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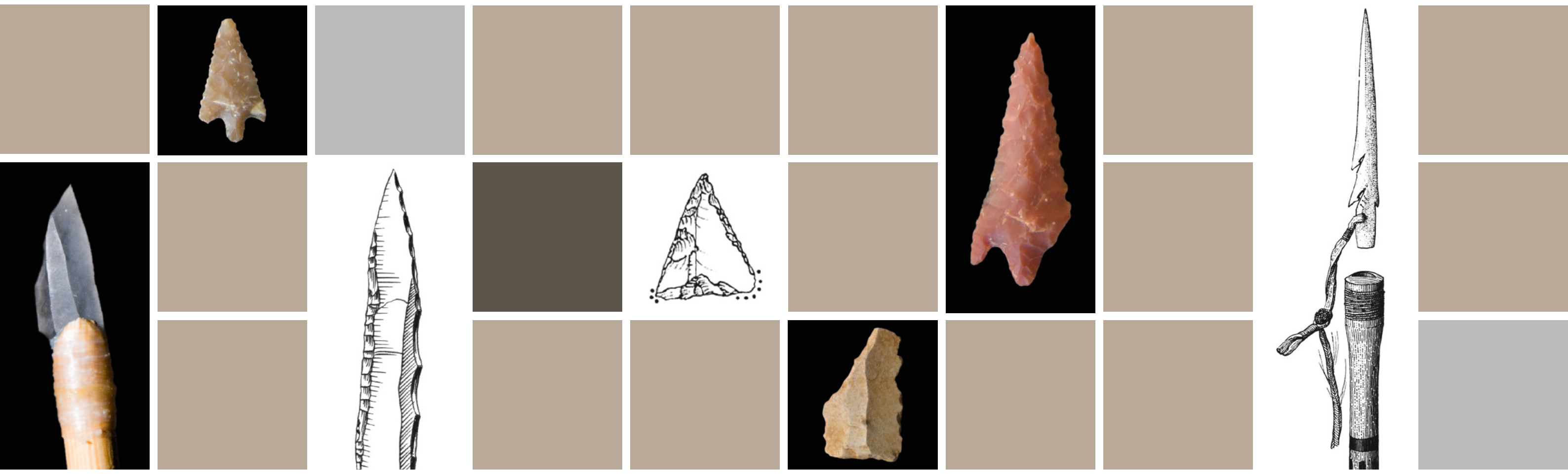
PROJECTILE WEAPON ELEMENTS FROM THE UPPER PALAEOLITHIC TO THE NEOLITHIC

Proceedings of session C83



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EXPERIMENTAL OBSERVATIONS OF EARLY MESOLITHIC POINTS IN NORTH-EAST ITALY

Stefano GRIMALDI

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Abstract

We present an analysis of Sauveterrian microlithic backed points from sites located in the Trentino region of the north-eastern Italian Alps: Pradestel, Lago delle Buse & Colbricon. Experimental arrows were produced, hafted and shot into an animal target. The results of this study indicate that these points may have been "ineffective" for the hunting of medium to large-sized prey, such as ibex, red deer, bear, or wild boar. We propose that Sauveterrian microliths can rather be correlated with the hunting of small forest prey such as roe deer, marmot and other animals with thick fur. An alternative hypothesis for the hunting of large game is also proposed.

Key-words : Sauveterrian, Backed points, Hunting, Experimental archaeology, Italy, Mesolithic.

Introduction

In this paper, we present a study of different aspects of microlithic points with retouch on one or two edges (fig. 1), characteristic of the Sauveterrian (Early Mesolithic) period in north-east Ital:. Some authors (e.g., Broglio & Kozlowski, 1984:112) class these tools, as well as other microliths such as geometric and backed and truncated pieces, in the category of weapon elements. This category is generally correlated with projectile weapons, or more precisely, due to their small dimensions, with arrowheads used essentially in hunting activities.

From a technological point of view, there are several possible manners of hafting these tools onto arrows consisting of simple or composite shafts usually made from wood: as a point, as a point accompanied by laterally positioned geometrics, with a geometric used as a point, with several geometrics used as points and lateral elements. These hypotheses are supported by the discovery of a few nearly whole arrows in humid contexts in northern, central Europe, which were hafted in some of these ways (e.g., Clark, 1963 & 1975; Bergman, 1993) (fig. 2).

All of these data lead to the conclusion that microliths were used as arrow armaturs. We must also remember, however, that functional analyses of geometrics have also shown that this tool type could have been used in other types of daily subsistence activities (e.g., the functional analyses of quartz objects in Pignat & Plisson, 2000).

The question that we asked is whether it is possible that such small arrowheads, backed on one or two sides, could be used to kill medium to large-sized prey such as red deer, ibex or wild boar, all characterized by a powerful musculature and a thick, hard skin. We thus decided to collect information concerning the behaviour of arrows at the moment of impact and penetration into the body of an animal. We consulted the experience of modern bow and arrow hunters, who are very numerous and well organized over the entire world. Magazines and specialized journals on the subject provided us with a large amount of practical and technical information. Another particularly interesting source was the essay by Pope, an avid bow hunter during the 1920's (Pope, 1923). Pope had the extraordinary opportunity to spend extensive time with Ishi, a Native American who was the last survivor of the Yahi tribe. With Ishi, Pope learned the bow hunting techniques of Native Americans. In Italy, the only current reference is that of Vittorio Brizzi (1989, 1993 a and b, 1995, 2004), an experienced bow hunter who uses natural materials, including flint points.

Arrowheads and hunting activities: a problem of weight and efficacy

The efficacy of bow and arrow hunting depends on a series of parameters directly related to the arrowhead. Since we can analyze only the stone points potentially used by the Mesolithic groups of Trentino, we limit our analyses to two of these parameters that are directly related to arrowheads: dimensions and cutting line.

Dimensional characteristics of arrowheads

The ballistic characteristics of a "heavy" arrow are different from those of a "light" one due to the influences of the forces of gravity and air resistance during flight. In general, a heavier arrow is more stable, less resistant to air and is less affected by wind or other obstacles such as leaves or twigs. Consequently, it is preferable to use heavier arrows for more distant targets, near or at the maximum distance of the bow utilized.

Modern red deer hunters recommend the use of arrowheads weighing around six grams (cf. also Comstock, 1990). Since the thickness of the arrowhead must be adapted to the diameter of the shaft, the stem or base of the arrowhead must never exceed two fifths of the thickness of the distal extremity of the shaft, whose optimal thickness for use with a bow is one centimetre.

[1] - « Ligne de tranchant » in French. This characteristic of a projectile point corresponds to the sum of the lengths of its sharp edges and its maximum width.

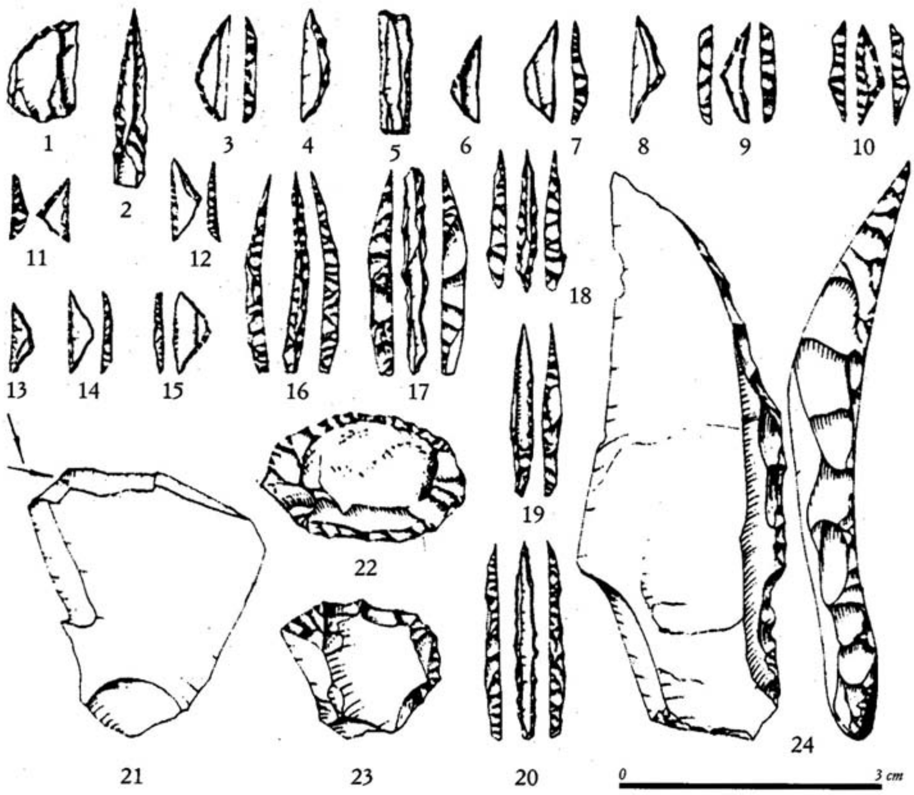


fig. 1 : Typology of the Early Mesolithic (Sauveterrian) in Trentino. Numbers 16-20 are points.

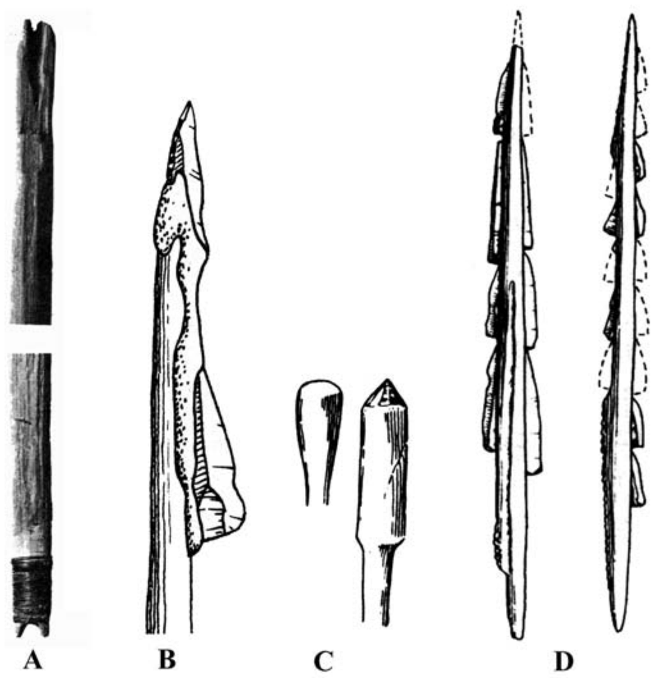


fig. 2 : Archaeological examples of arrows and points. A: base and arrowhead Vinkelmose, Denmark; modified after Clarke 1973); B: composite arrow (Loshult, Sweeden; modified after Clarke 1973); C: dulled wooden point (Denmark; modifié after Mithen, 1998); D: bone points with laterally inserted geometrics (Scandinavia; modified after Mithen, 1998).

Functional characteristics of arrowheads

The effectiveness of the cutting line of an arrowhead is another important element for understanding the characteristics of the arrow on which it is hafted. Intuitively, it is clear that the arrowhead cuts and penetrates the flesh of the animal at the moment of impact, but the depth of the wound is a function not only of the velocity of the arrow, but also of its cutting line, which corresponds to the sum of the lengths of its cutting edges and its width. The initial deformation of the flesh increases the section of the wound relative to the section of the impact: the longer and wider the point, the wider the wound. As intuitively, the efficacy of the cutting line is optimized when certain shooting and precision conditions allow vital points of the animal to be hit; the physical characteristics of the animal itself, such as skin thickness or fur length, can also influence the degree of efficacy.

Single or double backed points of the Early Mesolithic in Trentino

We selected points with one or two retouched edges from the Sauveterrian levels of the sties of Pradestel (Bagolini & Broglio, 1975; Bagolini *et al.*, 1973), Lago delle Buse (Dalmeri & Lanzinger, 1995) and Colbricon (Bagolini, 1972; Bagolini & Dalmeri, 1988; Bagolini *et al.*, 1975) (fig. 3). The first table (Table 1) presents the results of this sequence.

General observations of the archaeological sample analyzed

Though the archaeological assemblage analyzed may not be numerically significant, we believe it is statistically significant due to its extrapolation from a sample of remains selected based on published information and whose numeric value is sufficient. As proof, we observed a high degree of uniformity among the points of the different sites studied. This uniformity is manifest in the technological and morphological variability previously described, and which is almost non existent among the three sites. In each one, the sample of points is characterized by:

a) the dominance of pieces with a trapezoidal section (points with two retouched edges, most often with two backs) in association with pieces with a triangular section (points with one retouched edge and almost always characterized by a single back);
b) the diffuse presence of pieces with an intermediary (irregular trapezoidal) or variable section (isosceles triangle at the point and trapeze at the central part of the blank); These pieces present, in addition to a principal, carefully retouched edge, a secondary, less carefully retouched edge realized in order to form the apical part of the tool;
c) a fortuitous blank morphology, at least in appearance (bladelet, laminar flake, flake) associated with an equally fortuitous choice of the position of the point (proximal or distal). Moreover, we observe a selection of blanks with one, or more rarely two, parallel and rectilinear flake scars on the upper face. This characteristic explains the dominance of trapezoidal sections and could be related to a simplification of the hafting of points and/or a better adherence of them.

This low techno-morphological variability—which we again emphasize is the element that makes the analyzed sample homogeneous—is associated with a significant metric standardization. Though the pieces are highly fragmented, consequently limiting the number of whole pieces, we still observe a variability of just a few millimetres between the average length at Colbricon (11 mm) and the two other sites (16 mm at Pradestel and 19 mm at Lago delle Buse). The average widths and thicknesses are homogeneous at all the sites, oscillating between 2 and 3 mm and between 1 and 2 mm respectively.

These dimensional characteristics seem particularly important relative to the weights of these tools. In particular, we observe (table 2) that the length is almost directly proportional to the weight, for whole as well as fragmented pieces. Such a correlation is also partially existent between the width and weight,

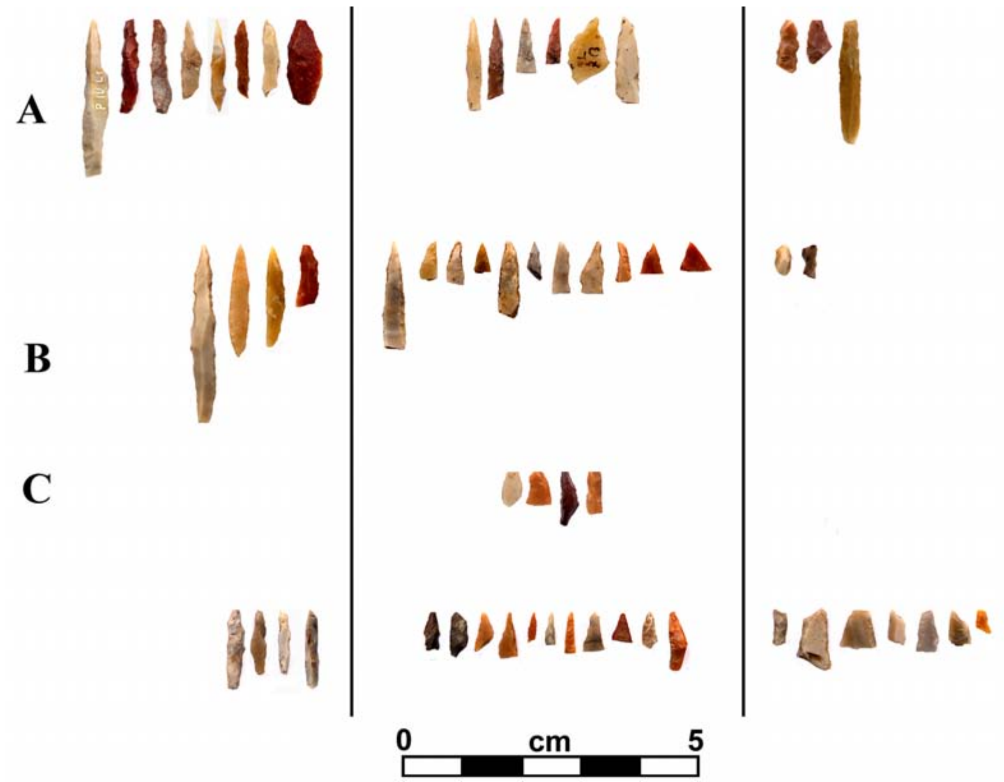


fig. 3 : Microlithic points from the Early Mesolithic levels of Pradestel (A), Lago delle Buse (B) and Romagnano 6 (C above) and 8 (C below). Whole blanks (left), broken (center) and fragmented (right) blanks.

Site	Provenance	Nombres des pieces lithiques	Nombre des pointes	Références
Pradestel	Couche L	1731	17	Broglio A. (1994) – Man and environment in the Alpine region (Paleolithic and Mesolithic), Preistoria alpina, t. 26, p. 61-69
Buse 1	Carré 4-5	1350	3	Dalmeri G., Lanzinger M. (1995) – Risultati preliminari delle ricerche nei siti mesolitici del Lago delle Buse nel Lagorai (Trentino), Preistoria alpina , t. 28,1, p. 317-349
Buse 2	Carré 6		10	
Buse 3	Carré 3-4		2	
Colbricon 6	Complet	5066	4	Bagolini B., Dalmeri G. (1988) – I siti mesolitici di Colbricon (Trentino): analisi spaziale e fruizione del territorio, Preistoria alpina, t. 23, p. 7-188.
Colbricon 8	Carré 1, 5, 14 Carré H7, I4, I7		21	
		8147	57	

tab. 1 : Synthesis of the sample of points with one or two retouched edges.

even if for several pieces an increase in width does not correspond to a clear increase in weight; on the contrary, these pieces tend to remain relatively stable in the weight range of approximately 0,1 grams. Finally, in observing the relationship between thickness and weight, a significant dimensional standardization of the pieces appears: while the thickness oscillates constantly between 1 and 2 mm, the weight is rarely higher than the threshold previously cited.

Conclusions concerning the archaeological sample analyzed

If we compare the dimensions of the pieces in the archaeological sample with what we have just described, we observe that:

- A- the average weight of the whole pieces is close to 0.1 gram;
- B- the average thickness of all pieces varies between 1 and 2 mm, indicating that the diameter of the shaft was not greater than 5 mm;
- C- the efficacy of the cutting line of nearly all of the points was practically zero due to the generalized absence of sharp edges and their extremely reduced thickness;
- D- the points analyzed correspond to the maximal values that characterize arrowheads used with a bow; this suggests that their utilization could be associated with either light bows, for which we can imagine a draw weight of around 20-30 pounds at full draw length, or more robust bows drawn without reaching the full draw length.

Experimentation

Understanding the function of Sauveterrian arrowheads requires extensive practical experience in the fabrication and use of these tools. We will now present a few preliminary observations based on an ongoing experimental program conducted with the goal of understanding the functional characteristics of the different morphologies of lithic weapon elements identified through typological analysis.

The sequence of operations was the following.

Point production

Twenty-three blanks were produced (fig. 4) using the indirect percussion technique with a soft hammer (red deer antler) and hard hammer. The raw material consisted of small flint nodules from the two largest siliceous formations in the region: Biancone and Scaglia Rossa.

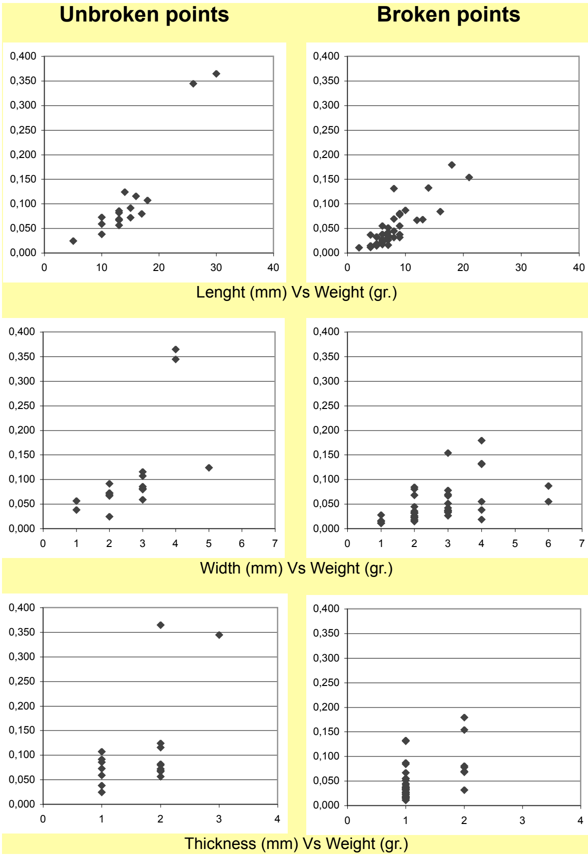
A unidirectional reduction sequence was employed to produce bladelets or laminar flakes with the following characteristics: a) the greatest possible length; b) the most regular edges possible, and; b) the straightest profile possible. Among the blanks obtained, we selected those with morphological characteristics adapted to the production of points with one or two backed edges, according to the criteria “minimum effort for maximum result”. The blanks chosen thus had morphological characteristics already functionally adapted to a rapid transformation into points, such as a homogeneous thickness over all or a large part of the length of the blank. This characteristic turned out to be particularly significant as we observed that variations in thickness had a negative influence on the quantitative production of points since they almost always resulted in fractures of the blank at the points of greatest imbalance. The qualitative production of points was also influenced by the curvature of the profile: the greater the profile curvature, the shorter the final point.

The selected blanks were transformed using the pressure technique applied with a copper compressor. The retouch was realized with the aim of producing one point from each blank, though in several cases the dimensions and morphology of the original blank would have allowed the production of two, or more rarely, three points.

The time taken to produce each point was approximately 40 minutes.

Arrow production

Nine arrows were produced using the experimental points (fig. 5). The arrows shafts were made from common dogwood (*Cornus sanguinea*) and pine (*Pinus*) branches. Their average length was 70 centimetres and average weight 26 grams. The shafts were made from branches collected about one year ago, from which we



tab. 2 : Dimensional relations of the microlithic points.

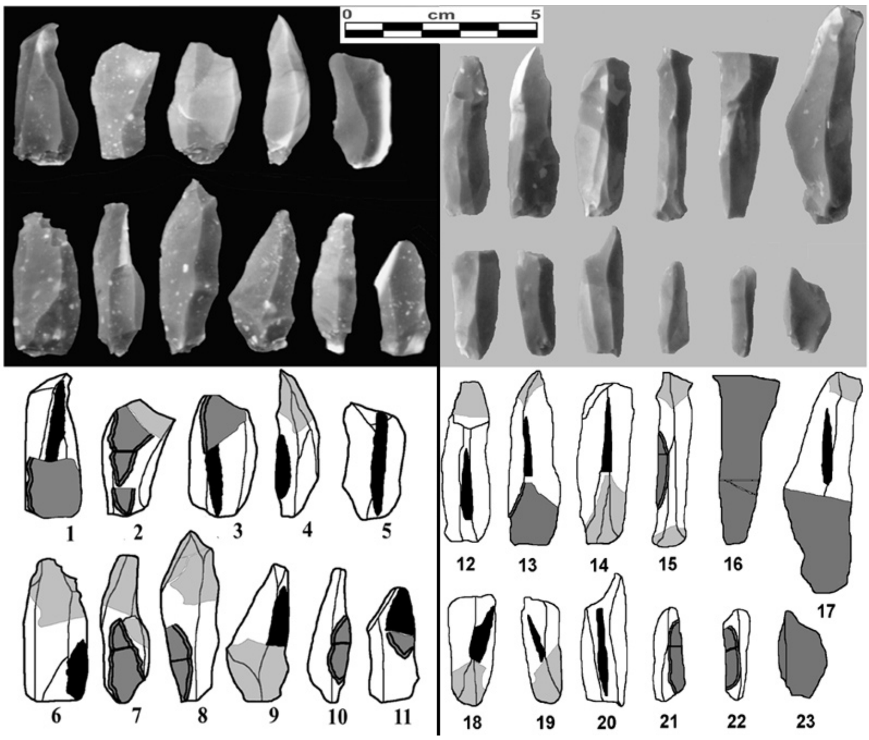


fig. 4 : Experimental lithic blanks and reconstitution of the technological categories produced by the experimental production of points; points produced (black), retouched fragments (dark gray with black edges), non retouched fragments (light gray), and extension of the blank surfaces destroyed by pressure retouch during the fabrication of the point (white).

removed the outer skin and then straightened them. All of the operations described from here on were realized with the aid of modern instruments since the objective of this study was not to experimentally verify the function of other lithic tool types. The shafts were then scraped, polished and straightened. In particular, around the last ten centimetres of the shafts was thinned by scraping and polishing in order to reduce their diameter to adapt them to the small dimensions of the points.

The fletching was realized with goose feathers attached to the shaft with a ligature composed of tendon. The nock was cut and polished. Finally, the terminal part of the shaft was perforated so that around one third of the length of the point could be inserted into it. The adhesive was made from a heated mixture of beeswax and bitumen. After filling the cavity at the end of the shaft with adhesive, the points were inserted into it after being slightly heated. Adhesive was then reapplied around the point in order to smooth the profile of the arrow between the wood and lithic parts. It took around two hours to produce the arrows.

Arrow use

The arrows were used following two procedures. The goal of the first was verify the ballistic properties of the arrows and the second to verify the functional properties of the points.

The first procedure (fig. 6) was conducted with two bows with different draw weights of 30 and 55 pounds. The sequence of shots was made at a distance varying from 7 to 15 metres from the target. The target was composed of a synthetic material (*Etaphoam*) and 5 centimetres thick. We observed that the small dimensions of the points did not limit the penetration of the arrows. In fact, the arrows generally traversed the target and came out the other side (at a length determined by the distance and bow used). Another observation concerns the properties of the arrows during flight. With both bows, the arrows were stable and sufficiently linear in their trajectory toward the target; the “bowman’s paradox” phenomenon turned out to be very limited regardless of the type of bow used. No appreciable difference was observed in terms of the ballistic properties of the arrows relative to the type of bow used.

The objective of the second procedure was to observe the functional properties of points at the moment of their penetration into the animal tissue. This time, the target was the carcass of a small pig, weighing around 9 kilograms (fig. 7). Thirty shots were made at a constant distance of 10 metres, using a bow with a draw weight of 40 pounds. The arrows penetrated a few centimetres into the carcass without ever traversing the thickest parts formed by the anterior thigh and the neck (fig. 8 and 9). In some cases, the arrows perforated the entire body of the animal, but only in the ventral part where the thickness is not greater than 5 centimetres. The arrow shafts were not damaged. The points, on the other hand, were all broken in the same manner characterized by a transverse fracture relative to their functional axis, located at the point of contact with the shaft, in which the proximal fragment remained inserted (fig. 10).

Conclusions

The data presented in this paper allow us to propose several working hypotheses. We observed in particular that the very light weight of the points with one or two retouched edges does not appear to influence the ballistic properties of arrows shot at a distance of approximately 10 metres. At this distance, the arrows allowed precise shots and assured relative velocity and stability. The functional limits were observed at the moment when the arrow hits the target: the penetration capacity seems to be more limited than that of arrows with heavier points, which are thus, at an equal speed, more powerful at impact. Consequently, the small dimensions of microlithic points seems to indicate that they would be “ineffective” if the objective of the hunt was to rapidly bring down medium to large sized prey species that have thick fur and are particularly agile and muscular, such as ibex, red deer, bear or wild boar. It is interesting to note that the use of laterally inserted geometrics cannot be considered as a functional improvement since their principal function is to widen the wound and this is not possible unless the arrow can penetrate the target.

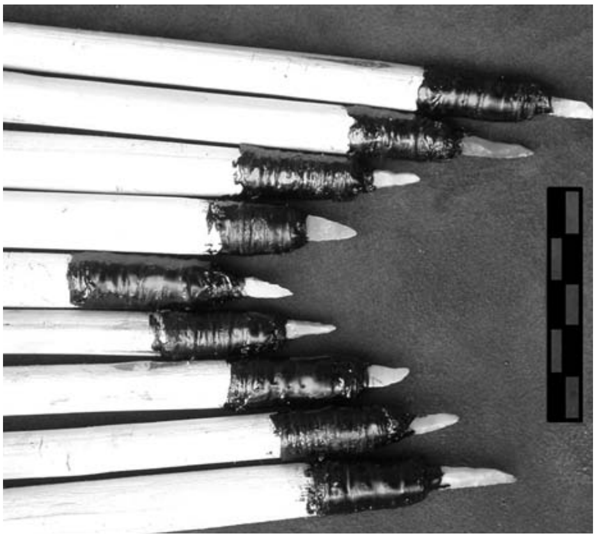


fig. 5 : Experimental arrows.

fig. 6 : . Shooting phase; in the lower part of the target, we can see the first arrow shot with a light bow, which suffered a significant loss of speed; the second arrow shot with a heavy bow shows a more rectilinear trajectory.

fig. 7 : The target.

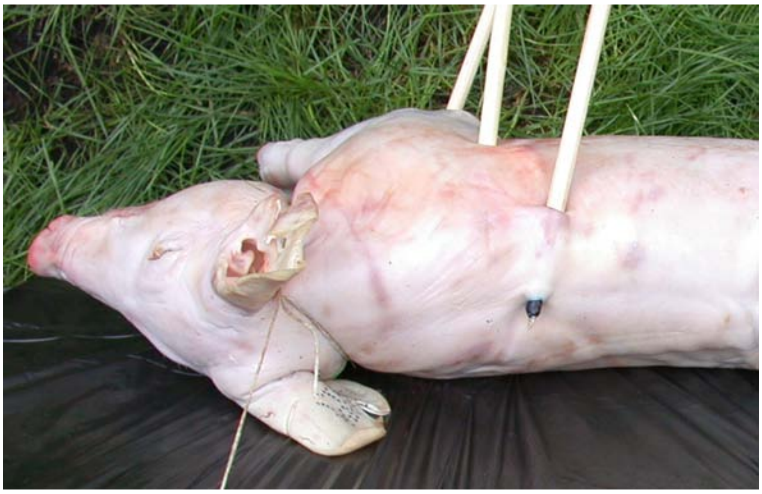


fig. 8 : Arrows that attained the target.

fig. 9 : The penetration depth of the arrow extracted from the target is indicated by the thumb of the hand that is holding it.

fig. 10 : The arrows after use.

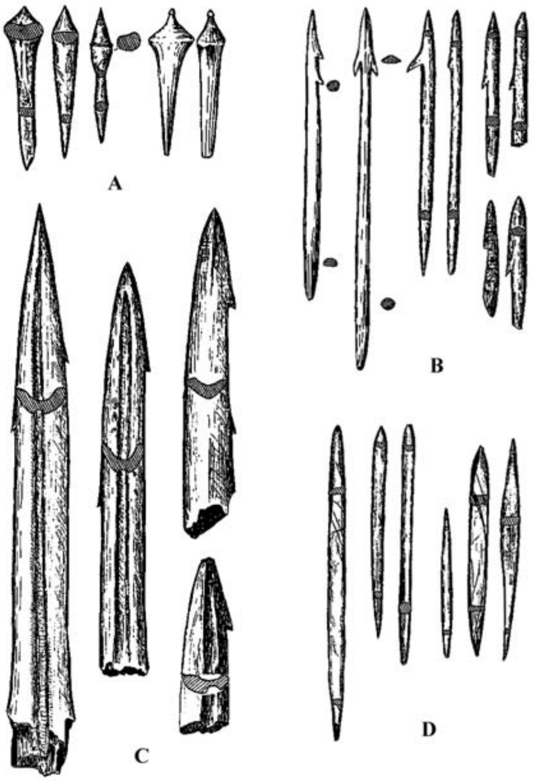


fig. 11 : Zamostje (Russie). Exemples de pointes en bois animal et os provenant de niveaux du Mésolithique ancien (modifié d'après Lozovski, 1996).

fig. 12 : Abri Pradestel (Trentino, Italie du nord-est). Exemples de pointes en bois animal provenant du niveau sauveterrien.

We thus propose the hypothesis that Sauveterrian microlithic points were associated with less "specialized", more occasional, hunting activities, conducted individually or as a group, to hunt small forest prey such as roe deer, marmot, beaver, squirrel and other animals with fur. The functional characteristics observed in the sample of archaeological points can be correlated with the necessity to perforate the tissues of smaller animals while tearing them as little as possible. A wound could thus be fatal without damaging the fur or skin. Unfortunately, the frequency of small animal hunting by the Mesolithic groups of Trentino is difficult to confirm due to the absence of faunal remains in high altitude sites such as Lago delle Buse and Colbricon. Small animal remains have been observed, however, in the valley bottom sites of Adige (Boscato & Sala, 1980; Royston, 2000). In addition, several Mesolithic sites in the Alps have yielded indications of small animal hunting (e.g., Bridault, 1998 and 2000; Chaix, 1998 a and b; Desbrosse *et al*., 1991; Monin, 2000; Muller, 1914; Patou, 1987; Rehazek, 2000). This indicates that small animal hunting was widespread and constituted an important element of the territorial strategy of Mesolithic groups in mountain and middle mountain regions.

But what about large prey hunting strategies? From a purely speculative perspective, and without excluding the possibility of spear use, we can propose the hypothesis that large animals were hunted with powerful bows that could shoot heavy arrows with different types of points, such as wooden arrow shafts with their points hardened by fire, or bone and antler points attached with resin or ligature. Archaeological examples of these types of points have been discovered in association with animal remains (Rust, 1943; Campbell, 1977) (fig. 2 and 11). In addition, many other sites have yielded bone or antler objects that could have been used as arrowheads or spear points (*cf.* Bonsall, 1989; Crotti, 2000; Lozovski, 1996; Vermeersch & Van Peer, 1990); this type of object has also been found in the valley bottom sites in the province of Trentino (fig. 12). Their morphological characteristics correspond perfectly to the standards described by modern bow hunters. With its length and penetrating capacity, a bone or antler point, even without sharp edges, fully satisfies one of the necessary parameters for the optimal functioning of a hunting weapon. The other parameter, width, could have been satisfied by the lateral insertion of geometric microliths on one or two sides of the point, which would increase its cutting capacity and thus the size of the wound produced. In this case also, there are two archaeological examples that demonstrate their realization (Bergman, 1993; Larsson, 1983).

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