Abstracts

Recognizing and characterizing projectiles armatures in the early Middle Stone Age of Africa
Alison Brooks & David Leslie

Lithic projectile armatures represent a significant innovation over thrusted spear points in hominin subsistence strategies with relevance to both the life history and behavior of our genus. Discerning an assemblage of projectile points archaeologically is difficult, as the plan and shape of a projected point may not differ from that of a thrusted armature except for in its area and weight, nor would we expect thrusted spear technology to disappear with the advent of projectile armatures. Currently, researchers disagree on the timing of this important innovation, with some arguing for an appearance of projectile technologies during the Middle Stone Age, others arguing for an appearance during the Upper Paleolithic. Others have argued that the pointed forms of the African Middle Stone Age were not weapons armatures at all but rather resharpened scrapers. This paper will review three aspects of MSA pointed forms: tip attributes, basal treatment, and overall form and will discuss the utility of these in determining the onset of projectile technology. We argue that many of the later MSA industries (Aterian, Aduma, ≠Gi, Sibudu, Stillbay, Howiesons Poort) contain projectile armatures, based on these criteria. In addition, the early archaeological record of the Middle Stone Age documents a number of different point forms that date to ~300 kya or before and based on the above criteria, some may be candidates for early projectile technology.

Morphological diversification of stemmed projectile points of Patagonia
Marcelo Cardillo & Judith Charlin

The aim of this work is to model patterns of morphological variation in middle-late Holocene stemmed projectile points from Patagonia through comparative methods. With this purpose we explore the potential of different analytical strategies using projectile point shapes, obtained by means of geometric morphometrics. Phylogenetic, spatial and environmental variation were used to build a set of statistical hypothesis to explain the morphological patterns in different scales. Morphological data comes from digitalized images of published projectile points for different patagonian areas. Morphometric characters were obtained using landmark and semilandmark descriptors. Mean shape by area was computed and used in cladistic analysis to model diversification trends. Then, phylogenetic, geographical and environmental coordinates were estimated for each data set and used as predictor variables in multiple regression procedures. Different models were compared based on statistical significance, explained variance and relative complexity. Mobility, interaction and change in middle-late Holocene human populations in Patagonia can be discussed in light of these results.

Points of Contention: Experimental testing of TCSA/TCSP as archaeological measures of projectile effectiveness
Chris Clarkson

Several recent articles have argued that TCSA and TCSP are valuable measures of projectile performance that may help differentiate the use of simple and complex projectiles in the archaeological record. Proponents of this view have also argued that TCSA / TCSP are relevant to identifying the origins and spread of complex projectile technology by modern humans. The logic and strength of these arguments will be examined and ethnographic data on Australian projectile technologies will be presented that questions any firm association between TCSA/TCSP and projectile type. New experimental evidence presented here calls into question the value of these statistics as measures of projectile effectiveness, at least in terms of penetration. An alternative approach to determining projectile type is developed using experimental data on impact fracture size for three different
diagnostic impact fracture types. This approach, while found to be valuable, also presents problems for archaeological identification of projectile technologies.

Bladelet cores as weapon tips? Residue and micro-wear analysis of carinated burins from the Aurignacian of Les Vachons, France

Rob Dinnis

The interpretation of certain Upper Palaeolithic carinated lithic artefacts as discarded cores from the production of micro-lithic bladelets is now well-established, and the weight of evidence to support this indisputable. Although present within many Upper Palaeolithic cultures, these bladelet-core artefacts are a particularly conspicuous component of the Aurignacian – the culture generally believed to have been created by Europe’s first *Homo sapiens*. Within the Aurignacian – as within all Palaeolithic industries – it is apparent that the relationships between lithic typology, technology and function are complex. Obvious problems arise when prehistoric activities are inferred from the contents of lithic assemblages. Described here are micro-wear and residue analyses of three bladelet-core “carinated burins” from the late Aurignacian level of Les Vachons, France. These artefacts serve as a perfect reminder of the complexity of prehistoric lithic artefacts, with their typological classification, techno-morphological form and apparent (final) function all suggestive of different activities. The remains of birch pitch adhering to the artefacts are clear evidence that they were hafted; the first time this material has been identified on Aurignacian artefacts. In addition, micro-wear traces are consistent with them having been hafted. Thus, while the techno-morphology of the artefacts is consistent with their status as discarded bladelet cores, other analyses indicate that they functioned as hafted tools. Unlike other Middle and Upper Palaeolithic industries, the Aurignacian is not thought to include (non-bladelet) lithic weapon tips. Despite this, due to patterns of use-wear present on two of the artefacts, it is suggested that this was their most plausible hafted function. However, even if this interpretation is correct, it is unlikely that a large number of large lithic weapon tips lie unrecognised in Aurignacian assemblages. To briefly conclude, possible reasons for their absence are explored.

The evidence for weapons: another functional investigation of Australian microliths

Richard Fullagar

Early functional studies suggested most Australian microliths were weapons, functioning as spear barbs and points. More recent work in southeastern Australia has argued that microliths were not demonstrably associated with hunting or killing but functioned as knives, drills awls and scrapers in many different tasks; and only rarely as spear tips or barbs. Small backed artefacts (microliths) found with an Aboriginal burial at Narrabeen (Sydney, Australia) certainly indicate death by spearing. Breakage and use-wear on most artefacts indicate use as barbs or ‘lacerators’, although some had traces suggesting other functions. The evidence for weaponry is reviewed and the traces of use on microliths from southeastern Australia are compared with a recent functional study of microliths from northwestern Australia.

Hunting lesions in Pleistocene and Early Holocene Faunas

Sabine Gaudzinski-Windheuser

For most of our past, the hunting way of life determined our behavioural repertoire. However, the importance of hunting is in stark contrast to what we actually know from the archaeological record about hunting strategies, the techniques employed as well as the immediate social implications. The study of hunting lesions offers a perspective to approach this important topic.

The paper presents direct evidence for hunting lesions in European Pleistocene faunas with reference to the Early Holocene. Results of experimental studies on indirect hunting lesions are referred against the archaeological context focussing of the question why hunting lesions are only scarcely identified in Middle and Lower Palaeolithic faunas.
When is a Point a Projectile? Impact Fractures, Scientific Rigor, and the Limits of Inference

Karl Hutchings

The incorporation of the scientific method in archaeology has produced remarkable contributions within a generation or two, most particularly as a result of multidisciplinary endeavors coupled with an increasing number of archaeologists with interest, as well as formal education, in the hard sciences. Employing modern experimental results to explain past behaviours demands, however, that archaeologists not only practice rigor in their experimental research, but give careful consideration to the limits of inference.

Controlled ballistic experiments with glass replicas of Levallois points

Radu Iovita, Holger Schönekeß, Sabine Gaudzinski-Windheuser & Frank Jäger

In the last decade, the body of evidence in favor of Neandertal hunting has grown. The concurrence of the faunal data, the discovery of the Schöningen spears (Thieme 1997, Nature 385:807-810), that of the Umm-el-Ttel stone tip embedded in a vertebra (Boëda et al. 1999 Antiquity 280:394-402), and the ever-increasing evidence for hafting in the Middle Paleolithic suggests that hunting with a variety of weapons is probably quite ancient. Despite much work on identifying fracture and wear patterns associated with stone projectile use, no unambiguous criteria for carrying out the identifications exist. We argue that this is because previous studies have not sufficiently controlled for confounding factors, and we describe here the first results of a rigorous experimental program which should enable us to create a reference collection of impact fractures. We test the effect of kinetic energy, momentum, and angle of impact on fracture patterns in identical glass copies of an archaeological Levallois point from Jabrud (controlling for shape and raw material fracture properties). The copies were cold-pressed as to not alter the brittleness of the glass, resulting in a material similar to archaeologically-available obsidian. A series of recent controlled experiments in flake propagation (Dibble and Rezek 2009 JAS: 1945-1954; Rezek et al. 2011, JAS:1346-1359) have further demonstrated the similarity of glass to many of the siliceous materials used by past hominins and, consequently, its suitability for experimentation. In our experimental design, the projectiles are slot-hafted with beeswax in wooden shafts and are shot at homogeneous targets made of synthetic materials (ballistic gelatine, ballistic soap, and synthetic polyurethane plates which simulate the properties of cortical bone). They are launched from a high-precision ballistic air-gun which measures the exact exit velocity with the aid of a photoelectric barrier. Each point is only launched once. The test velocities are matched to those of experimentally and ethnographically observed speeds found in the literature. The preliminary results of this work indicate that the variability of damage traces is much higher than expected for such tightly controlled conditions. However, of the factors investigated, the angle of impact seems to provide the most reliable indicator of damage extent on the tips of the projectile points. We present here the results of this experimental program and discuss implications for further work.

Results of experimental use of mammoth ivory projectile points of Upper Palaeolithic forms

Gennady Khlopachev, Dmytro Nuzhnyi & E.Y. Girya

Results of experimental use of mammoth ivory projectile points of Upper Palaeolithic forms. The experiments were carried out in two stages. The first connected the production of points with temperature regime and possibilities of mechanical properties of mammoth ivory (Siberia). The idea about of good knapping of ivory with low temperature was confirmed.

In the second experiment, arrows and darts were shot with a bow into a body of a young cow. The very good penetrative abilities of such “bipointe” arrow-heads and “sagaies a base recouci” were confirmed. However, small “bipointe” arrow-tips were more efficient than “sagaies a base recouci”.

Less to the Point: Curation of Magdalenian Antler Projectile Points

Michelle Langley

Magdalenian osseous projectile points are carefully worked components of a technological system vital to the acquisition of subsistence resources, and as such, it is important to understand the entire chaînes opératoire of these artefacts. Significant attention has been given to the manufacturing and use phases of these implements with recent studies focusing on manufacturing stigmata and use wear. While a number of studies have established the durability and efficiency of osseous projectile points, only a handful have touched on the final
phases of the chaînes opératoire – restoration, recycling and eventual discard with the embedded issue of
curation. As Dibble (1995:303) succinctly put it, “artifacts are analysed to understand not only why and how
they were manufactured, but also why they were thrown away”.

An understanding that the archaeological material which is the subject of technological analyses is, except for
the rare case, largely trash in the view of the people who were responsible for their deposition, is essential to
their interpretation. While this is a basic premise of archaeological interpretation, it has been occasionally
forgotten or ignored in analyses of Magdalenian osseous projectile points with analysts stating that the
importance of point restoration and reduction is ‘impossible to evaluate’. But is it?

This paper will explore the issues surrounding the investigation of how Magdalenian osseous projectile points
were restored, reduced and recycled. Can we determine if particular point types were curated or expedient?
How much can we hope to learn about the curation of these distinctive projectile points? It is hoped the ideas
presented in this paper will provoke discussion about how archaeologists may approach the issue of curation of
osseous projectile points.

New hunting evidences from projectile impacts on bones in Danish Maglemosian sites:
identification problems and contributions to archaeozoological analyses
Charlotte Leduc

Two kinds of evidence related to hunting activities exist from Mesolithic archaeological context: on the one hand,
hunting weapons (bow and arrow fragments, lithic and bone projectile weapon elements) and their use-wear
traces, on the other hand, hunting lesions from impact on animal bone remains. For instance, the embedding of
a lithic or a bone projectile in a bone constitutes incontestable proof of hunting, making the direct connection
between weapon and game. The recent archaeozoological re-analysis of the two Maglemosian faunal
assemblages from Mullerup and Lundby Mose (Sjælland), led to the discovery of new hunting lesions in Danish
Early Mesolithic Period. In total, these are at least two examples from the Lundby Mose site, and seven from the
Mullerup site, among them embedded flint fragments, perforations. This presentation aims to discuss the
potential and conditions required for such discoveries during archaeozoological studies. Such new data
emphasize the need of meticulous re-analysis of bone assemblages, leaning on recent experimental works on
projectile impacts, in order to increase such discoveries.

Following the presentation of these new hunting evidences, the link with weapons and hunting techniques and
the question of their frequency during the Danish Mesolithic are discussed, just as their meaning in terms of
mobility, particularly in case of healed lesions.

Experiments with projectile points of Upper Palaeolithic and Mesolithic industries of Ukraine
Dmytro Nuzhnyi

The experiments with use of bow and arrows tipped with different microlithic projectile points hafted with
various ways were carried out by author since the 1977 year. The many kinds of targets (paper, wood, bones,
various calf and freshly killed animals) were used for that for definition of projectile ability of these types of
arrow heads. As a result it was base data for investigation of specific diagnostic projectile fractures depended
from construction of latter. Near three hundreds of lithic insets of composite and other projectile arrow tips
were used. The hard influence of methods of their hafting (first of all glued substances) and construction of
ones as well as the kinds of used experimental targets were defined too.

Thirty years of experimental research on the breakage patterns of Upper Paleolithic bone
and antler projectile points: methodological problems and current perspectives
Jean-Marc Pétillon & Hugues Plisson

Since the 1980s, a number of replicative projectile experiments have been undertaken to document the
characteristic breakage patterns of Upper Paleolithic projectile points made of bone and antler. An assessment of
this research is presented here, and two main methodological problems are pointed out. First, the most common
type of impact macrofracture – beveled breaks, or bending fractures – is not diagnostic of projectile use, as it
also occurs on other osseous tools used in a longitudinal percussion or pressure motion (e.g., needles, awls, and
especially wedges). More comparison data is needed to exactly differentiate the macroscopic traces left by these actions. Second, the extent and level of damage on projectile points appears usually higher in the archeological assemblages than on experimental points used as projectiles. In mechanical terms, this discrepancy means that the Paleolithic points were subject to stronger stresses than the experimental ones, and/or that they were more breakable. A recent projectile experiment provided some first results on this issue by showing that, in most previous experiments, the use of unrealistic experimental settings might have downplayed the amount of damage caused by missed shots hitting the environment around the target. But other possible factors – such as heavier projectiles, a progressive fatigue of points used over long periods of time, a greater brittleness of points under low temperatures, etc. – must also be considered; they will be briefly discussed here.

Variability in the morphology of Mousterian Points: Testing the potential use of throwing spears among Neanderthals from a technological, functional and experimental perspective

Joseba Rios-Garaizar

The use of complex weapons among Neanderthals including projectile weapons as javelins is one of the main issues about the debate of Neanderthal capabilities. This debate has been biased by some disputable statements made by paleoanthropologists neglecting the possibility of long distance throwing due to special configuration of shoulder joint (Rhodes and Churchill 2009). But the biases didn’t come only from paleoanthropology, some archeologist have developed a mental template of Mousterian/Levallois points that doesn’t fit the standard of a projectile point even not of a spear point.

The reality is that behind these wide concepts hides a great variability of morphologies reflecting different designs adapted to different uses. We propose that some of these morphologies have been designed and are fully adapted to weapon use not only as spear points but also as projectile tips.

This idea is not new (Galván Santos et al. 2007-2008; Moncel et al. 2009; Shea 2006; Villa et al. 2009; Villa and Lenoir 2006) but we propose here a multi-proxy approach that will help us in a better identification of Middle Paleolithic weapons:

1. A morphological description which includes characteristics that are crucial (from a ballistic point of view) to discriminate between points and convergent or pointed tools (already known indices as TCSA combined with tip plan and section angles, side edge angles, curvature, weight and basal thickness),
2. Technological analysis of point production to describe the technical processes (blank production, retouch, rejuvenation) that leaded into the final morphology of the point.
3. Experimentation of the ballistic features of different morphologies (archeology based) of points and hafts.
4. Use-wear analysis with special incidence in impact scars
5. Experimentation to characterize impact scars and to discriminate between projectile o thrusting impacts.
6. Collection analysis

We have already identify some of these probable projectile points in some Iberian assemblages (Axlor, Amalda), French (Combe Brune I) and in one Northern African site (Irhoud) and analyzed them with this protocol. The results are quite promising; moreover if we compare them with indisputable Upper Paleolithic points (Chatepperronian, Gravettian, Solutrean). These results will be important not only to debate about Neanderthal capacities but to discuss about behavioral differences including subsistence strategies, technological provisioning and so on.

References:


Projectiles and hafting technology
Veerle Rots

Hafting is an essential part of projectile technology and it has a major impact on the performance of a projectile. The hafting arrangement needs to be adapted to the intended task, which requires a careful selection and manufacture of the shaft and fixation agent. As is the case with other hafted implements, the morphology of the stone point needs to be adapted to the chosen hafting arrangement.

While a projectile can be identified based on macro- and microscopic use-wear traces, characteristic hafting wear also forms. These wear features are sufficiently diagnostic to distinguish between hafted and hand-held stone tools and, in ideal circumstances, to interpret the hafting arrangement. Inferring hafting is equally important to inferring a stone tool’s use mode. For projectiles in particular, the identification of the hafted nature of the implement adds to the use identification based on impact wear. After all, no stone projectile can be projected without its attachment to a shaft. Hafting wear on projectiles exists both of wear formed due to the counter-pressure within the hafting arrangement at the moment of impact, and wear resulting from the direct contact with the shaft and/or fixation agent (e.g., bindings). It allows a more direct interpretation of the position of the stone point with regard to the haft than one that is indirectly derived based on impact wear on the tip.

Clues to the interpretation of the hafting and hafting mode of stone projectiles will be discussed, as well as details concerning the relation between a particular projectile technology and a particular hafting mode. The high relevance of understanding hafting issues when dealing with projectiles is stressed.

Experiments in fracture patterns and impact velocity with replica projectile points from Japan
Katsuhiro Sano, Yoshitaka Denda & Masayoshi Ohba

Recent studies indicate that anatomically modern humans would be the first humans who innovated long-range projectile hunting, while hunting of Neanderthals may have required frequent close encounters with prey animals. Additionally, a study of tip cross-sectional area based on aerodynamics suggests that it is possible to successfully shoot the stone-tipped points emerged after 40-50 ka in Africa, Levant and Europe by using spearthrower.

Confirming the validity of the hypothesis, we conduct controlled projectile experiments which employ a calibrated crossbow in order to accurately control loading conditions according to estimated impact velocities of thrusting, throwing, spearthrower, and bow respectively. A total of 280 lithic replicas including 40 trapezoids, 40 backed points, 40 leaf-shaped points and 160 microblades which are all representative Palaeolithic armatures from Japan are shot against targets. The dimension, shape and distribution of impact fractures as well as microscopic linear impact traces (MLITs) are observed. Finally, the relationship between the tip morphologies, the velocities, and the observed patterns of impact fractures and MLITs are discussed. The presentation exhibits a preliminary report of this study.

The Potential of Pre-Howieson’s Poort MSA Backed Blades from Pinnacle Point, South Africa as Projectile Armatures
Benjamin Schoville, Kyle Brown, Simen Oestmo, & Curtis Marean

An occurrence of microlithic backed blades from Pinnacle Point site 5-6 has recently been described by Brown, et al. (2011) and has been dated by OSL to ~71ka. Backed blade technology is often considered composite, allowing for replacement of worn and broken components while maintaining the haft for continued use. Ethnographic observations of backed blades hafted as tips of arrows in southern Africa and occurrences of backed points within animal remains from later archaeological sites indicates backed pieces are effectively utilized as projectile armatures in many contexts. In a series of experiments using a calibrated crossbow and heat-treated silcrete, the parameters within which pre-Howieson’s Poort replicated backed pieces function as
projectile armatures were explored – including variability in blade size, morphology, and hafting arrangement. Patterns of point impact macrofracture and edge damage from > 110 experimentally reproduced backed pieces are compared to the assemblage of pre-Howieson’s Poort backed blades from Pinnacle Point. Additionally, the location of each of the >250 individual experimental shots from across prey targets were combined into a prey-body GIS model to construct a spatial distribution of point breakage probability. Collectively, the results from the experimental sample suggest pre-Howieson’s Poort backed blades function effectively as projectile armatures in several hafting arrangements, and backed blades which strike a torso “kill-zone” suffer higher likelihood of damage than shots which hit uniformly across the torso. Given their use as projectiles, the Pinnacle Point pre-Howieson’s Poort backed blades may represent an early adoption of composite technology with forward investment in materials and preparation to offset a higher probability of breakage.

Weibull and Gompertz-Makeham Analysis of Experimental Spear/Dart Data: Implications for Stone-tool Survivorship

Michael Shott
TBA

A critical assessment of simple proxies for projectile plausibility

Matthew Sisk

In many archaeological contexts determining the function of a given tool type presents a significant challenge. For lithic tools there is the possibility of gaining direct data from use wear or residue analysis, but these data do not always preserve and are time consuming to collect. A common recourse is to compare morphological characters of a tool type to modern or recent tools for which use is known. Within the study of projectiles, simple measurement-based approaches can yield insight into whether a given type of pointed stone object is physically capable of serving as a projectile armature. These ballistically significant measurements can then be compared to ethnographic or experimental data from functional stone points. These techniques range from the relatively simple, like mass or tip cross-sectional area (TCSA) to the more computationally complex, like tip cross-sectional perimeter (TCSP) or convergence angle. Most of the primary researchers involved in developing these proxies are well aware that no single measure can be used as a litmus test of projectile use. However, there is an increasing trend of these measures being applied without proper concern for their limitations. In reality, a suite of physical characteristics contributes to the efficiency of a stone projectile point. It is only through understanding the underlying physics of stone projectiles and the morphological controls on their use that we can begin to disentangle what relevant information each of these proxies can yield. This paper discusses the strengths and weaknesses of several of these simple proxies (e.g. weight, TCSA, TCSP, convergence angle) in light of the physics of how stone-tipped projectiles penetrate a target. From this, a preliminary synthetic model, with the contributions of each proxy, is distilled. These measures are then applied to experimental and archaeological data from a variety of Paleolithic contexts.

The Role of Skill in the Production of Folsom Projectile Points

Nicole Waguespack

The manufacture of Folsom projectile points is notoriously difficult. Due to the high level of skill and the risk of failure involved in their production, they provide an ideal case for examining the potential role of prehistoric hunter-gatherer lithic craft specialization. Among foraging peoples, craft specialization tends to emphasize the productive abilities of specific individuals and groups operating under specific technological constraints. A model of production specialization linking raw material constraints and production risk is developed. Raw material availability and the relative frequency of Folsom projectile points, bifaces and associated manufacturing debris from a handful of sites in the western United States are examined in relation to the modeled predictions of specialized production.

Levers and Springs: How a Spearthrower Works and Why it Matters

John Whittaker

A spearthrower, or atlatl, works as a lever to propel a light spear or dart, but there are still alternative theories about spearthrower mechanical principles. Howard proposed that atlatls work by extending the time force can
Evidence of Hunting Weapon Variability in the Early Middle Paleolithic of the Levant. A view from Misliya Cave, Mount Carmel

Alla Yaroshevich, Yossi Zaidner & Mina Weinstein-Evron

We present an analysis of an assemblage of points from the Early Middle Paleolithic (EMP) of Misliya Cave, Mount Carmel, Israel, with the objective of investigating variability in hunting weapons. Our study is innovative in two ways: first, we analyzed the assemblage according to a detailed typological list; second, we applied two lines of analysis: ballistically important morphometric attributes and analysis of projectile damage. The study revealed correlations between point type, morphometric characteristics and frequencies of fractures diagnostic of projectile impact (DPIF). Levallois points and elongated Mousterian points have tip cross sectional areas similar to efficient thrusting spears and exhibit the highest frequencies of DPIF, about 20%. The difference between these two types in terms of width, thickness and the angle of the distal tip may indicate that Levallois and Mousterian points were designed to meet two different objectives of spearhead efficiency, namely, depth of penetration and durability. Another group, comprising newly defined Misliya points and some Hummal points were found statistically similar to ethnographic dart tips in terms of tip cross sectional area and perimeter. These types exhibited less than half the frequency of DPIF of that observed for Levallois/Mousterian points. Interestingly, the ratio of Levallois/Mousterian versus Misliya/Hummal points in the assemblage correlates with the ratio of large versus small size game hunted at the site – a correspondence which provides support for the suggested differentiation between point types as representing different kinds of hunting weapons. Our study also shows that blade production, a characteristic feature of the Levantine EMP is closely associated with hunting weapon technology: elongated Mousterian points identified as spearheads, as well as Misliya and Hummal points interpreted as possible tips of composite projectiles are produced predominantly on blades.

Although more studies must be done in order to verify the presence of complex projectiles in the Levantine Early Middle Paleolithic, our study has shown that a detailed classification of point assemblages, together with the application of several lines of analysis, has the potential to reveal significant information which otherwise would remain hidden.