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Something new in the quivers: experimental approach to functioning of the Late Mesolithic and Early Neolithic geometric bitruncations.

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INTRODUCTION

During the 7th and 6th millennium BC, in the most of Western Europe, a major cultural change affects the Mesolithic societies. Particularly perceptible in the lithic industries, a complete technological changeover occur at different levels, including the renewal of arrowheads, now trapezoidal in shape (Perrin and Binder, 2011, Perrin et al. 2009). Probably echoing changes in the different registers - technical, economic, social or symbolic - of the hunting system, the new design of the arrowhead is still functionally underexplored.

To try to characterize and interpret this new way of conceiving the wounding tip of the arrow, a projectile experimental program, "*the trapezoidal innovation*", has been centered on the Late Mesolithic (Castelnovian) and Early Neolithic arrowheads (Impressa/Cardial), which also raise specific functional issues (Philibert, 2016).

OBJECTIFS

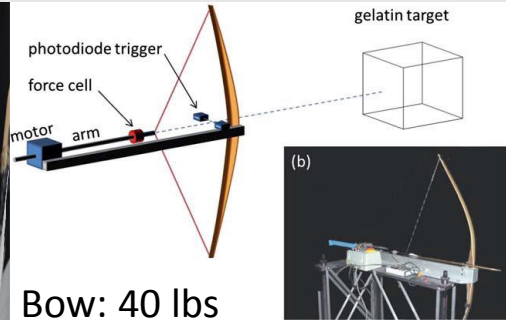
- To obtain a large reference collection and an impact damage pattern as well as on symmetrical and asymmetrical trapezes according to their shape and their hafting modalities (transverse or piercing tip) but also on bones. Through systematic research of the link between the wear on the arrowhead and on bone, one of the objectives was to assess how the nature of the impacted skeletal element and the angle of penetration of the arrow into the carcass, affect the type and the intensity of damage to lithic projectiles.
- To obtain some initial data on the behavior of the projectile (trajectory, damage, detachment...) and evaluate the performance and the wounding efficiency of different arrows, in term of penetration depths and damages (laceration, tearing, etc.).

EXPERIMENTAL PROTOCOLS

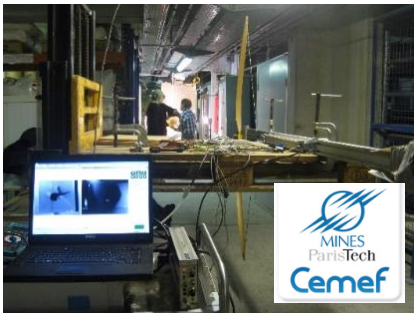
Shooting sessions

Shooting on animal carcass (red deer)

Parametric shooting on ballistic gel with automated bench...



Bow: 40 lbs



Arrow speed: 50m / s

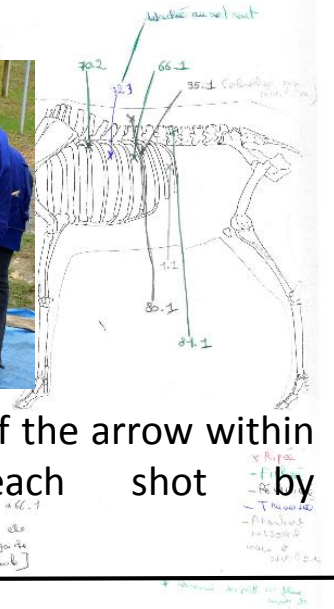
...according to a protocol developed by L. Chesnaux (Chesnaux, 2014, Gaillard et al., 2015).



Shooting distance: 10 meters
3 long bows: 40 – 45 lbs

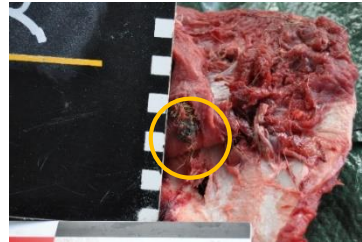


Recording of the position of the arrow within the carcass after each shot by archaeozoologists.



Observation protocol

Butchering / viscera sieving



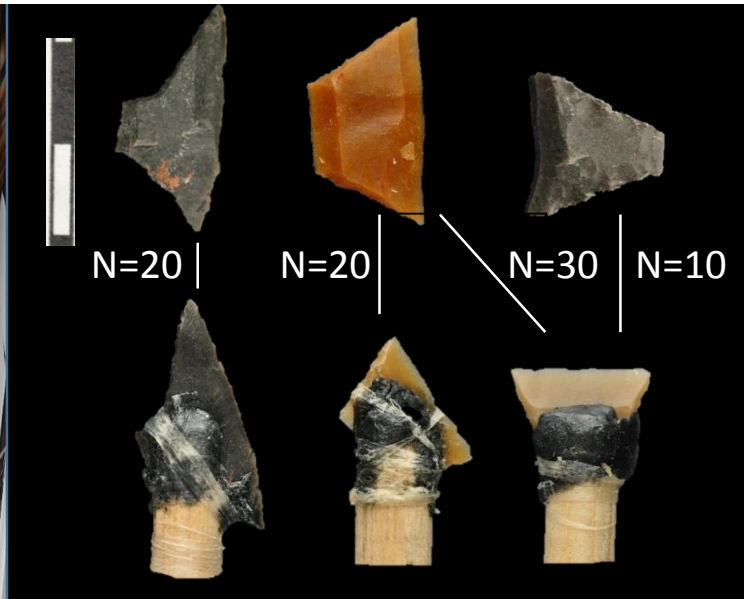
and reconstruction in the laboratory



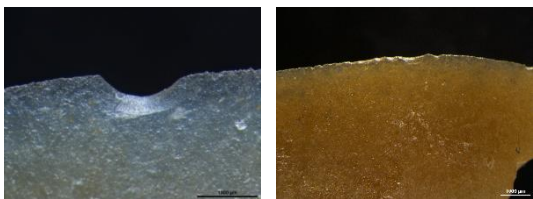
Reconstruction of the trajectory of the arrows and study of the correlations between the traces present on the bones and the projectiles that produced them: the skeleton is reconstructed and the attribution is made by cross-checking the information recorded during the shooting and that from the projectiles collected on the shafts and during the butchering phases.

Hafting modalities of experimental arrowheads

Asymmetrical / symmetrical trapezes and Montclus arrowheads

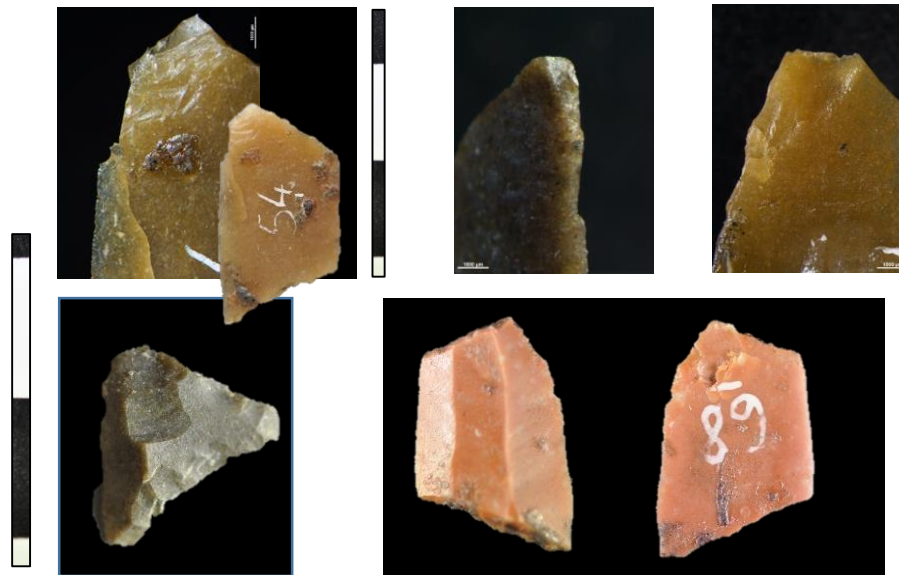


- 74 arrows = 100 shootings (6 arrows were shot on ballistic gel).
- 78 / 100 shootings reached the target.
- 46 damaged arrowheads.



30% of the arrowheads are undamaged or have tiny damages due to an impact in the stomach, a trajectory between the ribs or a removal from the shaft in the carcass.

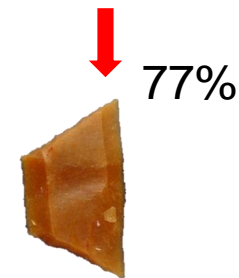
Damages pattern



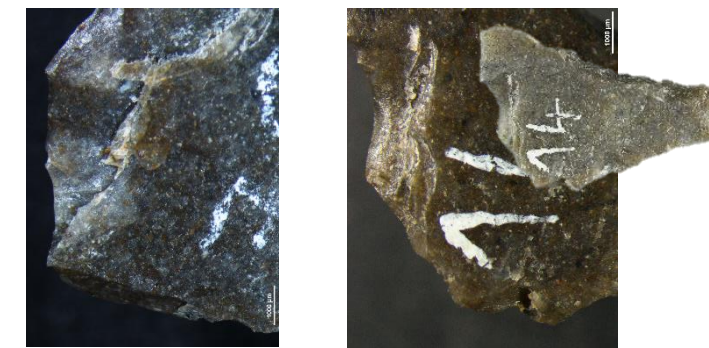
Fractures with initiation on the truncation and propagated along the large base are specific of the piercing arrowheads.

Diagnostic location and direction of damages

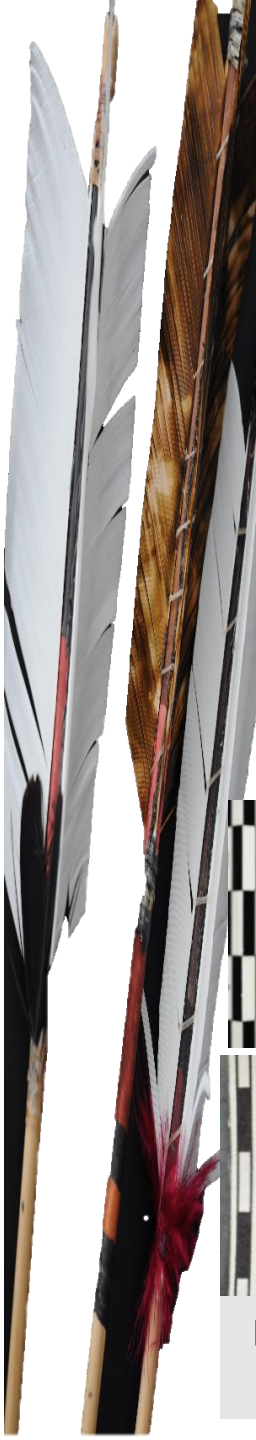
Piercing arrowheads



Transverse arrowheads



Burin-like or complex fractures at the both tips of the trapeze with initiation on the large base and oriented perpendicularly to it, are exclusively observed on the transverse arrowheads.

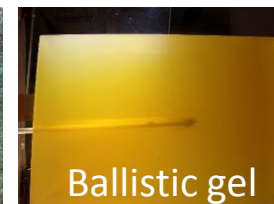


Wounding efficiency



The experimentation showed the high efficiency of the arrows which is sometimes questioned, especially for transversal projectile tips (Lombard and Parteger, 2008, Gibaja and Palomo, 2014). They have inflicted significant lacerations on flesh and traumas on skeletal elements.

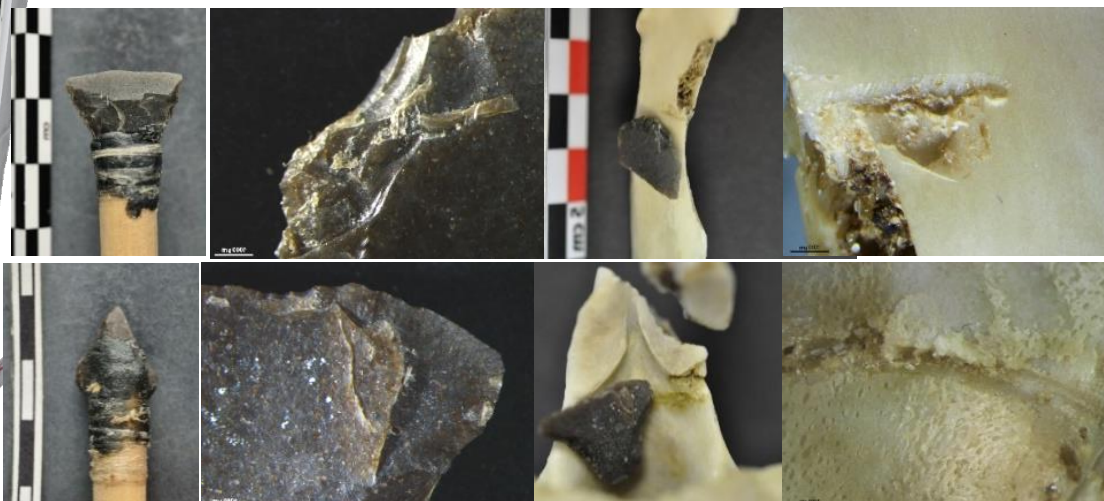
Penetration capacity



Transverse	12,8/19	24,8/24	20,3/51
Piercing	6,2/19	31/14	20,12/55

Average depth of penetration / number of shots, according to the nature of the impacted material.

In ballistic gel, transverse arrowheads have a slightly higher penetration depth which nevertheless does not allow to conclude to the greater effectiveness of this mode of hafting, at least in the context of this protocol. The specific properties for each type of arrow could be found in another register.



Examples of the interaction between the arrowhead and the impacted skeletal element part.

The impacted bones present various morphologies and associations of traces (perforation, notch, striae, dislocation etc.) that would seem to depend on the trajectory of the projectile and certainly on its shape and the way it is inserted. This variability is currently being explored.

To conclude...



- ▶ While some damage patterns appear to be highly diagnostic of the different arrowhead hafting modalities, others are more ambiguous, in particular because of their orientation, and are likely to misinterpretation on archaeological series. We hope to be able to identify the cause of this variability notably by reinforcing observation of the trajectory of the arrow in the target but it also underlines the need to consider the combination of the traces including striations that have not been discussed in this poster.
- ▶ Damages are correlated to the nature of the impacted material which is a major factor of variability. Projectiles that are not impacted or with tiny fractures, which constitute an important part even in experimental corpuses, have often hit the soft tissues of the carcass. They are difficult to interpret in archaeological context but they could reveal particular hunting tactics or slaughter practices.
- ▶ Finally, the experiment showed the efficiency of the two types of arrows, their good penetration and wounding ability, for piercing arrowheads as well as for transverse projectile tips, which highlights that weapons had to be particularly efficient for large game hunting.

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