Identification of "debitage by fracturation" on reindeer antler: case study of the Badegoulian levels at the Cuzoul de Vers (Lot, France)

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Identification of "debitage by fracturation" on reindeer antler: case study of the Badegoulian levels at the Cuzoul de Vers (Lot, France)

"Debitage by fracturation" is defined as the fracturing of a block by knapping in order to produce flakes. Until recently, it was considered that this method played a minor role in the production of osseous tools during the European Upper Paleolithic, and that it was rarely applied to reindeer antler, especially after the introduction of "debitage by extraction" in the Gravettian. However, recent studies show that debitage by fracturation may hold a predominant place in antler working during certain chrono-cultural phases. This could be the case of the Badegoulian, a culture contemporary with the Last Glacial Maximum and dated ca. 23,000-20,500 cal BP in Western Europe. This issue is addressed here through the study of the Badegoulian antler assemblage from the Cuzoul de Vers rockshelter (Lot, France). Our analysis shows that the two components of the antler assemblage (110 finished objects and 648 waste products and blanks) are technologically compatible and complementary, and attest to the production of blanks through debitage by fracturation for the manufacture of wedges and projectile points.

Keywords: Upper Paleolithic, Badegoulian, Cuzoul de Vers, reindeer antler, antler technology, debitage by fracturation.

During the Upper Paleolithic, two major modes of blank production dominate the exploitation of antler: "debitage by segmentation" and "debitage by extraction" (terminology after Averbouh 2000). "Debitage by segmentation" (Fig. 1:1) is the division of the antler in segments to be used as blanks for the manufacture of objects such as spearthrowers, perforated staffs (*bâtons percés*), etc. It is a transversal operation, usually made by the cutting, grooving and/or chopping techniques. "Debitage by extraction" (Fig. 1:2) is the extraction of the blank from the outer part of the antler. It is a longitudinal operation often done by the grooving procedure (the so-called "groove-and-splinter technique": Averbouh 2000; Clark, Thompson 1953; Goutas 2009; Semenov 1973; etc.). The blanks are shaped into artifacts such as projectile points, certain types of wedges and chisels, etc. However, a third mode of blank production, "debitage by fracturation", seems to dominate the transformation of antler during one particular period: the Badegoulian.

"Debitage by fracturation" consists in the fracturing of the block by knapping in order to produce flakes. This method has long been documented for bone working; its use on antler was first mentioned by J. Allain and colleagues in 1974 in the Badegoulian assemblage of the Fritsch shelter (Indre, central France: Allain *et al*. 1974). These authors also stress that no evidence of the groove-and-splinter technique is present in this assemblage, and suggest that this combination (presence of debitage by fracturation and absence of the groove-and-splinter technique)

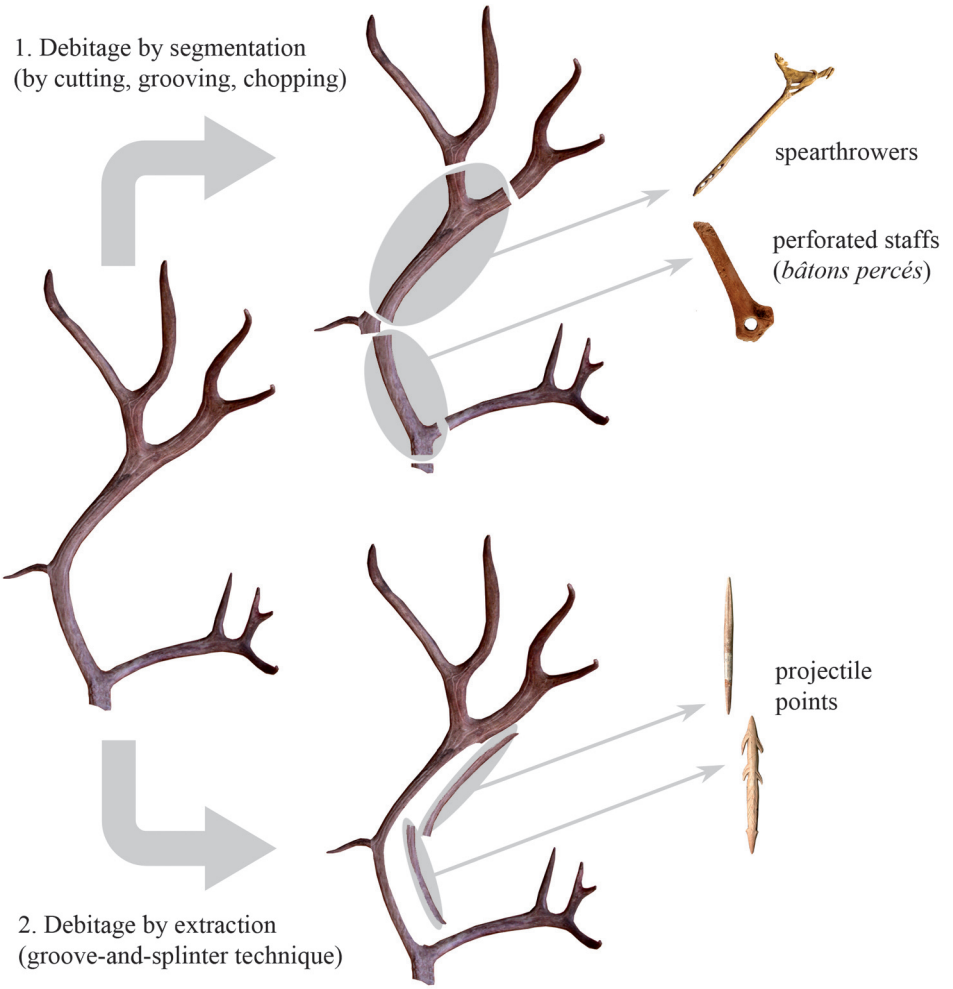

Fig. 1. The two major modes of antler exploitation in the Upper Paleolithic, and examples of typical products. 1: debitage by segmentation; 2: debitage by extraction (spearthrower picture by P. Cattelain; picture of perforated staff by the Pincevent CRP; all other pictures in the article are by J.-M. P. unless otherwise stated)

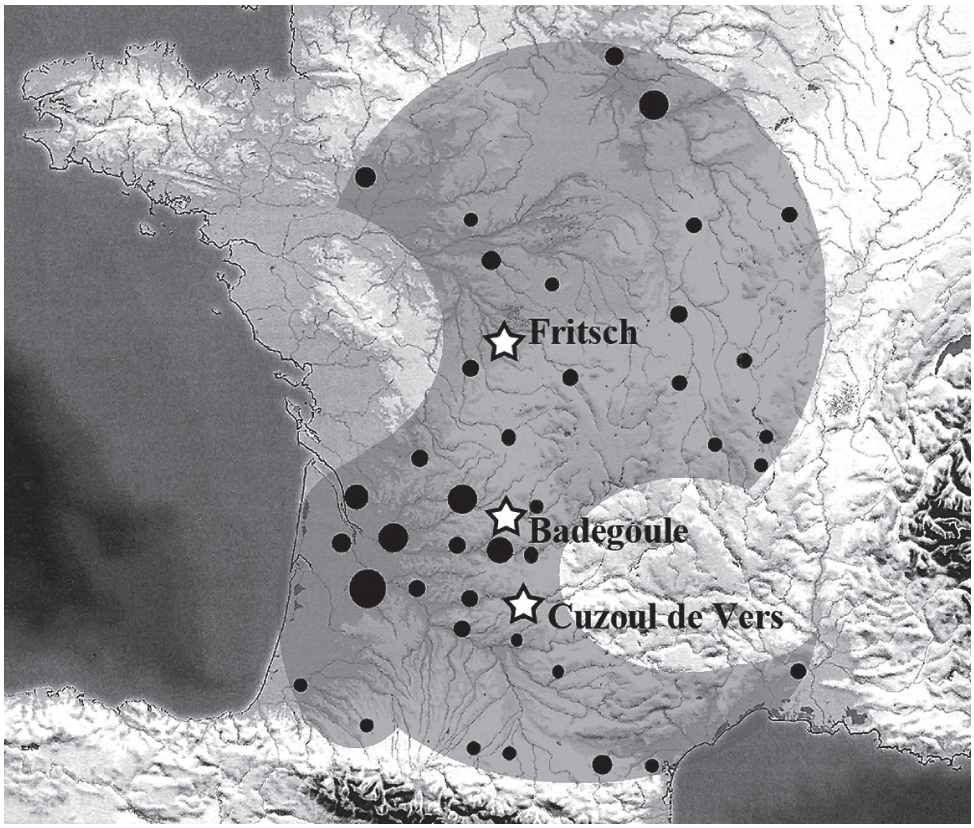

Fig. 2. Map of the Badegoulian sites (black dots) and the supposed distribution area of the Badegoulian culture in France (grey area). Sites mentioned in the text are indicated by white stars. Map after Demars 1996; Bodu et al. 2005

Fig. 3. Antler artifacts from the Badegoulian levels in Cuzoul de Vers. 1-3: wedges. 4 and 6: fragments of projectile points. 5: complete self-barbed point and its probable hafting mode

Fig. 4. Antler fragments with post-depositional breaks

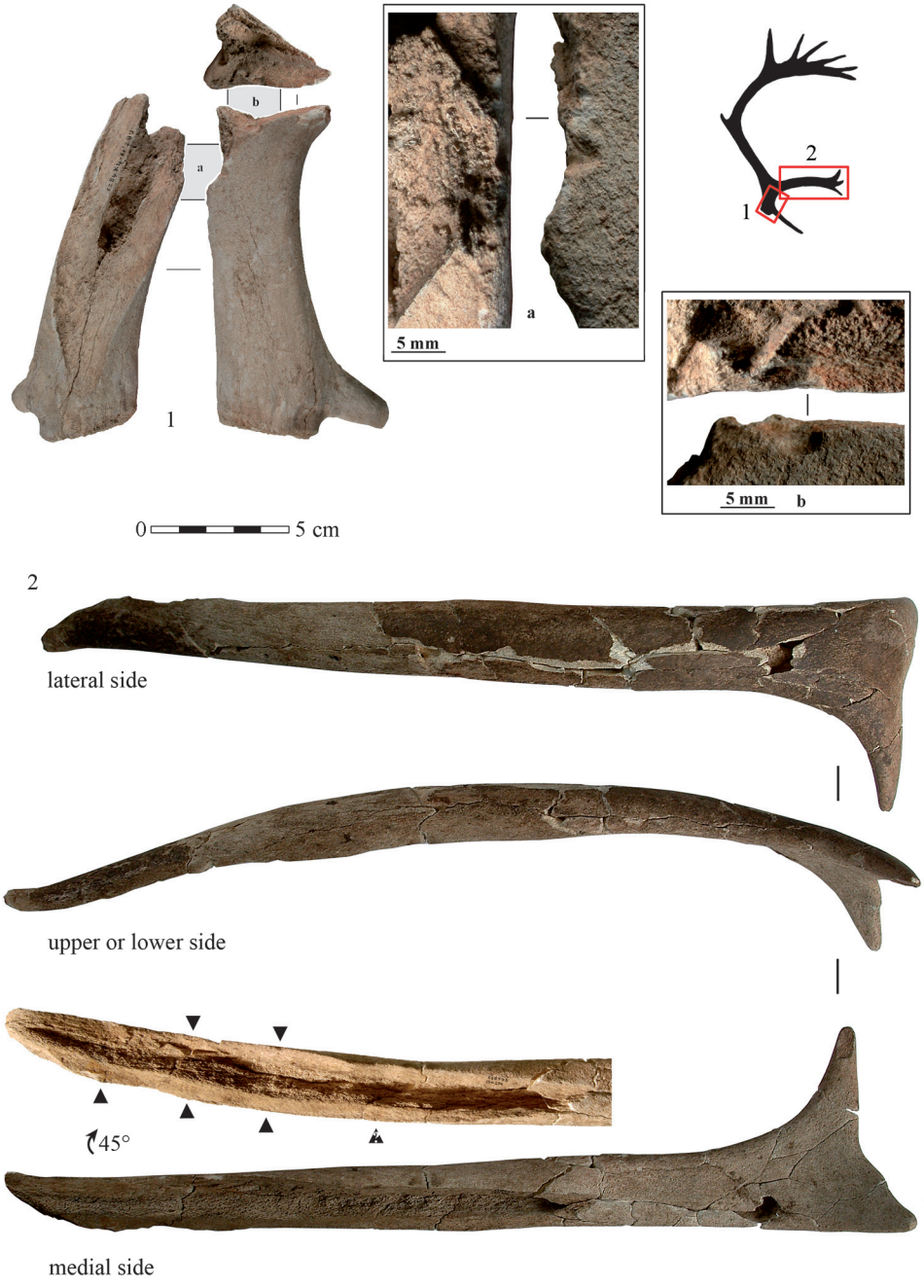

Fig. 5. Antler parts from which flakes were knapped off. 1: base of a large shed antler with the negative removal of a flake on the posterior side, and a breakage of the anterior side at the base of the tine; a, b: detail views of the percussion marks. 2: second tine of a large antler with several flake removals on the medial side; with detail view of the knapped part under low-angled light (black arrows: indication of the percussion points; detail picture: J.-F. Peiré, DRAC Midi-Pyrénées)

is specific for the Badegoulian antler technology. For more than 30 years however, the Badegoulian antler technology remained largely unstudied and Fritsch stood as the only published case of antler debitage by fracturation in the European Upper Palaeolithic (Averbouh 2006, Averbouh in press; Rigaud 2004).

In this article we briefly summarize the results of the technological study of the antler industry from the Badegoulian levels of the Cuzoul de Vers shelter (Lot, southwest France). This antler assemblage, studied in the context of the site monograph (Pétillon, Averbouh in press), is larger than the Fritsch collection and gives new insights into Badegoulian antler working.

Archeological context

The Badegoulian was named after the upper levels of Badegoule shelter (Dordogne, southwest France: Peyrony 1908). Its recognition as a specific archeological culture was a late and complex process, whose summary is beyond the scope of this article. Briefly speaking, the Badegoulian was officially

Fig. 6. Antler flakes

defined by J. Allain and his collaborators between the 1960s and the 1980s (Allain 1983, 1989; Allain, Fritsch 1967; Allain *et al*. 1974); in the 1990s and the 2000s, it has been the subject of many studies mostly centered on lithic technology (see Ducasse 2010, and contributions in Bodu *et al*. 2007). Badegoulian sites were identified only in France (Fig. 2), although there might be related assemblages in the Iberian Peninsula (Aura Tortosa 2007). In the cultural chronology of the Upper Palaeolithic in southwest Europe,

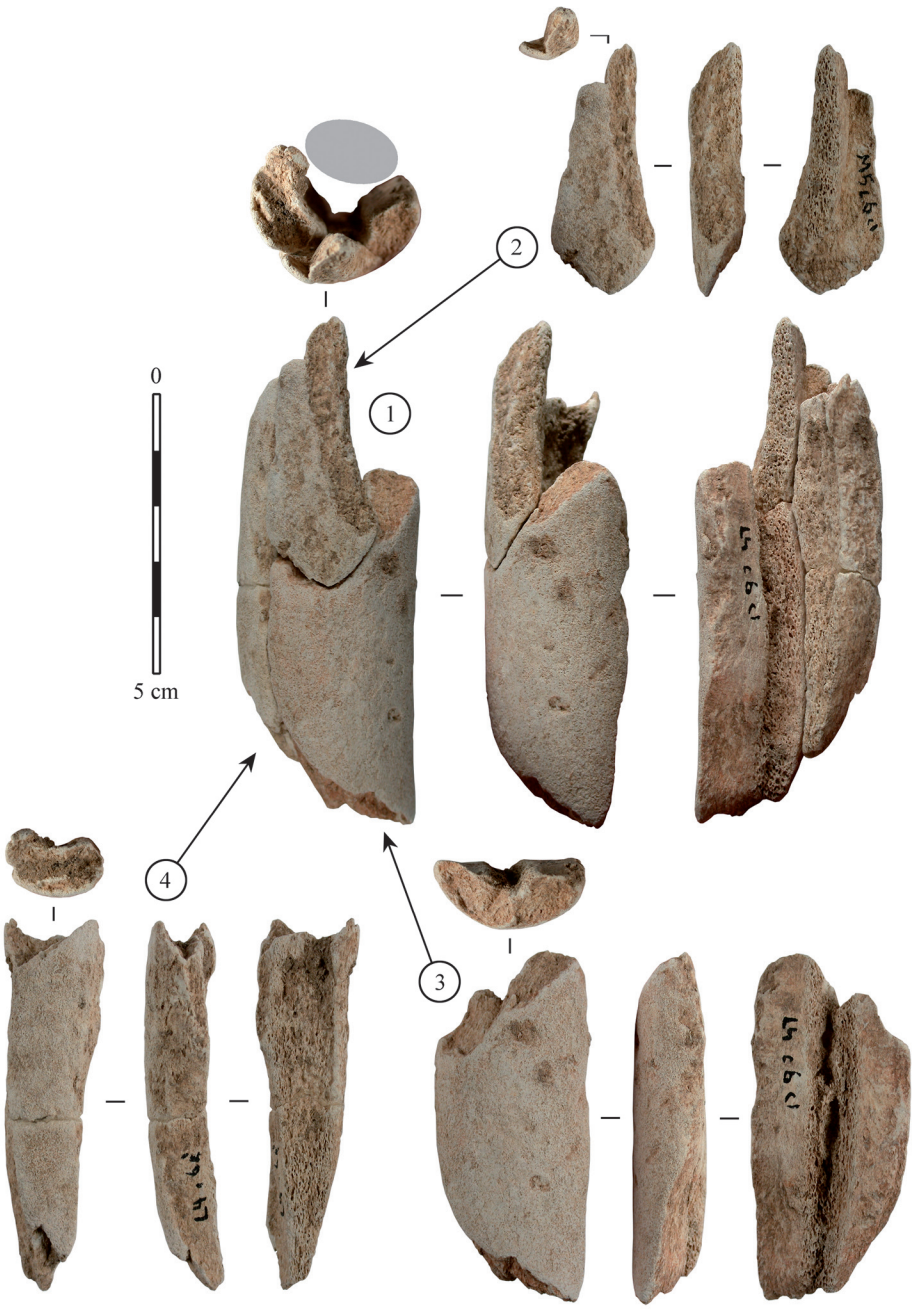

Fig. 7. Sequence of four flake removals from one segment of antler beam. 1-4: order of knapping; flake 1 is missing but its negative is still visible on flakes 2 and 3. Light grey oval: missing part of the antler circumference (likely corresponding to the blank sought by the knapper; see text)

the Badegoulian spans the gap between the Solutrean and the Magdalenian. The most reliable radiocarbon dates place it between 23,000 and 20,500 cal BP, during the Last Glacial Maximum, contemporary with the Ancient Epigravettian in southeast Europe – while most of northern Europe was uninhabited because of the extreme cold conditions.

The Cuzoul de Vers is a small rockshelter (ca. 30 square meters), located in southwest France (Lot), and excavated in 1982-1986 by J. Clottes and J.-P. Giraud (Clottes, Giraud 1986, 1989, 1996; Clottes *et al*. in press). The stratigraphy is 2.5-3 meters thick; from the 31 layers identified during the excavation, three (layers 29-31) were attributed to the Upper Solutrean, but the 28 overlying layers all yielded exclusively Badegoulian remains. A series of AMS radiocarbon dates place this Badegoulian approximately between 23,500 and 21,500 cal BP.

The antler assemblage

No differences in antler working techniques were observed from one layer to the other, and the antler material from the entire Badegoulian stratigraphy will thus be considered here as a single assemblage.

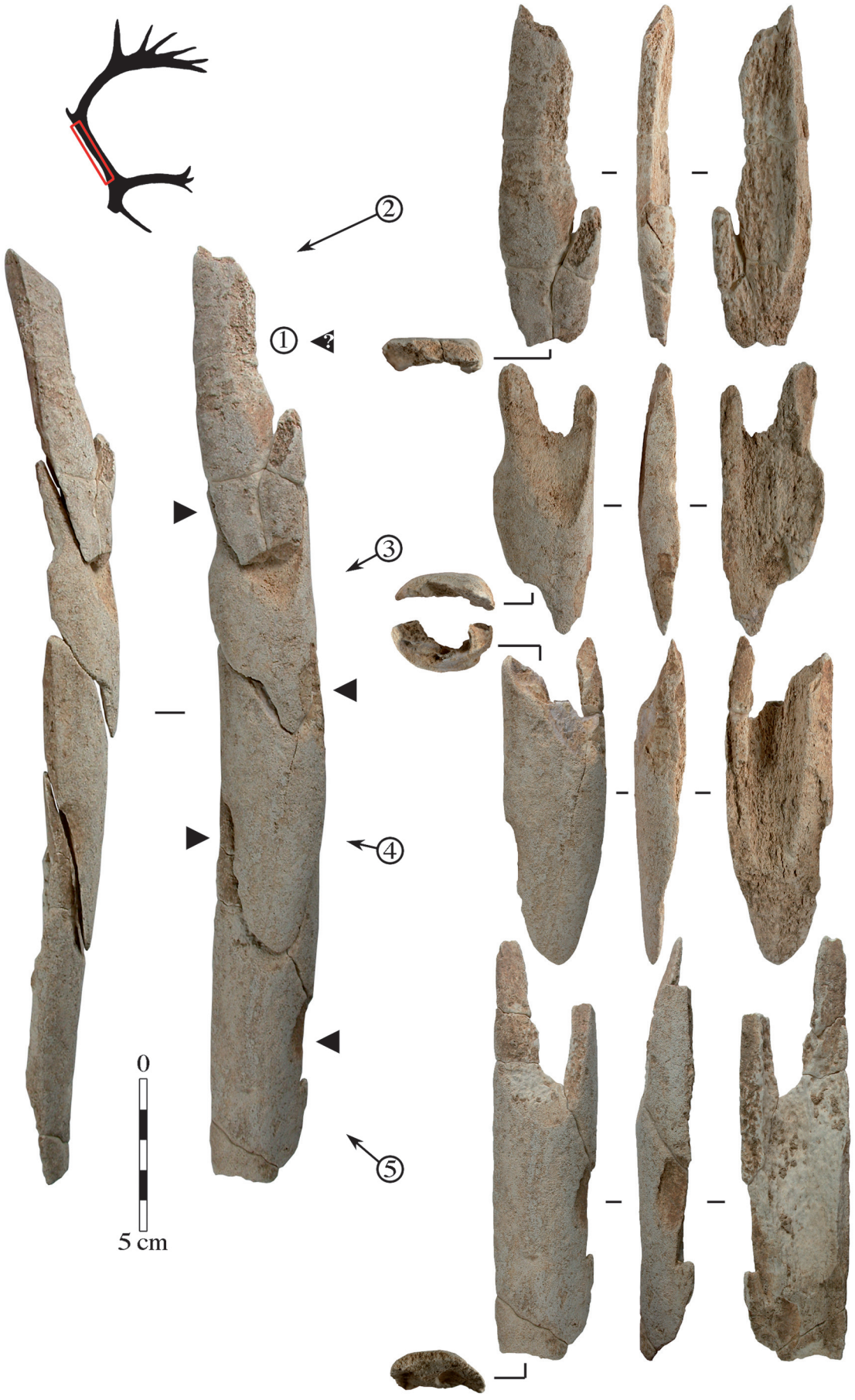

Fig. 8. Sequence of five flake removals from the lateral side of the beam of a large antler. 1-5: order of knapping; flake 1 is missing but its negative is still visible on flake 2. Black arrows: indication of the percussion points

Fig. 9. Antler "rods" shaped by percussion; possible blanks for tool manufacture

The preservation of this assemblage is quite mediocre, with an intensive post-depositional fragmentation and a frequent alteration of the surfaces of the artifacts. Only reindeer antler was identified, to the exclusion of other cervid species; reindeer is also, by far, the main game hunted by the Badegoulian groups at this site (Castel 1999).

Two components could immediately be distinguished in the antler assemblage:
– 110 finished or half-finished objects and fragments (Fig. 3). The objects that could be typologically identified are almost exclusively projectile points of small dimensions and large wedges (or chisels). All the objects are entirely shaped by scrap-

ing, thus the traces of blank production are no longer visible.
– 1,022 apparently unmodified antler fragments, with very varied dimensions.

The interpretation of the second component proved difficult. It was first necessary to distinguish between fractures on "dry" antler (likely resulting from post-depositional breakage) from fractures on "fresh" or "green" antler (possibly linked to human activity, i.e., antler knapping). While there exists an abundant literature on this topic for bone material ("fracture on dry bone" *vs*. "fracture on green bone": Aguirre 1985, 1986; ETTOS 1985; Tartar 2009; Villa, Mahieu 1991; etc.), no comparable work has been done for antler. We thus selected several criteria, based on our experience and on discussions with colleagues. We determined that on "dry" antler, the fracture plane and the outer surface of the antler form a wide angle (often close to 90°) and that the fracture surface can appear irregular, rough, but not fibrous. We thus considered that the 374 fragments that displayed only this kind of fractures (Fig. 4) were exclusively the result of post-depositional breakage; these 374 elements were excluded from the study. On the other hand, we could determine that on "green" antler, the fracture plane and the outer surface of the antler form a narrow angle (often less than 45°: "tongued" fracture) and that the fracture surface shows the fibrous structure of the material. Moreover, the extremity of the fracture surface can be irregular ("step-terminating" or "hinge-terminating" fractures: Pétillon 2006). At the Cuzoul de Vers, it is very unlikely that these fractures are related to carnivore activity, as the impact of carnivores on the faunal stock in general is negligible and traces of their intervention are almost absent on the bone remains (Castel 1999). Antler fracturing is thus an anthropic action. Of course, and contrary to bone, this action cannot be aimed at marrow collecting, marrow being absent in antler. The preparation of antler fragments as "osseous fuel" for hearths is also very unlikely (the fragments do not show any traces of burning). We thus concluded that the 648 fragments with "green" fractures were related to antler debitage activities.

The assemblage of anthropically-fractured antler consists of two complementary categories. On the one hand, there is a small collection of antler parts from which flakes were knapped off. Two examples are given in fig. 5. The base of a large shed antler (Fig. 5:1) shows the negative removal of a large flake on the posterior side, and a breakage of the anterior side at the base of the tine. In both cases, there are traces of transversal percussion – most probably direct percussion with a stone hammer (as shown by the presence of the notch, or percussion pit, and the negative bulb). The second tine of a large antler (Fig. 5:2) has had its medial side almost completely "peeled off" by the knapping of several flakes, the strokes being given from both lower and upper sides; here again, antler knapping was made by transversal percussion, likely direct percussion with a stone hammer.

On the other hand, the antler assemblage includes hundreds of flakes (Fig. 6), most of which are 2 to 6 cm long (mean length = 42 mm; maximum length = 20 cm). Some of them also bear traces of transversal percussion. Six flake refittings could be made, and were especially helpful in reconstructing the operatory sequence. Two are shown on fig. 7 and 8. A sequence of four flake removals from the same section of antler (Fig. 7) shows that what is left after the knapping operation is an antler "rod" representing about one third of the original circumference of the antler. A sequence of five flake removals from the lateral side of the main beam of a large antler shows that flaking started on the upper part of the antler and went down to the base, while percussion traces indicate that the strokes were given from alternate sides (Fig. 8).

Technological interpretation

The aim of the technological analysis is to answer the question: "what did they do this for?" – in other words: what was the objective of the debitage? In this case, it first seems that we have to deal with a flake production: the flakes would be the products sought by the antler knapper. These flakes, however, are not used as tools (they do not present any use-wear traces). They do not seem to be used as blanks either: in the assemblage of finished and half-finished objects, there is no population of artifacts that could be shaped from flake blanks (the morphology and dimensions of the two categories do not fit). Thus the flakes are most likely the waste products of the knapping process.

In this case, the objective of the debitage would be "the part that is left after the flakes have been taken off". Indeed, the knapped antler portions (Fig. 5) and the flake refittings (Fig. 7-8) show that the principle of the debitage is to knap off one half – or even the two-thirds – of the circumference of the antler beam or tine. Thus, what is left of the antler is a "rod" that represents one third to one half of the original circumference of the antler. Several artifacts in the Cuzoul de Vers actually fit this description (Fig. 9), as does

the knapped part of the large tine shown on fig. 5:2; all could be examples of the type of blanks that the knapper intended to produce. This hypothesis is supported by the fact that their dimensions are compatible with even the largest finished antler tools from the Cuzoul de Vers assemblage (Fig. 3:1-3): it is technically possible that the finished tools from Cuzoul de Vers were manufactured from such blanks, but since these tools are all entirely shaped by scraping, traces of blank production are no longer visible.

Perspectives

Beyond the case of the Cuzoul de Vers and the question of Badegoulian antler working, the purpose of this presentation is to attract the reader's attention on the identification of antler flakes as evidence of debitage by fracturation. Given the difficult technological diagnosis of this antler working procedure – as compared to the more "classic" groove-and-splinter procedure – we believe that other occurrences of antler knapping in different sites and periods might have gone unnoticed. Actually, this reassessment work has started already: at the time when this article is being written, studies in progress are showing that antler debitage by fracturation is attested in several sites in southwest France, attributed to the Badegoulian or to other Upper Paleolithic cultures.

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