13) and within the two circular features surrounding it (squares Y-C/12-13 and B-C/10-11). A minor concentration appears inside and south of the semi-circle of small blocks located at the entrance to the cave (squares C/7-8). These maximum concentration zones coincide with those of the Châtelperronian stone industry and other cultural remains found within these layers. Aurignacian awls, in contrast, mainly cluster in the eastern part of the cave, where most cultural remains of this technocomplex were found.

Comparing the spatial distribution of different categories of remains, Schmider et al. (2002) conclude that, in the Aurignacian (probably a palimpsest of several occupations), the main living area was located within squares Z-D/8-12, and probably associated to a number of peripheral features containing small hearths. Most of the awls retained for this study come from the main living area and from one peripheral feature located north of it, around hearth B15, where the well-known “fish-tail” ivory ring was also found. Two fragments of an anciently broken awl (Fig. 2, no. 9) were refitted. The decorated tip of the tool comes from square D10, the base from square C5.

It is noteworthy that the spatial distribution of awls from Châtelperronian layer VIII, the most susceptible to Aurignacian contaminations (see discussion in d’Errico et al., 1998), closely follows that of layer X, which is the richest and most distant from the Aurignacian (Fig. 4). The two awls from Mousterian layers XI and XII deserve special discussion. Although their manufacture by Mousterians cannot be excluded, their attribution to the Châtelperronian is suggested by their provenance from the two squares (A12 and C8) that yielded most of the Châtelperronian awls found in overlying layer X. This hypothesis is in agreement with the observation that limited mixing (attributed to a levelling of the soil made by the first Châtelperronian occupants of the site — Girard et al., 1990) exists between the latest Mousterian and earliest Châtelperronian layers. For this reason we have included both these pieces in the Châtelperronian sample.

In sum, Châtelperronian and Aurignacian awls present significantly different spatial distributions that, in both cases, closely match those of the archeological material characteristic of these two technocomplexes. This pleads in favor of an attribution to the Châtelperronian of the 48 bone awls discovered in the layers attributed by Leroi-Gourhan to this technocomplex. This conclusion is supported by the results of the new excavation conducted by David et al. (2001) in squares X-Z/10-11. Not only has the new excavation recognized the same major geological and cultural layers described by Leroi-Gourhan, it also identified the minor subdivisions (a, b, c) within layer X described by that author, thus directly challenging arguments of major reworking of the layers, percolation of objects or misinterpretation of the stratigraphic sequence.

Analytical methods

The following parameters were recorded for each tool: anatomical and species origin of the blank; extraction and manufacturing technique; type and technique of decoration; fracture pattern; and presence of worn areas. Morphometric variables included: length, width and thickness of each piece; width and thickness of the tool at 1 cm distance from the tip; and length of the area of the tool modified by manufacture. All pieces were studied under low power optical microscope; twenty-five were moulded with dental elastomer (Provil L, Bayer) and positive replicas made with a RBS resin (T2L Chimie) were examined with a transmitted light microscope and, after metal coating, with a SEM Jeol 840A.
Traces of manufacture and use wear were interpreted in the light of the criteria proposed by Newcomer (1974), Camps-Fabrer (1977a, 1977b, 1985), d’Errico et al. (1984), d’Errico (1993, unpublished data) as well as in the light of the experimental manufacture and use of replicas of the original Grotte du Renne awls. Sixteen diaphyseal and epiphyseal fragments of *Bos* and *Ovis* were manufactured into awls by scraping with flint burins and retouched blades. Eight of these tools were used by two of us to make between 200 and 350 perforations in leather 2.5 mm thick. Active areas were moulded with dental elastomer before use and after each 50 new perforations in order to record stages of wear formation. Resin replicas made from these moulds were examined using the same procedures described above for the archeological specimens.

**Comparative technological analysis**

*Anatomical and species origin of the blanks*

Identification of species and bone type was possible for all 9 Aurignacian awls and for 17 of the 50 Châtelperronian awls. Most of the unidentified 29 pieces were manufactured on shaft fragments of long bones from adult herbivores. Compact bone thickness indicates a preference for diaphyses 4 to 7 mm thick, typical of medium to large size animals, probably reindeer and horse. Four Châtelperronian awls are made out of fibulae from medium to large sized carnivores, whereas the only Aurignacian awl on a carnivore bone comes from an ulna (Table 1). This is the only difference between the two assemblages, which otherwise share the use of horse accessory metapodials, and reindeer metapodials and ulnae.

**TABLE 1**

Species and bone types chosen by Châtelperronians and Aurignacians to produce bone awls.

<table>
<thead>
<tr>
<th></th>
<th>Châtelperronian</th>
<th>Aurignacian</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horse Reindeer Hyena Carnivore Indet. Total</td>
<td>Horse Reindeer Carnivore Total</td>
</tr>
<tr>
<td>Accessory metapodial</td>
<td>2 — — — — 2</td>
<td>2 — — — 2</td>
</tr>
<tr>
<td>Metapodial</td>
<td>2 3 — — — 5</td>
<td>1 4 — 5</td>
</tr>
<tr>
<td>Fibula</td>
<td>— — 3 1 — 4</td>
<td>— — — —</td>
</tr>
<tr>
<td>Radius</td>
<td>— 2 — — — 2</td>
<td>— — — —</td>
</tr>
<tr>
<td>Tibia</td>
<td>— 1 — — — 1</td>
<td>— — — —</td>
</tr>
<tr>
<td>Ulna</td>
<td>— 1 — — — 1</td>
<td>— 1 — 2</td>
</tr>
<tr>
<td>Indet.</td>
<td>— 2 — — — 33 35</td>
<td>— — — —</td>
</tr>
<tr>
<td>Total</td>
<td>4 9 3 1 33 50</td>
<td>3 5 1 9</td>
</tr>
</tbody>
</table>

**Techniques of manufacture**

At least four different techniques, with variants due to blank selection, were used to produce Châtelperronian and Aurignacian awls from the Grotte du Renne (Table 2).
TABLE 2
Summary of Châtelperronian and Aurignacian reduction sequence to produce bone awls.

<table>
<thead>
<tr>
<th>Blank production</th>
<th>Resulting blank</th>
<th>Species</th>
<th>Techniques</th>
<th>Technocomplex (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of natural morphology</td>
<td>Naturally pointed limb bones</td>
<td>Horse</td>
<td>Marginal scraping</td>
<td>Aurignacian (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reindeer</td>
<td></td>
<td>Châtelperronian (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carnivore</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibulae</td>
<td>Hyena</td>
<td>Fracture</td>
<td>Marginal scraping</td>
<td>Châtelperronian (7)</td>
</tr>
<tr>
<td></td>
<td>Carnivore</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limb bone fracture</td>
<td>Robust epiphyseal fragment</td>
<td>Horse</td>
<td>Fracture</td>
<td>Châtelperronian (2)</td>
</tr>
<tr>
<td></td>
<td>Metaphyseal fragment</td>
<td></td>
<td>Marginal scraping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reindeer</td>
<td>Fracture</td>
<td>Intense scraping</td>
<td>Châtelperronian (2)</td>
</tr>
<tr>
<td></td>
<td>Bovid</td>
<td>Fracture</td>
<td>Scaping</td>
<td>Aurignacian (4)</td>
</tr>
<tr>
<td></td>
<td>Diaphyseal fragment</td>
<td>Reindeer</td>
<td></td>
<td>Châtelperronian (16)</td>
</tr>
<tr>
<td></td>
<td>Elongated epiphyseal fragment</td>
<td>Horse</td>
<td>Splitting (?),</td>
<td>Aurignacian (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>grooving (?), fracture (?)</td>
<td>Châtelperronian (10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scaping, polishing</td>
<td></td>
</tr>
</tbody>
</table>

**Marginal shaping of naturally pointed bones**

This technique, which consists of slightly modifying the end of a naturally pointed bone by scraping, was applied to two Châtelperronian (Fig. 5, no. 1-2) and two Aurignacian (Fig. 2, no. 1-2) horse accessory metapodials, to a Châtelperronian (Fig. 5, no. 2) and an Aurignacian (Fig. 2, no. 3) reindeer ulna, and to an Aurignacian carnivore ulna (Fig. 2, no. 4). The broken tip of another Châtelperronian tool might well come from a reindeer ulna and belong to this category (Fig. 5, no. 4).

**Marginal shaping of broken carnivore fibulae**

Carnivore fibulae are fractured in the middle or near the distal epiphysis and both of the resulting fragments are pointed by scraping. Thin, compact and almost circular in section, this bone requires, after breakage, very little shaping to be transformed into an effective tool. Two awls of this type are made on a proximal and a distal epiphysis of an adult hyena (Fig. 5, no. 10-11). Two other use a fibula of a young hyena (Fig. 5, no. 6) and that of a carnivore that, given its size, may be either a hyena or a wolf (Fig. 5, no. 7). Three other specimens modified through scraping (Fig. 5, no. 5, 8-9), one of them very marginally (no. 9), for which we were unable to establish the anatomical origin with certainty, were probably made using the same technique. This technique is only found in the Châtelperronian.

**Invasive shaping of limb bone fragments**

This technique includes three variants:

1) The first, only found in the Châtelperronian, consists of shaping by scraping massive sub-triangular blanks extracted from epiphyseal or metaphyseal fragments of long bones of horse. We include in this category an awl made on the metapodial of an adult horse (Fig. 6, no. 14) and the mesial fragment of a tool probably made on the same kind of blank (Fig. 6, no. 15).
MANY AWLS IN OUR ARGUMENT. BONE TOOL MANUFACTURE AND USE IN THE CHÂTELPERRONIAN AND AURIGNACIAN LEVELS OF THE GROTTE DU RENNE AT ARCY-SUR-CURE

2) The second variant of this technique, also absent in the Aurignacian, applies intensive scraping to a small area of massive epiphyseal blanks to carve short thin points. This category is represented by a complete specimen made on the distal epiphysis of a radius from a large size adult reindeer or bovid (Fig. 6, no. 16) and a distal fragment of another tool (Fig. 6 no. 17).

3) The last variant, common to both technocomplexes, modifies through scraping elongated shaft fragments obtained by fracturing reindeer long bones (Fig. 7, no. 1-20; Fig. 2, no. 5-6, 8-9). Only one Châtelperronian piece could, given the thickness of the compact bone, come from a horse or a large bovid (Fig. 7, no. 4).

Châtelperronian and Aurignacian tools made following this last variant differ, however, in the type of blank chosen. The Châtelperronians’ exploitation of shaft fragments from a variety of reindeer long bones suggests an opportunistic use of flakes recovered after breaking reindeer bones for marrow extraction. In contrast, the fact that all Aurignacian awls included in this category come from reindeer metapodials (Fig. 2, no. 5, 6, 8-9) may indicate a search for more elongated and standardized blanks. Another difference concerns the morphology of these tools. Contrary to Aurignacian ones, Châtelperronian awls (e.g., Fig. 7, no. 1-4, 6) often have irregular morphologies; the shaped point is not on the axis of the blank and point size is more variable. Also, one of the three Aurignacian tools is a double awl (Fig. 2, no. 8), a tool-type absent in the Châtelperronian sample.

Complete shaping of elongated blanks by fracturing, grooving or splitting of limb bones

These pin-like tools, only found in the Châtelperronian, are extracted from proximal epiphyseal and metaphysal portions of limb bones of reindeer and horse (Fig. 6, no. 1-4 and 7). Shaping by scraping heavily modifies the whole surface of the tools, sparing only a limited, often slightly concave area of the original articulation surface. Though lacking this last typical feature, a number of mesial and distal tool fragments (Fig. 6, no. 5-6, 8-13) probably should be included in this category. Two Châtelperronian pieces reveal a more refined manufacture. Their shiny appearance suggests that they were polished after being shaped by scraping. The perfectly conical morphology of one piece was produced by cutting and regularizing its base (Fig. 6, no. 18). The trapezoidal head of the other (Fig. 6, no. 19) was enhanced by engraving two adjoining semi-circular incisions.

The absence of waste products makes it difficult to firmly identify the technique used to produce the blanks for this tool-type. Fracturing by percussion, possibly followed by chipping to thin down and regularize the blank shape, cannot be excluded. Based on our experience, however, this technique generally produces, and more so when applied to fresh or semi-fresh bone, relatively massive blanks, which are difficult and time consuming to reduce to the shapes we encounter here. Although no traces of longitudinal grooving were identified on these pieces, the use of this technique, attested in the Châtelperronian layers of the Grotte du Renne, is also plausible. The hypothesis we favor is that of the use of a flint wedge, probably a splintered piece, positioned on the proximal articular surface to split the bone longitudinally. The use of this technique is consistent with the systematic use of proximal fragments since the flat morphology of their articulation surfaces facilitates the application of the technique. This interpretation is also consistent with the relatively high proportion (10%) of splintered pieces in the stone tool assemblages from Châtelperronian layers Xb and Xc (Farizy and Schmider, 1985).

The only Aurignacian piece (Fig. 2, no. 7) showing some technical similarities with the Châtelperronian pins differs from them in the incomplete shaping of the base, its larger
size, and the flat section of the blank and the point. Although we cannot exclude that this tool was used as an awl, the morphology of the tip does not seem suitable, in the light of our experimentation, to be used in piercing actions; if such was the intention of the Aurignacian artisans they could easily have shaped a more suitable conical end.

**Markings**

Seventeen Châtelperronian awls, i.e. more than one third of the total, and one Aurignacian awl, carry intentional markings made by a lithic point or cutting edge. The Aurignacian piece (Fig. 2, no. 9) is engraved with a pattern unseen in the Châtelperronian tools, consisting of a set of four crosses engraved on the flat aspect of the tool. These crosses are made of notches engraved by the to-and-fro movement of an unretouched cutting edge.

The markings on the Châtelperronian pieces are more discrete and in some cases partially erased by intense manipulation (Fig. 8e-f; Fig. 9). On eight pieces (Fig. 6, no. 14; Fig. 7, no. 4-5, 14, 16-17, 19-20), marking is limited to a few unevenly spaced and orientated superficial lines. Microscopic features indicate that, in two cases (Fig. 7, no. 16-17), these lines were incised by a point, in another case by a cutting edge (Fig. 8a-b). The location, irregularity and scarce legibility of these incisions suggest that they were made to facilitate the grasp of the tools rather than to decorate them. The intention of creating a visible, regular and potentially symbolic pattern seems more apparent on the nine remaining pieces. Six of them show 2 to 4 sets of equidistant parallel and perfectly aligned notches made with a sharp unretouched cutting edge (Fig. 5, no. 8; Fig. 6, no. 5-6, 8, 10, 13; Fig. 8d-e). Residues of red pigment are encrusted on the bottom of the notches of the two most intensively decorated pieces belonging to this group (Fig. 6, no. 13). On one piece (Fig. 6, no. 6), each set of notches shows a different degree of use wear (Fig. 9) suggesting that the sets were added at different moments of the tool’s life. On two other pieces (Fig. 6, no. 3, 19), circular notches seem to emphasize the base of the awl. Given their morphology and recessed location, these notches were not made to facilitate tool grasp. In one case (Fig. 6, no. 19) the incision may have been used to fix a thread for suspension, but this hypothesis fits the other piece poorly. Thus, the best interpretation of these markings seems to be that of deliberate decoration. Finally, a single piece (Fig. 6, no. 2) is decorated with a set of v-shaped marks pointing towards the tip of the tool. The lines composing this pattern were engraved by the same point and in just one session, as indicated by their microscopic analysis (Fig. 8c).

**Function and length of use**

Use wear analysis reveals that the awls from the Châtelperronian layers, the only ones examined so far, were intensively used. Only one out of the 30 Châtelperronian pieces that have tips undamaged by post-depositional processes shows no traces of use (Fig. 7, no. 15). The tips of the 10 pieces with a preserved active zone are either highly smoothed (Fig. 5, no. 11), or show microflaking associated to smoothing (Fig. 5, no. 3; Fig. 7, no. 1-2, 5, 10; Fig. 10a-b), or are covered by microflaking removing the point’s tip (Fig. 5, no. 5-6; Fig. 6, no. 17; Fig. 7, no. 8). The fact that the smoothing affects the edges of the microflaking suggests that the wear was produced by contact with a relatively soft material with low abrasive properties. Ten other pieces had their tips anciently broken off as a result of use (Fig. 5,
Fig. 8 – Markings on Châtelperronian bone awls. (a-b) superficial notches made by single strokes of a cutting edge on facets left by scraping with a burin or an unretouched stone tool; the freshness of the traces of manufacture suggests the tool was not used or resharpened before discard (R X-IIX-VII.sn, Fig. 7, no. 16); (c) sets of v-shaped marks engraved with a lithic point on the awl R Xc-B8.sn (Fig. 6, no. 2); (d) sets of parallel notches on a bone awl (R Xb2-C11.sn, Fig. 6, no. 6); (e) close-up view of (d) revealing the use of an unretouched blank to carve the notches; (f) edge of the lower notch in (e) indicating the obliteration of traces of manufacture and the homogenous appearance of the bone surface, interpreted as evidence of a long manipulation. (thin scales = 1 mm; thick scale = 10 μm).
no. 7-8, 10; Fig. 6, no. 1, 8-9, 16; Fig. 7, no. 4, 17-18). Three fracture surfaces bear traces of smoothing indicating that the awl continued to be used for a while after the point broke (Fig. 6, no. 9; Fig. 7, no. 9, 13). On unbroken pieces, the wear has removed all traces of manufacture over 1 cm from the tip (Fig. 10a-d). The worn areas show either a homogenous appearance or 5-10 µm wide longitudinally or transversally oriented individual striations (Fig. 10c). Farther from the tip, prominent areas between longitudinal grooves left by scraping are still highly smoothed and crossed by short transversal striations (Fig. 10d). Absence of similar wear on the remainder of the tool surface and the excellent state of preservation of the traces of manufacture rule out the possibility that wear on the tool tip may be due to postdepositional processes (Fig. 8a-b).

FIG. 9 – Decoration consisting of sets of notches made by unretouched cutting edges on the Châtelperronian awl R Xb2-C11.sn (Fig. 6, no. 6). The notches’ different degrees of wear suggest that sets may have been carved at different times. Notice the presence of residues of red pigment in the notches (scale = 1 mm).
FIG. 10 – Wear pattern on Chatelperronian awls. (a-b) microchipping worn by further use (a = R XII-A12.sn, Fig. 7, no. 1; b = R Xb2-W9.sn, Fig. 7, no. 2); (c) wear pattern consisting of longitudinal and transversal individual striations (R Xa-A13.sn, Fig. 7, no. 13); (d) wear affecting ridges close to the tool tip (R XII-A12.sn, Fig. 7, no. 1); (e) transversal striations on a worn area of an experimental bone awl after 350 perforations on leather (thin scales = 1 mm; thick scale = 100 µm).
Experimental perforation of leather with replicas of Châtelperronian awls produced a wear pattern comparable to that observed on the archeological specimens. The higher proportion of transversally oriented striations in our tools may be explained by the preferential use of rotating motions during piercing (Fig. 10c). The presence of wider striations on the experimental wear probably indicates that the archeological awls were used on softer materials, probably hides less resistant than the 2.5 mm thick leather used in our experiments. This is consistent with the fineness of some archeological points, which would have broken almost immediately if used on leather. It is more likely that the thinnest awls were used to pierce furs, bird hides or even less strong materials such as intestines.
In spite of their use on less abrasive materials, the used areas of the archeological specimens show a more advanced stage of wear than those of the experimental replicas. Never, even after 350 perforations, did we obtain the total obliteration of manufacture traces, nor the microflaking or breakage of the tip observed in the archeological awls. Given these results and the amount of Châtelperronian tools recovered, we estimate at no less than 20,000 the number of perforations made with these tools. This is probably an underestimation of the actual figure, considering that chipped tips continued in use for a long time after becoming damaged.

**Sharpening and reuse of distal fragments**

A prolonged use of these tools is confirmed by the evidence for resharping and reuse of broken distal fragments. Resharpening consisted of rubbing the damaged tip on an abrasive surface following a motion similar to that we use to resharpen the tip of a pencil on a piece of paper (Fig. 7, no. 3; Fig. 11). Changes in the direction of the striations found on adjacent facets indicate that several orientations and motions were applied to obtain optimal penetrating efficiency, and the partial removal of ground facets demonstrates that these points were damaged by use after resharpening. To the best of our knowledge, this
resharpening technique has been observed in no other Upper Paleolithic bone industries. The reuse of distal fragments is demonstrated by the fact that, in two cases, the fracture surfaces were basically re-shaped by scraping (Fig. 5, no. 4; Fig. 6, no. 12; Fig. 12) or show intense smoothing produced by prolonged manipulation of the fragment after breaking of the original tool (Fig. 6, no. 10; Fig. 12).

Implications and conclusions

Analysis of the stratigraphical and spatial distributions of the bone awls from the Châtelperronian and Aurignacian layers of the Grotte du Renne and due consideration of the results of the recent excavation conducted at this site strongly suggest that the cultural attribution given by Leroi-Gourhan to these tools was correct. The results presented here indicate that, if extended in the future to other categories of the site’s material culture, the comparative analysis of the stratigraphic and spatial distributions of archeological items will certainly contribute to a better understanding of its formation process and to solving the problem of the cultural affiliation of such other controversial remains as the personal ornaments.

The Châtelperronian bone industry from the Grotte du Renne is not an isolated case. Awls similar to those presented here come from the Châtelperronian levels of Quinçay (Lévêque, pers. comm.). The presence of bone awls in Uluzzian sites from the Italian peninsula (d’Errico et al., 1998) and of bone tubes in Streletskaian sites from the Crimea (d’Errico and Laroulandie, 2000) further demonstrates that, at the time of the Middle-Upper Paleolithic transition, bone technology cannot be considered the monopoly of the Aurignacian.

Our study makes it clear that the Grotte du Renne Châtelperronians possessed a complex bone technology, involving a perfect knowledge of the anatomy of a variety of species and of the mechanical properties of bone. Bone from hunted game or scavenged carcasses was seen by these hunter-gatherers as a valuable source of raw material for bone tool manufacture. Rather than expediency tools, Châtelperronian awls appear instead as the expression of an articulated know-how transmitted from generation to generation. Their prolonged use and reuse after breakage or resharpening suggest that these tools belonged to specific individuals who spent days, if not weeks, on domestic activities planned long ahead. These awls were used to produce ten to one hundred thousand holes, probably in hides of different toughness, including very thin ones.

The presence of deliberate decoration on a number of these pieces suggests that, far from being an intrusive behavior, poorly assimilated and limited to a few bartered objects, symbolism permeated all aspects of Châtelperronian life. This is further demonstrated by the fact that a correlation seems to exist between type of tool and type of decoration. Unevenly spaced incisions, probably made to facilitate grasping, are only found on awls made of shaft fragments, while sets of regularly spaced notches, incisions encircling the basis of the tool, or sets of v-shaped marks, i.e., visually recognizable patterns, are made on formal tools resulting from more elaborate and time consuming reduction sequences. Is this correlation between technique, tool morphology and decoration indicative of shared mental representations of techniques and of the social value attributed to the activities in which each tool-type is involved? This would certainly be put forward as the more reasonable explanation if these tools were attributed to the Aurignacian or a more recent Upper Paleolithic technocomplex. We see little reason not to propose this interpretation to explain Châtelperronian behavior.
This is all the more so if we consider that, compared to Aurignacian ones, Châtelperronian awls seem to show a higher degree of technological inventiveness. While both technical systems use naturally pointed bones (horse accessory metapodials and reindeer ulnae), shaft fragments from limb bone breaking for marrow extraction, and epiphyseal elongated fragments possibly obtained by splitting bone with a wedge, the Châtelperronians also take advantage of carnivore fibulae and massive epiphyseal fragments. Only in the Châtelperronian do we find completely shaped, perfectly symmetrical awls. The systematic selection for reindeer metapodials to produce awls made on shaft fragments seems to be the only technical choice peculiar to the Aurignacians.

One may argue that our conclusions are biased by the relatively small number of Aurignacian awls compared to the Châtelperronian sample, and that more varied repertoires of bone awls were made by Aurignacians at other sites. However, systematic analysis of Aurignacian bone tool assemblages (Liolios, 1999) suggests that, by comparison with those from the Châtelperronian levels of Arcy, and even when they are more abundant, Aurignacian awls do not show a greater degree of technological and symbolic creativity. Moreover, they are not manufactured and resharpened in the same way as in the Châtelperronian. These facts are consistent with the hypotheses that 1) the bone tools of the Aurignacian and the Châtelperronian reflect different cultural traditions and 2) they are the expression of human populations with comparable cognitive capabilities. The differences observed also support the idea that Aurignacians never resided for a long time at the Grotte du Renne, whereas Châtelperronian groups used the cave extensively as their base camp.

Acknowledgments

Anatomical and species identification of the blanks used to manufacture the awls has largely benefited from the archeozoological skills of Francine David. This research was funded by the CNRS-ESF program “Origin of Man, Language and Languages”.

REFERENCES


FARIZY, C., ed. (1990a) - Paléolithique moyen récent et Paléolithique supérieur ancien en Europe. Colloque international de Nemours, 1988. Nemours: Musée de Préhistoire d’Ile-de-France (Mémoires du Musée de Préhistoire d’Ile-de-France; 3). 


MANY AWLS IN OUR ARGUMENT: BONE TOOL MANUFACTURE AND USE IN THE CHÂTELPERRONIAN AND AURIGNACIAN LEVELS OF THE GROTTE DU RENNE AT ARCY-SUR-CURE