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Jean-Marc Pétilon. What are these barbs for? Preliminary reflections on the function of the Upper Magdalenian barbed weapon tips / Des barbelures pour quoi faire? Réflexions préliminaires sur la fonction des pointes barbelées du Magdalénien supérieur. *P@lethnologie*, 2008, 1, pp.66-97 / 69-102. halshs-00403708

HAL Id: halshs-00403708

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Submitted on 12 Jul 2009

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WHAT ARE THESE BARBS FOR ?

PRELIMINARY STUDY ON THE FUNCTION OF THE UPPER MAGDALENIAN BARBED WEAPON TIPS

Jean-Marc PÉTILLON

« If the arrow is of the barbed kind, you should disentangle the flesh caught between the barbs as much as you can, and then pull it out. »
translated from Bruno da Longobucco, *Chirurgia magna* (1252)

Abstract

Based on previous works by M. Julien (1982) and G.C. Weniger (1995), this paper presents some preliminary hypotheses on the possible functions of the osseous barbed points from the Upper Magdalenian (*ca.* 13,500-12,000 calBC). Taking as a starting point the statement that their appearance and development coincide with an increased interest in small animal hunting (fish, birds, lagomorphs), we attempted to correlate the relative abundance of barbed points with the representation of small game, but the data from our test area (Northern Pyrenees) did not provide conclusive results. A survey of the barbed points of Northern American hunter-gatherers known by ethnography shows a clear functional trend: « simple » barbed points are mostly used for fowling, for hunting big and small land game, and for war; while « true » harpoons are mostly used for fishing and hunting sea mammals and aquatic mammals. However, when based on a rigorous operational definition of harpoons, the morphology of the Magdalenian barbed points appears not to allow their positive classification as harpoon heads. Thus, their function remains largely undetermined. We therefore suggest several possible directions for future research on this topic.

Key-words : osseous industry, barbed points, hunting weapons, Magdalenian, zooarcheology, ethnography, functional study

Projectile points made of osseous material – bone, antler and ivory – appear in Europe at the very beginning of the Upper Paleolithic. They thereafter undergo numerous variations in shape, dimensions, surface features (decoration, longitudinal grooves...) and, most of all, hafting method. Most of these changes are not readily interpretable in operational terms. It is difficult to say, for example, if the shift from single- to double-beveled antler points at the beginning of the Upper Magdalenian has anything to do with a change in the weapon system operation – since both types of points can be hafted to similar projectiles projected in the same way against similar targets. There is however one Paleolithic technological innovation that stands out from this point of view: the addition of barbs.

In Europe, the first single-barbed osseous points probably date back to the Gravettian (see chronology below); but the major development of barbed tips begins with the Upper Magdalenian *ca.* 13,500 years BC, and continues into the subsequent Epipaleolithic and Mesolithic cultures, and to a lesser extent into the Neolithic. Compared to unbarbed osseous points, barbed weapon tips represent an important technological change: they are specifically designed to prevent their extraction from a wound. Because this particular feature obviously affects the weapon operating mode, it undoubtedly points to some kind of change in the game acquisition techniques.

The question we want to address here is the following: how, and to what extent, did the introduction of barbed points modify Paleolithic predatory behavior? What was their exact role and importance in the hunting kit? In other words, the issue considered here is that of the function(s) of the barbed points.

According to F. Sigaut, determining the function of an artifact implies establishing « the complete and exact set of ends to which an implement is used » (Sigaut 1991, p. 23). Dealing here with artifacts closely related to hunting, our main goal will be to determine the

type(s) of game against which barbed points were used. Of course, we cannot be sure to achieve such a precise diagnosis with Paleolithic artifacts (Sigaut *ibid.*), and this paper must be considered as a preliminary study exploring the feasibility of the project. It does not yield conclusive results but rather indicates possible relevant directions for future research.

For reasons detailed below, we will concentrate on the barbed items from the Upper Magdalenian, especially the artifacts usually called « *harpons* » in the French literature. For more than one century, these artifacts have been the subject of an abundant literature, the books by M. Julien (1982) and G.C. Weniger (1995) being the most comprehensive studies to date. The present paper only intends to develop some of their ideas in a new perspective.

Defining the scope of the study : a brief overview of Paleolithic osseous barbed items

On a projectile or thrusting spear, a « barb » can be defined as a more or less pointed lateral prominence, intended to hinder or forbid extraction of the weapon from the wound. Laterally-hafted flint bladelets, very common in many Upper Paleolithic cultures and occasionally found in association with osseous points (Nuzhnyj 1989), have sometimes been described as « lithic barbs ». However, in many cases it is not clear whether these implements had a real « holding » role or merely a shredding function, and we prefer to avoid using the word « barb » in this context.

In the present state of our knowledge, the oldest known barbed tips would be the bone points from the Ishango and Katanda sites (Nord-Kivu, Congo Democratic Republic), with respectively estimated dates of 20,000 BP and 90,000 BP. So far, these artifacts remain chronologically isolated, all other African barbed points known to date being of Holocene age (Yellen 1998).

In Europe, the oldest barbed items from the Upper Paleolithic, not included in the present study, are



probably the self-barbed antler points (fig.1a) from the Gravettian (Goutas 2004, p. 201), the Solutrean (e.g., Peyrony 1929, 1934; Castel *et al.* 2006, fig.7), the Cantabrian Lower Magdalenian (Pokines & Krupa 1997) and the Badegoulian (Séronie-Vivien 2005, p. 151). From the first discovery of this type of artifact, at the beginning of the twentieth century, it has been suggested that « this point type may have been hafted laterally so that the point was in line with the axis of the spear shaft and the basal portion protuded as a barb » (Pokines & Krupa 1997, p. 241-242). The geographical distribution of these points is limited to Cantabrian Spain and South-Western France, and they seem to represent a relatively small portion of the weapon kit¹. As they are absent from the Middle Magdalenian, they cannot be considered as the direct ancestors of the barbed points of the Upper Magdalenian.

The origin of the latter has sometimes been sought among the artifacts called « *protoharpons* », which appear during the Middle Magdalenian in some sites in France and Spain (fig.1b). We refer the reader to P. Cattelain's definitive clarification on these items, which constitute a small group of *ca.* 60 poorly defined objects with heterogeneous morphometric characteristics and unclear typological attribution (Cattelain 1995). For these reasons, they will not be considered here. The same goes, in our opinion, for the *ca.* 100 « *foënes* » found almost exclusively in Upper Magdalenian sites from Southern France (fig.1d). These small multi-pointed objects also have very heterogeneous characteristics, and in several cases their use as projectile elements is far from certain (for more details see Bellier *et al.* 1995).

Our study focuses on the classical « *harpons magdaléniens* »: antler points with one or two rows

of barbs, of *ca.* 130 mm long on an average, which M. Julien divided into seven main morphometric categories (fig.2, and see Julien 1995). Although « *harpon* » is the usual French name for these artifacts, we will follow G.C. Weniger's opinion (Weniger 1995, p. 2) and call them « barbed points », a name that bears much less presupposition about their function. Their appearance in the stratigraphic layers has long been used as a marker for the beginning of the Upper Magdalenian; the oldest reliable radiocarbon dates for these points go back to around 13,500 calBC², and continue at least until 12,000 calBC. Between 1,500 and 2,000 specimens have been accounted for in Magdalenian sites, their distribution area stretching from the northern and eastern coasts of Spain to central Germany. Their well-known typology, their long-lasting chronology, their high numbers and their wide geographical distribution make of them a very suitable case a thorough functional investigation.

Although the timing of their disappearance is still debated, it is generally admitted that, from 12,000 calBC on, the Magdalenian barbed points gradually transform into other types, specific of the subsequent Azilian culture (fig.1c). Being very different from a typological and technical point of view, used in a much more forested environment and in a very different technological context, these Azilian barbed points – and all the more recent types coming from the Final Paleolithic, the Mesolithic and later cultures – will not be addressed in this paper.

Archeological perspectives : barbed points against zooarcheological data

Taken as a whole, the Magdalenian hunting spectrum is largely dominated by several species of large and medium-sized ungulates (bovids, horse, red deer,

¹ - J.T. Pokines and M. Krupa (1997, table 1) report about eighty specimens in 13 sites for the whole Cantabrian Spain. There is no detailed list for the French sites, but the total number of specimens is very likely much smaller than that of Spain.

² - E.g., the 14C AMS date of 13,020±130 BP (13,910-13,050 calBC) on a barbed point from Bruniquel-Montastruc (Tarn-et-Garonne) and the 14C AMS date of 13,140±120 BP (14,070-13,180 calBC) on a barbed point from Fontalès (Tarn-et-Garonne) (Tisnerat-Laborde *et al.* 1997). All 14C dates have been calibrated with the CALIB program (Stuiver and Reimer 1993, version 5.0.1.) using the IntCal04 dataset (Reimer *et al.* 2004). In accordance with the authors' instructions, cal age ranges of samples with standard deviations greater than 50 years have been rounded to the nearest 10 years.



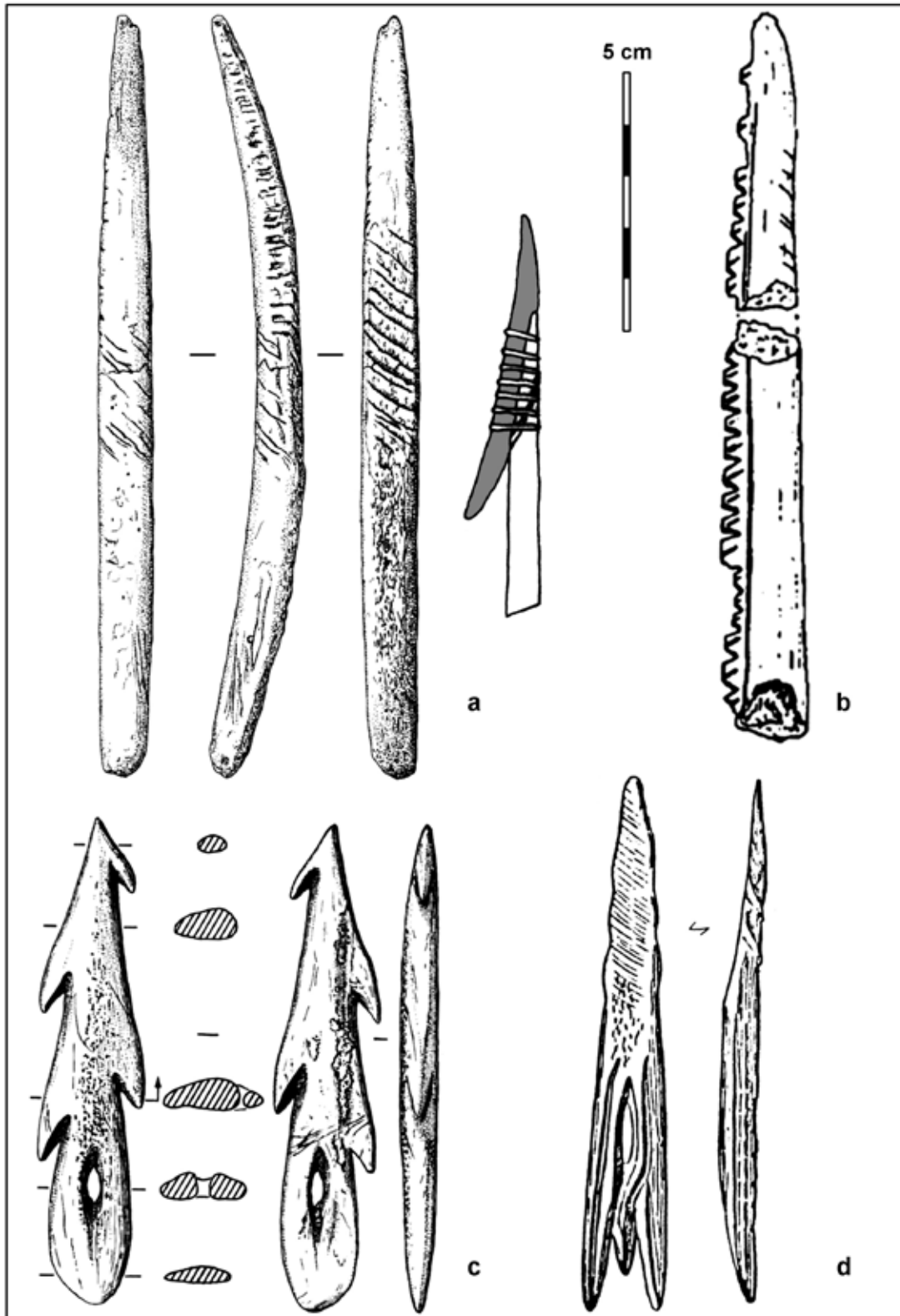


fig. 1 : palaeolithic barbed items not included in the present study. a: self-barbed point and its probable hafting mode (Le Petit Cloup Barrat, Solutrean; after Castel et al. 2006, fig.7. Hafting diagram by Pokines & Krupa 1997, fig.2). b: « protoharpon » (Fontalès, Magdalenian; after Pajot 1969). c: Azilian barbed point (La Vache, Azilian; drawing by D. Molez, after Julien & Orliac 2004, fig.158). d: « foëne » (Laurerie-Haute, Magdalenian; after Bellier et al. 1995, fig.6).



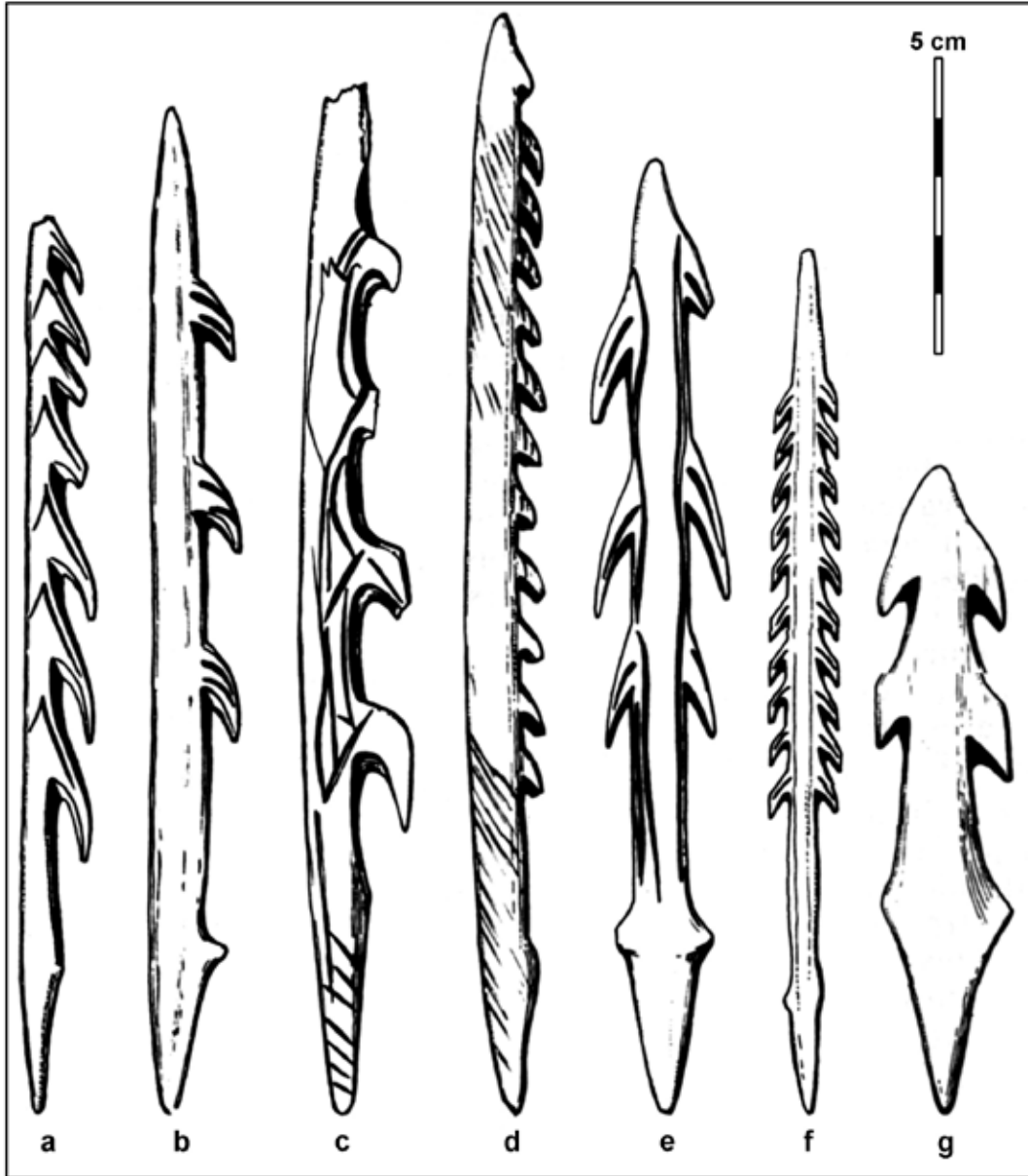


fig. 2 : typology of the Magdalenian barbed points after M. Julien. a: one row of barbs, type A1 (Mas d'Azil). b: one row of barbs, type A2 (Mas d'Azil). c: one row of barbs, type A3 (La Madeleine). d: one row of barbs, type B (Bruniquel). e: two rows of barbs, type A (Sainte-Eulalie). f: two rows of barbs, type B (Laurerie-Haute). g: two rows of barbs, type C (Gourdan). After Julien 1982, fig. 42 to 45.

reindeer and ibex). Regional variations³ are today more often interpreted as adaptations to specific local and/or seasonal conditions, affecting the available animal resources (Costamagno 2004; Gaudzinski & Street 2003).

However, the beginning of the Upper Magdalenian is marked by a significant increase in the exploitation of small game – especially fish and birds, but also hare, rabbit and marmot in specific areas. This diversification does not seem to be the answer to environmental change, as it begins before the warm-up and reforestation of the Bølling-Allerød interstadial (Costamagno & Laroulandie 2004). Nevertheless, since barbed points make their appearance in the Magdalenian weapon kit at the same time, it was tempting to correlate these two archeological facts, and to hypothesize that barbed projectiles had a specific role in the capture of small animals.

We tested this hypothesis by confronting the zooarcheological data (relative representation of the hunted species) and data from the osseous industry (frequency of barbed points in the assemblages). When considering the idea that the proportion of the different types of tools in an archeological assemblage roughly indicates the intensity of the different activities performed on the site (Binford 1983, p. 144-146), if barbed points were used against a specific type of game, one can expect remains of this game to be particularly abundant in sites that yielded a high proportion of barbed points in their industry.

For several reasons, we chose the northern side of the Pyrenees as a test area:

- along with northern Aquitaine and Cantabrian Spain, it is one of the 3 regions that yielded the greatest number of Magdalenian barbed points;
- it is also one of the regions where the Upper Magdalenian increase in small game hunting is well documented (Costamagno & Laroulandie 2004);

- it counts more than 70 Magdalenian sites (Clottes 1989, p. 292), which could provide a good study sample in the first place.

We selected the sites that fulfilled four criteria:

- presence of an indisputable Upper Magdalenian occupation;
- fairly abundant and well preserved osseous industry and faunal remains;
- artifacts of known stratigraphic origin;
- precise quantitative data available on fauna and osseous artifacts.

Only seven sites met these conditions (tab.1): they are all cave and rockshelter sites, and they form two groups in the western and eastern parts of the range (fig.3), a location that only reflects the state of research in the Pyrenean region. The small size of the sample makes statistical analysis useless. Moreover, the data must be considered with caution at least for three reasons. Firstly, some of these excavations are old, and the collecting of the faunal remains has been very selective (such is the case at Isturitz: Pétillon *et al.*, in press). Secondly, the absence of systematic sediment sieving at Isturitz, but apparently also at La Vache (Laroulandie 2000, p. 268-269), greatly reduces the proportion of small animals – especially fish – in the fauna. And lastly, the central sector of two of the sites (Arancou and Dufaure) has respectively been truncated by an illicit excavation and by an ancient, poorly-documented excavation. Despite these limitations, several results have been obtained.

In all the known Upper Magdalenian sites, the majority of the osseous points are unbarbed. The proportion of barbed points in the osseous weaponry was evaluated in the following way (tab.2): the total number of osseous points (barbed+unbarbed) was first added together, then the percentage of barbed points within this total was calculated, isolated barbs being excluded from all counts. This percentage is a more significant index

³ - E.g., the importance of red deer and ibex hunting in Cantabrian Spain (Straus & Clark 1986), the importance of ibex hunting in central and eastern Pyrenean high altitude sites (Fontana 1998, p. 229-238), the great number of saiga antelope in some Lower and Middle Magdalenian sites of the Gironde (Costamagno 2001), etc.



Site	Location	Type	Excavation	Layers
Arancou	Pyrénées-Atlantiques	cave	Chauchat 1987-2001; Dachary 2002-04	ens. B + rubble
Belvis	Aude	cave	Sacchi 1963-86	C1 to C4
Dufaure	Landes	rockshelter	Breuil & Dubalen 1900; Straus 1980-84	4
Duruthy	Landes	rockshelter	Arambourou 1958-75	3
Les Eglises	Ariège	cave	Clottes 1964-77	4 to 9
Isturitz (grande salle)	Pyrénées-Atlantiques	cave	Passemard 1912-22; Saint-Périer 1928-37	I/F1
La Vache (salle Monique)	Ariège	cave	Robert 1952-64	1 to 4

tab. 1 : Upper Magdalenian sites of the northern Pyrenees included in the sample.

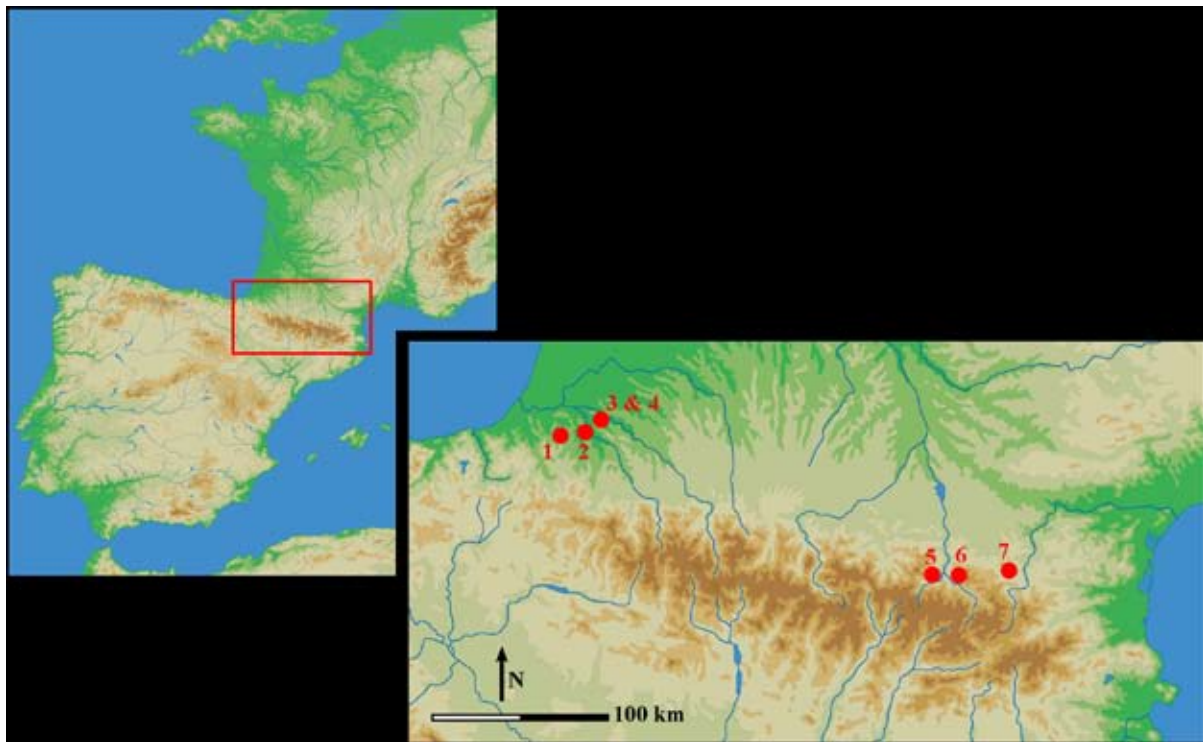


fig. 3 : map of the Pyrenees showing the location of the sites included in the sample. 1: Isturitz. 2: Arancou. 3: Dufaure. 4: Duruthy. 5: La Vache. 6: Les Eglises. 7: Belvis.



than the absolute number of barbed points, as the latter does not allow inter-site comparisons because of its dependence on factors such as duration of occupation or overall size of the dwelling, factors that should not be taken into account here.

The percentage of barbed points in the osseous weaponry appears to be very variable, from less than 7% at Isturitz to more than 30% at Duruthy. Three groups can be distinguished: a first one where barbed points represent less than 10% (Isturitz, Les Eglises), a second one around 15% (La Vache, Belvis and probably Dufaure), and a third one above 20% (Arancou, Duruthy).

Faunal data was compiled from the seven sample sites (tab.3). The MNI (Minimum Number of Individuals) would have been the best counting unit for comparison purposes, but since it was not available for all the sites, we used the NISP (Number of Identified Specimens). Carnivores were excluded as, in all well-documented cases, they appear more as the natural inhabitants of the cave than as the game of the Magdalenians. In all sites, the main ungulate species is either reindeer or ibex (except at Arancou where red deer dominates). Birds are almost always well represented. The same is true for fish – at least in sites where the sediment has been sieved – except at Dufaure. Lagomorphs are sometimes relatively abundant (Les Eglises, La Vache, Belvis) but are absent in the majority of the sites (Isturitz, Dufaure, Arancou, Duruthy); they have never been a very important animal resource for the Magdalenians of this region (Costamagno & Laroulandie 2004, p. 409).

These figures do not point at any obvious association pattern between the barbed points and the faunal spectrum, especially with the relative abundance of small game. The conclusion seems to be that barbed points as a whole were not dedicated to the capture of a specific type of game. But more importantly, this first survey of the data from northern Pyrenees mainly shows that there are few Magdalenian sites where the necessary information is available. In this situation, before any positive or negative conclusion can be

drawn, enlarging the study sample to other regions is a priority: the inclusion of data from other sites can greatly alter the picture. A good example is the recently published monograph on the Bois-Ragot cave (Vienne). In this site, the Upper Magdalenian layer 5 yielded a very high percentage of barbed points (29/78 = 37%; see Christensen & Chollet 2005, p. 224-229), and a faunal spectrum largely dominated by small game: birds, fish, and especially the arctic hare (*Lepus timidus*) which makes up 84% of the bone count for this level (Griggo 2005; Cochard 2005; Laroulandie 2005; Cravinho & Desse-Berset 2005).

Ethnographical perspectives: barbed points of hunter-gatherers in northern America

We have followed another research axis, which was to characterize the usage context of barbed points among the hunter-gatherers known by ethnography, and to discuss any possible inferences on the Magdalenian material. A similar work has already been done by M. Julien, mostly using ethnographical literature coming from the American continent. She concludes that Magdalenian barbed points were probably used in a water environment – mainly for fishing, but also possibly for hunting ungulates trapped in water (Julien 1982, p. 144-150). However, this research has been conducted on the assumption that a large majority of the Magdalenian points were harpoon heads (Julien 1982, p. 137-142), but M. Julien later qualified this hypothesis and suggested that part of the Magdalenian barbed heads might have been hafted to non-harpoon projectiles used in land game hunting (see Julien 1999; Julien & Orliac 2004, p. 246-247).

The identification of the Magdalenian barbed points as harpoon heads is also questioned by G.C. Weniger (1992, 1995, 2000). His own work relies on a comparison between Magdalenian barbed points and a sample of 311 ethnohistorical barbed weapon tips from northern America – mostly western Alaska and the Northwest Coast. Morphometric attributes allow him to distinguish four different functional categories among the Magdalenian material: spearheads, harpoon heads,



Site and layers	Unbarbed osseous points	Barbed osseous points	Osseous points total	Percentage of barbed points	References
Isturitz I/F1	705	48	753	6.4	Pétillon 2006
Les Eglises 4 to 9	40	4	44	9.1	Clottes 1983
La Vache (salle Monique) 1 to 4	1,481	250	1,731	14.4	Bertrand & Pinçon 2004; Julien & Orliac 2004
Belvis C1 to C4	65	12	77	15.6	Sacchi 1992
Dufaure 4 [+ 1900 excavation]	32 [+12]	4 [+8]	36 [+20]	between 11.1 and 21.4	Straus 1995
Arancou ens.B [+ rubble]	1 [+81]	9 [+16]	10 [+97]	minimum 23.4	Chauvière 1999; Dachary 2005
Duruthy 3	66	29	95	30.5	Arambourou 1978

tab. 2 : number of barbed and unbarbed osseous points in the Upper Magdalenian levels of the northern Pyrenean sites.

Site and layer	Percentage of barbed points	Ungulates (including dominant species)	Birds	Fish	Hare, Rabbit	References
Isturitz I/F1	6.4	265 (reindeer: 135)	768	0	0	Pétillon <i>et al.</i> in press
Les Eglises 4 to 9	9.1	9,097 (ibex: 9,085)	1,576	521	84	Delpech & Le Gall 1983; Laroulandie 1998
La Vache (salle Monique) 1 to 4	14.4	81,603 (ibex: 71,451)	54,724	present	1,121	Pailhaugue 2004; Laroulandie 2000; Le Gall 1992, fig.4
Belvis C1 to C4	15.6	2,113 (ibex: 1,512)	62	21	140	Fontana 1999; Le Gall, Vilette in Sacchi 1992
Dufaure 4	11.1 to 21.4	4,011 (reindeer: 2,356)	133	2	1	Altuna & Mariezkurrena 1995; Eastham 1995; Le Gall 1995
Arancou ens.B [+ rubble]	minimum 23.4	552 [+ 2,093] (red deer: 342 [+ 1,253])	20 [+ 1,255]	1 [+ 610]	0 [+ 0]	Fosse 1999; Eastham 1999; Le Gall 1999
Duruthy 3	30.5	2,851 (reindeer: 2,206)	126	52	1	Delpech 1978; Costamagno 2006; Laroulandie 2006

tab. 3 : representation of ungulates, birds and lagomorphs in the Upper Magdalenian levels of the northern Pyrenean sites (NISP). Concerning Duruthy, only the ungulate remains of the upper terrace have been taken into account (see Costamagno 2006).



harpoon-arrows and fixed arrowheads. In his opinion, all categories would have been used for fishing, but fixed spear- and arrowheads would also have been used for big land game hunting (Weniger 1995, p. 193-199 and table 77).

Our intention was to go back on this survey with a different methodology. Contrary to G.C. Weniger, we concentrated on the ethnographical literature and not on the actual study of the ethnographical artifacts. Contrary to M. Julien, we included all kinds of barbed points in our ethnographical survey. Our purpose is to build a comprehensive database on the parameters and modes of use of these points. The « Human Relations Area Files » of Yale University (New Haven, Connecticut) were used as the main investigation tool, thanks to the complete and updated version available at the Collège de France in Paris.

Our database is far from complete, but several general trends can already be drawn. Research was conducted primarily on hunter-gatherer groups of the northern half of North America, roughly corresponding to the territories of Alaska and Canada, thus including the Northwest Coast, the northern Athapascan and the northern Algonkian Indians, as well as the Inuits. This choice was justified by the fact that these groups are well-known for using a varied range of osseous barbed points; and also because their natural environment is closer that of the Magdalenians than that of the hunter-gatherers living in temperate, tropical or desert regions.

Most of the useable information was found in 19th century and early 20th century ethnographical observations. But even then, hunter-gatherer societies had been deeply altered by contacts with the Europeans. The very quick replacement of osseous materials by metal in the making of barbed points, the eventual replacement of traditional weapons by guns and steel traps in all hunting activities, except

fishing and sea mammal hunting, are only some of the strong biases that must be taken into account when interpreting the ethnographical data.

The data on barbed points was collected for 22 different groups (tab.4, fig.4). In each case, the two main pieces of information recorded were the nature of the game and the type of weapon used. Concerning the second point, the lack of accuracy of many descriptions limited us to a distinction between *harpoons* and *other barbed projectiles*. However the distinction is functionally very significant, as can be seen in tab.5. Harpoons are most often used in water environments, for fishing, hunting sea mammals or aquatic mammals such as beaver and otter. Barbed spears and arrows, on the contrary, are most often used for fowling, hunting big and small land game, and for war. Of course, there are exceptions in the two categories, so this disjunction must not be considered as a strict rule but does nonetheless represent a significant trend. Thus, if we were able to determine whether Magdalenian barbed points are harpoon heads, we would have made an important step in establishing their possible function. Indeed, since we have almost no material evidence of sea mammal and aquatic mammal hunting in the Magdalenian, the most probable use for Magdalenian harpoons would be fishing.

An operational definition of harpoons

However, before any further discussion of the Magdalenian material, it is necessary to specify our definition of the harpoon. O.T. Mason defines the harpoon as « a piercing and retrieving device with a moveable head. (...) The head is always set loosely on the end of a shaft, to which it is attached by means of a line » (Mason 1900, p. 197). Similarly, for A. Leroi-Gourhan, a harpoon is characterized by its detachable head, tied to a line used to hold the prey⁴. G.C. Weniger also characterizes the harpoon as « a hunting weapon, thrust or thrown, whose tip

⁴ - « Ce qui distingue catégoriquement le harpon, c'est sa tête détachable, qui reste prise dans le corps de l'animal alors que la hampe de l'arme se libère. La tête est rattachée à une ligne de cuir ou de corde au moyen de laquelle on manœuvre l'animal blessé » (Leroi-Gourhan 1945, p. 54).



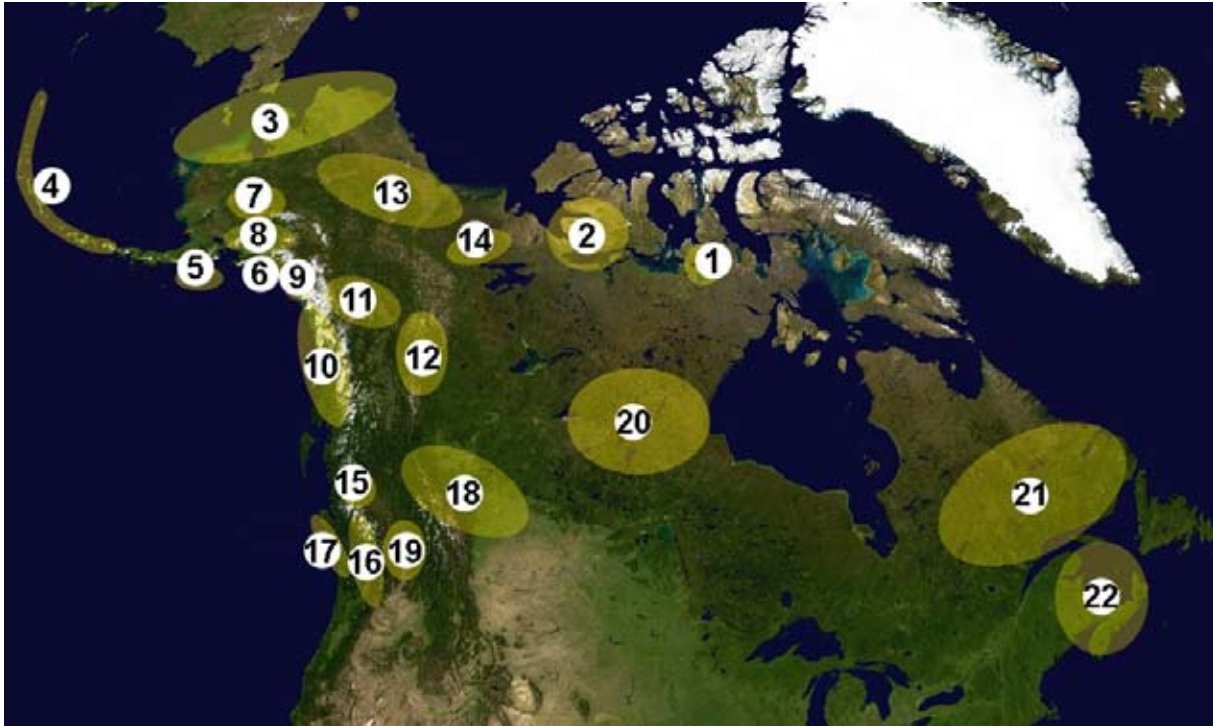


fig. 4 : satellite view of the North America's northern half with location of the hunter-gatherer groups included in the ethnographical sample. Numbers refer to the list in table 4. Satellite picture from NASA / Wikipedia.

Group	Main references
1 Netsilik Eskimo	Taylor 1974
2 Copper Eskimo	Stefánsson 1914; Cazdow 1920; Jenness 1922, 1946
3 Bering Strait Eskimo	Nelson 1899
4 Aleuts	Veniaminov 1840; Jochelson 2002/1925; Collins 1945; Antropova 1964; etc.
5 Koniag	Birket-Smith 1941; Heizer 1952; Clark 1974; Hrdlicka 1975/1944
6 Cugach	Birket-Smith 1953
7 Ingalik	Osgood 1970/1940
8 Tanaina	Osgood 1937
9 Eyak	Birket-Smith & De Laguna 1938
10 Tlingit	Knapp & Childe 1896; Oberg 1937; Krause 1956; De Laguna 1972
11 Southern Yukon Indians	McClellan 1975
12 Kaska	Honigmann 1954
13 Kutchin	Osgood 1936
14 Hare	Richardson 1852; Hara 1980
15 Bella Coola	McIlwraith 1948
16 Coast Salish	Barnett 1975/1955
17 Nootka / Makah	Swan 1870; Drucker 1951
18 Shuswap	Teit 1909
19 Thompson Indians	Teit 1900
20 Chipewyan	Birket-Smith 1930
21 Montagnais / Naskapi	Hind 1972/1863; Turner 1889-90; Lane 1952; McGhee 1961
22 Micmac	Denys 1908; Le Clerq 1910; Wallis & Wallis 1955

tab. 4 : hunter-gatherer groups of northern North America included in the ethnographical sample.



is mobile and linked by a line to the shaft, to another object or to the user »⁵.

These definitions focus on the morphological (or structural) attributes of the harpoon: the mobility of the tip and the presence of a line. However, we would like to suggest another definition. In our opinion, the word « harpoon » does not refer to a specific weapon morphology, but rather to a specific *modus operandi*, or operating mode. From this point of view, we can give the following definition of the harpoon: *a harpoon is a projectile, or thrusting spear, used in hunting. Its use aims mainly at preventing the escape or loss of the struck animal, by creating a link between it and a « drag » or impediment. This drag can be the user himself, another person or an object (float, detached shaft of the projectile, etc.). Therefore, a harpoon always has a tip designed to remain: a) caught in the target's body; b) directly or indirectly linked to the drag.*

According to this definition, the mobility of the tip and the presence of a line are morphological attributes that can – and often do – derive from the harpoon's operating mode, but they are not always present. In fact, this definition was prompted by an observation drawn from our ethnographic survey: several hunting weapons which can be defined as harpoons as to their operating mode do not have a detachable tip or a line. This appears clearly when classifying all projectiles and thrusting spears according to the three following criteria (fig.5):

- presence or absence of a line;
- fixed or detachable head;
- presence or absence of barbs.

Eight theoretical categories result from this classification, but since we do not know any example of a weapon with a line and a fixed unbarbed tip, all projectiles and thrusting spears can be placed among the seven A to G categories shown in fig.5.

Category A corresponds to the « classical » conception of a harpoon with a detachable barbed head and a line

(fig.6a). Category B groups together harpoons with unbarbed detachable heads: such as several types of « toggle harpoons » from the Arctic (fig.6c), or some with a specific design like the turtle harpoon of the Seri Indians in the Gulf of California (fig.6d). Category C refers to projectiles that are also harpoons, although they have no detachable head: the point is fixed, barbed, and the line attached to the shaft. Harpoons of this category are described by Le Jeune as being used in the 17th century by the Montagnais for beaver hunting: « Another method of hunting beaver involved the use of a barbed iron point fixed to a shaft. A string or cord was then attached to the shaft. When the beaver was struck with this kind of harpoon, it dove beneath the surface of the water, taking the harpoon with it. The hunter held the cord that was attached to the shaft (...) (Le Jeune, 1632-JR, vol. 6, p. 61) » (Lane 1952, p. 8; see Denys 1908, p. 481 for the description of a Micmac beaver hunting technique, using similar harpoons shot with a bow).

Categories D and E are not harpoons. They have a barbed or unbarbed detachable head, but no line: in this case, the detachment of the head only ensures that the point will remain in the wound, inflicting more damage to the target. This is a fairly common feature for projectiles used in war or in big land game hunting. Categories F and G correspond to « regular » projectiles and thrusting spears with a barbed or unbarbed fixed point and no other special feature: they are not harpoons either.

However, within categories F and G, a specific sub-category of thrusting spear must be considered: the multipronged specimens called « leister spears » or « leisters ». Used mostly for fishing, they work by impaling the fish on one or several prongs; often, the grip on the body is secured by lateral prongs that act as pincers (this feature is not always present: see Blackmore 1971, fig. 43). This type of weapon can have barbs (category F': e.g., fig.6e, after a Copper Eskimo salmon spear), but can also be unbarbed

⁵ - « Nach unserer Definition handelt es sich um eine Jagdwaffe, deren Spitze mobil ist und durch eine Leine mit dem Schaft, einem anderweitigen Objekt oder dem Benutzer der Waffe verbunden ist. Sie wird geschleudert oder gestoßen » (Weniger 1995, p. 20).



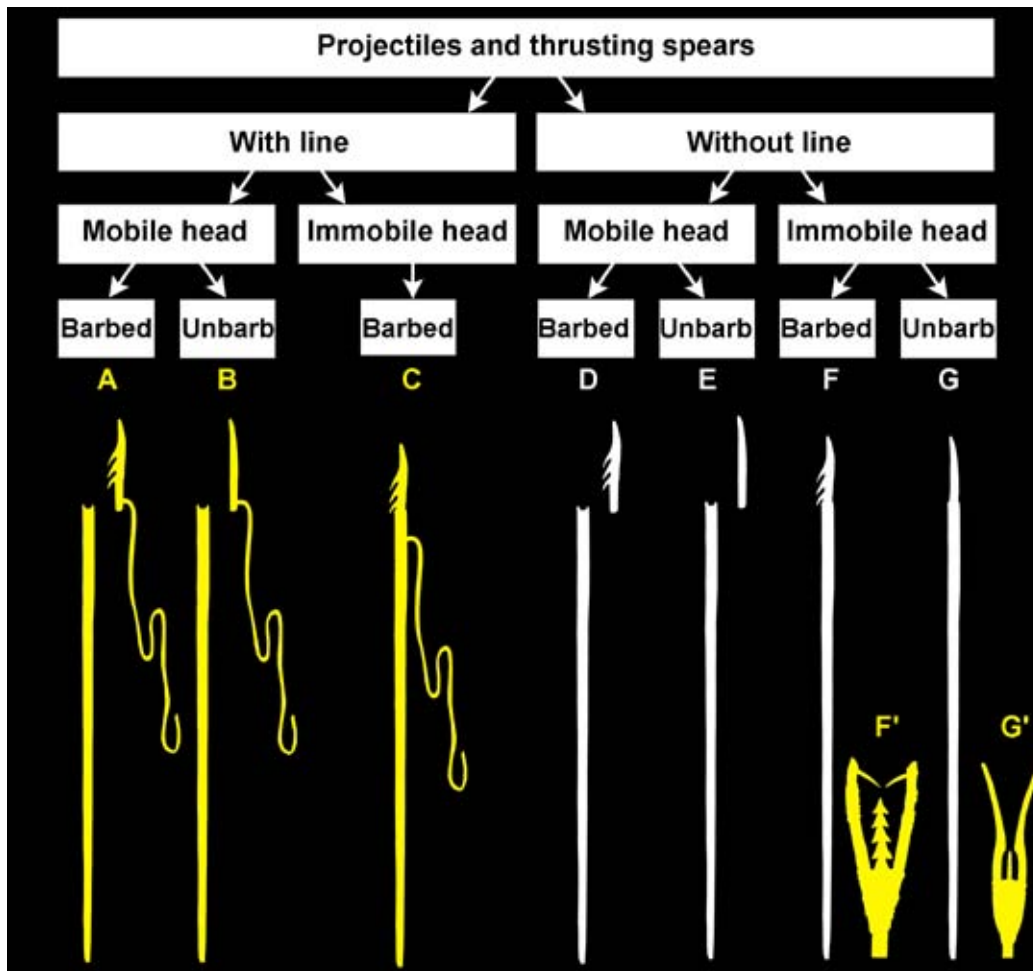


fig. 5 : typology of projectiles and thrusting spears. See text for description of the categories; harpoons are represented in yellow.

	Harpoons	Other barbed projectiles
Whale	5 (+1?)	2 (+1?)
Other sea mammals (seal, sea otter, sea lion, etc.)	12	2
Fish	17	3
Aquatic mammals (beaver, otter)	8 (+1?)	0
Birds	1 (+1?)	6 (+2?)
Small land game (rabbit, hare, squirrel, marmot, fox)	2 (+1?)	3 (+2?)
Cervids (deer, caribou, moose)	0	6
Bear	0	4
Other or unspecified large land game	0	4 (+1?)
War weapons	0	7
Total number of observations	45 (+4?)	37 (+6?)

tab. 5 : use of harpoons and other barbed projectiles related to game type among the groups of the ethnographical sample. Uncertain occurrences (because of a too vague description) are in parentheses.



(category G': *e.g.*, fig.6f, after the reconstruction of a Mesolithic leister from Aero; see Lane 1952, p. 9 for the description of a similar unbarbed leister used by the Montagnais for fishing eel). The functional principle of these spears is similar to that of harpoons: fixing the animal's body to the spear point in order to ensure its recovery by the hunter. Here the « drag » is the hunter himself, who keeps the weapon in his hands. Therefore, although leisters have no line and no detachable head, in our opinion they must functionally be considered as a specific sub-type of harpoon. The fact that leisters are nothing but specialized harpoons can clearly be seen with some fishing harpoons of the Coast Salish, that have both a detachable head with a line (our category A harpoons) and a three-pronged head similar to that of leisters (fig.6g).

To sum up these distinctions, we can say that:

- all projectiles and thrusting spears that display a line are harpoons. The presence of a line can therefore be considered as a diagnostic criterion for the identification of this type of weapon.

- however, not all harpoons have a line (*e.g.*, leisters). Thus the absence of line, in itself, is not a sufficient criterion to conclude that a weapon is not a harpoon.

- barbed and unbarbed tips, mobile and fixed heads are all found on both harpoons and non-harpoon types, and thus cannot be considered as diagnostic criteria to identify harpoons.

Reconsidering the « Magdalenian harpoons » debate

Equipped with this typology, is it possible to determine to which category of projectile or thrusting spear Magdalenian barbed points were hafted ? Fig.5 clearly shows that, when tips are isolated from their haft, the only diagnostic evidence is the presence on the points of a line fastening system. If Magdalenian barbed points do display a feature designed for fastening a line, then they were most presumably detachable harpoon heads of the « category A » type. If they do not, then it is not possible to decide in the first place if they belonged

to harpoons from categories C or F', or to the D or F « non-harpoon » types.

We would like to stress that the question of the line fastening system must be considered independently from the problem of determining if Magdalenian barbed points were fixed or detachable. As we said before, this second criterion alone is not diagnostic of harpoons. Detachable barbed points can belong to harpoons (category A) or non-harpoon types (category D). The same goes for fixed barbed points: see harpoons of categories C and F', and non-harpoons of category F. The possible existence of wooden foreshafts is a further call to caution. The Shuswap beaver harpoon, for example, is a « category A » harpoon with a barbed detachable head and a line; the head, however, is composed of an osseous point firmly fixed to a wooden foreshaft, this foreshaft being detachable from the shaft (Teit 1909, p. 523; see here fig.6b). Thus, if the osseous point was found isolated from its unpreserved wooden foreshaft and shaft (*i.e.*, in a classical Paleolithic archeological context), it would perhaps be correctly classified as a fixed point, but there would be no way to identify it as an element of a composite harpoon head.

Keeping these limitations in mind, let us now take a closer look at the proximal part of the Magdalenian barbed points (Julien 1982; Weniger 1995). Some of these points have a conical or double-beveled base with no other particular feature (fig.7): since they show no evidence of the fastening of a line, we cannot decide whether they were harpoon heads or not. However, these specimens are a minority (tab.6).

The other barbed points have a conical base, 25-30 mm long on an average, with one or two lateral spurs protruding by 1 to 4 mm from the shaft (fig.8). The spurs are generally on the same side of the shaft as the barbs: points with one row of barbs (R1) have one spur, while points with two rows of barbs (R2) have two, except for a few specimens (fig.8c, 8f). On both R1 and R2 points, spurs can be « clear cut » and steeply « erupt out of the base » (« sharp lateral bulb »: Weniger



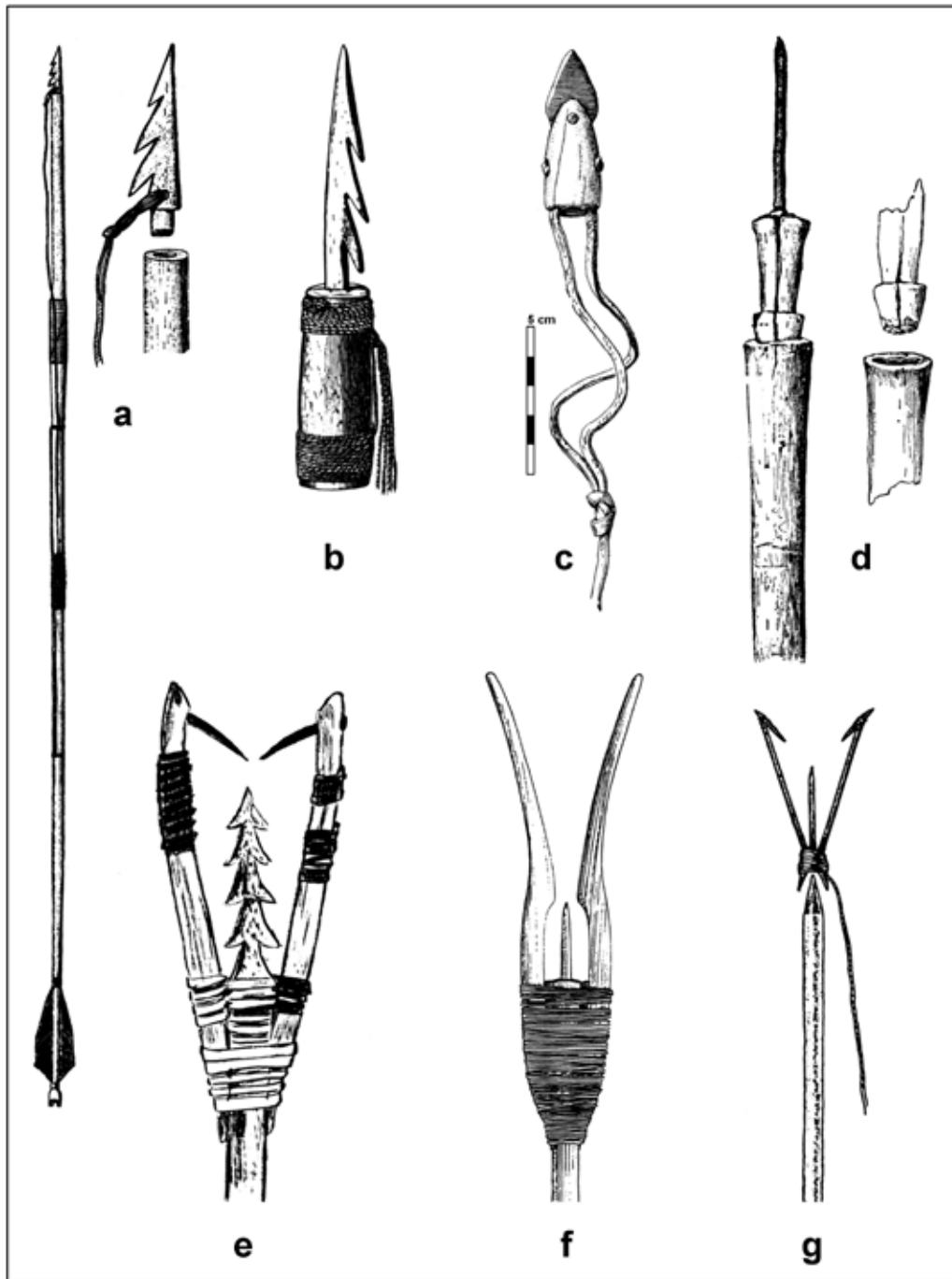


fig. 6 : examples of harpoon types. a: category A (Alaskan sea otter harpoon arrow, with detail of the head; after Mason 1900, pl. 17). b: category A (head of Shuswap beaver harpoon with osseous point and wooden foreshaft, total length 24 cm; after Teit 1909, fig. 240). c: category B (head of a seal harpoon from Cumberland Sound; after Mason 1900, fig. 58). d: category B (head and shaft of Seri turtle harpoon, shown without its line, with detail of hafting; after Mason 1900, fig. 15). e: category F' (head of a Copper Eskimo salmon leister, with central antler prong; HRAF sketch after Cazdow 1920, pl. II). f: category G' (head of reconstructed Mesolithic leister from Aero, Sweden; after Andersen 1981:63). g: category A (head and shaft of Coast Salish fishing harpoon, with three-pronged « leister-type » detachable head; after Barnett 1975, fig. 22). Objects are not to scale.

2000, p. 84, and see fig.8a, 8e), or be « smooth » and « evolve gradually out of the base » (« light lateral bulb »: Weniger *ibid.* and fig.8b, 8d). These spurs can of course be interpreted as being used for the fastening of a harpoon line: they would have been designed to prevent the line from slipping along the base of the point. Several ethnographical weapons show similar features (*e.g.*, fig.9a). However, as already stated by several authors, such lateral spurs can also be used to ensure the firmer lashing of a fixed barbed point on its haft. Such is the case, for example, for some Fuegian barbed points (fig.9b). For its demonstrative value, we must also quote the Aleutian barbed spearpoints described by W. Jochelson:

« The throwing-lance may be distinguished from a harpoon by the fact that all its parts are fixed and immovable. This lance was formerly the chief weapon in war, and also used to kill aquatic animals after they had been struck by a harpoon. The throwing-lance usually consists of three parts [see here fig.9c]: *a*, a wooden shaft (...); *b*, bone ring or belt (...); and *c, d*, the compound head, consisting of the barbed bone head (...) and stone point (...). Above the tang is a hole or sometimes 2 or a projection [*e*], by means of which the head is permanently tied to the shaft and bone belt. Such perforation or projections are sometimes seen above the tang of the head of a simple harpoon. But the tang of both these weapons differ; that on a harpoon is always broad and flat, while on the head of a throwing-lance it is usually conical in form. Writers on pre-historic archaeology usually regard the bone heads of implements of the latest Palaeolithic period of Western Europe as harpoon-heads. The present writer believes that most of these were not harpoon-heads, but heads of throwing-lances or arrows, *i.e.*, that they were permanently tied to the shaft. We refer particularly to the heads ascribed to the Magdalenian and Azilian epochs [*sic*], which were attached to the shaft by means of projections above the tang, or the tang had a conical and not a flat form » (Jochelson 2002/1925, p. 54-55).

We also found cases of lateral spurs on the base of detachable barbed points of non-harpoon projectiles

(category D). For example, each of the Southern Tutchone barbed arrowheads depicted by C. McClellan has a lateral spur very similar to that of many Magdalenian R1 points (G.C. Weniger's « light lateral bulb »): compare fig.8b and fig.10. These barbed antler points are detachable, but are not harpoon heads: they are apparently used for moose hunting. It seems that here, the spur is not used to fix a lashing or a line, but only serves as a notch to prevent the point from « backfiring » into the shaft on impact and split it.

Therefore, the presence of one or two lateral spurs on the proximal part of the Magdalenian barbed points is not enough in itself to identify them as harpoon heads. But G.C. Weniger suggests the use of another criterion: the location of the striations to be found on the proximal part of many Magdalenian specimens.

« These striations are different from decorations and are well known from the simple Magdalenian bone points. They are recorded from the beveled part of the base and are interpreted as technical aid. They rough up the surface, which results in a better fixing of the base on the shaft (Allain & Rigaud 1986). (...) It is important to distinguish the proximal part (the area between the tip of the base and the lateral bulb) and the distal part of the base (the area between the bulb and the barbed zone) [see here fig.11]. If the equation : *striations = rough surface = better fixing* is correct, then there are three reasons to put striations on the different parts of the base :

- (1) *proximal base = better fixing of base on shaft = immobile* [fig.11a];
- (2) *distal base = better fixing of harpoon-line = mobile* [fig.11b];
- (3) *proximal base + distal base = better fixing of base + better fixing of binding = immobile* [fig.11c] » (Weniger 2000, p. 84).

This criterion allows G.C. Weniger to demonstrate that the majority of the R1 barbed points are fixed (Weniger 1995, p. 129-140), while the majority of R2 barbed points are mobile and tied to a line, and are therefore



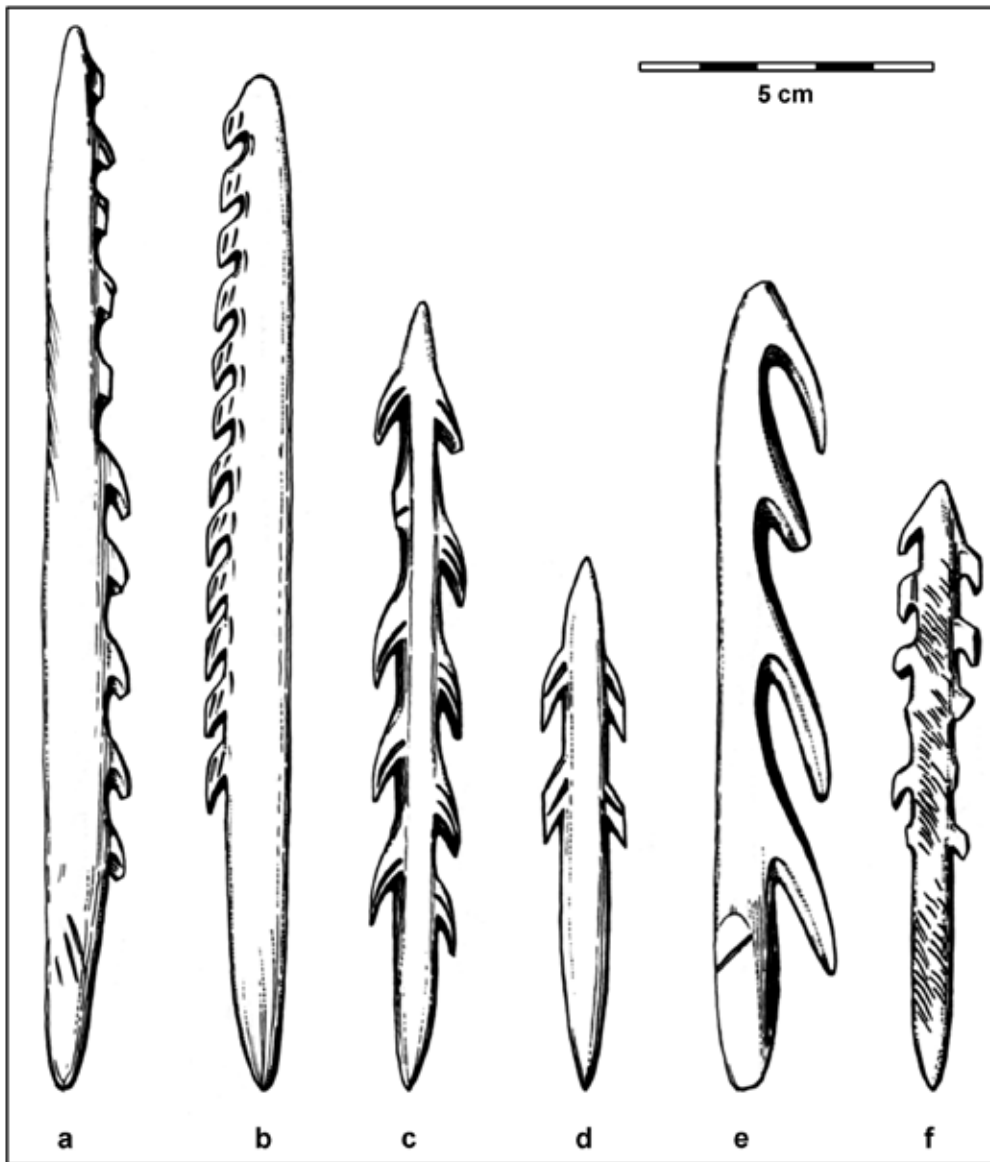


fig. 7 :Magdalenian barbed points with « simple » conical or double-beveled base. a: Bruniquel / Plantade. b-c: Fontalès. d: Gourdan. e-f: Isturitz. Artifacts curated in the Musée d'archéologie nationale (Saint-Germain-en-Laye, France), except for fig.7a (Musée de Montauban) and fig.7b-c (Musée de Saint-Antonin). After Julien 1982, fig.74, 77, 79, 96, 99, 100.

		No feature	Light spur(s)	Sharp spur(s)	Perforation	Other	Total
Julien 1982	One row of barbs (H1)	28 <i>13%</i>	93 <i>43%</i>	79 <i>36%</i>	14 <i>6%</i>	5 <i>2%</i>	219 <i>100%</i>
	Two rows of barbs (H2)	18 <i>6%</i>	72 <i>22%</i>	223 <i>68%</i>	10 <i>3%</i>	3 <i>1%</i>	329 <i>100%</i>
Weniger 1995	One row of barbs (H1)	19 <i>14%</i>	52 <i>39%</i>	37 <i>28%</i>	16 <i>12%</i>	10 <i>7%</i>	134 <i>100%</i>
	Two rows of barbs (H2)	8 <i>6%</i>	6 <i>4%</i>	111 <i>82%</i>	9 <i>7%</i>	2 <i>1%</i>	136 <i>100%</i>

tab. 6 : proximal features of Magdalenian barbed points. Samples studied by M. Julien (1982, p. 71-72) and G.C. Weniger (1995, p. 132 and 167).

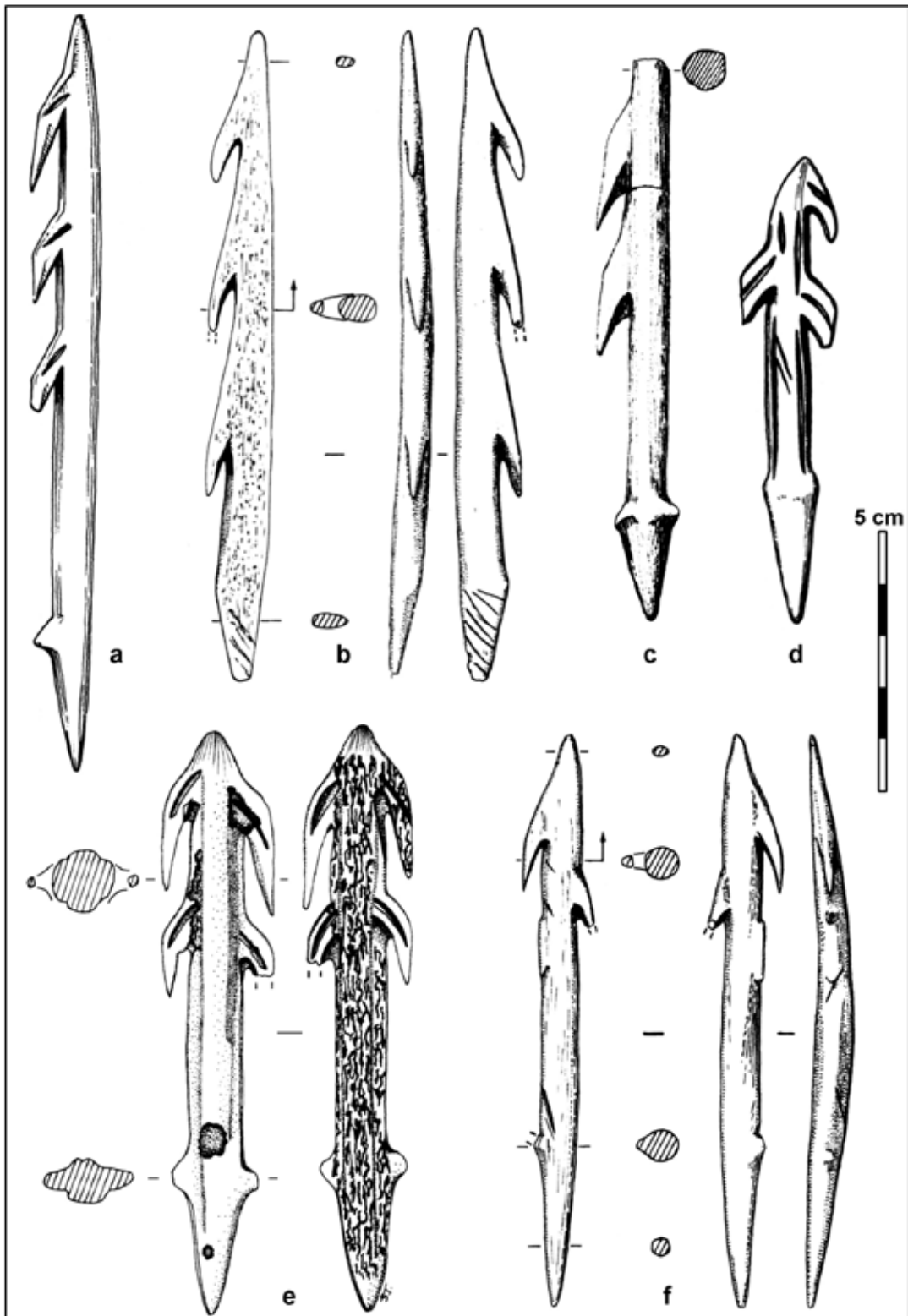


fig. 8 : Magdalenian barbed points with lateral spur(s) on the base. a: R1 point with one sharp lateral spur (Mas d'Azil; after Julien 1995, fig. 9). b: R1 point with one light lateral spur (La Vache; drawing D. Molez, after Julien & Orliac 2004, fig. 152). c: R1 point with two sharp lateral spurs (Duruthy; after Arambourou 1978, fig. 16). d: R2 point with two light lateral spurs (Limeuil; after Julien 1982, fig. 104). e: R2 point with two sharp lateral spurs (La Vache; after Tymula 2004, fig. 197). f: R2 point with one sharp (?) lateral spur (La Vache; drawing by D. Molez, after Julien & Orliac 2004, fig. 156).



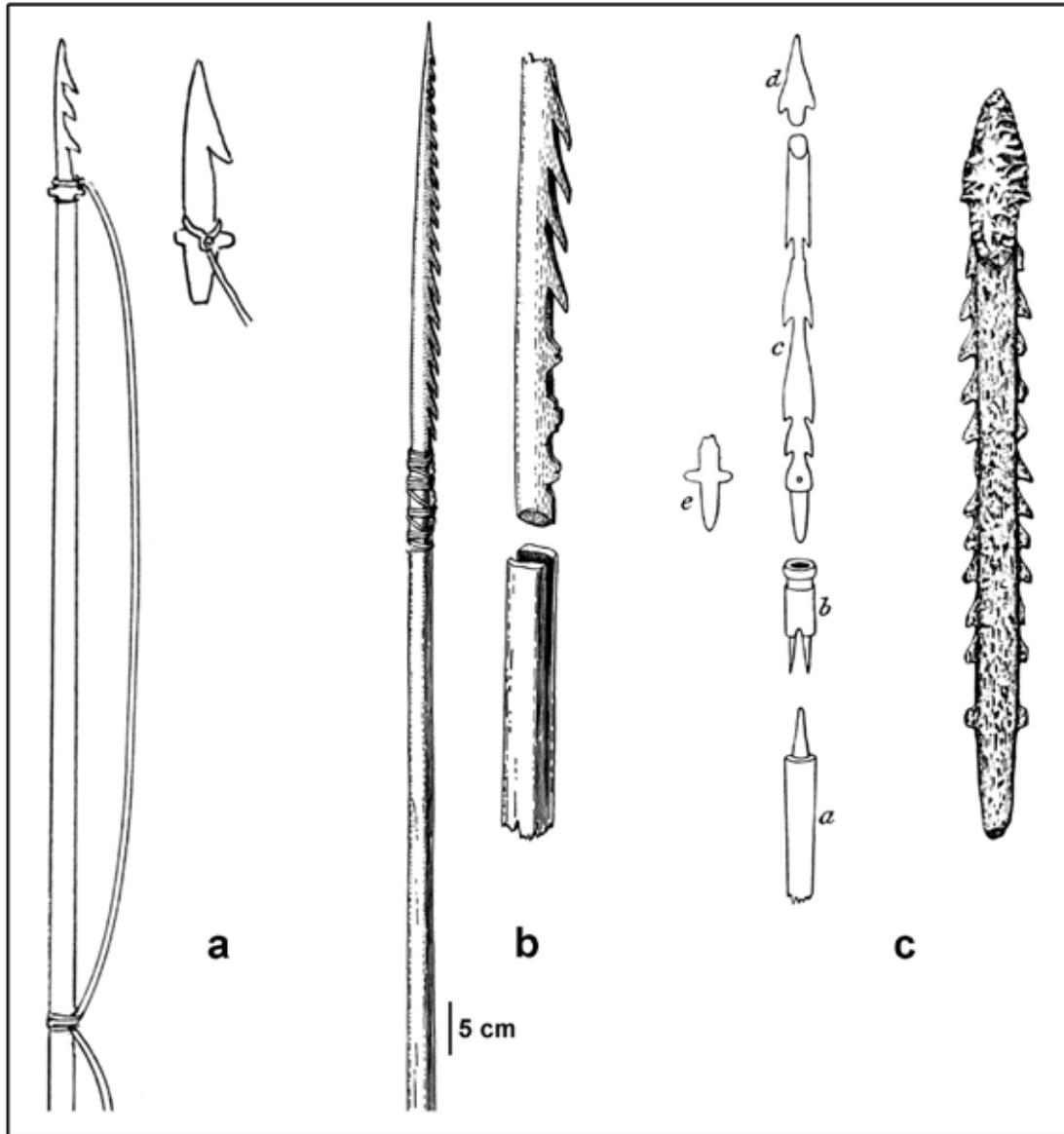


fig. 9 : ethnographical examples of mobile and fixed haftings for points with lateral spurs on the base. a: Northwest Coast harpoons with detachable head (after Stewart 1973, p. 132-133). b: Fuegian spear with fixed barbed head (after Mason 1900, plate 2). c: Aleutian composite spearhead, fixed and barbed (after Jochelson 2002/1925, fig. 9 & 54b). Objects are not to scale.

harpoon heads (Weniger *ibid.*, p. 166-168). However, the use of this criterion to differentiate mobile points from fixed ones has been questioned by M. Julien (1999, p. 134). We subscribe to her arguments, stressing that, as pointed out by G.C. Weniger (Weniger 1995, p. 132), striations are almost absent on the ethnographical material: they are specific of the Magdalenian points. Therefore, their interpretation does not rely on ethnographical comparisons, but only on « common sense » arguments. In our opinion, particularly problematic is the fact that the same feature – that is, the striations on the distal part of the base – is interpreted in two contradictory ways (fastening of a harpoon line, firmer hafting of a fixed point) depending on its association with the striations on the proximal part of the base. We must also stress that the R1 points with lateral perforation, that G.C. Weniger calls « Cantabrian type » and interprets as mobile (see below and fig. 12), apparently quite frequently show striations on the proximal part of the base. Indeed, among the 20 such points coming from eight Cantabrian sites and shown by C. González Sainz (1989, p. 29-98, *passim*), 13 have striations on the proximal part of the base, a feature supposed to be characteristic of fixed points. Moreover, the authors quoted by G.C. Weniger (Allain & Rigaud 1986) indeed suggest that the striations on the base of osseous points allowed a more efficient action of the hafting adhesive, and thus a better adherence of the point to its haft (which was confirmed by an experimental test: Allain & Rigaud 1989, p. 221-222); but they do not suggest that these striations might allow a firmer grip of a lashing or a line on the point – which is a different question, and was not tested experimentally.

For all these reasons, we consider that the presence and location of the striations on the base of the barbed points is not a conclusive argument to determine if the lateral spurs were used to fasten a harpoon line or to ensure a better fixing of the point on the shaft. Therefore, in our opinion, it is not possible to say in the first place if these points were harpoon heads or not.

One last minority group of Magdalenian barbed points deserves particular attention (fig. 12). Found only in sites of the Spanish Cantabrian coast and composed

almost exclusively of R1 points (fig. 12c is one of the few exceptions), this group is characterized by a base with a lateral perforation, 5x3 mm wide on average (Weniger 1995, p. 100). This feature has generally been interpreted as being a linehole – hole for a harpoon line – and these points have always been classified as harpoon heads. There are indeed numerous ethnographical examples of such artifacts (*e.g.*, fig. 13a, among many others). However, just as in the previous case of lateral spurs, basal perforations can also be used to strengthen the lashing of a fixed barbed point (*e.g.*, fig. 13b). G.C. Weniger stresses that in his ethnographical sample, the basal holes of the fixed points are smaller in diameter than the harpoon lineholes, while the Magdalenian values fall within the « linehole » range (Weniger *ibid.*, p. 44, 53, 61, 100). However, other ethnographical examples seem to contradict this trend. Here again, we will concentrate on one well-documented illustrative case: the barbed arrows of the Ingalik, Athapascans from south-western Alaska.

The material culture of the Ingalik has been observed in the 1930s and published in detail by C. Osgood (1970/1940). Among their five arrow types, two display Caribou bone barbed points, with one row of barbs, a « conical butt » about 1 inch long and a central hole near the base. The first point type (fig. 13c) is 5 to 8 inches long, has 3 to 8 barbs and is fixed: the tip « is fitted into a hole at the end of the arrow shaft, spruce gum glue (...) being added. Sinew lashing line binding the end of the arrow shaft goes through this hole (the tip is not detachable) » (Osgood *ibid.*, p. 204). The second point type (fig. 13d) is smaller, « only a few inches in length », and has generally three or four barbs; « the conical butt fits into a socket at the end of the arrow shaft. This tip is detachable and is fastened to the arrow shaft by means of a braided sinew line about 3 feet long which is attached to the hole. (...) When the water animal or fish is struck, the tip comes out and the arrow shaft drags » (Osgood *ibid.*, p. 205). These two types of arrow have very different functions: the first one is used « to kill all kinds of small birds and animals, and for war », and also as a replacement



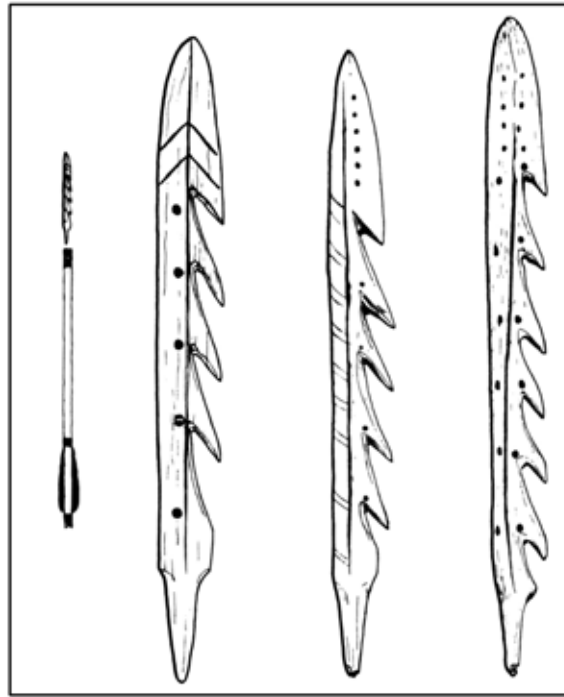


fig. 10 : Southern Tutchone barbed arrowheads for moose hunting, made in 1949. The heads are detachable, made of antler, and about 8 inches long. After McClellan 1975, p. 283 & 285.

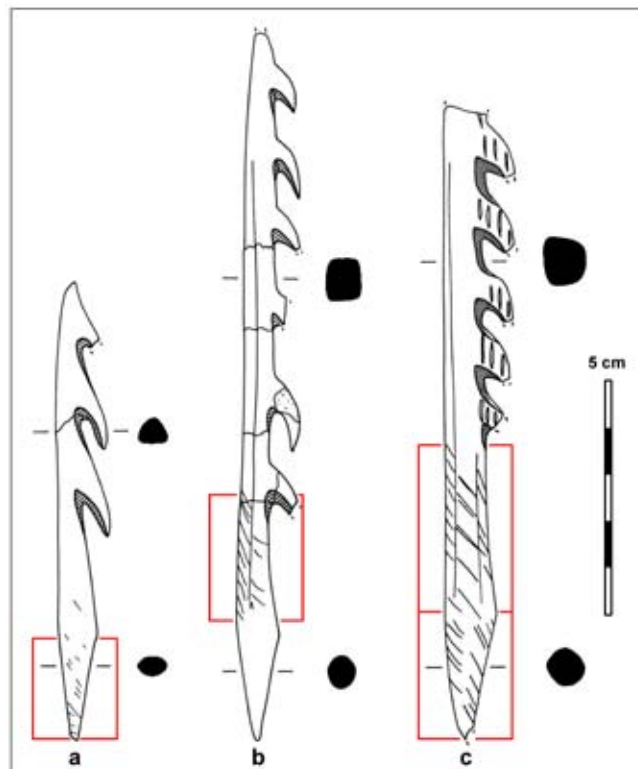


fig. 11 : location of striations on the base of Magdalenian barbed points. a: proximal part of base (La Vache). b: distal part of base (Laugerie-Basse). c: proximal and distal parts of base (Laugerie-Basse). All artifacts are curated in the Musée d'archéologie nationale (Saint-Germain-en-Laye, France). After Weniger 1995, pl. 30, 33, 36, modified.

arrow for big land game; the second one is used « for otter, beaver, and other water animals; also for big fish, such as salmon and large pike » (*ibid.*).

What we want to stress is that, here again, if these osseous points had been found isolated from their unpreserved shafts and lashings, it is doubtful that their respective operating modes would have been correctly reconstructed (let alone their specific functions!). In particular, the fact that the first type is a barbed arrow (category F in our typology on fig.5) and the other one an actual harpoon (our category A) would have been difficult to establish: both points have a similar base with a conical shape and a central round hole that – judging from C. Osgood's sketches – seems to be about the same size and in both cases serves to hold a sinew line.

The Ingalik arrows are not just an isolated example: W. Jochelson already stressed the same problem concerning basal perforations on the Aleutian barbed points (see above). Finally, our conclusion is that, given the variability of the ethnographic material, it is not possible to definitely interpret the basal perforations on the Cantabrian barbed points as lineholes. Thus, their identification as harpoon heads cannot be ascertained.

Discussion

This survey shows that the Magdalenian barbed points, as a whole, do not present a preferential association with one type of game, and that they cannot be interpreted as harpoon heads on a simple morphological basis. This can paradoxically be considered as a positive result, as it means that debate about these items is still wide open. According to the ethnographic data, the list of their possible functions is even longer than expected: indeed, the use of barbed points as war weapons appears to be quite common in our sample (see tab.5) and there is no *a priori* reason to dismiss this possibility for the Magdalenian specimens.

The relevance of further research on this topic appears when one considers the importance of barbed points in the weapon kit of the Final Paleolithic in western and northern Europe. Starting from their probable region of

origin in south-western France and/or Cantabrian Spain, the Magdalenian barbed points spread southward along the Spanish Mediterranean coast (Cacho & De La Torre Sáinz 2005; Villaverde & Roman 2005-06), eastward to south-eastern France and the Rhone valley (Combiér 1967, p. 356), and above all to the Northeast: they are present in central Germany, some 1,000 km away from south-western France, and in all the regions in-between (Julien 1995). Later on, barbed points can still be found in the northern European Final Paleolithic cultures, such as Creswellian (Barton & Dumont 2000, p. 153-154), Hamburgian (Bosinski 1990, p. 254) and Ahrensburgian (Andersen 1988, p. 535; Johansen 2000, p. 211-212). In western Europe, they are one of the few antler items that go on being to be manufactured after the Magdalenian, into the Azilian phase (Thompson 1954). Later on, they are found in many Mesolithic cultures, especially in northern Europe (*e.g.*, Cziesla, 2006).

This brief overview shows that osseous barbed points clearly rank among the Paleolithic innovations that met with a certain « technological success »: they knew a widespread diffusion and long persistence, under very changeable cultural traditions and environmental conditions (the Bølling-Allerød warm-up). Relatively speaking, this « success » might be compared with the « huge development » and quick dissemination of bladelet production at the beginning of the Upper Paleolithic (Bon 2005, 2006, p. 141-142); and, just as this latter phenomenon, it certainly needs to be explained. This explanation involves characterizing the technological advantage represented by barbed points from a functional point of view for the Paleolithic people. Starting from the results outlined in this paper, we consider several possible directions for future research on this topic:

- 1) Enlarging our Pyrenean sample of archeological sites to other regions, and see if any association with a specific game might appear (see above).
- 2) Within this sample, refining the typological distinctions between the different barbed points. Particularly striking is the fact, already noted by M. Julien (1982, p. 156), that



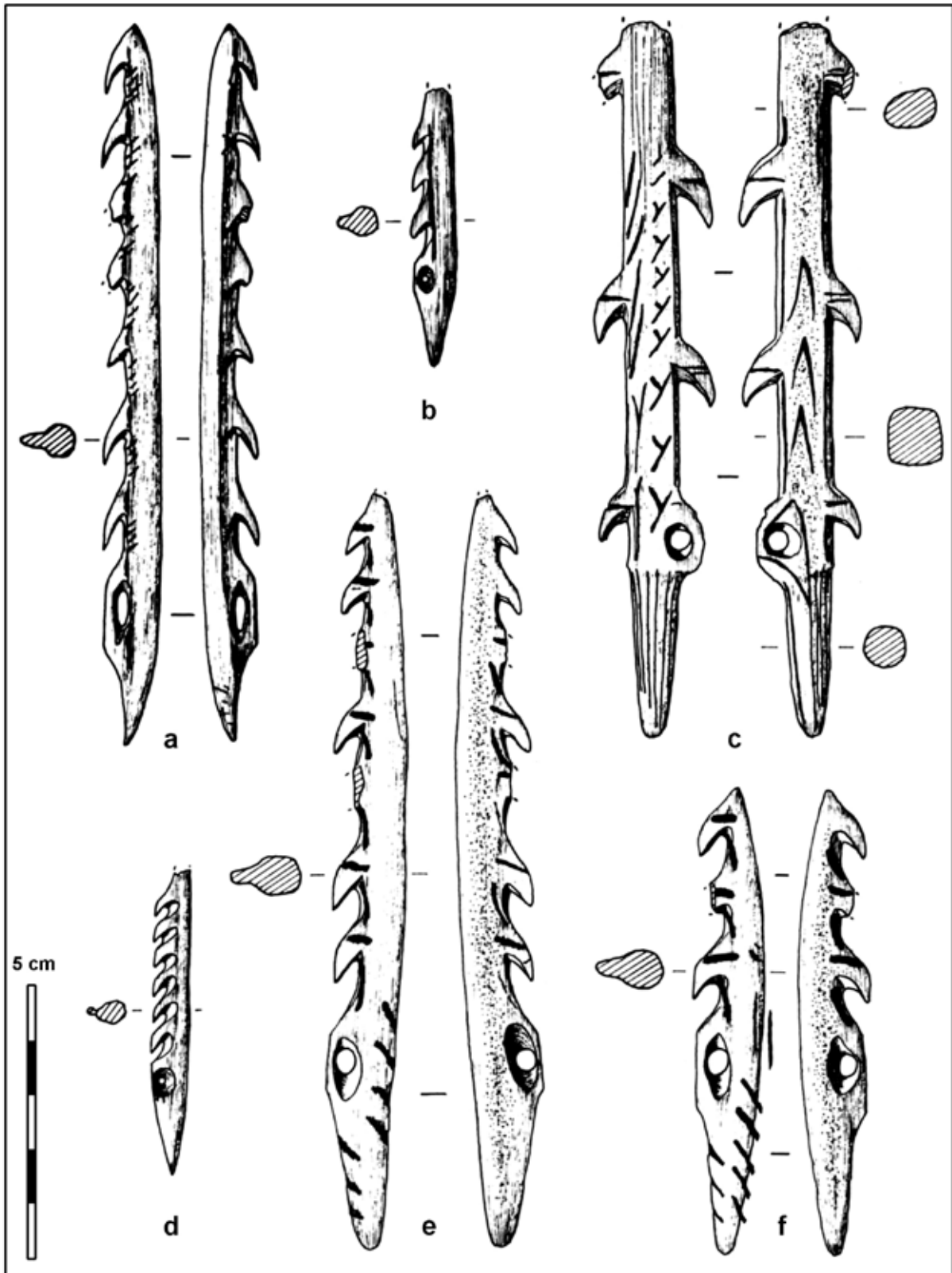


fig. 12 : Magdalenian barbed points with basal perforation (« Cantabrian type »). a: La Pila, level 4.3. b: El Valle. c to f: El Pendo. All artifacts except for fig.12a are curated in the Museo de Prehistoria de Santander. After González Sainz 1989, fig. 20, 25, 33.



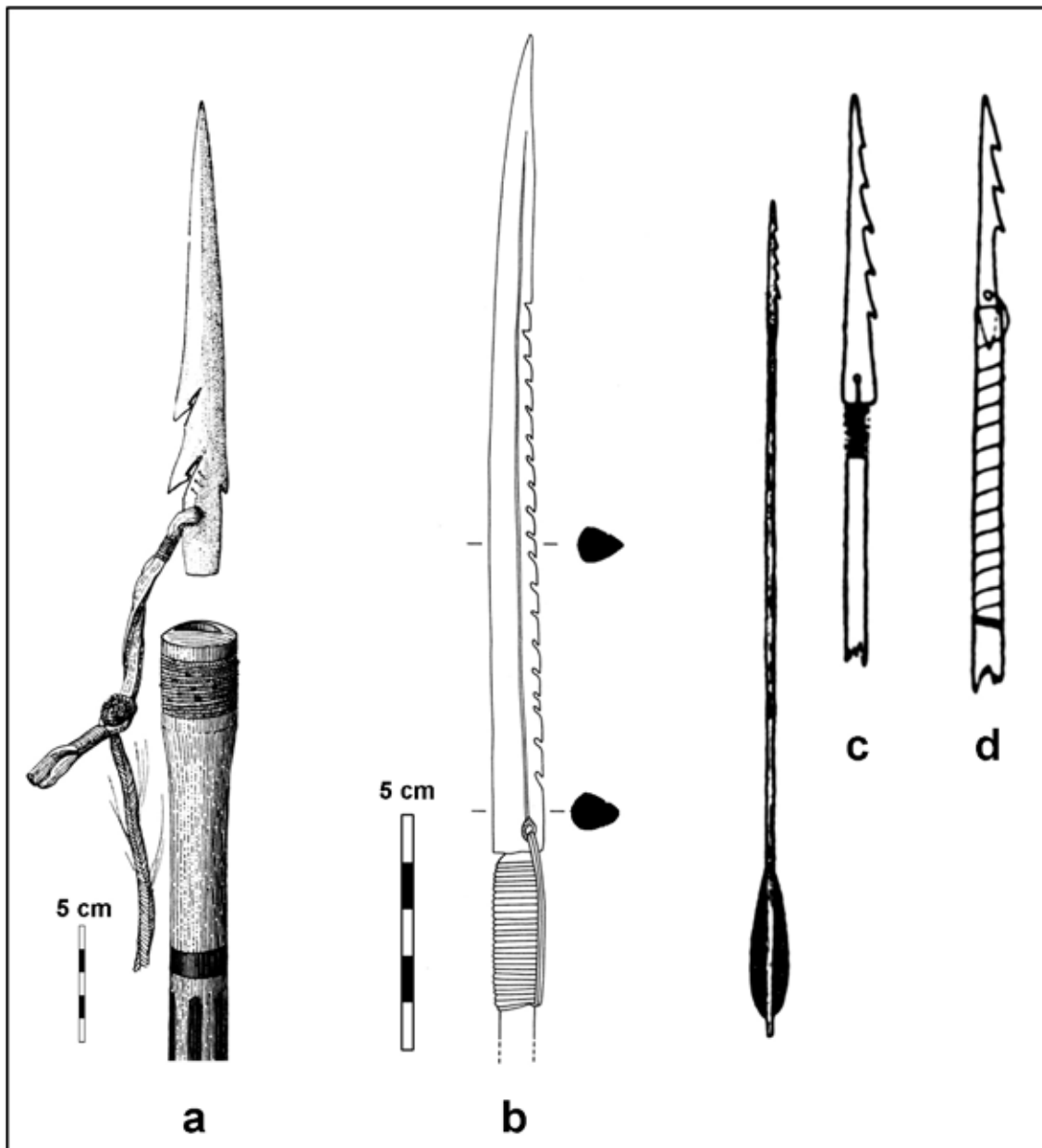


fig. 13 : ethnographical examples of mobile and fixed haftings for points with perforations on the base. a: Kodiak harpoon with detachable head (after Mason 1900, pl. 19). b: Bering Strait Inuit fixed arrowpoint (after Weniger 1995, pl. 15). c-d: Ingalik fixed and detachable arrowpoints (see description in text; after Osgood 1970/1940, p. 203). Objects are not to scale.

points with two rows of barbs (R2) are the large majority in most sites of south-western France, but are poorly represented in the other regions: they are rare in Cantabrian Spain; completely absent in Mediterranean Spain, where only R1 points have been found; etc. A closer investigation is necessary to study whether this situation result from functional factors.

3) Focusing our ethnographical sample on the barbed points that bear the closest morphological resemblance to the Magdalenian ones. Indeed, technological analogies between our archeological and ethnographical samples have been limited by the fact that many hafting types very common in North America – perforated bases, toggle harpoons – are rare or absent in the Magdalenian. However, closer parallels can be drawn from the Pacific coast groups (Aleuts, Northwest Coast Indians) who did make an extended use of barbed points with a conical base and lateral spurs – the most common Magdalenian hafting. Concentrating the research on these groups might provide better clues to understanding Magdalenian barbed points hafting.

4) Finally, in the long term, experimental perspectives must also be considered. Our own experiments with P. Cattelain (CEDARC / Musée du Malgré-Tout) on projectiles demonstrated that, for some osseous point types, the nature and location of impact damage could provide a clue to determining the projectile delivery mode (bow or spearthrower: see Pétillon 2006). Similarly, we cannot rule out the possibility that, on osseous barbed points, the nature and location of impact fractures (especially on the proximal part) might be characteristic of a specific hafting mode – *i.e.*, fixed or detachable head.

Acknowledgements

We are grateful to Pierre Cattelain, Michèle Julien and Alain Testart for their comments and suggestions on this text. Thanks also to Pierre Grainville, Valérie Lécrivain, Claire Letourneux and Nandini Singh

for their help with the bibliographic survey, and to Guylaine Letourneux and Nicolas Samuelian for their assistance in making the maps. This work was supported by a research contract by the Ile-de-France Regional Council.

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To quote this article

PETILLON J.-M. (2008) - What are these barbs for ? Preliminary study on the function of the Upper Magdalenian barbed weapon tips. In : J.-M. Pétillon, M.-H. Dias-Meirinho, P. Cattelain, M. Honegger, C. Normand, N. Valdeyron (coord.), Projectile weapon elements from the Upper Palaeolithic to the Neolithic (Proceedings of session C83, XVth World Congress UISPP, Lisbon, September 4-9, 2006). *Palethnologie*, 1, p. 66 - 97.

Article translated by Magen O’Farrell

