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PROJECTILE WEAPON ELEMENTS
FROM THE UPPER PALAEOLITHIC TO THE NEOLITHIC

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LITHIC WEAPON ELEMENTS IN WESTERN FRANCE (BRITTANY AND PAYS DE LA LOIRE) DURING THE LATE GLACIAL PERIOD: A PROPOSED CHRONO-CULTURAL ORGANIZATION AND REDUCTION SEQUENCE

Nicolas NAUDINOT

Abstract

In recent years, new data on the Late Glacial period in western France have allowed us to develop a model of chrono-cultural evolution based on comparative lithic technology and lithic hunting weapon elements. This period can be divided into four main phases: Early Azilian, Late Azilian, Final Azilian and Auvours-type industries. Though it presents some particularities, the western Late Glacial appears very similar to that which is well documented neighbouring regions. After a succinct presentation of these cultures, this article will focus on the lithic reduction sequences for the fabrication of weapon elements in order to identify and explain possible variations in the treatment of projectile points between the groups studied. This heterogeneity appears to be linked to a difference in approaches to raw materials and volumetric conceptions between the Late Azilian and Auvours-type industries rather than to a change in the status of weapon elements, which remain central to the production objectives.

Key-words: Western France, Tardiglacial, Azilian, Auvours-type industries, lithic technology, weapon armatures, use fractures
Introduction

After a roughly ten year hiatus, research concerning human groups at the end of the Late Glacial period (Alleröd, Late Dryas and early Preboreal interstadials) has been revived in many regions of western Europe. As western France was somewhat late in this domain, it was excluded from the few broad syntheses proposed in recent years (Thévenin, 1997; Fagnart, 1997; Bodu & Valentin, 1997), despite a few well known early excavations, such as that of Roc'h-Toul at Guiclan in the Finistère region (Le-Hir, 1874; Laplace, 1957; Monnier, 1980). Meanwhile, the recent work of G. Marchand (Marchand et al., 2004) demonstrated that this geographic zone was not deserted by the last hunter-gatherers of the Pleistocene. On the contrary, the seventy sites and indications of sites that have been recently identified and attributed to these cultural entities (ibid.) indicate that there was a very dense occupation during this period, despite geological and environmental particularities that were unfavourable to human occupation and which create difficult taphonomic conditions. Nearly three quarters of our study zone are located on the Armorican Massif, a geographic zone whose pedological characteristics prevent the preservation of organic remains (except in some coastal sectors where carbonates deposited by shelly sands allowed the preservation of bone remains). Due to this factor, radiocarbon dating and archaeozoological analyses are rare. In addition, a very low sedimentation rate prevents reliable recordings of occupation floors. Lithic raw material procurement was moreover conditioned by the geological nature of the massif on which there is no flint in primary position. The hunter-gatherer populations were thus required to adapt their technical and economic systems to other stones such as quartz, sandstone or small flint pebbles found in offshore bars or the terraces of the Loire River. One objective of my doctoral dissertation (in progress) is to define these prehistoric groups and reveal the nature of their techno-economic and social systems based on comparative lithic technology. After proposing a model of cultural evolution for these Late Glacial industries in western France, I will focus on the lithic reduction sequences for the fabrication of projectile weapon elements and attempt to perceive possible variations in the technical investment made in the conception of these tools during these few thousand years of technological changes.

The Azilianization of the west

The process of Azilianization in western France remains enigmatic. Despite numerous field surveys and new analyses of old collections, only one real site with bipoints is known in the geographic zone considered here. The Magdalenian is also currently totally unknown. Nonetheless, several sites, most located in the Pays de la Loire, were long thought to be associated with this period (Gruet & Jaouen 1957). Recent work (Marchand et al., 2004) on the Late Glacial, however, tends to reduce the age of these occupations, situating them within the transition from the Palaeolithic to the Mesolithic. Three hypotheses can be proposed to explain this absence of sites:

- for unknown reasons (perhaps related to the absence of high quality flint), these human groups simply did not occupy the west, though this appears highly unlikely;
- these sites have not yet been identified or have not been correctly attributed;
- these populations may have occupied zones that are now submerged by the Flandrian transgression. This is the hypothesis that we favour due the presence of several flint outcrops that are now submerged by the Manche River but which would have been accessible during the Bolling/Alleröd. The economic needs of these groups may have pushed them into occupying these sectors near these raw material sources, as well as the large valleys in which large prey circulated. On the southern slope as well, the rising sea level probably erased all potential traces of a coastal occupation that may have been organized around a marine predation economy.

A project currently being developed by the UMR 6566 laboratory to address this issue of submerged flint sources and their possible exploitation by humans during the Palaeolithic should allow us to further explore this hypothesis in the future. Despite
the significant occupation hiatus, one of the earliest excavated Late Glacial sites, Roc’h-Toul, seems to be attributable to first phase of the Azilian. According to published drawings, the lithic assemblage of this rock shelter would be constituted of symmetric bipoints with curved backs, along with small scrapers and burins on blades. According to extraregional references, such as the lower level of Closeau (Rueil-Malmaison, Hauts-de-Seine; Bodu 1995), these latter tools would be characteristic of the Early Azilian. Located off the coast of Brest and dominating the estuary of Elorn, the still unexcavated site of Rocher de l’Impératrice (Plougastel-Daoulas, Finistère), discovered by M. Le Goffic, could prove to be very interesting. Its study will probably prove essential to our perception of the process of Azilianization in the west.

The Late Azilian
The occupation of this territory by clearly Azilian groups is now well attested. The evidence for this occupation (sites and other traces) is more abundant than for any other group. Recent paleoenvironmental studies of the peat bogs of Mayenne (Barbier & Visset, 1999) provide information on the environment of these hunter-gatherer groups, indicating a steppe landscape with poaceae associated with herbaceae. Birch seems to be the only tree species (no pines). As in the neighbouring regions, the climate warmed up, but the very high humidity level corresponds more to the hygrometric conditions of the Outre-Manche region. Among the approximately fifty Azilian sites identified in the Brittany and Pays de la Loire regions, we can cite Le Perzo (Neuillac, Morbihan), Roc’h Glas (Penvénan, Côtes-d’Armor), Runigou/Notenno (Trébeurden, Côtes-d’Armor) and Lann-Gazel (Trémouezan, Finistère). The best recorded site is Chaloignes (Mozet-sur-Louet, Maine-et-Loire), excavated over a surface of 9200 m² by G. Marchand in 1999 before the construction of the A 87 motorway (Angers/La Roche-sur-Yon). G. Marchand demonstrated that the dispersion of tools and debitage products observed in certain loci support the hypothesis that the majority of concentrations correspond to zones of discard after the realization of multiple or specific activities and not to debitage concentrations in primary position (Fig. 1). Specialized activities are nonetheless perceptible in a few sectors. Locus 1, for example, seems to be essentially associated with the fabrication and maintenance of weapon elements, while loci 4 and 13 were probably debitage zones. It still seems however, that there was a low segmentation of activities at this site, a phenomenon that is observable at other contemporary ones. Though the subject of this presentation is weapon elements, I will rapidly present the debitage strategies of these Late Azilian groups since projectile points cannot be dissociated from their blanks and thus from the core reduction sequences employed in their production. These debitage strategies indicate a low level of technical investment. The bipolar exploitation of cobbles from the Loire River or silcrete plaques was realized with hard stone hammers. Actions related to the preparation of edges and striking platforms and to the maintenance of core convexities are rare. The objective of the reduction sequence seems to have been to produce blade blanks of varied dimensions and regularity, as well as elongated flake-blades. Many researchers see a technical regression in this Azilian technology, though it more likely represents a techno-economic innovation in which the knappers abandoned constraints judged to be of little utility. Following weapon elements, scrapers, made on small, relatively standardized flakes, are the most numerous tools. Burins, which are generally less numerous than scrapers, are mostly made on fractures or natural surfaces. Though truncations are present, they are highly variable. Most of the weapon elements are asymmetric monopoints with curved backs (though three bipoints were also identified) (Fig. 2). While they are most often made on small blades and bladelets, some were made on thick, irregular flakes. If we trust the data from outside of our study zone, this liberty would contradict the technical principles of the first phase of Azilianization with symmetric bipoints. The corpus of monopoints consists of around thirty pieces. G. Marchand reminds us that only whole pieces and fragments with a curved back were recorded, indicating that the number of objects is in fact higher. The width of the weapon elements is between 9 and 13 mm
fig. 1: Plan of the site of Les Chaloignes (Mozet-sur-Louet, Maine-et-Loire).
fig. 2: Curved-backed monopoints of locus 1 at Les Chaloignes (Mozet-sur-Louet, Maine-et-Loire).
with an average of 11 mm. The thickness increases in proportion to the width and varies between 2 and 8 mm with an average of 4 mm. The length is between 25 and 50 mm. These data, along with my observations, show a very weak morphometric standardization of monopoints. In clearly Azilianized industries, “...the standardization was mostly created by the retouch...” (Valentin, 1995), but we can see here that retouch was not sufficient to standardize the weapon elements at Les Chaloignes. The back was variably realized on the right or left edge of the blank, contributing to the low standardization of the assemblage. The apical part of the tool was most often located on the distal part of the blank. Five pieces resemble Malaurie Points with an abruptly retouched base, while others have a basal notch on the edge opposite the retouch (Penknife Points or Grundy Points).

Rather than constituting a cultural marker, this retouch seems to have been opportunistically realized for practical reasons related to hafting. The retouch is often alternating and the passage from direct retouch to alternating retouch can be associated with the removal of a guiding ridge through retouch (cf. supra). The weight of whole and almost whole points (missing part estimated at less than 5 mm) varies between 0.396 g and 7.539 g for an average of 2.120 g. A large, whole backed object weighing 15 g was excluded from these statistics because we believe it is closer to a backed knife than an Azilian Point. These data remain compatible with use as projectile points even if two pieces weigh over 5 g. It is possible that this dimensional variability attests to different uses of these Azilian Points. The use of some of these points as knives is actually attested. The weights and dimensions are slightly lower than those recorded at other Late Azilian sites within and outside of our study zone. As pointed out by G. Marchand, this phenomenon may be due to the use of Loire River cobbles as cores.

The Final Azilian

Here we consider as Final Azilian those industries which are often attributed to the “Laborian” tradition, especially in southwest France. These are industries with Malaurie Points (straight-backed points with an abruptly retouched base). Sites containing these industries are rare in our region, the best known being La Guichaumerie (Ecoulfaut, Maine-et-Loire; Gruet, 1938; Gruet, 1943; Naudinot, 2003; Marchand, Blanchet et al. 2004; Naudinot, 2003, 2004), whose assemblage was collected by M. Gruet at the end of the 1930’s. Study of unpublished documents by the discoverer, along with the marking of a small percentage of pieces, show that the site was probably organized around eight principal zones (Fig. 3). It possesses a lithic industry that clearly differs from the assemblages described above. The reduction sequence becomes more complex (or less simple). The cores are again carefully prepared (use of crests, frequent repairs, careful scraping and smoothing of the edge of the striking platform before debitage with a soft stone hammer) with the objective of producing small, regular and calibrated blades. The core reduction is most often preferentially unipolar in the first knapping sequences, which are particularly invasive. It then becomes regularly bipolar during the extraction of bladelets. If we exclude notches, which were probably created by a post-depositional phenomenon, end scrapers (38) dominate the tool assemblage, followed by truncations (6) and burins (4). There are 14 weapon elements. The blanks used for the latter are always rectilinear blade-bladelets produced during the full debitage phase. These armatures can be divided into three broad categories. The first consists of straight-backed points with a truncated base, corresponding to the definition of Malaurie Points. We have identified one whole piece, one basal fragment and two other more doubtful fragments that have the same morpho-dimensional characteristics as the preceding pieces. Based on stratified sites located outside of our study zone Pont d’Ambon (Bourdeilles, Dordogne; Célérie, 1994, 1998; La Borie-del-Rey in Blanquefort-sur-Briolance, Lot-et-Garonne; Coulonces, 1963; Le Tensorer, 1981); Le Closeau, Rueil-Malmaison, Hauts-de-Seine; Bodu, 1995), the presence of these pieces, associated with these reduction sequences, argues for an attribution to a final phase of the Azilian, which we can place at the beginning of the Late Dryas. Seven
fig. 3: Material concentration zones at the site of La Guichaumerie (Ecouflant, Maine-et-Loire) (after the original drawings of Michel Gruet).
pieces can be grouped into the category of bladelets with a straight back. Their width is from 4 to 5 mm, with a thickness of 1 mm. Their back is always formed by very abrupt, direct retouch. One of these pieces still has its apical portion, which is located on the proximal end of the blank and created by a very oblique truncation. The back would thus be located on the left edge of the piece. These weapon elements have many clear similarities with Blanchères Points (La Boissière-Ecole, Yvelines; Valentin, 1995), though considering their low numbers and high fragmentation, we must be very cautious. Finally, we identified three points with an oblique truncation (apical part on proximal end of blank, back on left edge), which are often associated with the preceding points with a rectilinear back in the Mesolithic transitional industries discussed above. Despite the low statistical value of this assemblage, these two categories of weapon elements slightly reduce the age of La Guichaumerie, placing it at the transition from the Final Azilian to the Techno-Complex of Auvours-type industries.

Auvours-type industries

The site, or more precisely, the sites of Camp d’Auvours (Saint-Mars-la-Brière, Sarthe; Allard, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1982; Allard & Guyot, 1972; Naudinot, 2004) are located on a small, sandy plateau at the bottom of a large alluvial plain of the Huisne River between the Ardenay and Auvours hills, which culminate at around 130 m (Allard & Guyot, 1972) (Fig. 4). These sites were discovered during the construction of a new road in a military camp of the same name. Five sites were identified by Mr. Guyot. The artefacts considered in this paper originate from the largest one, called “Site 1”, of which only 5 m² are still preserved after the enlargement of the road and installation of a fire-break. Several other small sites were discovered nearby by amateur archaeologists (Verdier, 1974). Our surveys in this area also revealed a few artefacts around the perimeter of the camp. Occupation of the region must thus have been particularly dense during the Palaeolithic, probably due to the favourable position of this immense alluvial plain along the Huisne River. This latter in fact opens a path across the Mancelles Alps, which rise a few dozen kilometres to the north of Auvours. To the south, the presence of several confluences, including those of the Huisne, the Loir and the Mayenne, as well as the proximity of the Loire, also likely played an important role in the choice of occupation location. These valleys constituted favourable circulation axes for human groups, as well as for large animals. In addition, on the site itself, there was residual tertiary flint that seems to have been abundantly used by these populations. The site of Camp d’Auvours has often been cited for its stone concentrations, which M. Allard interprets as habitat structures (Allard 1982). The results of recent test trenches (June 2006) moderated this interpretation and argued in favour of a natural origin for these blocks and mixed accumulations. In this case, the blocks would have been detached by gelifraction (frost breaking) from the Ardenay knoll that rises above the site. After they were detached, these stones would have been transported by solifluction and then reshaped by wind and corrosion by Cenomanian sands. It seems that the lithic raw materials had the same origin, which would explain the correlation between the density of these blocks and the flint. Rather than attesting to the presence of a structured hut, the installation of human groups on these dense, localized accumulations of blocks are therefore more likely related to the presence of siliceous materials (Naudinot, 2006). We hope to contribute more elements to this debate in the near future. The attribution of these final Late Glacial industries is highly debated. They are rather similar to the Epi-Laborian level (levels 3 and 4) of La Borie-del-Rey, but this term implies as yet unknown links with southwest France and the prefix “epi” forcibly implies a relationship with the underlying Laborian levels. In 2001, G. Marchand proposed the term “Techno-Complex of industries with straight-backed points” (TCIPDR) (Marchand et al., 2004). Though perfectly adapted to these assemblages, this terminology is problematic due to the existence of non contemporary and extra regional industries that also correspond to this definition, such as the Gravettian and Epigravettian. We thus propose to group these transitional industries under...
fig. 4: Location of the site of Camp D’Auvours (Saint-Mars-la-Brière, Sarthe).
the provisional term « Techno-complex of Auvours-type industries » (Fig. 5). The retouched tools are dominated by scrapers (27%) in equal proportions on blades or flakes. They are followed by truncations (24%) and burins (22%), most often on breaks or dihedral. The use of a GIS (Geographic Information System) did not reveal any concentration of a particular tool type, thus indicating multiple activity zones, even if the presence of a sandy level moderates this hypothesis and suggests a post-depositional disturbance of artefacts. We also agree with M. Allard’s hypothesis of intensive hearth emptying. As in the sites with Malaurie Points described above, the quality of debitage with a soft stone hammer further increases. The objectives are oriented toward the production of narrow, very regular and calibrated bladelets, the great majority of which were used as blanks for the fabrication of projectile points. Most of the flint blocks were exploited until exhaustion, most often through frontal removals on the widest surface. Preliminary observations of the cores suggest the production of bladelets and a few long blades within the same reduction sequence starting with cores prepared with two posterior-lateral crests. One of the principal characteristics of the management of core volumes in these industries appears to be the desire to permanently maintain a very small angle between the flaking surface and each flank, in order to create a very flat flaking surface (Fig. 6). Observations of the widest blade negatives on the largest repairs or rejuvenations show that this recurring modality was applied from the first flaking phases. This volumetric objective was imposed by the desire to obtain flat, rectilinear blanks. When the knapper wanted to recreate ridges in order to continue flaking on one of the flanks (as during initial flaking), he had only to remove this neo-crest (85% on one surface) and rework the striking platform in order to obtain an appropriate flaking angle between this latter and the new flaking surface. This method does not seem to be completely imposed by the morphology of blocks at Auvours and we also observe this type of flaking organization at other sites in the western zone with totally different raw materials and volumes. This exploitation continues until the exhaustion of the core unless an accident interrupts the reduction sequence or the convexities of the flaking surface become to flat (the principal risk in this type of core volume management). When the cores are abandoned, they have a generally fan-shaped form with a very large and flat flaking surface framed by two flanks and with a back still with cortex or with traces of posterior-lateral crests (Fig. 6). This assemblage is largely dominated by weapon elements with a straight back and an apex created by a very oblique truncation, which are very similar to the Blanchères Points described above (Fig. 7, 1-10). The retouched back of these very standardized pieces is most often on the left edge of the blank (80%) and the point is made on the proximal end (90%). Their average width is 6 mm, their thickness 2 mm, and length 30 mm. The standard deviation between the dimensions according to the location of the portion measured (basal, mesial, apical) is very low (0.01 for thickness, 0.2 for width), which clearly shows the regularity of the blanks and the straightness of the back. The weight of these pieces varies between 175 and 1092 mg, with an average of 450 mg, which is an ideal weight for use as arrowheads. The presence of two “reddish sandstone” objects with grooves (probable shaft polishers) also argues in this sense. The standard deviation between these weights is much lower than at Les Chaloignes (179 at Auvours versus 1053 at Les Chaloignes) (Graph 1). Analysis of the fractures of all of the weapon elements at Chaloignes (cf. supra), as well as microwear analysis of the retouched tools of Locus 1 by S. Philibert, shows no activity specialization at this site; this weight dispersion thus cannot be explained by a selection and significant exportation of weapon elements away from the site. It is more likely simply an illustration of the weak calibration of monopoints with a curved back evoked above. Points with an oblique truncation (Fig. 7, 13-17) are also well represented at Auvours. These are very similar to the points with straight backs and we suspect that they originate from the same reduction sequence. Their average length is 25 mm, with a width of 8 mm and thickness of 2 mm. Their average weight is logically slightly higher (576 mg) than that of the straight-backed points. In addition to these types, there
fig. 5: Succession of Late Glacial lithic weapon elements in western France.
**Fig. 6**: Diacritic scheme of a core from Camp d’Auvours presenting a typical volumetric organization.
fig. 7: Weapon elements from Camp d’Auvours (Saint-Mars-la-Brière, Sarthe).
are a few small spindle-shaped points similar to Istres Points (Fig. 7, 19), segments (Fig. 17, 18) and backed bladelets (Fig. 7, 11 & 12). Some bitruncations had also been discovered on the site (Fig. 7, 21-30). They could be considered as intrusive but other ones were also found in other contemporary sites of the area like La Fosse (Villliers-Charlemagne, Mayenne; Naudinot, unpublished) or La Vigie-Romaine (Le Croisic, Loire-Atlantique; Rouzeau & Rouzeau, 1984; Sicard-Marchand et al., 2004). These pieces are also present in sites in the southwest, such as Borie-del-Rey. It thus seems reasonable to imagine that these tools could constitute a good marker for the identification of these groups. It is still too early to sketch out an influence zone, but these bi-truncations, and more generally, the development of the principle of truncation, could be an important cultural element in the identification of this techno-complex. Moreover, this technical principle becomes even more significant in the following millennium, during the Early Mesolithic in this region, where points with oblique truncations become considerably more abundant in parallel with triangles.

Fracture analysis

It was first necessary to validate the hypothesis that the Azilian objects from Les Chaloignes and the straight-backed points from Camp d’Auvours were used as projectile points. Based on the methodologies of A. Fischer (Fischer, Hansen et al. 1984) and M. O’Farrell (O’Farrell 2000), we thus analysed the fracture types of two samples of these objects. In order to avoid influencing the results, objects with observable heat treatment were not included in this study (thus excluding around 50 pieces from Les Chaloignes). A total of 99 diagnostic fractures were identified on the curved-backed monopoints from Les Chaloignes. We divided these fractures into five broad categories: cone fractures (Photos 1 and 2), simple fractures (fracture lip less than 2 mm long) on a dorsal or ventral face (Photo 3), lateral simple fracture, complex fracture (fracture lip greater than 2 mm long) on dorsal or ventral face (Photo 4), lateral complex fracture. The limit at 2 mm for fracture lip lengths is not fully confirmed for the tools studied here. A. Fischer places it at 6 mm for Brommian Points and at 1 mm for tranverse arrowheads.

**tab. 1**: Fracture types observed on the weapon element fragments at Les Chaloignes (left) and Camp D’Auvours (right).
M. O’Farrell places it at 2 to 3 mm for Gravette Points. Cone fractures were divided into three categories according to the location of the point of percussion: on the edge of retouched back, central part or sharp edge. The simple and complex fractures can have a snap (flat), feather, hinge or step termination, with a path/lip extending onto a face of the piece or a lateral edge. Doubt remains concerning the morphology of positive fracture paths/lips at the moment of fracturation. These latter were thus classed in a separate category. The orientation of the fracture was also described for each piece. While simple fractures were the most numerous (41%), complex fractures and cone fractures occurred in roughly equal proportions (respectively 23% and 25%). The number of complex fractures could have in fact been greater, as indicated by the presence of 10% of positive fracture lips, some of which were probably longer than 2 mm. Complex bending fractures located on a surface are more numerous (65%) than lateral ones (35%). In both cases, fractures with a step termination are largely dominant (67% and 87.5% respectively), followed by feather terminations (27% and 12.5%) and hinge terminations (7% and 0%). The majority of the percussion fractures with an incipient cone (fracture fissure) are located on the edge with back retouch (68%), and less often in the central part (32%) of the piece, with none on the sharp edge. The fractures are most often perpendicular to the axis of the tool blank (77%). The oblique fractures (23%) are principally associated with cone fractures. All of these data indicate rather diverse causes for the fractures of Azilian Points at Les Chaloignes. Based on the research cited above, the complex fractures, especially those with step terminations, would have been created by a violent apical impact probably associated with use as a hunting implement. The cone fractures located on the retouched edge are probably diagnostic of fracturation during the retouching of the back of the tool. Finally, it is clear that some of the armatures at Les Chaloignes were broken by trampling or other taphonomic processes such as solifluction or water transport (central cone fractures). The largest category, which is that of simple fractures, is unfortunately not diagnostic even if a large number of them are likely due to trampling. Therefore, no specialization is observable at Les Chaloignes in terms of the activities associated with these backed tools, some of which can now be considered as projectile points. Within the concentrations, G. Marchand speaks of a large proportion of weapon elements in locus 1, though we did not identify specific fracture types in this locus. This would thus be a sector in which diverse activities associated with weapon elements (fabrication, repair, etc.) took place. In our study of Guichaumerie in 2002-2003, we unfortunately did not focus on the fractures of armatures. We can only say that two pieces have burin-like fractures and four others have fractures with lips that argue in favour of the fracturation of a few pieces during use as a hunting weapon element. The small size of the objects from Auvours made their analysis more difficult, despite the use of a low power microscope. Nonetheless, we observed 100 fragments of straight-backed points (50 bases and 50 points), still excluding all pieces modified through heat treatment, which are particularly numerous at this site. Unlike at Les Chaloignes, due to the small size of the objects, we were not able to divide the simple fractures into sub-classes (snap, feather, hinge and step). The simple fractures are largely dominant (72%) and the great majority with lips extending onto a face (92%). The complex fractures (11%) most often extend onto a face (82%) and have a step termination (78%). This argues for a violent apical impact, indicating that at least some of these pieces were used as projectile points. Cone fractures, indicating fracturation during back retouch, are rather rare (7%), which is surprising considering the presence of a very large number of preforms. It is possible that this phenomenon is due to the fragility of these fine blanks, which could thus break by bending before being subject to a real shock from the retouching tool. The intense fracturation of armatures (less than 5% whole), and of the rest of the lithic material at Camp d’Auvours, thus remains enigmatic, even if we currently favour the hypothesis of trampling. The large number of simple fractures could argue in this sense despite their low diagnostic value. The presence at Auvours of small triangular pieces, removed from between two fracture
ph. 1 & 2: Cone fractures on the retouched edges of two curved-backed monopoints from Les Chaloignes.
ph. 3 & 4: Complex fractures with step terminations on a face (left) and on a lateral edge (right) on two curved-backed monopoints from Les Chaloignes.
surfaces of refit pieces, could be diagnostic of trampling according to M. O’Farrell (O’Farrell, 2000) (Fig. 8). Our analysis of fractures at Camp d’Auvours thus seems to have reached its limits since the probable post-depositional fracturation of the lithic material hinders identification of the primary causes of the fracturation of weapon elements.

**Projectile point retouch modes**

Using the diagnostic criteria proposed by J. Pelegrin (Pelegrin, 2004), as well as the results of our own experimentation, we attempted to determine the retouch technique(s) employed to create the backs of the different types of weapon elements in the western Late Glacial period. Our analysis of the Late Azilian monopoints of Chaloignes indicates that stone percussion, rather than pressure, was the technique used for these tools. The back of most of these pieces present deep and irregular removal scars, often with a hinge termination (Photo 5). In contrast, with pressure retouch, J. Pelegrin observes “overlapping overshot removals”, which are totally absent at Les Chaloignes. These hinge, or micro-hinge, terminations result in fan-shaped flake scars (Photo 6), a morphology that we almost always produced by percussion. The surface that comes in contact with the retouching tool was almost always strongly abraded and non-denticulated, arguing in favour of percussion, but J. Pelegrin reminds us that an edge can be scraped and smoothed after the back has been retouched using the pressure technique. Another element in favour of this type of retouch, observed from the underside of the pieces, is that the back sometimes takes on a “stepped” form. This morphology is created by numerous hinge terminations and attests to the determination of the knapper to overcome difficulties (Photo 7). Finally, during our experiments, we found that stone percussion (realized with a small, oval shaped cobble with the tool blank placed on the extremity of a red deer antler used as an anvil) was much easier, “comfortable” and rapid than pressure retouch. For the armatures from Camp d’Auvours (rectilinear backed points with a very oblique truncation and simple points with an oblique truncation) the thickness of the blank would have allowed the back to be retouched with the pressure technique. Nonetheless, our observations argue in favour of stone percussion since we find the same stigmata as those observed on the pieces from Les Chaloignes. The pieces broken during fabrication have stigmata identical to those of the finished ones, indicating that the same type of retouch was used from the beginning to the end of the process of fabrication. We must nonetheless be cautious since we have no proof that the entire assemblage was retouched in the same way. It remains to be determined whether these pieces could have been regularized by pressure retouch before use and if the back of the finest blanks could have been retouched by a simple scraping. Meanwhile, these conclusions appear totally compatible with the mode of life of Late Glacial societies, particularly that of these last Palaeolithic groups. The study of these industries shows that the lithic reduction strategies were oriented toward the production of calibrated and standardized blanks destined for the fabrication of weapon elements, themselves highly standardized, to be mounted on arrow shafts. Ethnographic models show the difficulty of conceiving high quality arrow shafts. In addition to the fabrication of the body, it is necessary to realize the notches and feathering. We thus understand the interest of these calibrated arrowheads; the retouch in fact barely modifies the form of the original blank, but is used to form the apical part and to back the piece in order to facilitate its hafting: “The dimensional calibration of these tools seems to be in part assured by the debitage...”
ph. 5: Hinged removals visible on the back of a curved-backed monopoint from Les Chaloignes.

ph. 6: Deep, fan shaped removal scars on the back of a curved-backed monopoint from Les Chaloignes.

ph. 7: « Stepped » micro-hinges on a straight-backed point with a very oblique truncation from Auvours, photographed from the lower face of the tool.
If these are indeed the economic strategies developed by these knappers, the hypothesis of back retouch by pressure is difficult to imagine; it offers no advantage for this type of utilization (no thinning necessary) and implies economic concepts that are contrary to those observable in the lithic reduction sequence, which are oriented toward an optimization of the working time.

Production sequence, deviant pieces and associated fragments

We paid particular attention to the weapon element fragments and abnormal, or “deviant” pieces of the collections in our study in order to better perceive the lithic reduction strategies employed in the conception of weapon armatures during the Late Glacial period in the west, and particularly the during last phase of the techno-complex of Auvours-type industries. The number of deviant points (4 pieces) was too low to allow an understanding of the entire reduction sequence for the fabrication of curved-backed monopoints at Les Chaloignes. It is nonetheless interesting to note that these four objects were all retouched on blanks removed from the junction of the main removal surface and the lateral flank of the core. Considering the technical flexibility of these clearly Azilianized groups, it is possible that in certain situations, the retouch of these curved-backed monopoints was highly opportunistic. Following this reasoning, some points considered here as deviant (essentially piece n°2, which has a relatively straight profile and a thin back) could have in fact been used with a partially retouched back. Since the basic purpose of the back is to create a flat surface to be mounted on an arrow shaft, it is possible that in some cases the artisans simply took advantage of the initial morphology of these blanks. The first point in question has a highly twisted profile, which must have led the artisan to abandon it since it was probably unusable as a projectile point. This blank form indeed seems poorly adapted to this function (probable deviation of the trajectory of the arrow). The presence of small retouch traces on the apical part could show an attempt by the artisan to create the back from the opposite extremity, but without success given the overly open angle between the faces and the back. The second piece is more problematical. Despite microscopic observation, it is difficult to determine if the removal that occupies the proximal half of the back is anterior or posterior to the retouch. Meanwhile, the presence of a micro-hinge in the location of the back argues for an abandonment of the piece, rather than for a removal scar anterior to the shaping. The presence of forced alternating retouch in this area indicates that the artisan tried to remove a hinge created during the production of the blank. This attempt was partly effective, but not sufficient to allow the back to be completely retouched. Given its morphology, which is identical to the first piece (lateral flank blade), it remains to be determined whether the artisan considered this partial back to be sufficient or if the blank was abandoned. The third object has a partially retouched back. The artisan was forced to abandon the retouching of the piece due to the excessively open angle and thickness of the back. Once again, the form of the blank does not allow us to determine whether this type of piece with an originally flat back was used or not. Only a study of a large collection of pieces with these characteristics could confirm this hypothesis, which would again tend to show that these Late Azilian artisans had a high technical flexibility. The last “deviant” piece has a curved back and one missing extremity (probably apical). The fact that a few millimetres before the fracture were not retouched indicates that the piece was broken during the retouching of the back in this area. At La Guichaumerie, one piece is distinct from the rest of the assemblage: it is a point with an angular back, similar to the Creswell Points of Great Britain. We believe it is more likely a point with a straight back abandoned during fabrication. It appears that the relative thickness of the blank at the location of the angle lead the artisan to abandon the back retouch. With its 3,131 weapon elements and fragments, the assemblage at Camp d’Auvours constitutes an exceptional collection for the study of weapon element fabrication strategies. The study and classification of each of these thousands of fragments and deviant pieces, which are sometimes very small (5 mm²), was very laborious. This work nonetheless permitted us to understand the reduction
sequence of these projectile points and to replace the different types of fragments within this scheme (Fig. 10). We are aware that part of our methodology could appear subjective. It was in fact necessary to establish some norms in order to determine the origin of certain fragments. Therefore, based on the statistical data described above, we started from a model of points with the apical part on the proximal end of the blank and the back on the left edge. Some fragments thus considered as bases in our study could in fact be extremities of backed bladelets. Fortunately, the high proportion of fragments of whole points fitting these statistical criteria, as well as the domination of mesial fragments retouched on the left edge when they are oriented with the point at the proximal end, minimizes the margin of error.

The initiation of retouch provokes the formation of a notch (proximal fragments broken during this stage present a half-notch on the fracture opposite the proximal extremity and the distal fragments on the fracture opposite the distal extremity) or a truncation on the proximal part of the bladelet (the fragments have irregular, partial retouching of the proximal extremity). The truncation is then realized on this proximal extremity. When the retouch reaches the ridge of the blank, it immediately becomes alternating retouch. It seems that this type of retouch becomes necessary when the ridge is attained (Photos 8 and 9). Some authors have suggested that in the case of retouching on an anvil, the change in angle at the moment when the ridge is reached naturally results in alternating retouch through counter-shocks (Brézillon, 1968). This phenomenon can indeed occur accidentally and with very similar stigmata. We thus agree with J. Pelegrin when he suggests that the knapper makes a deliberate choice to turn the blank over to retouch this sensitive zone that is thicker than the face. Once the truncation is realized, the knapper can continue retouching the back toward the distal end of the blank (resulting in fragments with a partial back on the proximal part) or start over from the latter point (sometimes resulting in pieces similar to British Cheddar Points). At this point in the retouching sequence, the knapper can also choose to regularize the truncation in order to obtain a typical point with an oblique truncation. When a backed point with a straight back remains the objective of the reduction sequence, the retouching of the back continues over the entire
Fig. 10: Reduction sequence for the fabrication of straight-backed points with a very obtuse truncation and fragments associated with the different stages of fabrication.
ph. 8: Changing of retouch by a truncation during the passage from a guiding ridge on a straight-backed point from Auvours.

ph. 9: Changing of retouch by retouch during the passage from a guiding ridge on a curved-backed monopoint from Les Chaloignes.

ph. 10: Alternating retouch produced by counter shocks during retouch on a stone anvil, during the passage from a guiding ridge.
edge of the blank (when the distal part deviates from
the axis of the piece, the retouch stops at the point of the
inflection since this part does not need to be backed in
order to haft the armature). The fragment resulting from
this last backing stage has a total but very irregular,
angular or bumpy back. Some pieces are broken during
this phase, as is illustrated by a refit piece with an angle
on the back at the point of the break (Fig. 11). It is then
necessary to regularize the truncation and the back of
piece in order to obtain a point with a straight back and
a very oblique truncation. Small modifications can then
be made (retouch of the opposite edge at the base or
point, or abrupt retouch of the base) to correct anomalies
of the blank or facilitate its hafting.

Conclusions
These new data concerning the Late Glacial period
in western France show an evolutionary model
similar to that of neighbouring regions even if a few
differences, partly due to environmental and geological
particularities in this region, are perceptible. As absolute
dating is prohibited by the absence of faunal remains
and charcoal, cultural attributions can be made only
through comparative lithic technology and typology.
The use of small flint cobbles originating from coastal
offshore bars or alluvial terraces of the Loire River, along
with the use of debitage strategies adapted to substitutive
stones available on the massif, forcibly influenced the
socio-economic behaviours of the hunter-gatherers
of this region. The Early Azilian and its Magdalenian
substratum remain poorly known, while clearly
Azilianized industries are very numerous. The sites
with straight-backed points, long attributed to the Final
Magdalenian and now considered as a transitional facies
with the first Mesolithic, are now well characterized but
their relationship with presumably contemporaneous
southern groups remains to be determined. The technical
investment made in the fabrication of weapon elements
changes considerably between these two cultures. In
contrast to the straight-backed points of Auvours-type
industries, the curved-backed asymmetrical points of
the Late Azilian phase are not very standardized and
less care seems to have been taken in their production.
Retouch lateralization shows that in the Auvours-type
industries the conception of projectile points responds
to clearly defined norms, in contrast the Late Azilian
during which either of the edges was randomly chosen
to be retouched. The higher standardization (dimensions,
morphology, weight, modifications, etc.) of weapon
elements in the Auvours-type industries also argues in
this sense. This difference in the treatment of these tools
is not synonymous with a lack of interest in weapon
elements in the last phase of the Azilian, but may rather
correspond to a new approach to these objects benefitting
from a more simplified debitage strategy. Since weapon
elements can be considered as the objective of the lithic
productions of these hunter-gatherer groups, variations in
the technical investment devoted to them seem to reflect
the particular technical conceptions of human groups
rather than a varying degree of interest in the object
itself. Finally, we note that a large part of the cognitive
processes employed in the production sequences of
the weapon elements of Auvours-type industries are
observable in the first Mesolithic industries of the region.
The fabrication of projectile elements with truncations
appears during this period in the form of points with
oblique truncations and retouched or unretouched bases
and triangles. The development of this technique seems to
originate in the industries of groups with straight-backed
points, whose principal characteristics are observable in
the production strategies of the first Mesolithic groups;
the precise nature of these relationships and the origins
of these changes remain to be determined.

fig. 11 : Two refit fragments with an angle at the point of
the fracture.
Lithic weapon elements in Western France...

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