

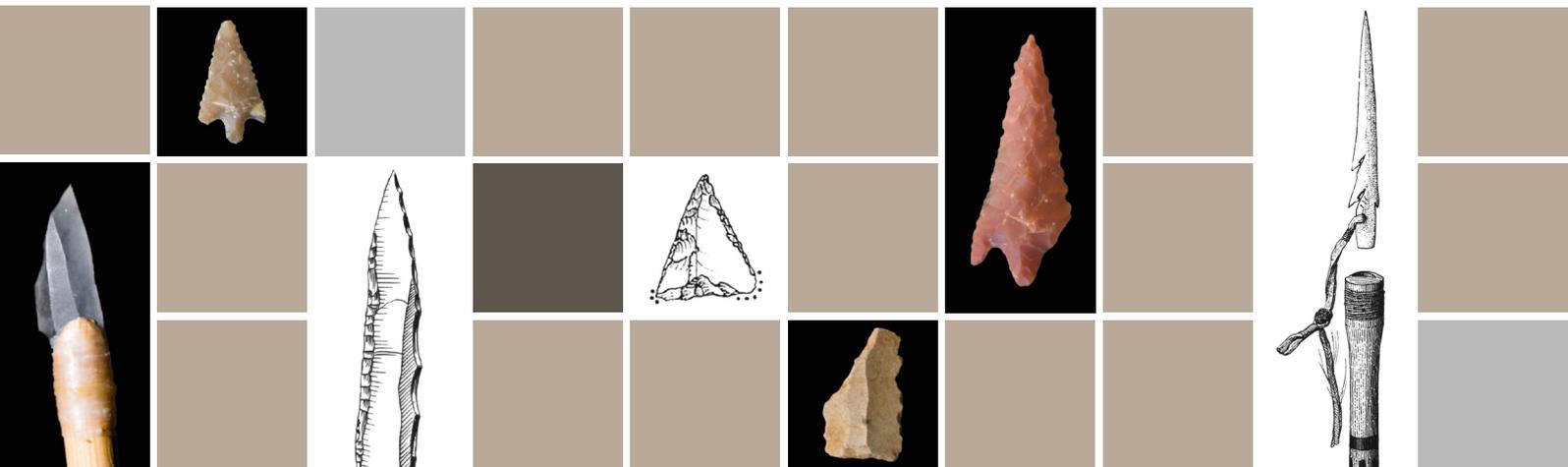
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PROJECTILE WEAPON ELEMENTS

FROM THE UPPER PALAEOLITHIC TO THE NEOLITHIC

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SAUVETERRIAN MICROLITHS : EVIDENCE OF THE HUNTING WEAPONS OF THE LAST HUNTER-GATHERERS OF THE NORTHERN ALPS

Lorène CHESNAUX

Abstract

In this paper, I present interpretations of the stigmata of fabrication (observation of retouch methods) and use (observation of impact traces and hafting glue residues) of microliths and hyper-microliths (arrowheads) of the Middle Mesolithic Sauveterrian period. Based on the first results obtained from the sites of Grande Rivoire, Pas de la Charmate (Vercors, Isère) and Sinard (Trièves, Isère), a reconstruction of the hafting modes of these tools is proposed. The results of a first experimental test are also presented.

Key-words : Mesolithic, typology, hunting, experimentation, weapon elements, usewear analysis, hafting

Introduction

The Middle Mesolithic Sauveterrian of southern France is characterized by the great morphological variability of its microliths (Sauveterrian points, different types of scalene and isosceles triangles and segments) and their very small size.

The function of microliths has long been a topic of speculation. J.-G. Rozoy (1978) summarizes the different hypotheses that have been put forward: tools for tattooing, for engraving, to pull snails out of their shell, to pierce skins, etc. Meanwhile, as early as the 19th century, several authors proposed the hypothesis that they functioned as arrowheads (Mortillet, 1896). The debates were later greatly enriched by numerous ethnographic examples (Vayson de Pradene, 1936).

All of the other hypotheses were refuted by several discoveries of hafted microliths, such as the famous Loshult arrow found in a peat bog in Sweden (Rozoy, 1978). A few other microliths were found embedded in human and animal bones (Odell, 1978; Nuzhnyj, 1989), including the elongated scalene with a small short side implanted in a human vertebra in Burial 8 at Téviec (Péquart, 1937, cited in Rozoy, 1978).

In addition, several projectile experiments (in particular that realized with Sauveterrian microliths by S. Pilibert, 2002) have shown that the impact traces observed on experimental microliths are similar to those observed on archaeological ones.

It is thus now generally accepted that these tools were used to as elements of composite projectile weapons. Meanwhile, there is no relationship between the traditional typological characterization of these tools (classification according to their form and dimensions; GEEM, 1969; Valdeyron, 1991) and their real functional role.

Through an interpretation of the forms of these microliths relative to their function (identification of the active parts such as the point and/or edge), based on a technological and traceological analysis (observation of the retouch methods indicative of intended uses; comparison of archaeological use traces with experimental impact fractures), I have been able to reconstruct assemblages of projectile elements that

could have been used on the same arrow shaft. I will thus first review the typological criteria used for the classification of these projectile elements.

This study was conducted on a collection of Early Sauveterrian and Late Sauveterrian microliths from the sites of Grande Rivoire (Sassenage, Isère - Vercors), Sinard (Isère - Trièves) and Pas de la Charmate (Châtelus, Isère -Vercors).

In the summer of 2006, projectile experiments were realized in order to test hypotheses concerning the reconstruction of Sauveterrian arrows (proposed in my DEA thesis and presented below), to constitute an experimental reference base and to evaluate the efficacy of these weapons.

Geographic context (figure 1) and study collection (tables 1 and 2)

The collection studied is composed of microliths from levels C2a and C2b of Pas de la Charmate (Bintz, 1990; Bintz, 1992), from the deep test trenches in the Middle Mesolithic levels (horizons D and C) of Grande Rivoire (excavation in progress: Picavet, 1991; Nicod & Picavet, 2003; Nicod *et al.*, 2003) and part of the assemblage from the Late Sauveterrian level of Sinard (Pelletier *et al.*, 2004).

The Grande Rivoire rock shelter is located on the northern slope of the Vercors massif (560 m altitude) in the commune of Sassenage (Isère). The site has a full southern exposure and is situated at the base of a Senonian limestone escarpment, extending into a steep talus slope. The Furon River runs below.

Levels D and C, attributed to the Middle Mesolithic, are dated to 7974-7554 BC and 7467-7056 BC respectively (LY 5434: 8740 ± 106 BP and LY 5433: 8278 ± 80 BP). The microlith collection from these levels is limited (table 1: 1 Sauveterrian point, 2 segments, 2 points-barbs (c.f. below) and 14 scalene and isosceles triangles) since it originates from test trenches covering a surface of only 2.5 m². This current collection thus represents only a sample of the total assemblage that these levels will yield during future excavations.



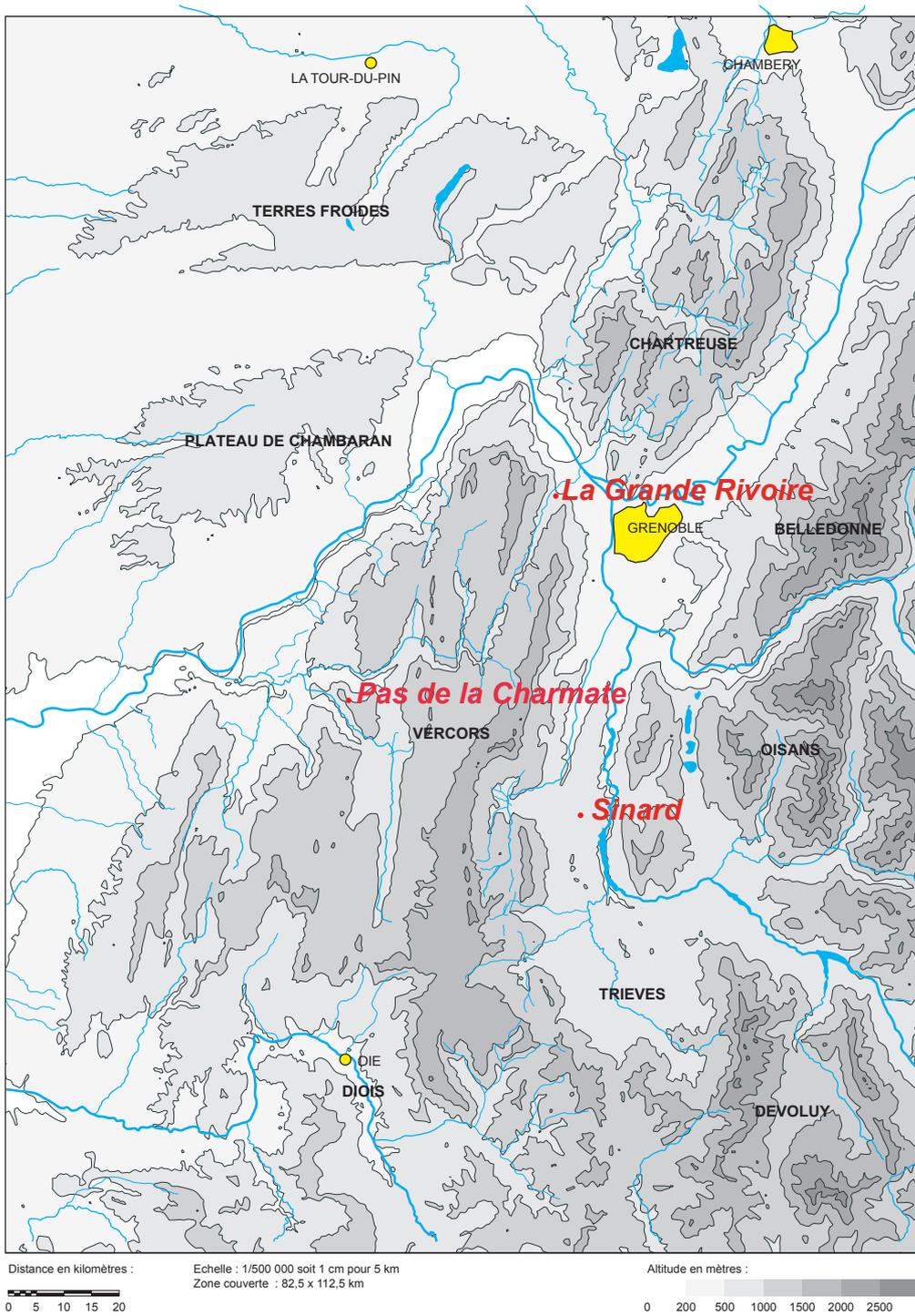


fig. 1 : Map of the northern Alps (after C. Bernard, AVDPA).



	Sauveterrian points	Point-barbs	Segments	Triangles
<i>Level C</i>	0	0	0	5
<i>Level D</i>	1	2	2	9
<i>Total</i>	1	2	2	14

tab. 1 : Number of microliths studied by type in levels C and D of Grande Rivoire.

The open-air site of Sinard (Isère, 830 m altitude) was discovered during preventive archaeology operations. “The geographic context is that of the Drac plateau, which extends through the Trièves Valley. The course of the Drac in this region follows the axis of the alpine trough and marks the limit between the external crystalline massif of Tailler and the subalpine sedimentary limestone massif of Vercors” (Pelletier *et al.*, 2004, p. 604).

Within the microlith assemblage (scalene triangles and Sauveterrian Points) attributed to the late phase of the Middle Mesolithic, I selected 60 whole or almost whole scalene triangles. I did not include the highly fragmented microliths, whose function is more difficult to determine. I will later conduct a detailed analysis of these fragmented pieces since they can contribute significant information, especially in terms of site function (Chadelle *et al.*, 1991).

The Pas de la Charmate rock shelter (Isère, 1100 m altitude) “is located at the western extremity of the Allier Plateau and marks the passage between the Petite and Grande Cornouze” (Bintz, 1992, p. 2). The site is situated near a path leading to the Vercors plateau and near a permanent water source.

The microlith collection studied originates from a homogeneous sedimentary level (C2) excavated by successive horizontal layers and later divided into two assemblages: C2a and C2b (respectively attributed to the recent and early phases of the Middle Mesolithic Sauveterrian).

This level has been dated to 7888-6474 BC and 7300-

6821 BC (Ly-4204 : 8240 ± 260 BP; Ly-5662 : 8100 ± 100 BP).

The collection is composed of 44 Sauveterrian Points, 52 point-barbs (cf. below), 246 segments, 298 scalene triangles and 11 isosceles triangles (table 2; analysis in progress).

Preliminary remarks

It is important to note that the homogeneity of these microlith assemblages may be disturbed by a possible mixing of occupation levels. My study of these assemblages thus remains purely functional.

A global study of these artefacts, integrating raw material procurement and production strategies, is in progress in collaboration with David Pelletier. Following these studies, we will be able to propose a chronology of the arrowheads used by these Mesolithic groups.

A new typology

The typology presented here is based on the criteria of presence or absence of certain active parts. In the case of projectile weapon elements, a distal point is necessary to pierce and penetrate into the flesh of the animal and a sharp edge, associated or not with a proximal point, is needed to cut and tear the flesh (in a flesh piercing system).

In the collection studied, I detected these two functional types, the former represented by Sauveterrian Points and point-barbs (scalene triangles), and the latter by isosceles and scalene triangles, as well as segments.

I was able to re-evaluate the criteria for the determination of a type through both the observation

	Sauveterrian points	Point-barbs	Segments	triangles
<i>Pas de la Charmate</i>	44	52	246	298
<i>Grande Rivoire</i>	1	2	2	14
<i>Sinard</i>	0	0	0	60
<i>Total</i>	45	54	248	372

tab. 2 : Number of microliths studied by type from Grande Rivoire, Pas de la Charmate and Sinard.

of discrete initial shaping actions attesting to precise utilisation intentions and to the recording of possible traces of ballistic damage on the active parts (Christensen and Valentin, 2004).

I was thus able to reconstruct plausible hafting systems for each microlith type.

For the moment, however, this typology remains a working hypothesis. Through experimentation, I will be able to confirm or reject the pertinence of these functional types.

Axial points

- Sauveterrian Points

The typological denomination of these objects is unequivocal. This type of microlith is formed by invasive, abrupt retouch on both edges (Christensen & Valentin, 2004), which meets to form a sharp distal point.

Usewear analysis of 44 Sauveterrian points from Pas de la Charmate revealed that one third of them have traces characteristic of use as an axial projectile element (bending fracture with a feather, step or hinge termination, sometimes associated with secondary spin-off fractures, according to the fracture types described by Fischer *et al.*, 1984) (figure 2a). The other third have smooth (Philibert, 2002), or “snap terminating bending fractures” according to Fisher *et al.*, whose origins can be diverse (damage from use or taphonomic processes). No traces were observed on the other microliths.

- Point-barbs

The objects that have already been called point-barbs (Philibert, 2002) correspond to the type “scalene triangle with a small short side” in the GEEM typology (1972).

Their general tapering form creates a large, sharp point and a rather long cutting edge (the third side), terminating at the other extremity with a small point projecting parallel to the axis of the piece.

The abrupt edge retouch, which forms the back of the tool, is progressively more intensive from the base to the large point. This results in a slightly oblique back and clearly accentuates the sharpness of the large point. The base is formed by a concave truncation that delineates a small, sharp point directed in the direction opposite that of the large point (figure 2b).

This tool was thus conceived to obtain a piercing distal point and a proximal flesh tearing point, associated with a long cutting edge.

Its use as an arrowhead has been confirmed, in proportions similar to those of Sauveterrian Points, by the presence of bending fractures on the distal extremity, which are diagnostic of a frontal impact (figure 2b).

Barbs

- Scalene and isosceles triangles

I identified 298 triangles in levels C2a and C2b of Pas de la Charmate, 60 in the Sinard assemblage and 14 in levels C and D of Grande Rivoire. Their dimensions are detailed in table 3.

All of these microliths are particular in that they have a non pointed distal end. The large point of the scalene triangles often corresponds to a small transverse zone constituted either by the butt of the original blank, by its hinged distal part, or by a portion of vestigial cortex. The back of the tool is formed by abrupt, rectilinear retouch. The base is formed by a straight or concave truncation that is always oblique. The obliqueness or concavity of the truncation allows the formation of the small point (figures 3a and 3b). The acuity of the small point is sometimes accentuated by a slight scraping-retouch of the proximal part of the sharp edge of the piece (or even by abrupt retouch of the edge: figure 3c). All of these modifications seem to have had the objective of creating this narrow point, which forms a protuberance toward the exterior, while preserving a sufficiently long cutting edge (figure 3d). This sharp edge and the narrow point would thus be the only flesh tearing parts of these weapon elements. We can thus imagine that these triangles were hafted as barbs with their backed edge glued against the weapon shaft.

- Segments

I identified 246 segments in levels C2a and C2b of Pas de la Charmate and 2 in level D of Grande Rivoire.

They have the same dimensional characteristics as the triangles, except that they are thicker (table 3). These objects are formed by curved, abrupt retouching



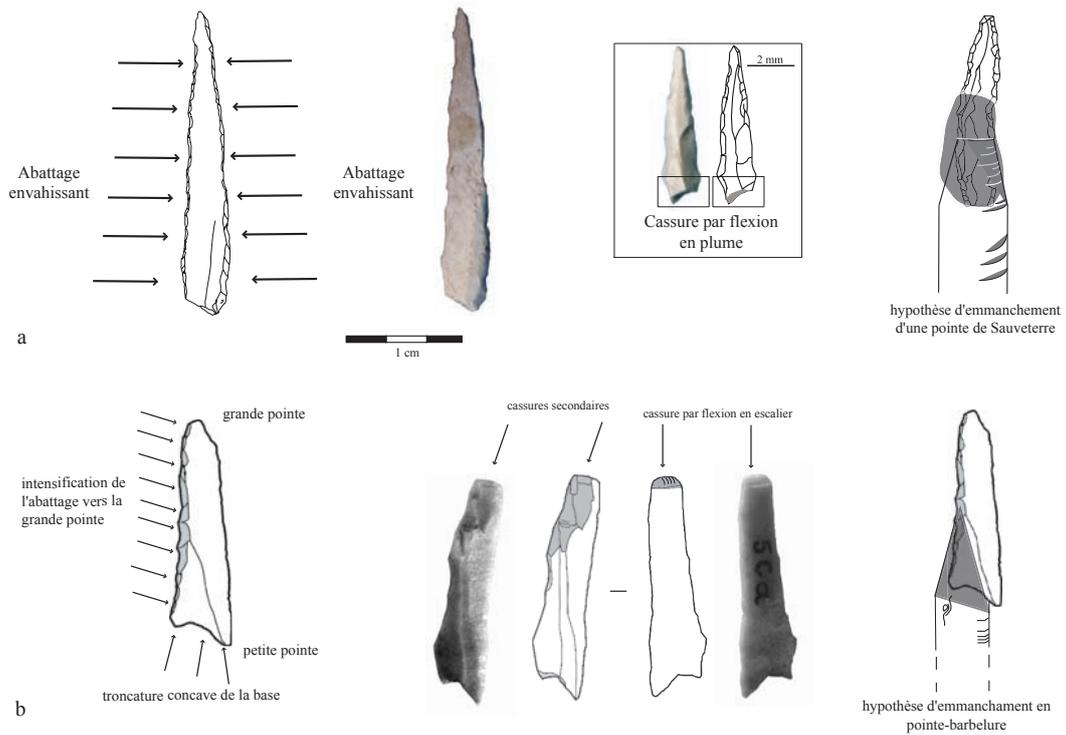


fig. 2 : Characteristics of axial points. a: Sauveterrian point; b: point-barb.

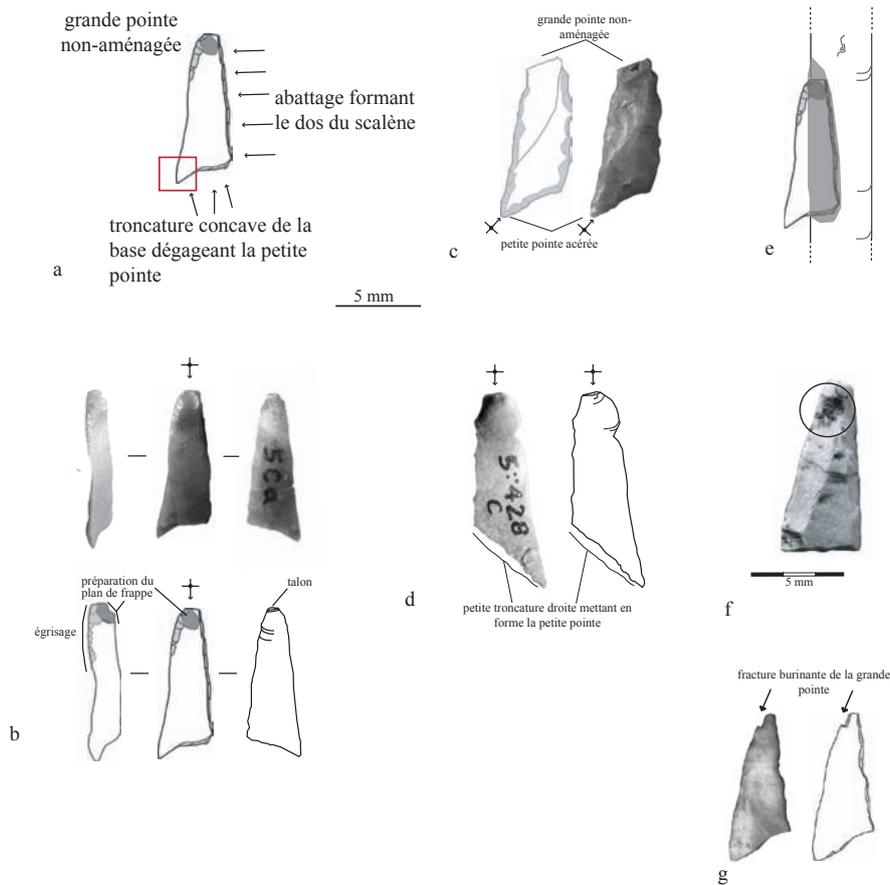


fig. 3 : a, b, c and d: retouch methods of triangles; e: Hafting hypothesis; f: Probable fossil remains of the adhesive; g: Example of a burin-like fracture on the distal part of a weapon element.



along one edge, which creates a point at each extremity. The opposite edge is either left unretouched, or slightly retouched by scraping (Pelegrin, 2004), or backed by semi-abrupt retouch.

The acuity of the two points is always accentuated by a curving of the abrupt retouch toward the point and/or by light, semi-abrupt retouch of the opposite edge at the location of the point (figures 4a and 4b).

As with the triangles described above, these sometimes inconspicuous actions reveal the objective to form a point associated with a sharp edge.

These segments could thus have been used as barbs with the distal part of the truncation glued against the weapon shaft (figure 4c).

- Use traces on barbs

The origin of the fractures of the barbs can be difficult to determine since they are often simple snap fractures, which are not diagnostic of use as a projectile weapon element.

Only six barbs (four triangles and two segments) present a diagnostic bending fracture with a lip on their small point (figure 5). Burin-like fractures are visible on the small or large points of eight barbs (figure 3g). These traces could be the result of a secondary shock at the moment of impact.

Microscopic analysis (maximum magnification 200x) revealed no impact striations on these barbs.

Meanwhile, the presence of more or less discrete black spots on the barbs is likely evidence of their hafting. These spots, whose analysis is in progress, could be fossil residues of the hafting adhesive.

- Summary

Segments and triangles have the same active parts and similar dimensions. It thus appears that they had an identical function.

The width of the barbs, in contrast to their length, varies little. Whether they are “short” or “long”, they are never less than 3.5 mm wide. This width could correspond to a threshold of flesh cutting efficacy (figure 6).

Meanwhile, segments and triangles do not seem to have been made from the same blank types. First, the average thickness of segments (2.1 mm) is greater than that of triangles (1.2 mm). And second, segment blanks were fragmented by the microburin technique (remains of a trihedral point on the extremity opposite the flesh cutting point of the object: figure 7), while no triangles show evidence of fracturation before retouching.

We have thus revealed two different traditions for the fabrication of projectile weapon elements, which are either diachronic, or synchronic but representative of different techno-economic behaviours.

Experimentation

Two hypotheses for the assemblage of weapon elements

It was first necessary to reconstruct a hafting system based on the functional hypotheses for each weapon element type. These assemblage methods are of course hypothetical since we cannot confirm the contemporaneity of the different microlith types (cf. above).

	Length (mm)	Width (mm)	Thickness (mm)
<i>Sauveterrian points</i>	20-25	2-4.5	2-avr
<i>Point-barbs</i>	20-24	4.5-5.5	2-mars
<i>triangles</i>	mai-18	3.5-5	0.9-2.5
<i>Segments</i>	mai-17	3.5-5	1.5-2.5

tab. 3 : Dimensions of the microliths studied.



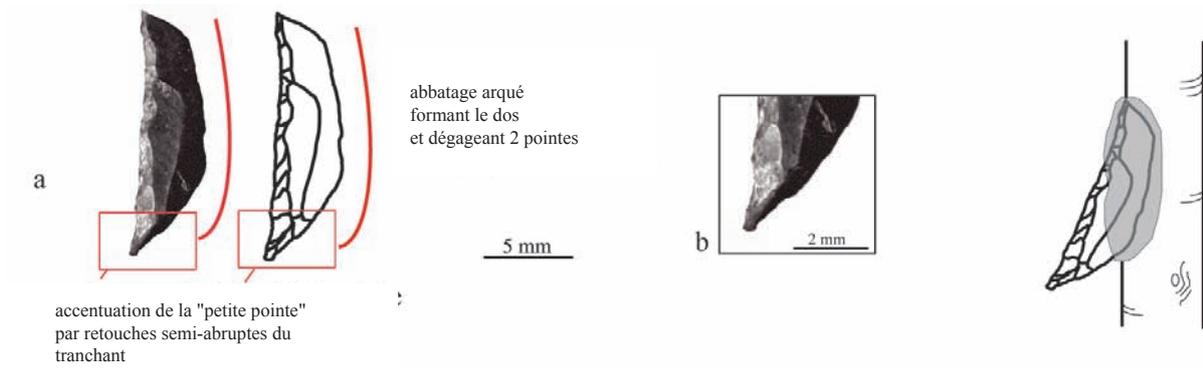


fig. 4 : a : Retouch method of segments; b: Close-up of the small point of a segment; c: Hafting hypothesis.

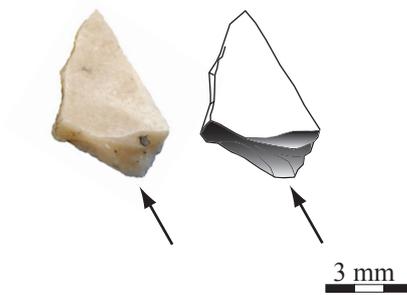


fig. 5 : Bending fracture with a hinge termination on the proximal part of a segment.

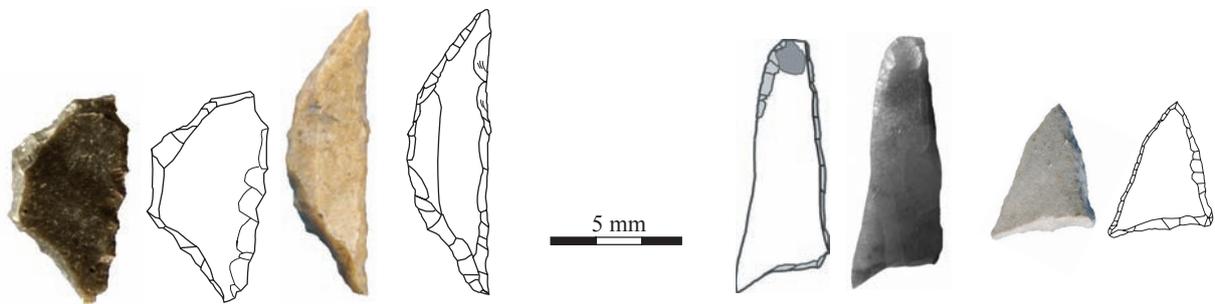


fig. 6 : Segments and triangles.

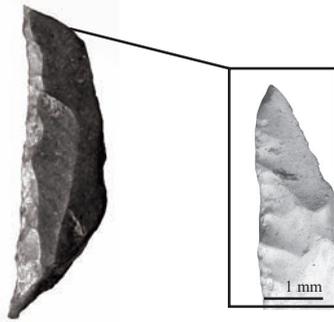


fig. 7 : Trihedral point visible on the distal part of a segment.

Two functional types were identified within the study collection: distal points and cutting edges associated with a proximal point. Each is associated with two weapon element types: points (Sauveterrian Points and point-barbs) and barbs (triangles and segments).

To compare the ballistic functioning of triangles and segments, two types of hypothetical arrows were tested. The first was composed of a Sauveterrian point and four scalene triangles, and the second of a Sauveterrian point and four segments (fig. 8).

We placed a short barb (length of experimental pieces between 5 mm and 11 mm) in front of a longer barb (length of experimental pieces between 12 mm and 18 mm) in order to facilitate penetration.

We did not integrate point-barbs into our haft settings in the interest of varying only one parameter at a time (here the nature of the barbs used in the composition of arrows). We will test these weapon elements in a future experimental session.

Assembly

The points and barbs were inserted in notches made in the shaft and glued with an adhesive composed of vegetal resin and beeswax. The points were ligatured at the base in order to insure the solidity of the distal part of the arrow.

The cedar arrow shafts were feathered with three half-feathers, 10 cm long. The arrows measured 80 cm long and 0.8 cm in diameter.

Forty arrows were assembled according to this system (20 with scalene triangles and 20 with segments: figure 8).

Experimental procedure

- The shots

Our target was a wild boar (animal represented in the Sauveterrian assemblages of Grande Rivoire and Pas de la Charmate) killed two hours before the first experimental shot.

The 40 arrows were shot into the 75 kg animal from a distance of 15 metres with a 45 lb simple longbow.

The archer shot 32 arrows into the whole left side of the animal and 8 into the ground (figure 9a, 9b and 9c).

All of the shots were realized by the same archer and took around 20 minutes to accomplish.

- Recovery of the arrows, lithic elements, and butchering of the animal

It was impossible to pull the arrows out of the animal by hand. We thus cut a space around each arrow with steel knife blade (cf. figure 9d).

The anatomical position of each arrow was precisely described in collaboration with L. Chaix. The weapon elements and fragments of them, still attached to the shaft or not, were recovered.

After extracting the 32 projectiles from the animal, it was butchered and its bones were recovered in order to observe possible impact traces (study in progress by L. Chaix).

Finally, the meat was cut, prepared and consumed, and microliths or fragments were found and recovered during these activities.

- The experimental reference base

After cleaning the lithic weapon elements with acetone and alcohol, we observed them with a low power microscope and with a metallographic microscope (maximum magnification of 200x) in order to detect all use traces.



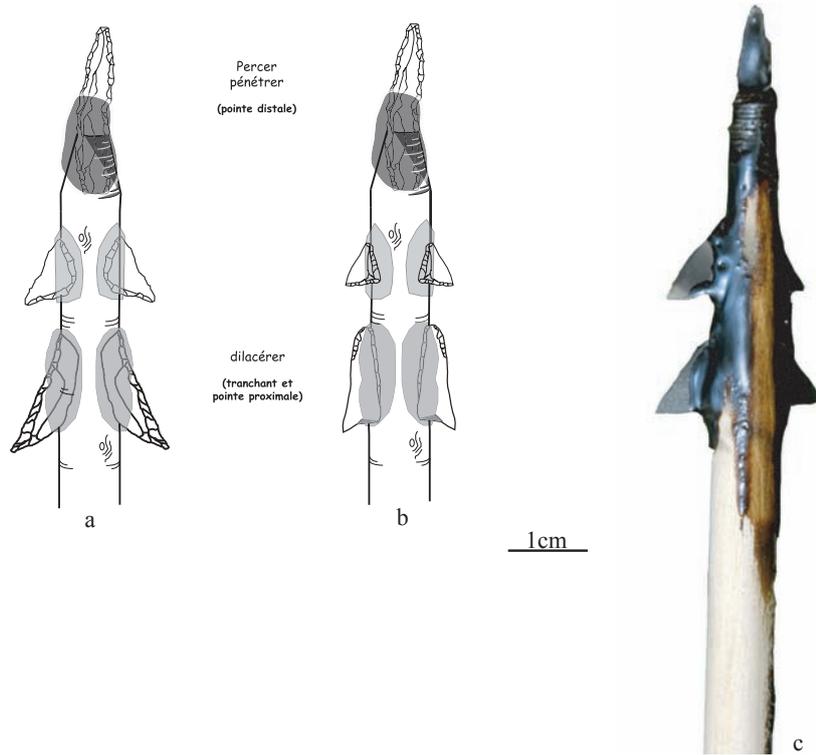


fig. 8 : Experimental reconstruction of two arrow types. a: Assembly of a Sauveterrian point and 4 segments as barbs; b: Assembly of a Sauveterrian point and 4 triangles as barbs; c: Photo of a type “a” arrow before use (photo C. Bernard).

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fig. 9 : Different stages of experimentation. a, b, and c: arrow shots; d: extraction of the arrows from the wild boar; e: segment that migrated to the surface of the animal during penetration. (Photos C. Bernard)



Twenty-nine Sauveterrian points (nearly 75% of the total sample) were broken in 2 or 3 fragments. The fractures occurred in the location of the ligature and/or at the distal extremity. They were caused by a bending force produced during penetration into the animal. They are smooth (snap fractures) or fractures with a lip with a hinge or feather termination (figure 10).

Only two large segments show impact damage on the proximal point, one with a smooth, snap fracture (figure 11b), and the other with a fracture with a hinge termination (figure 11a).

One large triangle and one large segment have edge damage (figure 12).

High power microscopic observation of all the barbs recovered did not reveal any impact traces such as hafting polish or striations (all the lithic elements were almost entirely covered with the hafting adhesive).

Behaviour of the arrows and lithic elements at impact

The arrows of both assemblage types had different penetration depths according to the zones of the animal into which they were shot. The arrows that perforated the rib cage penetrated to an average depth of 14 cm, while the others (shot into the backbone, for example) penetrated to an average depth of 9 cm.

Twenty-nine barbs (13 segments and 16 triangles), found on the ground, were detached at the moment of impact and thus did not penetrate into the animal.

Forty-six barbs (25 segments and 21 triangles), found during the butchery and consumption of the meat, were detached during the penetration of the arrow into the animal (figure 9e: segment that migrated to the surface of the skin of the animal after it penetrated it and was detached from the haft). Others migrated deep into the muscles (distance not recorded).

Five distal extremities of Sauveterrian points were also found during butchery and consumption.

Forty-three barbs (26 triangles and 17 segments) remained hafted to the shaft after use (figure 11b).

Forty-two barbs were not found. It is possible that they were lost on the ground or in the viscera of the animal.

Summary

First, the impact traces created on our experimental weapon elements resemble the traces observed on the archaeological microliths and hypermicroliths.

We also remarked a near absence of traces on the experimental barbs. Therefore, the “snap fractures” and edge “chippings” observed on the archaeological pieces could have a taphonomic origin.

Second, we found that the functioning of segments and triangles used as barbs is identical for this projection method.

It is also interesting to note that some barbs were detached inside the animal, thus augmenting their flesh tearing efficacy.

Could the multiplication of barbs, their occurrence and penetration capacity in the flesh, thus resulting in a significant cutting and tearing of muscles, render these arrow systems lethal? Or did these barbs serve simply as a support for a toxic substance prepared and applied by the Mesolithic hunters. They would thus have the role of inoculating a poison through contact with the numerous blood vessels traversed during their course through the animal (Rozoy, 1978, p.1050; Philibert, 2002, p.133; Surmely, 2006).

This question of course remains unanswered...

Conclusions

This double approach of identifying the retouch methods used to create the active parts of a tool and observing the impact traces present on them has enabled us to propose a functional typology of Sauveterrian microliths from three sites in the northern Alps.

A procedure associating experimentation (fabrication and use) and observations of the archaeological material has proven to be essential in order to restrict the range of possible functions of this object type (hypermicrolithic projectile weapon elements).

I thus attempted to test the efficacy of the arrow systems that I reconstructed.

The experimentation team observed that the arrows do not penetrate deeply into the animal, but that the barbs detach from the arrow shaft and tear through the flesh



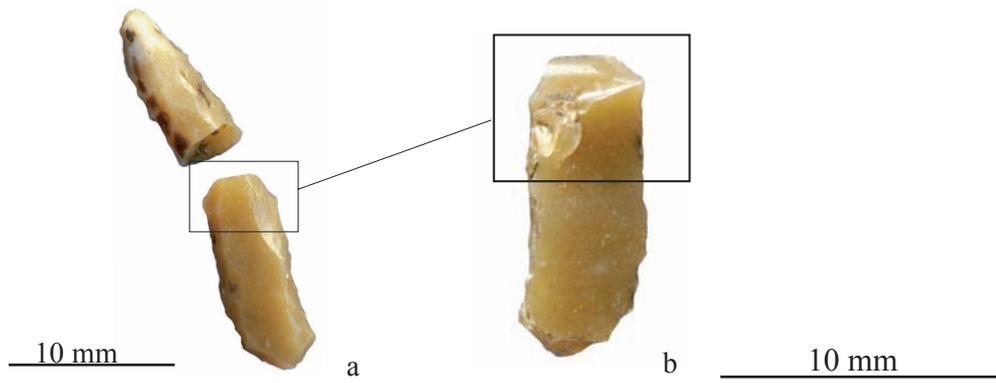


fig. 10 : Bending fracture with a feather termination of an experimental Sauveterrian point. a: Upper face of the distal and proximal parts; b: Lower face of the proximal part with secondary fractures.

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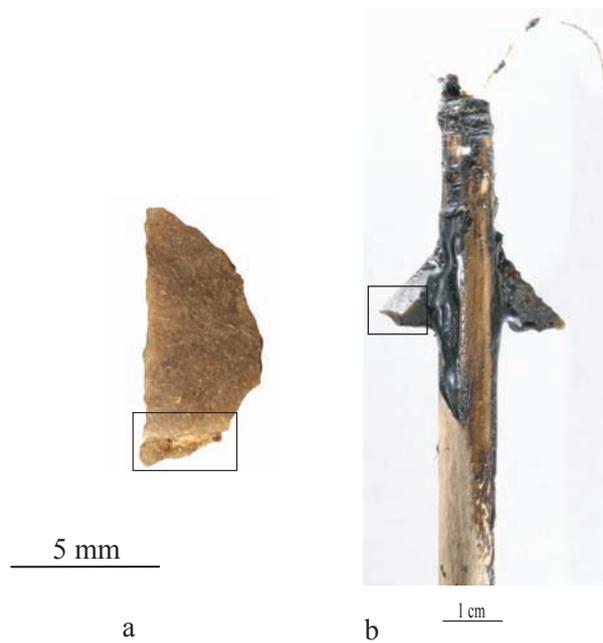
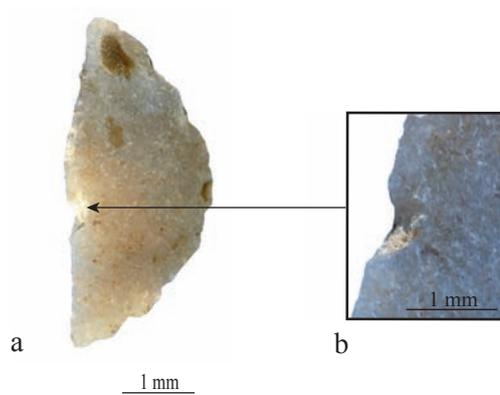


fig. 11 : a: Bending fracture with a hinge termination on the small point of an experimental segment; b: Experimental arrow after use and smooth bending fracture (snap fracture) of the small point of a segment still attached to the shaft.



as they penetrate deeply (we unfortunately have no quantitative data on this point).

We were somewhat surprised by the behaviour of these barbs during the penetration of the arrow into the animal. For this reason we will pay special attention in future experiments to the manner in which they are attached to the weapon shaft. We will test an adhesive of birch pitch to attach the microliths and observe whether there is a modification of the functioning of the arrows during penetration (evaluation of the resistance of the adhesive and observation of a possible variation of the types and quantity of damage affecting the weapon elements after use).

We have shown that a double approach, associating functional and experimental analyses, is necessary. Meanwhile, it is now evident that a global study of Sauveterrian weapon elements (production strategies, microlith economy) is also necessary. This will contribute information concerning the distinction between the two barb types—segments and triangles—identified within the same sedimentary level.

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